United States Department of the Interior

NATIONAL PARK SERVICE
Golden Gate National Recreation Area
Fort Mason, San Francisco, California 94123

IN REPLY REFER TO:

L76 (GOGA-VRPWF)

DEC 16 2005

RE: *Golden Gate National Recreation Area Fire Management Plan*
Final Environmental Impact Statement

Dear Friend:

The National Park Service (NPS) is pleased to announce publication of the Golden Gate National Recreation Area (GGNRA) Fire Management Plan, Final Environmental Impact Statement (FEIS). The FEIS has been developed in accordance with the National Environmental Policy Act (NEPA); the Environmental Protection Agency (EPA) will be publishing a Notice of Availability for the FEIS in the Federal Register in the coming weeks.

This is an important document for the GGNRA, setting forth how the park complies with current federal wildland fire management policy, and meets objectives for public and firefighter safety, resource management, and hazard reduction in the wildland urban interface. The public's involvement has been a key element in the fire management planning process. We wish to thank all of the organizations, agencies and individuals who provided comments, attended public meetings, and showed interest in the Fire Management Plan EIS.

Copies of the FMP FEIS may be obtained from Superintendent, Golden Gate National Recreation Area, Building 201, Fort Mason, San Francisco, CA 94123 or by email request to goga_fire@nps.gov (please mark the email subject line "FMP FEIS Copy Request"). A bound copy of the FMP FEIS, or the FEIS on compact disc (CD) will be sent to those requesting it, as well as to those who requested a copy of the Draft EIS. In addition, the document will be posted at NPS's Planning, Environment and Public Comment (PEPC) website at http://parkplanning.nps.gov/goga. The FEIS will also be available at park headquarters at Fort Mason, Building 201 (on the Review Table just inside Building 201 front entrance, directly across from Visitor Center), and at other park Visitor Centers and local libraries.

The official responsible for the final decision on the Fire Management Plan is the National Park Service Regional Director of the Pacific West Region. A Record of Decision, describing the selected alternative and project commitments, will be signed by the Regional Director no sooner than 30 days after the listing of the FEIS Notice of Availability in the Federal Register by the EPA. The date of publication of the Notice of Availability in the Federal Register will also be posted with the document on the PEPC website. Once the Record of Decision is released, a notice to that effect will be published in the Federal Register and in local newspapers. Following the issuance of the Record of Decision, implementation is the responsibility of the General Superintendent, Golden Gate National Recreation Area. Any questions can be directed to the Fire Management Office at (415) 331-6374.

Thank you for your interest.

Sincerely,

Mai-Lis Bartlett

for Brian O'Neill
General Superintendent

Fire Management Plan
Final Environmental Impact Statement

Golden Gate National Recreation Area

National Park Service
November 2005

Fire Management Plan
Final Environmental Impact Statement

Golden Gate National Recreation Area

Lead Agency: National Park Service

This Final Environmental Impact Statement (FEIS) evaluates a Fire Management Plan (FMP) for lands within the Golden Gate National Recreation Area (GGNRA), Muir Woods National Monument, and Fort Point National Historic Site. The FMP that currently applies to these areas was adopted in 1993. The National Park Service (NPS) proposes to prepare a new FMP to reflect recent changes in fire management policy and the addition of newly acquired lands within the park boundary since the 1993 FMP was written.

The FEIS describes and assesses three alternative strategies, including a preferred alternative, for managing fire in the park to reduce risks to the public, firefighters, sensitive resources, and park facilities. The alternatives encompass a range of approaches to using prescribed fire and mechanical fuel reductions as tools for achieving fire risk reduction and resource protection and enhancement objectives. The alternatives are Alternative A – No Action, 1993 Fire Management Plan; Alternative B – Hazard Reduction and Restricted Fire Use for Research and Resource Enhancement; and Alternative C – Hazard Reduction and Resource Enhancement through Multiple Treatments. The NPS prefers Alternative C.

Impact topics assessed in the FEIS include: watershed processes, air quality, vegetation, wetlands, wildlife and important habitat, special status species, cultural resources, human health and safety, visitor use and visitor experience, park operations, and socioeconomics.

The public comment period on the DEIS began March 18, 2005 and ended on May 27, 2005. Comments and responses are presented in Appendix H of this FEIS. Comments were reviewed, considered, and the EIS was revised in light of those comments.

The Record of Decision adopting the alternative or actions constituting the approved plan will be prepared not sooner than thirty days after the publication in the Federal Register of the EPA's notice of filing of the FEIS. The complete FEIS will be posted on the GGNRA website at http://parkplanning.nps.gov/goga and directly mailed to recipients of the DEIS. For further information on the FMP, please check this website or call the GGNRA Fire Management Office at 415-331-6374.

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Executive Summary

Introduction

This Final Environmental Impact Statement (FEIS) evaluates alternative strategies for a Fire Management Plan (FMP) for lands within the Golden Gate National Recreation Area (GGNRA), Muir Woods National Monument, and Fort Point National Historic Site. The National Park Service (NPS) has prepared the DEIS in accordance with the National Environmental Policy Act (NEPA). The FEIS analyzes three alternatives for managing fire in the park. The alternatives are based upon park values, effective fire management strategies, NPS policy, and applicable law.

NPS Director's Order 18 (NPS 1998) requires that each park with vegetation capable of burning prepare a strategic, operational plan to guide a fire management program. An FMP is a strategic plan describing detailed procedures for managing the full range of fire management activities, including wildland fire suppression and fuel reduction projects. GGNRA (including Muir Woods National Monument and Fort Point Historic Site) is currently operating under a 1993 FMP. The NPS proposes to prepare a new FMP to reflect recent changes in fire management policy and the addition of newly acquired lands within the park boundary since the 1993 FMP was written.

The FEIS for the FMP describes and assesses alternative strategies for reducing risks to the public, firefighters, sensitive resources, and park facilities from wildland fire. The document also examines the opportunities to use prescribed fire and mechanical fuel treatments as tools for achieving fire risk reduction and resource protection and enhancement objectives. The FMP FEIS evaluates fire management planning at a general, "program" level.

A Notice of Availability for the DEIS was published in the Federal Register and the document made available for public review and comment on March 18, 2005. The Federal Register noticed a 60-day public comment period ending on May 17, 2005 but this was extended to May 27, 2005 to ensure adequate review time. Twelve comment letters were received on the DEIS during the public comment period. Responses are provided to all substantive comments made on the DEIS, and, where warranted, text changes were made to the FEIS text to reflect the response to the comment. Responses to all relevant comments submitted can be found in Appendix H – Response to Comments on the Draft Environmental Impact Statement. As the last action in the process, the NPS will prepare a Record of Decision documenting the selection of an alternative and conclusions of potential environmental effect.

The alternative selected at the end of this NEPA process will define the overall strategy for the park's fire management actions, serving as the basis for the FMP. The FMP is a separate, stand-alone operational document for fire management and fuel reduction actions in the park and will be completed following designation of the selected alternative in the Record of Decision. The FMP will identify areas of the park where fuel reduction actions will occur during the first five years of implementation; the five-year program will be reviewed and updated annually to reflect areas that have been treated and add other areas where treatment is needed. As an operational manual, the FMP will include sections on preparedness planning, firefighter standards, training requirements, wildfire suppression, monitoring, research, interagency cooperation, prescribed burning, fire prevention, and public education. FMP projects that

involve issues not sufficiently assessed by the programmatic EIS will be subject to additional environmental review prior to implementation.

Principal Differences and Clarifications Between the Draft and Final Environmental Impact Statements

The DEIS was revised in light of comments received during the public review period of the FMP DEIS which identified some sections of the document that required modification or further clarification. The following is a summary of the principal changes to the FEIS text in comparison to the DEIS:

- A tenth FMP goal, accompanied by two objectives, to address smoke management and protection of air quality has been added to the list of FMP goals in Chapter 1, Section 1.4.

- Figures 2-7 and 2-8 of the DEIS, which identify roads in GGNRA, were removed from the document and text edits were made in Chapter 2 to clarify which road-related functions at GGNRA are the responsibility of fire management staff and which are the responsibility of other NPS divisions.

- Additional information has been provided in Chapters 2 and 3 on herbicide use in conjunction with mechanical fuel removal. This includes information on the park's common herbicide used, the review and approval process, regulatory conformance, protections for sensitive resources, the public and firefighters.

- Changes have been made to the Mitigation Measures for Air Quality and Special Status Species found in Chapter 2, Section 2.7. In response to a comment from the U.S. Environmental Protection Agency, air quality mitigation measures AIR-1 and AIR-2 were combined to become AIR-1 and the balance of air quality mitigation measures were renumbered accordingly. As a result of the consultation between the NPS and the U.S. Fish and Wildlife Service (USFWS), two new Special Status Species mitigation measures, SS-5 and SS-6, were added and all Special Status Species mitigation measures greater than SS-4 were renumbered accordingly.

- Changes have been made to Chapter 4, Environmental Consequences, Impacts on Air Quality to clarify the relationship between BAAQMD's smoke management plan (SMP) and the State Implementation Plan (SIP). Text was added to address whether the three FMP alternatives would trigger a conformity analysis with the SIP; new text and a new table (4-3b: De Minimus Levels for State Implementation Plan Conformance) were also added to explain and state the *de minimus* levels for criteria pollutants with which the Air Basin is in nonattainment or maintenance status. Table 3-4 has been updated to reflect the current attainment status of criteria pollutants for the Bay Area Air Basin.

- A short description of the criteria and process by which projects were selected for inclusion in Appendix C – Cumulative Actions has been added to the introduction of Appendix C.

- In response to the EPA's request to further highlight smoke management practices in the FEIS, a new appendix has been added that is a listing of smoke management techniques and non-burning

alternatives that GGNRA could incorporate into a smoke management plan and/or that BAAQMD could require as part of the smoke management plan approval process. The referenced appendix is Appendix I – Non-burning Alternatives and Air Emissions Reduction Techniques for Fuel Reduction and Resource Benefiting Prescribed Burns in GGNRA.

- The NPS completed the consultation process for the FMP EIS as required for conformance with Section 106 of the National Historic Preservation Act (NHPA). This resulted in a Programmatic Agreement (PA) between the State Historic Preservation Officer (SHPO) and the NPS that directs the process the NPS will use to identify, evaluate, treat, and mitigate adverse affects to historic properties from implementation of the FMP. The Programmatic Agreement is included in the FEIS as Appendix J.

- The NPS has completed the formal consultation process with the USFWS as required for conformance with the Endangered Species Act (ESA). The USFWS has issued a Biological Opinion stating their conclusions of potential impacts of FMP actions on eleven wildlife species and four plant species listed as threatened or endangered under the ESA, as well as the impact on critical habitat designated for the one threatened species. The Biological Opinion is included in the FEIS as Appendix K.

Purpose of and Need for the Fire Management Plan

The 1993 FMP for GGNRA focuses primarily on natural resource management issues and needs to be revised to more fully address cultural resource concerns, provide guidance for parklands acquired since 1993, and provide more guidance on effectively reducing fire risk along the wildland urban interface areas in the park. A new FMP is needed to reflect the importance of a more concerted effort to effectively reduce wildfire risk to park resources and to private property along the wildland urban interface, and to examine the feasibility of facilitating the role of fire where it is safe to do so.

In addition, ecosystem changes in the park are evidenced by the spread of more flammable nonnative plant species, dense single-aged second-growth forests, conversion of shrublands to forest, forest and shrubland encroachment on grasslands, and decadence and decline of fire-adapted species. A new FMP is needed to provide a framework for managing these ecosystems and fuel loads. Important characteristics of cultural landscapes have also been altered in the absence of fire, and the risk of wildland fire damaging historic structures has increased as fuel loading has increased. A new FMP is needed to address management of increased fuel loads in the vicinity of cultural resources as well as within the park at large.

The purpose of the FMP is to provide a framework for all fire management activities in a manner that is responsive to natural and cultural resource objectives, reduces risks to developed facilities and adjacent communities, and provides for public and staff safety. The intent of this FEIS is to present and analyze alternatives for carrying out the fire management program at GGNRA. It also presents and analyzes effects that would occur as a result of implementing these alternatives. The purposes of this planning process are:

- To prepare a new FMP that is consistent with Federal Wildland Fire Management Policy and conforms to agency guidelines for fire management plans and programs; and
- To help achieve resource management objectives consistent with the park's cultural resource, natural resource, and land management plans, and to be responsive to safety considerations for park visitors, employees, and resources.

FMP Goals

As part of the planning process, FMP goals were developed by NPS staff to reflect federal policy as well as the comments and concerns expressed by the public during the scoping period. The goals were derived from guidance of the NPS Management Policies 2001 (2000) and NPS Director's Order and Resource Handbook 18, Wildland Fire Management, in addition to federal policy and scoping input. The goals and subsequent management objectives describe what must be accomplished in order for the fire management program to be successful and were used to formulate the alternatives analyzed in this FEIS. The FMP goals are as follows:

Goal 1. Ensure that firefighter and public safety is the highest priority for all fire management activities.

Goal 2. Reduce wildland fire risk to private and public property.

Goal 3. Protect natural resources from adverse effects of fire and fire management activities, and use fire management wherever appropriate to sustain and restore natural resources.

Goal 4. Preserve historic structures, landscapes, and archeological resources from adverse effects of fire and fire management activities, and use fire management wherever appropriate to rehabilitate or restore these cultural resources.

Goal 5. Refine management practices by improving knowledge and understanding of fire through research and monitoring.

Goal 6. Develop and maintain staff expertise in all aspects of fire management.

Goal 7. Effectively integrate the fire management program into park and park partner activities.

Goal 8. Foster informed public participation in fire management activities.

Goal 9. Foster and maintain interagency fire management partnerships and contribute to the firefighting effort at the local, state, and national level.

Goal 10. Minimize smoke generation during prescribed burning through the use of a smoke management plan (SMP) that details best management practices or non-burning alternatives where these options would meet resource management and fuel reduction objectives and also achieve emissions reduction.

Planning Issues Considered

Public scoping on this EIS began on August 8, 2003 and ran until December 5, 2003. (See Chapter 5, Section 5.1, Public Involvement and Scoping, for more information.) Scoping comments provided guidance to NPS staff in preparation of this EIS. 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. The comments received by the NPS during scoping helped determine which issues and alternatives are relevant to this planning process and should be included in the EIS and which issues would be better addressed in another planning effort. Planning issues discussed in the EIS include impacts on the physical environment (watershed processes and air quality), the biological environment (vegetation, wetlands, wildlife, and special status species), and the social environment (cultural resources, human health and safety, visitor use and visitor experience, park operations, and socioeconomics).

Alternatives

Formulation of Alternatives

The process of formulating FMP alternatives began with an examination of federal policy for wildland fire management, NPS management policies, regulatory considerations, past wildland fire and prescribed fire experience in the park, GGNRA's natural and cultural resource objectives, input from the public and agencies during the scoping period, and analysis of potentially hazardous fuel conditions. An interdisciplinary team of NPS staff reviewed this information and developed goals and objectives for the FMP. NPS staff reviewed all public and agency scoping comments, including those from park staff, and developed a reasonable range of alternatives that would help achieve FMP goals and objectives to be assessed in the FEIS. NPS staff participating in scoping and alternatives development represented expertise in fire management, fire ecology, natural resource management, cultural resources, planning, public safety, interpretation, and public affairs.

Several alternatives were considered during the development of this FEIS, of which three are fully analyzed in this document. The others were considered carefully but rejected because they would not adequately meet the fire program's objectives. 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 last several years and as they were described and analyzed in the 1993 FMP and its environmental assessment (EA).

The following are summaries of the three alternatives developed for GGNRA's FMP EIS:

Alternative A (No Action) – *1993 FMP, No Action*

This alternative would be an update to the 1993 FMP only to reflect changes to the park's boundary (e.g., addition of new lands since 1993) and current national fire management policies. The focus of the 1993 FMP program is on vegetation management through the application of prescribed fire to perpetuate fire-dependent natural systems. In recent practice, many fire management actions have been mechanical fuel reduction projects (e.g., mowing, cutting to remove nonnative shrubs and trees, and selective thinning in forested stands) as a result of the establishment of the Wildland-Urban Interface Initiative. A combination of staff shortages, the requirement to develop a new FMP, and a year-long moratorium on prescribed burning has resulted in limited prescribed burning over the past five years. This alternative would rely on the continued implementation of the 1993 FMP and recent emphasis on mechanical fuel reduction along with prescribed fire, and suppression of all wildfires. The fire management approach for Muir Woods National Monument would be the same for the No Action alternative and the two action alternatives (Alternatives B and C) and would include the use of prescribed fire as well as mechanical fuel reduction. Current research projects would continue and would focus on the role of fire to enhance natural resources and the effects of fire on key natural resources to determine the effectiveness of various fuel treatments.

Alternative B – *Hazard Reduction and Restricted Fire Use for Research and Resource Enhancement*

Under Alternative B, fire management actions would emphasize the use of mechanical methods to reduce fire hazards and fuel loads in areas with the highest risks. Compared to Alternative A, Alternative B would increase the number of acres mechanically treated each year, with a focus on the reduction of high fuel loads in the wildland urban interface area. The suppression strategy for wildfires and the approach used in the Muir Woods fire management unit (FMU) would be the same as under Alternative A. Limited use of prescribed fire could occur for research purposes within the park interior. Research projects would examine the role of fire to enhance natural resources and the effects of fire on key natural resources to determine the effectiveness of various fuel treatments. Natural and cultural resource goals and objectives would be integrated into the design and implementation of fuel reduction projects.

Alternative C (Preferred Alternative) – *Hazard Reduction and Resource Enhancement through Multiple Treatments*

This alternative would allow for the greatest number of acres to be treated on an annual basis to achieve fire management and resource objectives through the use of a broad range of fire management strategies. Mechanical treatment and prescribed burning would be used as a means to reduce fuel loading near developed areas and achieve resource enhancement goals. Mechanical treatments, complemented by prescribed fire, would be employed to assist with restoration and maintenance of the park's natural and cultural resources. The suppression strategy for wildfires and the approach used in the Muir Woods FMU would be the same as under Alternative A. Research projects would examine the role of fire to enhance natural resources and the effects of fire on key natural resources to determine the effectiveness of various fuel treatments; they would also be used to adaptively guide the fire management program and help to maximize the benefits to park resources. Natural and cultural resource goals and objectives would be integrated into the design and implementation of fuel reduction projects.

The three alternatives analyzed meet the park's 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. The three alternatives involve different combinations of prescribed burning and mechanical treatments. 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 (see Table ES-1). These numbers are based upon an understanding of the park's resources, staffing and funding, hazard risk assessment, and technical feasibility.

Table ES-1: Summary of Alternatives by Annual Acres Treated and Treatment Type

Treatment Type	County	Alternative A[1]	Alternative B	Alternative C
Mechanical Treatment[2] (acres/year)	Marin	75	180	225
	San Francisco	5	10	10
	San Mateo	20	40	40
	TOTAL	100	230	275
Prescribed Burning (acres/year)	Marin	100	120	285
	San Francisco	<1	<1	<1
	San Mateo	10	0	35
	TOTAL	110	120	320

Source: NPS, GGNRA 2004.

[1] Estimated based upon current practice, since 1993 FMP did not specify number of acres per year for treatments.

[2] Mechanical treatment refers to fuel reduction through methods such as mowing, cutting, short-term grazing, and selective thinning.

Actions Common to All Alternatives

Several actions that are currently part of the fire management program at GGNRA would continue under all of the alternatives analyzed in this EIS. These activities are described below.

Wildland-Urban Interface Initiative

In 2001, the NPS began implementing provisions of the federal Wildland-Urban Interface 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. This is accomplished through implementation of fuel reduction projects in communities adjacent to GGNRA. Through this program, the NPS also receives funding for fuel reduction projects on parklands near the interface with private property or lands managed by other agencies. This program would continue under all alternatives, but the details of specific projects and related environmental analysis are independent from this EIS.

Defensible Space/Vegetation Clearing around Buildings

The protection of all buildings from wildfire within GGNRA would continue under all alternatives. NPS staff or private contractors would continue to clear vegetation around park structures. Individual structures would be assessed to determine the appropriate vegetation treatment based on fuel type and slope, building construction type, historic significance, and potential sources of ignition.

Roadside Fuel Reduction

The park routinely clears vegetation and debris from selected paved and unpaved roads that provide routes for emergency evacuation, public safety, and access for suppressing fires or conducting prescribed burns, or that serve as control lines for prescribed fire projects. Designated fire roads would continue to be maintained to allow for safe and efficient access and egress by emergency vehicles, at a minimum allowing access by Type III fire engines. The park would evaluate, on an ongoing basis, the condition of fire roads for direct and safe access conditions. As a result of this evaluation, unnecessary fire roads may be eliminated, in coordination with other park planning efforts, and the sites restored to address erosion problems. In some cases, existing roads may be reconfigured or rerouted to address erosion and/or maintenance concerns, but these actions would be subject to further study. The effects of these actions on cultural resources would be taken into account prior to implementation.

Suppression

The current policy at GGNRA is to suppress all unplanned ignitions using minimum impact suppression tactics (MIST) whenever possible and feasible given the constraints along the urban interface. Suppression of fires would be aggressive and would be conducted with the highest regard for human safety. Wildland fire suppression would be conducted to suppress wildfire at minimum cost consistent with values at risk, while minimizing the impacts from suppression activities. A “confine,” “contain,” or “control” strategy would be used in the suppression of all wildfires, with the majority of wildfires suppressed using the control strategy. Suppression would be accomplished through a combination of cooperative agreements with local fire agencies and qualified park fire personnel. Annual operating plans would identify individual suppression concerns in order to minimize suppression impacts. Furthermore, all control efforts would be evaluated for consideration of effects on resource values. Fire suppression methods used would be those that cause minimum resource damage while accomplishing effective control.

Treatment of Muir Woods FMU

Preservation of the pristine character of Muir Woods National Monument is a management priority stated in the 1993 FMP. Many species contribute to the ecosystem in and around Muir Woods National Monument and this diversity calls for a variety of prescription parameters. The objectives for the fire management strategy in Muir Woods are to:

- Restore the role of fire in the relevant vegetation communities;
- Reduce fuel loading and the threat of catastrophic wildfire; and
- Further study fire effects in old-growth coast redwood forest.

Under all three alternatives, the proposed fire management strategy for Muir Woods National Monument would be similar to that of the 1993 FMP and would include a mix of prescribed fire and mechanical fuel reduction. Prescribed burning would be used to reduce fuel loading and to benefit from the reintroduction of fire into the diverse plant communities in the monument. Prescribed fire would be used in the redwood/Douglas-fir forest to restore the role of fire to this ecosystem and may also be used for management of nonnative species in the monument. Small-scale mechanical fuel reduction projects, such

as construction of shaded fuel breaks and thinning of the understory, would be implemented as elements of an overall strategy to reduce the hazard of a high-intensity fire. Research in the monument could also employ prescribed burning to investigate the relationship between fire and Sudden Oak Death (SOD) and the use of prescribed burning in limiting or controlling French broom.

Treatment of San Francisco County Project Area

Much of the lands in GGNRA within the City and County of San Francisco are heavily used, containing coastal scrub and nonnatives or beach sand and bluff with little burnable vegetation. In a few areas, very dense, nonnative evergreen forest does pose a high fire hazard to the public and firefighters. Clearing dense vegetation from historic structures throughout the San Francisco parklands would benefit public safety and help preserve the structures in case of a wildfire or structural fire in the area. The fuel reduction strategy for the San Francisco lands – to maintain defensible space around buildings adjacent to wildland fuels and to provide some mechanical removal of nonnative evergreen trees – would improve firefighter safety and reduce the risk of a fire spreading from federal lands to the adjacent dense residential neighborhoods. No prescribed burning is proposed for the San Francisco County project area, including Alcatraz Island, except in conjunction with implementation of approved U.S. Fish and Wildlife Service recovery plan objectives for federally listed threatened and endangered plant species, which could entail research burns. The areas with the highest existing fire hazard contain nonnative and highly flammable trees or dense nonnative shrubs that could most effectively be treated by mechanical fuel reduction and follow-up maintenance.

Public Information and Fire Education Programs

The NPS manages an active fire information and education program within the park that also serves local communities. This program assists in educating NPS employees, volunteers, park partners, other agencies, park visitors, and the general public about fire management goals and policies. The fire information and education program is in the developmental stages at both local and national levels and is adding to what has been traditionally provided through GGNRA's Office of Public Affairs and the Division of Interpretation and Education. The program addresses fire safety and prevention, fuels management, the role of fire in GGNRA's ecosystems, GGNRA's fire history and the cultural use of fire on the landscape, and fire research programs and opportunities. The education program currently produces flyers for nearly all fire management projects within the park for distribution to the public, posting at the project site, and posting on the park's fire management web pages.

A comprehensive public information and education program would be included as part of all of the alternatives. Communication with the public, neighbors, visitors, partners, NPS employees, and the news media would be done using a variety of methods.

Fire Cache

The fire cache facilities store and supply the equipment and supplies necessary to support all fire operations within GGNRA, as well as two national park units in the East Bay – John Muir and Eugene O'Neill national historic sites. Currently, fire vehicles and equipment are stored in several facilities in the Marin Headlands and Fort Baker. Ideally, the fire cache would be housed in a single location at some time in the near future, resulting in a decrease in response time to major park assets and facilitating

communication among park staff members responsible for fire management. This cache/wildland station could potentially be an interagency facility in conjunction with the Marin County Fire Department or one of the city fire organizations. The park would conduct a facilities assessment for the fire cache to refine the program and storage needs and study options for relocation and consolidation. This assessment would be done in coordination with other interested agencies, and appropriate environmental review would be conducted for implementation.

Fire Effects Monitoring

Fire effects monitoring is essential to determining the effects of the fire program on GGNRA ecosystems and to providing guidance to the fire program for adaptive management. As part of the Fire Effects Monitoring Program, both prescribed burns and wildfires are monitored during a fire event for weather conditions, fire behavior, and air quality. In accordance with the NPS Fire Monitoring Handbook (FMH), vegetation and/or fuels data are collected both before and one, two, five and ten years after prescribed burns in order to assess whether or not the burn has met stated objectives. Both live fire monitoring as well as the establishment and monitoring of FMH plots as described above are carried out by the Fire Effects Monitoring Crew, which is hosted at Point Reyes National Seashore. Funding for the Fire Effects Monitoring Crew is provided through the National Fire Office. These monitoring efforts would continue under all three alternatives.

Environmental Impacts

A list of specific resource topics was developed to focus on and compare environmental impacts of fire management activities among alternatives. The list was drafted based on applicable laws, regulations and policies, as well as comments from park staff and the interested and affected public, including other agencies that were contacted during scoping. Chapter 3 of the FEIS describes, for each resource topic, the existing environment that could be affected by the proposed actions. These existing conditions establish the baseline for the analysis of effects. Chapter 4 provides a detailed analysis and discussion of the probable environmental consequences, or impacts, of implementing each of the three alternatives.

NPS management policies require analysis of whether an alternative might impair NPS values or resources. None of the alternatives considered in this document would impair park resources.

The table on the following pages describes the range of impacts for each resource topic by alternative.

Table ES-2: Summary of Impacts

	Alternative A – 1993 FMP (No Action)	Alternative B – Hazard Reduction and Restricted Fire Use	Alternative C (Preferred Alternative) – Hazard Reduction and Resource Enhancement through Mult. Treatments
Watershed Processes: Soils, Hydrology, and Aquatic Habitat	Fire management actions under Alternative A would have adverse, short-term, minor effects on water quality, and beneficial, long-term minor-to-moderate effects on restoration of watershed hydrology. Effects of prescribed fire on water quality related to increased erosion would be adverse, minor and short-term. Impacts from soil disturbance related to mechanical treatments would be adverse, short-term, and negligible to minor. However, the watershed effects within the areas treated by mechanical means would be beneficial, long-term, and minor to moderate. Wildland suppression activities would affect soils due to compaction and ground disturbance. Because the number of acres burned by wildfires each year remains quite low, impacts on watersheds would be adverse, short-term, and minor.	Similar to Alternative A, with a small increase in the short-term, minor adverse effects and long-term beneficial effects due to the increased mechanical treatments.	Similar to Alternative A, with both increased short-term, minor adverse impacts and long-term beneficial impacts. The increased mechanical treatments and prescribed burning in this alternative would create the greatest number of beneficial effects.
Air Quality	The levels of VOC produced in this alternative would create a long-term, moderate, adverse impact. The levels of NO_X and SO_2 would create a long-term, negligible adverse impact. Smoke generation would create short-term, minor-to-moderate adverse impacts. Particulate matter would create long-term	The levels of VOC, NO_X, SO_2 produced in this alternative would create impacts similar to Alternative A. Smoke generation would create short-term, minor adverse impacts on visibility during prescribed or pile burning. This level would be reduced compared to Alternative A as burning is	The levels of VOC, NO_X, SO_2 produced in this alternative would create impacts similar to Alternative A. Smoke generation would create impacts similar to Alternative B. Particulate matter would create long-term moderate adverse impacts. Cumulative effects would be long-term,

Table ES-2: Summary of Impacts

	Alternative A – 1993 FMP (No Action)	Alternative B – Hazard Reduction and Restricted Fire Use	Alternative C (Preferred Alternative) – Hazard Reduction and Resource Enhancement through Mult. Treatments
	minor adverse impacts. Cumulative impacts would be long-term, moderate, and adverse. There would be long-term major beneficial effects in reducing the potential for catastrophic fires.	restricted to the Interior FMU. Particulate matter would create long-term moderate adverse impacts. Cumulative impacts on basin air quality would be long-term, moderate, and adverse. There would be long-term minor beneficial effects in reducing the potential for catastrophic fires.	moderate, and adverse. Long-term moderate beneficial effects would be created by the accelerated treatment of fire management areas.
Vegetation	Overall, Alternative A in combination with other related actions would have cumulative long-term negligible effects on vegetation. Mechanical treatments would have negligible-to-minor long-term beneficial impacts on coastal scrub, chaparral, grasslands, herbaceous wetlands, riparian forest and scrub, native hardwood forests, and Douglas-fir and coast redwood. These benefits would only persist if follow-up actions prevent the encroachment of nonnative species. Short-term minor adverse impacts could occur in these communities due to ground disturbance. Prescribed burning could have negligible-to-minor, long-term beneficial impacts on most native vegetation communities, although more study of grasslands is required.	Similar effects to Alternative A, with a slight increase in beneficial impacts from more mechanical treatment. However, the use of prescribed burning would be more limited than in Alternative A, which would reduce the beneficial effects of this treatment in the WUI FMU.	Increased mechanical treatments and prescribed burning in this alternative relative to Alternatives A and B would result in an overall minor-to moderate, long-term beneficial effects on vegetation. A broader range of management actions and a more comprehensive method for identifying, prioritizing, and implementing specific fire management actions would allow for larger-scale restoration of ecologically sustainable stands of native vegetation.

Table ES-2: Summary of Impacts

	Alternative A – 1993 FMP (No Action)	Alternative B – Hazard Reduction and Restricted Fire Use	Alternative C (Preferred Alternative) – Hazard Reduction and Resource Enhancement through Mult. Treatments
Wetlands	Overall, fire management activities would have minor-to-moderate long-term benefits to wetland communities through reduction of nonnative plant species, stimulation of native species, and reduced potential for a large-scale wildfire. Mechanical treatments and prescribed fire could have adverse, short-term, minor impacts on wetland soils, hydrology, and vegetation. Fire management activities would avoid wetland areas to the greatest extent possible, and a buffer would be maintained around wetland areas where fire management activities would be restricted. Any impacts on wetland soils, hydrology, or vegetation that occur in the buffer area would be correctable by site-specific actions, and must be confined to short-term, minor (or less) adverse effects.	Similar to Alternative A, with a small increase in the short-term, minor adverse effects and long-term beneficial effects due to the increased prescribed burning in the Park Interior FMU.	Similar to Alternative A, with both increased short-term, minor adverse impacts and long-term beneficial impacts due to increased mechanical treatments and prescribed burning in both the Park Interior and WUI FMUs.

Table ES-2: Summary of Impacts

	Alternative A – 1993 FMP (No Action)	Alternative B – Hazard Reduction and Restricted Fire Use	Alternative C (Preferred Alternative) – Hazard Reduction and Resource Enhancement through Mult. Treatments
Wildlife	Fire management activities would have overall long-term, beneficial, minor effects on wildlife and important habitat. Mechanical removals and prescribed burns would create beneficial, long-term impacts by enhancing native habitats and reducing chances for catastrophic fires. These effects would outweigh the minor adverse impacts of vegetation removal and associated disturbance.	Overall, impacts on wildlife under Alternative B would be very similar to those under Alternative A. More areas would be subjected to mechanical treatment under Alternative B, but the impacts would remain beneficial, long-term, and minor.	Impacts on wildlife would be similar to Alternatives A and B, with overall beneficial, long-term, and minor effects. This alternative would allow for the greatest and most flexible use of mechanical treatment and prescribed fires, which would create the highest level of beneficial effects. Alternative C would allow for the greatest amount of research, which would provide park staff the greatest opportunity for adaptive management.
Special Status Species – Wildlife	No impairment to any threatened and endangered species would occur under Alternative A.	No impairment of any threatened and endangered species would occur under Alternative B.	No impairment of any threatened and endangered species would occur under Alternative C.
San Bruno Elfin Butterfly	Mechanical fuel reduction, prescribed burning, pile burning, and research burns would not occur directly in areas supporting San Bruno elfin butterfly habitat, but may occur in adjacent habitat. Adverse impacts would be negligible to minor and short-term. Potential beneficial impacts from reduced risk of catastrophic wildfire and removal of nonnative vegetation would be minor and long-term.	Impacts would be similar to those for Alternative A, with the potential for a slight increase in the extent of impacts as the amount of land that could be treated under Alternative B would be about twice as much as in Alternative A. Beneficial impacts would be the same as in Alternative A.	Same as Alternative A.
Mission Blue Butterfly	Adverse impacts on mission blue butterflies and their habitat from site disturbance and vegetation removal, associated with mechanical fuel reduction and prescribed fire, would be minor and short-term	Adverse impacts from mechanical fuel reduction in Alternative B would be slightly greater than in Alternative A since more than twice the acreage would be treated, but still minor and	Similar to Alternative B, with a moderate increase in the amount of lands that could be treated under Alternative C. Greatest potential for minor-to-moderate long-term beneficial impacts due to

Table ES-2: Summary of Impacts

	Alternative A – 1993 FMP (No Action)	Alternative B – Hazard Reduction and Restricted Fire Use	Alternative C (Preferred Alternative) – Hazard Reduction and Resource Enhancement through Mult. Treatments
	following mitigation, with moderate, long-term, beneficial impacts through protection and expansion of mission blue butterfly habitat. Research burns conducted in existing mission blue butterfly habitat would have short- to long-term adverse impacts. Burning less than 5 percent of existing habitat in any one year, under an approved research plan, would minimize impacts. Research burns could result in long-term beneficial effects.	short-term following mitigation. The long-term beneficial impacts from potential increased expansion of mission blue butterfly habitat would be greater in Alternative B.	extensive use of mechanical treatment, prescribed fire and research burns that could be used to improve and expand mission blue butterfly habitat.
Tidewater Goby	Adverse impacts from mechanical fuel reduction, prescribed burning, pile burning, and fire research would be short-term and negligible to minor following mitigation since none of these activities would occur directly within tidewater goby habitat.	Same as Alternative A.	Same as Alternative A.
Coho Salmon and Steelhead	Mechanical fuel reduction would result in short-term, minor adverse impacts resulting from potential disturbance to soils and vegetation in riparian areas, with long-term beneficial impacts from restoration of riparian habitat through removal of nonnative trees.	Impacts would be similar to those for Alternative A, with a slight increase in the extent of impacts as the amount of land that could be treated under Alternative B would be more than twice the amount in Alternative A. Potential for greater long-term beneficial impacts through restoration of riparian habitat by removal of nonnative vegetation.	Similar to Alternatives A and B, with a slight increase in the extent of both adverse (short-term, minor) and beneficial impacts (long-term, minor) due to increased amount of areas treated.

Table ES-2: Summary of Impacts

	Alternative A – 1993 FMP (No Action)	Alternative B – Hazard Reduction and Restricted Fire Use	Alternative C (Preferred Alternative) – Hazard Reduction and Resource Enhancement through Mult. Treatments
California Red-Legged Frog	Mechanical fuel reduction, prescribed fire, and research burns may result in short-term, negligible-to-minor adverse impacts related to disturbance in or adjacent to red-legged frog habitat. Long-term, minor beneficial impacts could result from reducing the threat of catastrophic wildfire that could adversely affect wetland habitat.	Same as Alternative A.	Same as Alternative A.
San Francisco Garter Snake	Mechanical fuel reductions, use of prescribed fire, research burns, associated vegetation removal, and heavy equipment operation have the potential for adverse, minor, short-term impacts on the San Francisco garter snake following mitigation. Long-term, minor beneficial impacts would result from these actions by reducing the threat of catastrophic wildfire that could adversely affect garter snake habitat, and by restoring and maintaining coastal grassland and scrub habitat.	Impacts associated with mechanical fuel reduction and pile burning would be the same as in Alternative A. Even though twice as many acres may be treated in San Mateo and San Francisco counties, garter snake habitat is unlikely to be targeted for these activities. Prescribed burning and research burns would not occur in San Mateo County under Alternative B so there would be no associated impacts.	Same as Alternative A.
Marbled Murrelet	Potential marbled murrelet habitat is only present in the Muir Woods FMU. Fire management activities that focus on protecting and enhancing coast redwood and Douglas-fir trees, such as mechanical fuel reduction and prescribed burning, would result in overall long-term, beneficial, and minor impacts on this species.	Same as Alternative A.	Same as Alternatives A and B.

Table ES-2: Summary of Impacts

	Alternative A – 1993 FMP (No Action)	Alternative B – Hazard Reduction and Restricted Fire Use	Alternative C (Preferred Alternative) – Hazard Reduction and Resource Enhancement through Mult. Treatments
Western Snowy Plover	The only potential impacts on western snowy plovers would be from suppression activities that are common to all alternatives. Plovers would not be affected by any other actions in Alternative A.	Same as Alternative A.	Same as Alternative A.
California Brown Pelican	Impacts on roosting brown pelicans would be negligible by avoiding use of helicopters for mechanical fuel reduction in areas adjacent to Bird Island, and Rodeo and Bolinas Lagoons. Impacts from drifting smoke during prescribed burns, pile burning, or research burns would also be negligible.	Same as Alternative A.	Same as Alternative A.
Northern Spotted Owl	Adverse impacts associated with vegetation removal and disturbance during mechanical fuel reduction, prescribed fire, research burns, and pile burning would be minor and short-term, following mitigation. Long-term, minor beneficial impacts on spotted owls and their prey would result from native habitat restoration and enhancement and by reducing the threat of catastrophic wildfire.	Impacts from mechanical fuel reduction and pile burning would be similar to those for Alternative A, with a slight increase in the extent of both adverse and beneficial impacts. Impacts associated with prescribed burning and fire research would be the same as in Alternative A.	Similar to Alternative B, with a moderate increase in the extent of both adverse (short-term, minor) and beneficial impacts (long-term, minor) as the amount of land treated annually under Alternative C would be greater than in Alternative B. Impacts of prescribed fire would be similar to Alternatives A and B, with an increase in the extent of both adverse (short-term, minor) and beneficial impacts (long-term, minor) as the number of acres subject to burning annually under Alternative C would be more than twice that under Alternative A or Alternative B.

Table ES-2: Summary of Impacts

	Alternative A – 1993 FMP (No Action)	Alternative B – Hazard Reduction and Restricted Fire Use	Alternative C (Preferred Alternative) – Hazard Reduction and Resource Enhancement through Mult. Treatments
Salt Marsh Harvest Mouse	Adverse impacts from mechanical fuel reduction, prescribed burning, pile burning, and fire research would be short-term and negligible to minor following mitigation, since none of these activities would occur directly within potential salt marsh harvest mouse habitat.	Same as Alternative A.	Same as Alternative A.
Special Status Species – Plants	Suppression actions with mitigation measures applied whenever possible would reduce potential effects of wildland fire suppression to short-term, adverse, and negligible to minor. A prescribed burn, properly timed and mitigated, could have a long-term, major, beneficial impact on Oakland star tulip. Prescribed burning would have a short-term, negligible, adverse effect and long-term, beneficial impact on California bottle-brush grass. Most special status plants would have a minor-to-moderate benefit from reduction of nonnative species as a result of prescribed burning and mechanical treatment in all three counties. Removal of nonnative trees and shrubs and carefully conducted research burns (in consultation with the USFWS) could result in long-term, minor, beneficial impacts on the same three federally listed species in San Francisco. Monitoring programs would	Effects of mechanical treatment would be more limited in types of plant communities affected and have a reduced adverse effect on special status plants compared to Alternative A – negligible to minor, long-term, and beneficial. Effects of prescribed burning would be the same as in Alternative A with the exception of no burning in San Mateo County and the ability to conduct burns in the chaparral in Marin County. Short- and long-term, minor, beneficial effects on the three species on Bolinas Ridge would occur. Overall, this alternative would have long-term, negligible-to-minor, beneficial effects.	Mechanical treatments would affect more acreage, resulting in minor-to-moderate, long-term, beneficial impacts throughout all FMUs. Prescribed burning would occur in all areas of the park, resulting in a larger number of acres treated that Alternatives A and B. Opportunity for broadcast burns would be minor-to-moderate, long-term, and beneficial.

Table ES-2: Summary of Impacts

	Alternative A – 1993 FMP (No Action)	Alternative B – Hazard Reduction and Restricted Fire Use	Alternative C (Preferred Alternative) – Hazard Reduction and Resource Enhancement through Mult. Treatments
	have a minor-to-moderate long-term, beneficial impact. No prescribed burning would occur in chaparral communities, so there would not be beneficial impacts on three locally rare fire-adapted species on Bolinas Ridge.		
Cultural Resources	This alternative would have short-term, moderate, beneficial effects on historic buildings by reducing fuels around these structures. Moderate, long-term, beneficial effects on cultural landscapes would result from their restoration or maintenance through prescribed fire or mechanical treatments. This alternative would have the potential for long-term, adverse, major effects on archeological resources from suppression effort with heavy equipment. A large-scale uncontrolled wildfire could have long-term, major, adverse effects on historic buildings and cultural landscapes with loss of historic features and structures.	Beneficial effects on historic buildings and cultural landscapes would be greater than in Alternative A, as additional acreages for mechanical treatments and prescribed fire would be allowed for resource management objectives. Likewise, there would be a potential for greater adverse impacts on archeological resources, but these could be kept short-term and minor with appropriate mitigation measures.	Beneficial effects would be greater than in Alternatives A and B, but would remain in the moderate category.
Human Health and Safety and Nuisance Effects	Overall, this alternative would have a long-term, minor benefit to the public and firefighter safety by decreasing the risk of catastrophic fire. The potential to breathe in particulates and other toxins in the smoke produced by prescribed burning and fire suppression would have a short-term, negligible adverse	Similar to Alternative A, except that increased treatments would render long-term, moderate benefits to public and firefighter safety.	Similar to Alternative B, except larger prescription burning component would yield long-term, moderate, beneficial effect.

Table ES-2: Summary of Impacts

	Alternative A – 1993 FMP (No Action)	Alternative B – Hazard Reduction and Restricted Fire Use	Alternative C (Preferred Alternative) – Hazard Reduction and Resource Enhancement through Mult. Treatments
	effect on public and fire staff health and safety.		
Visitor Use and Visitor Experience	This alternative would have a short-term, minor adverse effect on visitor experience, public access, aesthetics, and park soundscapes from mechanical fuel reduction and prescribed burning. A long-term, moderate beneficial effect on the visitor experience and aesthetics would be gained due to improved viewsheds and enhanced growth of native vegetation.	Similar to Alternative A. More mechanical fuel reduction than Alternative A would mean more areas would be disturbed in short-term, but projects would be dispersed to reduce impacts on visitor experience in one area.	Similar to Alternative A with potential for larger burn areas. Related activity could result in short-term, minor-to-moderate and adverse effects. Following site restoration, effects would be long-term, moderate, and beneficial.
Park Operations	Moderate, long-term adverse effects on park operations would be anticipated from the full implementation of this alternative due to current staffing limitations throughout the park. Scaling back the implementation of Alternative A may reduce adverse effects on park operations to minor, but could result in reduced accomplishments and a longer time period needed to achieve FMP goals. One-time funding of a new fire cache would have a short-term moderate adverse impact on the park's budget, but would have long-term minor benefits on efficiency in fire management operations. Under any scenario, the suppression of a large-scale wildfire would have a short-term adverse major effect on park operations, management, and budget.	Similar to Alternative A but with an increased budget to conduct additional mechanical treatment projects. Under this alternative, 16.25 FTEs in the Wildland Fire Office would be required.	An overall increase in fire management program in order to conduct additional prescribed burning and mechanical treatment projects compared to Alternatives A and B. This alternative would produce moderate, long-term adverse impacts on park operations compared to the full implementation of Alternative A. FMP goals could be met in expedient timeframe, so long-term effect would be minor and beneficial. Under this alternative, 18 FTEs in the Wildland Fire Office would be required.

Table ES-2: Summary of Impacts

	Alternative A – 1993 FMP (No Action)	Alternative B – Hazard Reduction and Restricted Fire Use	Alternative C (Preferred Alternative) – Hazard Reduction and Resource Enhancement through Mult. Treatments
	Under this alternative, 13 FTEs in the Wildland Fire Office would be required.		
Socioeconomics	Overall, socioeconomic impacts associated with budget and payroll under the planned mechanical treatments and prescribed fire could be characterized as negligible, short-term benefits under all three alternatives. Tourism would not be affected by short-term closures, but could be reduced by the occurrence of a catastrophic fire. This would reduce spending on lodging, food, and travel. However, these effects could be offset by an increased demand for services by employees involved in fire suppression and restoration. Hence, the economic impacts of these larger events may have both beneficial and adverse short-term and minor effects.	Same as Alternative A.	Same as Alternative A.

Notes:
WUI = Wildland Urban Interface
FMU = Fire Management Unit
SOD = Sudden Oak Death
VOC = volatile organic compounds
NO_X = nitrogen oxides
SO_2 = sulfur dioxide
USFWS = U.S. Fish and Wildlife Service
FTEs = full-time equivalents

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Chapter 1 – Purpose and Need

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1.1 Introduction

This Final Environmental Impact Statement (FEIS) evaluates a Fire Management Plan (FMP) for lands within the Golden Gate National Recreation Area (GGNRA), Muir Woods National Monument, and Fort Point National Historic Site (collectively known as "the park" for purposes of this FEIS). The National Park Service (NPS) has prepared the FEIS in accordance with the National Environmental Policy Act (NEPA). See Figure 1-1 for the park's location and Figure 1-2 for the regional setting. The FEIS analyzes three alternatives for managing fire in the park; these alternatives are based upon park values, effective fire management strategies, NPS policy, and applicable law.

An FMP is a strategic plan describing detailed procedures for managing the full range of fire management activities, including wildland fire suppression and fuel reduction projects. NPS Director's Order 18 (NPS 2003a) requires that each park with vegetation capable of burning prepare a plan to guide a fire management program. GGNRA is currently operating under a 1993 FMP. The NPS proposes to prepare a new FMP to reflect recent changes in fire management policy and the addition of newly acquired lands within the park boundary since the 1993 plan was written.

The FEIS for the FMP describes and assesses alternative strategies for reducing risks to the public, firefighters, sensitive resources, and park facilities from wildland fire. The document also examines the opportunities to use prescribed fire and mechanical fuel treatments as tools for achieving fire risk reduction and resource protection and enhancement objectives.

The alternative selected at the end of this NEPA process will define the overall strategy for the park's new FMP. The FMP will be supplemented by operational procedures and plans such as preparedness plans, preplanned dispatch plans, prescribed fire plans, and prevention plans. The FMP is a separate stand-alone document that will be completed following the adoption of the alternative or actions constituting the approved plan in the Record of Decision (ROD).

1.2 Decision to Prepare an Environmental Impact Statement

The decision to prepare an Environmental Impact Statement (EIS) for the FMP was made by the superintendent of GGNRA after considering the scope, complexity, and public interest related to issues being addressed in the plan. The role of fire has implications for park use, ecosystem structure and function, and human activities in the region. This complexity and associated public interest suggested a level of analysis commensurate with an EIS. By completing an EIS for the FMP, sufficient analysis can be undertaken to assess the effects of particular alternatives and to ensure adequate involvement by the public and interested agencies.

The EIS for the FMP conforms to the provisions of the NEPA (42 U.S.C. 4321 et. seq.), and NPS Director's Order 12 (NPS 2001a) and Handbook for Environmental Impact Analysis. Following the public comment period on the DEIS and any necessary consultation for actions that may affect natural and/or cultural resources, the FEIS is prepared and distributed to the public. At the conclusion of a 30-day waiting period, the NPS will prepare a Record of Decision. Following the Record of Decision, the recommendations of the new FMP, when completed, will include 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 FMP will become the working document guiding fire management actions in the park for the next 10 to 15 years.

This FEIS evaluates fire management planning at a more general, "program" level. Additional NEPA review may be needed for subsequent FMP implementation projects that involve issues not sufficiently assessed in the programmatic EIS. A five-year fire management program for implementation will be developed based on the alternative selected by the FMP EIS process. The five-year implementation program will be updated annually to reflect completed projects and add new projects that continue the progressive implementation of the selected alternative.

1.3 Planning Area

The legislated boundary of GGNRA consists of 74,816 acres in San Mateo, San Francisco, and Marin counties in California (see Figure 1-2). Within the legislated boundary, 15,700 acres of land are directly managed by GGNRA and an additional 15,400 acres on Bolinas Ridge are managed for GGNRA by Point Reyes National Seashore (PRNS). (The balance of acres are managed by other agencies.) New lands may be added, in the future, within the legislated boundary of GGNRA.

The FMP planning area encompasses those lands directly managed by GGNRA, including Muir Woods National Monument and Fort Point National Historic Site. The majority of lands directly managed by GGNRA are in Marin County and include three former military posts in the Marin Headlands and Fort Baker, and the 554-acre Muir Woods National Monument. The San Francisco GGNRA lands encompass nearly all of the city's Pacific Ocean shoreline, including Lands End and Ocean Beach, as well as Alcatraz Island, and lands formerly held by the military at Fort Mason and along the coastal portion of the Presidio of San Francisco. The larger GGNRA units in San Mateo County are Milagra Ridge and Sweeney Ridge, former military sites between Pacifica, San Bruno, and Mori Point. The 1,200-acre Phleger Estate is the southernmost area in GGNRA. The acreage the NPS manages directly contains more than 1.7 million square feet of building space in both historic and non-historic structures. In all, GGNRA has roughly 59 miles of Pacific coast and San Francisco Bay shoreline and an estimated 40-mile long interface with developed lands, primarily residential communities. The Federal Wildland Fire Management Policy (January 2001) emphasizes the importance of reducing risk along the area between federally managed parklands and the urban interface and is therefore an important consideration in this planning effort.

The parklands in the planning area are also part of the Golden Gate Biosphere Reserve – two million acres of protected terrestrial and marine ecosystem in central California managed to promote resource conservation, research opportunities, and economically sustainable development. GGNRA lands support 19 separate ecosystems and 12 distinct plant communities. An island of open space in the densely developed nine-county San Francisco Bay Area, GGNRA lands provide habitat for 25 federally listed endangered or threatened plant and animal species and 52 additional species of concern. Park inventories have identified 872 terrestrial native plant species, 336 nonnative plant species, 282 resident terrestrial native vertebrate species, and 33 nonnative vertebrate species to date. Within GGNRA are five National

Pacific West Region

National Park Service

U.S. Department of the Interior

Produced by the Pacific West GIS Group Seattle, Washington

Figure 1-1

October, 2005

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San Francisco Bay Area
Golden Gate National Recreation Area
National Park Service
Department of the Interior
Area managed by Golden Gate National Recreation Area
Other public lands
PETALUMA
TOMALES
TOMALES BAY
Tomales Bay State Park
Point Reyes National Seashore
Tomales Bay
SAN ANDREAS FAULT ZONE
INVERNESS RIDGE
BOLINAS RIDGE
NOVATO
SAN PABLO BAY
VALLEJO
Samuel P. Taylor State Park
Marin Municipal Water District
SAN RAFAEL
RICHMOND
Olema Valley
Audubon Canyon Ranch
Bolinas Lagoon
Muir Woods
Mount Tamalpais State Park
Gulf of the Farallones National Marine Sanctuary
Angel Island State Park
BERKELEY
Marin Headlands
Alcatraz
Fort Point
San Francisco Maritime National Historical Park
Presidio
Golden Gate Biosphere Reserve
Cliff House
SAN FRANCISCO
ALAMEDA
Ocean Beach
Fort Funston
PACIFIC OCEAN
SAN FRANCISCO BAY
Farrallon National Wildlife Refuge
Milagra Ridge
PACIFICA
Sweeney Ridge
SAN MATEO
San Francisco Peninsula Watershed
James V. Fitzgerald Marine Reserve
HALF MOON BAY
Phleger Estate
Huddart County Park
WOODSIDE
Monterey Bay National Marine Sanctuary
North
0 5 10 Kilometers
0 5 10 Miles

Figure 1-2

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Historic Landmark Districts, 667 historic structures, and more than 350 known archeological sites. Each year, more than 16 million visitors come to the park from all over the world, the country, and the Bay Area for recreation, education, inspiration, and respite (NPS 2003d).

The FMP EIS evaluates fire management options for approximately 15,000 acres of GGNRA's nearly 75,000 legislated acres. The FMP planning area does not include the following lands:

(1) The northern lands of GGNRA, comprising 15,400 acres north of the Bolinas-Fairfax Road in western Marin County, which are managed by the Point Reyes National Seashore (PRNS) under an agreement between the two park units. Fire management responsibilities for these northern lands are addressed in the PRNS FMP Final EIS (NPS 2004a). GGNRA and PRNS have worked together to develop a complementary strategy for fire management that meets each park's objectives for sharing resources, research, and staffing during implementation of the respective FMPs.

(2) The interior portion of the Presidio of San Francisco, Area B, which is managed by the Presidio Trust, a federal corporation. Because this area is not under the direct management of the NPS, it is not included in the FMP planning area.

In addition to lands currently under the management of the NPS, the FMP planning area includes those lands within the legislated boundary that may pass to NPS management in the near future. These areas, all in San Mateo County, include Cattle Hill and Pedro Point.

1.4 Purpose and Need for Action

Need

The park's 1993 FMP needs to be updated to conform to the Federal Wildland Fire Management Policy, which was developed to reflect lessons learned following a particularly catastrophic fire season in the year 2000. The federal policy provides guidance for the U.S. Forest Service and land management agencies in the Department of the Interior. The director of the NPS has issued new agency guidelines to direct the parks in updating their FMPs in conformance with current federal requirements.

The park's 1993 FMP focuses primarily on natural resource management issues and needs to be revised to more fully address cultural resource concerns, provide guidance for park lands acquired since 1993, and provide more guidance on effectively reducing fire risk along the wildland urban interface areas in the park. Changes are necessary to address conformance with current federal policy on issues of public and firefighter safety, hazard reduction in the wildland urban interface zone, the use of best available information as the basis for fire management planning, and the need to pair fuel reduction with management objectives for park resources.

Residential development flanking the park boundaries has intensified the potential for uncontrolled ignitions to spread across boundaries, threatening firefighters, residential areas, park visitors, and park resources. In addition, fire suppression practices have resulted in dangerous amounts of hazardous vegetative fuels that have accumulated in dense forests and shrublands. Because of these high fuel loads, residences and businesses are at risk from wildfire spreading from adjacent park lands. Also, a structural

fire close to the park could spread into park lands and develop into a wildland fire that damages park resources. A new FMP is needed to reflect the importance of a more concerted effort to effectively reduce wildfire risk to park resources and to private property along the wildland urban interface, and to examine the feasibility of facilitating the role of fire where it is safe to do so.

The undeveloped areas of GGNRA support ecosystems that have evolved through time with periodic fire, both natural and human-ignited. Many components of these ecosystems are adapted to and may require periodic fire. As is typical of many national parks and other federal lands, active and effective fire suppression efforts for the past 150 years, in addition to logging, ranching, cultivation, pollution, and general urbanization, have changed native ecosystems. Ecosystem changes are evidenced by the spread of more flammable nonnative plant species, dense single-aged second-growth forests, conversion of shrublands to forest, forest and shrubland encroachment on grasslands, and decadence and decline of fire-adapted species. A new FMP is needed to provide a framework for managing these ecosystems and fuel loads.

Important characteristics of cultural landscapes have also been altered in the absence of fire, and the risk of wildland fire damaging historic structures has increased as fuel loading has increased. A new FMP is needed to address this issue.

Purpose

The purpose of the FMP is to provide a framework for all fire management activities in a manner that is responsive to natural and cultural resource objectives, reduces risks to developed facilities and adjacent communities, and provides for public and staff safety. The intent of this FEIS is to present and analyze alternatives for carrying out the fire management program at GGNRA. It also presents and analyzes effects that would occur as a result of implementing these alternatives. The purposes of this planning process are:

- To prepare a new FMP that is consistent with Federal Wildland Fire Management Policy and conforms to agency guidelines for fire management plans and programs; and
- To help achieve resource management objectives consistent with the park's cultural, natural resource, and land management plans and be responsive to safety considerations for park visitors, employees, and resources.

As part of the planning process, FMP goals were developed by NPS staff to reflect federal policy as well as the comments and concerns expressed by the public during the scoping period. Public scoping on this EIS began on August 8, 2003 and ran until December 5, 2003. (See Chapter 5, Section 5.1, Public Involvement and Scoping, for more information.) The goals were derived from guidance of the NPS Management Policies 2001 (NPS 2000a) and NPS Director's Order and Resource Handbook 18, Wildland Fire Management (NPS 1999a), in addition to federal policy and scoping input. The goals conform to the 1980 General Management Plan for GGNRA and the park's Resources Management Plan (1999). The goals and subsequent management objectives describe what must be accomplished in order for the fire management program to be successful and were used to formulate the alternatives analyzed in

this FEIS. Specific objectives for individual projects would be developed on a project-by-project basis and would be tied back to these FMP goals.

The FMP goals and management objectives are as follows:

Goal 1. Ensure that firefighter and public safety is the highest priority for all fire management activities.

Objectives:

Provide fire management workforce with the training, equipment, operating procedures, safety measures, and information needed to manage risks and carry out their activities safely.

Ensure that all fire management employees meet the Interagency Qualification Standards for their positions and those held while assigned to an incident.

Identify, inform, and protect visitors, communities, park partners, and other groups and individuals that potentially would be affected by fire management activities.

Comply with the National Wildfire Coordinating Group and agency fitness requirements for staff and make sure staff have personal protective equipment appropriate to the job or assignment.

Follow all aviation policies and practices during fire management activities. The fire management officer or designee will stay abreast of aviation policy changes by maintaining periodic contact with the regional aviation manager.

Goal 2. Reduce wildland fire risk to private and public property.

Objectives:

Annually analyze fire hazards, fire values, and risks to inform project priority selection for fire management units (FMUs).

Support the development of evacuation plans for wildland urban interface communities, where such plans do not exist.

Develop prevention plans to reduce the number of human-caused ignitions.

Goal 3. Protect natural resources from adverse effects of fire and fire management activities, and use fire management wherever appropriate to sustain and restore natural resources.

Objectives:

Manage ecosystems within the natural range of variability for plant community structure and fuel loads.

Reduce potential spread of nonnative plant species to adjacent natural areas and ensure any fire activities include follow-up actions (planting, seeding, etc.) to meet overall vegetation goals. Ensure that any fill used and/or maintenance activities do not introduce weeds.

Reduce nonnative trees and shrubs (Monterey pine, Monterey cypress, acacia, eucalyptus, etc.) to the greatest extent possible.

Protect and restore rare and endangered species and sensitive habitat through fire management activities and project implementation.

Reduce erosion from fire roads and reduce sediment transport through ongoing maintenance of roads and the removal and site restoration of unnecessary fire roads.

Develop standards for the use of water and retardants in fire management activities, such as minimization of the use of saltwater and brackish water, and avoidance of use of nearby water sources with rare species, for the protection of water quality and aquatic habitat characteristics.

Identify and protect natural soundscapes through the course of mechanical treatment activities involving the extended use of power equipment.

Goal 4. Preserve historic structures, landscapes, and archeological resources from adverse effects of fire and fire management activities, and use fire management wherever appropriate to rehabilitate or restore these cultural resources.

Objectives:

Survey for and identify historic resources within a project area in the earliest possible stage of planning fire management activity.

Conduct surveys for areas of potential archeological resources (based on sensitivity modeling or prediction) prior to project implementation. Avoid ground disturbance prior to survey of sensitive areas for archeological resources. Protect archeological resources (known, predicted historical, or discovered sites).

Develop standard procedures for projects calling for the use of fire and other treatments in order to maintain the setting of historic sites and to maintain the integrity of cultural resources.

Regularly monitor fire management activities to assess their effects on cultural resources.

Protect historic structures and landscape features through the course of fire management project implementation.

Use fire management activities to preserve and in some cases to perpetuate historic vegetation patterns.

Rehabilitate pastoral landscapes where fire danger would be lessened by the establishment of a lower fuel-loading plant community.

Goal 5. Refine management practices by improving knowledge and understanding of fire through research and monitoring.

Objectives:

Monitor and evaluate the effects of fire and fuels management activities on park resources. Evaluate monitoring information to refine fire management actions and project objectives.

Identify issues or missing information important to developing effective implementation of the park's fire and fuels management program.

Continue ongoing inventory and baseline data collection to enhance existing resource information systems. Use vegetation maps, fire history maps, and other tools to develop risk assessments that will be used to identify and set priorities for appropriate treatments.

Conduct research that will help park managers to understand fire regimes, refine prescriptions, provide data for fire behavior models, and effectively implement the fire management program.

Research the role of fire in old-growth redwood forests.

Conduct research into issues of Sudden Oak Death, and the potential of fire as a management tool.

Determine how fire can be used to target nonnative plant species for eradication.

Research the effects of fire exclusion.

Determine how current fire frequency affects related ecosystems with respect to the historic fire regime.

Determine how post-fire recovery patterns may be used in restoration projects.

Goal 6. Develop and maintain staff expertise in all aspects of fire management.

Objectives:

Implement annual program reviews for fire management office and personnel.

Implement training plans for each employee to reach target qualifications for the positions in the fire management organization. Conduct annual training appropriate to instructor qualifications.

Keep abreast of the latest developments and technology applicable to fire management.

Establish and promote measurable qualifications and staff experience to accomplish fire management program objectives in a safe manner.

Follow all safety standards and guidelines identified within the Interagency Incident Business Management Handbook.

Goal 7. Effectively integrate the fire management program into park and park partner activities.

Objectives:

Develop a fire management program that is consistent with, and meets the goals of, the park's General Management Plan (GMP) and resource management plans.

Encourage interdisciplinary pre-project planning for fire management activities.

Plan for and conduct fire management activities in an integrated manner with respect for overall resource goals and in an effort not to exacerbate existing problems.

Conduct educational outreach programs on the park's fire management activities and fire safety for park partners, including tenants in park structures within project areas.

Goal 8. Foster informed public participation in fire management activities.

Objectives:

Continue and enhance communication and education programs to broaden an understanding of the NPS fire management mission, for both internal and external audiences.

Maintain and expand the current park website to provide information about fire management activities in the park as well as fire safety.

Support an increase in fire ecology and safety programs in schools.

Increase public meetings and homeowners group presentations.

Provide more interpretive programs on fire safety and ecology.

Provide trailhead brochures on fire safety.

Goal 9. Foster and maintain interagency fire management partnerships and contribute to the firefighting effort at the local, state, and national level.

Objectives:

Maintain cooperative fire management agreements with county and city fire departments.

Continue interagency coordination and cooperation with federal land management agencies and other related agencies supporting or participating as full partners in wildland fire management activities and programs.

Attend interagency planning meetings prior to each fire season to enhance coordination and cooperation to maximize efficiency to manage wildland fire incidents.

Continue participation in regular fire management coordination meetings to share information and discuss related issues with organizations such as FIRESafe Marin.

Goal 10. Minimize smoke generation during prescribed burning through the use of a smoke management plan (SMP) that details best management practices or non-burning alternatives where these options would meet resource management and fuel reduction objectives and also achieve emissions reduction.

Objectives:

Confer regularly with Air Resources staff at the NPS Pacific West Regional Office, other parks, fire agencies, and the Bay Area Air Quality Management District (BAAQMD) to keep current on best management practices and non-burning alternatives.

Maintain current information on smoke-related health issues affecting firefighters such as exposure limits, exposure monitoring, risk minimization, and respiration technology.

Legislative and Policy Framework

The following laws, regulations, plans, and policies set the planning framework for this FMP. These include federal documents such as the NPS management policies, the park's enabling legislations, and the General Management Plan, along with related regional and local plans and policies.

Applicable Federal Regulations, Plans, and Policies

National Environmental Policy Act (NEPA)

NEPA (1970) requires that, before making decisions, federal agencies conduct a public involvement process that analyzes the potential effects of proposed actions on the human environment. Among many goals, NEPA recognizes each generation as a trustee responsible for protection of the environment and sets as national policy the attainment of the widest range of beneficial uses of the environment without degradation, risk to health or safety, or other undesirable and unintended consequences (42 USC 4331[b]). NEPA created a Council on Environmental Quality (CEQ) as part of the Executive Office of the

President to develop implementation regulations for NEPA. Pursuant to these regulations, each federal agency must "implement procedures to make the NEPA process more useful to agency decision makers and the public" (40 CFR 1500.2).

National Park Service Director's Order 12 (DO-12) and Handbook

The procedures for implementing NEPA, adopted by the NPS, are found in Director's Order 12 (NPS 2001a) and the Handbook on Environmental Assessment (rev. 2004). Though known as a "handbook," the processes described within it are legally binding on all NPS personnel. DO-12 instructs NPS staff on the integration of the NEPA process in all NPS planning efforts. An essential precept of NEPA is public involvement, and Director's Order 12 provides guidance on integrating the public and regulatory agencies into the development of NEPA plans and projects. DO-12 never conflicts with the CEQ regulations and adds some requirements to ensure that NEPA processes respond to the specific mandates of the NPS such as the NPS Organic Act (1916).

Federal Wildland Fire Management Policy

The federal government has set fire and fuels management as a high priority issue nationwide. In 2001, the Interagency Federal Wildland Fire Policy Review Working Group revised the Federal Wildland Fire Management Policy (National Interagency Fire Council 1995), which applies to all federal land management agencies. Key elements of the policy are listed below.

- Firefighter and public safety is the first priority.
- The full range of fire management activities will be used to help achieve ecosystem sustainability.
- 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.
- Wildland fire will be used to protect, maintain, and enhance resources and, as nearly as possible, be allowed to function in its natural ecological role.
- Rehabilitation and restoration efforts will be undertaken to protect and sustain ecosystems, public health, and safety, and to help communities protect infrastructure.
- Fire Management Plans and programs will be based on a foundation of sound science. Research will support ongoing efforts to increase scientific knowledge of biological, physical, and sociological factors.
- Agency administrators will ensure that their employees are trained, certified, and made available to participate in the wildland fire program locally, regionally, and nationally as the situation demands.
- Agencies will develop and implement a systematic method of evaluation to determine effectiveness of projects begun under the 2001 Federal Fire Policy. The evaluation will ensure

accountability, facilitate resolution of areas of conflict, and identify resource shortages and agency priorities.

National Park Service Director's Order 18: Wildland Fire Management

Policies and directives in Director's Order 18 (DO-18) specifically require the development of a fire management plan for each park with burnable vegetation and direct that each approved FMP will:

- Reinforce the commitment that firefighter and public safety is the first priority.
- Describe wildland fire management objectives, which are derived from land, natural, and cultural resource management plans and address public health issues and values to be protected.
- Address all potential wildland fire occurrences and consider the full range of wildland fire management actions.
- Promote an interagency approach to managing fires on an ecosystem basis across agency boundaries and in conformance with the natural ecological processes and conditions characteristic of the ecosystem.
- Include a description of rehabilitation techniques and standards that comply with resource management plan objectives and mitigate immediate safety threats.
- Be developed with internal and external interdisciplinary input and reviewed by appropriate subject matter experts and all pertinent interested parties, and approved by the park superintendent.
- Comply with the National Environmental Policy Act (NEPA) and any other applicable regulatory requirements.
- Include a wildland fire prevention analysis and plan, a fuels management analysis and plan, and procedures for short- and long-term monitoring to document that overall programmatic objectives are being met and undesired effects are not occurring.

DO-18 also specifies that until a fire management plan is approved, park areas must take an aggressive suppression action on all wildland fires, taking into account firefighter and public safety and resources to be protected within and outside the park.

National Park Service Management Policies

The NPS Management Policies 2001 document (NPS 2000a), the basic NPS-wide policy document, includes the following elements related to fire management in NPS units:

- 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

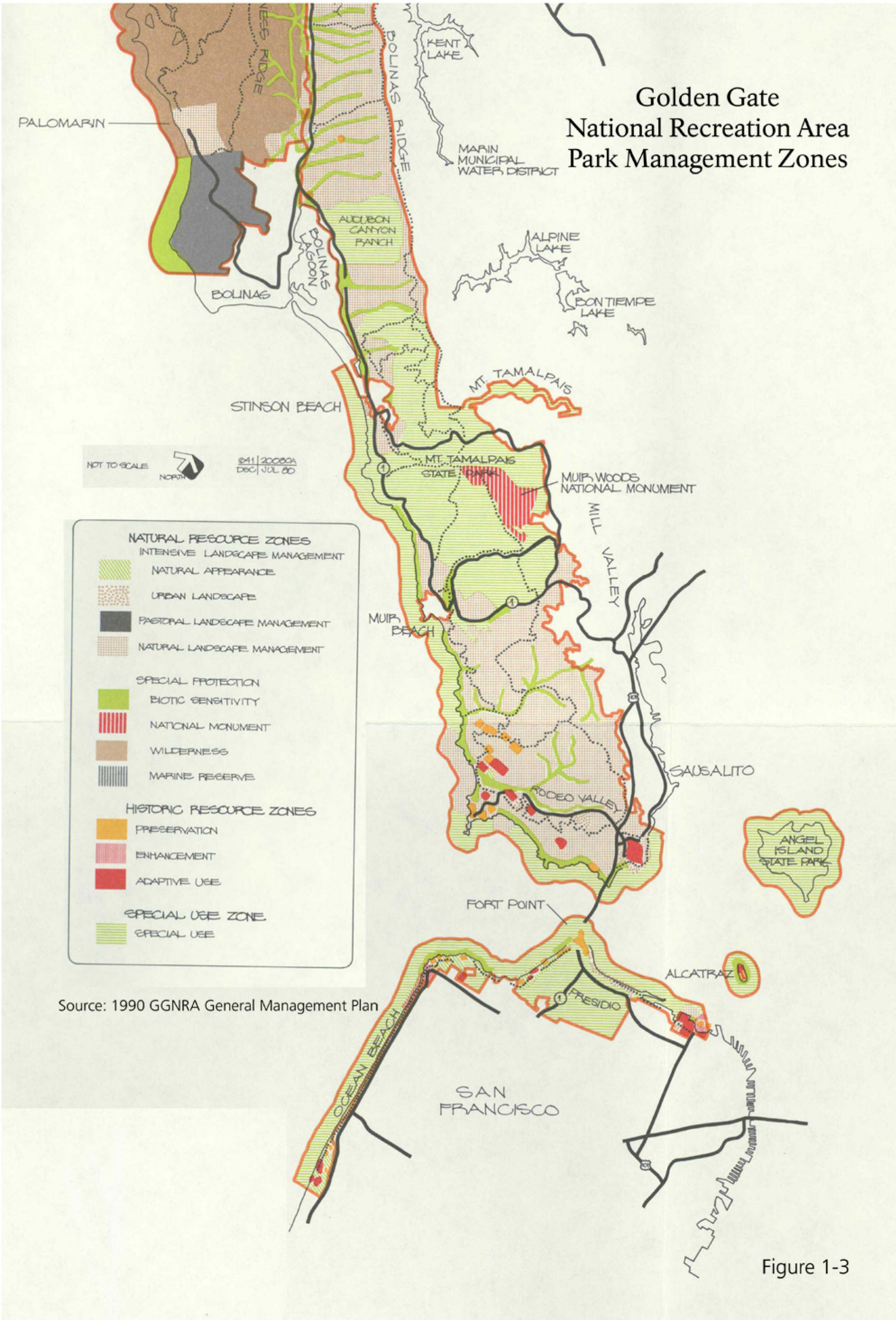
developed facilities; and addresses potential impacts on public and private property adjacent to the park.

- An environmental assessment developed in support of the plan will consider the effects on air quality, water quality, health and safety, and natural and cultural resource management objectives. Preparation of the plan and environmental assessment will include collaboration with adjacent communities, interest groups, state and federal agencies, and tribal governments.
- Until a plan is approved, parks must immediately suppress all wildland fires, taking into consideration park resources and values to be protected, firefighter and public safety, and costs.
- Parks lacking an approved fire management plan may not use resource benefits as a primary consideration influencing the selection of a suppression strategy, but they must consider the resource impacts of suppression alternatives in their decisions.
- All parks must use a systematic decision-making process to determine the most appropriate management strategies for all unplanned ignitions or prescribed fires that are no longer meeting resource management objectives.
- Parks will use methods to suppress wildland fires that minimize impacts of the suppression action and the fire, and are commensurate with effective control, firefighter and public safety, and resource values to be protected.

Golden Gate National Recreation Area General Management Plan and General Management Plan Update

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 1980 General Management Plan defined a series of land management zones to guide the strategy for "how the park will be managed and developed in the future based on legislative and administrative requirements, resource studies, and public preferences." This zoning approach allows for the treatment of specific resources, while relating them to an overall approach to the park as a whole. The FMP's proposed fire management actions for different areas of the park need to respect and reflect this current zoning, to minimize visitor, user, and resource management conflicts. The land management zones pertinent to the FMP are as follows (see Figure 1-3):

- *Intensive Landscape Management Zone* – where the landscape has been substantially modified by human activities.
- *Pastoral Landscape Management Zone* – in which dairying and cattle ranching are desirable aspects of the scene.
- *Natural Landscape Management Zone* – in which natural resources and processes will remain as undisturbed as possible.



Source: 1990 GGNRA General Management Plan

Figure 1-3

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- *Special Protection Zone* – where Muir Woods National Monument retains special status to protect the old-growth stand of coast redwoods.
- *Preservation Zone* – where spaces and objects are managed primarily for their historic values.
- *Adaptive Use Zone* **–** where structures or spaces of historic value will be adapted for recreation, park management, and related activities.

The park is currently in the initial stages of preparing a new general management plan for GGNRA to replace the 1980 General Management Plan for GGNRA and Point Reyes National Seashore. Until a new plan is completed, the land use designations of the 1980 General Management Plan constitute the basic constraint imposed upon fire management planning at the park level.

Golden Gate National Recreation Area Natural Resource Management Plan

The Natural Resources Management Plan (1999) describes the status of GGNRA's natural resources and a parkwide program aimed at resource preservation, monitoring, maintenance, and restoration. A primary challenge identified in the plan is addressing the changes in ecosystem composition and accumulation of fuels resulting from the focus on fire suppression during the last century. One of the 10 principal threats to the health of the natural resources of GGNRA listed in the plan is lack of fire stimulus in fire-adapted environments. A fire history of the park suggests that in prehistoric times wildland burning occurred at frequencies of once every 21 to 27 years (McBride and Jacobs 1978). A more extensive discussion of fire history is presented in Chapter 3, Section 3.2, Project Setting, Fire Regime of the Central California Coast.

The plan acknowledges that suppression leads to high fuel loading and an increase in the risk of a catastrophic fire. Wildland fire and its suppression could have direct and indirect impacts on natural resources by contributing to the spread of nonnative plant species, compaction and disruption of soils, alteration of drainage patterns, alteration of wildlife habitat, and high mortality of wildlife. In the absence of fire, plant diversity and overall biodiversity are declining in fire-adapted plant communities such as chaparral and oak woodlands. Douglas-fir and other forest species less tolerant of regular fires are invading these communities, potentially threatening the long-term viability of several rare plant species endemic to chaparral.

The Natural Resource Management Plan recognizes the benefits gained through hazard fuel reduction programs, including prescribed burning and habitat modification, designed to prevent such catastrophic losses of park resources. Consistent with the 1993 FMP, the Natural Resource Management Plan calls for prescribed fire to be used in GGNRA to revitalize fire-adapted communities and reduce the encroachment of fire-sensitive trees. Additional research on these communities could assist in resolving natural resource concerns. Prescribed burning and fire effects monitoring is woven into strategies for protection of the endangered San Bruno elfin butterfly, Mission blue butterfly, Northern spotted owl, old-growth forest species, and the rare manzanita and ceanothus species that are found in GGNRA. Since habitat modification through prescribed fire and mechanical fuel reduction projects can have direct and indirect effects on wildlife and their habitats, the plan calls for careful interdisciplinary planning to protect existing habitat values and guide habitat enhancement.

Golden Gate National Recreation Area Cultural Resource Management Plan

The GGNRA Cultural Resource Management Plan (1998) presents a prioritized list of 128 cultural resource projects and provides a problem statement, a description of the recommended project or activity, and an estimate of budget and staff needed to complete each project. The Cultural Resource Management Plan does not include overarching objectives for resource protection and does not address fire management planning as a strategy. A forthcoming update of this plan may incorporate objectives that integrate both fire and vegetation management as means to protect, restore, or rehabilitate cultural resources and landscapes within the park.

A preliminary listing of cultural landscapes in the park has been completed for all three counties with lands in the park. See Appendix D for this listing. Cultural landscape reports have been prepared for the Presidio of San Francisco and one for Fort Baker is in final review. The Cultural Landscape Inventory, an NPS database listing properties either on or eligible for the National Register of Historic Places, has been completed for the Fort Mason, Fort Baker, Sutro Heights, Lands End, and Cliff House areas. These cultural landscape listings serve as a starting point for discussion of cultural resource protection in the FMP and NEPA document. The FMP will address the circumstances under which implementation actions trigger the need for additional cultural resource compliance through the National Historic Preservation Act (NHPA). FMP actions have the potential to affect cultural resources both adversely and beneficially. While the FMP FEIS assesses potential effects on cultural resources from proposed actions under the alternatives, the goal of cultural resource compliance is to formulate a process through which cultural resource goals for a project area can be considered early in the planning process for fire management projects.

Golden Gate National Recreation Area Strategic Plan for 2001-2005

The five-year performance plan for GGNRA (NPS 2000c) lists parkwide goals with performance measures built into each goal statement. Strategic planning goals for the restoration of GGNRA parklands disturbed by nonnative species called for research into the applicability of prescribed fire as a restoration tool to be completed by 2005 and a burn plan incorporating that research to be formulated. The strategic plan is currently in the process of being updated with goals and measurable objectives through 2008.

Vegetation Management Plan, Presidio of San Francisco

The Vegetation Management Plan (VMP) (NPS 2001b) for the Presidio was completed in 2001 as part of a collaborative planning effort between the NPS and the Presidio Trust for both Area A (under NPS management) and Area B (under Presidio Trust management) of the Presidio. The VMP addresses all vegetation resources and contains policies and actions that guide fire management activities as well as natural resources management activities, including efforts to test the efficacy, through research, of using fire to enhance and/or manage threatened and endangered plant species. Carefully planned and executed fuels treatments consistent with VMP resource management objectives have reduced the risk of wildland fire while improving ecosystem conditions. The activities proposed in the new FMP that apply to Area A of the Presidio should be consistent with the VMP resource management objectives and be coordinated with the Presidio Trust.

Applicable County, Special District, and State Plans

Mount Tamalpais Area Vegetation Management Plan, Marin Municipal Water District and Marin County Open Space District

The Mount Tamalpais Area Vegetation Management Plan (VMP) (MMWD 1995), prepared in 1995, presents strategies for managing vegetation on over 19,000 acres owned by the Marin Municipal Water District (MMWD) and an adjacent 1,150 acres owned by the Marin County Open Space District (MCOSD). The plan provides specific recommendations for reducing fire hazards and enhancing biodiversity. GGNRA lands are present in both MMWD watersheds (West Marin and Mount Tamalpais) and have common boundaries with MMWD holdings. All jurisdictions in the Mount Tamalpais area share essentially the same resource challenges of high fuel accumulation, a complex and lengthy urban wildland interface, and the spread of highly flammable, nonnative plant species within the interface. Addressing the issues incrementally within each jurisdiction contributes to the overall success in combating these challenges throughout the Mount Tamalpais region.

A primary goal of the Mount Tamalpais Area VMP is to reduce fire hazard. Major fires covering 20,000 to 65,000 acres have raged through Marin County periodically since recordkeeping began in 1859. The last major fire on MMWD lands occurred in 1945, and fuels have been accumulating since then. Some areas of chaparral and evergreen forest have not burned in almost 70 years. The VMP calls for a network of fuel breaks to help firefighters contain wildfires. The fuel breaks will use existing ridgetop roads in the watershed buffered by zones of reduced vegetation density. The VMP also calls for prescribed burning of 100 to 200 acres per year (less than one percent of watershed land) to control nonnative plants, reduce fuels, and maintain natural habitats.

Under the proposed GGNRA FMP DEIS alternatives, the NPS would continue to provide staff support and, when available, financial support, through the federal Wildland Urban Interface (WUI) funding program to support MMWD vegetation management projects described in the VMP. The NPS would continue to seek opportunities for cooperative efforts to implement the VMP using prescribed fire and mechanical fuel reduction, and make improvements to ingress/egress for emergency vehicles and evacuation of the public and firefighters in the event of wildland fire.

Point Reyes National Seashore Fire Management Plan

The Point Reyes National Seashore (PRNS) FMP and FEIS (NPS 2004a) examine a range of alternatives for addressing the wildland fire risk and hazard at Point Reyes National Seashore and the northern lands of GGNRA. The 18,000 acres of GGNRA lands included in the PRNS FMP are under the direct administration of PRNS through an agreement between the two parks. With the catastrophic Vision Fire as a recent historical example, much of the focus of the PRNS FMP is on strategies that increase firefighter and public safety and reduce the risk of fire spreading from wildlands into neighboring communities. The alternative selected for implementation (Alternative C in the FEIS) allows up to 2,000 acres of prescribed burning and 1,500 acres of mechanical treatment to occur within the park each year. With the exception of smaller size research burns, prescribed burning would not occur within the area currently leased for agriculture.

The GGNRA and PRNS FMPs share the same goals. To the greatest extent possible, NPS will develop objectives and proposals that contribute to meeting these shared goals and promote an efficiency of scale for the two parks through joint staffing and/or funding of projects. The planning areas of the PRNS and GGNRA FMPs adjoin each other at the Bolinas–Fairfax Road, with PRNS managing lands north of the road and GGNRA managing lands to the south. With reference to the interface between the two management areas, the PRNS FMP states that "Prescribed burning in the southernmost portion of the ridge [Bolinas Ridge] in coastal chaparral and mixed scrub habitats would also help achieve a natural resource benefit by simulative reproduction in the rare, fire adapted species Marin manzanita and Mason's ceanothus" (NPS 2004a). The GGNRA FMP should develop a strategy for the southern end of Bolinas Ridge that is consistent with the objectives for the northern section of the Bolinas Ridge covered in the PRNS FMP.

California Fire Plan and Vegetation Management Program

In 1996, the California State Board of Forestry and the California Department of Forestry and Fire Protection (CDF) 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 increasing initial attack success. Key elements of the plan are developing wildfire safety zones and working with stakeholders, including federal agencies.

Fuel reduction actions implemented by the Marin County Fire Department (MCFD) and the California Department of Forestry and Fire Protection in San Mateo County conform to the state Vegetation Management Program. The program, adopted in 1981, strives to reduce the risk of large damaging wildfires and improve the growing conditions of native plant and wildlife species through prescribed burning and mechanical fuel reduction.

Marin Countywide Plan

A number of the policies and programs in the Environmental Hazards Element of the Marin Countywide Plan (Marin County 1994) seek to mitigate wildland fire hazards through a variety of management efforts. The element sets public education as a priority for the County and MCFD and calls for a countywide map to be developed showing fire hazard areas subject to wildland fire. This hazard map was subsequently developed as the basis for the Marin County Fire Plan published in 2000 (see "Local Fire Departments" below). The Marin County Fire Plan was developed to respond to the Marin Countywide Plan requirement for a systematic and environmentally sound reduction of hazardous vegetation, in order to reduce the buildup of vegetation created by fire suppression activities. Fire hazard reduction programs included standards for clearance around structures, guidelines for fire-resistant landscaping and resistant building materials, and a requirement for the installation of residential sprinkler systems in all new and remodeled structures. The 1994 Marin Countywide Plan directs the MCFD and other local fire protection agencies to work in concert with the Marin County Open Space District, the State Department of Forestry and Fire Protection, and the NPS to encourage and promote the maintenance of existing fuel breaks and emergency access routes for effective fire suppression.

The County is currently in the process of updating the 1994 Countywide Plan; a draft plan update is currently out for public review and a California Environmental Quality Act (CEQA) document is under

preparation. The plan update includes policies and programs intended to minimize harm to people and property due to a range of environmental hazards, including fire. The update acknowledges the new risk to wildland firefighters and the public represented by increased fuels and weakened trees and limbs from dead and dying trees infected with Sudden Oak Death. The update also notes insufficient water supply and difficult access as contributors to the risk of property damage, injury, and loss of life from fire in some locations. In addition, with most of the level areas of the county already developed, new construction continues "to encroach on wildlands" and be sited in steeper areas that are more "vulnerable to rapid changes in fire behavior" (page 3-78). The plan update advises that "careful siting and construction can lessen hazard potential" and that "adequate site clearing and construction techniques such as fire sprinklers can help reduce the threat of fire" (page 3-79).

An important goal cited in the update – to "protect people and property from risks associated with wildland and structural fires" – closely conforms to the first two goals of the FMP evaluated in this DEIS. The County proposes an impressive list of implementation programs, summarized below, to help achieve this goal.

EH-4a. Provide information about fire hazards. Make fire hazard maps readily available and provide information on hazard reduction techniques to the public.

EH-4b. Maintain fuel breaks and access routes (in conjunction with other fire protection and land management agencies such as the NPS).

EH-4c. Restrict land divisions. Prohibit new land divisions in areas with high fire hazard unless:

- the adequacy of water supply is demonstrated,
- emergency vehicle access is provided from more than one point,
- necessary fire trails and fuel breaks are provided,
- fire-resistant materials are used exclusively,
- adequate defensible space is provided around structures, and
- fire-resistant plants are used in landscaping.

EH-4d. Require compliance with fire department conditions (and the incorporated State Fire Code).

EH-4e. Review applications for fire safety,

EH-4f. Continue to require sprinkler systems.

EH-4g. Continue to require fire-retardant roofing.

EH-4h. Amend the Development Code to require adequate defensible space and use of fire-resistant materials. (Draft Community Plan, pages 3-87 to 3-89)

The Marin County Local Coastal Plan, Units 1 and 2 (1980 and 1981), guides development in the coastal region of Marin County but does not address wildland fire hazard, fuel reduction, wildland urban interface, nor vegetation management.

The existing GGNRA Fire Management Plan conforms to the current Draft Marin Countywide Plan and to the proposed plan update, and the new FMP would contribute to County efforts to implement Programs EH-4a and EH-4b. Through the new FMP, the NPS would continue to work with local fire departments in providing information on fire hazard reduction to local residents as required in Program EH-4a. Under all alternatives, the NPS would continue routine maintenance of fire trails and roads acting in partnership according to the guidance in Program EH-4b.

Marin County Community Plans

The principal unincorporated residential areas of Marin County have Community Plans that were developed through a CEQA process led by the County with the participation of local residents. The Community Plans guide land use and development for each residential area by setting goals, policies and objectives. Relevant to this FMP FEIS are the Marin City Community Plan (1992), Stinson Beach Community Plan (1985), the Muir Beach Community Plan (1972), the Bolinas Community Plan (1975), and the Tamalpais Area Community Plan (1992). The Tamalpais Area Community Plan includes the neighborhoods of Tam Valley, Homestead Valley, Almonte and Muir Woods Park. The section of the Tamalpais Area Plan addressing Homestead Valley includes an objective to reduce wildfire hazard by working with residents and landowners to catalog and remove stands of eucalyptus trees which pose a risk to persons and property (LU30.1a, page III-69). The Plan encourages homeowners in the urban/wildland interface areas to remove flammable vegetation and to plant fire-resistant landscaping around the perimeter of their properties (page V-4).

Local Fire Departments

The State of California contracts with the county to provide protection to the “State Responsibility Area.” This area includes most of the inland rural and coastal portions of the county and several communities, including Homestead Valley, Kentfield, Lucas Valley, Marin City, Marinwood, portions of Santa Venetia, and Tamalpais Valley. Marin County Fire Department (MCFD) vegetation management projects are informed by the Marin County Fire Plan (Marin County Fire Department 2000), which provides a prescription for reducing cost and losses from wildland fire. The plan uses a four-factor assessment that defines Marin County’s wildland fire risk and hazards. The plan addresses generalized wildland fire risk for federal parklands. Marin County vegetation management actions, such as prescribed burns, comply with the California Vegetation Management Program.

Other local fire departments with jurisdiction adjacent to federal lands are the Southern Marin Fire Department, which is responsible for Tamalpais Valley and Homestead Valley, and volunteer fire departments in Muir Beach and Stinson Beach.

Unincorporated areas of San Mateo County contract with the California Department of Forestry and Fire Protection (CDF) for vegetation management and fire suppression services. CDF actions comply with the

California Vegetation Management Program. Incorporated areas of San Mateo County adjacent to GGNRA lands are served by the Pacifica and San Bruno fire departments.

San Mateo County General Plan

The San Mateo County General Plan (November 1986) requires clearance of defensible space around residential structures and inspections to ensure conformance with defensible space requirements. The plan promotes the use of fire-retardant vegetation in landscaping. San Mateo County fire agencies are encouraged to develop fire hazard maps, plan for coordination of efforts and evacuation of residents, conduct prescribed burns to reduce fuel loading, and maintain fuel breaks and fire roads.

San Francisco County Natural Areas Program and San Francisco Peninsula Watershed Management Plan

Prescribed burning is included as a strategy for controlling the spread of nonnative plant species and encouraging the germination of native species in the San Francisco Recreation and Park Department's County Natural Areas Program (NAP). The San Francisco Recreation and Park Department is responsible for managing the City's "Natural Areas." The City General Plan (Open Space Element, Policy 13) mandates the protection of significant Natural Resource Areas. NAP began in 1997 and is a community-based habitat restoration program. San Francisco Natural Areas adjacent to GGNRA lands include Mountain Lake Park on the southern border of the Presidio and Sharp Park, bordered by Mori Point on the southwest and Sweeney Ridge on the southeast and east. Sharp Park is unique in the City's Significant Natural Areas Program in that it supports the federally listed endangered San Francisco garter snake and Mission blue butterfly; the federally listed threatened California red-legged frog; the common yellowthroat, a federal bird of conservation concern; and possibly the bumblebee scarab beetle, a federal species of concern.

The 23,000-acre San Francisco Peninsula Watershed, managed by the San Francisco Public Utilities Commission (SFPUC), lies adjacent to NPS lands at Sweeney Ridge. The watershed lands are designated as a Hazardous Fire Area by the California Department of Forestry and Fire Protection (CDF). As such, the area is subject to closure by the SFPUC, as necessary or as requested by CDF, during times of high fire danger. One of the secondary goals of the recently completed Peninsula Watershed Management Plan (SFPUC 2002) is to protect the watershed, adjacent urban areas, and the public from fire hazard. Fire in the watershed would not only place nearby populated urban areas at risk but could also affect water quality, water supply, and ecological and cultural resources within the watershed and in adjacent areas. One of the primary reasons for restricting public access to the watershed lands is to reduce the potential for the deliberate or accidental start of a wildland fire. Fire Policies F1 through F10 address the protection of watershed resources through the improvement of firefighting facilities and implementation of a fire management plan for the watershed. This SFPUC fire management plan was a technical report prepared to support the San Francisco Peninsula Watershed Management Plan.

In implementing the GGNRA FMP, the NPS will coordinate with the SFPUC Land and Resources Management Section to ensure that NPS actions conform to the watershed's Watershed Management Plan and Fire Management Plan to the extent possible to meet NPS objectives. GGNRA staff meets annually with the SFPUC Land and Resources Management Section to discuss issues of joint interest and will

inform SFPUC staff of proposed fire management actions at the Phleger Estate, particularly those that could affect management of the adjacent watershed lands.

Considerations and Constraints

Conformance with the Mandate of the National Park Service

The FMP DEIS alternative selected by the NPS should best accomplish the legislated purposes of GGNRA and the statutory mission of the NPS and cannot lead to an impairment of park resources and values. The NPS mission is defined in the 1916 National Park Service Organic Act, which created the agency, and reaffirmed in the 1970 General Authorities Act. The underlying goal of the FMP, and all NPS planning and resource management documents, is the fulfillment of the NPS mission, which states:

> The fundamental purpose of all units of the National Park Service is to conserve the scenery and the natural and historic objects and the wildlife 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. (Public Law 91-383, Sec. 1)

To assure fulfillment of the NPS mission, NPS Management Policies 2001 (NPS 2000a) requires decision makers to consider impacts and determine in writing that a proposed action will not lead to an impairment of park resources and values before approving the action. NPS Management Policies 2001 states that impairment prohibited by the Organic 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 would otherwise be present for the enjoyment of those resources or values." NPS Management Policies 2001 further provides specific guidance for NPS managers to use in analyzing whether a proposed action would result in impairment. The policies state:

> . . . an impact would be more likely to constitute 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;[1]
>
> – Key to the natural or cultural integrity of the park or to the opportunities for enjoyment of the park; or
>
> – Identified as a goal in the park's general management plan or other relevant National Park Service planning documents.[2]

[1] GGNRA was established to "...preserve for public use and enjoyment...outstanding natural, historic, scenic, and recreation values, and in order to provide for the maintenance of needed recreational open space necessary to urban environment and planning" (Public Law 92-589). Muir Woods was established to protect the old-growth redwood described as "an extensive growth of redwood trees (Sequoia sempervirens) embraced in said land is of extraordinary scientific interest and importance because of the primeval character of the forest in which it is located . . ." (No. 793, Jan. 9, 1908 35 Stat.2174). In 1970, President Nixon signed Public Law 91-457 creating Fort Point National Historic Site, and gave GGNRA administrative authority over Fort Point as part of Public Law 92-589 establishing GGNRA. Fort Point was created "to preserve and interpret for future generations the historical significance of Fort Point in the Presidio of San Francisco, California" (47 18410 FP NatHistSite).

As with many of the management actions considered by NPS decision makers today, the careful balance of sometimes competing park resources and values is an important component of the review and decision-making process. However, NPS decision makers are given little leeway when considering impairment of park resources. All elements of an NPS action must avoid impairing park resources. If avoidance is not possible, the elements of the NPS action must be modified or deleted. However, "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" (NPS 2000a). NPS Management Policies 2001 provides guidance in this regard by reaffirming that the "fundamental purpose" of the national park system begins with a mandate to conserve park resources and values. Though providing for the enjoyment of park resources and values by the people of the United States is also an NPS mandate, the NPS is directed by Congress that, in cases where there is a conflict between conserving resources and values and providing for enjoyment of them, conservation is considered predominant (NPS 2000a).

The FMP will provide GGNRA with the framework through which the NPS statutory requirements, NEPA commitments, and planning objectives associated with fire management actions can be attained while assuring protection of cultural, natural, scenic, and recreational resources.

National Park Resource Considerations and Constraints

NPS legislation and management policies provide guidance on appropriate resource protection and regulatory compliance for national parks and guide the agency in land management programs that balance the NPS mandate of resource stewardship and provision of public recreation. Similarly, NPS Management Policies 2001 directs NPS fire management programs to "be designed to meet park resource management objectives while ensuring that firefighter and public safety are not compromised" (NPS 2000a). The directive to incorporate resource management objectives into fire management planning places an important constraint on the planning and implementation phase of a fire management program that otherwise might focus primarily on wildland fire risk reduction.

The definition of resources that merit protection within NPS lands is comprehensive and applies to "a park's scenery, natural and historic objects, and wildlife, and the processes and conditions that sustain them, including, the ecological, biological, and physical processes that created the park and continue to act upon it; scenic features; natural visibility, both in daytime and at night; natural landscapes; natural soundscapes and smells; water and air resources; soils; geological resources; paleontological resources; archeological resources; cultural landscapes; ethnographic resources; historic and prehistoric sites, structures, and objects; museum collections; and native plants and animals" and "any additional attributes encompassed by the specific values and purposes for which it was established" (NPS 2000a).

In addition to compliance with agency policy, the NPS must conform to all relevant federal legislation for environmental and cultural resource protection, including federal legislation that has been delegated to the

[2] For example, the 1980 General Management Plan, 1994 General Management Plan Amendment for the Presidio, 1996 Crissy Field Plan, or 2000 Fort Baker Plan.

State of California for implementation. Planning for fire management action must conform to the requirements of the following regulations and orders.

National Environmental Policy Act (NEPA)

All NPS actions, including specific projects funded with NPS money or performed by NPS staff on non-NPS lands, require conformance with NEPA. The goal of NEPA is "to make sure that agencies fully consider the environmental costs and benefits of their proposed actions before they make any decision to undertake those actions" (NPS 2001a). The primary constraints on fire management planning related to conformance with NEPA are (1) scheduling actions to coincide with the completion of NEPA review, (2) staffing needed for preparation of NEPA documents, and (3) funding of document preparation and implementation of mitigation measures adopted after initial project funding is awarded.

National Historic Preservation Act (NHPA)

This act authorizes the Secretary of the Interior to maintain a National Register of Historic Places, requires federal agencies to survey their lands for historic properties, and requires federal agencies to consider the effects of their undertakings on National Register properties. At present there are 22 properties managed by GGNRA, including National Historic Landmarks, that are listed on the National Register of Historic Places. These range from individual structures set within grasslands or forest, such as the Randall House or the Marine Exchange Lookout, to extensive historic districts where the landscape is a part of the character of the resource, such as at Forts Baker, Barry, and Cronkhite. However, a number of areas of the park, primarily former ranching properties, have not yet been fully evaluated for National Register eligibility. Furthermore, much of the park has not been surveyed for the presence of archeological resources. These two factors constrain fire management activities by requiring individual assessment of the potential of the activities to affect resources prior to any action being taken, until such point as appropriate consultations are held and further surveys and evaluations are completed.

Archeological Resource Protection Act

This act requires development of plans for surveying public lands for archeological resources. At GGNRA, areas proposed for fire management plans with the potential to disturb or damage archeological resources are surveyed prior to project implementation. If sensitive resources are found within a project area, the project may need to be modified to avoid damaging cultural resources.

Native American Graves Protection and Repatriation Act

This act assigns ownership or control of Native American cultural patrimony excavated or discovered on federal lands to lineal descendants or affiliated Indian tribes. If archeological pre-project surveys identify Native American burials or funerary objects, the NPS would begin consultation with tribal representatives and modify projects to avoid disturbance to burials and all objects protected under this act.

Endangered Species Act

GGNRA provides habitat for 25 plant and animal species listed under the federal Endangered Species Act. The NPS is required to consult with the U.S. Fish and Wildlife Service and/or the National Oceanic and Atmospheric Administration (NOAA Fisheries) if fire management actions have the potential to adversely affect these listed species or habitat values. Consultation provides a means for biologists to

modify proposed actions to either avoid or minimize effects on listed species. Research on the effects of fire management actions on the range of listed species is being compiled but is incomplete. Until further research is conducted, actions proposed for habitat areas will be constrained to a research scope and limited effect. In addition to the time involved in the consultation process, avoidance measures may constrain fire management actions to particular months, times, areas, or implementation techniques.

Migratory Bird Treaty Act

In conformance with the Migratory Bird Treaty Act and Executive Order 13186, the NPS strives to avoid disturbance to nesting birds protected under the Migratory Bird Treaty Act by conducting actions outside the locally defined breeding period. For GGNRA lands, the breeding period is currently set from March 1 through July 31 annually. (Some exceptions apply in specific areas and for specific resources.) Limiting disturbance to late summer through late winter constrains fire management actions to both the hottest time of year (September–October), when fire hazard is greatest, and the wettest period of the year (November–March), when erosion potential from ground-disturbing actions is highest.

Magnuson-Stevens Fishery Conservation and Management Act and Essential Fish Habitat Designation

The Magnusson-Stevens Fishery Conservation and Management Act (FCMA) as amended by the Sustainable Fisheries Act of 1996 (PL 104-267) was designed to prevent over-fishing in U.S. waters while still maintaining the yield from each fishery. The FCMA addresses the three major causes of fish and shellfish declines – overfishing, loss or degradation of habitat, and by catch. Management is governed by fish management plans, of which 36 have been developed to date and 3 apply to the GGNRA Fire Management Plan area. The planning area provides Essential Fish Habitat for salmonids species (found in Lagunitas Creek and Redwood Creek in Marin County) and Pacific groundfish and coastal pelagic fish. Under the FCMA, the NOAA Fisheries reviews federal projects, such as the Fire Management Plan evaluated in this DEIS, proposed for areas identified as important habitat in fish management plans. For example, the FCMA discourages actions that would increase sedimentation flowing to streams that provide important habitat and discourages the use of these streams during critical times of the year for fish breeding.

Executive Order 11990, Protection of Wetlands

This executive order applies principally to new construction in wetlands but also directs that proposed actions include “all practicable measures to minimize harm to wetlands which may result from such use.” Conformance with this executive order is strengthened by NPS Management Policies 2001 guidance on wetland protection that stresses “no net loss of wetlands.” Conformance places extra requirements on the design and implementation of fire management actions. (NPS 2000a)

Executive Order 13112, Invasive Species

This executive order directs the NPS, within the limits of existing appropriations, to restore native species and habitat conditions in ecosystems that now support nonnative invasive species. Research should be conducted on invasive species and technologies developed to prevent introduction and provide for environmentally sound control of invasive species. Further, the NPS is directed “not to authorize, fund, or carry out actions that it believes are likely to cause or promote the introduction or spread of invasive

species." Fire management actions are often planned to address high fuel loading from very flammable, dense stands of nonnative vegetation. Under this executive order, the NPS must integrate the control of nonnative species into fire management planning and place special focus on the post-implementation effects of projects and increasing costs, staffing requirements, and project duration.

California Native Plant Society Rare Plant Inventory

NPS Management Policies 2001 states that the NPS will inventory, monitor, and manage state and locally listed species in a manner similar to its treatment of federally listed species, to the greatest extent possible. In California, the California Native Plant Society (CNPS) Rare Plant Inventory is the recognized authority for identifying state and locally rare plants within the national park. Through the NEPA process, the NPS develops strategies for maintaining and enhancing CNPS-listed plant populations.

Climatic Considerations and Constraints

GGNRA's location in the middle latitudes and on the west coast of North America places it in the relatively rare Mediterranean-type climate. The only other regions of the earth sharing this climate type are located in southwestern Africa, the west coasts of Chile and Australia, and the region surrounding the Mediterranean Sea. Winters are mild and wet, while summers alternate between hot and dry and heavy fogs. This unusual weather pattern places several seasonal constraints on wildland fire hazard and fire management planning at GGNRA.

The park experiences a very long fire season, from early summer when fine fuels cure through October/November when the first rains fall. Typically, only one inch of rain falls between April and November. In the United States, this prolonged dry season is unique to coastal California. Several synoptic weather types produce high fire danger during this period. One is the cold-front passage followed by winds from the northeast. A second high fire danger type occurs when a pressure ridge persists over the western portion of the United States. At the surface, this pattern produces very high temperatures, low humidity, and air mass instability. The period of highest fire hazard occurs in September through November during the last period of the drought and is often accompanied by strong winds from the hot, eastern interior of the state. The period of high danger can last as long as a week, but is more typically one to two days.

Other climatic considerations include the following:

- Though a rare occurrence in the Bay Area, summer thunderstorms with lightning strikes can occur during the dry season, causing wildland fires.
- A thick, wet summer fog pattern often develops offshore of GGNRA in mid-summer and persists until early fall. The fog bank moves inland and back out to sea in a three- to four-day cycle in response to heating and cooling in the Central Valley. Fine fuel moisture fluctuates in this cycle, while wood fuels and duff remain relatively wet, making prescribed burning difficult to schedule and carry out successfully. The summer fog pattern brings variable high winds predominantly from the northwest during many summer afternoons. The combination of dry fuels and afternoon

winds may take a controlled burn out of prescription by the afternoon before objectives can be met or cause nuisance smoke to drift unexpectedly to residential areas.

- Mechanical fuel reduction projects scheduled for the summer and fall using heavy equipment and power hand tools must use extra caution during the dry season to avoid sparks that could result in accidental fire starts.

- In shrubland and forested areas, burning can be extremely difficult due to the narrow burning window from late September to early October when fuels dry out. Northeast wind events during this same time frame can result in “red-flag days” on which no burning is allowed. Smoke can have impacts on residents surrounding the park and impair road visibility. Often, “burn days” do not coincide with weather conditions appropriate for burning in GGNRA.

- On the average, GGNRA parklands in the three Bay Area counties receive from 20 to 40 inches of rain annually, with 80 percent falling between November and March. Though burns are easier to control during the winter, saturation and cool temperatures may make it difficult to keep the fire burning.

- Multiyear droughts can intensify fire behavior. One dry year does not normally constitute a drought in California. Droughts occur slowly, over a multiyear period. Droughts exceeding three years are relatively rare in Northern California. California’s most recent multiyear drought was 1987-1992.

- More moisture than usual also increases fire danger by increasing the amount of highly ignitable fuels. During El Niño episodes like 1982-1983 and 1997-1998, the San Francisco Bay Area received more than twice its “normal” rainfall. Although El Niño events occur every four to seven years, they vary greatly in timing and strength. A mild El Niño will scarcely have any important effect, but a strong one can bring disaster. The wintertime effect of La Niña in the Bay Area is likely to be colder, windier weather and perhaps abnormal rainfall in either direction, too much or too little (or sometimes neither). If La Niña persists into the summer, stronger upwelling off the California coast brings more fog to the area. The Pacific Decadal Oscillation (PDO) affects these phenomena as follows: a high PDO at the same time as an El Niño event or a low PDO concurrent with La Niña increases the severity of El Niño and La Niña events. When the inverse of the above occurs the results are highly unpredictable and range from canceling the effect to high reinforcement.

Operational and Risk Constraints

The Bay Area Air Quality Management District (BAAQMD) issues permits for prescribed burns on the day of burn. BAAQMD must consider ambient air quality on that day and other proposed burns or special events that are within the general time period to ensure that discretionarily permitted actions do not exceed air quality standards.

In order to conduct a prescribed burn on NPS lands, “contingency resources” must be committed and assigned to the burn (NPS 2003b). These resources are in addition to those on scene to conduct the burn and are based on needs in a worst-case scenario. Availability of additional resources can become a factor in busy fire seasons when resources are often stretched throughout the region. GGNRA maintains a wildland fire engine crew. This crew plays an active role in completing hazard fuel reduction projects.

GGNRA has approximately 40 miles of wildland urban interface (WUI) areas that are at risk from wildland fire spreading either from NPS lands to developed areas or from structural fires on private parcels into the wildlands. NPS Management Policies 2001 (NPS 2000a) indicates that park units must comprehensively consider firefighter and public safety costs as well as resource values in deciding appropriate strategic and technical options for managing wildland fires. Due to the risk presented to surrounding communities, all natural or accidental ignitions in GGNRA are suppressed, consistent with the park’s 1993 FMP.

Risk is considered in planning for mechanical fuel reduction projects. Priorities include defensible space surrounding structures, buffer zones between parklands and surrounding communities, and maintenance of strategic access, including fire roads.

Prescribed burns on GGNRA-administered lands also represent potential risk to surrounding communities. GGNRA is committed to managing prescribed fire in such a manner as will mitigate risk to private lands. Costs per acre are generally higher than for large-scale burns as more time is invested to cover fewer acres.

1.5 Fire Management Plan Scoping

Public Scoping Process

Public scoping for the FMP EIS began on August 8, 2003, with the publication of a Notice of Intent to Prepare an Environmental Impact Statement in the Federal Register. After holding scoping meetings for park staff and local fire agencies, the NPS held three public meetings during the scoping period. The meeting dates, the duration of the scoping period, and instructions on submitting comments by mail or email were published in the Notice of Intent and included in mailings sent out to the GGNRA mailing list. Information on the scoping period and how to submit comments was posted on the GGNRA fire program website.

Park staff gave presentations on the FMP at each public scoping meeting. The presentations were followed by an oral public comment session. The first and third meetings were part of the regularly scheduled, bimonthly, public GGNRA meetings held by NPS. The first meeting was held at Pacifica City Council Chambers on September 16, 2003, and the third meeting was held November 18, 2003, at Fort Mason, Building 201 in San Francisco. The second meeting was specially scheduled to focus only on the FMP and was held in Sausalito on September 24, 2003. Comments were recorded by a court reporter at each of the meetings. NPS staff also gave presentations on the FMP to FIRESafe Marin, a nonprofit organization of fire agencies and homeowners associations, and Fire Safe San Mateo County.

At the close of the scoping period on December 5, 2003, a scoping report summarizing the comments received was prepared and posted on the GGNRA fire website. A total of approximately 200 persons participated in these combined outreach efforts for scoping. For more information, see Chapter 5, Section 5.1, Public Involvement and Scoping.

Issues and Concerns Raised During Scoping Relevant to the FMP EIS

Scoping comments provided guidance to NPS staff in preparation of this EIS. The comments identify sectors of the biological, human, or social environment that the public and/or NPS staff think fire management actions could affect, either negatively or beneficially. Comments also pertain to types of fire management actions or overall strategies that were considered in the formulation of the alternatives. The comments received by the NPS helped determine which issues and alternatives are relevant and should be included in the EIS and which issues would be better served in another planning effort.

General Comments

General comments included the following:

- Whenever possible, FMP projects should seek to achieve both cultural and natural resource objectives in addition to reducing fire hazard.
- Monitoring of the implementation and results of projects should play an important role in the FMP.
- When discussing community projects funded by the Wildland Urban Interface Program, the FMP EIS should address whether these projects will be held to the same standards for monitoring, maintenance, and native plant restoration as projects within the park.
- Ongoing fuel mapping should continue as part of the FMP as it serves as a very valuable tool for identifying and setting priorities for areas.
- The FMP should address the potential for use of wildland fire where possible in GGNRA.
- Pesticides should be considered in the alternatives as one of the available FMP tools to prevent resprouting of nonnative flammable vegetation.
- The FMP alternatives should include an education component that could provide information on reducing fire hazard to neighboring communities.

Land Use

Land use issues address how the implementation of the FMP within the park could affect adjacent residents or change use patterns in that part of the park. Issues raised were the following:

- The EIS should assess the potential for changes to local wind patterns and strength to occur in neighboring communities when trees are removed within the park.

- The EIS should assess whether FMP actions that remove parts of woodlands could increase the potential for windthrow (tree failure from weakening when supporting trees are removed) to affect the remaining trees.
- FMP projects that change vegetation type from more flammable nonnative vegetation to native plants may result in a restriction of use in that area to promote the plant restoration.
- The FMP should address how projects would be implemented in areas of the park where the boundary is not known.

Visitor Experience and Aesthetics

FMP actions could change views or elements of the park that are important to visitors and park users. Issues raised were the following:

- To avoid affecting views, the alternatives should include understory thinning rather than tree removal in eucalyptus groves.
- The FMP should describe how public education and public outreach will be incorporated into the implementation of fuel management actions.
- The NPS should consider that many visitors highly value all trees, including nonnative species such as eucalyptus.
- The EIS should evaluate whether fire management actions could result in unsightly changes to viewsheds.

Fire Risk and Life Safety

Ensuring firefighter and public safety is a primary goal of the FMP. Comments relating to fire risk and life safety included the following:

- The EIS should provide information characterizing the degree of fire hazard in the wildland urban interface in Pacifica.
- Both native and nonnative vegetation should be considered as fuels.
- The EIS should address the fire hazards inherent in the different types of fuel reduction methods such as mowing or prescribed burning.
- Does the NPS have adequate equipment (including radio equipment) and staffing to deal with wildfires?
- What are the training needs for firefighting and fire ecology for park staff?

- San Francisco areas of the GGNRA should be excluded from FMP actions such as prescribed burning, as these areas are too densely settled and the fire hazard is too high.
- The EIS should address how Sudden Oak Death has locally raised fire hazard levels where there is high tree mortality.
- The EIS should address evacuation and warning of visitors, staff, and neighbors in the event of wildland fire.
- The EIS should identify which fire roads need improvements and which could be abandoned and restored.
- There is a potential hazard if FMP actions disturb known or unmapped subsurface infrastructure interrupting service or disturbing hazardous materials.

Air Quality

FMP actions typically include prescribed burning and use of fuel-powered equipment and vehicles, all of which contribute pollutants to the atmosphere. Issues raised were the following:

- The EIS should address the effects of prescribed burning and equipment use on air quality.
- The EIS should address the health and nuisance effects of smoke on nearby residents.

Cultural Resources

Fire management implementation could disturb subsurface cultural resources, pose a hazard to historic structures, and inadvertently alter cultural landscapes. Issues raised were the following:

- The scope of the EIS triggers the need for review under the National Historic Preservation Act.
- Fuel reduction projects could remove trees and vegetation important to a cultural landscape.
- Significant effects could inadvertently occur due to the lack of existing information on the historic role of fire in the park and on many of the park's cultural resource areas, and the consequent need for research and survey in these areas.
- The EIS should develop mitigation measures that will serve as a standard protocol to follow to avoid adverse effects on cultural resources when planning or implementing FMP projects.
- The EIS should include measures for reducing fuel levels around historic structures.
- The EIS should include recommendations for the restoration of cultural landscapes to the appearance and function they had during a site's most significant historic period.

- The EIS should address the fact that projects funded by the Wildland-Urban Interface Initiative on property outside of the park will need to conform to NHPA requirements.
- The EIS should address how improvements to fire roads will incorporate NHPA conformance.
- Grazing, a historic land use in GGNRA, should be considered as a potential strategy to reduce fire hazard where appropriate.
- The EIS should identify those areas of GGNRA with characteristics that may indicate potential archeological sensitivity.
- Tribal consultations on the EIS would be important for gathering information on sacred sites within GGNRA or important ethnographic areas within the planning area.

Vegetation and Wildlife

FMP actions could have either a positive or negative effect on natural resources, including native plant communities, wetlands and riparian corridors, and other aquatic habitats. Issues raised were the following:

- The EIS alternatives should consider restoration with native plants following FMP actions and address the needs of the native plant nurseries to supply plants for restoration projects.
- The EIS should address the potential for FMP actions to create conditions that favor the spread of nonnative plant species.
- The EIS should evaluate the effect of using saltwater scooped from the ocean for suppression on salt intolerant native plant communities.
- The EIS should evaluate the extent to which FMP actions could inadvertently result in vegetation change.
- The EIS should examine effects of prescribed burning on Marin manzanita and other plants that are fire adapted. The EIS should evaluate the potential for fire management and suppression actions to affect listed animal species, such as federally listed threatened red-legged frogs.
- The EIS should develop a natural resource protection protocol to be followed when developing and implementing FMP projects.

Hydrology, Soils, and Water Quality

Fire management actions can result in changes to water quantity, quality, and flow patterns and affect soils, soil organisms, soil permeability, soil nutrients, and levels of erosion. Issues raised were the following:

- The EIS should evaluate the potential for prescribed burning to increase erosion and subsequent sedimentation of creeks,

- Use of retardant during suppression or retardant spills could contaminate water resources potentially harming sensitive fish species.
- The EIS should evaluate whether suppression actions during late summer could use up significant amounts of water needed by plants and wildlife.
- The FMP should identify which water sources would be used to suppress fires in the interface area.
- The FMP should consider project planning on a watershed scale.

Issues Outside the Scope of the FMP

Leash Laws

During scoping meetings, the issue of off-leash areas for dog walking was raised by several members of the public. This issue is being addressed by a separate rule-making process and is not within the scope of proposed fire management planning.

State, County, and City Managed Lands

The FMP will not address fire management planning on lands within the legislated GGNRA boundary that are under the direct administration of other land management entities. The FMP will address conformance with fire management plans of adjacent public open space areas such as the northern lands administered by Point Reyes National Seashore, San Pedro Valley County Park, and the City of San Francisco watershed lands.

Impact Topics Included in the EIS

Selection of topics to be addressed in the EIS was based on concerns raised during internal and public scoping, and on federal laws, regulations, executive orders, and NPS policy requirements. These issues involve significant resources that could be beneficially or adversely affected by project implementation. All resources evaluated in impact topics are described in Chapter 3, Affected Environment, and analyzed in Chapter 4, Environmental Consequences. The impact topics include:

Watershed Processes: Soils, Hydrology, Water Quality, and Aquatic Habitat

Air Quality

Vegetation

Wetlands

Wildlife and Important Habitat

Special Status Species

Cultural Resources

Human Health and Safety

Visitor Use and Visitor Experience

Park Operations

Socioeconomics

Impact Topics Dismissed from Further Analysis

Seismically Related Geologic Hazards

Actions related to the FMP would not increase the exposure of the public to harm from other geologic hazards such as surface rupture, liquefaction, tsunami, rockfalls, or severe ground-shaking. Seismically induced landslides are addressed in Chapter 3, Section 3.2, under the heading of Geology and Seismicity.

Traffic Congestion, Traffic Levels, and Traffic Safety

FMP actions would not affect traffic congestion or traffic levels. All burn plans would include traffic safety control measures where smoke from burns could affect traffic on vicinity roadways. This is common practice for fire departments in Marin and San Mateo counties and is also a component of integrated NPS burn plans. Tree removal projects may require off-hauling of felled trees from the project site by haul trucks. Past experience has shown that off-hauling is typically limited to fewer than five truck trips per day during the project. Tree removal does not call for contracting for multiple haul trucks that are frequently associated with traffic generated by large-scale development projects that have a time-sensitive initial grading component. Past projects have relied on one or two haul trucks over the life of the project. Visitor safety during truck transport is controlled by temporary trail closures and flag persons ensuring safe pullouts of the trucks from the park onto more heavily traffic roadways. These safeguards are common requirements for trucking contractors and for park tree removal projects. The projects generate a minimal level of additional traffic during peak hour periods and on an hourly basis throughout the day. This increase in traffic levels and the potential effect on traffic congestion and traffic safety would be negligible and short-term.

Smoke from prescribed burns and wildland fire can result in short-term, adverse effects on traffic congestion and traffic safety where smoke obscures visibility on roadways. Traffic safety hazards associated with wildland fire can be so substantial as to be life-threatening and require road closures. The effect of smoke on traffic safety is addressed in the EIS under the heading “Impacts on the Social Environment,” specifically human health and safety.

Provision or Demand for Public Transportation

The FMP would not generate additional visitation to the park or change existing transit patterns. The FMP would have no effect on the provision or demand for public transportation and this topic is not addressed in the EIS.

Minority and Low-Income Populations

Under Executive Order 12898, Environmental Justice in Minority and Low-Income Populations, federal agencies must consider whether their actions would have disproportionately high and adverse human

health or environmental effects on minority and low-income populations. The FMP alternatives seek to reduce the risk of wildfire hazard spreading from the federal parklands into neighboring residential communities. To date, fuel reduction actions have occurred throughout Marin County, adjacent to communities with varying rates of income and population mix. This parkwide focus would continue in the FMP planning process and be expanded to San Mateo and San Francisco counties. The FMP would not unduly result in adverse effects on minority or low-income populations in the park vicinity or using parklands for recreation.

Provision of Public Utilities and Services (Electricity, Natural Gas, Solid Waste)

Activities associated with implementation of the FMP would not require new or modified delivery or improvements of infrastructure delivering utilities or services, such as electricity and natural gas. Past experience has shown that alternatives to landfill disposal can be found for nearly all fuel reduction projects. Typically, brush and small trees and branches are chipped onsite and distributed within the project area. Broadcasting chipped material onsite protects surface soils from erosion by wind or water and discourages weed regeneration from the existing seed beds following fuel reduction projects. Past tree removal projects have resulted in trees off-hauled from the project areas to be used as woody debris in creek restoration projects and for commercial use as flooring and firewood. Impacts on drinking water supplies from accelerated sedimentation from fire management actions are addressed under “Watershed Processes: Soils, Hydrology, Water Quality, and Aquatic Habitat” under “Impacts on the Physical Environment.”

Chapter 2 – Alternatives

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2.1 Overview of Alternatives

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 substantial change in fire management actions as they have been implemented over the last several years and as they were described and analyzed in the 1993 FMP and its EA.

The following are summaries of the three alternatives developed for GGNRA's FMP FEIS:

Alternative A (No Action) – *1993 FMP, No Action*

This alternative would be an update to the 1993 FMP only to reflect changes to the park's boundary (e.g., addition of new lands since 1993) and current national fire management policies. The focus of the 1993 FMP program is on vegetation management through the application of prescribed fire to perpetuate fire-dependent natural systems. In recent practice, many fire management actions have been mechanical fuel reduction projects (e.g., mowing, cutting to remove nonnative shrubs and trees, and selective thinning in forested stands) as a result of the establishment of the Wildland Urban Interface Initiative. A combination of staff shortages, the requirement to develop a new FMP, and a year-long moratorium on prescribed burning has resulted in limited prescribed burning over the past five years. This alternative would rely on the continued implementation of the 1993 FMP and recent emphasis on mechanical fuel reduction along with prescribed fire, and suppression of all wildfires. The fire management approach for Muir Woods National Monument would be the same for the No Action alternative and the two action alternatives (Alternatives B and C) and would include the use of prescribed fire as well as mechanical fuel reduction. Current research projects would continue and would focus on the role of fire to enhance natural resources and the effects of fire on key natural resources to determine the effectiveness of various fuel treatments.

Alternative B – *Hazard Reduction and Restricted Fire Use for Research and Resource Enhancement*

Under Alternative B, fire management actions would emphasize the use of mechanical methods to reduce fire hazards and fuel loads in areas with the highest risks. Compared to Alternative A, Alternative B would increase the number of acres mechanically treated each year, with a focus on the reduction of high fuel loads in the wildland urban interface area. The suppression strategy for wildfires and the approach used in the Muir Woods fire management unit (FMU) would be the same as under Alternative A. Limited use of prescribed fire could occur for research purposes within the park interior. Research projects would examine the role of fire to enhance natural resources and the effects of fire on key natural resources to determine the effectiveness of various fuel treatments. Natural and cultural resource goals and objectives would be integrated into the design and implementation of fuel reduction projects.

Alternative C (Preferred Alternative) – *Hazard Reduction and Resource Enhancement through Multiple Treatments*

This alternative would allow for the greatest number of acres to be treated on an annual basis to achieve fire management and resource objectives through the use of a broad range of fire management strategies. Mechanical treatment and prescribed burning would be used as a means to reduce fuel loading near developed areas and achieve resource enhancement goals. Mechanical treatments, complemented by prescribed fire, would be employed to assist with restoration and maintenance of the park's natural and cultural resources. The suppression strategy for wildfires and the approach used in the Muir Woods FMU would be the same as under Alternative A. Research projects would examine the role of fire to enhance natural resources and the effects of fire on key natural resources to determine the effectiveness of various fuel treatments; they would also be used to adaptively guide the fire management program and help to maximize the benefits to park resources. Natural and cultural resource goals and objectives would be integrated into the design and implementation of fuel reduction projects.

The three alternatives analyzed meet the park's 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. All three alternatives involve different combinations of prescribed burning and mechanical treatments. 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 (see Table 2-1). These numbers are based upon an understanding of the park's resources, staffing and funding, hazard risk assessment, and technical feasibility.

Table 2-1: Summary of Alternatives by Annual Acres Treated and Treatment Type

Treatment Type	County	Alternative A[1]	Alternative B	Alternative C
Mechanical Treatment[2] (acres/year)	Marin	75	180	225
	San Francisco	5	10	10
	San Mateo	20	40	40
	TOTAL	100	230	275
Prescribed Burning (acres/year)	Marin	100	120	285
	San Francisco	<1	<1	<1
	San Mateo	10	0	35
	TOTAL	110	120	320

Source: GGNRA Fire Management Office Data 2004.

[1] Estimated based upon current practice, since 1993 FMP did not specify number of acres per year for treatments.

[2] Mechanical treatment refers to fuel reduction through methods such as mowing, cutting, short-term grazing, and selective thinning.

2.2 Alternatives Formulation Process

The formulation of alternatives for the GGNRA FMP FEIS was based upon guidelines for fire management and NEPA implementation, as expressed in Director's Order 18 and Director's Order 12, respectively. Initially, several alternatives were considered during the development of this FEIS, of which three are fully analyzed in this document. The others were considered carefully but rejected because they would not adequately meet the fire program's objectives. These alternatives are briefly discussed in Section 2.6, Alternatives Considered but Rejected.

An interdisciplinary team of NPS staff developed a set of alternatives based upon the purpose and goals contained in this FEIS (see Chapter 1), with input from other park staff, the general public, and public safety agencies. The interdisciplinary team was composed of staff with expertise in fire management, fire ecology, natural resource management, cultural resources, planning, public safety, interpretation, and public affairs.

The planning team began the process by conducting a review of the existing 1993 FMP and looking specifically at the manner in which it has been carried out in actual park operations over the last 12 years. In particular, the team reviewed the usefulness of the existing FMP with an eye to how effective its guidance has been in regard to recent fire management operations. Other pertinent data, such as maps of parklands, vegetation types, and resource locations, were assembled in order to provide information necessary to stimulate informed discussion at a series of scoping sessions. The park held a series of internal scoping sessions that included fire management personnel; subject-matter experts from a wide range of disciplines, including archeology, hydrology, Geographic Information Systems (GIS), and vegetation and wildlife management; park management; and park personnel at large. These internal sessions were followed by a series of scoping meetings in Marin, San Francisco, and San Mateo counties with local firefighting agencies, public safety organizations, and the interested public. As part of this scoping process, draft FMP goals were presented for public comment.

Reference to the goals of the FMP, area topography and hydrology, settlement patterns, and types of resources in the park informed staff about the development of Fire Management Units (FMUs). An FMU is any land management area that can be defined by management goals and constraints, topographic features, access corridors, values at risk or values to be protected, political boundaries, fuel types, or major fire regime groups that set it apart from management characteristics of an adjacent unit. As an example, FMUs may have dominant management goals, such as wildland urban interface protection issues. (See Fire Management Units section below.) The existing FMUs from the 1993 FMP are based upon vegetation communities. Park staff felt that more factors needed to be considered for defining FMUs and concluded that the action alternatives would have different FMUs from the 1993 FMP. The new FMUs are one consisting of areas adjacent to relatively dense suburban neighborhoods bordering the park (Wildland Urban Interface FMU); a larger, more open and undeveloped unit of parklands away from builtup areas (Park Interior FMU); and the special unit of Muir Woods National Monument (Muir Woods FMU), reflecting the important natural resources combined with high visitor use.

These new, proposed FMUs allowed a range of preliminary alternatives to be drafted, based upon an assessment of parklands within each FMU and public input from scoping with regard to appropriate fire

management techniques, FMP objectives, and risk assessment involving life safety, property protection, and resources at risk. These preliminary alternatives were checked against the purpose and goals, relevant constraints, and potential impacts; compared to see that they provided real options; and reviewed to ensure that they were based on environmental differences. They were refined in comparison to the Marin County Fire Department's risk assessment model, and modified as necessary in regard to detailed fuel type data, park visitor and employee use patterns, watershed, topography, vegetation and wildlife patterns – especially those for rare and endangered species – and knowledge of archeological, cultural landscape, and historic values as appropriate. In addition, a GGNRA Fire Hazard Model (see Appendix E) was developed to provide further analysis within the park managed lands and provide additional input into the alternatives and FMU formulation. This model defines fire hazard as areas where steep slopes, south-facing aspects, and high-danger fuels exist in close proximity to values at risk and was created in GIS using several factors that could lead to a dangerous and costly wildland fire. Fuel type, topography, and the wildland urban interface were spatially analyzed to identify the areas of the park with the highest potential for destructive fire.

During this refinement phase, the FMUs were further subdivided into smaller, logical geographic project areas, allowing for an informed discussion of treatment strategies and management goals tailored to each project area, and, ultimately, a better definition of the individual alternatives. The sum total of the scoping effort, filtered through the specific expertise of the park interdisciplinary team, informed by recent experience with the 1993 FMP, checked against the purpose and goals of this planning effort and knowledge of park resources, property and use patterns, were the ingredients that resulted in the formulation of the alternatives presented in this FEIS.

Fire Management Units

FMUs provide the framework for development of a wildland fire program. As directed by NPS Reference Manual-18: Wildland Fire (RM-18) (NPS 1999a), each FMU should be unique as evidenced by management strategies, objectives, and attributes; should be consistent with management goals and objectives found in land and resource management planning documents; and should avoid redundancy. In addition, the number of units should be kept to a minimum. Two sets of FMUs are used in this FEIS – the existing six FMUs from the 1993 FMP are used in Alternative A, and three proposed FMUs are used in Alternatives B and C.

The No Action alternative retains the 1993 plan's FMUs, which are defined by plant communities found within GGNRA. These are:

1. Grassland and Coastal Scrub. The grassland community at GGNRA extends from sea level to nearly 2,600 feet. It forms a mosaic with the coastal scrub community and mixed evergreen forests. The grasslands have had the greatest disturbance of any natural habitat in Marin County. The four main factors that have contributed to this disturbance are an increase in grazing pressures, the introduction of highly competitive nonnatives, cultivation, and the elimination of fire.

2. Chaparral. Chaparral is not in abundance at GGNRA. Small communities exist in Muir Woods National Monument, the Marin Headlands, and at Sweeney Ridge and Milagra Ridge in San Mateo County. There are several types of chaparral in GGNRA.

3. Broadleaf Evergreen Forest. This community extends from 200 to 2,500 feet in elevation and is dominated by oak and/or tanbark oak. Along the mesic boundary of this mixed evergreen forest is the redwood/Douglas-fir community and along the xeric boundary is the coastal scrub and grasslands community.

4. Old-Growth Redwood. This community mainly consists of the redwood forest at Muir Woods National Monument. Many species contribute to this ecosystem. Major overstory and understory trees include coastal redwood, Douglas-fir, California bay laurel, tanbark oak, California hazel, and madrone.

5. Second-Growth Redwood and Douglas-Fir. Douglas-fir communities are found on Bolinas Ridge and within Muir Woods National Monument. The communities on Bolinas Ridge have been logged. Douglas-fir in Muir Woods National Monument sites have a brush understory and a significant component of dead fuel. Fuel loadings are increasing and need reduction in this community.

6. Eucalyptus/Other Nonnatives. Many vegetative species have been introduced into GGNRA park lands as ornamentals, wind breaks, or shade, or for pasture. Many of these have escaped cultivation and are invading native communities. Several stands of blue gum are found throughout GGNRA and typically occur near former ranchlands and along park boundaries, usually planted as windbreaks.

Table 2-2 lists total acreage in each FMU for the No Action alternative (Alternative A).

Table 2-2: Alternative A – Acreage by Fire Management Unit (FMU) and by County

FMU	Marin	San Francisco	San Mateo	Total Acres
Grassland/Coastal Scrub	8,252	446	1,907	10,605
Chaparral	147	0	53	200
Broadleaf Evergreen Forest	865	8	558	1,431
Old-Growth Redwood	471	0	0	471
Second-Growth Redwood/Fir	565	0	556	1,121
Eucalyptus/Other Nonnative/Developed	686	469	170	1,325
Total Acres	10,986	923	3,244	15,153

Source: GGNRA Fire Management Office Data 2004.

For the action alternatives, the park's landscape has been divided into three FMUs, and 17 project areas (subunits of the FMUs). The FMUs for the action alternatives are largely based upon geography, proximity to developed areas, fuel hazards, and values at risk. Each FMU has its own set of management strategies, objectives, and attributes. Dividing the park into three FMUs allows park management to set broad strategies for each unit, with a set of allowable fire management actions under each. The strategies for each FMU vary by alternative, and the types of management actions that would occur in each are addressed in the discussions of the alternatives in this FEIS.

The proposed FMUs for the action alternatives are:

Unit 1, Wildland Urban Interface (WUI). This FMU includes those lands that border developed or "interface" zones. The basic WUI zone was defined as any land within 1,200 feet of an urban/developed area. Where it made practical sense, the WUI FMU boundary was extended to fire roads, trails, and jurisdictional boundaries. Lands within this FMU are characterized by a close proximity to values at risk (i.e., houses, infrastructure, etc.); have high hazard fuels/slopes and dry, easterly wind exposure; and receive high visitation (increased chance of ignitions).

Unit 2, Park Interior. This FMU is the largest and is characterized by a lower probability of fire threatening structures and the potential to use prescribed fires to achieve some resource management goals. The park interior lands include larger expanses of natural areas and cultural landscapes, inclusive of ranching and farming lands, and contain relatively intact native plant communities and contiguous areas and corridors of wildlife habitat.

Unit 3, Muir Woods National Monument. The designation of Muir Woods National Monument as an FMU is based on the area's unique values at risk (first-growth redwoods), the area's high visitation (ignition potential), and an ongoing fire management program for this area.

Table 2-3 lists total acreage in each FMU for the action alternatives (Alternatives B and C).

Table 2-3: Alternatives B and C – Acreage by Fire Management Unit (FMU) and by County

FMU	Marin	San Francisco	San Mateo	Total Acres
Wildland Urban Interface	2,524	923	1,479	4,926
Park Interior	7,910	NA	1,765	9,675
Muir Woods	552	NA	NA	552
Total Acres	10,986	923	3,244	15,153

Source: GGNRA Fire Management Office Data 2004.
NA = not applicable

Figures 2-1 and 2-2 illustrate the FMUs for the No Action alternative (Alternative A), and Figures 2-3 and 2-4 illustrate the FMUs for the action alternatives (Alternatives B and C).

Project Areas

The three FMUs proposed for the action alternatives are further broken down into a total of 17 project areas, allowing for a finer level of understanding of existing resource values, vegetation and fire management conditions, treatment options, and management objectives specific to the resources contained within that area. It is anticipated that project areas would form the framework for planning the five-year implementation program for the selected alternative. Project areas were delineated using practical and geographically logical boundaries such as roads and trails, watersheds, park boundary, and buffers from urban development. Figures 2-5 and 2-6 show the fire management project area boundaries for the planning area. See Table 3-10 for acreages and vegetation classification by project area. The project areas are organized by county and are as follows:

Alternative "A" Fire Management Units

Marin County

National Park Service
Department of the Interior
Golden Gate National Recreation Area

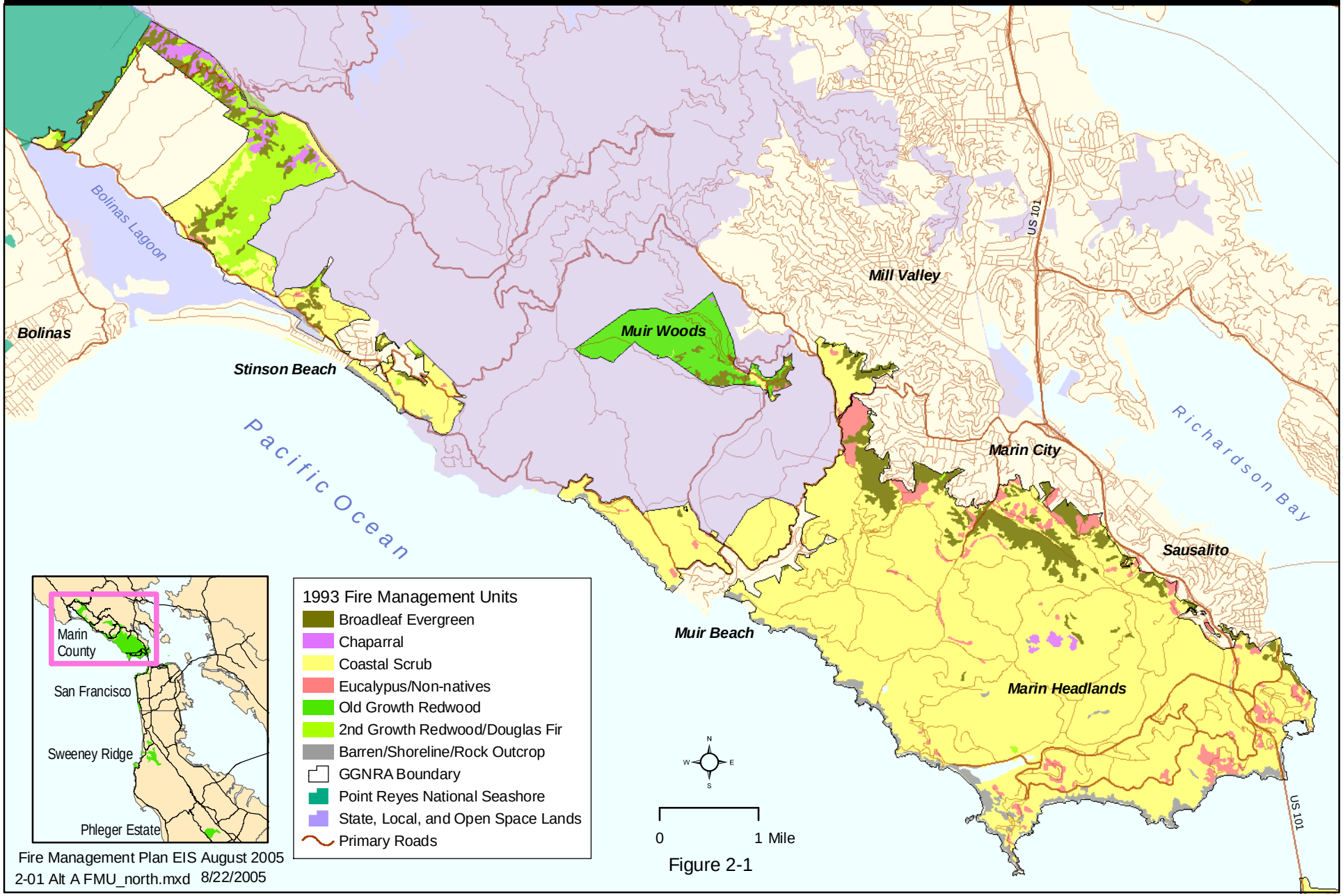

Figure 2-1

Fire Management Plan EIS August 2005
2-01 Alt A FMU_north.mxd 8/22/2005

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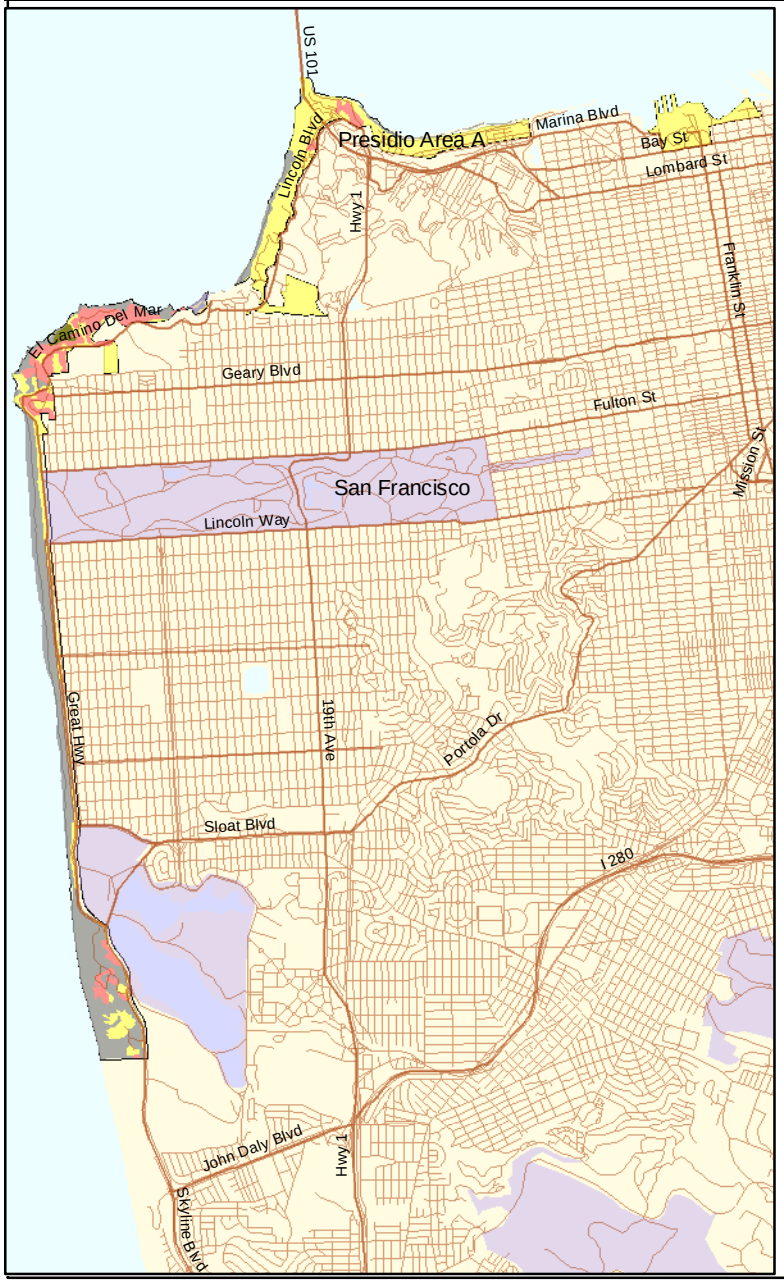
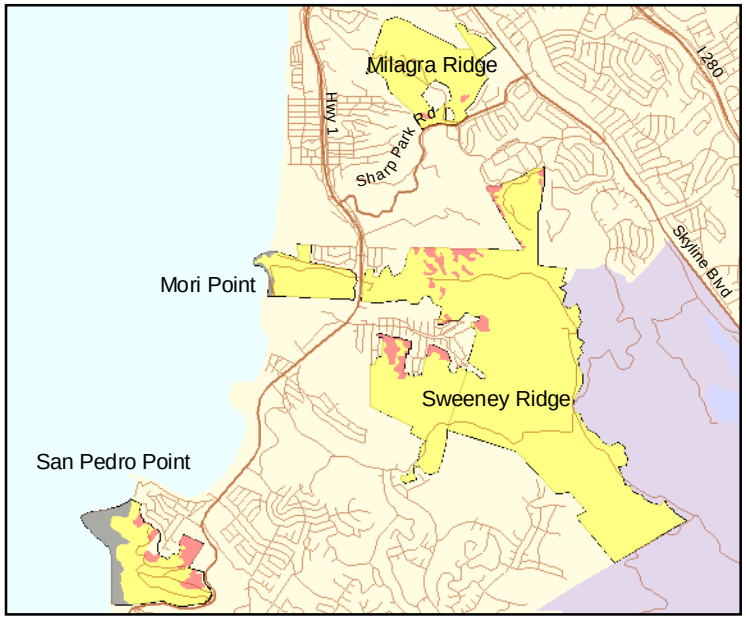
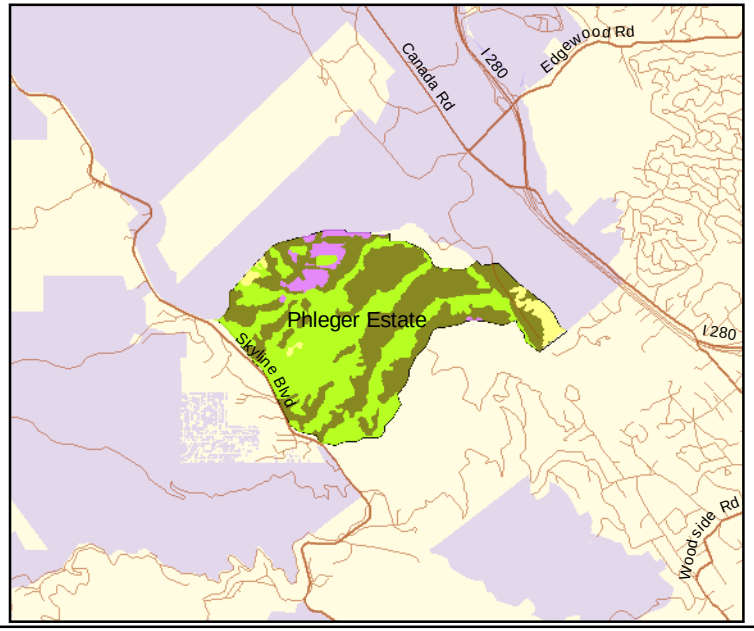
Alternative "A" Fire Management Units

San Francisco and San Mateo County

National Park Service
U.S. Department of the Interior
Golden Gate National Recreation Area

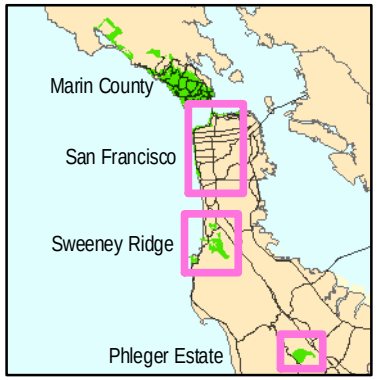






1993 Fire Management Units

- Broadleaf Evergreen
- Chaparral
- Coastal Scrub
- Eucalypus/Non-natives
- Old Growth Redwood
- 2nd Growth Redwood/Douglas Fir
- Barren/Shoreline/Rock Outcrop
- GGNRA Boundary
- State, Local, and Open Space Lands
- Roads



N W E S

0 1 Miles

Figure 2-2

Fire Management Plan EIS August 2005
2-02 93FMU_south.mxd 8/22/2005

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Alternative "B" and "C" Fire Management Units

Marin County

National Park Service
U.S. Department of the Interior
Golden Gate National Recreation Area

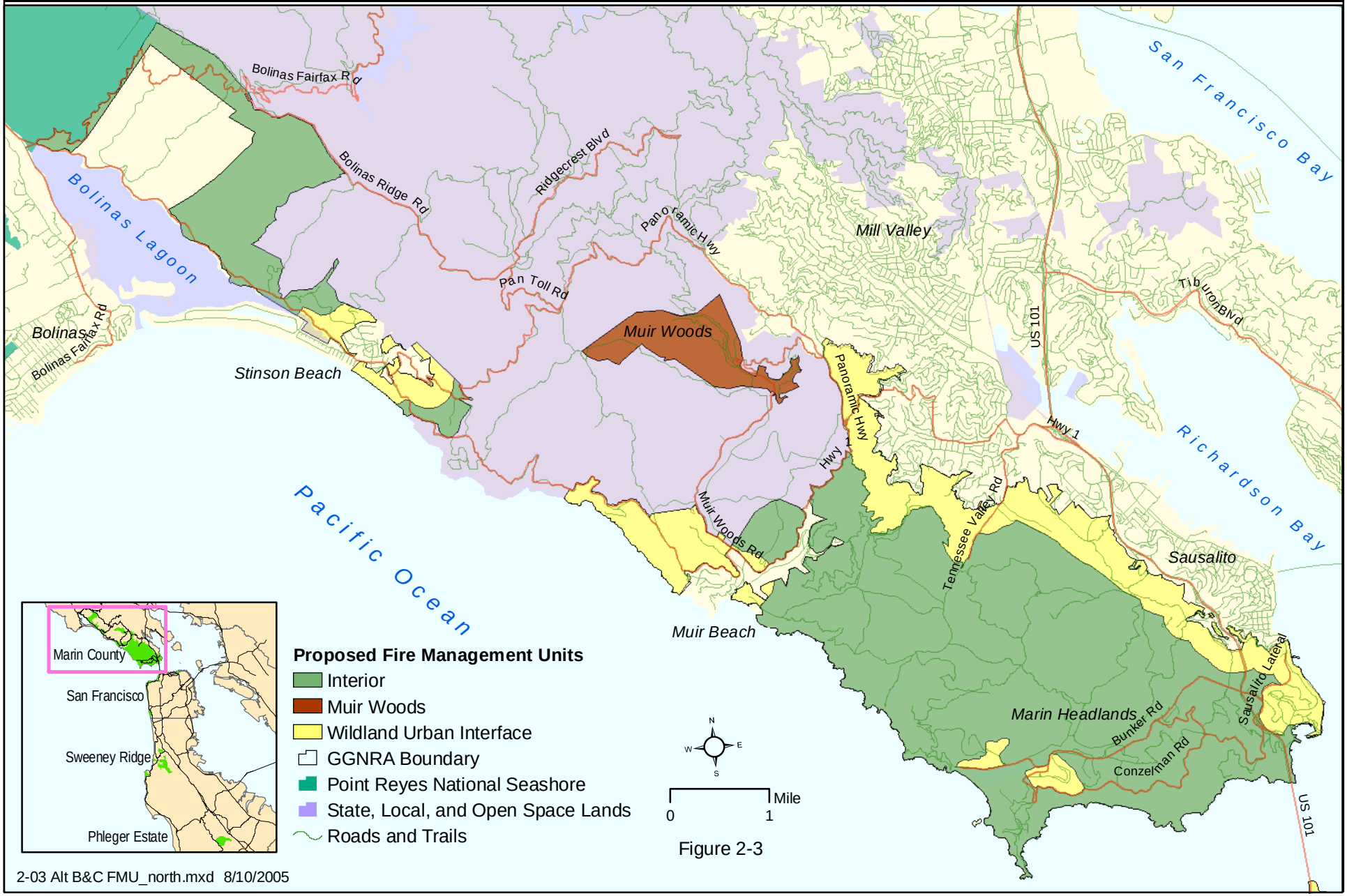

Figure 2-3

2-03 Alt B&C FMU_north.mxd 8/10/2005

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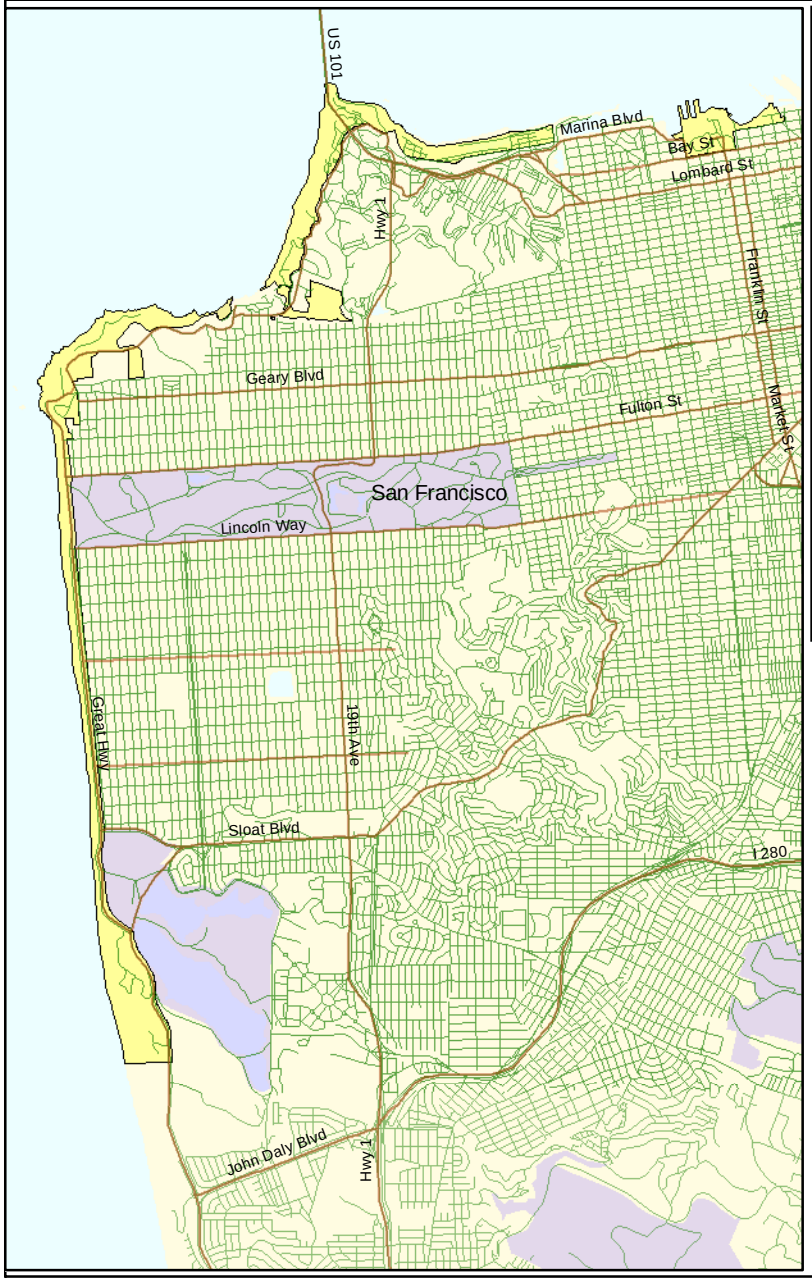
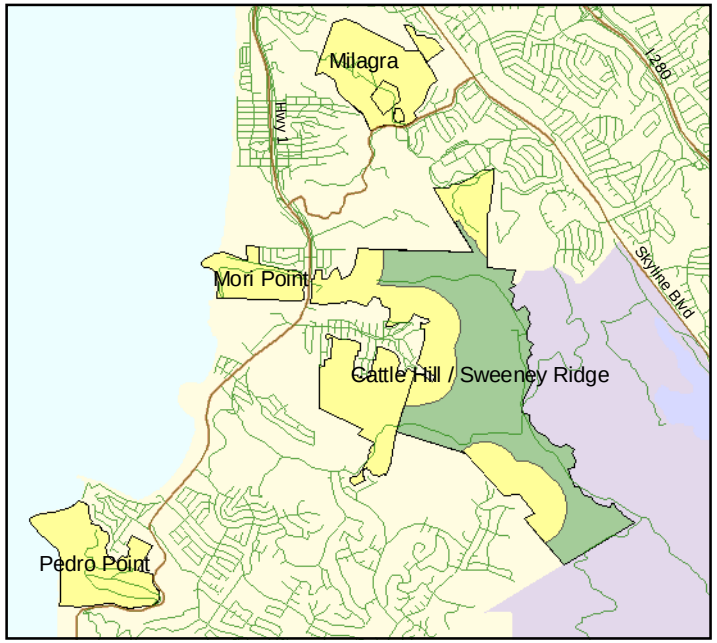
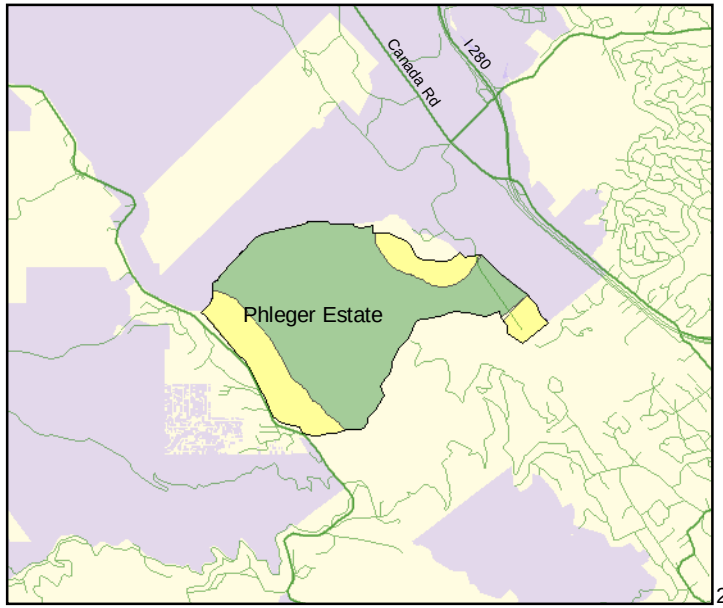
Alternative "B" and "C" Fire Management Units

San Francisco and San Mateo County

National Park Service
U.S. Department of the Interior
Golden Gate National Recreation Area

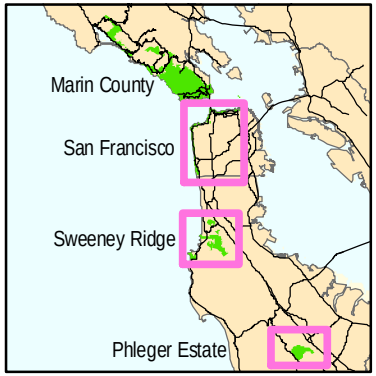






Proposed Fire Management Units

- Interior
- Wildland Urban Interface
- GGNRA Boundary
- State, Local, and Open Space Lands
- Roads and Trails



N
W E
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0 1 Mile

Figure 2-4

2-04 Alt B&C FMU_south.mxd 8/22/2005

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Fire Management Project Areas

Marin County

National Park Service
U.S. Department of the Interior
Golden Gate National Recreation Area

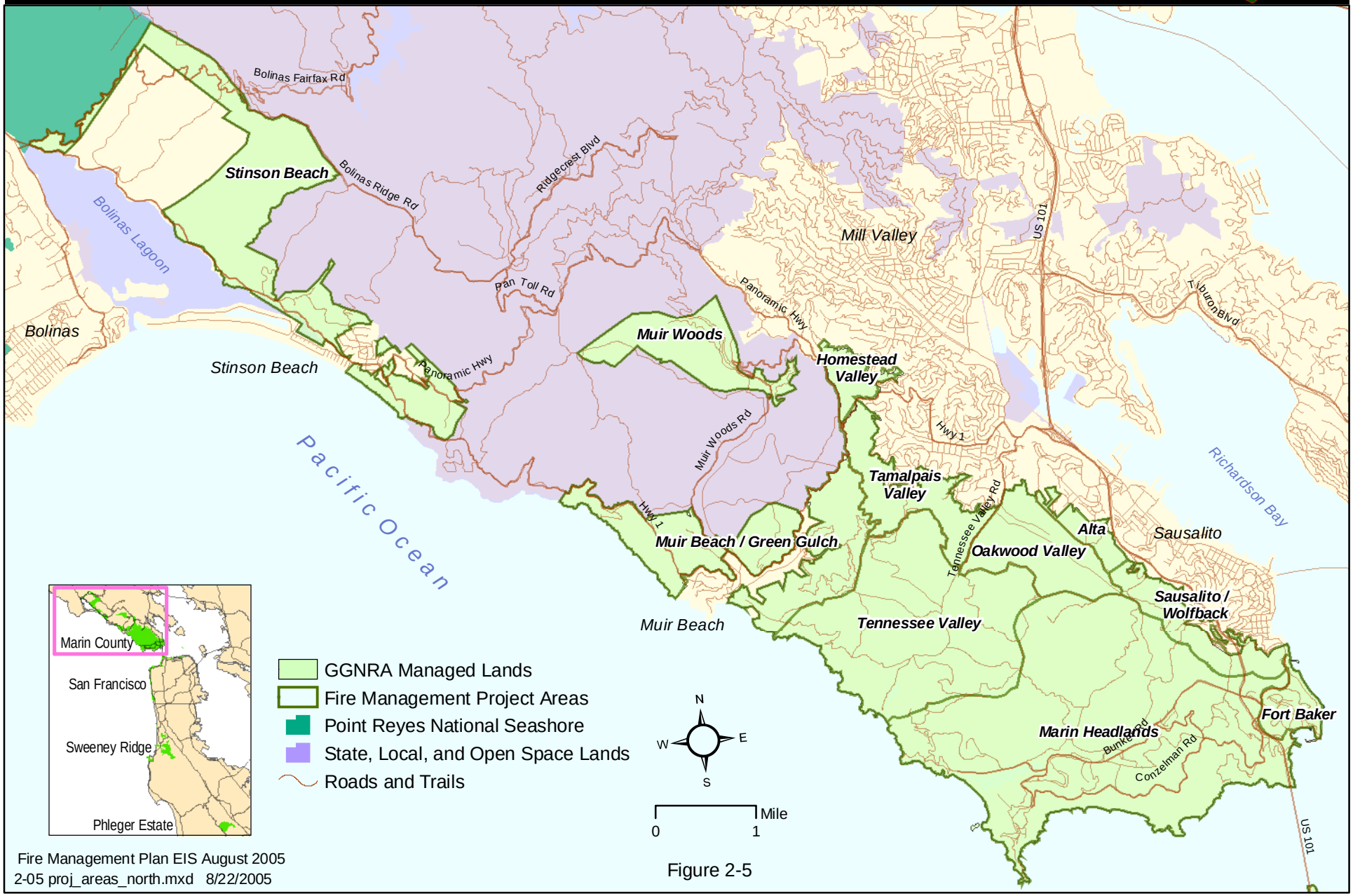

Figure 2-5

Fire Management Plan EIS August 2005
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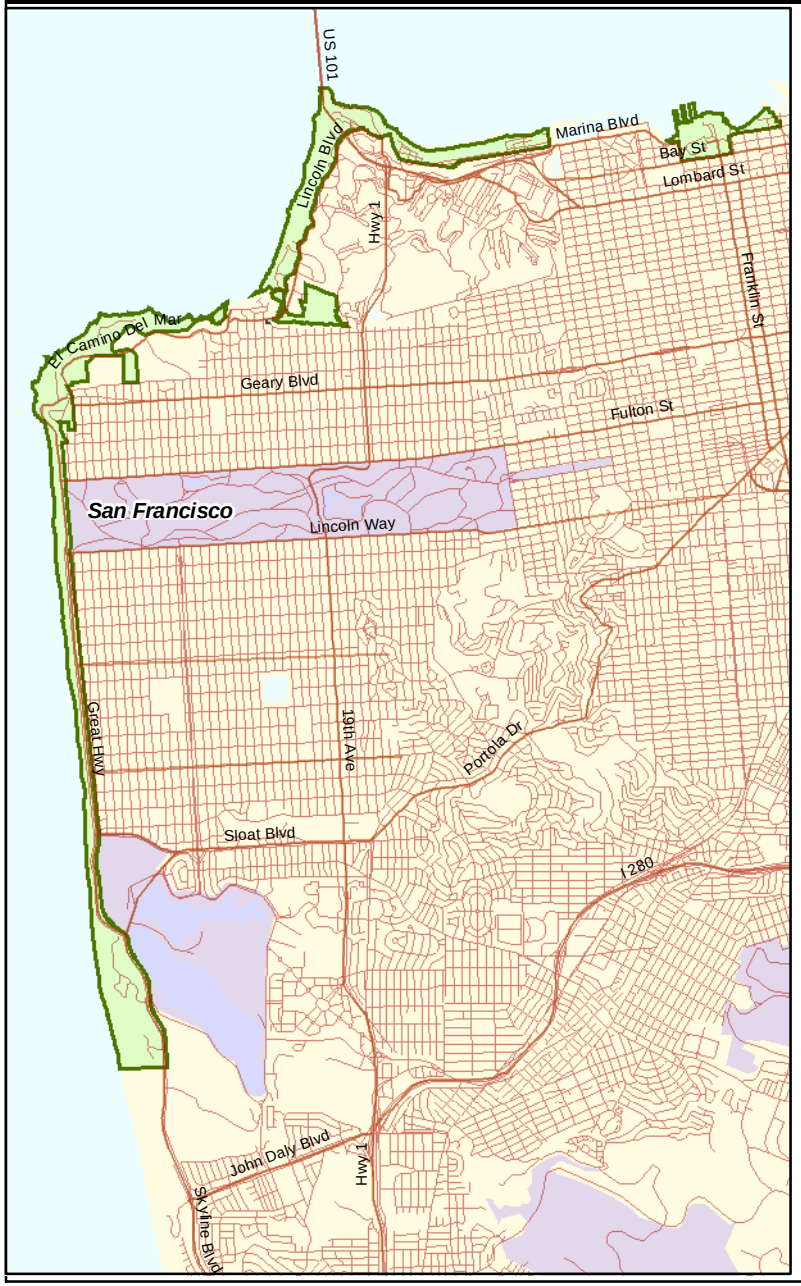
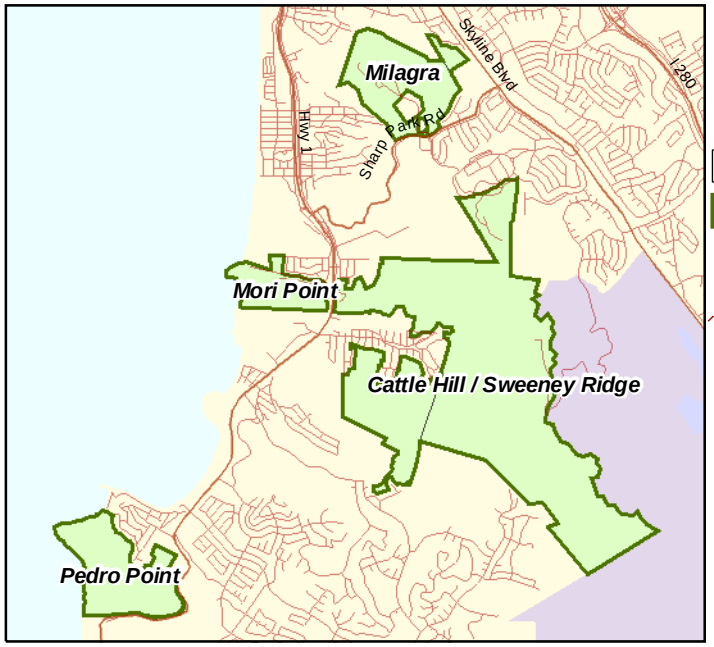
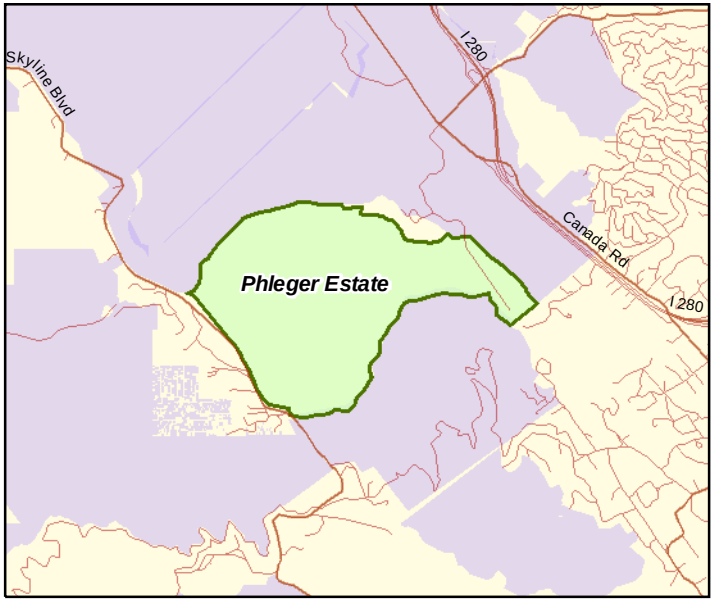
Fire Management Project Areas

San Francisco and San Mateo County

National Park Service
U.S. Department of the Interior
Golden Gate National Recreation Area







GGNRA Managed Lands
Fire Management Project Areas
State, Local and Open Space Lands
Roads and Trails

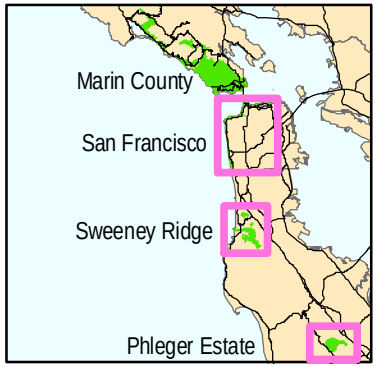


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Figure 2-6

Fire Management Plan EIS August 2005
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Marin County

1. Alta. This area is entirely within the Wildland Urban Interface FMU. The Alta project area is bordered by Marin City and Sausalito to the northeast, the Alta Trail to the southwest, and the Wolfback project area at the Rodeo off-ramp to the southeast. The project area is adjacent to the neighborhood represented by the Headlands Homeowners Association and Marin City. While the area was not mapped during the vegetation classification mapping effort, vegetation types include coastal scrub/chaparral, native hardwood forest, and nonnative evergreen forest (primarily eucalyptus). This area also contains mission blue butterfly habitat. The fire management issues are the extensive stands of nonnative evergreen forest in close proximity to developed and populated areas, and the need to reduce fuel conditions along access roads.

2. Fort Baker. This area is entirely within the Wildland Urban Interface FMU. The Fort Baker project area includes the Fort Baker cantonments as well as the Bay Area Discovery Museum, the future home of the Fort Baker conference center and institute, the U.S. Coast Guard structures located near the north anchorage of the Golden Gate Bridge, and the Vista Point viewing area by the Golden Gate Bridge. This project area has a moderate degree of park visitation. The project area is bordered by San Francisco Bay to the east and south, Sausalito to the north, and the Marin Headlands project area to the west. Portions of the areas closest to the bay are builtup or developed, with the remaining land area covered by a mix of coastal scrub, grassland, oak woodland, and nonnative forests. This project area contains important mission blue butterfly habitat. Fire management issues in this project area include (1) the need to manage the dense overgrowth of nonnative evergreen trees, which have expanded beyond the historic bounds and created fire hazards to nearby historic structures; (2) the need to reduce hazards along the Highway 101 and Alexander Avenue corridors; and (3) the need to improve the defensible space around buildings and below the High Vista neighborhood.

3. Homestead Valley. This area is entirely within the Wildland Urban Interface FMU. The Homestead Valley project area is bordered by Panoramic Highway to the west, Shoreline Highway to the south, and the Homestead Valley neighborhood to the north and east. The predominant vegetation types in this area are coastal scrub, grassland, native hardwood forest, and nonnative evergreen forests (eucalyptus and cypress). Spotted owls have been known to use the native forests in this area for habitat. A key fire management issue in this area is the buildup of hazardous fuels in close proximity to residential areas.

4. Marin Headlands. This area is predominantly within the Park Interior FMU with a small amount within the Wildland Urban Interface FMU. The Marin Headlands project area includes the Gerbode Valley and Rodeo Valley watersheds. It is bordered by the Fort Baker and Sausalito wildland urban interface buffer to the east, the Tennessee Valley watershed to the northwest, and the Pacific Ocean to the west and south. The Marin Headlands are dominated by coastal scrub and grasslands, with herbaceous wetlands and riparian scrub in the low-lying areas. Nonnative stands of eucalyptus and Monterey pine are present in some of the developed areas, and native hardwood forest is present in Gerbode Valley. A large portion of the land along the Pacific Ocean is unvegetated rocky slopes. There are several clusters of development from the past military occupation found in this area, including Fort Barry and Fort Cronkhite, a former Nike missile, historic coastal fortifications, and the

Marine Mammal Center area. This project area supports habitat for several significant plant and wildlife species, such as the federally listed threatened California red-legged frog and the endangered tidewater goby and mission blue butterfly. Examples of fire management issues in this area include buildup of hazardous fuels adjacent to historic structures, nearby residential areas, and popular visitor destinations where access is limited.

5. Muir Beach/Green Gulch. This area is within the Park Interior FMU and the Wildland Urban Interface FMU. The Muir Beach/Green Gulch project area is comprised of three parcels surrounding the Muir Beach community and the Green Gulch Zen Center, including the Banducci Ranch area. The area is bordered by Tennessee Valley to the south, the Tamalpais Valley area to the east, Mount Tamalpais State Park to the north, and the Pacific Ocean to the west. This project area contains habitat for coho salmon, steelhead, and the California red-legged frog. The vegetation in this project area includes mainly coastal scrub and grassland, with herbaceous wetlands and riparian forests in the drainages. The forested portions include native hardwood forest and nonnative eucalyptus. An additional eucalyptus stand is located outside the GGNRA boundaries and could encroach into the project area. Some developed land and unvegetated shoreline is also present in the project area. The dune scrub areas along Muir Beach are often ignited by beach fires. This area is a popular visitor destination. Fire management issues here include the overgrowth of nonnative evergreens and other fuel loads along critical access/egress routes and developed areas.

6. Muir Woods National Monument. This project area is entirely within the Muir Woods FMU. The area is defined by the boundaries of the Muir Woods National Monument and lies west of Mill Valley off Panoramic Highway. At the eastern end of the project area, Camino Del Canyon contains several residences and historic structures. The project area consists predominantly of native hardwood and evergreen forests, including Douglas-fir, old-growth and second-growth redwoods, bay laurel, tanoak, and madrone. The area near Camino Del Canyon includes riparian forest, grassland, and nonnative evergreen forests, and has been affected by many nonnative species. This project area contains habitat for the spotted owl, salmonids, and bats. This is one of the most popular visitor destinations within the entire GGNRA. The fire management concerns in this project area are to reduce the fuel loads and threats to key access/egress routes and surrounding communities, and to provide for visitor safety in case of a fire.

7. Oakwood Valley. This area encompasses lands within both the Park Interior FMU and the Wildland Urban Interface FMU. The Oakwood Valley project area is bordered by the Alta Fire Road to the northeast, Tennessee Valley Road to the northwest, and the Miwok Trail to the south. The Oakwood Valley and Marinview residential communities are adjacent to the project area. The vegetation consists mainly of native hardwood forests (oaks), coastal scrub, and some grassland. Riparian forests, as well as nonnative eucalyptus, are present in the drainages. The primary fire management concerns in this area are to maintain low fuel conditions and adequate fire road access/egress, particularly along the residential community interface.

8. Stinson Beach. This area predominantly encompasses acres within the Park Interior FMU and some acres within the Wildland Urban Interface FMU. The Stinson Beach project area is comprised of

three distinct regions that surround the Stinson Beach community. This area includes GGNRA lands north of Stinson Beach and south of the Bolinas/Fairfax Road as well as land south of Stinson Beach near Panoramic Highway. The vegetation types in this project area are coastal scrub, grasslands, Douglas-fir/coast redwood, and native hardwood forest. Smaller amounts of herbaceous wetlands, riparian forests, and nonnative evergreen forests are present, as are areas of unvegetated shoreline. Spotted owl habitat is present in Stinson Gulch, and several Bolinas Lagoon tributaries, including Easkoot Creek, contain coho salmon and steelhead. Stinson Beach is a popular visitor destination. Fire management issues in this area include the need to reduce fuel loads between the park and adjacent communities and developed areas, and to provide for safe fire road access and egress routes.

9. Tamalpais Valley. This area is entirely within the Wildland Urban Interface FMU. The Tamalpais Valley project area is defined by the Miwok Trail to the south and west, Tennessee Valley Road to the southeast, and the park boundary to the northeast. The Homestead Valley project area lies to the north and the Tennessee Valley project area lies to the south. The vegetation in this area is dominated by coastal scrub, grassland, and native hardwood forest, with large stands of nonnative eucalyptus throughout the area. A small area of riparian forest is located along Tennessee Valley Road, and some developed areas are found along the northern boundary. Fire management issues in this area include the need to reduce fuel loads between the park and adjacent communities and to provide for safe fire road access and egress routes.

10. Tennessee Valley. This area is named for the watershed it encompasses and is entirely within the Park Interior FMU. It is bound by the Pacific Ocean to the southwest, Coyote Ridge to the northwest, the Miwok Trail to the northeast, and the Hill 88 ridge to the south. The majority of vegetation in Tennessee Valley is coastal scrub, with grasslands comprising nearly a fifth of the acreage. Herbaceous wetlands, riparian scrub, and nonnative evergreen forests are present in the drainages. Disturbed lands surround the Miwok riding stables and the old farmhouse, and much of the coastline is unvegetated rock outcrops. The area has frequently visited trails. Fire management issues here include the need to maintain adequate fire road access with reduced fuel loads.

11. Wolfback Ridge/Sausalito. This area is entirely within the Wildland Urban Interface WUI. The eastern boundary of the project area is defined by the park boundary adjacent to Highway 101 and Sausalito. Wolfback Ridge consists mainly of coastal scrub and grassland, and includes native hardwood forest, riparian forest, and nonnative evergreen forest (mostly eucalyptus) scattered throughout the area. The Wolfback Ridge neighborhood is bordered on the west and partially on the east by dense eucalyptus forest. Mission blue butterfly habitat is also located here. Fourteen acres of disturbed land are found along the borders of the project area. The primary fire management issue here is the need to create defensible space along the park boundary that adjoins the residential communities.

San Francisco County

12. San Francisco. The San Francisco project area includes all NPS-managed lands within San Francisco County and is entirely within the Wildland Urban Interface FMU. These include Fort Mason, Alcatraz, NPS-managed lands (Area A) of the Presidio of San Francisco including Fort Point National

Historic Site, and the area from Fort Miley to Fort Funston. The FMP does not include any fire management actions or priorities for the lands within the Presidio managed by the Presidio Trust (Area B). The vegetation types within the project area are the coastal dune communities, with areas of coastal scrub, native hardwood forest, and riparian scrub. Large stands of nonnative evergreen forest are located throughout the project area. The primary fire management issues in this project area are to create defensible space around buildings that adjoin wildland fuels, and to work closely with the Presidio Fire Department (which is responsible for structural fire suppression as well as fire management in Area B of the Presidio) in wildfire planning and management actions. In addition, small research burns could occur in conjunction with approved U.S. Fish and Wildlife Service recovery plans for federally listed threatened and endangered plant species.

San Mateo County

13. Milagra Ridge. This area is entirely within the Wildland Urban Interface FMU. The project area is defined by the park boundary on Milagra Ridge and lies just north of Sweeney Ridge and northeast of Pacifica. The site contains significant cultural and historical resources as well as important mission blue butterfly, California red-legged frog, and San Francisco garter snake habitat. The vegetation in the project area is dominated by coastal scrub, and includes areas of grassland and riparian forest. Nonnative evergreen forest is also present. The primary fire management issue here is the reduction of hazardous fuel loads in areas adjacent to developed communities.

14. Mori Point. This area is entirely within the Wildland Urban Interface FMU. The Mori Point project area stretches from the Pacific Ocean to Highway 1 west of the Vallemar section of Pacifica. Along its northeastern boundary it connects with the northwestern arm of the Sweeney Ridge project area, near Shelldance Nursery. The area is dominated by grassland interspersed with coastal scrub. The low-lying areas contain herbaceous wetlands and riparian scrub, which are home to the San Francisco garter snake and the California red-legged frog. The western edge of the area consists of unvegetated shoreline.

15. Phleger Estate. This area is mostly within the Park Interior FMU, with some acres within the Wildland Urban Interface FMU. The Phleger Estate boundary adjoins Huddart County Park and the town of Woodside to the southeast. Highway 35/Skyline Highway defines the boundary to the southwest. Lands to the north include Midpeninsula Regional Open Space District, San Francisco watershed, and California Department of Fish and Game holdings, as well as private estates. Vegetation in the area is dominated by Douglas-fir/coast redwood (second-growth) and native hardwood forests. Several acres of coastal scrub are located along the northern boundary, and a small amount of grassland is found along the eastern edge. The Phleger Estate is in the West Union/Francisquito Creek watershed, which contains steelhead. The fire management concern in this project area is the hazardous fuel load buildup with the potential for wildland fire in close proximity to developed areas.

16. Pedro Point. This area is entirely within the Wildland Urban Interface FMU. Pedro Point lies 2.5 kilometers southwest of Cattle Hill and is defined by Highway 1 and the Pacific coast. The Pedro Park area of Pacifica lies to the north, open space to the south and east, and the Pacific Ocean to the

west. The vegetation in this area is mostly coastal scrub, with nonnative evergreen forest encroaching from the northern boundary. The western portion of the area is nonvegetated coastal bluffs. The fire management issue here is the buildup of hazardous fuels adjacent to the Highway 1 corridor and other builtup areas.

17. Sweeney Ridge/Cattle Hill. This area is divided equally between the Park Interior FMU and the Wildland Urban Interface FMU. The Sweeney Ridge/Cattle Hill project area is defined by the boundaries that constitute these two GGNRA parcels. The project area lies just east of Pacifica and is bordered to the south by San Francisco watershed lands managed by the San Francisco Public Utility Commission (SFPUC). The majority of this area is coastal scrub, with large areas of grassland in the north and riparian scrub in several of the drainages. Stands of nonnative evergreen forest (mostly eucalyptus) encroach into the project area from outside the park boundary. The fire management needs in this project area are to reduce the fire hazards adjacent to the Vallemar neighborhood and to maintain adequate fire road access.

2.3 Fire Management Actions

Vegetation within NPS units is managed to achieve resource benefits and management goals such as restoring ecosystems, maintaining ecosystem health, maintaining or improving the condition of cultural landscapes, and reducing hazard fuels. Fuels management includes strategic planning and implementation of treatments ranging in scale from site-specific to landscape level. These treatments are designed to improve the park's ability to protect life and property and to maintain or restore the sustainability of healthy ecosystems, which is a fundamental legislative mandate (NPS 2003a).

Fuel reduction activities reduce the fire hazard of all fuel types when risk assessments demonstrate a reasonable chance for future wildland fire damage. The beneficial outcome is that firefighter and public safety is enhanced, real property as well as natural and cultural resources may be protected, and potential suppression and property damage costs may be significantly reduced. The goal of fuel reduction projects is to provide for increased protection of homes within and adjacent to parklands, and to protect sensitive species and their habitats and important cultural resources within the park.

The following sections review types of fire management activities that are further described and articulated in each of the alternatives.

Suppression

Wildfire suppression is the activity that most people associate with fire management. Suppression includes all actions taken to put out an active fire, and is defined as the restriction of the spread of a wildland fire and the elimination of all threats from that fire. All wildland fire suppression activities provide for firefighter and public safety as the highest consideration while minimizing loss of resource values, economic expenditures, and/or the use of firefighting resources (NPS 2003a). Fire suppression methods used should be those that cause minimum resource damage while accomplishing effective control. A flexible suppression strategy allows for the choice of using methods to confine, contain, or control a wildland fire, with input from the park, suppression forces, and adjacent landowners.

Mechanical Treatment

Mechanical treatment is a term used to describe the application of various tools and equipment to reduce fuels and achieve fire and resource management goals. The park often uses mechanical treatments, including mowing, short-term grazing, cutting, and selective thinning, to remove hazardous fuels around buildings, along travel corridors, and in a number of places within the park where wildland fuels grow directly against the urban interface (i.e., along the boundaries where there are houses and other built developments), and to reduce the long-term fuel hazard through vegetation type conversion. The most common method of mechanical fuel reduction is through the use of chain saws to thin or remove targeted vegetation, which is then piled to be burned at a later date, or chipped using a chipper. In other instances, such as for fire road maintenance, large mowers and brush-cutting attachments are used for controlling vegetation.

Mechanical treatment includes provisions such as the following:

- Fuel breaks – clearing corridors of vegetation;
- Shaded fuel breaks – reducing density of underbrush, removing tree limbs;
- Mosaics of cleared areas, areas with reduced vegetation density, and uncleared areas;
- Short-term use of animals (such as cows or goats) to reduce fuels;
- Removal of nonnative, nonhistoric trees and treatment of cut stumps with herbicide to prevent resprouting when necessary; and
- Revegetation, as appropriate, of treated areas to avoid erosion and retain natural and/or cultural resource values over the long term.

Prescribed Fire

Prescribed fire is the use of management-ignited fire to meet specific resource and fire management goals and objectives under predefined fuel and weather conditions. (A prescription will always factor in a set of conditions to address the safety of the public and fire staff, weather, and probability of meeting the burn objectives.) Prescribed fires are used to manage vegetation, reduce hazardous fuel loads near developed areas, manage cultural landscapes, and restore natural systems, and for research purposes. Before any prescribed fire is permitted, a smoke management plan approved by the Bay Area Air Quality Management District (BAAQMD) must be in place. Also, a burn plan, signed by the superintendent, is required.

Ecosystem restoration projects can use prescribed fire to control nonnative plants and restore degraded habitat. Information gained through the use and effect of prescribed fire on natural resources can be critical to sound, scientifically based management decisions for a particular resource and can aid in future management decisions. Similarly, cultural resource management goals can also be achieved through the judicious application of prescribed fire to, for instance, modify vegetation type and patterns in cultural landscapes, or provide opportunity to reveal previously unknown archeological resources in densely overgrown areas.

Pile Burning

Pile burning refers to the controlled burning of piles created during mechanical fuel reduction activities or general park maintenance operations. Pile burning is frequently used when chipping is not feasible or is done in conjunction with prescribed burning (in the first phase) to reduce fuel loads to a level that allows burning over the landscape. Pile locations are sited to minimize impacts from intensive soils heating. Piles are covered, allowed to dry, and then typically burned during wet conditions when the probability of fire extending beyond the piles is low. This can occur any time during the year, depending upon weather conditions. As pile burning contributes emissions to the Bay Area Air Basin, a smoke management plan

must be submitted to BAAQMD and approval received prior to burning. An approved burn plan must also be in place.

Monitoring and Research

Integral to any fire management plan are monitoring and research programs that allow the park to document basic information, to detect trends, and to ensure that the park meets its fire and resource management objectives. By studying trends, park staff can identify specific concerns, develop hypotheses, and identify specific research projects to develop solutions to problems. Using results from a high-quality monitoring program to evaluate a park's prescribed fire management program is important to successful adaptive management. These results can help managers determine whether objectives are being met and verify that the program is on track, or conversely, provide clues to what may not be working as planned so that appropriate changes can be made.

The NPS uses a standardized fire effects monitoring program as a data collection procedure nationwide. The benefits of establishing standardized data collection procedures in a fire monitoring program include documenting basic information, detecting trends, identifying future research needs, and facilitating information exchange between resource protection staff and fire suppression agencies. Research projects, their methodology and objectives vary over the park landscape depending on the research questions and the researchers involved. Research projects developed in association with the fire management program will be managed in conjunction with the NPS Research and Collection Permit Program through the GGNRA Natural Resources Management and Science Division.

2.4 Actions Common to All Action Alternatives

Several actions that are currently part of the fire management program at GGNRA would continue under all of the alternatives analyzed in this EIS. These activities are described below.

Wildland-Urban Interface Initiative

In 2001, the NPS began implementing provisions of the federal Wildland-Urban Interface 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. This is accomplished through implementation of fuel reduction projects in communities adjacent to GGNRA. Through this program, the NPS also receives funding for fuel reduction projects on parklands near the interface with private property or lands managed by other agencies.

Defensible Space/Vegetation Clearing around Buildings

The protection of all buildings from wildfire within GGNRA would continue under all alternatives. NPS staff or private contractors would continue to clear vegetation around park structures. Individual structures would be assessed to determine the appropriate vegetation treatment based on fuel type and slope, building construction type, historic significance, and potential sources of ignition.

Priorities for hazardous fuels removal projects are set annually and the projects are performed throughout the year. The defensible space required at each structure is based on individual site topography and usually ranges from 30 to 100 feet around structures.[1] 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. Fuel type and fuel loading are also factors considered in determining these types of projects. Large trees are pruned or removed if the tree poses a threat. Grasses are cut, and smaller trees are pruned or removed based on an individual assessment. Pruning and removal actions must be in conformance with approved cultural landscape preservation plans and historic preservation compliance stipulations when the landscape has been determined to be historic.

Roadside Fuel Reduction

The park maintains roads that provide routes for public safety, recreation, and access for park management uses. Front-country roads that are paved are generally open to public motor vehicle traffic. Unpaved, back-country roads are generally open only to NPS vehicles, but may also be open to foot, horse, and/or bicycle users. Some roads may serve as control lines during a prescribed fire or wildland fire suppression operation.

Upkeep of park roads is the responsibility of the GGNRA Maintenance and Engineering Division. The FMP alternatives do not propose changes to the status or management of park roads and trails. All fire roads would continue to be maintained to allow for safe and efficient access by emergency vehicles, and

[1] Parcels in Marin and San Mateo counties, mapped by the State Board of Forestry as State Responsibility Areas, must comply with PRC 4290-4291, which requires a minimum 100 feet of defensible space as of January 2005.

at a minimum, to allow access by Type III fire engines. Maintenance standards for emergency vehicles access on back-country roads in Marin County would conform to those described in the Memorandum of Understanding (MOU) between the Marin Municipal Water District (MMWD) and the NPS. FMP actions may include grading of road surfaces, placement of erosion control measures, and vegetation thinning by mowing or cutting along the road corridor to a specified width based on fuel type, slope, and roadway composition. Larger trees along the sides of the roadways may be limbed up and smaller trees removed as needed to ensure emergency vehicle clearance is met. Grass that grows within the roadway may be cut or mowed. Debris would be cut up and broadcast in the immediate area, piled and burned, or chipped and hauled offsite.

In separate actions apart from the FMP, the park may evaluate on an ongoing basis the condition of park roads. Unnecessary roads may be eliminated or designated for non-vehicular use, in coordination with other park planning efforts such as the Trails Forever initiative. In some cases, existing roads may be reconfigured or rerouted to address erosion and/or maintenance concerns.

In Marin County, there are approximately 44 miles of fire roads, amounting to 52 acres requiring treatment each year to keep clear and open from debris. In San Mateo County, there are 10 miles of fire roads, amounting to 16 acres of mechanical treatment each year. San Francisco County roads, as well as paved roads in parklands in Marin and San Mateo counties, would be maintained on a regular basis under the park's maintenance operation and are not included as part of the fire road calculations.

Suppression

The current policy at GGNRA is to suppress all unplanned ignitions using minimum impact suppression tactics (MIST) whenever possible and feasible given the constraints along the urban interface. Suppression of fires will be aggressive and will be conducted with the highest regard for human safety. Specifics of MIST tactics are included in Appendix G.

Wildland fire suppression would be conducted to suppress wildfire at minimum cost consistent with values at risk, while minimizing the impacts from suppression activities. A "confine," "contain," or "control" strategy would be used in the suppression of all wildfires, as follows, with the majority of wildfires suppressed using the control strategy.

- Confine – to restrict the wildfire within boundaries determined either before or during the fire. These identified boundaries will confine the fire, with no action being taken to put the fire out.
- Contain – to restrict a wildfire to a defined area using a combination of natural and constructed barriers that will stop the spread of the fire under the prevailing and forecasted weather conditions until the fire is out.
- Control – to fight a wildfire aggressively through the skillful use of personnel, equipment, and aircraft to establish fire lines around a fire to halt the spread and extinguish all hot spots until the fire is out. Control activities will use standard suppression practices.

Suppression will be accomplished through a combination of cooperative agreements with local fire agencies and qualified park fire personnel. Annual operating plans will identify individual suppression concerns in order to minimize suppression impacts. Furthermore, all control efforts will be evaluated for consideration of effects on resource values.

Fire suppression methods used should be those that cause minimum resource damage while accomplishing effective control. Suppression activities will attempt to avoid disturbance of all threatened and endangered (T&E) species and their habitats, as well as archeological and cultural sites, whenever reasonably possible, i.e., when these activities do not preclude life, safety, or private property considerations. A representative from the NPS will be present during extended attack suppression activities within or near GGNRA.

A Wildland Fire Situation Analysis (WFSA) and Delegation of Authority (DOA) will be prepared for the superintendent's approval each time a wildfire escapes initial attack or burns into a second burning period. It is also possible that, during an emergency situation in which an unplanned ignition has grown to a large and dangerous 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 offroad vehicle use by trucks, fire engines, and lowboys for hauling heavy equipment.

Aircraft may drop retardant and water during suppression of unplanned ignitions. Since retardant (e.g., Phoschek) contains phosphorus, retardants will not be used in streams or wetlands when feasible. Helicopters may also be used to deliver water, foam, and/or retardant. Helicopters will need areas to land (helispots) within the park. All landing areas will meet the standards outlined in the Interagency Helicopter Operations Guide (IHOG). In addition, the GGNRA Aviation Management Plan identifies safe locations for landing in areas administered by the park. Temporary road and trail closures may occur during fire suppression events.

Treatment of Muir Woods FMU

Preservation of the pristine character of Muir Woods National Monument is a management priority stated in the 1993 FMP. Many species contribute to the ecosystem in and around Muir Woods National Monument and this diversity calls for a variety of prescription parameters. Fuel buildup currently presents a fire hazard to the resources of the monument and residential development to the east along Panoramic Highway and in Homestead Valley. The exclusion of fire from the monument perpetuates and increases the degree of hazard to these adjacent areas and increases the likelihood of higher-intensity fires within the redwood stands. Prescribed fire would be used in the redwood/Douglas-fir forest to restore the role of fire to this ecosystem. Prescribed burning may also be used for management of nonnative species in the monument, such as in the Conlin Avenue area near the maintenance yard.

A fire chronology based on fire scar examination was done for two redwood *(Sequoia sempervirens)* forest sites in Marin County (McBride and Jacobs 1978). Fire frequencies averaged 21.7 and 27.3 years. The difference between the two sites was attributed to the increased influence of fog (Jacobs et al. 1985). The short interval is thought to be an artifact of Native American burning. Natural fires would ignite and burn through sections of the forest, cleaning out undergrowth, dead and down material, and litter on the

forest floor. The beneficial effects of this process were numerous in that nutrients were released into the soil, forest density was regulated, fire-dependent species were provided with a favorable environment for reproduction, and wildlife was provided with more favorable habitat. Redwoods themselves require bare mineral soil to reproduce successfully from seed after the passing of a fire. Conversely, pests and pathogens find conditions generally less favorable.

The interruption of this ecological cycle through 150 years of fire suppression has produced visible deleterious effects. The buildup of dead and down material on the forest floor and the density of undergrowth create conditions favorable to catastrophic fire. Increased amounts of fuel produce fires that burn faster, hotter, and with greater intensity. Control becomes more difficult and the likelihood of adverse ecological effects such as mortality in mature trees is increased.

The existing fire hazard can be illustrated by the Ben J. Fire of June 13, 2001, which may have been started by an illegal campfire. The fire burned on the slopes west of Redwood Creek and the Hillside Trail and south of the Ben Johnson Trail. NPS staff responded quickly and were able to contain the fire. If this fire had occurred in late summer/early fall, during the height of the fire season, it would have been much hotter and spread faster, posing a significant threat to the first-growth redwood groves.

The NPS reintroduced fire into the ecology of Muir Woods National Monument during the second half of the 1990s under the 1993 FMP. Three burns were conducted in the redwood/Douglas-fir forest. In 1996, the nine-acre Upper Deer Park Burn between Deer Park Fire Road and the Dipsea Trail was conducted to serve as an anchor point for future suppression efforts and as a starting point for future burns. In 1997, the Deer Park 2 Prescribed Fire (52.5 acres) was completed, and in the following year (1998) the Johnson Prescribed Fire (35 acres) was conducted on neighboring forested units. Two Conlon Prescribed Burns at the lower end of Camino Del Canyon were completed in 1997 and 1999 (20 acres each) to reduce nonnative broom species in grassland areas. Several other burns were planned but not executed for many reasons. In addition to burns on NPS lands, the California Department of Parks and Recreation has conducted several burns around Muir Woods National Monument in order to create fuel breaks and to manage nonnative plant species.

Under the FMP FEIS alternatives, the strategy for Muir Woods National Monument is the same under each of the three alternatives and therefore is addressed as an element common to all alternatives. The objectives for the fire management strategy in Muir Woods are to:

- Restore the role of fire in the relevant vegetation communities;
- Reduce fuel loading and the threat of catastrophic wildfire; and
- Further study fire effects in old-growth coast redwood forest.

The proposed fire management strategy for Muir Woods National Monument is similar to that of the 1993 FMP and includes a mix of prescribed fire and mechanical fuel reduction. Prescribed burning would be used to reduce fuel loading and to benefit from the reintroduction of fire into the diverse plant communities in the monument. Small-scale mechanical fuel reduction projects, such as construction of shaded fuel breaks and understory thinning, would be implemented as elements of an overall strategy to

reduce the hazard of a high-intensity fire. Mechanical fuel reduction would be used to treat approximately five acres annually. In woodlands hard hit by Sudden Oak Death (SOD), thinning could be used to reduce standing snags and ladder fuels and to remove smaller-diameter trees. Nonnative species may be controlled by either applying prescribed fire or mowing first, leaving the brush to cure in place followed by prescribed fire. Research in the monument could also employ prescribed burning to investigate the relationship between fire and SOD and the use of prescribed burning in limiting or controlling French broom in the Conlin Avenue area.

Established trails, roads, and natural features would be used to the extent possible as fire control lines to avoid disturbance to ground cover, soils, and possible subsurface cultural resources. In keeping with NPS standards, all burn preparations and operations would be designed to produce the lightest impact possible to the monument. Post-burn rehabilitation of burn units would be an important aspect of the program. Prescribed burns would range in size from 0.5 to 50 acres for approximately 50 acres annually. The total acreage would include one or more research burns conducted on smaller plots. A total of five acres of mechanical clearance would be conducted annually at the monument, including clearing defensible space around park structures and treating areas of nonnative plants.

Use of prescribed fire for both fuel reduction and resource enhancement has proven effective throughout the range of coast redwood forests, and will continue within Muir Woods National Monument. Expansion of the current public education program will be necessary in order to carry out further prescribed burning. Interpretive and educational opportunities that are currently available or in process include fire ecology provisions in school and public programs, a self-guided walk featuring fire ecology in Muir Woods National Monument, a public display on fire ecology and control burning, a fire wayside exhibit, and placement of the fire weather station in an area visible to the public with an interpretive explanation. Use of prescribed fire in Muir Woods National Monument is a sensitive issue requiring availability of staff to inform and educate the public, neighboring agencies, and other interested parties about the benefits and role of fire in coast redwood forests.

Treatment of San Francisco County Project Area

The lands managed by GGNRA within the City and County of San Francisco are heavily used and are comprised primarily of coastal scrub, nonnative grassland, landscaped grounds, nonnative shrubs and trees, or beach sand and bluff with little burnable vegetation. In a few areas, very dense, nonnative evergreen forest does pose a high fire hazard to the public and firefighters. For example, an area of overly mature cypress trees on the southern end of Sutro Heights and a dense stand of blackwood acacia near the Lobos Creek channel in the southwestern edge of Area A of the Presidio adjoin residential properties and would benefit from mechanical fuel treatment. Clearing dense vegetation from historic structures throughout the San Francisco parklands would benefit public safety and help preserve the structures in case of a wildfire or structural fire in the area. The fuel reduction strategy for the San Francisco lands – to maintain defensible space around buildings adjacent to wildland fuels and to provide some mechanical removal of nonnative evergreen trees – would improve firefighter safety and reduce the risk of a fire spreading from federal lands to the adjacent dense residential neighborhoods.

No prescribed burning is proposed for the San Francisco County project area, including Alcatraz Island, except in conjunction with implementation of approved U.S. Fish and Wildlife Service recovery plan objectives for federally listed threatened and endangered plant species, which could entail research burns. The areas with the highest existing fire hazard contain nonnative and highly flammable trees or dense nonnative shrubs that could most effectively be treated by mechanical fuel reduction and follow-up maintenance. Neither fire management staff nor resources staff has identified areas of Alcatraz Island or the majority of the San Francisco project area that would benefit from prescribed burning. Given the brief window for permissible burning each season in the Bay Area, fire management staff prefer to concentrate their efforts in areas where they can be most effective in reducing fire hazards and producing resource benefits in relation to the amount of investment of time and budget required.

Public Information and Fire Education Programs

The NPS manages an active fire information and education program within the park that also serves local communities. This program assists in educating NPS employees, volunteers, park partners, other agencies, park visitors, and the general public about fire management goals and policies. The education program currently produces flyers for nearly all fire management projects within the park for distribution to the public, posting at the project site, and posting on the park's fire management web pages. The fire management office has arranged for, conducted, or presented at a wide range of public meetings in communities close to WUI program projects.

A comprehensive public information and education program would be included as part of all of the alternatives. GGNRA has shared a full-time fire education, prevention, and information specialist with Point Reyes National Seashore since 2001. The fire information and education program is in the developmental stages at both local and national levels. This program is adding to what has been traditionally provided through GGNRA's Office of Public Affairs and the Division of Interpretation and Education. This fire information and education program includes fire safety and prevention, fuels management, the role of fire in GGNRA's ecosystems, GGNRA's fire history and the cultural use of fire on the landscape, and fire research programs and opportunities. The fire information and education program is directed at neighbors, visitors, partners, NPS employees, and the news media.

The proposed program could include the following:

- Site bulletins and temporary exhibits/bulletin boards about prescribed burns;
- Fire ecology and wildfire wayside exhibits at key visitor locations;
- Public Information Officer (PIO) on wildfires;
- Site bulletins and temporary exhibits/bulletin boards about mechanical fuels treatment projects;
- "Burning Issues" teacher workshop;
- Fire education ranger-led or self-guided walk at Muir Woods National Monument;
- Fire news reporting/ParkNet;
- Enhanced fire management web pages;

- Fire education internship program;
- Increased press releases, media briefings, and tours;
- Defensible space home evaluation program;
- Community notification electronic mailing lists integrated with fire and fuels management planning;
- Two community mailings per year; and/or
- Short fire and fuels management video presentations at some visitor centers.

Notification of fire and fuels management activities would be done prior to project commencement and could be achieved by using road and trail signs as well as postings at visitor centers, entrance stations, post offices, and other areas of high visitor use. The fire management office will develop and implement an education and communication plan for all site-specific fire management implementation projects. For large-scale fuel reduction projects (more than one acre) that could affect mid- to close-range viewsheds for residents on the park boundary, park staff will arrange a meeting with the community to present the scope of work and provide an opportunity for public comment. Communication plans for projects may require information such as the project scope, schedule, and alternative trail routes, where needed, to be posted in the project vicinity.

Communication with adjacent land management agencies (e.g., State Department of Parks and Recreation, Marin County, and Marin Municipal Water District) would always be conducted when projects occur at or near their boundaries. These agencies also would be notified if a project on GGNRA 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 fire education specialist would be present, if possible, to alleviate public concern and to teach visitors about 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.

GGNRA 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 for the local area, fire managers may 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 ensure that the park message is delivered accurately and effectively. Wildland fire will also be reported to BAAQMD as soon as possible. Media and public queries would receive prompt replies that would contain information about the fire, the fire management plan, and ecosystem restoration as appropriate.

Community mailings would reinforce prevention measures and inform the public of fire and fuels management activities. A defensible space homeowner education program would provide an opportunity for homeowners to learn about ways to minimize loss of property.

Fire Cache

Fire cache facilities are used to store the equipment and supplies necessary to support all fire operations within GGNRA, as well as two national park units in the East Bay – John Muir and Eugene O'Neill. Currently, fire vehicles and equipment are stored in several facilities in the Marin Headlands and Fort Baker. Building 1068 at Fort Cronkhite houses the main fire management offices; Building 1069 at Fort Cronkhite houses the engine crew along with the power tool cache, hand tool cache, personal protection equipment, and line gear for additional personnel. The Regional Training Center at GGNRA has been reactivated and personnel are often outfitted from the GGNRA Fire Cache. Building 1069 also contains hose and hardware for the two Type 6 and two slip-on wildland fire engines assigned to the park. A separate building, T1111 at Fort Cronkhite, contains surplus gear and equipment not used on a daily basis. Finally, the two Type 6 wildland fire engines are housed in Building 407 at Fort Baker.

Storage of fire equipment and vehicles in a central location would decrease response time to major park assets and facilitate communication among park staff members responsible for fire management. Ideally, the fire cache will be housed in a single location at some time in the near future. Such a facility would need to be strategically located and have engine bays for at least two wildland fire engines, including one Type 3 engine. Sufficient office space would be required in addition to area for crew members and equipment. This cache/wildland station could potentially be an interagency facility in conjunction with the Marin County Fire Department or one of the city fire organizations. In the past, GGNRA has operated a regional mobilization center. As this program could possibly be reactivated, it should be given some consideration in planning for future cache needs.

The park will conduct a facilities assessment for the fire cache to refine the program and storage needs and study options for relocation and consolidation. This assessment will be done in coordination with other interested agencies, and appropriate environmental review will be conducted for implementation.

Fire Effects Monitoring

Fire effects monitoring is essential to determining the effects of the fire program on GGNRA ecosystems and to providing guidance to the fire program for adaptive management. The effects of prescribed fire have been monitored in GGNRA since 1991. In accordance with the NPS Fire Monitoring Handbook (FMH), vegetation and/or fuels data are collected both before and one, two, five and ten years after prescribed burns in order to assess whether or not the burn has met stated objectives (NPS 2003b). Existing FMH plots at GGNRA are located at Bolinas Ridge, Stinson Beach, Muir Woods National Monument, Tennessee Valley, Rodeo Valley, Milagra Ridge, and Sweeney Ridge, in habitat types subject to prescribed burning. Under all alternatives, these plots would continue to be monitored according to the FMH schedule and new plots would be established as necessary to determine the effects of fire. Further, the data from this program would be analyzed and reviewed on a regular basis to help direct the GGNRA fire program as well as to identify areas where fire research or other monitoring efforts should be focused, such as evaluating the effectiveness of mechanical fuel treatments and follow-up, and effects on threatened and endangered species.

As part of the Fire Effects Monitoring Program, both prescribed burns and wildfires are monitored during a fire event for weather conditions, fire behavior, and air quality. This monitoring would also continue under all alternatives. Both live fire monitoring as well as the establishment and monitoring of FMH plots as described above are carried out by the Fire Effects Monitoring Crew, which is hosted at Point Reyes National Seashore. Funding for the Fire Effects Monitoring Crew is provided through the National Fire Office.

2.5 Alternatives

Alternative A – 1993 FMP, No Action

Description of Alternative

Under this alternative, GGNRA staff would update the 1993 FMP to reflect changed conditions – including changes recently made to the national fire management policy, the establishment of the Wildland-Urban Interface Initiative program, and the addition of new parklands (since 1993) – and would continue to apply existing fire management practices by implementing elements of the 1993 FMP. Very few action items called for in the approved 1993 FMP have been implemented, due to a variety of factors including funding and staffing availability. Under Alternative A, it is assumed that the actions identified in the 1993 plan (primarily prescribed burns to achieve vegetation management goals) would be implemented and the fire and fuels management actions would not differ from current practices.

The objectives of the 1993 FMP are to develop an integrated program where managed fires are used to perpetuate fire-dependent natural systems and wildfires are suppressed in a manner that results in a minimum of damage to resources. The program would use prescribed fire, mechanical manipulation of hazard fuels, and suppression of all wildfires. Key elements of the 1993 FMP, updated to reflect current policies, are to:

- Protect life;
- Protect park resources and private property;
- Reduce fuels in the wildland urban interface;
- Use fire as a management tool to reduce fire hazards;
- Restore native ecosystems and special status species habitat through a program of prescribed fire and fire suppression; and
- Suppress all unplanned fires.

In ecosystems modified by prolonged exclusion of fire (primarily coastal grassland/scrub mosaic, oak woodland, and coastal redwood), prescribed burning would be used to restore fuel loading or vegetative composition to natural levels. Additionally, fire and/or mechanical manipulation of hazard fuels would be used to create narrow fuel breaks along boundaries of a fire management area and thereby reduce the probability of wildfires crossing into or out of that area. This alternative would result in a very gradual reduction of fire risk and would have an emphasis on achieving natural resource objectives.

Strategic Approach

Under this alternative, management-ignited prescribed fire would primarily be used to gain the missing ecological benefit of natural fire, and mechanical manipulation would be used primarily to reduce hazardous accumulations of vegetation. A combination of prescribed burning, mechanical manipulation of fuels, fire suppression, and fire effects monitoring would be implemented. All fires would be

monitored at the appropriate level (NPS 2003b), and research projects may be involved with specific burns.

Under this alternative, a maximum of 100 acres would be subject to mechanical fuel treatments, and a maximum of 110 acres would be subject to prescribed burning. 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 be reviewed annually and updated as needed.

Mechanical Treatment

Consistent with the 1993 FMP as well as current practice under the Wildland-Urban Interface Initiative program and National Fire Plan, a number of mechanical fuels reduction projects are currently conducted to manage hazardous fuels. Mechanical manipulation also allows for effective fuel reduction adjacent to structures or high-value areas.

Recent projects completed or initiated primarily focused on the removal of nonnative, highly flammable eucalyptus trees close to park boundaries. Most of these project sites were strategically located with the intent to help protect adjacent communities from wildfire and also to break up the continuity of fuels within a few large stands. Projects were sited to take advantage of fuel reduction projects implemented by the community for areas along the park boundary. The removal projects focused on containing the spread of existing stands, reducing ladder fuels, and providing breaks in the canopy to help limit the ability of fire to spread from tree crown to tree crown. The projects typically involved the felling of eucalyptus trees with chain saws, which can then be piled, burned onsite, cut into lengths and loaded on haul trucks for removal, or chipped and spread evenly over the project area. Eucalyptus wood removed from the park in the past has been recycled as firewood, used in stream restoration projects, and made into flooring. On average there have been two projects completed each year totaling approximately 10 acres. The work has been completed by park staff and through the use of private contractors. Some mechanical removal of French broom and other dense roadside nonnative vegetation has occurred in an effort to contain its spread and ensure that fire roads have adequate clearance for safe usage by emergency equipment.

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 and map its boundaries. Treatments are documented to ensure that a park has a historical record of the types of landscape treatments used in each area. After the site and project environmental review process is completed, the project is approved by the superintendent with mitigations if appropriate. For example, specific mitigation measures could include leaving buffers along riparian zones and wetlands and/or creating a larger buffer around an archeological site.

The most common method of mechanical fuel reduction is the use of chain saws to thin or remove targeted vegetation, which is then either piled to be chipped, removed, or burned at a later date through the use of pile burns. In some instances, the materials are left in place. Other equipment used during mechanical fuel reduction may include weedwackers, mowers, and masticators. If herbicides are used

during any project, they are applied according to strict specifications provided by the park's Integrated Pest Management (IPM) coordinator per the product label and applicable regulations, on nonnative tree and brush species that vigorously resprout. Any application requires the approval of the park's integrated pest manager and the Washington Office coordinator for herbicide application. The pesticides used on GGNRA lands are registered with EPA and the California Department of Pesticide Regulation and are used according to the label directions and federal and state pesticide laws.

For all projects that propose an herbicide use, a site specific environmental analysis is conducted by GGNRA staff. This assessment is conducted by, at a minimum, the supervisory vegetation ecologist, the chief of natural resources, and the GGNRA IPM coordinator; the latter also reviews it under his/her capacity as a licensed California Pest Control Adviser. If terrestrial or aquatic threatened or endangered wildlife species are in the vicinity of the application site, the park's wildlife biologist and/or aquatic biologist are also consulted. If there is the potential for the listed species to be affected, the park would contact the USFWS for consultation under Section 7 of the Endangered Species Act. Any stipulations provided by the NPS staff and USFWS biologists are included in the written pest control recommendation by the IPM coordinator and issued to the herbicide applicator(s) to provide exact herbicide usage and application requirements. No applications occur in riparian or wetland areas with the exception of the use of specifically formulated herbicides in or near ephemeral drainages of seasonal wetlands applied during the dry season. Using aquatic formulations of herbicide, these areas would only be treated when targeted nonnative invasive plant species cannot feasibly or effectively be controlled by mechanical means and the threat posed by the infestation is considerable. This could be due to the plant's persistent resprouting, its high rate of spread, or the extensive size of the existing infestation. All use of herbicide must follow federal, state, and county regulations.

To protect sensitive species found in the treatment area, a variety of application techniques are used. These techniques may include the use of stump treatment using paint brushes or wick applicators, and/or the use of "shields" to prevent herbicide drift. The use of landscape fabric may also be considered as an alternative to herbicide application in cases where a smaller number of trees are involved, and when other conditions permit. If goats or other animals are used as a type of mechanical treatment in the future, they would be closely monitored and contained by electric fences to eliminate the potential for feral animals or contamination of sensitive watersheds and wetlands.

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. As appropriate, treated areas would be revegetated to avoid erosion and retain natural and/or cultural resource values over the long term. As recommended by staff, through the park's project review process, the NPS would monitor sites over the course of several years to review the success of the treatments. If nonnative plants are found, other treatments would be planted and implemented on the project area.

Pile Burning

All vegetation burning within the boundaries of GGNRA must have a burn plan completed and approved before any ignition can begin. Fire engines or portable pumps are on-scene to extinguish any unwanted fire spread. Piles are lit in a manner that distributes the heat released from piles throughout the unit.

Crews "tend" piles, rearranging fuels at the edges of the piles to reach objectives and ensure minimum potential for escape, and providing maximum consumption. Pile burning and prescribed burning have the same air quality and smoke emissions requirements and regulations. The park's practice is to limit piles to 4 cubic yards of material for each burn. All actions require compliance with and approval from the Bay Area Air Quality Management District (BAAQMD) prior to any actions being initiated. Prescriptions are based on a fire behavior prediction computer program (BEHAVE) model, which is a predictive model of fire based on a set of parameters such as fuel type and weather, with firefighter safety as a determinant.

Prescribed Fire

Under the 1993 FMP, prescribed fire operations have played an important role in fuel and resource management activities within GGNRA, and under Alternative A they would continue to be used. Prescribed burns have been initiated to reduce hazard fuels in strategic locations, to mimic the effects of natural fires, and to aid in the control of nonnative plant species.

Numerous prescribed burns were successfully executed under the 1993 FMP, including Whitegate in 1996 (16 acres), Deer Park in 1996 (10 acres), Deer Park 2 in 1997 (52.5 acres), Conlin in 1997 (20 acres), Ben Johnson in 1998 (35 acres), Whitegate 2 in 1998 (35 acres), Pablo in 1998 (35 acres), and Conlin in 1999 (20 acres). During this period, pile burning was also used to clear additional acres of hazard fuels. Several other burns were planned but not executed due to the various controls and constraints that regulate the use of prescribed fire.

Under Alternative A, prescribed burns would be conducted in coastal prairies, coastal scrub, oak woodlands, and redwood forest; used to lower the fuel hazard in the eucalyptus understory; and used to determine fire's effect on nonnative plants as well as fire's contributing effect in the restoration of native plant communities. Through the use of prescribed fire, other resulting benefits include an increased regulation of forest density, the release of nutrients into the soil, the creation of a favorable reproductive environment for fire-dependent species, and the creation of improved habitat for wildlife. Prescribed burning would also allow for fuel modification in large areas away from structures and high-value areas.

Every year fire management and resource management personnel identify priority areas for prescribed burning based upon fuels management and resource management objectives. Projects are then scheduled for implementation. After a project area is selected, fire and resource personnel visit the site to define its boundaries. After surveying for cultural and historic resources and completing internal environmental and overall project screening for other affected physical or natural resources, a burn plan is prepared for each unit.

The burn plan estimates the percentage of the unit covered by different fuel types (i.e., grass, timber, shrubs) and the tons per acre of material within the unit. The BEHAVE model is used to determine potential fire behavior based on a range of possible environmental factors that may be present during burn operations: wind speed and direction, temperature, relative humidity, slope, aspect, and fuel moisture. A decision is then made about the optimal burning conditions that will achieve the desired goals and remain within the control abilities of firefighters on the ground.

The onsite fuel loading information is also fed into an air quality model (SASEM) for the burn, which estimates the amount of particulate matter that would be released into the air during the burn and its potential direction based on various wind models. This information is submitted as part of the application to the Bay Area Air Quality Management District (BAAQMD) for approval along with a smoke management plan (SMP) at least 30 days before the proposed burn date. 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, and approval of the SMP is received from BAAQMD, the project site is prepared for the burn. To prepare for a burn in grassland habitat, as an example, a line is mowed around the perimeter of the burn by cutting grasses with a weed whacker, mower, or tractor. In shrub or forested habitats a fire line, kept as narrow as possible for the purposes of stopping fire spread, is typically cut and cleared and vegetation density reduced. Whenever possible, roads and trails are used as fire lines to reduce the amount of line that must be created. A hose lay or direct fire engine supports operations along the burn perimeter.

If the burn is being conducted in nonnative tree or shrub stands (e.g., Monterey pine or Scotch broom), the nonnatives may be cut down or mowed and left in the burn unit to dry before burning. This increases mortality of the targeted nonnative species.

As the proposed burn day approaches, NPS staff contact BAAQMD's Meteorology and Data Analysis (MDA) 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 receives final approval from BAAQMD on the burn day and an acreage burning allocation for that day. BAAQMD requires verification that the meteorological conditions fall within the range described in the SMP. Based on wind and weather, BAAQMD makes a final decision about whether it will permit the burn. Onsite weather information is gathered to predict the day's weather and future trends, and to ensure that conditions fall within desired conditions. A detailed Go/No-Go checklist is completed immediately before the burn and has a superintendent's final signature.

The burn is ignited using a combination of fusees, flare guns, and drip torches with a mixture of diesel and gasoline (at a three-to-one ratio). During the burn, fire staff patrols the fire line and keeps 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. If needed to control spot fires, additional fire lines may be cut using hand tools or chain saws. Any spot fires are extinguished using water, hand tools, and if necessary, power tools. Fire weather and behavior are carefully monitored during the burn to ensure that the conditions stay within the prescribed parameters.

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), 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 material causing nuisance smoke is extinguished.

Fire personnel monitor the fire until dark or until the perimeter is secured. Personnel stay onsite overnight for burns in forested habitats. The burn area is patrolled daily until the fire is determined to be completely out. As required by BAAQMD, the total acreage of burned vegetation is reported by telephone the following day.

Research

Specific research projects regarding the application and effects of prescribed burning, mechanical treatments, and suppression actions in all of the FMUs would continue under this alternative.

Goals by Fire Management Unit (FMU)

The vegetation zones described in the 1993 FMP would continue to be used as Fire Management Units, and prescribed fire would be used in each of the units.

1. Grassland and Coastal Scrub. The intent would be to reduce nonnative plant densities while encouraging native perennials by conducting prescribed burns in fall or early winter. The prescribed fire program would consist of small burns (1 to 35 acres). The objective of these burns would be to maintain species diversity, reduce fire hazard by reducing fuel loadings, return the role of fire to this community, monitor fire behavior and the distribution of nonnative plant species, and monitor effects on the ecosystem and sensitive species habitat.

2. Chaparral. Since the health of the plant community's diversity depends on fire, prescribed fire would be used within this community to maintain species diversity, reduce fire hazard by reducing fuel loadings, and return the role of fire to the community.

3. Broadleaf Evergreen Forest. Prescribed research fires in this community would be done to study fire behavior and effects on mixed broadleaf communities, to refine prescriptions, and to return the natural process of fire into the community. Management fires would mimic the fire behavior and frequency traits that would best preserve the ecology of these species.

4. Old-Growth Redwood. Prescribed fire would be used in Muir Woods National Monument in order to restore the role of fire into the community, reduce fuel loads, research the effects of fire on Sudden Oak Death syndrome and special status species habitat, and reduce the potential for a catastrophic fire. Burns would be from 0.5 to 50 acres with some mechanical fuel treatment on up to 5.0 acres per year.

5. Second-Growth Redwood and Douglas-Fir. Prescribed fire would be used to restore the role of fire into this vegetation community, research the effects of fire on Sudden Oak Death syndrome, reduce fire hazards by reducing fuel loading, and monitor the effect of fire on the ecosystem.

6. Eucalyptus/Other Nonnatives. To address the problems of the buildup of flammable fuels in proximity to urban areas and the encroachment of eucalyptus on native plant communities, a combination of mechanical removal and prescribed fire would be employed. The intent of prescribed fire, at a low intensity, would be to prevent populations from invading natural habitats, to reduce the

fuel loading and therefore reduce the fire hazard, and to determine the frequency needed to accomplish the first two objectives. Burns could also be conducted to manage historic forest stands through implementation of low-intensity burns to remove nonhistoric saplings and ground and ladder fuels.

Alternative B – Hazard Reduction and Restricted Fire Use for Research and Resource Enhancement

Description of Alternative

Under this alternative, fire management actions would be focused on using mechanical methods to reduce fire hazards and fuel loads in areas with the highest risks. Specific project objectives would be to reduce fire threats to developed private parcels along the park boundary as well as to developed enclaves within the park. Natural and cultural resource goals and objectives would be integrated into the design and implementation of mechanical fuel reduction projects. Mechanical fuel reduction projects would create areas of reduced fuels to slow the rate of fire spread and facilitate fire suppression. 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.

Under Alternative B, the lands within the Wildland Urban Interface (WUI) FMU would not be subject to prescribed burning, though pile burns would be allowed. Limited use of fire for research purposes would occur within the Park Interior FMU. The objective of these burns would be to add to NPS staff's knowledge of fire effects on specific resources through monitoring and analysis of the results with feedback to the Fire Management Office to refine burn prescriptions, implementation techniques, and data collection efforts.

Strategic Approach

Under this alternative, mechanical treatments and limited prescribed burns would focus on:

- Reducing fuel accumulations where an unplanned fire in these fuels would directly threaten human lives or property;
- Reducing fuels in areas where doing so could aid firefighters in slowing or stopping the spread of fire in the event of unplanned ignition; and
- Using prescribed fire to answer pertinent research questions and better understand its effects for natural resource management options (such as improving threatened and endangered species habitat or controlling nonnative plant species).

An annual maximum of 230 acres would be subject to mechanical fuel treatments, and an annual maximum of 120 acres would be subject to prescribed burning. 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 be reviewed annually and updated as needed.

Mechanical Treatment

The primary fire management activities under this alternative would be mechanical treatments to reduce fire hazards and fuel loads. In addition, mechanical treatment may be used to achieve other resource management goals. When possible, mechanical means would be used to simulate the ecological effects of fire. An example would be use of mechanical treatment to reduce stand densities and the encroachment of fire-intolerant species, and to maintain densities and species composition at prescribed levels. These levels would be determined through consultation with natural and cultural resources staff. In comparison to Alternative A, Alternative B would involve a larger number of mechanical treatment activities to address fire management objectives. Pile burns would be allowed in all FMUs, in association with mechanical fuel reduction projects.

Prescribed Fire

Burns would be allowed within the Park Interior FMU with individual burn size restricted to 0.5 to 15 acres per year, and in the Muir Woods FMU where prescribed burns would be allowed on up to 50 acres per year. Projects would be selected based upon vegetation type and restoration goals, with the intent to test effectiveness of elimination or reduction of nonnative plant species and native plant and/or threatened and endangered species or habitat restoration options. Overall, opportunities for prescribed burns under this alternative would be more restrictive than under Alternative A.

Research

Under Alternative B, current fire research activities would continue and new research would be initiated based on the resource management needs of GGNRA. Potential research topics might include the effects of fire on both nonnative and rare plant species, the interactions between plant diseases such as Sudden Oak Death (SOD) and fire, the effects of wildfires on plant and/or animal communities, and the effectiveness of using fire to reduce fuel loads and manage fire hazards.

Goals by Fire Management Unit (FMU)

Unit 1, WUI

The primary goal in this FMU would be to reduce hazardous fuel loads through mechanical fuel reduction projects. Some pile burning would be allowed following mechanical removal undertakings. Examples of mechanical treatment projects would include:

- Removal of nonnative evergreen trees that do not contribute to the historic setting and that are spreading beyond boundaries of the historic Forts Baker and Barry;
- Removal of nonnative plants in coastal scrub and grassland communities;
- Removal of nonnative evergreen trees in the Alta, Homestead Valley, Muir Beach/Green Gulch, Oakwood Valley, and Tamalpais Valley project areas;

- Reduction of fire hazards and maintenance of a zone of reduced fuels between Stinson Beach school and federal lands; and
- Removal of nonnative evergreen trees in Milagra Ridge, Pedro Point, and Sweeney Ridge/Cattle Hill.

Unit 2, Park Interior

Under Alternative B, prescribed burns of restricted extent would be permitted in the Park Interior FMU. The primary treatment method for fuel reduction would be mechanical. Examples of these burns would include:

- Prescribed burns to test the feasibility of managing nonnative perennial grasses and coastal scrub communities with fire in the Marin Headlands;
- Limited prescribed fire for Harding grass and broom removal in the coastal scrub and grassland communities of Tennessee Valley;
- Limited prescribed burns to study effects on mission blue butterfly habitat in Wolfback Ridge;
- Limited prescribed burns for management of the chaparral community in areas of the Stinson Beach project area; and
- Mechanical treatments to reduce fuel loading and fire hazard along roads and near sensitive resources and historic properties.

Unit 3, Muir Woods National Monument

Goals for this FMU would be those described in Section 2.4, “Actions Common to All Action Alternatives.”

Alternative C (Preferred Alternative) – Hazard Reduction and Resource Enhancement through Multiple Treatments

Description of Alternative

This alternative would permit the broadest use of fire management strategies throughout the park – mechanical treatment, pile burns, and prescribed burning to reduce fuel loading near developed areas and resources. Fuel reduction would primarily occur in those areas with the highest risk for being affected by unplanned fires: developed private areas along the park boundary, developed enclaves within the park, and/or areas and habitats that could be adversely affected by unplanned fire. The objective of fuel reduction projects would be to establish areas of reduced fuels to slow the rate of fire spread and facilitate fire suppression. Natural and cultural resource goals and objectives would be integrated into the design and implementation of mechanical fuel reduction and prescribed fire projects. Prescribed fire would be used to assist with restoration and maintenance of the park’s ecosystems and cultural resources in all FMUs where research, monitoring, and experience have proven the efficacy of these activities.

Strategic Approach

Under this alternative, 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 habitat for threatened and endangered species; reducing infestations of nonnative 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).

Annually, a maximum of 275 acres would be subject to mechanical fuel treatments, and a maximum of 320 acres would be subject to prescribed burning. 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 projects would be reviewed annually and updated as needed.

Mechanical Treatment

The approach to mechanical treatment under Alternative C would be the same as under Alternative B. Mechanical treatments would be used to reduce hazardous fuel accumulations and to create and maintain defensible space and fuel breaks. 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). In many instances, mechanical treatments would be used to complement prescribed burning, with the two treatments being used hand-in-hand to address specific fire management and vegetation needs. Therefore, in comparison to Alternative B, a larger number of acres could be treated annually with mechanical means.

Prescribed Fire

Implementation of Alternative C would result in a substantial increase in the acres that could be subject to prescribed burning. The focus for prescribed burns under this alternative would be in areas where NPS ecologists believe ecosystem health would be enhanced by burning and in areas where fuel accumulations create fire hazards. To the extent possible, prescribed burns would be conducted to approximate natural fire intensity and fire intervals. The intent would be 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. Prescribed fire would be used to reduce infestations of highly nonnative plant species, restore native habitat, and rehabilitate cultural landscape settings.

Prescribed burns intended for resource enhancement would initially 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. All prescribed burns would be conducted under specific burn plans in accordance with national fire policy requirements.

Research

Under Alternative C, current fire research would continue. New research would be initiated as needed to direct the prescribed burning program. Potential research topics might include the following:

1. The effects of fire on management of nonnative plant species such as eucalyptus, Scotch/French broom, and Harding grass;
2. The effects of fire on the species composition and fuel load of coastal grassland and scrub communities;
3. The role of fire in Douglas-fir/coastal redwood communities and the effect of fire on fuel loading in these communities;
4. The interaction between plant diseases such as Sudden Oak Death (SOD) and fire; and
5. The effects of prescribed fires and wildfires on plant and/or animal communities, including rare or sensitive species and their habitat.

Goals by Fire Management Unit (FMU)

Unit 1, WUI

The primary goal in this FMU would be to reduce hazardous fuel loads through mechanical fuel reduction projects and some prescribed burning to complement mechanical treatments. Prescribed fire would be available as a management tool, but restricted in its use and applied strategically to answer research questions and inform proposed project work for the Park Interior FMU. Examples of fire management treatments in this FMU would include:

- Removal of nonnative evergreen trees in most project areas where needed to achieve fire management objectives;
- Removal of nonnative evergreen trees that do not contribute to the historic setting and that are spreading beyond boundaries of the historic Forts Baker and Barry;
- Control and reduction of nonnative plant species in coastal scrub and grassland communities with mechanical treatments in combination with follow-up burning treatments in most project areas, and when possible, restoration and expansion of these native plant communities;
- Prescribed test burns for enhancing mission blue butterfly habitat;
- Limited research burns for Douglas-fir/redwood areas to reduce fuel loads in the Phleger Estate project area; and

- Research into prescribed burning for restoration of grassland communities.

Unit 2, Park Interior

Under Alternative C, prescribed burns would be used to reduce fuel loads and also to implement natural and cultural resource management goals. Prescribed burn projects would be based upon an understanding of vegetation type, restoration goals, and location. Projects would have a strong research and monitoring component. Examples of the types of projects that would occur in this FMU include:

- Prescribed burns, including broadcast burns, to manage nonnative perennial grasses;
- Research burns, and potentially broadcast burns, for management of coastal scrub communities in the Marin Headlands;
- Research into use of fire for managing Sudden Oak Death syndrome in key locations;
- Use of some prescribed fire, including broadcast burns, for management of Harding grass and broom in the coastal scrub and grassland communities in Tennessee Valley.
- Mechanical treatment to reduce fuel loading and fire hazard along roads and near sensitive resources and historic properties.

Unit 3, Muir Woods National Monument

Goals for this FMU would be the same as described in Section 2.4, “Actions Common to All Action Alternatives.”

2.6 Alternatives Considered but Rejected

During the course of alternatives formulation, the multidisciplinary team considered, but rejected, several other alternatives, as explained below.

Hazard Reduction and Focused Resource Enhancement (No Prescribed Fire, No Pile Burning)

Under this alternative, all fire management actions would focus only on risk reduction. Only mechanical methods, such as chain saws, chippers, weed wrenches, and heavy equipment, would be used to reduce fuels. No prescribed fire use would occur in any part of the park and natural and cultural resource goals would only be accomplished through mechanical means as part of fuel reduction actions.

The alternative was rejected because it would not conform with the guidance provided in the 2001 Federal Wildland Fire Management Policy. The Working Group on Wildland Fire Management concluded that federal fire management activities and programs are to provide for firefighter and public safety, protect and enhance land management objectives and human welfare, integrate programs and disciplines, require interagency collaboration, emphasize the natural ecological role of fire, and contribute to ecosystem sustainability. This policy serves as the basis for the goals developed for the FMP.

Focusing only on risk reduction without pile burning would not provide for a sustainable solution to debris disposal. Often only part or sometimes none of the vegetation cut at a site can be chipped and broadcast in place. Without the recourse for pile burning, all cut vegetation must be deposited in a state-licensed landfill at standard costs. Chipping onsite can be restricted due to the presence of sensitive plant or animal species, the risk of spread of nonnative plant seeds or viable parts, the potential for suppressing native seed bank revegetation, or the risk of fire represented by an overly thick duff and debris. Pile burning is important for vegetation that harbors SOD, pitch pine canker, or other infectious diseases or pests that threaten native or landscaped vegetation. The need to deposit cut vegetation at a landfill runs contrary to the concept of sustainability, which is promoted when vegetation does not need to be removed from the work site and is treated by either chipping or burning.

The mechanical-treatment-only alternative would also reduce the potential for interdisciplinary benefits from the project by eliminating the potential for research burns to be conducted. As is apparent from the description of this alternative, it would not emphasize the ecological role of fire in the park or reintroduce the role of fire into the park ecosystem. The limited benefits from this alternative and its failure to meet FMP goals resulted in its rejection from further consideration in the FEIS.

Hazard Reduction and Focused Resource Enhancement (No Prescribed Fire, Pile Burns Allowed)

This alternative would be the same as the alternative above but pile burning of cut materials would be permitted. This alternative was considered but rejected because it neither fully met the purposes and goals of the FMP nor conformed with federal wildland fire management policy. As with the mechanical-treatment-only alternative, the ecological role of fire in the ecosystem could not be emphasized under this alternative, nor could the cultural and natural resource benefits accrued from prescribed burning be researched or implemented on a broader scale. The current strategy for fire hazard reduction and resource benefits at Muir Woods National Monument, which relies on a series of prescribed burns, would have to be abandoned. For these reasons, this alternative was considered but rejected from further assessment in the FEIS.

2.7 Mitigation Measures

The NPS will implement the following mitigation measures as they apply to each of the three alternatives, and therefore the mitigation measures can be considered common to all alternatives. The measures are designed to minimize or avoid the potential environmental impacts of the actions implemented under the FMP or to create a beneficial effect. These measures would not be fully applicable in the event of a catastrophic fire. A complete discussion of the environmental consequences of the alternatives with these mitigation measures applied is provided in Chapter 4 of this EIS. The NPS will regularly evaluate and monitor the mitigation measures during FMP implementation to determine their continued effectiveness in reducing impacts. The NPS, as Lead Agency, will have primary and full responsibility for coordinating the specific elements of each mitigation measure and will be responsible for ensuring that each mitigation measure has been implemented as specified in this document.

Many of the FMP mitigation measures have been developed to avoid or minimize potential effects on plant and animal species found at GGNRA that are listed as threatened or endangered by the U.S. Fish and Wildlife Service (USFWS) or NOAA Fisheries under the federal Endangered Species Act (ESA). As required by the ESA, the NPS is consulting with the USFWS and NOAA Fisheries to ensure that the FMP will not jeopardize the survival of these listed species but rather protect the species and their habitats. As part of the consultation process, the NPS has prepared a biological assessment that discusses the potential effects of the FMP on listed species and recommends measures for their protection. The measures presented here are consistent with those submitted by the NPS to the USFWS and NOAA Fisheries for their consideration and may be altered based on the guidance provided in the biological opinions issued by these agencies at the end of the consultation process.

Review of proposed projects for conformance with Section 106 of the National Historic Preservation Act (NHPA) will be conducted according to the Advisory Council on Historic Preservation's regulations for implementing the NHPA (described in the Code of Federal Regulations, Title 36, Section 800), or through a process defined in a Programmatic Agreement that will be developed specifically for GGNRA's fire management program. The potential effects of fire management projects and annual work programs on cultural and natural resources will be evaluated for all fire management activities through the park's NHPA and NEPA review processes (see FMP 1(a) and -1(b) below). A variety of treatments and techniques, as detailed in the mitigation measures that follow, would be applied where appropriate to the site preparation, project implementation, and post-action rehabilitation phases of projects for the protection of cultural and natural resources.

General FMP Mitigation Measures

FMP-1(a) To ensure that GGNRA fire management actions are in conformance with NEPA, the Record of Decision on the Final EIS, and NPS policy, individual fire management projects and modifications to the GGNRA five-year implementation plan will be subject to the GGNRA project review. Through the project review process, an interdisciplinary team will evaluate whether the potential effects of a proposed action or five-year plan, including appropriate mitigation measures, are adequately addressed by the Final EIS and reflect NPS management policies. If it is determined that the project has the potential for new environmental effects not addressed in this EIS or effects greater than those described in this EIS, a separate environmental process will be conducted.

FMP-1(b) To ensure compliance with 36 CFR 800, the regulations for implementing the NHPA, the Programmatic Agreement that will be developed specific to this park's fire management program will stipulate that each five-year implementation plan will made available to the State Historic Preservation Officer, the Advisory Council on Historic Preservation, and the public for comment.

FMP-2 GGNRA staff will meet with representatives of local fire agencies that could respond to wildfires in GGNRA lands in Marin, San Francisco, and San Mateo counties. The purpose of the meeting will be to provide information to fire agencies on the location and preferred strategies for suppression actions that will minimize damage or afford protection to important

park resources in the event of a wildfire. The information exchanged between the NPS and local fire agencies will include notification procedures, new or modified facilities in the park, updated information on cultural and natural resources, low-impact suppression techniques, or potential protection techniques for certain locales in GGNRA.

FMP-3 GGNRA cultural and natural resources staff will work with the fire management staff in preparing and updating maps and other data sources showing areas of the park with sensitive resources such as National Register properties; archaeological sensitivity; cultural landscapes; plant communities of special management concern (e.g., wetlands, riparian areas, dunes, and Special Ecological Areas identified in the park's Natural Resource Management Plan); habitat of federal, state, and locally listed species; and other important natural and cultural resources.

FMP-4 GGNRA staff will conduct a training session for all contractor crews at the beginning of new fuel reduction projects to familiarize the crews with sensitive resources at the project site and review project conditions. Training sessions may include identification of NPS staff resource contacts; special status plants, wildlife, or other sensitive resources in the work area; identification and specific removal techniques to protect cultural resources from disturbance or prevent resprouting of nonnative plants; markings for the limit line of disturbance; thresholds that trigger a change in implementation techniques or require a halt in project implementation; proper disposal of food waste and garbage to discourage feeding by vectors and corvids; daily close-up of the project site to assure public safety; and information for public contacts during project implementation.

FMP-5 An education program for field personnel involved with implementation of FMP projects will be conducted prior to the initiation of field activities. The program may include a brief presentation on any listed species at the work area, including a description of the species and its ecology, habitat needs, legal status, and protection afforded to the species. Cultural resource issues may include the type of artifacts or soils that could indicate the presence of subsurface cultural resources, the presence of known resources at the site, and important elements of the cultural landscape that must be left undisturbed, among other issues.

FMP-6 The superintendent of GGNRA will appoint members of GGNRA staff to act as resource specialists to consult with operations crews in the event of wildland fire and during planning and execution of prescribed fire. The resource specialists will meet with local fire agencies likely to command wildland fire suppression actions on GGNRA lands and develop strategies for implementing flexible suppression to protect important resources.

FMP-7 Natural and cultural resources staff will be notified of wildland fires as soon as possible so that appropriate staff can advise the lead fire agency on the location of sensitive resources and preferred suppression techniques and begin planning for rehabilitation of the burned area**.** Natural and cultural resource advisors will be assigned to the incident as needed.

FMP-8 For any multiday fire suppression event, a local or regional Burned Area Emergency Response team will be requested to facilitate development, in conjunction with park staff, of the emergency suppression stabilization and rehabilitation proposals.

Air Quality Mitigation Measures

AIR-1 If recommended by BAAQMD, smoke management plans submitted by the NPS for BAAQMD review can be modified to reduce production of pollutants by reducing the amount of fuels available for burning. Options for reducing the amount of fuels available and emissions produced include reducing the area to be burned, reducing fuel loading (e.g., mowing and understory thinning), managing the rate of fuel consumption, and redistributing the emissions. Treatments to reduce overall air emissions from prescribed burns will be based on current smoke management techniques such as those listed in the Western Regional Air Partnership publication "Non-burning Alternatives to Prescribed Fire on Wildlands" (Jones and Stokes, 2004) and those listed in Appendix I of this FEIS.

AIR-2 The NPS 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 locally to provide adequate advance notice to persons with sensitivities to smoke.

AIR-3 To reduce smoke and pollutant generation during the prescribed burning season, efforts will be made to burn fuel concentrations, piles, landings, and jackpots at other times of the year.

AIR-4 To reduce impacts on visibility in the national park, burning will be avoided on holidays or other periods when recreational visitation is typically high.

AIR-5 To avoid public health and nuisance impacts on neighboring communities, information about upcoming prescribed burns, including guidance for those who are sensitive to smoke, will be provided to park visitors, park employees, and park partners. Prescribed burns will be conducted under meteorological conditions that best avoid smoke drift into nearby residential areas and roadways.

AIR-6 The NPS will arrange in advance with other parks that routinely monitor air quality (i.e., Yosemite National Park or Sequoia National Park) to monitor particulate levels during larger prescribed burns in GGNRA provided the necessary staff and equipment can be made available for GGNRA use.

Soils and Water Quality Mitigation Measures

SW-1 Planned and unplanned fire actions will include strategies to minimize impacts from erosion, such as avoiding steep slopes and highly erosive soils, timing burns to minimize erosion potential, avoiding scraping or burning to bare mineral soil (layer below duff), or using erosion control techniques during or after burns. Subject matter experts will ensure that the erosion control plan for each action is sufficient to prevent long-term moderate or major

impacts on the rate of soil erosion. Sites with identified high potential for soil erosion will be monitored.

SW-2 Following a prescribed fire or wildland fire, visual monitoring will be conducted downslope of the area burned and at down-gradient water bodies (including ditches, streams, and wetlands) for evidence of increased soil erosion or increased sedimentation. Additional erosion control/sediment control measures will be applied where warranted.

SW-3 Following wildland fires or prescribed burning, all fire lines (both hand and dozer lines) or other areas disturbed by equipment or vehicles will be rehabilitated as quickly as possible to prevent erosion, discourage the spread of nonnative plants and address soil compaction. Burned area rehabilitation techniques, including recontouring, soil stabilization, and removal and monitoring of nonnative plants, will be used for rehabilitation efforts.

SW-4 Unless no feasible alternative is available, heavy equipment working on fire management actions (excluding suppression) will not be used in areas with soils that are undisturbed, saturated, or subject to extensive compaction. Where staging of heavy equipment, vehicles, or stockpiling is unavoidable, the limit of allowable disturbance will be clearly demarcated by staking, flagging, or fencing. Following the end of work, surface soils will be scarified to retard runoff and promote revegetation.

SW-5 During implementation of prescribed burns, some of the available coarse, woody debris will be left on the site to foster nutrient recycling and mycorrhizal function and other natural resource benefits.

SW-6 Mechanical regrading and rehabilitation of fire roads will be conducted to specifications identified in the GGNRA Trails Inventory and Condition Assessment and the Memorandum of Understanding for Maintenance and Management of Dirt Roads with adjacent land management agencies.

SW-7 After tree felling, stumps will be left in place in areas with highly erosive soils or on steep slopes.

SW-8 Where surface soils supporting native vegetation will be disturbed as part of fire management actions, the topsoil layer will be excavated and stockpiled separately from other fill and replaced as topsoil at the end of the action.

SW-9 Erosion and sediment control measures will be implemented as prescribed where project actions could leave soils exposed to runoff prior to revegetation.

SW-10 Where multiple burn piles are created on undisturbed soils, the size of the piles will be kept small with sufficient distance between piles to minimize impacts on soils from high-intensity fires and to facilitate reestablishment of mycorrhizal fungi and soil microorganisms from adjacent unburned land.

SW-11 A post-project site stabilization plan will be developed and implemented for all fire management projects.

Wetland Mitigation Measures

WET-1 Fires will be allowed to back into, around, or through wetlands and meadows to avoid suppression damage. Wetlands will be avoided to the greatest extent possible while constructing fire lines and breaks during wildfire suppression. Where wetlands are used as a natural boundary to help contain a fire, the control line will be sited outside the wetland area. Trample lines (rather than dug lines) may be used if it is necessary to site the control line in the wetland.

WET-2 Foams, saltwater, or other fire retardants will not be used on or near wetlands to the greatest extent possible.

Vegetation Mitigation Measures

VEG-1 Prescribed burns will be conducted at a time of year when introduction or spread of nonnative plants will be minimized and mortality of nonnative plant species will be maximized.

VEG-2 Soil disturbance during mechanical treatments, prescribed burns, and suppression fires will be minimized to the greatest extent possible to reduce the potential for introduction or spread of nonnative plant species, to protect topsoil resources, and to reduce available habitat for new nonnative plant species.

VEG-3 Areas subject to fire management treatments will be monitored periodically for the presence of nonnative plant species; if such species become established or spread as a result of such activities, the nonnative, nonhistoric plants will be removed.

VEG-4 All vegetation management actions under the FMP will conform to federal and state regulations governing interstate and intrastate restrictions (respectively) adopted to prevent the artificial spread of Sudden Oak Death (*Phytophthora ramorum*) beyond the currently affected area. It will be the responsibility of the natural resources division chief to ensure that current guidelines and regulations are circulated to GGNRA staff involved in fire management actions. Relevant regulations are the Code of Federal Regulations, Title 7, Section 301.92 (updated 9/27/04) and California Code of Regulations, Title 3, Section 3700 (updated 9/2/04). Current regulations do not permit the movement of plant species and associated material listed in 3700(c) outside of the regulated quarantine area (defined in 3700(b)), which includes all three GGNRA counties.

VEG-5 All FMP projects will incorporate techniques that control existing populations of weed species at the project site and incorporate practices to reduce the potential spread of weed species to noninfested areas of the park. Practices to reduce the spread of weed species include the following:

- Movement or deposition of fill, rock, or other materials containing weed seed or viable plant cuttings to areas relatively free of weeds will be restricted.
- Where feasible based on the density of the weed population present, the fire management project manager will survey the road shoulders of the routes that provide project access for nonnative plant species and coordinate removal of those plants that could be disturbed by passing vehicles.
- When project vehicles are required to move from offroad use in weed-infested areas to relatively weed-free areas, and water lines and water tenders are available for use, the tires and body of heavy equipment and vehicles will be hosed down before each transit to the relatively weed-free area.

VEG-6 All herbicide use will be administered through the park's integrated pest management (IPM) coordinator, and only licensed personnel will be allowed to apply pesticides. All herbicide use for fire management actions will be reported monthly to the IPM coordinator.

VEG-7 No herbicide foliar spraying or direct stump applications will be allowed in riparian or wetland habitats supporting special status species except in the dry season.

Special Status Species Mitigation Measures

SS-1 When emergency actions must be taken to prevent imminent loss of human life or property and these actions would result in a taking of listed species or adverse modification of critical habitat not covered under existing FMP biological opinion, the NPS will respond to the situation in an expedient manner to protect human health and safety. After the incident is under control, the NPS will initiate emergency consultation procedures with the appropriate agency(ies).

SS-2 The fire management project manager will ensure that contractor crews working in areas designated as habitat of listed species are monitored by a qualified biological monitor to ensure that project actions conform to restrictions developed for species protection.

SS-3 All fire management actions will operate under a policy of No Net Loss of Endangered Species Habitat, which applies to all species federally listed as threatened or endangered or proposed for listing. The project review process will be used to document the no net loss finding through the conformance assessment conducted for each FMP action proposed for listed species habitat.

SS-4 To avoid the spread of highly nonnative animal species (e.g., bullfrogs) and protect the habitat of federally listed threatened or endangered species, GGNRA resource advisors and fire management staff will advise local fire agencies responding to wildland fires in the park and vicinity of the following guidance:

- Drawing water from freshwater bodies in GGNRA and Rodeo Lagoon should be avoided unless there are no alternative sources available. If freshwater is drawn or scooped from water bodies in the park, it should be used on wildfires within the same watershed whenever possible.

- Ocean and bay waters are preferred water sources for fighting wildfires in the park and vicinity. Habitats of sensitive aquatic species and mission blue butterflies should be avoided when saltwater is used.

SS-5 An education program for the field personnel involved with the FMP 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 California red-legged frog, San Francisco garter snake, mission blue butterfly, and other appropriate listed species. The program shall include the following: a description of these species, their ecology, and habitat needs; an explanation of their legal status and their protection under the Act; and an explanation of the measures being taken to avoid or reduce effects to these species during implementation of the FMP. The education may be conducted in an informal manner (e.g., ranger and field personnel in a field setting).

SS-6 If a California red-legged frog(s), San Francisco garter snake, or early stages of the mission blue butterfly are observed in the work/burn areas, a qualified biologist or an individual trained in the biology and ecology of these listed animals and designated by the NPS shall capture it and move the animal(s) to an appropriate aquatic of upland location outside of the work area.

Special Status Plants

SS-7 Potential impacts associated with tree removal in the vicinity of the Raven's manzanita, San Francisco lessingia, and Marin dwarf-flax will be evaluated in consultation with the USFWS.

SS-8 To address fire actions occurring within special status plant species populations, site- and/or species-specific rehabilitation plans will be developed to minimize or avoid impacts on the greatest extent possible.

SS-9 When FMP actions disturb the habitat of special status plant species, revegetation and weeding plans will be developed in conjunction with project planning.

SS-10 The potential for research burning and/or mechanical fuel treatments to enhance federally listed threatened or endangered plant habitat will be investigated. Burning in these habitats will be limited to carefully prescribed research burns, designed in conjunction with USFWS staff consultation and in accordance with established recovery plan objectives. Experimental treatments will be scientifically designed with replicate controls and a commitment to post-treatment monitoring.

Salmonids

SS-11 Except in emergency situations, water drafting from park streams and creeks that support salmonids must be halted when water levels drop to a level that could result in disconnected pools of water in the channel. Any water pumping from salmonid streams will require measures to prevent injury to fish, such as using offstream sumps, restricting approach velocities to less than 0.8 foot per second, and screening at intake with openings no greater than 0.25 inch.

SS-12 A buffer will maintained around riparian areas where fire management activities will be restricted. Staging, fire line construction, and vehicle use will occur outside the buffer area, and any activities such as nonnative vegetation removal and limited prescribed burning will occur under tightly controlled conditions. Any impacts that occur in the buffer area must be correctable by site-specific actions, and must be confined to short-term, minor (or less) adverse effects.

SS-13 The fire management officer will consult with natural resources subject matter experts to identify rehabilitation and revegetation strategies where fuel reduction projects require bank stabilization in riparian areas. Rehabilitation in riparian areas will be accomplished by hand treatment techniques, using erosion control materials if treatment areas are bare prior to rains, revegetating where needed, and where possible, returning native woody material (large woody debris) to stream banks. No work will be conducted directly in the wetted channel without additional consultation.

Northern Spotted Owl

SS-14 Treatment activities described in the FMP or any noise generation above ambient noise levels will not occur within 0.40 kilometer (0.25 mile) of a known occupied or previously used northern spotted owl nest site, or within potential spotted owl habitat between February 1 and July 31 (breeding season), or until such date as surveys conforming to accepted protocol have determined that the site is unoccupied or nonnesting or nest failure is confirmed.

SS-15 Mechanical fuel reduction activities in suitable spotted owl habitat, known or potential, will not substantially alter the percent cover of canopy overstory and will preserve multilayered structure. When shaded fuel break features in suitable northern spotted owl habitat are constructed, the resulting multilayered canopy will only be reduced to a height of 6 to 8 feet, or along roadways as needed for emergency vehicle clearance.

SS-16 Prior to fire management activities, project areas will be surveyed for the presence of dusky footed woodrat nests. If feasible, woodrat nests will be protected.

SS-17 Within northern spotted owl habitat, the cutting of native trees greater than 10 inches diameter at breast height (dbh) will be avoided unless a determination is made that the native tree presents a clear hazard in the event of a fire or cutting is the only option to reduce high fuel loading.

SS-18 The fire management officer will arrange for qualified biologists to conduct post-project monitoring to determine short- and long-term effects of fire management actions on spotted owl activity centers if resources are available.

San Francisco Garter Snake

SS-19 No heavy equipment will be used off of existing fire roads or developed features in areas of known San Francisco garter snake habitat. If use of heavy equipment and trucks is required during emergency situations or for work that would improve San Francisco garter snake habitat, mitigation measures to avoid mortality will be incorporated into the project schedule. Measures to avoid mortality include hand-clearing areas prior to fire management activities, hand-excavating all burrows, trapping snakes out of the excavation area, using monitors to prevent equipment from injuring listed species, and training workers on identification and avoidance of listed species. Work will be conducted by biologists with a valid 10(a)(1)(A) permit and any collected San Francisco garter snakes will be relocated outside affected areas.

Marbled Murrelet

SS-20 Where marbled murrelet habitat overlaps northern spotted owl habitat, the restrictions on noise generation in spotted owl habitat above the level of ambient noise will be to August 5. Further, from August 6 through September 30, noise generation will be limited to ambient noise levels from two hours before sunset to two hours after sunrise to protect any nesting marbled murrelets that have not been noted during surveys (USFWS letter to NPS dated April 13, 1994).

SS-21 In marbled murrelet habitat, felling of very large Douglas-fir or coast redwood trees will be avoided and the fire perimeter will be established at a distance that will preclude the need to fell large trees.

Mission Blue Butterfly

See also Mitigation Measure SS-4 regarding use of ocean and bay waters for suppression actions.

SS-22 Fire management activities will not occur within or immediately adjacent to existing or potential mission blue butterfly habitat during the flight period of the butterfly from February 15 through July 4.

SS-23 Pile burning will only be permitted on barren, disturbed soils in mission blue butterfly habitat.

SS-24 During the information meeting with local fire agencies, the location of mission blue butterfly habitat will be identified. During this meeting and when providing information at an active wildland fire as a resource advisor, natural resources staff will advise the local fire agency of the following guidelines:

- Avoid staging fire suppression actions in or directly adjacent to mission blue butterfly habitat;
- Construct fire lines outside of mission blue butterfly habitat to the greatest extent possible;
- Use wet lines wherever feasible, or narrow, hand-constructed fire lines where water is not available to help contain the spread of the fire; and
- Avoid using saltwater or retardant on habitat of the mission blue butterfly.

SS-25 The potential for research burning and/or mechanical fuel treatments to enhance butterfly habitat will be investigated. Burning in mission blue butterfly habitat will be limited to carefully prescribed research burns. Experimental treatments will be scientifically designed with replicate controls and a commitment to post-treatment monitoring. No more than five percent of existing mission blue butterfly habitat in each county will be treated experimentally each year.

SS-26 Where possible, maintain a 100-foot-wide buffer between fire management activities and mission blue butterfly habitat except when fires are being conducted for research purposes. For habitat enhancement projects, additional measures will include establishment of buffer areas, flagging of *Lupinus albifrons* in the vicinity of activities, installation of temporary fencing, dust control, and worker education (USFWS Biological Opinion for the Fort Baker Plan/EIS, September 29, 1999).

SS-27 The fire management officer will arrange for the removal of nonnative plants within and adjacent to mission blue butterfly habitat following fire management actions, including fire suppression.

San Bruno Elfin Butterfly

SS-28 No planned fire management actions will occur in San Bruno elfin butterfly habitat. Proposed project areas in San Mateo County will be assessed to determine the potential for occurrence of San Bruno elfin butterfly habitat.

SS-29 A 100-foot-wide buffer will be maintained between fire management activities and potential San Bruno elfin butterfly habitat.

SS-30 During the information meeting with local fire agencies, the location of San Bruno elfin butterfly habitat will be identified. During the meeting and when advisors are called to provide information at an active wildland fire, natural resources staff will advise the local fire agency of the following guidelines:

- Avoid staging fire suppression actions in or directly adjacent to San Bruno elfin butterfly habitat;

- Construct fire lines outside of San Bruno elfin butterfly habitat to the greatest extent possible;
- Use wet lines wherever feasible, or narrow, hand-constructed fire lines where water is not available to help contain the spread of the fire; and
- Avoid the use of saltwater or retardant drops on San Bruno elfin butterfly habitat.

SS-31 Conduct fire management activities in areas directly adjacent to San Bruno elfin butterfly habitat outside the flight period of the butterfly, which is from February 1 through May 15.

Tidewater Goby

See also Mitigation Measure SS-4 regarding scooping of Rodeo Lagoon water for use in suppression actions.

SS-32 During information meetings with local fire agencies (see Mitigation Measure NR-1), and on the scene of active suppression actions, natural resource advisors will inform responding fire agencies that Rodeo Lagoon shall not be used for water drafting unless needed to protect life and property and no other feasible water source is available.

California Red-Legged Frog

See also Mitigation Measure SS-4 regarding use of freshwater ponds as a water source for suppression actions and areas of the park sensitive to the use of ocean and bay waters for suppression actions.

SS-33 All suitable habitat within areas proposed for fire management activities will be surveyed and flagged by a qualified biologist to determine whether the site supports suitable breeding or nonbreeding areas for the California red-legged frog.

SS-34 To prevent direct injury to California red-legged frogs, removal of vegetation within suitable frog habitat will be accomplished by a progressive cutting of vegetation from the overstory level to ground level to allow frogs to move out of the treatment area.

SS-35 If likely habitat is identified at the project site, a qualified and permitted biologist will follow accepted protocol and collect and relocate any individual red-legged frogs to nearby suitable habitat, in accordance with the biological opinion from the USFWS.

Western Snowy Plover

SS-35 Where fire management actions involve operation of vehicles or heavy equipment on the beach, the fire management officer or the resource advisor (in the case of a wildfire) will ensure that vehicles will be driven at slow speeds (15 miles per hour maximum) over the wet sand portion of the beach and that natural wave-cast debris will be left on the beach to provide foraging habitat for the western snowy plover.

SS-37 To avoid disturbance of western snowy plovers, aircraft assisting the NPS in the implementation of FMP projects will avoid flying directly over and parallel to the beach to the greatest extent possible.

California Brown Pelican

SS-38 To avoid disturbance to the California brown pelican from late spring to early winter:

- Avoid operating aircraft below and within 500 feet of Rodeo Lagoon, Bird Island, and Bolinas Lagoon to the greatest extent possible.
- Avoid drafting water from Rodeo Lagoon, the ocean near Bird Island, or Bolinas Lagoon.

Monarch Butterfly

SS-39 All known clustering sites of monarch butterflies will be considered for protection from fire management actions.

Wildlife and Important Habitat Mitigation Measures

WIL-1 Prescribed burns, mechanical treatments, and mowing of shrubs and grasses taller than 8 inches will not be conducted during the bird-nesting season, from March 1 through July 31, unless a qualified biologist conducts a pre-project survey for nesting birds and determines that birds are not nesting within the project area. To the greatest extent possible, these activities will be planned and conducted outside bird-nesting season. In intensively managed landscapes where mowing is justified for fuel reduction, vegetation will be maintained at a height of less than 8 inches throughout the nesting season (March 1 through July 31) to discourage the nesting of ground-dwelling bird species.

WIL-2 In addition to WIL-1, in order to protect nesting raptors, trees shall not be removed between January 1 and March 1 unless qualified personnel conduct a pre-project survey for nesting birds and determine that birds are not nesting within the project area. If nesting raptors are detected, a qualified biologist will delineate a suitable buffer.

WIL-3 Subject to project review conditions, fire management actions proposed for areas of the park that provide only limited habitat (such as areas dominated by broom or ivy species) may be conducted at any time

WIL-4 Since older burn piles could provide wildlife habitat, the piles will be spread out (to move out animals) as much as possible before burning. If moving the piles is not feasible, the fire management project manager will ensure that piles are lit from one side only (with firefighters on the ignition side), so that any wildlife in the pile can run out.

WIL-5 For prescribed fire projects proposed in the Muir Woods FMU, the fire management officer will arrange for a qualified biologist to conduct bat surveys of the tree hollows within the

burn unit to identify potential maternity colonies. Measures will be implemented to protect active maternity roosts.

Cultural Resources Mitigation Measures

CUL-1 Project Preparation Phase. To assure that cultural resources are considered early in the fire management planning process and afforded the utmost protection, the following preparatory actions will be undertaken:

- Computer and other databases containing cultural resources data will be maintained by cultural resource staff in coordination with the needs of fire management activities.
- Appropriate cultural resources monitoring protocols will be established by cultural resources staff and applied to fire management practices as warranted.
- Potential research opportunities to study the effects of fire management actions on cultural resources will be identified by cultural resources staff.
- Cultural resources specialists from adjacent land management agencies will be consulted by NPS staff, as appropriate, in order to coordinate mitigation efforts prior to fire management actions.
- Indigenous archeological sites, spiritual sites, and important plant communities will be identified and appropriately managed for preservation, maintenance, and/or enhancement by park cultural resources staff. Consultation with local Native American communities will, where pertinent, continue to occur in the context of fire management actions.
- Fire management personnel and other staff will receive annual training in cultural resources in relation to fire management activities.

CUL-2 Project Planning Phase. All areas slated for fire management activities will be considered for pre-action field surveys, based on the recommendations of cultural resource specialists and the need to identify cultural resources in proposed project areas. This includes areas likely to be disturbed during future wildfire suppression activity, such as helispots, staging areas, and spike camps. Site-specific information gathering may include the following:

1. In cultural landscape areas, parameters for identifying vegetation for removal or retention will be incorporated into project planning.
2. Evaluation of the relative hazards of fuel loads in proposed project areas will address the protection of cultural resource values, including:

   2(a) Maintenance of light fuel loads on and in close proximity to cultural resources;

   2(b) Benefits gained from reduced fuel loads in relation to the need to avoid or minimize adverse effects on cultural resources;

2(c) Opportunities to restore or enhance the historic character of cultural landscapes;

2(d) In developing burn plans, assessment of the potential effects of heat intensity and duration above, at, and below the surface in relation to cultural resources; and

2(e) For projects with the potential for accelerating the rates of erosion, potential effects of erosion on cultural resources.

CUL-3 Project Implementation. Adverse effects on known and unknown cultural resources will be avoided or minimized during the implementation of fire management projects. A variety of treatments and techniques, as detailed in the project planning and preparation phase for individual projects, will be used for the protection of cultural landscape features during implementation of both prescribed fire and mechanical treatment activities, as follows:

1. A cultural resource specialist or resource advisor will:

   1(a) Be present during fire management actions, as stipulated, where recorded and suspected but not-yet-recorded historic or prehistoric resources are considered at risk;

   1(b) Deliver a pre-project briefing to fire management staff as necessary; and

   1(c) Share data with fire management personnel as needed to avoid or minimize adverse effects.

2. Vegetation will be flagged, or otherwise identified, in order to properly carry out project planning stipulations for:

   2(a) Retention, based upon age determination or diameter thresholds as previously agreed upon;

   2(b) Raising the skirts on landmark trees and other tree pruning;

   2(c) Flush-cutting trees removed from cultural resource areas unless otherwise stipulated; and

   2(d) Brush removal within agreed-upon boundaries.

3. Fences may be a character-defining feature of historic properties. In such cases:

   3(a) Avoid fences with heavy equipment;

   3(b) Remove brush and scrub only by hand or with hand-tools in a 10-foot-wide buffer zone along fence lines;

   3(c) Provide vehicle access at gates where necessary; and

3(d) Cut other openings, if necessary, between fence posts.

4. Field patterns may be a character-defining feature of historic properties. In such cases:

4(a) Use prescribed burn to restore field patterns;

4(b) Protect fences by not using heavy equipment within a 10-foot-wide buffer zone, and instead using less damaging methods to lessen fire danger, such as watering, hand removal, and hand tools; and

4(c) Use hand removal of noncontributing vegetation near or in historic vegetation.

5. Structures and small-scale features may contribute, or be themselves, historic properties. In such cases:

5(a) Remove brush approximately 30 feet from burnable structures, depending on slope, with hand tools being the default method; and

5(b) If there are foundation plantings, create defensible space outside ornamental edge plantings wherever possible.

6. Some areas may be sensitive for archeological resources on or near the surface. In such cases:

6(a) Do not drag cut vegetation;

6(b) Do not use rakes;

6(c) Use no burning when surface or subsurface resources are sensitive to heat; and

6(d) Avoid using surface scarification to retard runoff in archeological sites.

7. Erosion will be minimized to the extent possible, by methods such as:

7(a) Constructing control lines perpendicular to the slope;

7(b) Using the existing road network;

7(c) Keeping heavy equipment off paths and trails;

7(d) Keeping heavy equipment away from areas adjacent to ponds and riparian corridors; and

7(e) Avoiding these and other areas marked by flagging.

CUL-4 Post-Project Phase. Adverse effects on known and suspected cultural resources will continue to be avoided or minimized through careful consideration of actions during the post-action phase of mechanical treatment, prescribed fire, and fire suppression activities.

1. The post-action condition of all recorded cultural resources will be assessed, as necessary.

   1(a) Post-action surveys may be conducted both in previously surveyed areas and in unsurveyed areas.

   1(b) Previously unrecorded cultural resources will be assessed for condition, and stabilization and other protection needs.

2. Stabilization and other treatment needs of cultural resources will be addressed in the development and implementation of Emergency Stabilization Plans and Burned Area Restoration Plans, and in the development of funding requests for these and other post-fire programs as needed.

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

Visitor Use and Visitor Experience Mitigation Measures

VUE-1 Project work hours will normally be limited to normal work hours (8 A.M. to 5 P.M.) to minimize potential noise impacts on nearby residents and park visitors. Exceptions may occur outside of normal work hours where warranted, for example to take advantage of windows of favorable weather or to allow for project completion before wildlife breeding period restrictions begin.

VUE-2 Where noise levels from project operations could be intrusive to adjacent residents or park trail users, all efforts will be made during project planning to site project staging areas in order to optimize the noise level reduction gained from natural barriers and screening vegetation. Staging areas will be sited to minimize noise levels for sensitive receptors to the extent feasible without causing adverse environmental effects on park resources, values, or public access.

VUE-3 Park fire staff will avoid temporary closures of areas of the park during fuel reduction projects if spotters can be available to escort the public safely through the work area.

VUE-4 To the extent feasible while protecting public health and safety, fire management officer will instruct contractors or NPS crews to secure work sites at the end of the work day so that closures around a project site can be lifted prior to and after working hours during weekdays and all day on weekends.

VUE-5 The fire management office will develop and implement an education and communication plan for all site-specific fire management implementation projects. For large scale fuel reduction projects (more than 1 acre) that could affect mid- to close-range viewsheds for residents on the park boundary, park staff will arrange a meeting with the community to present the scope of work and provide an opportunity for public comment. Communication

plans for projects may include information such as the project scope, schedule, and alternative trail routes, where needed, to be posted in the project vicinity.

Public Health and Safety Mitigation Measures

PHS-1 Site plans for tree removal projects will be reviewed by the project review committee for potential safety hazards from windthrow and wind pattern change as a result of implementation.

2.8 Environmentally Preferred Alternative

The NPS policy regarding implementation of NEPA requires that an environmentally preferred alternative be identified. The environmentally preferred alternative is determined by applying criteria identified in Section 101 of NEPA to each alternative considered. Determination of the preferred alternative occurs after the environmental analysis is complete. In accordance with NEPA, the environmentally preferred alternative would best (1) fulfill the responsibilities of each generation as trustee of the environment for succeeding generations; (2) assure for all generations safe, healthful, productive, and esthetically and culturally pleasing surroundings; (3) attain the widest range of beneficial uses of the environment without degradation, risk to health or safety, or other undesirable and unintended consequences; (4) preserve important historic, cultural, and natural aspects of our natural heritage and maintain, wherever possible, an environment that supports diversity and variety of individual choice; (5) achieve a balance between population and resource use that will permit high standards of living and a wide sharing of life's amenities; and (6) enhance the quality of renewable resources and approach the maximum attainable recycling of depletable resources.

The environmentally preferred alternative for the FMP is based upon these national environmental policy goals. The environmentally preferred alternative is the one that causes the least damage to the biological and physical environment and is best suited to protect, preserve, and enhance historic, cultural, and natural resources and process. The NPS has considered all alternatives in this analysis in accordance with NEPA and CEQ regulations and has determined that Alternative C, *Hazard Reduction and Resource Enhancement through Multiple Treatments*, is environmentally preferable. Through a careful and thorough review of the alternatives and the environmental consequences as analyzed in this document, the NPS has determined that Alternative C would best achieve the purposes and goals of the plan by allowing for the use of a variety of management tools in order to achieve resource goals in balance with protection of visitors, life, and property. In comparison to Alternatives A and B, Alternative C fire management treatment options would allow for the park to achieve in a timely manner a high level of protection of human health, life, and property while maximizing opportunities for restoring and maintaining ecological integrity and protecting and enhancing cultural resources.

2.9 Preferred Alternative

The NPS has selected Alternative C as the preferred alternative. 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. Alternative C offers the best

combination of benefits with a high level of protection of life property, and greater long- and short-term natural and cultural resource benefits than either Alternatives A or B.

2.10 Comparison of Alternatives

This section compares the key features of the alternatives and summarizes the potential environmental consequences (see Tables 2-4 and 2-5). Potential environmental consequences are analyzed in more detail in Chapter 4, Environmental Consequences.

Table 2-4: Summary of Alternatives by Fire Management Unit (FMU) and Treatment Type

Treatment Type	County	Alternative A		Alternative B				Alternative C			
		All FMUs[1]	Total	WUI FMU	Park Interior FMU	Muir Woods FMU	Total	WUI FMU	Park Interior FMU	Muir Woods FMU	Total
Mechanical Treatment (acres/year)	Marin	75	100	130	45	5	230	130	90	5	275
	San Francisco	5		10	0	0		10	0	0	
	San Mateo	20		30	10	0		30	10	0	
	Total Acres	100		170	55	5		170	100	5	
Prescribed Burning (acres/year)	Marin	100[2]	110	0	70	50	120	50	185	50	320
	San Francisco	<1		<1	NA	NA		<1	NA	NA	
	San Mateo	10		0	0	0		5	30	0	
	Total Acres	110		0	70	50		55	215	50	

Source: GGNRA Fire Management Office Data 2004.
Notes:
[1] Since 1993 FMP did not give number of acres per year for treatments by FMU, and since FMUs are by vegetation type and dispersed throughout park, total acreage is given by county only based upon projects cited in 1993 FMP and current practice.
[2] Includes 50 acres of prescribed burning in Muir Woods National Monument annually.
WUI = Wildland Urban Interface
NA = not applicable

Table 2-5: Summary of Alternatives

	Alternative A – 1993 FMP (No Action)	Alternative B – Hazard Reduction and Restricted Fire Use	Alternative C (Preferred Alternative) – Hazard Reduction and Resource Enhancement through Mult. Treatments
Fire Management Units (FMUs)	6 FMUs based upon vegetation communities: • Grassland/Coastal Scrub – 10,605 acres • Chaparral – 200 acres • Broadleaf Evergreen Forest – 1,431 acres • Old-Growth Redwood – 471 acres • Second-Growth Redwood/Fir – 1,121 acres • Eucalyptus/Other – 1,325 acres	3 FMUs based on geography, proximity to developed areas, fuel hazards and values at risk: • WUI FMU – 4,926 acres • Park Interior FMU – 9,675 acres • Muir Woods FMU – 552 acres 3 FMUs subdivided into 17 project areas for future project planning.	Same as Alternative B.
Mechanical Treatment	Up to 100 acres would be treated mechanically, including 70 acres roadside treatment, across an FMU Associated pile burning allowed	Up to 230 acres would be treated mechanically, including 70 acres roadside treatment. Total acres treated by FMU: • 170 acres in WUI FMU • 55 acres in Park Interior FMU • 5 acres in Muir Woods FMU • Associated pile burning allowed	Up to 275 acres would be treated mechanically, including 70 acres roadside treatment. Total acres treated by FMU: • 170 acres in WUI FMU • 100 acres in Park Interior FMU • 5 acres in Muir Woods FMU • Associated pile burning allowed
Prescribed Fire	Allowed in all 6 FMUs. Up to 110 acres would be treated with prescribed fire annually: • 50 acres in Muir Woods National Monument • 60 acres across FMUs • No prescribed fire in San Francisco except small research burns for threatened and endangered species	Allowed in Muir Woods and Park Interior FMUs. Up to 120 acres would be treated by prescribed fire annually: • 50 acres in Muir Woods FMU • 70 acres in Park Interior FMU • No prescribed fire in San Francisco except small research burns for threatened and endangered species	Allowed in Muir Woods, Park Interior, and WUI FMUs. Up to 320 acres would be treated with prescribed fire annually: • 50 acres in Muir Woods FMU • 215 acres in Park Interior FMU • 55 acres in WUI FMU • No prescribed fire in San Francisco except small research burns for threatened and endangered species

Table 2-5: Summary of Alternatives

	Alternative A – 1993 FMP (No Action)	Alternative B – Hazard Reduction and Restricted Fire Use	Alternative C (Preferred Alternative) – Hazard Reduction and Resource Enhancement through Mult. Treatments
WUI Initiative – Community Projects	Continued cooperative ventures would reduce potential for wildland fire to burn from federal lands to neighboring properties.	Same as Alternative A.	Same as Alternative A.
Defensible Space/Vegetation Clearing Around Structures	Program of hazardous fuel removal projects would continue, including clearing vegetation around park structures based on fuel type and slope, building construction, historic significance, and potential sources of ignition.	Same as Alternative A.	Same as Alternative A.
Roadside Fuel Reduction	70 acres roadside mechanical treatment annually across all FMUs. Maintenance of existing fire roads for emergency evacuation, public safety, and access for fire suppression activities would continue. Road conditions would be regularly evaluated. In future, the NPS would evaluate and consider removal of unnecessary roads, or reconfigure/reroute to address erosion or other concerns.	Same as Alternative A.	Same as Alternative A.
Suppression	Full suppression would be provided using minimum impact suppression tactics and strategy of Confine, Contain, and Control.	Same as Alternative A.	Same as Alternative A.

Table 2-5: Summary of Alternatives

	Alternative A – 1993 FMP (No Action)	Alternative B – Hazard Reduction and Restricted Fire Use	Alternative C (Preferred Alternative) – Hazard Reduction and Resource Enhancement through Mult. Treatments
Treatment of Muir Woods FMU	Mix of prescribed fire, mechanical fuel reduction, and understory thinning would be used; role of fire in redwood ecosystem would be restored. Up to 55 acres would be treated annually to reduce the risk of catastrophic fire.	Same as Alternative A.	Same as Alternative A.
Treatment of San Francisco County Project Area	Emphasis would be on maintenance of defensible space around structures adjacent to wildland fuels, some mechanical removal of nonnative evergreen trees. No prescribed research burns would be conducted except to support recovery plans for threatened and endangered plant species.	Same as Alternative A.	Same as Alternative A.
Public Information and Fire Education Programs	Current programs would continue. Information and education programs on fire safety and prevention, fuels management, role of fire in ecosystems, fire history and cultural use of fire on landscape, fire research programs and opportunities would be enhanced.	Same as Alternative A.	Same as Alternative A.
Fire Cache	Currently in Buildings 1068, 1069, and T1111 at Fort Cronkhite and 407 at Fort Baker. Would be relocated to central location in Marin County, site to be determined in future.	Same as Alternative A.	Same as Alternative A.

Table 2-5: Summary of Alternatives

	Alternative A – 1993 FMP (No Action)	Alternative B – Hazard Reduction and Restricted Fire Use	Alternative C (Preferred Alternative) – Hazard Reduction and Resource Enhancement through Mult. Treatments
Fire Effects Monitoring	Existing program to monitor prescribed burns and wildfires according to the NPS Fire Monitoring Handbook (NPS 2003b) would continue.	Same as Alternative A.	Same as Alternative A.
Research	Research and monitoring projects would be conducted for application and effects of prescribed fire in all FMUs and within Muir Woods National Monument.	Research burns would be conducted in Muir Woods and Park Interior FMUs. New research or monitoring would be initiated based on resource management needs for topics such as effects of fire on nonnative and rare plants and habitats, diseases such as SOD, and effectiveness of fire to reduce fuel loads and manage fire hazards.	Research burns would be conducted in Muir Woods, Park Interior, and WUI FMUs. New research or monitoring would be initiated based on resource management needs for topics such as effects of fire on nonnative and rare plant or wildlife species and habitats, diseases such as SOD, and effectiveness of fire to reduce fuel loads and manage fire hazards.

Table 2-6: Summary of Impacts

	Alternative A – 1993 FMP (No Action)	Alternative B – Hazard Reduction and Restricted Fire Use	Alternative C (Preferred Alternative) – Hazard Reduction and Resource Enhancement through Mult. Treatments
Watershed Processes: Soils, Hydrology, and Aquatic Habitat	Fire management actions under Alternative A would have adverse, short-term, minor effects on water quality, and beneficial, long-term minor-to-moderate effects on restoration of watershed hydrology. Effects of prescribed fire on water quality related to increased erosion would be adverse, minor and short-term. Impacts from soil disturbance related to mechanical treatments would be adverse, short-term, and negligible to minor. However, the watershed effects within the areas treated by mechanical means would be beneficial, long-term, and minor to moderate. Wildland suppression activities would affect soils due to compaction and ground disturbance. Because the number of acres burned by wildfires each year remains quite low, impacts on watersheds would be adverse, short-term, and minor.	Similar to Alternative A, with a small increase in the short-term, minor adverse effects and long-term beneficial effects due to the increased mechanical treatments.	Similar to Alternative A, with both increased short-term, minor adverse impacts and long-term beneficial impacts. The increased mechanical treatments and prescribed burning in this alternative would create the greatest number of beneficial effects.

Table 2-6: Summary of Impacts

	Alternative A – 1993 FMP (No Action)	Alternative B – Hazard Reduction and Restricted Fire Use	Alternative C (Preferred Alternative) – Hazard Reduction and Resource Enhancement through Mult. Treatments
Air Quality	The levels of VOC produced in this alternative would create a long-term, moderate, adverse impact. The levels of NO_X and SO_2 would create a long-term, negligible adverse impact. Smoke generation would create short-term, minor-to-moderate adverse impacts. Particulate matter would create long-term minor adverse impacts. Cumulative impacts would be long-term, moderate, and adverse. There would be long-term major beneficial effects in reducing the potential for catastrophic fires.	The levels of VOC, NO_X, SO_2 produced in this alternative would create impacts similar to Alternative A. Smoke generation would create short-term, minor adverse impacts on visibility during prescribed or pile burning. This level would be reduced compared to Alternative A as burning is restricted to the Interior FMU. Particulate matter would create long-term moderate adverse impacts. Cumulative impacts on basin air quality would be long-term, moderate, and adverse. There would be long-term minor beneficial effects in reducing the potential for catastrophic fires.	The levels of VOC, NO_X, SO_2 produced in this alternative would create impacts similar to Alternative A. Smoke generation would create impacts similar to Alternative B. Particulate matter would create long-term moderate adverse impacts. Cumulative effects would be long-term, moderate, and adverse. Long-term moderate beneficial effects would be created by the accelerated treatment of fire management areas.

Table 2-6: Summary of Impacts

	Alternative A – 1993 FMP (No Action)	Alternative B – Hazard Reduction and Restricted Fire Use	Alternative C (Preferred Alternative) – Hazard Reduction and Resource Enhancement through Mult. Treatments
Vegetation	Overall, Alternative A in combination with other related actions would have cumulative long-term negligible effects on vegetation. Mechanical treatments would have negligible-to-minor long-term beneficial impacts on coastal scrub, chaparral, grasslands, herbaceous wetlands, riparian forest and scrub, native hardwood forests, and Douglas-fir and coast redwood. These benefits would only persist if follow-up actions prevent the encroachment of nonnative species. Short-term minor adverse impacts could occur in these communities due to ground disturbance. Prescribed burning could have negligible-to-minor, long-term beneficial impacts on most native vegetation communities, although more study of grasslands is required.	Similar effects to Alternative A, with a slight increase in beneficial impacts from more mechanical treatment. However, the use of prescribed burning would be more limited than in Alternative A, which would reduce the beneficial effects of this treatment in the WUI.	Increased mechanical treatments and prescribed burning in this alternative relative to Alternatives A and B would result in an overall minor-to moderate, long-term beneficial effects on vegetation. A broader range of management actions and a more comprehensive method for identifying, prioritizing, and implementing specific fire management actions would allow for larger-scale restoration of ecologically sustainable stands of native vegetation.

Table 2-6: Summary of Impacts

	Alternative A – 1993 FMP (No Action)	Alternative B – Hazard Reduction and Restricted Fire Use	Alternative C (Preferred Alternative) – Hazard Reduction and Resource Enhancement through Mult. Treatments
Wetlands	Overall, fire management activities would have minor-to-moderate long-term benefits to wetland communities through reduction of nonnative plant species, stimulation of native species, and reduced potential for a large-scale wildfire. Mechanical treatments and prescribed fire could have adverse, short-term, minor impacts on wetland soils, hydrology, and vegetation. Fire management activities would avoid wetland areas to the greatest extent possible, and a buffer would be maintained around wetland areas where fire management activities would be restricted. Any impacts on wetland soils, hydrology, or vegetation that occur in the buffer area would be correctable by site-specific actions, and must be confined to short-term, minor (or less) adverse effects.	Similar to Alternative A, with a small increase in the short-term, minor adverse effects and long-term beneficial effects due to the increased prescribed burning in the Park Interior FMU.	Similar to Alternative A, with both increased short-term, minor adverse impacts and long-term beneficial impacts due to increased mechanical treatments and prescribed burning in both the Park Interior and WUI FMUs.

Table 2-6: Summary of Impacts

	Alternative A – 1993 FMP (No Action)	Alternative B – Hazard Reduction and Restricted Fire Use	Alternative C (Preferred Alternative) – Hazard Reduction and Resource Enhancement through Mult. Treatments
Wildlife	Fire management activities would have overall long-term, beneficial, minor effects on wildlife and important habitat. Mechanical removals and prescribed burns would create beneficial, long-term impacts by enhancing native habitats and reducing chances for catastrophic fires. These effects would outweigh the minor adverse impacts of vegetation removal and associated disturbance.	Overall, impacts on wildlife under Alternative B would be very similar to those under Alternative A. More areas would be subjected to mechanical treatment under Alternative B, but the impacts would remain beneficial, long-term, and minor.	Impacts on wildlife would be similar to Alternatives A and B, with overall beneficial, long-term, and minor effects. This alternative would allow for the greatest and most flexible use of mechanical treatment and prescribed fires, which would create the highest level of beneficial effects. Alternative C would allow for the greatest amount of research, which would provide park staff the greatest opportunity for adaptive management.
Special Status Species – Wildlife	No impairment to any threatened and endangered species would occur under Alternative A.	No impairment of any threatened and endangered species would occur under Alternative B.	No impairment of any threatened and endangered species would occur under Alternative C.
San Bruno Elfin Butterfly	Mechanical fuel reduction, prescribed burning, pile burning, and research burns would not occur directly in areas supporting San Bruno elfin butterfly habitat, but may occur in adjacent habitat. Adverse impacts would be negligible to minor and short-term. Potential beneficial impacts from reduced risk of catastrophic wildfire and removal of nonnative vegetation would be minor and long-term.	Impacts would be similar to those for Alternative A, with the potential for a slight increase in the extent of impacts as the amount of land that could be treated under Alternative B would be about twice as much as in Alternative A. Beneficial impacts would be the same as in Alternative A.	Same as Alternative A.
Mission Blue Butterfly	Adverse impacts on mission blue butterflies and their habitat from site disturbance and vegetation removal, associated with mechanical fuel reduction and prescribed fire, would be minor and short-term following	Adverse impacts from mechanical fuel reduction in Alternative B would be slightly greater than in Alternative A since more than twice the acreage would be treated, but still minor and	Similar to Alternative B, with a moderate increase in the amount of lands that could be treated under Alternative C. Greatest potential for minor-to-moderate long-term beneficial impacts due to

Table 2-6: Summary of Impacts

	Alternative A – 1993 FMP (No Action)	Alternative B – Hazard Reduction and Restricted Fire Use	Alternative C (Preferred Alternative) – Hazard Reduction and Resource Enhancement through Mult. Treatments
	mitigation, with moderate, long-term, beneficial impacts through protection and expansion of mission blue butterfly habitat. Research burns conducted in existing mission blue butterfly habitat would have short- to long-term adverse impacts. Burning less than 5 percent of existing habitat in any one year, under an approved research plan, would minimize impacts. Research burns could result in long-term beneficial effects.	short-term following mitigation. The long-term beneficial impacts from potential increased expansion of mission blue butterfly habitat would be greater in Alternative B.	extensive use of mechanical treatment, prescribed fire and research burns that could be used to improve and expand mission blue butterfly habitat.
Tidewater Goby	Adverse impacts from mechanical fuel reduction, prescribed burning, pile burning, and fire research would be short-term and negligible to minor following mitigation since none of these activities would occur directly within tidewater goby habitat.	Same as Alternative A.	Same as Alternative A.
Coho Salmon and Steelhead	Mechanical fuel reduction would result in short-term, minor adverse impacts resulting from potential disturbance to soils and vegetation in riparian areas, with long-term beneficial impacts from restoration of riparian habitat through removal of nonnative trees.	Impacts would be similar to those for Alternative A, with a slight increase in the extent of impacts as the amount of land that could be treated under Alternative B would be more than twice the amount in Alternative A. Potential for greater long-term beneficial impacts through restoration of riparian habitat by removal of nonnative vegetation.	Similar to Alternatives A and B, with a slight increase in the extent of both adverse (short-term, minor) and beneficial impacts (long-term, minor) due to increased amount of areas treated.

Table 2-6: Summary of Impacts

	Alternative A – 1993 FMP (No Action)	Alternative B – Hazard Reduction and Restricted Fire Use	Alternative C (Preferred Alternative) – Hazard Reduction and Resource Enhancement through Mult. Treatments
California Red-Legged Frog	Mechanical fuel reduction, prescribed fire, and research burns may result in short-term, negligible-to-minor adverse impacts related to disturbance in or adjacent to red-legged frog habitat. Long-term, minor beneficial impacts could result from reducing the threat of catastrophic wildfire that could adversely affect wetland habitat.	Same as Alternative A.	Same as Alternative A.
San Francisco Garter Snake	Mechanical fuel reductions, use of prescribed fire, research burns, associated vegetation removal, and heavy equipment operation have the potential for adverse, minor, short-term impacts on the San Francisco garter snake following mitigation. Long-term, minor beneficial impacts would result from these actions by reducing the threat of catastrophic wildfire that could adversely affect garter snake habitat, and by restoring and maintaining coastal grassland and scrub habitat.	Impacts associated with mechanical fuel reduction and pile burning would be the same as in Alternative A. Even though twice as many acres may be treated in San Mateo and San Francisco counties, garter snake habitat is unlikely to be targeted for these activities. Prescribed burning and research burns would not occur in San Mateo County under Alternative B so there would be no associated impacts.	Same as Alternative A.
Marbled Murrelet	Potential marbled murrelet habitat is only present in the Muir Woods FMU. Fire management activities that focus on protecting and enhancing coast redwood and Douglas-fir trees, such as mechanical fuel reduction and prescribed burning, would result in overall long-term, beneficial, and minor impacts on this species.	Same as Alternative A.	Same as Alternatives A and B.

Table 2-6: Summary of Impacts

	Alternative A – 1993 FMP (No Action)	Alternative B – Hazard Reduction and Restricted Fire Use	Alternative C (Preferred Alternative) – Hazard Reduction and Resource Enhancement through Mult. Treatments
Western Snowy Plover	The only potential impacts on western snowy plovers would be from suppression activities that are common to all alternatives. Plovers would not be affected by any other actions in Alternative A.	Same as Alternative A.	Same as Alternative A.
California Brown Pelican	Impacts on roosting brown pelicans would be negligible by avoiding use of helicopters for mechanical fuel reduction in areas adjacent to Bird Island, and Rodeo and Bolinas Lagoons. Impacts from drifting smoke during prescribed burns, pile burning, or research burns would also be negligible.	Same as Alternative A.	Same as Alternative A.
Northern Spotted Owl	Adverse impacts associated with vegetation removal and disturbance during mechanical fuel reduction, prescribed fire, research burns, and pile burning would be minor and short-term, following mitigation. Long-term, minor beneficial impacts on spotted owls and their prey would result from native habitat restoration and enhancement and by reducing the threat of catastrophic wildfire.	Impacts from mechanical fuel reduction and pile burning would be similar to those for Alternative A, with a slight increase in the extent of both adverse and beneficial impacts. Impacts associated with prescribed burning and fire research would be the same as in Alternative A.	Similar to Alternative B, with a moderate increase in the extent of both adverse (short-term, minor) and beneficial impacts (long-term, minor) as the amount of land treated annually under Alternative C would be greater than in Alternative B. Impacts of prescribed fire would be similar to Alternatives A and B, with an increase in the extent of both adverse (short-term, minor) and beneficial impacts (long-term, minor) as the number of acres subject to burning annually under Alternative C would be more than twice that under Alternative A or Alternative B.

Table 2-6: Summary of Impacts

	Alternative A – 1993 FMP (No Action)	Alternative B – Hazard Reduction and Restricted Fire Use	Alternative C (Preferred Alternative) – Hazard Reduction and Resource Enhancement through Mult. Treatments
Salt Marsh Harvest Mouse	Adverse impacts from mechanical fuel reduction, prescribed burning, pile burning, and fire research would be short-term and negligible to minor following mitigation, since none of these activities would occur directly within potential salt marsh harvest mouse habitat.	Same as Alternative A.	Same as Alternative A.
Special Status Species – Plants	Suppression actions with mitigation measures applied whenever possible would reduce potential effects of wildland fire suppression to short-term, adverse, and negligible to minor. A prescribed burn, properly timed and mitigated, could have a long-term, major, beneficial impact on Oakland star tulip. Prescribed burning would have a short-term, negligible, adverse effect and long-term, beneficial impact on California bottle-brush grass. Most special status plants would have a minor-to-moderate benefit from reduction of nonnative species as a result of prescribed burning and mechanical treatment in all three counties. Removal of nonnative trees and shrubs and carefully conducted research burns (in consultation with the USFWS) could result in long-term, minor, beneficial impacts on the same three federally listed species in San Francisco. Monitoring programs would have a	Effects of mechanical treatment would be more limited in types of plant communities affected and have a reduced adverse effect on special status plants compared to Alternative A – negligible to minor, long-term, and beneficial. Effects of prescribed burning would be the same as in Alternative A with the exception of no burning in San Mateo County and the ability to conduct burns in the chaparral in Marin County. Short- and long-term, minor, beneficial effects on the three species on Bolinas Ridge would occur. Overall, this alternative would have long-term, negligible-to-minor, beneficial effects.	Mechanical treatments would affect more acreage, resulting in minor-to-moderate, long-term, beneficial impacts throughout all FMUs. Prescribed burning would occur in all areas of the park, resulting in a larger number of acres treated that Alternatives A and B. Opportunity for broadcast burns would be minor-to-moderate, long-term, and beneficial.

Table 2-6: Summary of Impacts

	Alternative A – 1993 FMP (No Action)	Alternative B – Hazard Reduction and Restricted Fire Use	Alternative C (Preferred Alternative) – Hazard Reduction and Resource Enhancement through Mult. Treatments
	minor-to-moderate long-term, beneficial impact. No prescribed burning would occur in chaparral communities, so there would not be beneficial impacts on three locally rare fire-adapted species on Bolinas Ridge.		
Cultural Resources	This alternative would have short-term, moderate, beneficial effects on historic buildings by reducing fuels around these structures. Moderate, long-term, beneficial effects on cultural landscapes would result from their restoration or maintenance through prescribed fire or mechanical treatments. This alternative would have the potential for long-term, adverse, major effects on archeological resources from suppression effort with heavy equipment. A large-scale uncontrolled wildfire could have long-term, major, adverse effects on historic buildings and cultural landscapes with loss of historic features and structures.	Beneficial effects on historic buildings and cultural landscapes would be greater than in Alternative A, as additional acreages for mechanical treatments and prescribed fire would be allowed for resource management objectives. Likewise, there would be a potential for greater adverse impacts on archeological resources, but these could be kept short-term and minor with appropriate mitigation measures.	Beneficial effects would be greater than in Alternatives A and B, but would remain in the moderate category.

Table 2-6: Summary of Impacts

	Alternative A – 1993 FMP (No Action)	Alternative B – Hazard Reduction and Restricted Fire Use	Alternative C (Preferred Alternative) – Hazard Reduction and Resource Enhancement through Mult. Treatments
Human Health and Safety and Nuisance Effects	Overall, this alternative would have a long-term, minor benefit to the public and firefighter safety by decreasing the risk of catastrophic fire. The potential to breathe in particulates and other toxins in the smoke produced by prescribed burning and fire suppression would have a short-term, negligible adverse effect on public and fire staff health and safety.	Similar to Alternative A, except that increased treatments would render long-term, moderate benefits to public and firefighter safety.	Similar to Alternative B, except larger prescription burning component would yield long-term, moderate, beneficial effect.
Visitor Use and Visitor Experience	This alternative would have a short-term, minor adverse effect on visitor experience, public access, aesthetics, and park soundscapes from mechanical fuel reduction and prescribed burning. A long-term, moderate beneficial effect on the visitor experience and aesthetics would be gained due to improved viewsheds and enhanced growth of native vegetation.	Similar to Alternative A. More mechanical fuel reduction than Alternative A would mean more areas would be disturbed in short-term, but projects would be dispersed to reduce impacts on visitor experience in one area.	Similar to Alternative A with potential for larger burn areas. Related activity could result in short-term, minor-to-moderate and adverse effects. Following site restoration, effects would be long-term, moderate, and beneficial.
Park Operations	Moderate, long-term adverse effects on park operations would be anticipated from the full implementation of this alternative due to current staffing limitations throughout the park. Scaling back the implementation of Alternative A may reduce adverse effects on park operations to minor, but could result in reduced accomplishments and a longer time period needed to achieve FMP goals. One-time funding of a new fire cache would have a short-term moderate adverse impact on the park's budget, but would have long-term	Similar to Alternative A but with an increased budget to conduct additional mechanical treatment projects. Under this alternative, 16.25 FTEs in the Wildland Fire Office would be required.	An overall increase in fire management program in order to conduct additional prescribed burning and mechanical treatment projects compared to Alternatives A and B. This alternative would produce moderate, long-term adverse impacts on park operations compared to the full implementation of Alternative A. FMP goals could be met in expedient timeframe, so long-term effect would be minor and beneficial.

Table 2-6: Summary of Impacts

	Alternative A – 1993 FMP (No Action)	Alternative B – Hazard Reduction and Restricted Fire Use	Alternative C (Preferred Alternative) – Hazard Reduction and Resource Enhancement through Mult. Treatments
	minor benefits on efficiency in fire management operations. Under any scenario, the suppression of a large-scale wildfire would have a short-term adverse major effect on park operations, management, and budget. Under this alternative, 13 FTEs in the Wildland Fire Office would be required.		Under this alternative, 18 FTEs in the Wildland Fire Office would be required.
Socioeconomics	Overall, socioeconomic impacts associated with budget and payroll under the planned mechanical treatments and prescribed fire could be characterized as negligible, short-term benefits under all three alternatives. Tourism would not be affected by short-term closures, but could be reduced by the occurrence of a catastrophic fire. This would reduce spending on lodging, food, and travel. However, these effects could be offset by an increased demand for services by employees involved in fire suppression and restoration. Hence, the economic impacts of these larger events may have both beneficial and adverse short-term and minor effects.	Same as Alternative A.	Same as Alternative A.

Notes:

WUI = Wildland Urban Interface
FMU = Fire Management Unit
SOD = Sudden Oak Death
VOC = volatile organic compounds
NO_X = nitrogen oxides
SO_2 = sulfur dioxide
USFWS = U.S. Fish and Wildlife Service
FTEs = full-time equivalents

Chapter 3 – Affected Environment

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3.1 Introduction

This chapter provides an understanding of both the general environmental setting of the planning area and a more focused description of those resources with the potential to be affected by the implementation of the FMP alternatives. Section 3.2, Project Setting, has been included to provide the background necessary to understanding the geographic, demographic, and geologic environment in which the park is set. The remainder of the chapter is the Affected Environment discussion required by NEPA (CEQ Regulations, § 1502.15); it focuses on the current condition of only those elements of the environment that could be significantly affected by implementation of the FMP alternatives. Through the scoping process, it has been determined that the resources with potential to be significantly affected are watershed processes (soils, hydrology, water quality and aquatic habitat), air quality, vegetation, wetlands, wildlife, special status species, cultural resources, visitor experience and visitor use, human health and safety, park operations, and socioeconomics.

3.2 Project Setting

Overview of the Planning Area

The planning area for the GGNRA FMP is located in central California, in the three westernmost counties that comprise the nine-county San Francisco Bay Area – the fifth largest metropolitan area in the United States. In addition to lands within GGNRA, the planning area for the FMP includes Muir Woods National Monument and Fort Point National Historic Site, both of which are managed by GGNRA.

The planning area consists of approximately 15,000 acres of national park land under the direct management of GGNRA. The parklands include beaches, marshes, coastal cliffs and headlands, marine terraces, coastal uplands, woodlands, old-growth and second-growth forests, several extensive and historically significant former military installations, and approximately 59 miles of shoreline on the Pacific Ocean and on San Francisco Bay.

The GGNRA parklands border on lands with a wide range of ownership type and land use. Adjacent land use is a mix of private residential and agricultural lands, publicly held watershed, and parks and open space. Apart from the approximately 59 miles of shoreline, approximately 40 miles of GGNRA boundary adjoins residential communities in the three counties. In Marin County, adjacent lands include the unincorporated communities of Marin City, Muir Beach, Stinson Beach, Tamalpais Valley, and Homestead Valley, and the incorporated towns of Mill Valley and Sausalito in southern Marin. Parklands in San Francisco adjoin the City and County of San Francisco as well as the Presidio of San Francisco, managed by the Presidio Trust. San Mateo parkland is mostly located in the northern part of the county adjacent to the city of Pacifica; the Phleger Estate is currently the only GGNRA parcel in southern San Mateo County.

GGNRA lands range from landmarks recognized nationwide to areas largely serving adjacent residential communities. National parks more remote from urbanization often see the gradual development of one or more gateway communities at park entrances that provide services and accommodations for both park visitors and staff. By contrast, GGNRA was created in 1970 as an amalgamation of surplus federal lands in the midst of the rapidly developing west bay counties of San Mateo, San Francisco, and Marin. Parcels

have been added to GGNRA through the transfer of lands from other federal agencies (such as the U.S. Army) or outright purchase when suitable lands become available. In this urban setting, it has not always been possible to acquire lands that are adjacent to other holdings; some park parcels are close to but not contiguous with other GGNRA lands. This creates a very convoluted boundary for parts of the park, as well as a varied range of adjacent land uses. Some GGNRA lands form more than one boundary of an adjacent residential area, while in other parts of GGNRA residential development nearly surrounds the park parcel. This situation lends itself to many cooperative efforts, including programs to reduce wildland fire risk along the common boundaries.

The section of the Bolinas Ridge south of the Bolinas-Fairfax Road comprises the northernmost portion of the planning area. Bolinas Ridge trends northwest to southeast and parallels the east side of the Olema Valley, Bolinas Lagoon, and the San Andreas Fault Zone. Its southwest-facing slope is primarily grassland and shrub, with east-facing slopes forested with Douglas-fir and coast redwood. The section of the ridge north of the planning area was included in the PRNS FMP as the lands are managed by PRNS under an agreement between the two parks and the NPS Pacific West Regional Office.

Adjacent to parklands in western Marin are properties managed by Audubon Canyon Ranch, California State Parks, the Marin Municipal Water District, and the Green Gulch Farm belonging to the San Francisco Zen Center. Marine boundaries are shared with the Gulf of the Farallones National Marine Sanctuary (NMS), the Monterey Bay NMS, and the Bolinas Lagoon Preserve.

Generally, the more densely developed regions of the Bay Area are around the bay itself, with smaller cities, towns, open spaces and agricultural areas in an outer ring around this urban core. For example, 48 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) of the county is in agricultural use. Only 11 percent of the land in Marin County is developed, and only 5 percent of the county has future development potential. While the Highway 101 corridor in eastern Marin is heavily developed, western Marin is primarily rural with scattered, small, unincorporated towns providing services for agriculture, local residents, and tourism. Roughly 90 percent of the 250,000 residents of Marin County live in the eastern half of the county along the major transportation corridor, Highway 101.

The City and County of San Francisco, with a population of approximately 800,000 residents, covers 46.7 square miles. The city is built out with the exception of redevelopment areas, small isolated parcels, and undeveloped hilltops. GGNRA manages 1,013 acres within the city limits, including the 29 acres of Fort Point National Historic Site at the northwestern tip of the San Francisco peninsula. GGNRA also manages Area A of the Presidio of San Francisco, comprising 312 coastal acres on the northern and western sides of the former military base. Approximately 1.5 million visitors came to the Civil War-era Fort Point in 2002 and 2003.

Other lands managed by GGNRA in San Francisco include Lands End, Sutro Heights, Ocean Beach, and Fort Funston. Lands End lies in the rugged northwest corner of the San Francisco peninsula between Lincoln Park and the Cliff House. The area is heavily vegetated by a mix of landscape plants and nonnative and native coastal scrub species. At the southern end of Lands End lies the Sutro Baths ruins

and the newly reconstructed Cliff House. Overlooking both of these is Sutro Heights, where Adoph Sutro built an estate in the 19th century, now represented by scattered ruins, dense Monterey cypress, and other remnant landscaping. The relatively flat and wide Ocean Beach extends roughly three miles from the Cliff House south to Fort Funston. Fort Funston encompasses approximately 250 acres and is vegetated by iceplant, eucalyptus trees, and native coastal scrub, with scattered remains of military fortifications dating from the Spanish Civil War through World War II.

Lands in San Mateo County managed by GGNRA include Sweeney and Milagra Ridges, Mori Point, Pedro Point, Cattle Hill, and several other smaller parcels in and around the coastal city of Pacifica in northern San Mateo County. GGNRA's Phleger Estate is north of the town of Woodside in southern San Mateo County.

Four areas of residential development in the cities of San Bruno and Pacifica are within the wildland urban interface area of Sweeney Ridge. The subdivisions are either directly adjacent to parkland or separated by relatively small intervening open space parcels. Neighborhoods in the Sweeney Ridge interface include Pacifica's Vallemar, Sharp Park, and Park Pacifica neighborhoods; the Pacific Heights neighborhood of San Bruno; and Skyline Junior College.

Milagra Ridge is almost fully surrounded by medium-density neighborhoods of single-family detached and single-family attached homes. Only the extremely steep slopes in the Milagra Creek drainage north of the park remain undeveloped. Parklands at the southern end of Pacifica at Pedro Point are directly to the south and adjacent to medium-density, single-family detached housing. The interface zone, including part of the residential area, is vegetated by a large, dense eucalyptus woodland. The new park acquisition at Cattle Hill is bordered to the north by the Vallemar neighborhood and to the south by the narrow, streamside, eastern section of the Rockaway Beach neighborhood. There is very limited low-density residential development on the 0.25-mile interface of the Raymunda Road area of northern Woodside with Phleger Estate, and the longer 1.25-mile interface between the western edge of Phleger Estate and the rural residential neighborhood of King's Mountain on Skyline Boulevard.

Special Designation Areas

Golden Gate Biosphere Reserve

GGNRA is part of the Golden Gate Biosphere Reserve, which includes over two million acres of protected lands and waters and extends through the central California coastal region from the Bodega Research Reserve of the University of California at Davis in the north to Stanford University's Jasper Ridge in San Mateo County in the south. Seaward, the Biosphere Reserve extends out from the shore approximately 30 miles to the edge of the Continental Shelf and includes the Farallon Islands. Within San Francisco Bay it includes Angel Island and Alcatraz Island. The Biosphere Reserve also includes lands managed by the NPS, California State Parks, Marin Municipal Water District, and San Francisco Public Utilities Commission, and the Gulf of Farallones and Monterey Bay National Marine Sanctuaries.

Since 1971, the United Nations has designated over 400 "biosphere reserves" in over 95 countries to serve as models of how to protect the extraordinary resources of wildlands and protected areas while

ensuring their nondestructive human use and enjoyment. Designation of the Golden Gate Biosphere Reserve as an international biosphere reserve confers international recognition of its importance to the conservation of biodiversity and sustainable development, and to research and education relevant to these areas. It is administered in cooperation with the United Nations Educational, Scientific, and Cultural Organization (UNESCO), as part of its Man and the Biosphere (MAB) program.

Special Ecological Areas (SEAs)

GGNRA's Natural Resources Section of the Resource Management Plan (1999b) designated nine Special Ecological Areas (SEAs) in the park. An SEA is the identified area in each ecological community type that is most biologically intact and diverse and, in the case of grassland and lagoon in the park, represents the only example. SEAs were selected for their biological values. Communities currently represented include perennial grassland, coastal scrub, chaparral, oak woodland, redwood forest, foredune community, coastal strand community, serpentine grassland, riparian forest, estuarine community, fresh water pond community, aquatic stream community, and the intertidal community. The creation of SEAs is not intended to discount the biological value of other natural resources zones within GGNRA and does not exclude management activities in other park areas. One such area in each plant community was designated to ensure the protection and maintenance of ecological diversity and processes.

Preservation of natural resources and processes is the highest priority in these areas. Other uses, therefore, must be documented as having little to no impact on these particular ecosystems prior to use approval. Dogs, bicycles, and offtrail hiking are to be excluded from these areas due to possible conflict with vegetation and wildlife. Equestrian use and park vehicle traffic are limited.

Management programs for concerns such as nonnative species control, erosion, and water quantity and quality have a high priority for implementation in these areas. Emphasis will be made to expand this management into the buffer areas bordering SEAs.

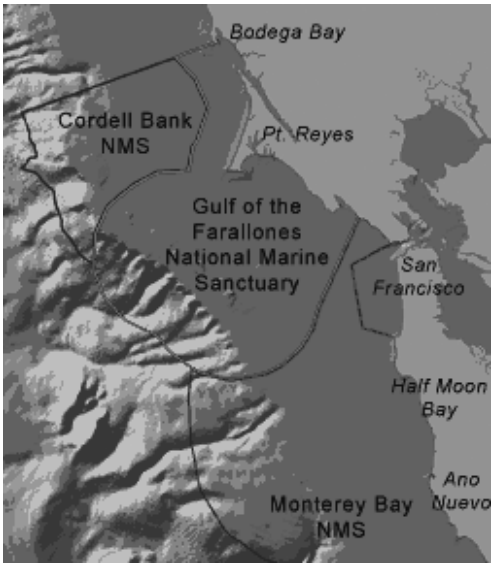
Identified SEAs include:

- The northeast-facing slope of the Muir Woods National Monument redwood forest community.
- The Wolf Ridge area between the Gerbode and Tennessee valleys for the perennial grassland and coastal scrub plant communities.
- The Rodeo Lagoon estuarine community.
- The Bolinas Ridge chaparral community and oak woodland community.
- Presidio serpentine for the rare serpentine grasslands that are the last refuge for many rare and endangered native plant species.
- The Crissy Field dune community.
- The Baker Beach coastal strand community.

- Redwood Creek aquatic, stream, and riparian communities.
- Intertidal communities in Slide Ranch (north end) and Bird Rock (in the Marin Headlands).

National Marine Sanctuaries

Two National Marine Sanctuaries overlap GGNRA jurisdiction along the Pacific coastline. The Gulf of the Farallones National Marine Sanctuary (GFNMS) protects an area of 1,255 square miles off the northern and central California coast. Within the portions of GGNRA addressed in the FMP, the waters up to mean higher high tide line from Stinson Beach to Slide Ranch in Marin County are part of the GFNMS. The Monterey Bay National Marine Sanctuary (MBNMS) extends along GGNRA's shoreline from Slide Ranch south to Point Bonita in Marin County, and then juts seaward outside of GGNRA's boundary south until it meets the shoreline again at Devil's Slide in San Mateo County. MBNMS encompasses 5,322 square miles of ocean and 276 miles of coastline and extends an average of 30 miles offshore. These marine sanctuaries were established for the purpose of resource protection, research, education, and public use. The marine sanctuaries harbor some of the most diverse and productive marine ecosystems in the world, including 33 species of marine mammals, 94 species of seabirds, 345 species of fish, and numerous invertebrates and plants. Sanctuary regulations prohibit discharge or depositing, from beyond the boundary of the sanctuary, any material or other matter that subsequently enters the sanctuary and injures a sanctuary resource or quality (with limited exceptions for some marine activities).



National Marine Sanctuaries in Bay Area

Bolinas Lagoon, Wetland of International Importance

Bolinas Lagoon, a 1,100-acre wetland located along the San Andreas Fault between the towns of Bolinas and Stinson Beach in Marin County, was designated a Wetland of International Importance in 1998 by the Ramsar Convention on Wetlands. The Convention on Wetlands, signed in Ramsar, Iran in 1971, is an intergovernmental treaty that provides the framework for national action and international cooperation for the conservation and wise use of wetlands and their resources. Bolinas Lagoon is considered internationally important because it is a representative, rare, or unique example of a natural or near-natural wetland type found within the biogeographic region; it regularly supports more than 20,000 waterbirds; and it is an important source of food for fishes, spawning ground, nursery; and/or migration path on which fish stocks depend.

The majority of the lagoon is held in public ownership by the County of Marin and GGNRA. Bolinas Lagoon is an Open Space Preserve managed by the Marin County Open Space District. The area is a public open space, used predominantly for recreation. Thousands of people visit the area annually.

Activities include bird watching, nature photography, fishing, clamming, shrimping, boating, use of manually powered watercraft (kayaks, canoes, sailboards), bicycling, walking, jogging, and picnicking. A marine laboratory building and dock owned by the College of Marin are located near the mouth of the lagoon. Scientific facilities are also located at the PRBO Conservation Science Center (formerly known as the Point Reyes Bird Observatory) and the Audubon Canyon Ranch (ACR), a private, nonprofit environmental protection, education, and research organization. The lagoon's eastern shore and much of the Bolinas Lagoon watershed lie within GGNRA. The entire lagoon up to mean higher high water is part of the Gulf of the Farallones National Marine Sanctuary.

The lagoon is a tidal embayment with estuarine habitats including subtidal channels, intertidal flats, and emergent salt marsh. These habitats are bordered by sandbars, beaches, freshwater streams, and riparian forest. The lagoon's principal estuarine habitats are all undergoing significant changes in total area and relative amounts. Between 1968 and 1988, the rate of sediment accumulation and loss of tidal prism resulted in conversion of subtidal habitat to intertidal, and intertidal to emergent marsh and upland habitat. The continued increase in sedimentation and loss of tidal prism will result in the narrowing and loss of tidal channels. This will lead to a loss of total estuarine habitat and cause significant changes in the diversity and abundance of lagoon life and ecological functions. Bolinas Lagoon is currently the subject of a study to examine the need, feasibility, and alternative strategies for restoring tidal prism to the system, which has been subject to high levels of sedimentation in recent decades.

Bolinas Lagoon has been subject to numerous research studies, including the behavior and habitats of harbor seals and the ecology of shorebirds. Bird numbers have been monitored since the 1970s. Current research includes a study to determine the relative contribution of sediment to the lagoon from eight perennial creeks. This information will be used to determine erosion control strategies for the Bolinas Lagoon watershed. Monitoring would be conducted following any catastrophic fire event to help direct rehabilitation efforts.

The Bolinas Lagoon Resource Management Plan was developed in 1981 and updated in 1996. Proposed conservation measures include watershed management geared toward reducing sediment inputs, and dredging to remove accumulated sediment and to promote sediment removal from the lagoon via tidal scouring. A public awareness program includes nature tours, information brochures, and public archives.

Geology and Seismicity

GGNRA is located in a seismically active zone. The San Andreas Fault Zone (SAFZ) extends northwest from Mussel Rock in Pacifica through Bolinas Lagoon, the Olema Valley, and Tomales Bay. Southeast of Mussel Rock, the SAFZ crosses the ridgeline above Pacifica and is clearly expressed by Crystal Springs and San Andreas reservoirs in the San Francisco watershed property to the southeast. The SAFZ forms the active tectonic boundary between the Pacific Plate and the continental North American Plate. The Pacific Plate is thought to have displaced as much as 94 miles (150 kilometers) to the northwest in the last 11 million years (Clark and Brabb 1997). Recent investigation within the SAFZ has led researchers to believe that large-scale land movement events may have a recurrence interval of approximately one major event every 250 years (Zhang et al., 2003). Due to different bedrock rock types, the geomorphology, hydrology, soils, and plant communities east of the SAFZ may differ in many ways from conditions to the

west. For example, the exposed granite of Montara Mountain on the Pacific Plate differs from the sedimentary deposits lying to the east.

Bedrock parent materials of the Franciscan Formation can be jumbled as a result of the grinding movement along the SAFZ. The Franciscan Formation is believed to have originated as ocean floor deposits 80 to 140 million years ago. The rocks were greatly deformed and partly metamorphosed from the extreme pressure of plate tectonics wherein the ocean floor (the Pacific Plate) is thrust under the western edge of the North American Plate, resulting in a landscape of easily eroded, sheared, and crushed sandstone and shale, with occasional blocks of more resistant rock forming prominent outcrops. The Franciscan Formation is mostly composed of greywacke, sandstone, and shale with different grades of metamorphosis. Some parts of the formation are a mélange, including highly metamorphosed, low-grade mudstone, siltstone, and sandstone with occasional inclusions of limestone, chert, serpentinite, eclogite, and amphibolite conglomerate. Soils are typically thin with high runoff rates and slopes are unstable (Galloway 1977).

The serpentine outcrops within the Franciscan Formation provide the substrate for what is now rare habitat supporting rare endemic plant species. GGNRA serpentine sites are small, and are threatened by a lack of protection and the continued development of privately owned parcels. Serpentine slopes are unstable, very erodible, and subject to further increased instability when degraded by offroad vehicle use or trampling.

Bolinas Ridge is east of the SAFZ and is comprised of the Franciscan Formation that makes up much of California's Coast Range. The ridge is primarily grassland with the steep, narrow ravines dominated by oak, bay laurel, and Douglas-fir.

The Marin Headlands contain Franciscan Formation rocks that are generally more resistant than the erodible Franciscan Formation north of Pirates Cove. Radiolarian chert composed of fossilized radiolaria underlies about half of the headlands, and because of its resistance to weathering, makes up nearly all the ridgetops and summits.

The parklands in the southwest part of San Francisco, contain younger rocks – soft sedimentary deposits that are less than two million years old. The sea cliffs at Fort Funston were formed from the oldest of these tilted fossil-rich beds of sand and clay (the Merced Formation), and are easily eroded by wave action. In the last few hundred thousand years, sand and clay have accumulated as beaches, dunes, and nearshore deposits, and these are now exposed at Sutro Heights, Baker Beach, and Rodeo Cove.

Climatic and Topographic Factors Influencing Wildland Fire Hazard

Relative Humidity

Humidity is the amount of invisible water vapor in the air. When air contains all the water vapor it can hold, it is saturated. Beyond this point, the vapor condenses and becomes visible as fog or clouds. The most common way to measure water vapor is by relative humidity, which is expressed as the percentage of saturation of the air. If air holds half the moisture it is capable of holding, the relative humidity is 50 percent. If air is saturated, the relative humidity is 100 percent. Warm air is capable of holding more

moisture than cold air, so as air cools the relative humidity increases. Because of frequent ocean winds and fogs, the average relative humidity of the coastal section is high, except when the dry northeasterly winds from the interior of the state bring fire weather to the Bay Area, sending the humidity down to 20 percent. The record low is 10 percent at Bear Valley in PRNS.

In general, relative humidity is moderate to high along the coast throughout the year. Inland humidity is high during the winter and low during the summer. Since the ocean is the source of the cool, humid, maritime air of summer, it follows that relative humidity tends to decrease with increasing distance from the ocean. Where mountain barriers prevent the free flow of marine air inland, humidity decreases more rapidly. Where openings in these barriers permit a significant influx of cool, moist air it mixes with the drier inland air, resulting in a more gradual decrease of moisture. This pattern is characteristic of most coastal valleys (Golden Gate Weather Services 2002).

Wind Patterns

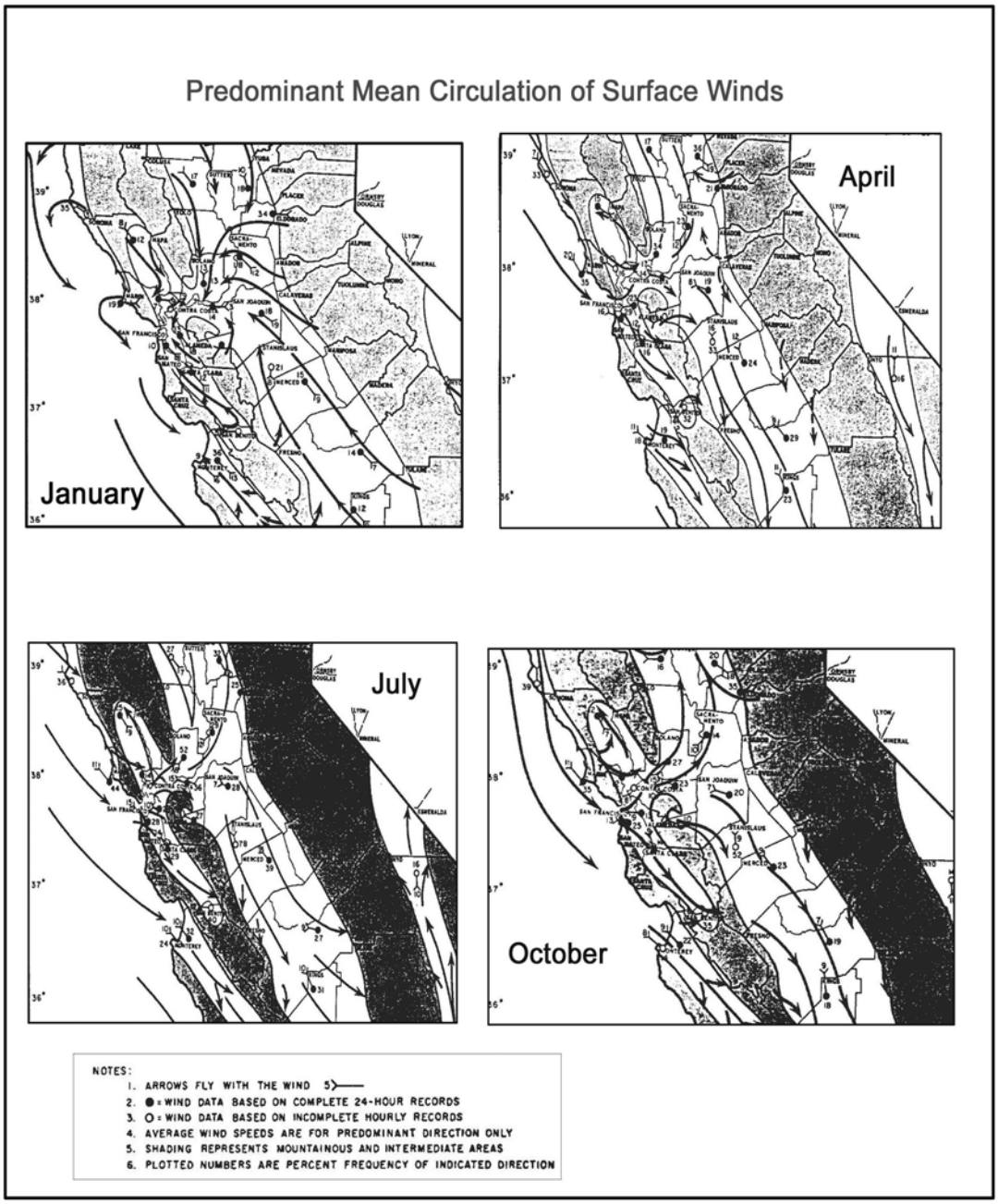
California lies within the zone of prevailing westerlies and on the east side of the semi-permanent high-pressure area of the northeast Pacific Ocean. The basic flow in the free air above GGNRA is therefore from the west or northwest during most of the year. A local characteristic of the northwest wind alongshore is the creation of a jet effect around some of the more prominent headlands. Eddies form near the Golden Gate and just south of Point Reyes. Wind speeds in the immediate vicinity of these major headlands can be two or three times as great as the wind flow at nearby points (Golden Gate Weather Services 2002).

The typical northwest wind of summer is reinforced by the dynamics of the thermal low-pressure area located over the Central Valley and the Southeastern Desert area. In the San Francisco Bay Area, there is a marked diurnal pattern in the strength of the wind even though an onshore circulation tends to continue throughout the 24-hour period. This helps to carry locally produced smoke away from the Bay Area, but creates problems for the regions immediately south and east of the source area.

When wind patterns shift from the prevailing pattern in the summer, winds can flow out of the Great Basin into the Central Valley, the Southeastern Desert Basin, and the South Coast. The result is high pressure over Nevada and lower pressure along the central California coast. The lower coastal pressure causes the hot interior air to be rapidly drawn to the west from the hot, dry interior. The winds are dry, strong, and gusty, sometimes exceeding 100 miles per hour, particularly near the mouths of canyons oriented along the direction of airflow. These interior winds are known as Diablo winds in the Bay Area, “northers” in the Sacramento and San Joaquin valleys, and Santa Ana winds in southern California (Golden Gate Weather Services 2002).

Figure 3-1 illustrates the predominant wind patterns in central California (Bell 1958). In the winter, the regional surface winds blow 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 3-1: Predominant Wind Patterns in Central California



Source: Bell 1958.

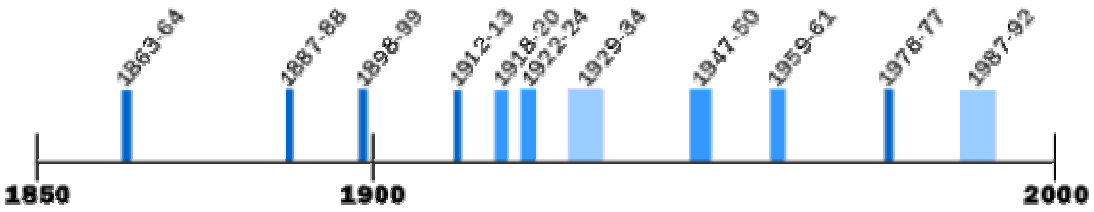
Recurrent Drought

One dry year does not normally constitute a drought in California. Droughts occur slowly, over a multiyear period. There is no universal definition of when a drought begins or ends. Areas most reliant on annual rainfall typically feel impacts of drought first.

Droughts exceeding three years are relatively rare in northern California, the source of much of the state's developed water supply. The 1929-1934 drought years established the criteria commonly used in designing storage capacity and yield of large northern California reservoirs. Figure 3-2 compares the 1929-1934 droughts in the Sacramento and San Joaquin valleys to the 1976-1977 and 1987-1992 droughts. The driest single year of California's measured hydrologic record was 1977. California's most recent multiyear drought was 1987-1992.

Measured hydrologic data for droughts prior to 1900 are minimal. Multiyear dry periods in the second half of the 19th century can be qualitatively identified from the limited records available combined with historical accounts, as illustrated in Figure 3-2, but the severity of the dry periods cannot be directly quantified.

Figure 3-2: California's Multiyear Historical Dry Periods, 1850-Present



Notes:
1. Dry periods prior to 1900 estimated from limited data.
2. Covers dry periods of statewide or major regional extent.

California sustained two epic drought periods, extending over more than three centuries. The first epic drought lasted more than two centuries before the year 1112; the second drought lasted more than 140 years before 1350. Studies of epic droughts evaluated drowned tree stumps rooted in Mono Lake, Tenaya Lake, West Walker River, and Osgood Swamp in the central Sierra Nevada. These investigations indicate that California has been subject to droughts more severe and more prolonged than those evidenced by the brief historical record.

El Niño and La Niña

Under "normal" circumstances over the Pacific Ocean, trade winds rush toward the equator to replace rising sun-heated air and cause an upwelling of air off Peru. These winds are pushed farther west by a high-pressure zone over Tahiti and attracted by a low-pressure zone over northern Australia. During an El Niño episode, the situation is reversed, with a low over Tahiti and a high over Australia. The trade winds die, the upwelling stops, and the ocean surface warms up in the eastern Pacific. The jet stream over the

North Pacific, which normally brings storms to Oregon, Washington, and British Columbia, moves south, picking up warmth from the warm-water bulge below, and deluges California (Gilliam 2002).

During severe El Niño episodes like 1982-1983 and 1997-1998, the Bay Area received more than twice its "normal" rainfall. Houses were destroyed by mudslides, bridges were washed out, and highways were blocked. Although El Niño events occur every four to seven years, they vary greatly in timing and strength. A mild El Niño will scarcely have any important effect, but a strong one can bring disaster. The outlook for El Niño episodes in the 21st century is uncertain. As global warming continues, increasing temperatures of both the air and the water, El Niño events may increase in frequency and intensity (Gilliam 2002).

The opposite of El Niño is the less well-known La Niña. La Niña occurs when trade winds are stronger than usual over the Pacific Ocean, pushing more sun-warmed surface waters westward, causing more upwelling off Peru, and further intensifying the oceanic currents of the northern Pacific Ocean (Gilliam 2002). The wintertime effect of La Niña in the Bay Area is likely to be colder, windier weather and perhaps abnormal rainfall in either direction, too much or too little (and sometimes neither), depending on the erratic location of the jet stream. If La Niña persists into the summer, stronger upwelling off the California coast brings more fog to the area (Gilliam 2002).

Climate Change

Climate has changed over the millennia (e.g., the "Little Ice Age" from 1300-1800 AD), and will continue to change. For example, the amount of fog seems to have increased from 1885 to 1970 (Verran 1982). Unfortunately, after 1970, these data were no longer taken. Climatic change, caused to some degree by human actions, can have an important influence on the human environment, in part by altering the occurrence of wildland fire. It is thought that the influence of human activities upon climate began at least 8,000 years ago with the advent of the agricultural revolution (Ruddiman 2003).

Surface temperature measurements recorded daily at hundreds of locations for more than 100 years indicate that the Earth's surface has warmed by about 1 degree Fahrenheit in the past century. This warming has been particularly strong during the last 20 years, and has been accompanied by retreating glaciers, thinning arctic ice, rising sea levels, lengthening of growing seasons for some, and earlier arrival of migratory birds (Union of Concerned Scientists 2004).

In California, average surface temperatures have increased 0.7 to 3.0 degrees Fahrenheit in the past century. The 20th century's ten warmest years all occurred in the last 15 years of the century. Seventeen of the eighteen warmest years in the 20th century occurred since 1980. In 1998, the global temperature set a new record, exceeding that of the previous record year, 1997 (National Assessment Synthesis Team 2000). Air temperature has increased over the past 90 years, more so in large cities than in rural areas. Large urban areas are generally warmer than rural areas, and can have temperatures up to 5 degrees Fahrenheit higher, creating their own weather belt. This can be due to the removal of vegetation and trees, the presence of buildings and streets (which reflect heat stored in pavement), and the production of heat by human activities.

Along the California coast, sea levels will likely continue to rise. Depending on the climate model, they could rise at a rate similar to the historical rate (about 7 inches per century) or almost four times faster (Union of Concerned Scientists). Differences in sea level rise along the coast can occur because of local geological forces, such as land subsidence and plate tectonic activity. The rise in sea level may be associated with increasing global temperatures. Based on results from modeling, warming of the ocean water will cause a greater volume of seawater because of thermal expansion. This is expected to contribute the largest share of sea level rise, followed by melting of mountain glaciers and ice caps (IPCC 2001). The impact of a rise in sea level on coastal areas will be amplified by any increases in the frequency and/or intensity of major storms.

GGNRA winters will quite probably become warmer, windier and wetter during the next century (Fried et al. 2003, Union of Concerned Scientists 2002). Summers may well become warmer, though winter will become proportionally even warmer. El Niños may increase in intensity and/or frequency.

Changes in the timing or amount of precipitation over the next century are likely to have a greater impact than changes in temperature (Union of Concerned Scientists 2002). For example, increases in the amount of winter rains could intensify flooding and landslide hazards. The suitable range will inevitably shift for each mix of plants and animals. Some of these changes are already occurring, providing a first glimpse of the processes and problems ahead. For example, the Edith's Checkerspot (a species of butterfly) is shifting from the southern to the northern limits of its range and from low-elevation to high-elevation sites, a likely consequence of rising temperatures. Other shifts are likely in the future, e.g., expanding grasslands will likely encroach on the foothill shrublands of the coastal ranges. In many cases, however, plant and animal species will not be able to shift northward or upslope because the potential habitat has been claimed by development or nonnative species, or contains unsuitable soils or other physical limitations.

A large proportion of change will occur in the frequency and/or intensity of extreme weather events such as severe storms, winds, droughts, and frosts. Similarly, the frequency and/or magnitude of some ecologically important processes such as wildfires, floods, and disease and pest outbreaks will likely change. Fried et al. (2003) predict that these conditions will produce more intense, faster-spreading fires in most locations. Their model shows that, despite any enhancement of fire suppression efforts, the number of escaped fires (those exceeding initial containment limits) increased 51 percent in the San Francisco Bay Area. Area burned by contained fires could increase by 41 percent. Furthermore, Fried et al. (2003) predicted that fire return intervals in grass and brush vegetation types would be cut in half on average. Their reported estimates represent a minimum expected change, or best-case forecast. In addition to the increased suppression costs and economic damages, changes in fire severity of this magnitude would have widespread impacts on vegetation distribution, ecological condition, and carbon storage, and would greatly increase the risk to property, natural resources, and human life.

Fire Weather

Post-frontal offshore flow can bring high fire danger to the Pacific Coast from British Columbia to southern California. The bulge of the Pacific High moving inland to the rear of a front produces offshore northeasterly winds (Fischer and Hardy 1976). Thunderstorms may occur in California at any time of the

year; lightning strikes in the Bay Area are rare but do occur annually. Several lightning ignitions are known to have occurred in the last 18 years (see Table 3-1). Local fire sources (CDF 1980-2002; Sunget and Martin 1984) tell of 14 separate lightning-ignited fires: two in the Douglas-fir forest on Inverness Ridge, two on Mount Tamalpais, one on Bolinas Ridge, and eight additional fires (seven of which occurred during a September 1984 storm). The Bay Area averages about three lightning days a year. Storms with lightning occur, on average, 1.9 times per year on Mount Tamalpais. The storms are usually light and infrequent (Golden Gate Weather Services 2002).

The fire season usually starts in June and lasts into October. Several synoptic weather types produce high fire danger. One is the cold-front passage followed by winds from the northeast quadrant. Another is similar to the east-wind type of the Pacific Northwest coast, except that the high is farther south in the Great Basin. This Great Basin High produces the foehn-type Diablo winds in the central Coast Ranges. Peak occurrence of these winds is in November, and there is a secondary peak in March. A third high fire-danger type occurs when a ridge or closed high aloft persists over the western portion of the United States. At the surface, this pattern produces very high temperatures, low humidity, and air mass instability (Fischer and Hardy 1976).

Table 3-1: Source of Fire Starts/Size of Fire, 1992-2002

Fire Cause (1992–2002)	Marin County (acres)	San Mateo County (acres)
Lightning	3	20
Campfire	12,390 (includes 12,356-acre Vision Fire)	27
Smoking	12	9
Debris Burning	42	14
Arson	25	15
Equipment Use	196	108
Playing With Fire	42	4
Miscellaneous	261	154
Vehicle Fires	0	86
Railroad	0	0
Powerline	87	23
Total Acres	**13,058**	**460**

Source: NPS, Pacific West Regional Office, 2004

The meteorological causes of the October 20, 1991 Oakland Hills fire appear to occur approximately 22 years. Conflagrations have struck the East Bay hills in 1923, 1945, 1970, and 1991. This approximately 20-year cycle coincides with the peaks in the sunspot cycle, which may influence local weather. The magnetic poles of the sun flip every 11 years so that the North Pole returns to the top every 22 years, with calendar dates closely approximating East Bay conflagrations. This pattern suggests that the 1991 conflagration will be repeated in approximately 2013.

As each cycle has occurred, the increased level of urban development in the hills has produced more serious conflagrations. The scenario that emerged for October 1991 was a fire occurring after a very dry, hot, strong wind had desiccated vegetal and structural fuel. This fuel was initially dry from a long drought, an unusual freeze, and a rainless extended summer. The altitude of the fire placed it within a strong inversion layer so that brands shooting out from the fire were channeled downwind into a heavy fuel-loaded urban wildland intermix. Since the interface area sat upslope above the surrounding urban development, brands shooting from the main body of the fire were flung even farther afield, further aiding the fire's spread.

Prescribed Fire Weather

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

In shrublands and forested areas, burning can be extremely difficult due to the narrow burning window from late September to early October when fuels dry out. Northeast wind events during this same timeframe can result in Red-Flag Days on which no prescribed or pile burning is allowed. "Burn days," or days when burns would be in prescription, often do not coincide with weather conditions appropriate for burning in GGNRA, as on many of these days smoke dispersal would contribute to air quality problems.

Fire Regime of the Central California Coast

Landscapes consist of a dynamic mosaic of patches, which are created by successive disturbances of various types, including fire (White and Pickett 1985). Disturbances are defined as "any relatively discrete event in time that disrupts ecosystem, community, or population structure and changes resources, substrate availability, or the physical environment" (White and Pickett 1985). Disturbances affect community structure and dynamics at various spatial scales (Pickett et al. 1989). Factors such as fire, landslides, and precipitation variability usually act at relatively large spatial scales, while disturbances such as grazing, burrowing, and falling tree limbs often affect communities at much smaller spatial scales (Pickett and White 1985). Fire/disturbance regimes help to define the pattern or mosaic of age classes, successional stages, and vegetation types on the landscape.

Five successive fire regimes have been identified for the Pleistocene era in the central California coast. The "management practices" or human influence on the landscape during last the last four eras have dramatically influenced the disturbance regime for this landscape, though to a lesser degree than change in climate. Fire's influence on species composition and productivity can be relatively minor, though fire can influence the rate, direction, and magnitude of more dramatic changes due to climate.

Natural Fire Occurrence (128,000 to About 10,000 Years Before Present)

During the last 20,000 years, the Earth's climate underwent a dramatic transition from glacial to interglacial conditions, a change as large as any change during the past three million years. These climatic

variations resulted in large biotic responses, including migrations of individual species and rearrangements of vegetation associations. Table 3-2 shows the changes in Bay Area climate over the last 128,000 years and summarizes the changes in the aforementioned pollen record. For areas in central and northern California, pine is generally an indicator of cooler or glacial conditions, and oak is an indicator of warm conditions. Redwood is an indicator of increased moisture and moderated summer coastal temperature related to coastal fog, also related to coastal upwelling (Heusser 1998).

The Mediterranean climate with hot, dry winters attained prominence in the early Pleistocene (Axelrod 1988) and has been dominant throughout this period. In this climate, high fire danger typically exists during the dry months of May through November. Vegetation characteristics in regions of Mediterranean climate help determine the frequency and intensity of fires (Philpot 1977). Several plant communities, including native chaparral and oak woodland in Marin, San Francisco, and San Mateo counties, display fire-adaptive characteristics, indicating a role for fire in determining the persistence of these species.

Table 3-2: San Francisco Bay Area Climatic Changes

Time Period	Climatic Characteristics	Dominant Plant Communities
128,000 – 28,000 BP	Much cooler than present	Conifers predominate (Abies and Pseudotsuga)
28,000 – 13,000 BP	Cold and dry	NA
13,000 – 7,500 BP	Warm and wet	Oaks begin to increase Abies, Pseudotsuga dominate
7,500 – 2,900 BP	Warm and dry	(Altithermal) oak woodland, prairies and coastal scrub dominate until modern era
2,900 – 900 BP	Cooler	NA
900 – 625 BP	Warm and dry at end	Medieval Warm Period
625 – 500 BP	Current climate	NA
500 – 300 BP	Wetter and cooler	Little Ice Age
300 BP – present	Current climate	Nonnative plants introduced

Source: NPS, Pacific West Regional Office, 2004.
Note:
BP = before present
NA = not applicable

Prior to human settlement of central California, natural ignition sources for wildfire would be lightning or spontaneous combustion. Recent records of lightning strikes in the Bay Area show that fires could occur along the Marin coastline throughout much of the year, regardless of the high probability of dense fog. Without human intervention, it is thought that fire could linger in tree trunks for weeks, and reemerge under drier conditions; thus a fire could burn through the summer and fall until the rainy season began (Stuart 1987). The fog gradient is a principal influence on fire behavior in this scenario.

Native American Period (≈10,000 BP – 1775 AD)

There is increasing evidence that Native American land management practices, including the use of fire, caused cumulative and permanent effects in plant communities and species composition for many Bay Area vegetation types (Stewart 1955, Reynolds 1959, Duncan 1992, Anderson 1993, Lewis 1993, Blackburn and Anderson 1993, Anderson 2001).

Sapsis and Martin (1994) estimated that fire burned from one half million to over 19 million acres of California's total area each year. The exact spatial extent of the influence of burning on the landscape is not known and has been debated. Still, the level of fire use necessary to maintain specific resources in conditions required by the various cultures suggests that extensive and very intensive burning would have been common in important vegetation types (Anderson and Moratto 1996). Over the course of the past 10,000 years, periods of intensive land use and higher population levels were separated by times of diminished populations and reduced land use. The most recent period of intensive land use lasted for roughly 500 years before Euro-Americans came to the San Francisco Bay Area. This interval was long enough for Native American management activities to cause substantial environmental changes.

In California, the oldest definite evidence indicates that humans arrived 9,000 to 10,000 years ago. Although earlier dates have been proposed, they are still not definite (Heizer and Elsasser 1980, Chartkoff and Chartkoff 1984, Fagan 2003). It is thought that California was the most densely populated area of the United States at the time of European arrival, with a population of approximately 150,000 (1.5 persons per square mile). Ohlone and Coast Miwok are native peoples aboriginal to GGNRA parklands. Kroeber (1977) estimates that there were about 7,000 Ohlone in their territory from the Monterey Bay area to the tip of the San Francisco Penninsula, and 3,000 Coast Miwok from present-day Marin County into Sonoma County. Other estimates are much higher (Cook 1976). Archeologists have identified more than 100 Coast Miwok and Ohlone village sites (Kelly 1978, Levy 1978), with the majority being located in valleys and along the bay. The dense population was the product of the relatively peaceful culture of the California tribes and the abundant supply of fish, game, and edible vegetation.

Native American Burning Practices

Although information on their burning practices is scant, both the Coast Miwok and Ohlone peoples are known to have regularly burned extensive areas of coastal prairie, coastal scrub, marshlands, and oak woodland (Collier and Thalman 1996, Duncan 1992, Kelly 1978, Levy 1978). Fire is also thought to have been used as a tool for communication, driving game, security from human enemies and predators, improving the flow of springs, increasing productivity for grazing, increasing yield of food sources (acorns, grasses, forbs, tubers, bulbs, fruits, grains), and removing competing conifers from oak woodland.

Fire management was more common in grassland, oak savannas, and ecotones of grassland and chaparral than in shrublands and forests (the latter two communities burning between 10 and 28 years on average). Palynological (spores and pollen) records from the San Francisco Bay region support the hypothesis that Native American use of fire helped shape the landscape over the past 5,000 years (Russell 1983, Byrne et al. 1991, Duncan 1992, Anderson 2001). For example, prior to suppression, chaparral and coastal scrub

are generally believed to have been restricted to the higher slopes and ridges (Lewis 1993). The Bear Valley and Olema fire chronologies (Sunget and Martin 1984, Brown et al. 1999) also suggest that the coastal Coast Miwok burned the land more frequently than lightning-ignited fires occurred.

Fire was an important part of oak management. Fire served to control oak pests and diseases, e.g., the filbert weevil (*Curculio occidentis*) and the filbertworm (*Melissopus latiferreanus*) (McCarthy 1993). Fire also produced larger, more productive trees by removing competition and made it easier to gather acorns (McCarthy 1993). Acorns were then stored for two to four years (Fagan 2003).

Lewis (1993) indicates that California Native Americans generally burned in the fall season, with some summer and spring burns. Fall burns are frequently noted in grasslands, chaparral, and coniferous forests. It is known that inland Miwok burned the land each August after seed gathering from May to August (Kelly 1978). California grasses, along with many chaparral shrubs, produce extraordinary amounts of seeds, and grass and chaparral shrub seeds were an important protein source, especially in treeless zones. Seeds were typically parched, ground into flour, and consumed as dry meal or formed into cakes. Spring burns are noted in chaparral. Summer burns were the time for natural fires (Lewis 1993). Seeds of desirable species were sown after burning.

Spatially, California Native Americans used two types of fire patterns: fire corridors and fire yards (Lewis 1993, Lewis 1999). Fire corridors were created by a consistent pattern of summer burning along higher elevation grassland corridors through coastal coniferous forests or fringes of streams, sloughs, ridges, and trails inland away from redwood forests. Fire yards were open prairie, clearing, meadow, swale, or lakeshore areas created at any elevation within forested areas (Lewis 1993, Lewis 1999). These areas were typically small in acreage in areas where animals congregated or traversed. The clearings increased the abundance of plant and animal resources and made hunting and gathering more predictable.

Ohlone and Coast Miwok fire management is thought to have been similar in strategy and technique. This is because the differences between the tribal groups are largely social (e.g., housing, socio-political organization, technology, ritual) as the two groups had similar seasonal movements, subsistence patterns, and mobility. There is a larger amount of Coast Miwok ethnographic material, so more is known about the Coast Miwok life than the Ohlone. One important difference was that within GGNRA lands, Ohlone populations (with many small villages of less than 100 people) were sparsely populated when compared to the Miwok (with many small villages and three larger villages with populations of 100 to 300 in Olema Valley, Bolinas Lagoon, and Sausalito).

Spanish-Mexican Influences (1769-1848)

Spanish and later Mexican settlement introduced year-long cattle and sheep grazing, burning, and cultivation that led to the extirpation of many native animal species and the further spread of nonnative plants. The rapid, extensive conversion of the landscape to nonnative annual vegetation was so complete that the original extent and species composition of most native perennial grasslands are largely unknown (Burcham 1957, Holland and Keil 1995).

The move toward fire exclusion began early in California. The first law against starting fires was issued under Spanish rule in 1793 (Barrett 1935, Gordon 1977). It was aimed at halting Indian burning of grasslands that reduced the amount of forage available to Spanish horses and livestock. Ranchero owners burned coastal scrub, chaparral, and oak woodland to expand pastures. The rancho period, primarily under Mexican rule, was relatively short-lived (1822-1846), but it exerted such a strong influence on the landscape that the fence lines, roads, and vegetation pattern are still visible today. Within GGNRA, there were three ranchos in San Mateo County (Buri Buri, Corral de Tierra, and San Pedro), two in San Francisco (Laguna de la Merced and Cañada de Guadalupe, although the majority of the latter was in San Mateo County, and three in Marin County (Saucelito, Tomales y Baulines, and Las Baulines).

American Influences (1848-1945)

Following the Mexican American War in 1848, California became first a territory of the United States and then a state. The discovery of gold in the Sierra foothills in 1848 led to an immense influx of Americans and other gold seekers to the area virtually overnight.

In this period the large ranchos, such as Rancho Saucelito, were subdivided into smaller ranches and a 1900-acre parcel in the Marin Headlands was sold to the Army. Other ranchos within GGNRA lands were similarly subdivided and sold to farmers, dairymen, and timber outfits. This change in ownership and management changed the pattern and types of disturbance across the landscape as fences went up, fertile marine terraces were tilled, and forests were logged on a large scale (Stanger 1967, Hynding 1982, Fairley 1987).

Dairy farming began in Marin in 1857 and, by 1880, a census counted 32,449 cattle (mostly dairy cows). More and more lands were burned to increase grazing. Grazing and farming in the San Mateo lands of GGNRA were less intense and started later in the 1930s. As the Central Valley became the primary cattle producer, the coastal cattle industry began to fade (Burcham 1957, Toogood 1980) but many of the burning and grazing practices lasted until the 1960s.

Logging, focused primarily on redwoods, began in earnest in 1849. In the Bolinas area alone, 13 to 15 million board feet were removed in a 10-year period. (A board foot equals a piece of wood 12 inches by 12 inches and 1 inch thick). On the Phleger property, the Whipple Mill operated from 1852 to 1855 until the entire property was logged. After redwood was removed, loggers focused on cordwood (oak, bishop pine, madrone, etc.). In some areas after the trees were cut, workers skimmed the soil for clay to make bricks (Fairley 1987). Logging operations began to fade on GGNRA lands in the 1850s as operations moved north to the larger forests. Among the legacies of this period are dense second-growth forests and high levels of siltation, such as at Bolinas Lagoon (Fairley 1987).

The spread of fire-adapted nonnative species further changed the landscape and further altered the fire regime. Eucalyptus was first planted in San Francisco Bay Area in 1856 (McClatchie 1902). Extolled for its qualities as a fast-growing timber species, eucalyptus became a widely planted for ornamental use, timber, and windbreaks. These stands filled in quickly and expanded, making eucalyptus one of the dominant trees around the Golden Gate. French broom (*Genista monspessulana*), Portuguese broom (*Cytisus striatus*), Scotch broom (*Cytisus scoparius*), and Spanish broom (*Spartium junceum*) all were

introduced into California in the mid-1800s for landscaping and to control roadside erosion control. The ability of these plants to fix nitrogen, to produce copious amounts of long-lived seed, and to tolerate almost any soil condition allowed these species to grow rapidly and form dense stands, making regeneration of most native species difficult or impossible. The thick brush also created a dangerous fire hazard.

Wildland fires were frequent and large in the late 1800s and early 1900s (Perry 1984). In many cases, the fires prevented grasslands from being invaded by brush. The Forest Reserve Act of 1891 introduced programs to control fire and grazing. In the late 1800s, foresters were urging the public to support fire exclusion in forests to increase future wood production (California State Board of Forestry 1888). By 1900, fire exclusion became a general policy among government agencies, although it was not yet fully accepted by the public (Office of the State Forester 1912). Despite initial public reluctance, the beginnings of successful reduction of fires occurred by 1910 (Office of the State Forester 1912). Active suppression changed the old pattern of smaller fires. Fire control would contain wildfire for several decades. In the 1900s, prescribed fire was part of early efforts at fire prevention in Marin County (Spitz 1997). The 18,000-acre Carson Canyon fire in 1945 was the last large fire to date in Golden Gate lands in Marin, and in 1946 a northern San Francisco Watershed fire was the last large fire-intense event in GGNRA lands in San Mateo County.

Modern Influences (1945-present)

Grazing by domesticated livestock and clearing of pastureland continued to be practiced until the 1960s (Burcham 1957). These practices had resulted in lighter fuel loading, especially near residential areas, markedly lowering the fire danger for the area. By 1990, explosive growth had filled in the central flats of the San Francisco Bay Area and agriculture had moved beyond the suburbs.

In general, disturbances by fire have gone from long intervals in the pre-human period to shorter intervals in the late Native American and Spanish-Mexican periods, moderate intervals in the early Anglo era, back to long intervals in the modern era. The altered fire regime has led to an increase in crown and surface fuels, increased tree density bringing high-intensity fires and higher fire frequency in some areas (which continued until 1940s), conversion of oak woodland to grassland, and the invasion of understory woody vegetation.

If current management strategies are continued indefinitely, it is difficult to predict where this change in fire regimes will ultimately lead, especially with the potential of future warmer and drier climate patterns. However, if warm, dry years become more common, as some suggest is likely (Fried et al. 2003, Union of Concerned Scientists 2002), the recent paradigm of large, severe fires would be expected to continue.

Fire Regime Research in the Central California Coast

Fire history can be reconstructed from a variety of data sources: tree-ring analysis (dendrochronology), cultural and historical accounts, written records, and the analysis of charcoal in sediment cores. Each of these data sources has limitations with regard to spatial and temporal detail and accuracy. Several fire history studies have been completed within the San Francisco Bay Area

Sunget and Martin (1984) studied the occurrence of lightning in the Marin coastal area and the potential for a fire start. Storms with lightning occurred 1.9 times per year at Mount Tamalpais in the years 1901 and 1908-1926. The weather station at this site indicates that 18 percent of these storms occurred in September. At this time of year fuels are dry, relative humidity is low, temperatures are high, and winds are frequently of high velocity.

Prior to the 20th century, fires burned through redwood and Douglas-fir/hardwood forests in the San Francisco Bay Area at intervals of 5 to 175 years (Langenheim et al. 1983, Jacobs et al. 1985, Finney 1990, Greenlee and Langenheim 1990, Finney and Martin 1992). In northern redwood forests, Veirs (1980) found that coastal stands experienced fire intervals of 250 to 300 years, inland stands 33 to 50 years, and stands intermediate to the two locations 150 to 200 years. Stuart (1987) found average fire sizes for inland coastal redwood of 1,942 acres for pre-settlement, 2,711 for settlement (1875-1897), and 2,268 acres for post-settlement. Oswald (1968) found recent average timber losses from windthrow (uprooted by the wind) exceeded the combined losses from fire, insects, and disease in coastal Humboldt County.

Locally, a fire chronology based on fire scar examination was done for two redwood *(Sequoia sempervirens)* forest sites in Marin County (McBride and Jacobs 1978). Fire frequencies averaged 21.7 and 27.3 years. The difference between the two sites was attributed to the increased influence of fog (Jacobs et al. 1985). The distribution of fire intervals was skewed and displayed a larger number of shorter interval fires. This suggests that fires were separated by first a short and then a longer time interval. In general, it is thought that fires occurring at shorter intervals would have been less intense. High-severity fires were rare.

The aforementioned findings are fairly similar to those found by Finney and Martin (1989) at Salt Point State Park and those at the Bear Valley area of Point Reyes National Seashore (Sunget and Martin 1984). The intervals at Bear Valley were shorter than expected and are probably related to the fact that Bear Valley was a center for much Native American activity and associated burning practices. While Brown et al. (1999) found similar numbers for frequency, they also reported that fires generally occurred late in the growing season or after growth had ceased for the year. In addition, fires were highly variable in size, from local stands to extensive landscape-scale events (Brown et al. 1999).

The paleoecological record and historical data show that changes in wildfire frequency are closely linked to changes in climate. Several recent studies tracking trends over the past century have found that fire frequency (Clark 1990, Brown and Swetnam 1994) and fire size (Flannigan and Van Wagner 1991) correlate with air temperature. The long-term importance of fire in San Francisco Bay Area ecosystems is suggested by the common occurrence of charcoal in the paleoecological record of the last 6,000 years (Russell 1983, Duncan 1992, Anderson 2001). This record suggests that climate and vegetation have varied considerably over this period (Adam and West 1983, Rypins et al. 1989, Reidy 1994). Given that fire can act as a catalyst for vegetation change during periods of rapid climate change (Whitlock 1992, Wigand et al. 1995), it is important to note the large charcoal peaks (indicating heightened fire activity) during the last 3,000 years were followed by vegetation proportions considerably different from those found before this period (Russell 1983, Duncan 1992, Anderson 2001). However, the available data for

the San Francisco Bay Area are insufficient to allow a more precise description of the role fire played in reorganizing vegetation at various times in the past. Still, the evidence from interpretation of long-term trends in sediment cores has shown that fire was a component of the San Francisco Bay Area environment even before the current vegetation communities became established (Russell 1983, Duncan 1992, Anderson 2001).

Marin County

Sediment cores in Marin County (Russell 1983, Rypins 1989, Duncan 1992, Anderson 2001) found that high-intensity storm activity existed between 12,000 and 7,000 years ago (Rypins et al. 1989). Abies (coniferous trees referred to commonly as true firs) declined beginning10,000 years ago, suggesting cooler conditions until that time (Rypins et al. 1989). True firs and Douglas-firs disappear from the records at the beginning of the period from 10,000 to 7,500 years ago; during the remainder of the period there were marked increases in grassland, coastal scrub, and oak woodland (Rypins et al. 1989). Anderson (2001) found that fire activity increased dramatically after the period from 6,000 to 2,300 years ago during which fire was relatively infrequent. This increase in frequency cannot be attributed to climate change (Rypins et al. 1989), and may be due to the increased use of fire by Native Americans beginning around 3,000 years ago (Duncan 1992, Meyer 2001, Fagan 2003). In the last 1,000 years, the proportion of grassland and coastal scrub seems to have been stabilized even before European settlement (Russell 1983, Duncan 1992). Effects of colonization (e.g., grazing) are correlated with some changes in pollen (e.g., increase in grass-shrub pollen ratio). The sudden drop in Sequoia pollen and subsequent recovery are interpreted as reflecting the heavy logging of this species in the early 20th century (Russell 1983).

San Francisco

Interpretation of sediment cores from Mountain Lake in the Presidio (Reidy 1994), a lake that formed approximately 2000 years ago, suggests that redwood and pine pollen percentages remained stable across the Pre-European-Early Spanish period boundary. In addition, *Artemisia* pollen dropped dramatically early in the Spanish period, which probably reflects the clearing of sagebrush to encourage grasses for grazing. During the Spanish period, nonnative pollen types first appeared at Mountain Lake. The first nonnative plant to appear was *Erodium cicutarium* in approximately 1800; it was probably introduced by cattle grazing. The second nonnative weed pollen to appear was *Rumex* acetosella around 1840 during the Mexican period in San Francisco. Plants from the mustard family also become locally important in the later Mexican period according to the sediment record.

San Mateo County

A sediment core was taken from Pearson’s Pond, near the community of La Honda in central San Mateo County near the Pacific coast (Adam 1975). The core indicated that coast redwood was much more abundant in approximately 850 AD than it is today. Logging probably was responsible for the increase in Douglas-fir pollen as redwood pollen decreased (Adam 1975). Adam et al. (1981) recognized three zones over the past 30,000 years from Laguna de Las Trancas, northern coastal Santa Cruz County. The deepest (earliest) zone was dominated by pine species and tentatively aged at 30,000 to 24,000 years ago; the pine-fir zone, 24,000 to 12,000 years ago; and the redwood zone, approximately 12,000 to 5,000 years

ago. In the redwood zone, pine was virtually absent, and redwood was apparently dominant in the mesic sites (those with a balanced source of moisture), with the drier sites supporting open grassland.

Recent Fire History in Marin and San Mateo Counties

Nineteenth and early 20th century newspapers from Marin and San Mateo counties and records from local fire departments document many fires that occurred in coastal Marin and San Mateo counties (Perry 1984, U.S. Forest Service 1939-41). These fires were often the result of known human activities, but the locations and impacts of the fires are often vague. Table 3-3 lists fires by date for the two counties, and Figures 3-3 and 3-4 show fire locations. Months are given when known.

Table 3-3: Fire History of Coastal Marin and San Mateo Counties

Date	Description
1859 September	Wildland fire, Mount Tamalpais, burned for three months.
1865	Woods of Marin along the shore of Bolinas Bay burned for two weeks.
1877	Area west of San Andreas Lake burned over large territory for more than three weeks.
1878	1,200-1,500 acres of chaparral, grass, and timber burned near Nicasio.
1880	Campers caused fires, burned 5-mile by 10-mile area in San Mateo County.
1881 September	65,000-acre wildland fire burned for seven days, one fatality. Started near Blithedale Canyon, Mill Valley, by a man who set fire to a pile of brush.
1887	Fire spread from below San Andreas Lake to San Mateo Creek, burning 2,500 acres of second growth bay, oak, and madrone.
1889	On the ridge between San Andreas Lake and Crystal Springs Lake and two ridges west of San Andreas Lake. “For miles the hills are black and bare, the fire burned for at least 4 days spreading at least 1 ½ square miles a day.”
1890 October	More than 8,000 acres burned between San Rafael and Bolinas.
1891 June	12,000 acres of Mount Tamalpais burned; fire started in Bill Williams Gulch near Ross.
1892 August	Fire started on Bolinas Road by two men cooking breakfast, spread over several hundred acres.
1893 August	Fire thought to have been started by campers burned over 3,000 acres of Mount Tamalpais and Mill Valley.
1894 September	Mill Valley fire originated from a campfire left by hunters started in redwood forest and “burned over a large stretch of country.”
1904 September	15,000-20,000 acres of grass and timber burned on the west side of Bolinas Ridge.

Date	Description
1913 July	On Mount Tamalpais, between 1,600 and 2,000 acres burned, from Rock Springs to Larkspur, including summit of mountain, Blithedale and Cascade Canyons, most of Fern Canyon, and spot fires beyond Muir Woods National Monument on the Dipsea Trail. Started west of West Point Inn at 10 A.M. probably by railroad sparks.
1919 September	Fire started near Pipeline Reservoir, burned 40 houses on the ridge and stopped within 100 yards of Muir Woods.
1919	Fire swept from the hills above Sausalito, burned a hall, 5 stores, and 12 homes.
1923	Fire burned from Bolinas Ridge to within four miles of Fairfax, with a total size of 30-50 square miles.
1928	200 acres of brush burned around Fort Barry.
1929 July	"Great Mt. Tamalpais Fire," involving 2,500 acres of brush, forest, and grassland. Fire burned into Mill Valley from Fern and Cascade Canyons; 117 homes burned.
1929	A week-long fire around the town of Montara; completely burned down the town.
1931 December	Illegal campfire in large group of charred redwoods in Cathedral Grove, Muir Woods.
1932 November	Thanksgiving Eve Fire. Started at 10:25 P.M. in heavy grass 50 feet west of Panoramic Highway near Alpine Club. North winds spread it toward Muir Woods and Tourist Club. Sixty acres burned, including two acres of chaparral inside Muir Woods' boundaries.
1933 December	Fires prohibited in Muir Woods; all fireplaces eliminated.
1945 September	18,000-acre fire that began at the entrance to Carson Canyon (Kent Lake).
1946	Large intense fires in northern San Francisco watershed.
1959 July	2:53 A.M. fire report in Kent Canyon near logging operations on Brazil Ranch. No wind; burned 50 acres before being controlled by 75 men.
1965 October	150 acre fire ¼ mile from Muir Woods, near southeast boundary.
1995 October	12,354 acres at Mount Vision, Point Reyes National Seashore. Forty-eight structures destroyed; 1,200 firefighters participated, took 9 days to control fire.

Source: NPS, Pacific West Region, 2004.

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Fire History 1929-2004

Marin County

National Park Service
U.S. Department of the Interior
Golden Gate National Recreation Area

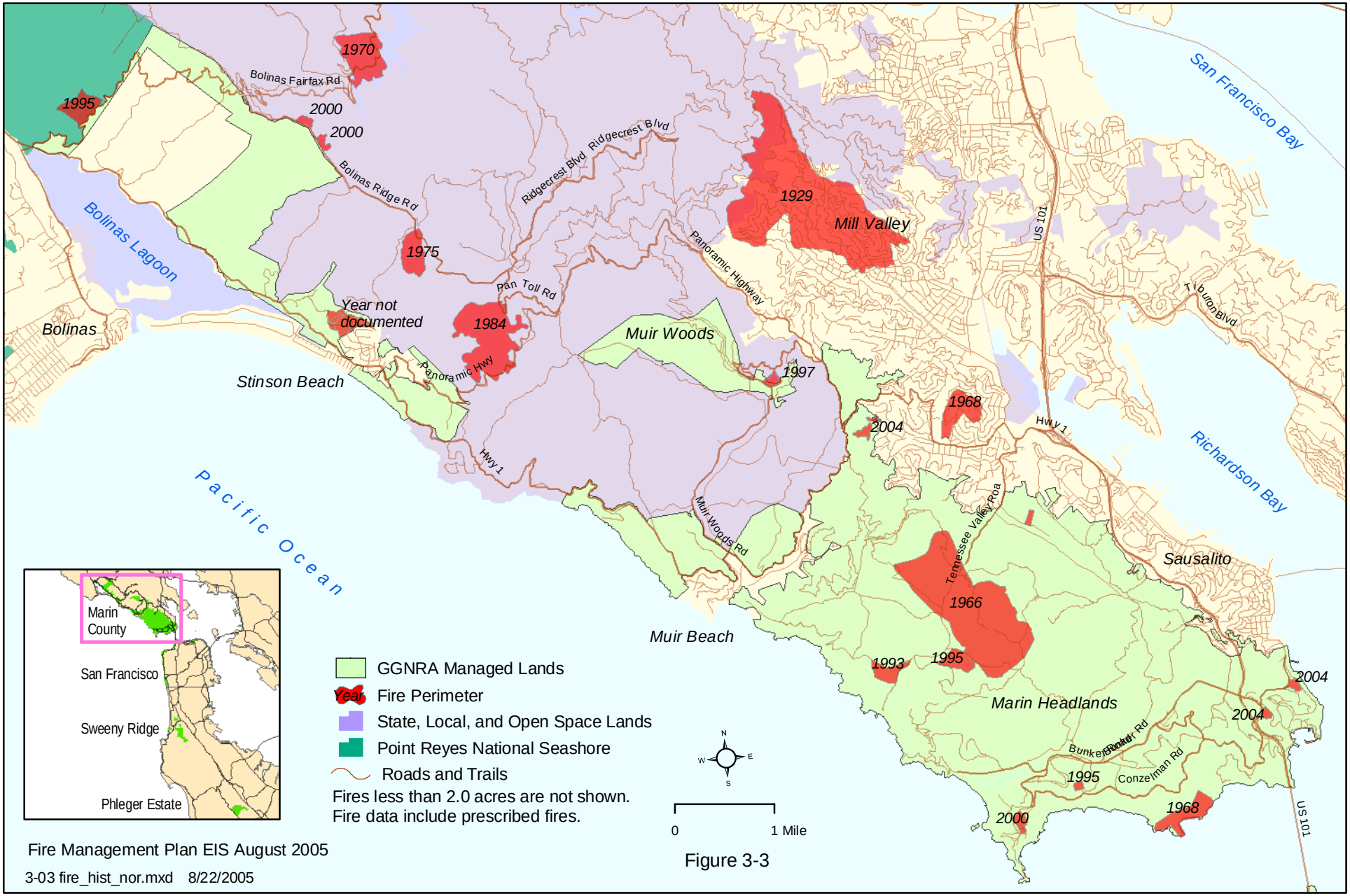

Figure 3-3

Fire Management Plan EIS August 2005

3-03 fire_hist_nor.mxd 8/22/2005

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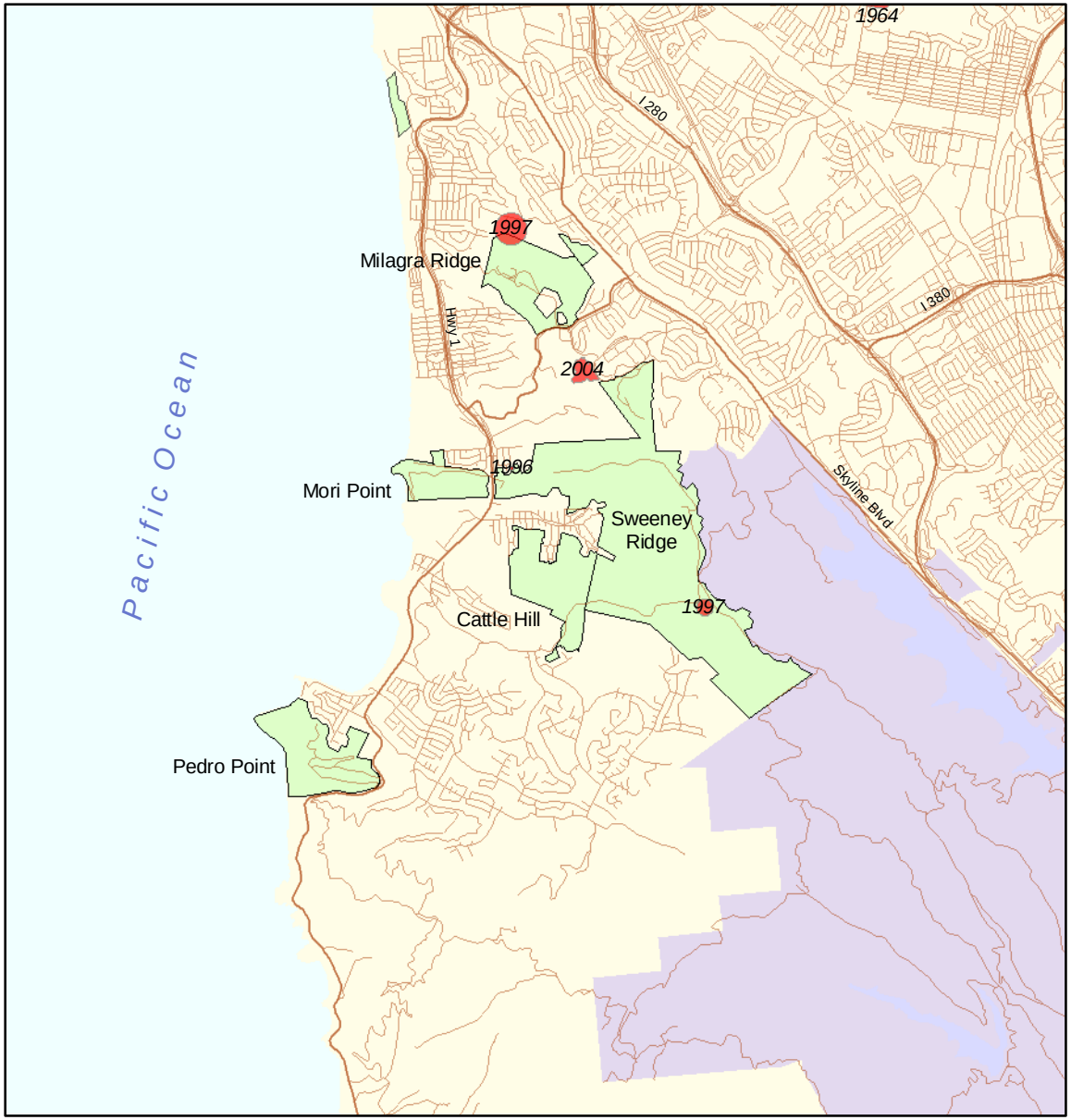
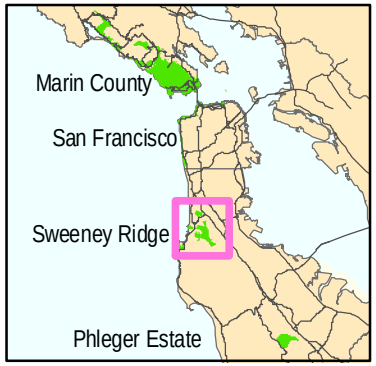
Fire History 1929 - 2004

San Mateo County

National Park Service
U.S. Department of the Interior
Golden Gate National Recreation Area



GGNRA Managed Lands
Year Fire Perimeter
State and Open Space Lands
Roads and Trails



Note:
Fires less than 2.0 acres are not shown.
There is no record of fires greater than 2.0 acres in San Francisco and no record of any fires in Mori Point, Pedro Point, or Phleger Estate.

Historical records indicate a 25 acre fire occurred near Sweeney Ridge in 1988, however the exact location and geographical extent is not known.

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Figure 3-4

Fire Management Plan EIS August 2005

3-04 fire_hist_south.mxd 8/22/2004

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3.3 Physical Environment

Watershed Processes: Soils, Hydrology, Water Quality, and Aquatic Habitat

Water resources, water quality, and soils are interrelated in their impacts within a watershed. Therefore, these resources are discussed together in the affected environment. Each of the watersheds described in this section has unique resources and characteristics, but the types of soils within the park do not vary significantly enough to warrant discussion of any particular area.

Soils

From an aerial view of the GGNRA landscape, the threats posed to the park from erosion are clear. Coastal waves rhythmically crash against the shoreline; deep, long gullies originate at old roads; heavily used areas are devoid of vegetation; undesignated social trails crisscross through the natural areas; and landslides or slumps exist in most of the small valleys.

Past and current land use practices such as logging, grazing, and development, as described above in the Fire Regime descriptions, have altered vegetative composition, aggravated and increased soil erosion, and precipitated landslide activity and recurrent gully formation. These practices have contributed to increasing sediment loads to streams, bays, and shorelines. They have also accelerated the loss of large quantities of top soil and have resulted in prominent visual scars and recurrent maintenance costs.

Slopes in the Coast Range are inherently unstable. Intense shearing associated with faulting along the plate margin has reduced the strength of the rock. Ongoing uplift of the mountains causes continued erosion as the landscape strives to become stable. Surface disturbances, such as cuts for trails and roads, vegetation clearing, and alteration of surface water drainages, can trigger or lead to slope failures.

Most of the soils within GGNRA belong to the following complexes: Blucher-Cole, Centissima-Barnabe, Cronkhite-Barnabe, Dipsea-Barnabe, Felton Variant-SoulaJule, Gilroy-Gilroy Variant-Bonnydoon Variant, Henneke stony clay loam, Kehoe, Rodeo Clay Loam, and Tamalpais-Barnabe Variant (USDA, Soil Surveys for Marin, San Francisco, and San Mateo Counties). All of these soils are susceptible to sheet and rill erosion when disturbed or exposed. The susceptibility to wind erosion is generally low.

Hydrology and Watersheds

Water resources in GGNRA include springs, streams, ponds, lakes, wetlands, lagoons, the San Francisco Bay, and the Pacific Ocean. Many significant watersheds are located wholly or partially within the park. From north to south, the watersheds are Bolinas Lagoon, Redwood Creek, Tennessee Valley (Elk Creek), Rodeo Lagoon (including Gerbode Valley subwatershed), Nyhan Creek, Lobos Creek, Milagra and Sweeney Ridges, San Pedro Creek, West Union Creek, and the San Francisco watershed lands in San Mateo County (see Figures 3-5 and 3-6). Many smaller watersheds drain the steep coastal bluffs directly into the San Francisco Bay or Pacific Ocean.

Eleven rare wildlife species are associated with GGNRA waters, including nine federally listed species: the California freshwater shrimp (*Syncaris pacifica*), tidewater goby (*Eucyclogobius newberryi*),

red-legged frog (*Rana aurora draytonii*), Sacramento River winter-run chinook salmon (*Oncorhynchus tshawytscha*), steelhead trout (*Oncorhynchus mykiss*), coho salmon (*Oncorhynchus kisutch*), San Francisco garter snake (*Thamnophis sirtalis tetrataenia*), Steller sea lion (*Eumetopias jubatus*), and California brown pelican (*Pelecanus occidentalis*).

The NPS has been monitoring water quality to varying degrees within these aquatic systems (discussed more in the next section). Most water quality sampling to date has focused on specific sites with known or suspected water quality impacts, including beach water quality monitoring. The NPS is presently designing a more comprehensive monitoring program that should identify any existing impacts and serve as baseline data to determine future impacts such as catastrophic fire events. For the lands in the southern part of the park (San Francisco and San Mateo counties), this work will also include an inventory of the largely unknown water resources. The monitoring will be coordinated through the San Francisco Bay Area network of regional national park sites.

Watershed Characteristics

The watersheds in GGNRA vary in the ratio of forest cover to scrub vegetation. Watersheds in southern Marin, such as Rodeo Lagoon and Tennessee Valley, are dominated by scrub and grassland vegetation with the majority of the trees in the riparian zone. These watersheds also have extensive stream and wetland complexes throughout their valley floors. Other watersheds, such as the Redwood Creek watershed, Bolinas Lagoon watershed, and the San Pedro Creek watershed, have denser forests beyond the riparian zone. These watersheds have steeper slopes and narrower valleys, and thus restrict the extent of wetlands.

Marin County Watersheds

Most Marin County watersheds drain to the Pacific Ocean. Watersheds relevant to GGNRA lands are as follows:

Bolinas Lagoon

The NPS manages several small subwatersheds that drain to the southern end of Bolinas Lagoon. The Bolinas Lagoon watershed extends from the Bolinas Ridges west to Inverness Ridge, encompassing 16.7 square miles. Sixty-six percent of the watershed is in public ownership and is managed by GGNRA, Point Reyes National Seashore (PRNS), Mount Tamalpais State Park, the Marin Municipal Water District (MMWD), and the Marin County Open Space District (MCOSD). Private lands in the watershed include Audubon Canyon Ranch and the communities of Bolinas, Seadrift, and Stinson Beach. Streams within the NPS-managed areas of Bolinas Lagoon Watershed in GGNRA include Morses Gulch, McKinnon Gulch, Stinson Gulch, Easkoot Creek, and several unnamed tributaries. Easkoot Creek provides domestic water supply to the town of Stinson Beach (via the Stinson Beach Water District) and GGNRA facilities at Stinson Beach.

Watersheds

Marin County

National Park Service
U.S. Department of the Interior
Golden Gate National Recreation Area

Fire Management Plan EIS 2005

3-05 Watersheds_FMP_north.mxd 8/22/2005

Figure 3-5

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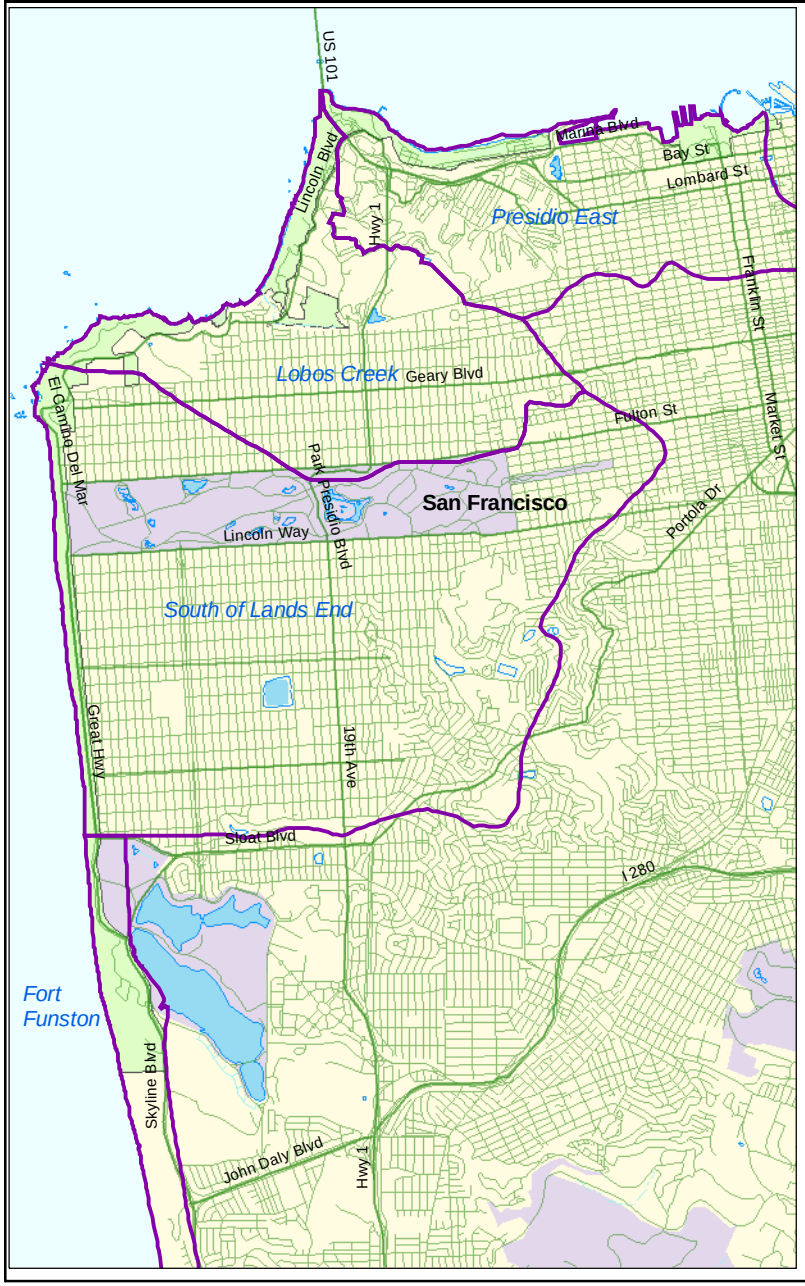
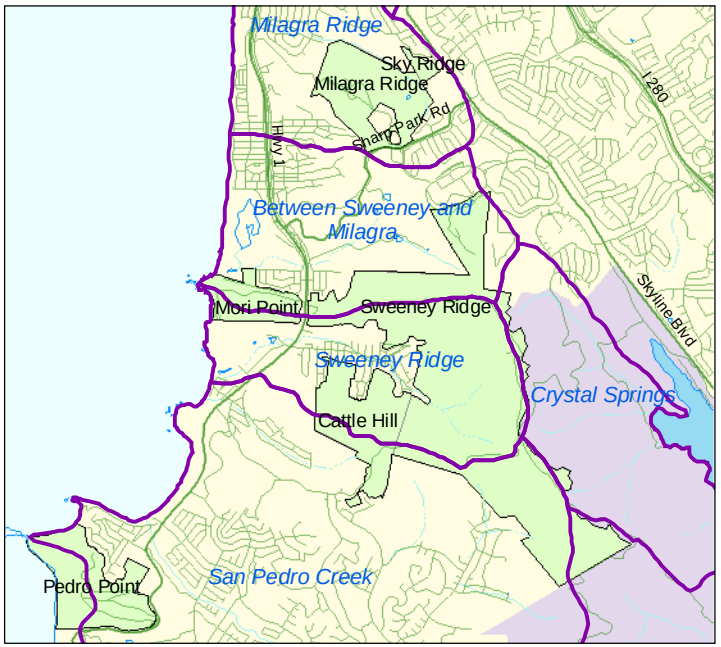
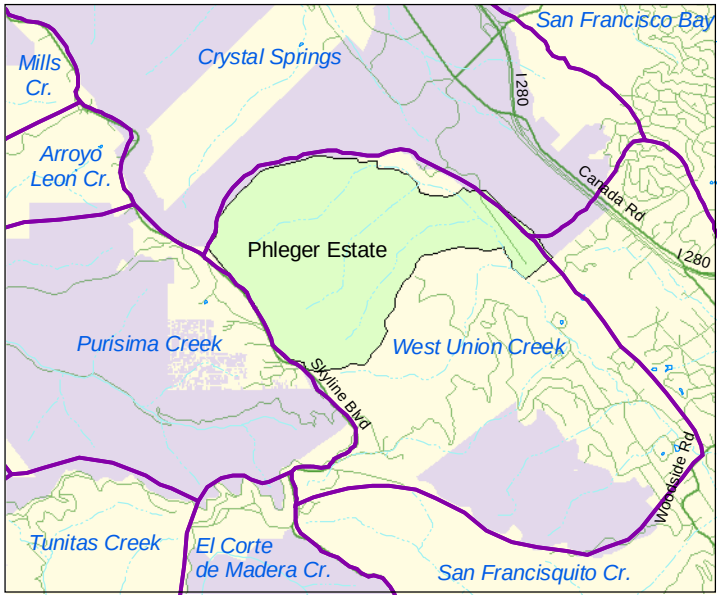
Watersheds

San Francisco and San Mateo County

National Park Service
U.S. Department of the Interior
Golden Gate National Recreation Area







GGNRA Managed Lands
Watershed Boundary
State, Local, and Open Space Lands
Roads and Trails

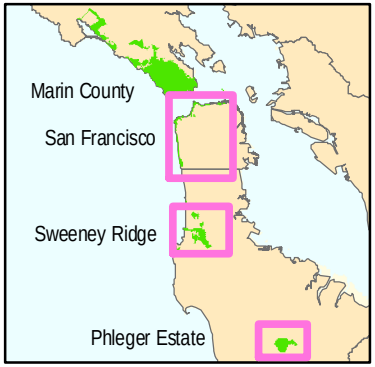


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Figure 3-6

Fire Management Plan EIS
August 2005

3-06 Watersheds_FMP_South.mxd
8/22/2005

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These tributaries are steep and flow through highly erodible Franciscan Complex. Any activity that creates soil disturbance in these watersheds, including fire management actions, could potentially increase erosion and sediment delivery rates to Bolinas Lagoon through loss of vegetation cover and subsequent soil exposure to rainwater erosion. MCOSD is currently evaluating the need to restore Bolinas Lagoon, as well as potential strategies to increase tidal prism, that may include dredging of accumulated sediment from the lagoon.

South of Bolinas

Between Bolinas Lagoon and Muir Beach, the "Game Refuge" watershed drains 3.6 square miles of Mount Tamalpais State Park and GGNRA lands directly to the Pacific Ocean. Several streams, including Steep Ravine Canyon, Lone Tree Creek, and Cold Stream, drain steep landscapes that are dominated by Franciscan Formation. Landslides are common in this area, and the steep terrain combined with unstable geology results in high erosion rates and sensitivity to disturbance in these watersheds.

Redwood Creek

The Redwood Creek watershed encompasses 8.9 square miles extending from the peaks of Mount Tamalpais, through Muir Woods National Monument, to the Pacific Ocean at Muir Beach. Ninety-five percent of the watershed is owned and managed by three public agencies: Marin Municipal Water District, California Department of Parks and Recreation (Mount Tamalpais State Park), and the NPS (Muir Woods National Monument and GGNRA). Three residential communities also are located in the watershed: Muir Beach, Muir Woods Park, and Green Gulch Farm (a part of the San Francisco Zen Center). Several threatened animal species also occur in the watershed, including coho salmon, steelhead, California red-legged frog, and the northern spotted owl (*Strix occidentalis caurina*). Public agencies in the watershed, including the NPS, have recently published the Redwood Creek Watershed Vision for the Future (July 2003). FMP actions in this watershed should be consistent with the Guiding Principles and Desired Future Conditions stated in this vision document.

Marin Headlands

The 2.4-square-mile Tennessee Valley watershed extends from Coyote Ridge to Wolf Ridge. GGNRA encompasses several facilities in this watershed, including Miwok Horse Stable, a parking lot, extensive trails, and a walk-in camping area. The watershed contains several small impoundments, all of which are remnant stock ponds from prior ranching. Recent dam removal activities at one of the stock ponds have led to a short-term increase in sediment to the streams; sediment levels are expected to stabilize as the new stream configuration becomes vegetated. Two small watersheds, Pirates Cove Bluffs and Tennessee Bluffs, drain into the Pacific near the mouth of the Tennessee Valley watershed.

The Rodeo Lagoon watershed, including the Gerbode Valley subwatershed, drains 4.4 square miles of GGNRA. Rodeo Lagoon is a significant wetland/estuarine resource that provides important habitat for marine birds and other species. The NPS is currently working with the University of California at Berkeley (U.C. Berkeley) to assess resources conditions in this watershed and develop a restoration plan for the creek and its associated wetlands. West of Rodeo Valley, the Point Bonita Bluffs watershed drains the steep cliffs into the Pacific.

San Francisco Bay Drainages (Marin)

The upper reaches of the Homestead Valley, Nyhan Creek, and Morning Sun watersheds are in GGNRA lands, while the lower reaches include the communities of Sausalito, Marin City, Tam Junction, and Mill Valley. The streams in these watersheds drain to Richardson Bay.

Golden Gate Channel and San Francisco Bay

Several small, steep watersheds drain 1.9 square miles of GGNRA lands in the southern Marin Headlands directly to the Golden Gate Channel and San Francisco Bay in the vicinity of the Golden Gate Bridge. These include the Bonita Cove, Kirby Cove, East Fort Baker, and Sausalito watersheds.

San Francisco City and County Watersheds

The majority of the watersheds in San Francisco are highly urbanized, and their boundaries have been modified by storm drainage projects and other urban infrastructure. The NPS manages lands in San Francisco draining to San Francisco Bay, the Golden Gate Channel, and the Pacific Ocean. Tennessee Hollow and Lobos Creek, both of which are within the GGNRA and the Presidio, remain in a relatively unurbanized state and are significant water resources in the park. The Tennessee Hollow stream, in the Presidio East watershed, is the main fresh water source for the Crissy Field marsh, a recently completed wetland restoration project. Lobos Creek, in the Presidio West watershed, is the main water supply for the Presidio.

San Mateo County Watersheds

The watersheds in San Mateo County have not been comprehensively studied due to piecemeal land management by various agencies and private holdings. The watersheds that wholly or partly contain GGNRA land include Milagra, between Sweeney and Milagra, Sweeney, San Pedro Creek, Crystal Springs (part of the larger San Francisco watershed), and West Union/San Francisquito Creek.

The 23-square-mile San Francisco watershed is owned by the San Francisco Public Utilities Commission and is part of the water supply storage for the City and County of San Francisco. This watershed includes San Andreas Lake, Crystal Springs, Pilarcitos Lake, and a portion of the Pilarcitos Creek watershed.

The San Pedro Creek watershed drains portions of the San Francisco watershed lands, Picardo Ranch, and portions of Devils Slide. The West Union Creek watershed contains a tributary to the Searsville Lake that drains the Phleger Estate at the south end of GGNRA.

Water Quality

The size and nature of the park (including high visitor use, the urban interface, and multitude of land uses) create several water quality-related issues. Accelerated erosion due to roads, trails, and other uses and developments threatens the sediment balance and ecological health of several watersheds. Grazing is no longer allowed on NPS-managed lands in GGNRA (NPS 1999b) but some of the impacts remain. Bacteria and nutrient inputs from equestrian operations, pet waste, agricultural operations, and potentially sewer and septic systems can affect wildlife and public health as well as the overall ecological balance of water resources. Alteration of channels (including dams and culverts) affects the ecological health of park watersheds. These primary issues occur to varying extents within multiple park watersheds.

Many park water quality issues are related to facilities and structures. A roads and trails inventory exists and many structures are documented in the Maintenance Division's facilities database. However, a comprehensive inventory of park facilities and structures (including dams, culverts, and outfalls) has not been conducted.

Work is in progress to document facilities/roads and trails and other water quality threats more thoroughly. For example, for the Redwood Creek watershed, a sediment budget study and a report of all sediment sources in the watershed were conducted. Trail maps are being updated for the park and erosion surveys continue throughout the Marin Headlands. Culvert mapping has occurred in Rodeo Valley.

A summary of existing data for GGNRA water resources and a description of future monitoring needs is included in a report entitled San Francisco Area Network Preliminary Water Quality Status Report (Cooprider, 2004), which is a review of the nine regional park units. The following information summarizes the park watersheds that are described in the report.

Marin Headlands/Redwood Creek/Stinson Beach/Bolinas Lagoon Areas

Water quality monitoring has been conducted in Redwood Creek and tributaries (including Kent Creek, Camino del Canyon, Banducci Tributary, Green Gulch, and Golden Gate Dairy Tributary) at numerous locations throughout the years. Several data sets exist for discrete (i.e., short-term, focused) monitoring projects. For example, monitoring by the NPS in the Redwood Creek watershed was conducted in 1986-1988, 1990-1991, and 1993-1996. Much of the water quality monitoring within the park has focused on lower Redwood Creek due to concerns related to nutrient and bacteria inputs in this locale, including recent data related to the Golden Gate Dairy and Big Lagoon.

Short-term data sets also exist for Rodeo Creek and Tennessee Valley (1994-1996). Rodeo Creek and Tennessee Valley were monitored along with Green Gulch between 1998 and 2001 as part of intensive sampling related to stable operations and other potential sources of bacteria and nutrients. Parameters typically monitored included flow (though flow data has been sporadic), pH, temperature, dissolved oxygen, conductivity, BOD (Biological Oxygen Demand), salinity, TSS (Total Suspended Solids), fecal and total coliforms, nitrates, ammonia, phosphates, Total P, metals (emphasis on copper), MBAS (Methyl Blue Activated Substances), and chloride. Not all parameters were monitored at all sites.

Consultants, the United States Geological Survey (USGS), and other entities have also conducted monitoring. For example, the Stinson Beach County Water Agency currently monitors Easkoot Creek for fecal coliforms and nutrients. Limited monitoring has also been conducted in Oakwood Valley and Nyhan Creek as part of an overall stormwater monitoring project including Redwood Creek, Tennessee Valley, and Rodeo Creek.

Flow monitoring by various entities, including the NPS, USGS, local universities, and consultants, has also been conducted. Flow monitoring sites have typically corresponded with water quality monitoring sites and include the Redwood Creek watershed (including Camino del Canyon, Kent Creek, Banducci Tributary, and Green Gulch Creek) as well as Easkoot Creek, Rodeo Creek, and Tennessee Valley. The USGS also monitored sediment and streamflow in Audubon Canyon and Morses Creek (near Bolinas) between 1967 and 1969. UC Berkeley (Lehre 1974) monitored Lone Tree Creek (south of Stinson Beach) between 1972 and 1974. Stream gauges were installed by the NPS at Redwood Creek (Highway 1 bridge) and Easkoot Creek.

Because of high/toxic nutrient loads, algal blooms have occurred in Rodeo Lagoon. In addition to nutrient issues, Rodeo Lagoon sediments may contain elevated amounts of copper from copper sulfate (algaecide) treatment.

San Francisco and San Mateo County

Water quality monitoring has been conducted periodically at the Presidio for several years. Until very recently, however, no monitoring of surface water had been conducted by the NPS in the southern GGNRA lands.

At Lobos Creek in the Presidio, the Urban Watershed Project (UWP), a nonprofit group has conducted fecal coliform monitoring through a contract with the Presidio Trust. The City and County of San Francisco has also recently conducted monitoring in Lobos Creek. Limited sampling of Lobos Creek was also conducted through the Environmental Remediation Program. Likewise, basic water quality parameters have been collected in Tennessee Hollow by UWP, and by the NPS at the Crissy Field marsh.

Some limited water quality monitoring has been conducted within the West Union/San Franciscquito Creek watershed (West Union Creek is located within this watershed), but no monitoring has been conducted on NPS lands. The San Francisquito Creek Watershed Council is actively involved in management and monitoring of this watershed. Through the Watershed Council, consultants have monitored the Bear Creek watershed (including West Union Creek). However, no sites have been located within Phleger Estate or the adjacent county park.

The Environmental Protection Agency (EPA) and the City of San Francisco Waste Water Treatment Plant conducted water quality monitoring (including several indicator bacteria) in San Pedro Creek. A local high school student has also tested the creek for temperature, pH, conductivity, transparency, and oxygen. The San Pedro Creek Watershed Coalition has submitted a proposal to conduct DNA testing and optical brightener testing to determine the source of high indicator bacteria levels in the creek (San Pedro Creek Watershed Council 2002).

San Francisquito Creek is listed on the Section 303d list as being impaired by sediment and diazinon. Concerns in West Union Creek, a San Francisquito Creek tributary within Phleger Estate, include erosion and runoff from trails. Landslides and significant bank erosion have been observed.

Issues in Milagra, Sanchez, and Calera Creeks are mostly unknown due to the lack of water quality data. However, suspected issues in these urban creeks include fertilizer or pesticide runoff from lawns in residential areas and a golf course. In addition, pet waste, oil and chemical runoff from roads, and bacteria and nutrient inputs from leaky sewer pipes are also suspected concerns.

Air Quality

The primary objective of the Clean Air Act (CAA) is to establish federal standards for various pollutants from both stationary and mobile sources and area sources and to provide for the regulation of polluting emissions via state implementation plans. Substantial amendments to the CAA were enacted in 1977[1] (P.L. 95-95; 91 Stat. 685) and in 1990 (P.L. 101-549, 104 Stat. 2399). A principal objective of the 1977 amendments is to prevent significant deterioration in areas where air quality meets or is better than the national ambient air quality standards (NAAQS), and to provide for improved air quality in areas that do not meet NAAQS ("nonattainment" areas).

The 1977 amendments to the CAA established Class I, II, and III areas, where emissions of particulate matter, sulfur dioxide, and nitrogen dioxide are to be restricted to control impacts on visibility from haze and smog. The restrictions are most protective in Class I areas, such as Yosemite National Park and PRNS. Mandatory Class I areas are defined by the CAA as international parks, national wilderness, and national memorial parks greater than 5,000 acres and national parks greater than 6,000 acres that were in existence when the 1977 amendments were enacted. Such areas may not be redesignated to either Class II or Class III. GGNRA is a "Class II area", defined as areas that are national monuments, national primitive areas, national preserves, national recreation areas, national wild and scenic rivers, national wildlife refuges, and national lakeshores or seashores that were in existence (or authorized) on August 7, 1977 and exceed 10,000 acres, and national parks and wilderness areas established after August 7, 1977. A Class III designation, where new air pollution would be allowed, was envisioned by Congress, but no areas have been given that designation (Sandburg et al. 2002). Only states or Native American governing bodies have authority to redesignate areas to Class III.

In accordance with the CAA, the NPS, as the Federal Land Manager (FLM) of GGNRA, is responsible for the protection of the park's air quality-related values (AQRVs) such as visibility, odors, plants, animals, soils, water quality, and cultural and historic structures that may be affected by air pollution. Historically, the EPA has regarded smoke from wildland fires as temporary and therefore not subject to issuance of a PSD permit that would allow an action to increase pollution levels (Sandburg et al. 2002)

Actions of the GGNRA FMP must also protect air quality at Point Reyes National Seashore (PRNS), a Clean Air Act Class I park to the northwest of GGNRA. There are currently no significant air pollution

[1] The 1977 amendments to the Clean Air Act established a national visibility goal of "the prevention of any future, and the remedying of any existing, impairment of visibility in mandatory Class I federal areas..."

emission issues at PRNS, which was rated by a recent NPS report as having low exposure to ozone, sulfur, and nitrogen emissions and low potential for acidification of surface waters (Sullivan et al. 2001).

GGNRA is located in the San Francisco Bay Area Air Basin and is under the jurisdiction of the Bay Area Air Quality Management District (BAAQMD). BAAQMD regulates air quality under agreements with the California Air Resources Board (CARB) and the U.S. Environmental Protection Agency (EPA), Region 9. BAAQMD has direct responsibility for the protection of air quality and implementation of local rules and the State Implementation Plan (SIP) measures for achieving and maintaining the national and state standards within the Bay Area Air Basin. To achieve these objectives, BAAQMD is charged with monitoring air pollution emissions under the Clean Air Act and permitting stationary sources, such as power plants, that contribute emissions to the ambient air quality of the Bay Area Air Basin.

Both CARB and the EPA have general oversight responsibilities to ensure that local, state, and federal rules and regulations, including the issuance of air pollution permits, are implemented consistent with PSD requirements and attainment and maintenance of the California standards and NAAQS. In most circumstances, mobile sources, such as vehicle traffic, are regulated by CARB.

A required by the Clean Air Act, the EPA identifies and sets standards to protect human health and welfare for six pollutants: ozone, carbon monoxide, particulate matter (PM_{10} and $PM_{2.5}$), sulfur dioxide, lead, and nitrogen oxide. The term "criteria pollutants" derives from the requirement that the EPA describe the characteristics and potential health and welfare effects of these pollutants. EPA periodically reviews new scientific data and may propose revisions to the standards as a result. The standards for the criteria pollutants – NAAQS – have been established and are shown in Table 3-4. Both primary (or

Table 3-4: Ambient Air Quality Standards and Bay Area Attainment Status

Pollutant	Averaging Time	California Standards[1]		National Standards[2]	
		Concentration	Attainment Status	Concentration[3]	Attainment Status
Ozone	8-Hour	0.070 ppm (137 µg/m^3)	See Note 9	0.08 ppm	N[4]
	1-Hour	0.09 ppm (180 µg/m^3)	N		See Note 5
Carbon Monoxide	8-Hour	9.0 ppm (10 mg/m^3)	A	9 ppm (10 mg/m^3)	A[6]
	1-Hour	20 ppm (23 mg/m^3)	A	35 ppm (40 mg/m^3)	A
Nitrogen Dioxide	Annual Average			0.053 ppm (100 µg/m^3)	A
	1-Hour	0.25 ppm (470 µg/m^3)	A		
Sulfur Dioxide	Annual Average			80 µg/m3 (0.03 ppm)	A
	24-Hour	0.04 ppm (105 µg/m^3)	A	0.14 ppm (365 µg/m3)	A
	1-Hour	0.25 ppm (655 µg/m^3)	A		

Pollutant	Averaging Time	California Standards[1]		National Standards[2]	
		Concentration	Attainment Status	Concentration[3]	Attainment Status
Particulate Matter (PM_{10})	Annual Arithmetic Mean	20 µg/m^3	N[7]	50 µg/m3	A
	24-Hour	50 µg/m^3	N	150 µg/m3	U
Particulate Matter – Fine ($PM_{2.5}$)	Annual Arithmetic Mean	12 µg/m^3	N[7]	15 µg/m3	A
	24-Hour			65 µg/m3	A
Sulfates	24-Hour	25 µg/m^3	A		
Lead	Calendar Quarter			1.5 µg/m3	A
	30-Day Average	1.5 µg/m^3	A		
Hydrogen Sulfide	1-Hour	0.03 ppm (42 µg/m^3)	U		
Vinyl Chloride (chloroethene)	24-Hour	0.010 ppm (26 µg/m^3)	No information available		
Visibility-Reducing Particles	8-Hour (1000 to 1800 Pacific Standard Time)	See Note 8	A		

Source: BAAQMD July 2005.
Notes:
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 CARB determines would occur less than once per year on the average. The Lake Tahoe carbon monoxide 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 fourth 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 µg/m3.
   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 June 2004, the Bay Area was designated as a marginal nonattainment area for the national 8-hour standard.
5. The national 1-hour ozone standard was revoked on June 15, 2005.
6. In April 1998, the Bay Area was redesignated to attainment for the national 8-hour carbon monoxide standard.
7. In June 2002, CARB established new annual standards for $PM_{2.5}$ and PM_{10}.
8. Statewide Visibility-Reducing Particles 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.
9. This standard was approved by the California Air Resources Board on April 28, 2005 and is expected to become effective in early 2006.

health-based) and secondary (or welfare-based) standards are provided for under the NAAQS. As already noted, a geographic area that meets or does better than the NAAQS is called an "attainment" area; areas that do not meet the NAAQS are called "nonattainment" areas.

Under state statutes, California regulations can be stricter than federal regulations. For example, in California there are ambient standards for vinyl chloride and hydrogen sulfide, and a visibility protection standard that regulates visibility-reducing particles. Criteria for determining violations of a state standard vary, depending on the pollutant, from any exceedance of the standard to a statistically-based test requiring multiple years of monitoring data. Also, the standards themselves vary from short-term average levels such as 83-hour or 24-hour concentrations, to annual average concentrations of a particular pollutant.

Five of the six criteria pollutants are potential by-products of FMP actions such as prescribed burning, wildland fire suppression, and mechanical fuel reduction treatments. The health and ecological effects of these five criteria pollutants are shown in Table 3-5. The sixth criteria pollutant – lead – is not a by-product of FMP actions, and current Bay Area Air Basin levels of lead would not be affected by implementation of the FMP alternatives.

Smoke from wild and prescribed fires is inventoried and managed differently from air pollution emissions. Wildfires are natural events and their emissions are addressed by the Environmental Protection Agency (EPA) Natural Events Policy. Emissions from prescribed fire are addressed by EPA's Interim Air Quality Policy on Wildland and Prescribed Fire. The states use these policy documents and other information in the development of the SIP. In accordance with the California Smoke Management Guidelines, BAAQMD manages smoke emissions from prescribed burning through a Smoke Management Program by regulating allowable burn days, reviewing burn plans, and coordinating the number of allowable burns per day. The goal of BAAQMD's smoke management program is to continue prescribed burning as a resource management tool while minimizing smoke impacts on public health in populated areas.

The San Francisco Bay Area Air Basin is a nonattainment area for the state standard for PM_{10} and $PM_{2.5}$ (particulate matter less than 10 microns and 2.5 microns in diameter, respectively), the state one-hour ozone standard, and in marginal non-attainment for the federal eight-hour ozone standard (see Table 3-4). Under the 1990 CAA amendments, the EPA was mandated to adopt conformity regulations for implementing Section 176 of the CAA. Under this provision and the implementing requirements of 1993, federal actions proposed in areas that exceed NAAQS must conform to the SIP. Since the area is in nonattainment for ozone and PM, federal actions, such as the GGNRA FMP, must conform to the federally approved SIP. Exceedance of federal standards cannot occur more than once per year for an area to stay in attainment. California ambient air quality standards (AAQS) are generally not to be exceeded at all.

Table 3-5: Health and Ecological Effects of the Federal Criteria Pollutants[1]

Federal Criteria Pollutant	Important By-Product of FMP Actions?	Principal Health and Ecological Effects
OZONE (O_3) Oxygen we breathe is 2 oxygen atoms (O_2) while ozone is 3 atoms (O_3). Ozone occurs in nature; it produces the sharp smell noticed near a lightning strike. High concentrations are found in the stratosphere, where ozone shields the Earth against harmful sunrays. Ground-level ozone is a component of smog produced by burning, especially coal, gasoline, and other fuels, and chemical emissions from products such as solvents and paints.	**No,** not a significant by-product.	• High levels can cause lung irritation and inflammation, wheezing, coughing, and breathing difficulties during exercise or outdoor activities. People with respiratory problems are most vulnerable, but healthy adults and children that exercise outdoors can be affected. • Repeated exposure to ozone pollution over several months may cause permanent lung damage. • Even at very low levels, ozone can aggravate asthma, reduce lung capacity, and increase susceptibility to respiratory illnesses like pneumonia and bronchitis. • Ozone interferes with the ability of plants to produce and store food, which can make them more susceptible to disease, insects, other pollutants, and harsh weather. • Ozone damages the leaves of trees and other plants, reducing crop and forest yields, and degrading the appearance of cities, national parks, and recreation areas.
CARBON MONOXIDE (CO) A colorless, odorless, poisonous gas, produced by incomplete burning of synthetic and carbon-based fuels, including gasoline, oil and wood.	**Yes,** CO is one by-product of the incomplete burning or smoldering of fuels during wildland fire, pile burning, and prescribed burning.	• Low levels of CO can be a serious threat for sufferers of heart disease, clogged arteries, or congestive heart failure. • Healthy people who breathe high levels of CO can develop vision problems, reduced ability to work or learn, reduced manual dexterity, and difficulty performing complex tasks. • At extremely high levels, CO is poisonous and can cause death. • CO contributes to the formation of smog (ground-level ozone), which can trigger serious respiratory problems.
PARTICULATE MATTER (PM) Includes dust, soot and other tiny bits of solid materials released into the air. PM_{10} particles are between 2.5 and 10 micrometers in size (25 to 100 times thinner than a human hair). Particles less than 2.5 micrometers are a California criteria pollutant and are referred to as $PM_{2.5}$.	**Yes,** PM is the main pollutant of concern associated with smoke.	• Breathing PM is linked to significant health problems, including eye, nose, and throat irritation; aggravated asthma; coughing and difficult or painful breathing; chronic bronchitis; decreased lung function; and premature death. • PM is a major source of visibility impairment in national parks. • PM can be carried long distances by wind before settling on ground or water. The effects can include making lakes and streams

Federal Criteria Pollutant	Important By-Product of FMP Actions?	Principal Health and Ecological Effects
		acidic, changing the nutrient balance in coastal waters and large river basins, depleting the nutrients in soil, damaging sensitive forests and farm crops, and affecting the diversity of ecosystems. • PM causes damage to cultural resources by eroding and staining (soot) structures such as monuments and statues.
NITROGEN OXIDES (NO_X) Highly reactive gases emitted primarily by fuel combustion and present in all urban atmospheres. NO_X is an important precursor to both ozone and acid rain. The reaction between NO_X and VOCs (volatile organic compounds) forms ozone or smog.	**Yes**, formed mainly by fuels burning at high temperatures.	• Smog can cause lung tissue damage and reduction in lung function in people working or exercising outside and people with lung diseases (e.g., asthma). • NO_X, sulfur dioxide, and other substances form acidic precipitation or dry particles in the air. Acid rain causes deterioration of vehicles, buildings, and historical monuments, and can degrade aquatic habitat as water becomes more acidic. • NO_X reacts with ammonia, moisture, and other compounds to form nitric acid that can affect breathing and cause permanent damage to lung tissue. • Small acidic particles can penetrate deeply into the lungs and can cause or worsen respiratory diseases such as emphysema and bronchitis, and aggravate heart disease. • Increased nitrogen loading in water bodies, particularly coastal estuaries, upsets the chemical balance of nutrients used by aquatic plants and animals and accelerates oxygen depletion. • NO_X accumulating in the atmosphere with other gasses is causing a gradual rise in the Earth's temperature with risks for human health, sea level rise, and habitat change. • NO_X reacts readily with common organic chemicals and ozone to form a wide variety of toxic products, some of which may cause biological mutations (nitroarenes and nitrosamines). • Nitrate particles and nitrogen dioxide can block the transmission of light, reducing visibility in urban areas and on a regional scale in national parks.

Federal Criteria Pollutant	Important By-Product of FMP Actions?	Principal Health and Ecological Effects
SULFUR DIOXIDE (SO_2) A gas consisting of one sulfur and two oxygen atoms. SO_2 converts to an aerosol that is a very efficient light scatterer. It can convert into acid droplets consisting primarily of sulfuric acid. Principally produced by coal- and oil-burning power plants.	**No,** not a significant by-product.	• High levels of SO_2 can cause temporary breathing difficulty for people with asthma who are active outdoors. Long-term exposure to SO_2 gas and particles can cause respiratory illness and aggravate existing heart disease. • Sulfate particles are the major cause of haze, which reduces visibility in many national parks. • SO_2 and nitrogen oxides react to form acids, which fall to earth as acidic rain or dry particles. Acid rain damages forests and crops, changes the makeup of soil, and makes lakes and streams acidic and unsuitable for fish. Continued exposure can change the natural variety of plants and animals in an ecosystem. • SO_2 accelerates the decay of building materials including irreplaceable monuments, statues, and sculptures.

Source: BAAQMD, 2004.
Note:
1. Five of six federal criteria pollutants could be emitted to the air by FMP actions. The sixth criteria pollutant, lead, would not be a by-product of the actions included in the FMP.

Section 176 of the Clear Air Act states that federal actions, such as implementation of the FMP alternatives, 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 SIP requirements.

GGNRA has historically ensured the conformity of fire management actions by ensuring that all prescribed burning is planned and implemented in accordance with the BAAQMD Smoke Management Program.

The overall attainment status of the Bay Area Air Basin with regard to the NAAQS and state AAQS is shown in Table 3-4.

Air Quality Monitoring Sources of Emissions within GGNRA

In order to assess and minimize the impacts of NPS activities such as fire management actions on air quality and other resources and values in GGNRA, the other current sources of air pollution within the parks need to be identified. An air emissions inventory was conducted in 1999 to determine the origins, compositions, and rates of emission of pollutants affecting park lands and resources (NPS 2000d). In addition to GGNRA activities, the inventory included air emissions associated with park partners and concessionaire operations and visitor activities to the extent that data were available. Standardized emission factors and air quality models from the California Air Resources Board (CARB) and the U.S. Environmental Protection Agency (EPA) were used to develop emission levels for the range of activities and facilities that can emit pollutants in GGNRA.

Sources of air emission within GGNRA include all three types identified by the Clean Air Act – stationary sources, area sources, and mobile sources. Stationary sources can include fossil fuel-fired space and water heating equipment, backup generators, fuel storage tanks, paint and chemical usage, and woodworking equipment. Area sources may include prescribed burning, campfires, and bonfires. Mobile sources may include vehicles and other equipment operated within the park by visitors, tour operators, GGNRA employees, and concessionaire employees.

The emissions inventory included all lands and uses within the FMP planning area with the exception of the Presidio, which is primarily under the management of the Presidio Trust, a separate federal agency. Included in the inventory were all structures, vehicles, boats, and equipment used by the park, park partners, or concessionaires, such as the Blue and Gold Fleet that operates the ferry service to Alcatraz Island.

As shown in Tables 3-6 and 3-7, carbon monoxide (CO) and particulate matter (PM) emissions from prescribed burning, although not major by CAA definitions, were the largest air emission sources generated at GGNRA for the year 1998,when the emissions inventory was calculated. Three prescribed burns were conducted that year totaling 123 acres. Table 3-6 shows how lighter fuels, such as the grasses burned at the Pablo and Whitegate prescribed burns, emit much lower levels of emissions per acre than shrublands or forested areas. Table 3-7 compares the annual emissions estimated for all stationary, mobile, and area sources at GGNRA as part of the 1998 emissions inventory.

Table 3-6: GGNRA 1998 Prescribed Burning Emissions

Fire Name	Acres	Fuel Type	PM_{10} (lbs/yr)	SO_2 (lbs/yr)	NO_X (lbs/yr)	CO (lbs/yr)	VOC (lbs/yr)
Pablo	35	Grass	1,400	190	2,530	10,530	0
Whitegate	50	Grass	2,000	275	3,600	15,040	0
Ben Johnson	38	Timber	16,250	210	2,740	151,700	8,700
Total	123		19,650	675	8,870	177,270	8.700

Source: NPS 2000d, GGNRA Emission Inventory 1998.

PM_{10} = particulate matter NO_X = nitrogen dioxide VOC = volatile organic compounds
SO_2 = sulfur dioxide CO = carbon monoxide lbs/yr = pounds per year

Table 3-7: Summary of Annual Emissions from Stationary and Area Sources

Activity	Particulates		Sulfur Dioxide		Nitrogen Oxides		Carbon Monoxide		VOCs (ozone precursor)	
	lbs/yr	tons/yr	lbs/yr	tons/yr	lbs/yr	tons/yr	lbs/yr	tons/yr	lbs/yr	tons/yr
Stationary Combustion Sources										
Space and Water Heating Units	958	0.48	50	0.03	29,220	14.61	4,650	2.33	714	0.36
Generators	33	0.02	31	0.02	470	0.24	101	0.05	38	0.02
Fireplaces	484	0.24	6	0.00	36	0.02	3,536	1.77	3,206	1.60
Combustion Emission Subtotal	1,475	0.74	87	0.05	29,726	14.87	8,287	4.15	3,958	1.98
Area Sources										
Campfires	129	0.06	–	–	30	0.02	1,060	0.53	144	0.07
Beach Fires	39	0.02	–	–	9	0.00	322	0.16	44	0.02
Prescribed Burns	19,650	9.83	190	0.10	8,870	4.44	177,270	88.64	8,700	4.35
Area Source Emission Subtotal	19,818	9.91	190	0.10	8,909	4.46	178,652	89.33	8,888	4.44
Vehicles										
Visitor Vehicles	870	0.44	–	–	394	0.20	2,804	1.40	214	0.11
GGNRA Vehicle	Not Available									
Park Partner/Concession	Not Available									
Vehicle Emission Subtotal	870	0.44	–	–	394	0.20	2,804	1.40	214	0.11
Ferry Vessels										
Blue and Gold Fleet Vessels	15,780	7.89	13,930	6.97	331,000	165.50	106,600	53.30	26,900	13.45
Totals										
Totals	Particulates		Sulfur Dioxide		Nitrogen Oxides		Carbon Monoxide		VOCs	
	lbs/yr	tons/yr	lbs/yr	tons/yr	lbs/yr	tons/yr	lbs/yr	tons/yr	lbs/yr	tons/yr
	37,943	18.98	14,207	7.12	370,029	185.03	293,343	148.18	39,960	19.98

Source: NPS 2000d, GGNRA Emission Inventory 1998.
VOCs = volatile organic compounds lbs/yr = pounds per year tons/yr = tons per year

There are no air quality monitoring stations in operation for the coastal areas of the Bay Area Air Basin that are certain to represent air quality conditions within GGNRA. A monitoring station at Fort Cronkhite in the Marin Headlands records levels of toxins present in the air as a by-product of manufacturing, such as acetone and benzene, and does not monitor for criteria pollutants. The closest monitoring stations to GGNRA lands that record levels of criteria pollutants are in the eastern halves of the three GGNRA counties in the cities of San Rafael, Redwood City, and eastern San Francisco. The levels recorded at these stations, which are based in the midst of urbanized development, would be more representative of the cumulative levels of air pollutants in urbanized areas that contain heavily trafficked roadways, urban and residential sources, and existing stationary sources throughout the air basin. Data collected at these

stations can serve as very conservative estimates of ambient air quality affecting the parklands, which are largely coastal and generally upwind (based on prevailing wind direction) of local sources of Bay Area air emissions, but are still subject to pollutant problems such as ozone that have a more regional effect on air quality. However, the actual ambient pollutant concentrations within the parklands are anticipated to have lower background levels of these pollutants because the project area and surroundings are more remote and generally upwind of roadways and other emission sources.

As shown in Table 3-4, the nine-county San Francisco Bay Area Air Basin (consisting of seven entire counties and parts of two counties) is in nonattainment for the state PM_{10} and $PM_{2.5}$ standards and federal and state ozone standards. Attainment status is based on air basin-wide air quality, e.g., if one monitoring station in the air basin records qualifying exceedances to the standards, the entire air basin is judged nonattainment. On July 10, 1998, EPA published a final rule (63 FR 37258) designating the San Francisco Bay Area as nonattainment with the federal 1-hour ozone NAAQS, but did not assign the Bay Area a classification. Then on July 22, 1999, EPA published a final rule (64 FR 39416) assigning the area a nonattainment classification of moderate for purposes of funding appropriation under the Transportation Equity Act for the 21st Century (TEA 21), Congestion Mitigation and Air Quality improvement Program (CMAQ) only. In the April 15, 2004 *Federal Register*, the EPA also designated the Bay Area nonattainment for the 8-hour ozone NAAQS and classified the region as marginal, which indicates an attainment date of June 2007. The 1-hour ozone nonattainment status for the area will only be in effect until the area demonstrates attainment of that standard or until the State of California develops an approvable 8-hour SIP, whichever occurs first.

Table 3-8 shows how attainment status would vary from county to county and presents the attainment status for the three-county area with respect to the state and federal ambient air quality standards for criteria pollutants. . All three counties have a higher overall conformance with federal and state standards than the full air basin. For example, Table 3-9 details the ambient ozone monitoring status for the three monitoring stations in the GGNRA counties. The three stations in the GGNRA counties have similar trends: each station complies with the federal standards for both 1-hour and 8-hour NAAQS and, with the exception of one day of exceedance occurrence recorded at the Redwood City station, all three conform to the stricter state 1-hour ambient standard (see Tables 3-8 and 3-9). Generally, the monitoring stations in the three GGNRA counties recorded air quality that meets federal and state standards.

However, on a broader scale, the San Francisco Bay Area as a whole is designated by the EPA as nonattainment for both the 1-hour and the new 8-hour ozone NAAQS. These nonattainment designations are based on ambient monitoring conducted in the nine-county Bay Area air basin. As mentioned above, although the county monitoring stations indicate attainment of the ozone 8-hour NAAQS, in the summer of 2004, the EPA designated the entire Bay Area Air Basin as nonattainment for ozone. The three stations representing the GGNRA counties meet the federal and state standards for carbon monoxide, nitrogen dioxide, and sulfur dioxide, and the federal standard for particulate matter less than 10 microns in diameter. All three sites have one or more exceedances recorded for 24-hour maximum standard for PM_{10} of 50 micrograms per cubic meters but have been in conformance with the less stringent federal annual average standard of 150 micrograms per cubic meter or less (BAAQMD 2004).

Table 3-8: County Variation in Attainment Status*[1]
Demonstrated by Monitoring Station Data, 2001–2003

Pollutant	Redwood City San Mateo County		San Francisco San Francisco County		San Rafael Marin County	
	State Standard	Federal Standard	State Standard	Federal Standard	State Standard	Federal Standard
Ozone (1-hour)*	N	NA	A	NA	A	NA
Ozone (8-hour)	NA	NA	NA	NA	NA	NA
Carbon monoxide	A	A	A	A	A	A
Nitrogen dioxide	A	A	A	A	A	A
Sulfur dioxide	ND	ND	A	A	ND	ND
Particulate matter (PM_{10}) (Max. 24-hour)	NA	A	N	A	NA	A

Source: BAAQMD Annual Bay Area Air Quality Summary 2003
Notes:

A = Attainment N = Nonattainment U = Unclassified NA = Not Applicable ND = No Data

[1] The EPA does not designate areas for the lead standard in the same manner as for other pollutants. There are no areas in California that exceed the federal standard for lead.

* Attainment status is assigned only on an air-basin level. Though specific county monitors indicate attainment with NAAQS, all counties are included in the San Francisco Bay Area Air Basin, which is designated as a nonattainment area for 1-hour and 8-hour ozone national standards and for state standards for PM_{10}.

The annual ambient air quality standard for particulate matter in California became more stringent in 2004. Federal and state standards for particulate matter of 2.5 microns in diameter or less are now enforced as sufficient baseline monitoring data has been collected. EPA and the State of California are designating all areas of the state as attainment, unclassified, or nonattainment based on availability of ambient monitoring data. The federal 24-hour standard will be attained when 98 percent of the daily concentrations, averaged over three years, are equal to or less than the standard. Averaging of $PM_{2.5}$ emissions over several years would prevent spikes from overly influencing data collection for purposes of determining average ambient levels. Events that could lead to spikes could include a large wildfire that would otherwise have impressive yet short-term effects.

Project activities are expected to be minimally affected by implementation of the new national standards for ozone and $PM_{2.5}$, 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 compliance with all applicable rules and regulations. Moreover, the NPS is required under Section 118 of the CAA to comply with all applicable local, state, and federal rules and regulations to help ensure that all ambient air quality standards are attained and maintained.

Table 3-9: Ozone Levels at Monitoring Stations in the Three Counties with GGNRA Lands, 2001-2003

	1-Hour Standard (0.09 pphm State/0.12 pphm Federal)				8-Hour Standard (0.08 pphm Federal)		
Monitoring Station (County)	**Maximum Level (1-hour)[1]**	**Number of Days Exceeding Federal Standard[2]**	**Number of Days Exceeding State Standard[3]**	**3-Year Average (days)[4]**	**Maximum Level (1-hour)[1]**	**Number of Days Exceeding Federal Standard[2]**	**3-Year Average (pphm)[5]**
San Rafael (Marin County)	0.09 ppm	0	0	0.0	0.07 ppm	0	0.04.9 ppm
San Francisco (SF County)	0.09 ppm	0	0	0.0	0.06 ppm	0	0.04.8 ppm
Redwood City (San Mateo County)	0.11 ppm	0	1 day	0.0	0.08 ppm	0	0.05.8 ppm

Source: Bay Area Pollution Summary 2003.

Notes:

pphm = parts per hundred million ppm = parts per million

[1] The highest average contaminant concentration over a 1-hour or 8-hour period in parts per million.

[2] The number of days during the year for which the monitoring station recorded contaminant concentrations in excess of the federal standard.

[3] The number of days during the year for which the monitoring station recorded contaminant concentrations in excess of the state standard.

[4] For the 1-hour ozone standard only, 3-year average is the average number of days per year during which ozone levels were in excess of the federal 1-hour standard, based on the most recent 3-year period. An average higher than 1.0 means the region will be considered nonattainment by the EPA.

[5] For the 8-hour ozone standard only, the 3-year average is the fourth highest 8-hour average ozone concentration for each monitoring station. A 3-year average greater than 8.4 at any monitoring station means that the region will be considered nonattainment by the EPA.

Also, with the disclosure of projected worst case emissions envisioned in this EIS for GGNRA, it is the intent of the NPS to ensure that state and local air management authorities include these emissions in the area's emissions budget used for 8-hour ozone (and $PM_{2.5}$, if necessary) SIP development activities. Incorporation of emissions generated from NPS activities and facilities at GGNRA during SIP planning would make it unnecessary for the NPS to conduct SIP conformity determinations or demonstrations under Section 176(c) of the CAA on a project-by-project basis. This accountability by air management authorities would ensure that GGNRA emissions conform to the SIP, by definition.

Influence of Climate and Topography on Smoke Dispersion and Air Quality

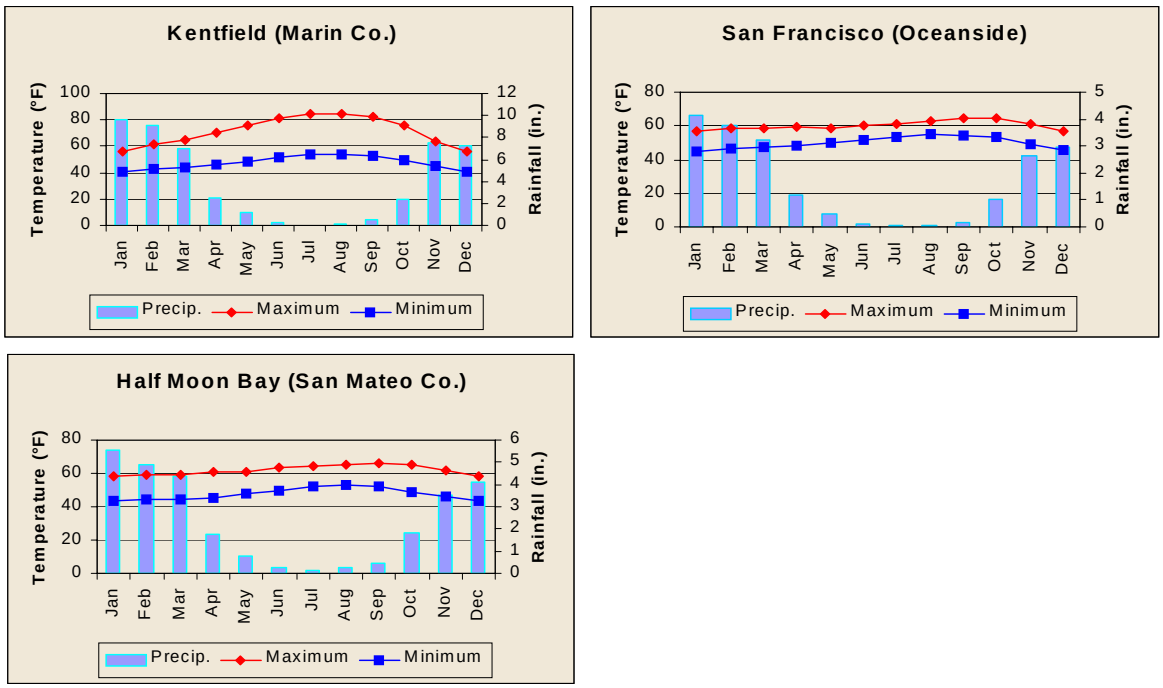
The weather pattern of the project area, along with much of the West Coast, is controlled by a semi-permanent high-pressure system centered over the northeastern Pacific Ocean a thousand miles or so offshore. This mass of air is referred to as the Pacific High (Gilliam 2002, BAAQMD 1998). Precipitation from late fall through spring provides significant moisture. In the summer, the relatively northern location of this strong high-pressure system results in clear skies and dry weather away from the coast, such as at the Phleger Estate, while coastal parklands such as Pedro Point or the Marin Headlands can be in dense fog. Because of the fog, humidity, and cool temperatures, vegetation dries out more slowly on the coast, reducing the summer fire hazard. 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 reduce vegetation moisture levels throughout GGNRA 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.

Generally cool and mild temperatures characteristic of the coastal part of central California prevail throughout the year in GGNRA. The seasonal range of temperatures is small; this is in keeping with the predominant flow of marine air that moves over the area. Average winter temperature ranges from 48 to 53 degrees Fahrenheit (F) with minimums from 45-50 degrees F. Summer average temperatures range from 55 to 65 degrees F with maximums of 64 to 70 degrees F (SWA Group 1975). Temperatures below freezing are expected on clear nights in winter and early spring, when extensive cold-air drifts occur in the gullies and canyons (see Figure 3-7).

Spring weather is highly variable in GGNRA. Cold gusting winds typical in winter months often continue into early spring. This is caused by northwest winds intensifying with the Pacific High. The Pacific High causes upwelling of offshore ocean water. The upwelling waters cool the air, causing condensation of moisture and subsequent formation of a thick fog bank. (The strongest upwelling tends to occur in August.) The fog bank intermittently hangs along the coast throughout the late spring and summer, though warm, calm days in the spring season may occur.

Figure 3-7: GGNRA Regional Climate – 1971-2000 Monthly Normals



Source: National Weather Service, 2004.

During the summer, the Pacific High typically moves farther north, causing stronger cooler winds to move inland from the ocean. These moisture-laden offshore winds cross cold coastal upwelling zones to form the fogs, which pour through gaps in the Coast Ranges (Azevado and Morgan 1974). Within GGNRA are several gaps that channel air through the hills and allow fog blocked by the main ridges of GGNRA to reach the bay. The Golden Gate is the largest gap and as such it has the most significant influence on Bay Area climate, but other gaps function as “little Golden Gates” (Gilliam 2002). Immediately north of the Golden Gate there are three gaps: a narrow one at Tennessee Valley, a higher one above Muir Woods National Monument, and one at Nicasio Gap in West Marin near the valley created by the Tomales Bay and the San Andreas Fault. On the San Francisco peninsula, there are two important gaps at San Bruno and at Crystal Springs. The San Bruno Gap extends from the west at Fort Funston to the San Francisco International Airport on the bay. The gap is oriented in the same direction as prevailing winds and the low elevation (less than 200 feet) allows marine air to flow easily toward the bay (BAAQMD 1998). The gap is second only to the Golden Gate in its influence on Bay Area climate (Gilliam 2002). The San Andreas Fault has created another gap in the coastal range called the Crystal Springs Gap, which lies along the Highway 92 corridor between Half Moon Bay and San Carlos. The low point is 900 feet with elevations of 1,500 feet north and south of the gap. This gap facilitates a cooling effect commonly seen from San Mateo to Redwood City (BAAQMD 1998).

As the cool, moisture-laden fog moves in through the gaps, it slides beneath the warm air layer and continues to push up as more and more cool air flows in. This phenomenon creates an inversion layer with temperatures actually increasing at higher elevations. The height of the inversion, which marks the boundary between the two contrasting layers, is variable but averages from 1,500 to 2,000 feet. Characteristically, this layer of clouds extends inland farther during the night and then recedes to the vicinity of the coast during the day. By comparison, spring inversion layers typically reach about 200 feet (61 meters) in elevation. Some of the coldest weather in GGNRA occurs during the summer when fog created by cooled surface air meets warm air.

In the summer, rainstorms are usually blocked by the Pacific High. Rainfall from May through September is relatively rare, with an aggregate of less than an inch, or only about five percent of the yearly average. During the spring and summer months, coastal fog normally keeps fuels moist from the ridges to the coast. The amount of additional moisture deposited by fog drip is a function of the presence and the type of vegetation as well as local topography. For example, Oberlander (1956) found a range of 1.8 to 58.8 inches of additional precipitation from fog drip, with trees with direct seaward exposure receiving more moisture, followed by a gradual decline in precipitation to the east and downslope. The taller the trees, the greater the amount of fog drip deposited.

While the coastal areas of GGNRA are often foggy during the summer, the surface of the eastern portion of GGNRA is warmer. The warm air evaporates any fog approaching from the west; thus fog rarely reaches areas to the east like Fort Baker.

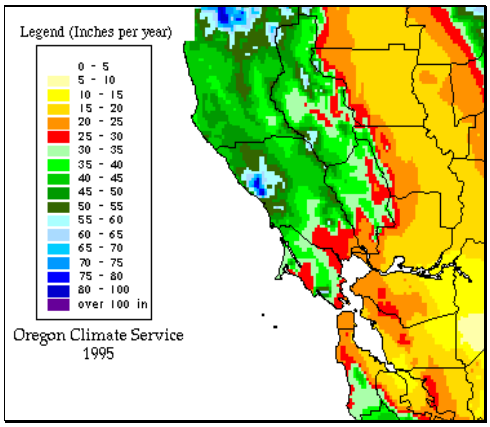
September and October are usually the two warmest months of the year (Western Regional Climate Center 2004). In autumn, the Pacific High begins to move south, winds decrease, and an inversion layer forms, usually at 1,500 feet above sea level. Inversions during the fall can act as a nearly impenetrable lid

to the vertical mixing of pollutants level and are particularly conducive to concentrating pollutants, such as CO from auto exhaust, emitted close to the ground.

In winter, when the Pacific High weakens and shifts southward, upwelling ceases, and winter storms become frequent. During the winter rainy periods, inversions are weak or nonexistent, winds are often moderate, and air pollution potential is very low. With a strong high-pressure area over the Great Basin and an intense low-pressure area approaching the coast from the west, strong and sometimes damaging winds occur, usually from an easterly or southeasterly direction. As the storms move inland, the winds veer to southerly and southwesterly directions, and high wind speeds may occur anywhere in GGNRA with the greatest velocities at high elevations. Occasionally, the Pacific High becomes dominant, and surface-based inversions become strong and pollution potential is high. These periods are characterized by winds that flow out of the Central Valley into the Bay Area and often include tule fog (BAAQMD 1998).

Over 80 percent of GGNRA's seasonal rain falls between November and March, with a mean number of 66 days with measurable rain. The yearly average ranges from 20 to 25 inches in San Francisco, and from 20 to 60 inches in Marin and San Mateo counties. Winter thunderstorms occur on the average only twice per season in cold unstable post-frontal air masses (Golden Gate Weather Services 2002). GGNRA generally has a high diversity of microclimates, particularly in its rainfall patterns. Within a distance of only a few miles in GGNRA there can be more than a 50-percent difference in average annual rainfall (e.g., from 25 to 52 inches) (see Figure 3-8) (Oregon Climate Service 1995).

Figure 3-8: Annual Average Precipitation in Inches



Source: Oregon Climate Service, 1995.

Localized Effects of Climate and Topography Influence on Smoke Dispersion

Marin County

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, and are typically in the high 50s in the winter and low 60s in the summer. The warmest months are September and October, with temperatures into the mid- to upper 60s (BAAQMD 1998).

The eastern side of Marin County has warmer weather and less fog. This is due less to the blocking effect of the hilly terrain to the west, but more to the area's distance from the ocean. Although there are a few mountains above 1,500 feet, most of the terrain is only 800 to 1,000 feet high. Much of time, this is not high enough to block the marine layer, which averages 1,700 feet in depth. Because of the wedge shape of the county, areas to the north are farther from the ocean. This extra distance from the ocean allows the marine air mass to be heated before it arrives at eastern Marin County cities. In southern Marin County, the travel distance is short and the elevations lower, so there is a higher incidence of cool, unmodified, maritime air (BAAQMD 1998).

Cities next to the bay have their temperatures somewhat moderated. For example, San Rafael, being near the bay, experiences average maximum winter temperatures in the high 50s to low 60s, and average maximum summer temperatures in the high 70s to low 80s. Inland areas, such as Kentfield, experience average maximum temperatures two degrees cooler in the winter and two degrees warmer in the summer. Average minimum temperatures in San Rafael are in the low 40s in winter and low 50s in summer. Minimum temperatures farther inland in Kentfield are two degrees cooler all year (BAAQMD 1998).

Wind speeds are highest along the western coast of Marin, about 8 to 10 miles per hour. 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 the former Hamilton Air Force Base in eastern Marin County, the annual average wind speeds are only 5 miles per hour. The prevailing wind directions throughout Marin County show less variation, and are generally from the northwest (BAAQMD 1998).

The mountainous terrain in Marin County has higher rainfall amounts than most parts of the Bay Area with the exception of the southern Santa Cruz Mountains. Areas near Mount Tamalpais have rainfall amounts twice as high as the rest of the Bay Area, with San Rafael reporting an average of 37.5 inches per year and Kentfield reporting 49 inches per year (BAAQMD 1998).

Smoke problems are likeliest on the eastern side of Marin County. This is where the semi-sheltered valleys and largest population centers are located. Most urban development is located along the bay, particularly in southern Marin. In the south, where distances to the ocean are short, the influence of the marine air will keep smoke levels low. Farther north where the valleys are more sheltered from the sea breeze, the potential for greater smoke accumulation is higher (BAAQMD 1998).

San Mateo County

The peninsula region of GGNRA extends from the Golden Gate south to the Phleger Estate in Woodside. The Santa Cruz Mountains extend up the center of the peninsula, with elevations exceeding 2,000 feet at the south end, and gradually decreasing to 500 feet near South San Francisco. Coastal towns such as Half Moon Bay and Pacifica experience a high incidence of cool, foggy weather in the summer. The larger cities on the eastern side of the peninsula experience warmer temperatures and few foggy days, because of the blocking effect of the 2,000-foot ridge to the west. At the north end of the peninsula lies San Francisco, where most elevations are less than 200 feet and the marine layer is able to flow across nearly all of the city, making its climate cool and windy (BAAQMD 1998).

The blocking effect of the Santa Cruz Mountains can be seen in the summertime maximum temperatures. For example, at Half Moon Bay and San Francisco, the maximum daily temperatures in June through August are 62 to 64 degrees Fahrenheit, F, while on the eastern side at Redwood City, the maximum temperatures are in the low 80s for the same period. Daily maximum temperatures throughout the peninsula during the winter months are in the high 50s. Large temperature gradients are not seen in the minimum temperatures, which range from the 40s to 50s (BAAQMD 1998).

Annual average wind speeds range from 5 to 10 miles per hour throughout the peninsula. The tendency is for the higher wind speeds to be found along the western coast. However, winds on the eastern side of the peninsula can also be high in certain areas because low-lying areas in the mountain range, i.e., San Bruno Gap and Crystal Springs Gap, commonly allow the marine layer to pass across the peninsula (BAAQMD 1998). While prevailing winds are westerly along the peninsula's western coast, individual sites can show significant differences. For example, Fort Funston has a southwest wind pattern, while Pillar Point in San Mateo County has a northwest wind pattern. A rise in elevation of ridgelines by a few hundred feet will induce wind flow around that feature instead of over it during stable atmospheric conditions. This can change the wind pattern by as much as 90 degrees over short distances. On mornings without a strong pressure gradient, areas on the eastern side of the peninsula often experience eastern flow in the surface layer, induced by upslope flow on the east-facing slopes and by the bay breeze. The bay breeze is rarely seen after noon because the stronger sea breeze dominates the flow pattern (BAAQMD 1998).

Rainfall amounts on the eastern side of the peninsula are somewhat lower than on the western side. San Francisco and Redwood City report an average rainfall of 19.5 inches per year, while Half Moon Bay reports 25 inches per year. Areas to the south in the Santa Cruz Mountains have significantly higher rainfall, especially west of the ridgeline, due to elevation-induced condensation, close proximity to a moisture source, and fog drip.

Smoke accumulation potential is highest along the southeastern portion of the peninsula because this area is most protected from the high winds and fog of the marine layer, the emission density is relatively high, and smoke transport from upwind sites is possible. In San Francisco, wind speeds are generally fast enough to carry any smoke away before it can accumulate (BAAQMD 1998).

3.4 Biological Environment

Plant Communities

The vegetation of GGNRA is a result of the juxtaposition of physical landforms and water masses, associated geology, climate, and history. The moist maritime climate along the coastline is a dominant influence, while the park's east-facing sites are subject to drier inland conditions. Distinct changes in soils from the rich conditions of the Franciscan mélange to the unique chemistry of serpentinitic outcrops have created a diverse mosaic of vegetation communities. Natural processes that affect these patterns add another layer of complexity to the system, with landslides, rainfall patterns, and fires. GGNRA is known to support 572 native and 336 nonnative terrestrial plant species, including 25 federally listed threatened and endangered plant and wildlife species.

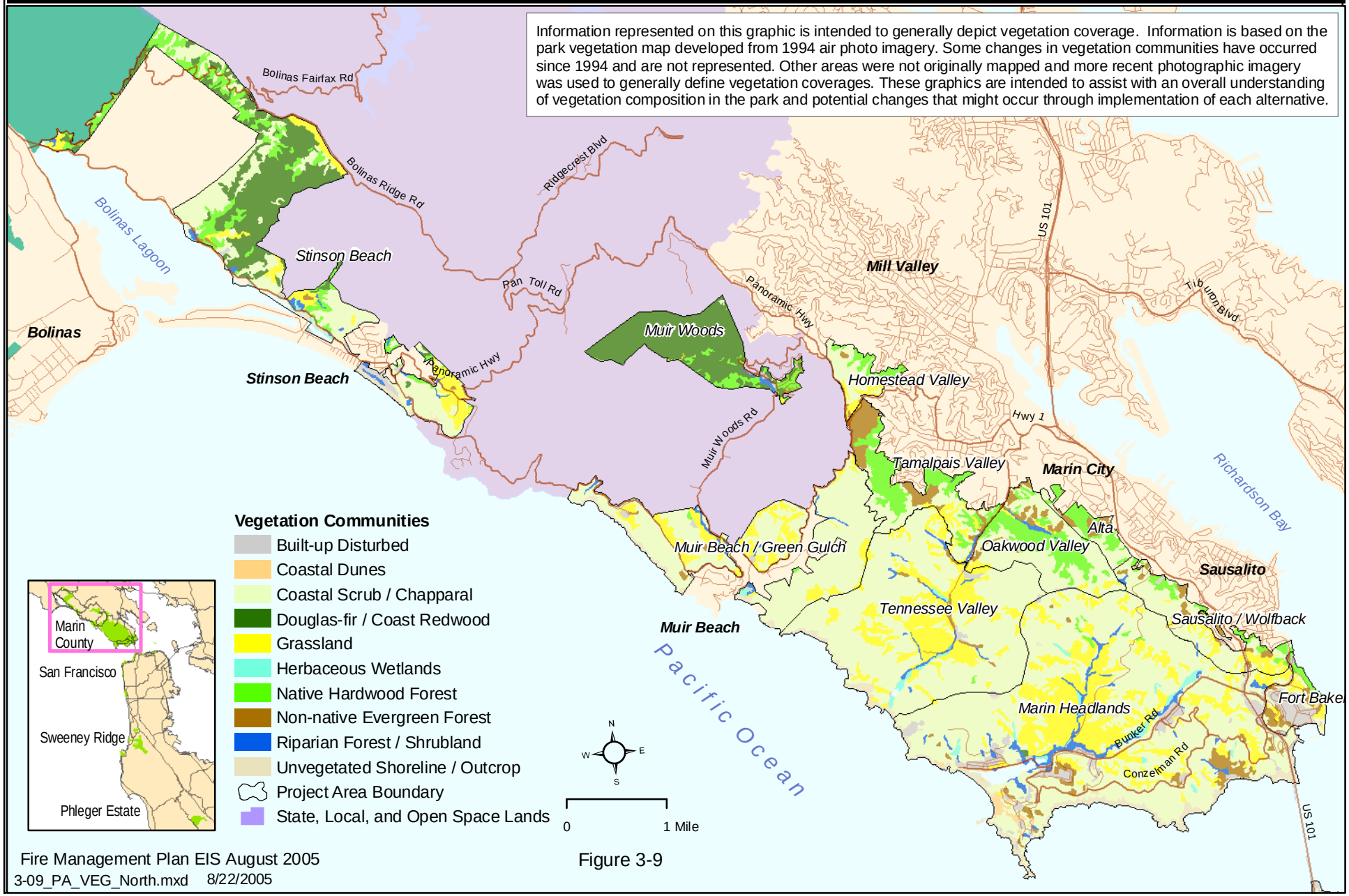
Fires can play a significant role in Mediterranean ecosystems such as those found in GGNRA. Many plants are adapted to fire, and tree growth rings in some portions of the park document significant fire histories. Mediterranean plant communities change in the absence of fire, and fuels can build up to hazardous proportions. These hazardous fuel buildups create highly flammable conditions, particularly in native chaparral and introduced forests. The FMP will not distinguish between the roles of Native American and lightning fires. It will recognize that Native American burning occurred more often than lightning fires. The intention is not to duplicate Native American burning but to recognize that it influenced fire frequency and the vegetative mosaic. In general, disturbances by fire have gone from long intervals in the pre-human era to shorter intervals in the Native American, Spanish-Mexican, and early Anglo eras, back to long intervals in the modern era (see "Fire Regimes" section above). The vegetation patterns exhibited today have been largely influenced by these changes.

The vegetation of GGNRA was mapped and incorporated into the park's Geographic Information System (GIS) using aerial photography and interpolation in 1994. This mapping effort used the National Vegetation Classification System, with groupings based on structure and environmental factors such as elevation and hydrologic regime, resulting in over 80 vegetation alliances. For the FMP, these alliances have been grouped into 10 different vegetation communities for the purposes of analysis: Coastal Dunes, Unvegetated Shoreline and Rock Outcrops, Builtup/Developed/Disturbed, Coastal Scrub and Chaparral, Grasslands, Herbaceous Wetlands, Riparian Forest and Scrub, Native Hardwood Forest, Douglas-Fir and Coast Redwood, and Nonnative Evergreen Forest (see Figures 3-9 and 3-10). Each "community" has been defined by overall species composition, structure, geographic location, and fire dependency/adaptation. Acreages and overall distributions are based on the 1994 GGNRA vegetation map, and are rounded to the nearest acre (see Table 3-10). These FMP communities correspond most closely to the "community level" of the vegetation map classification hierarchy; however, some communities have been grouped where fire and fire effects have little to no influence on overall distribution and structure. Three of these "communities" either have no fire management objectives or are unlikely to support fire, and are not described further in the document: Coastal Dunes, Unvegetated Shoreline and Rock Outcrops, and Builtup/Developed/Disturbed areas.

Fire Management Project Areas and Vegetation Types

Marin County

National Park Service
U.S. Department of the Interior
Golden Gate National Recreation Area



Fire Management Plan EIS August 2005
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Figure 3-9

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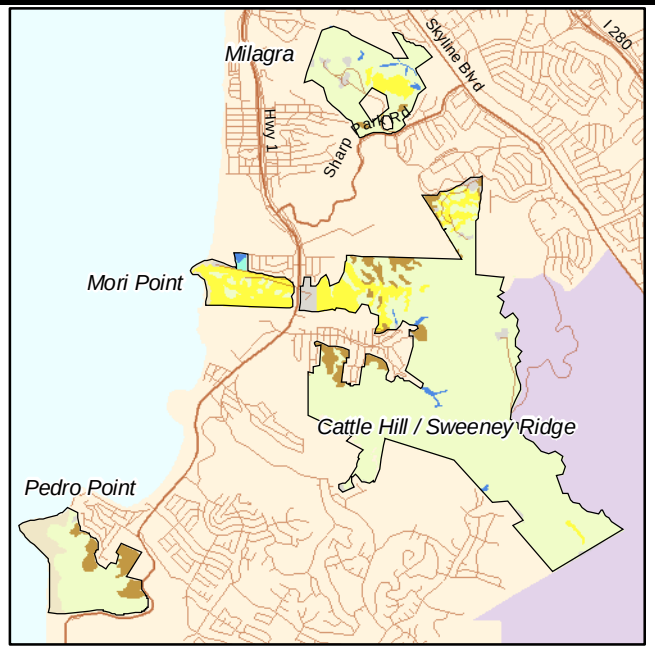
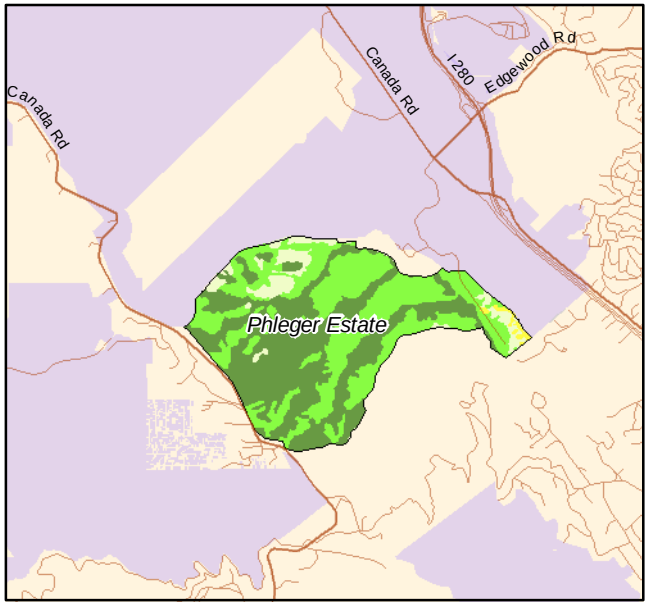
Fire Management Project Areas and Vegetation Types

San Francisco and San Mateo County

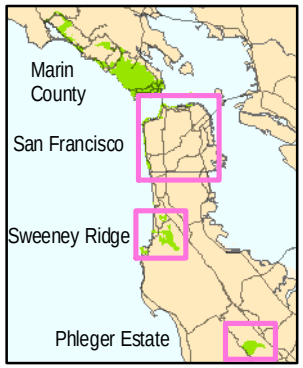
National Park Service
U.S. Department of the Interior
Golden Gate National Recreation Area





Vegetation Communities

- Built-up Disturbed
- Coastal Dunes
- Coastal Scrub / Chapparal
- Douglas-fir / Coast Redwood
- Grassland
- Herbaceous Wetlands
- Native Hardwood Forest
- Non-native Evergreen Forest
- Riparian Forest / Shrubland
- Unvegetated Shoreline / Outcrop
- Project Area Boundary
- State, Local, and Open Space Lands



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Information represented on this graphic is intended to generally depict vegetation coverage. Information is based on the park vegetation map developed from 1994 air photo imagery. Some changes in vegetation communities have occurred since 1994 and are not represented. Other areas were not originally mapped and more recent photographic imagery was used to generally define vegetation coverages. These graphics are intended to assist with an overall understanding of vegetation composition in the park and potential changes that might occur through implementation of each alternative.

Figure 3-10

Fire Management Plan EIS August 2005

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Table 3-10: Acres Within Each General Vegetation Class By Project Area

Project Area	FMU	County	Acres	Developed	Coastal Dunes	Coastal Scrub/ Chaparral	Douglas-Fir/ Coast Redwood	Grassland	Herbaceous Wetlands	Native Hardwood Forest	Nonnative Evergreen Forest	Riparian Forest/ Shrubland	Unvegetated Shoreline/ Outcrop
Alta	WUI	Marin	**153**			55				60	38		
Fort Baker	WUI	Marin	**178**	75		34		26		12	31		
Homestead Valley	WUI	Marin	**166**			94		23		44	5		
Marin Headlands	Park Interior	Marin	**3,667**	202	30	2,230	3	785	53	11	92	116	145
Milagra Ridge	WUI	San Mateo	**245**	10		204		23			3	5	
Mori Point	WUI	San Mateo	**110**	3		15		79	3			2	8
Muir Beach/ Green Gulch	WUI/Park Interior	Marin	**1,202**	15		905		208	4	3	11	25	31
Muir Woods National Monument	Muir Woods	Marin	**558**	6		2	472	2		59	2	15	
Oakwood Valley	WUI/Park Interior	Marin	**567**	2		310		27		171	45	12	
Phleger Estate	WUI	San Mateo	**1,205**			82	556	9		558			
San Francisco	WUI	San Francisco	**923**	347	150	69				8	122	75	152
San Pedro Point	WUI	San Mateo	**229**	1		142					33		53
Stinson Beach	WUI/Park Interior	Marin	**1,683**	38		555	561	172	13	265	10	34	35
Sweeney Ridge/ Cattle Hill	WUI	San Mateo	**1,432**	29		1,231		95			64	13	
Tam. Valley	WUI	Marin	**495**	3		147	1	42		188	109	5	
Tennessee Valley	Park Interior	Marin	**1,928**	16		1,348		453	19	2	18	30	42
Wolfback/ Sausalito	WUI	Marin	**398**	14		231		60		49	41	3	
Total			**15,139**	**761**	**180**	**7,654**	**1,593**	**2,004**	**92**	**1,430**	**624**	**335**	**466**

Source: NPS, GGNRA Fire Management Office, 2004.

FMU = Fire Management Unit WUI = Wildland Urban Interface

The vegetation communities of concern from a fire management standpoint are described below in detail in terms of overall vegetation composition, fire ecology, and management objectives. The communities consist of:

Coastal Scrub and Chaparral
Grasslands
Herbaceous Wetlands
Riparian Forest and Scrub
Native Hardwood Forest
Douglas-Fir and Coast Redwood
Nonnative Evergreen Forest

Coastal Scrub and Chaparral

General Characteristics

The coastal scrub community is dominated by coyote brush (*Baccharis pilularis*), California sagebrush (*Artemisia californica*), bush lupine (*Lupinus arboreus*), and poison oak (*Toxicodendron diversilobum*), with variations in dominant species based on moisture levels, soil types and slopes, and past land use history (Howell 1970). This community intergrades and creates a mosaic with the grassland community, and is found throughout the park from near sea level to 2,500 feet. The coastal scrub community also contains large numbers of nonnative species, and at times is dominated by nonnative shrubs such as French broom (*Genista monspessulana*) and thoroughwart (*Ageratina adenophora*). Chaparral stands, although not abundant at GGNRA, contain a high number of locally to regionally rare species of concern for the park, and are contiguous with coastal scrub stands. Small communities of chaparral exist in Muir Woods and the Marin Headlands, as well as larger areas on Bolinas Ridge. There are several types of chaparral in GGNRA, including chamise chaparral, ceanothus chaparral, and manzanita chaparral.

Fire Ecology

Most species in the coastal scrub and chaparral communities are adapted to fire, sprouting being the most common adaptation. Species that do not sprout often have fire-resistant seeds that retain viability for years. Almost all of the germination cues identified for these species are related to fire: heat, chemicals leached from charred wood, release from toxic compounds, increased light, and stratification (Parker and Kelly 1989).

Fire is often used to convert brushland, such as coastal scrub and chaparral, to grassland. This can be accomplished through a series of successive burns in close proximity to each other, and may kill new brush seedlings before they produce seed (Emrick and Adams 1977). Vogl (1977) observed that coastal scrub communities can result from premature burning or increased fire frequency within chaparral.

Timing of prescribed burns and the resulting intensity can drastically influence post-fire revegetation (Parker 1987, Florence 1987). Species diversity in coastal scrub and chaparral is best accomplished by late summer or fall burns of medium intensities (Rundel 1982). This fuel type produces a high fire intensity with fast spreading fires involving the foliage and live and dead fine woody material in the

crowns of a nearly continuous secondary overstory. The fire behavior can be expected to be erratic and extreme when live fuel moisture drops below 90 percent.

Decadent stands located on steep slopes, like the one that exists on Bolinas Ridge, present an extreme fire behavior potential.

Young growth chaparral stands, like the one that exists in the Gerbode Valley, show evidence of recent fire and do not present a current potential for extreme fire behavior. Spring burns create higher root and burl mortality, probably due to the phenological state of the dominant plants and their depleted carbohydrate reserves. Carbohydrates are tied up in growing plant parts, and deficiencies in root and lignotuber carbohydrates result in a lack of sprouting activity during this period. Fire can serve to break down litter, which is resistant to decomposition; remove inhibitors of decomposition; and alter the wettability of the soil.

High fire intensities are correlated with high shrub mortality. High-intensity fires in mature chaparral often have flame lengths exceeding 50 feet (Lotan et al. 1981) and temperatures as high as 1,200 degrees F (Sampson 1944b, Bentley and Fenner 1958), with fuel consumption of all but the largest branches.

Indications are that organic and inorganic nutrient levels are increased as a result of fire (Christensen 1973, Christensen and Muller 1975). Soil levels of organic nitrogen are reduced, but the level of available nitrogen increases (Rundel 1981). Post-fire bacteria and fungi are more abundant in burned than unburned soils (Christensen 1973, Christensen and Muller 1975). Mineral levels as well as available nutrients added by ash increase dramatically (Hanes 1977). These characteristics of moderate intensity fires decrease the likelihood of development of hydrophobic soils, lessening associated problems of soil erosion and sedimentation, loss of topsoil, and invasion by nonnative plant species in these uninhabited sites.

The historic role of fire in coastal scrub was most related to manipulation of the vegetation to support other activities, such as farming and ranching. Coastal scrub, while adapted to fire, is not dependent upon it for regeneration, although fire can clear out woody materials and create openings for sub-shrubs and forbs, whereas older stands are more characterized by similarly-statured shrubs with little to no herbaceous or forb component. Fire increases overall species diversity in this community, and can exclude coyote brush to the point that the scrub gives way to grasslands (described below). Fire can also be used to manage and suppress nonnative shrubs such as French broom that have become established in these shrublands. Fires may periodically serve to suppress fungal pathogens and other soil-borne diseases affecting plant species. The host plant for mission blue butterfly, silver-leaf lupine (*Lupinus albifrons*), occurs within coastal scrub (and grassland). Lupines in general are known as disturbance-dependent or -tolerant species, and this lupine may benefit from periodic fires that create openings and soil conditions favorable for establishment within the usually dense stands of coastal scrub in the Marin Headlands.

The fire return interval for chaparral varies between 20 and 45 years, depending on the dominant species. The continued statewide suppression of fires within this community has endangered many plant species that grow in association with it, including 14 threatened and 11 endangered species of manzanita and five threatened and 4 endangered species of ceanothus. Of these, GGNRA has one endangered species of manzanita, two rare manzanita, and one rare ceanothus. The mason's ceanothus *(Ceanothus masonii)* is

state-listed rare, and the only known population of this species occurs at Bolinas Ridge in Marin County. Lack of fire in the habitat has contributed to its decline. Prescribed fire of moderate intensity may be necessary to stimulate germination of this species and other species with hard seed coats.

The coastal scrub fuel type remains in a semi-fire-resistant state until the fall of the year when the live fuel moistures drop and the fuels can produce fire with flame lengths of 12 to 20 feet. The fuel normally does not present a fire behavior problem unless it is in the fall of the year, when live fuel moisture drops below 90 percent, or it is burning in a slope and preheating the fuels above it.

Chaparral produces a high fire intensity with fast-spreading fires involving the foliage and live and dead fine woody material in the crowns of a nearly continuous secondary overstory. The fire behavior can be expected to be erratic and extreme when live fuel moisture drops below 90 percent. Decadent stands located on steep slopes, like the one that exists on Bolinas Ridge, present an extreme fire behavior potential. Young growth chaparral stands, like the one that exists in the Gerbode Valley, show evidence of recent fire and do not present a current potential for extreme fire behavior.

Grasslands

General Characteristics

The grassland community at GGNRA extends from sea level to nearly 2,600 feet. It forms a mosaic with the coastal scrub community and mixed evergreen forests (Savage 1974). It is generally accepted that fires are part of the evolutionary forces affecting grassland (Heady 1972). Native American burning has occurred for at least the last 8,000 years in the San Francisco Bay Area according to early narrative reports (Sampson 1944b). The coastal prairie areas appear to have evolved under light seasonal grazing pressure with occasional fire (Heady et al. 1977).

Pristine grassland was thought to have been composed of evenly spaced bunchgrasses with annual forbs occupying areas between tussocks. It has been shown that purple needlegrass (*Nasella pulchra)* – the California state grass – was a major dominant of that grassland type (Bartolome et al. 1986), along with other perennial grasses. The lack of continuous fuels and compactness of the bunches themselves would have resulted in fires of moderate intensity with low to moderate rates of spread. These grasslands have had the greatest disturbance of any natural habitat in this area (Savage 1974). Four main factors have contributed to this disturbance: (1) an increase in grazing pressures, (2) the introduction of highly competitive nonnative plants, (3) cultivation, and (4) the elimination of fire.

Today, the grasslands are dominated by nonnative annual grasses and forbs adapted to Mediterranean conditions. These dense stands of annual grasses burn with greater intensity and more rapid rates of spread. Additionally, annual species cure rapidly with the onset of summer drought, resulting in a longer fire season (Langenheim et al. 1983).

Tilling and controlled grazing or clipping experiments have been employed in an attempt to enhance native perennial grasses in rangelands. Dennis (1989) found that the timing of grazing is critical, and concluded that annual vegetation affects the growth of perennials more through its influence on the physical environment than through resource competition.

Exclusion of grazing, extirpation of large native mammals, and suppression of wildfires have caused a marked increase in acreage covered by coyote bush (*B. pilularis*) and the resulting coastal scrub community in the Bay Area (McBride and Heady 1968, Clark 1952). It should be noted that grassland and coastal scrub communities are a dynamic mosaic with changes in dominance over time (Russell 1983), and in some areas these two communities are in equilibrium with no invasion occurring (Davidson and Barbour 1977). The boundary between grassland and coastal scrub is probably maintained by one or more of the following factors: allelopathy, herbivory, limited seed dispersal, and differential use of soil moisture (Davis and Mooney 1985). Invasions of coyote brush are sporadic with the shrub canopy developing quickly, effectively shading out most grassland species and providing shelter for herbivores that further reduce grassland species (Hobbs and Mooney 1986).

Fire Ecology

The native perennial grasses in GGNRA, including purple needlegrass (*N. pulchra*)**,** appear to have evolved under periodic fire (Bartolome 1981). These species thrive when annual grassland is burned in the fall season. Disturbance during other seasons is detrimental, suggesting that the plants have adapted to fall fires, rather than the grazing that is common in any season. Purple needlegrass can be favored by burning in the fall to decrease competition and provide a suitable seedbed, enhancing establishment conditions for residual seeds in the soil seed bank (Bartolome 1981).

Prescribed burning research at Henry Coe State Park supports the hypothesis that the presence of heavy annual mulch residue is an inhibitor to perennial grass (Parker 1989). Fall burning was found to reduce the abundance of annual grasses while increasing the diversity of native species. This research also concluded that reduction in annual grass mulch will potentially increase perennial grass establishment.

Fire can also be used to slow the invasion of coyote brush *(Baccharis pilularis)* into annual grassland (McBride and Heady 1968, McBride 1974). The reintroduction of fire to duplicate natural processes will kill susceptible seedlings and top kill some adult plants. Ford (1991) has found that the rate of cover regrowth is inversely related to fire severity.

Prescribed fires within this community have been conducted for the purposes of maintaining native species diversity, maintaining grasslands (that are being converted to scrubland through the invasion of coyote brush), and controlling nonnative species. When the objective is to reduce nonnative plant densities while encouraging native perennials, it is advantageous to burn in fall or early winter (Bartolome 1984). Germination of annual grasses and forbs often occurs one to three weeks after the first rain (Bartolome 1979). Burning during this period can destroy the annual seed crop, thereby reducing competition of annuals. The perennial rootstock is wet after the first rain and less susceptible to fire intensities (Biswell 1984), supporting the strategy of carefully timed fires to favor reestablishment of native species.

Herbaceous Wetlands

General Characteristics

Herbaceous wetlands are known as emergent wetlands in the Cowardin wetlands classification. They consist of a mix of low-growing species of sedges (*Carex* spp.), rushes (*Juncus* spp.), and other wetland-

dependent species (*Scirpus microcarpus*, *Typha* spp. *Cyperus eragrostis*, *Equisetum* spp.), as well as some nonnative species of grasses (especially velvet grass [*Holcus lanatus*] and harding grass [*phalaris aquatica*]) and forbs including Cape-ivy (*Delaria odorata*) and Vinca (*Vinca major* and *V. minor*). Areas covered with various reeds along the shores of lagoons and ponds, herbaceous strips of vegetation along perennial and ephemeral stream courses, and isolated wetland patches where seeps spring from the hill slopes throughout the park are included. Some special status plant species – locally to regionally rare – occur within this community.

Fire Ecology

While this community is not fire-dependent or -adapted, it is found intermixed with other communities that could be manipulated for fire management purposes, and can be affected by those actions.

Riparian Forest and Scrub

General Characteristics

These streamside forests and shrub lands are dominated by broad-leaved deciduous trees or shrubs, most commonly willows (*Salix lasiolepis* or *S. lucida* ssp. *lasiandra*) and occasionally red alder (*Alnus rubra*). The understory is typically dense, with a variety of shrubs including berries – native salmonberry (*Rubus spectabilis*), thimbleberry (*R. parviflorus*), and California blackberry (*R. ursinus*), as well as nonnative Himalayan blackberry and Cape-ivy. Numerous herbaceous species including ferns, rushes, and sedges dominate the shrub understory. Nonnative trees including eucalypts (*Eucalyptus* spp.) and Monterey cypress (*Cupressus macrocarpa*) have become successfully established within the riparian forest strands in the park.

Fire Ecology

While this community is not fire-dependent or -adapted, it is found intermixed with other communities that could be manipulated for fire management purposes, and can be affected by those actions, including actions specific to removal of nonnative species.

Native Hardwood Forest

General Characteristics

This variable community extends from 200 to 2,500 feet in elevation, and is dominated by oak *(Quercus* spp.), California bay laurel *(Umbellularia californica)* and/or tanbark oak *(Lithocarpus densiflorus).* Along the mesic boundary of this mixed evergreen forest is the redwood/Douglas-fir community and along the xeric boundary is the coastal scrub and grasslands (Sawyer et al. 1977).

Coast live oak (Q*uercus agrifolia*) dominates this community at elevations below 1,000 feet. It is often the only species present on hills frequented by a cool, foggy, coastal climate. Interior live oak (*Q. wislizenii*) sometimes replaces coastal live oak in canyon bottoms and north-facing slopes. As the community approaches 1,000 feet in elevation, California bay (*Umbellularia californica*), tanbark oak (*Lithocarpus densiflorus*), and other hardwoods become common.

Fire Ecology

The old-growth oak and bay laurel woodlands are stately California communities where the past occurrence of fire is evident in the multiple-trunked character of most trees, indicating early bole damage and subsequent sprouting (Plumb 1980). As for mature trees, bark thickness is the most important factor contributing to their degree of fire tolerance. Coastal live oak has thick bark and is therefore the most resistant to fire. It sprouts from the main trunk and upper branches following complete charring, as does California bay laurel. Prescribed burns in Cuyumaca State Park have shown that both coast live oak and canyon live oak respond well to low-intensity, backing fires, and new sprouts that appear after fire are palatable and attractive to deer.

The native hardwood forests support little ground fuel (probably less than five tons per acre) (Plumb 1980) and as a result associated fire intensities are minimal. The exception is where eucalyptus are invading these woodlands. Here, the community has become more susceptible to fire than it was historically.

Fall burns following rainfall will create erratic fire behavior and effectively reduce small ground fuels. Surface fine fuels typically dry approximately one week after rain, whereas larger fuels take most of the summer to dry out. Thus, the reduction of these larger fuels can be accomplished under low fire intensities when duff layers are moist. Isolated pockets of heavy fuel accumulation can be expected to create erratic but localized fire behavior.

The native hardwood forest has many fire-resistant properties and many species sprout. The gradual incursion of Sudden Oak Death (SOD) into these forests (Figure 3-11) poses a serious threat to their continued existence, and the use of fire may help manage both the forest structure and potentially stall or inhibit the effects of SOD. Recent studies suggest fire can be used to manage the spread of SOD, and may kill off fungal spores.

Douglas-Fir and Coast Redwood

General Characteristics

The majestic old-growth redwood forest at Muir Woods, with Redwood Creek peacefully flowing through groves of tall trees, attracts much visitor attention. This tranquil scene is a rare sight close to a large metropolitan area. Preservation of the pristine character of these woods is a management priority. Many species contribute to this ecosystem. Major overstory and understory trees include coast redwood *(Sequoia sempervirens)*, Douglas-fir *(Pseudotsuga menziesii)*, California bay laurel *(Umbellularia californica)*, tanbark oak *(Lithocarpus densiflorus)*, California hazel *(Corylus californica)*, and madrone *(Arbutus menziesii).*

Douglas-fir communities are found on Bolinas Ridge and within Muir Woods. The communities on Bolinas Ridge have been logged. Douglas-fir in Muir Woods sites have a brush understory and a significant component of dead fuel. When mature, Douglas-fir has thick bark that acts as fire insulation to vital cambium tissues. Young Douglas-fir are susceptible to fire and are often killed. Mortality increases with scorch height, percent crown scorch, and bole damage, but decreases with trunk diameter. In addition, mortality following fall fires is slightly higher than following spring fires (Ryan et al. 1988).

Douglas-fir seeds ripen in burned cones and require relatively open conditions for reproduction (Franklin and Dyrness 1973); the species is considered shade-intolerant. It takes a severe fire to destroy the seed bank of Douglas-fir. Following a light to moderate burn an adequate seed bank remains (Sawyer et al. 1977). An open environment is brought about by burning and Douglas-fir germination is enhanced.

Fire Ecology

The many fire-scarred trees in Muir Woods provide evidence of historical fire occurrence. The last recorded fires occurred in 1800 on the valley floor (Sudborough 1966) and 1850 on the slope (Cornelius 1969). The most complete fire history in Marin County redwood communities (McBride and Jacobs 1978) was done using fire scar data from redwood stumps at two study sites: Old Mill Creek and Alpine Dam. Average fire return intervals of 21.7 and 27.3 years occurred respectively, the difference between these intervals being attributed to climatic moisture differences (Jacobs et al. 1985). It should be noted, however, that fire scar data provide conservative estimates of fire frequency, since low-intensity fires would not always scar the trees.

These aforementioned fire intervals are post-human settlement. Available evidence indicates that the "natural" mean fire interval in southern redwood forests is 50 to 300 years, and the presence of humans has caused the decrease in the mean fire interval to today's levels (Langenheim et al. 1983). Recent changes in fire suppression abilities have somewhat increased fire intervals in the redwoods themselves, but Veirs (1980) found that redwood forests in northern California have not significantly changed as a result of fire suppression, since most species have the ability to sprout. Other studies indicate that the exclusion of fire may reduce the opportunity for redwood establishment but not the establishment of many competitors, and long-term fire exclusion could result in redwood replacement by other species.

The effect of fire intensity is important to the role of fire. Low-intensity fires favor redwood rather than Douglas-fir, while high-intensity fires do the opposite (Veirs 1980). However, most large redwoods (greater than 20 centimeters [cm] at breast height [dbh]) survive prescription levels higher than those that have been used in Muir Woods (Finney 1991). Fungal pathogens can enter redwoods through fire scars, creating rot in the heartwood. Although it is not fatal to the redwood, it places stress on the trees and increases the chance of wind breakage and damage by fire (Fritz 1932).

Fire plays a primary role in coast redwood reproduction. Seedling establishment and sprouting are stimulated by burning. Redwood seedling establishment requires bare mineral soil with adequate soil moisture, which protects seedlings from attack by damping-off and root-rotting fungus (Davidson 1971). These conditions exist after fires – which remove ground litter and sterilize the soil – and after floods when soils are exposed and silt deposition occurs on stream banks. Another form of reproduction is vegetative sprouting, which is triggered by mechanical injury, changes in light intensity, and fire (Simmons 1973).

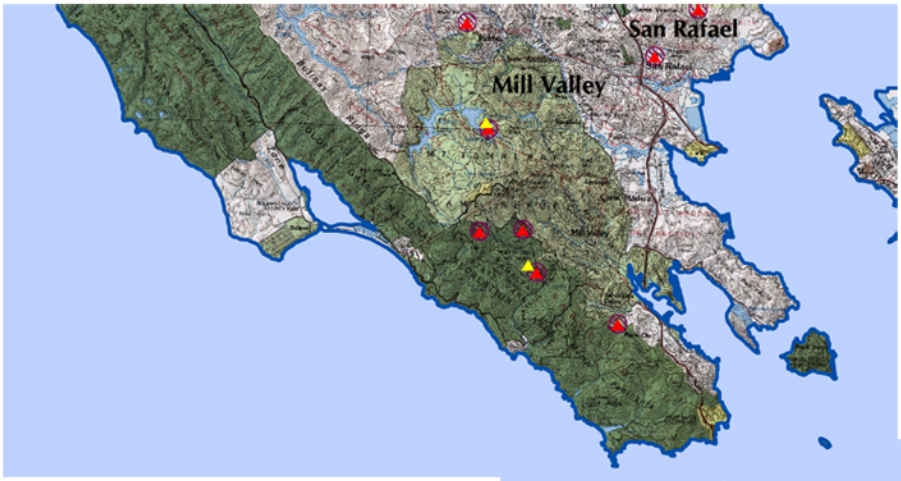
Douglas-fir will generally dominate the post-fire generation in this community. Other tolerant tree species such as redwood develop almost simultaneously (Lotan et al. 1981). The majority of herbs and shrubs associated with this community sprout following crown destruction by fire (Lyon and Stickney 1974). Seeds of some species (e.g., *Ceanothus* spp.*)* require heat treatment before germination. Redwood needles are more flammable than Douglas-fir and will burn with a higher relative humidity. The redwood bark

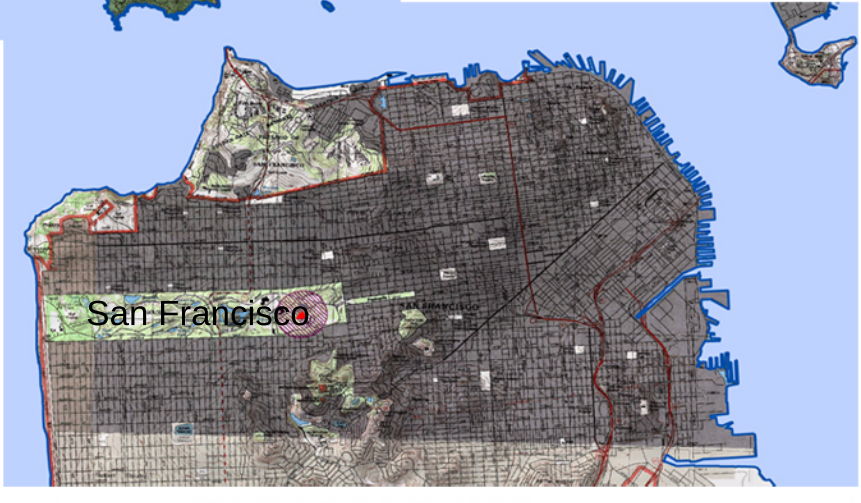
California Oak Mortality Task Force

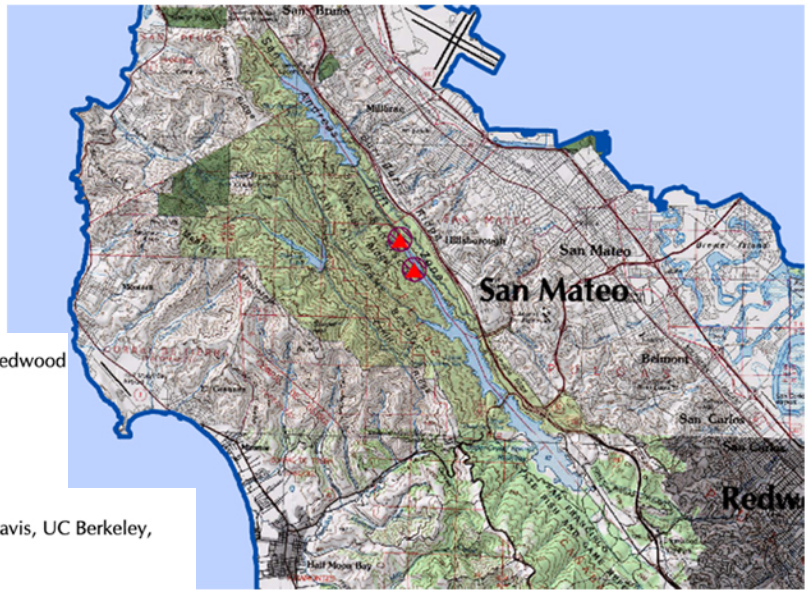
Areas of Sudden Oak Death Infestation from Best Available Field Information

Golden Gate National Recreation Area

CAMFER







N

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Map Version 1.1 | Produced on 9/1/04 by UCB CAMFER
http://www.suddenoakdeath.org/
http://kellylab.berkeley.edu/SODmonitoring/

LEGEND

- Confirmed isolation of *Phytophthora ramorum*
- Approximate location of *Phytophthora ramorum* in Coast Redwood and/or Douglas Fir (not an officially regulated sample)
- 1/4 mile buffer around confirmed SOD
- County boundary

Data Sources:
- Confirmed isolations of *Phytophthora ramorum* provided by UC Davis, UC Berkeley, and CDFA. Nursery confirmations are not depicted.
- USGS Digital Raster Graphics

Sampling is occurring throughout the state.

Figure 3-11

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chars even with low-intensity fire. Charring can be reduced significantly by limited raking of litter 1 to 2 feet away from trees (Boyd 1984).

The vegetation of the coast redwood and Douglas-fir communities is adapted to the varying effects of fire and can benefit from carefully implemented management actions. Fuel loads within the Douglas-fir-dominated areas present a hazard, and elimination of fire from this environment will only perpetuate and increase this hazard.

These forests have developed a large fuel buildup due to years of fire suppression. The fuel accumulations around the base of redwood trees provide fuels that will produce fire intensity causing fire to climb up the trunks of individual trees. The Douglas-fir trees have very significant ladder fuels that will contribute to fire being carried high into the trees. A fall season fire in this forest can be expected to produce a crown fire. This type of fire is difficult to control, requiring a backing off or containing strategy. Past prescribed fire experience in this fuel type produced fire climbing the bark of trees and burning for hours in the tops of the trees. This fuel type normally produces slow-burning ground fires with low flame heights. The fire may encounter occasional “jackpot” or heavy fuel concentrations that can flare up. Under hot fall weather conditions extreme fire behavior can exist.

The fire hazard at Muir Woods was analyzed by McBride and Jacobs (1978). Five major categories of fire hazard were identified: surface-fuel condition, ladder-fuel condition, downed woody fuel, slope-wind correlations, and ignition risks. The greatest threat of wildfire exists in the alluvial flat and on the northeast and south boundaries of Muir Woods. It should be emphasized that the hazard in this portion of Muir Woods is greater now than when the fire hazard was analyzed and will continue to increase without treatment.

In 1985 a prescribed burn was conducted in Muir Woods National Monument. This was the first step in reducing fuel loads and reintroducing fire into that environment. Subsequent prescribed burns have been implemented with positive results for both fuel load reductions and control of nonnative species moving into the forest understory from adjacent coastal scrub and grassland communities.

Nonnative Evergreen Forest

General Characteristics

Many nonnative tree species have become established in GGNRA through both intentional and unintentional introductions, including ornamental plantings, wind breaks or shade for pastures, and escapes from cultivated and developed areas. Many of these trees – including a number of eucalypts (*Eucalyptus* spp.), acacia (*Acacia* spp.), Monterey pine (*Pinus radiata*), and Monterey cypress (*Cupressus macrocarpa*) – have invaded native communities. Most are very flammable, or significantly change the fire potential in areas that otherwise would support low-intensity or minimal fires, such as the coastal scrub and grassland areas of the park. Some stands of trees are located in close proximity to urban areas, or are within areas that would otherwise support rare communities or species (such as the mission blue butterfly). Both situations pose a threat to park neighbors and to these sensitive species due to the highly flammable nature of the nonnative trees and the changes they cause in environmental conditions including shade, duff and litter loads, moisture levels, and chemical additions to the soil.

Fire Ecology

Blue gum (*Eucalyptus globulus*), other eucalypt species, and acacia are inhabitants of the dry schlerophyll forests of Australia, where they have evolved under a frequent fire regime. Adaptations to moderate and intense fire are many, including rapid growth to great heights, which minimizes lower limb exposure to fire; thick fire-resistant bark; fire-resistant seed capsules that take advantage of the open post-fire seedbed and germinate quickly; and the ability to produce epicormic shoots and lignotubers sprouts after intense fires. Since high-severity fires are more advantageous to species reproduction, these trees are considered to be fire-maintained. Such communities tend to have adaptations that allow them to burn more readily than other communities. Eucalyptus in particular produces a ground fuel with high energy potential (due to the high levels of oils) to insure flammability (Mutch 1970).

Low- to moderate-intensity fires are not as advantageous to these species because fewer seeds germinate, the seedbed is not as open, less light is available due to survival of overstory trees and shrubs, and more native fungal pathogens are present. Prescribed fire in eucalyptus needs to be of low intensity in order to reduce hazardous fuel loadings. Frequent burns are needed to keep regeneration low. Low-intensity spring burns typically inhibit most eucalyptus and acacia regeneration (Mount 1969).

The fuel beneath GGNRA eucalyptus and acacia stands has been accumulating due to slow decomposition. Organic matter in eucalyptus soil accumulates slowly and litter decomposition remains as duff, sometimes one foot deep (Mount 1969). All eucalypt studies indicate that the amount of available fuel on the forest floor is one of the most significant factors influencing fire spread and fire intensity (McArthur 1962, Cheney 1988). An extreme fire hazard is apparent in Marin County (Howell 1982). Similar eucalypt stands in the Berkeley hills showed 45 to 100 tons per acre of ground surface fuels prior to the devastating fires in 1991.

Monterey pine and Monterey cypress, although native to California, are nonnative to GGNRA. These tree stands are generally found in conjunction with developed areas such as batteries and other military installations throughout the park, and represent an historic attribute of the vegetation. However, their adaptation to the climate and soils has enabled these planted trees to spread through seedlings to cover large expanses beyond the cultural landscape, again encroaching upon communities that would otherwise have little to no fuel buildup or potential for more than low-intensity flashy fires, including coastal scrub and grasslands. Many of the stands, similar to eucalyptus and acacia, form a continuous vegetation cover between wildland interior areas of the park and adjacent urban or developed zones, posing a threat to both the natural communities (due to changes in fire frequency and intensity) and cultural landscapes and features. Both species are fire-adapted, with serotinous cones (cones open after intense heating, allowing seeds to fall onto newly fire-cleared soils) and oily needles, scales, and underlying duff and litter.

Eucalyptus can be expected to produce an intense fire any time after the surrounding grasslands have cured. The dead and down fuel buildups can be expected to be 125 tons per acre or higher. This fuel does not have a fuel model that represents it. The trees have ladder fuels of shedding bark that produces torching and the very high potential of a crown fire. In December 1990, GGNRA experienced a hard freeze, causing large-scale leaf and limb damage to eucalyptus groves. This freeze damage has significantly contributed to increases in aerial and ground fuels.

Nonnative evergreen forests have created a fire hazard in GGNRA due to the nature of the fuels, fire behavior, and locations in proximity to both urban/developed areas and sensitive species. A hazard fuel reduction program using prescribed fire and mechanical manipulation will continue to be implemented in GGNRA nonnative evergreen forests to reduce fuel buildups and lessen the fire hazard. Fire may also be used to manage historic stands of nonnative forests to remove saplings and ground and ladder fuels, thus both preserving the historic stand structure and reducing fire hazard and potential spread into adjacent native habitats.

Wetlands

Wetlands in GGNRA

GGNRA has abundant wetland resources, including wet meadows, seeps, streams, riparian forests, lakes, ponds, and lagoons. Wetlands, according to the definition developed by the U.S. Fish and Wildlife Service and adopted by the NPS, are lands 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 (Cowardin et al. 1979). Wetlands generally include marshes, riparian zones, mudflats, rocky intertidal zones, and gravel beaches. Deepwater habitats such as rivers, lakes, and estuaries are not technically wetlands but are classified as aquatic sites using the same classification system. Wetland ecosystems act to buffer hydrologic and erosional cycles, control and regulate cycles of nitrogen and other key nutrients, and create valuable habitat for animal species.

The wetlands in GGNRA have been field-mapped in several watersheds, including the Rodeo Creek watershed, the Presidio of San Francisco, and portions of the Redwood Creek and Bolinas Lagoon watersheds. The remainder of the park has not been field-mapped but contains areas of wetland vegetation that can be extracted from the parkwide vegetation mapping. The majority of wetlands in GGNRA are located in the valley bottoms, with seeps and small intermittent streams reaching into the higher portions of the watersheds.

Detailed wetland classification in the Rodeo Valley watershed will enable GGNRA to begin to assign the important functions of the wetland resources throughout the park. By documenting the vegetation type and life form, as well as the hydrogeomorphic characteristics of a wetland, a functional assessment can be completed that determines each wetland’s relative importance in surface water detention, streamflow maintenance, nutrient transformation, sediment retention, fish and wildlife habitat, and other important wetland functions. This information could be used to identify high-value wetlands that require special considerations.

Effects of Fire Management Activities on Wetlands

The major impact of fire management activities on wetlands will result from increased sedimentation. Excess sediment input into a wetland can alter the hydrology and in turn the vegetation composition. Conversely, heavy scouring from increased runoff could affect wetland hydrology by forming new drainage channels that deplete the site of water.

Wetlands burn infrequently and are unlikely to play a role in fire ignition or maintenance, but are important in inhibiting fire spread. When wetlands do burn, the fire usually spreads into them from adjacent vegetation.

Wildlife

The park's diverse habitats support a rich assemblage of wildlife. At least 387 vertebrate species are known to occur within the park boundaries. Species lists compiled from a variety of sources and incomplete inventories include 11 amphibians, 20 reptiles, 53 fish, 53 mammals, and 250 birds (ICE 1999). Terrestrial invertebrates in the park are less well-known, with the exception of butterflies in two areas of the park, Marin Headlands and Milagra Ridge, that support diverse butterfly populations.

Wildlife habitats within the park range from introduced eucalyptus and closed-cone Monterey pine and cypress forests to hardwood, mixed evergreen, Douglas-fir, redwood, and riparian forests; coastal scrub, annual and perennial grasslands; freshwater and saline wetlands and wet meadows; and estuarine, lacustrine, marine, and riverine aquatic habitats.

Mammals

Terrestrial habitats within the planning area support a high diversity of mammals. Meso-carnivores, including the gray fox (*Urocyon cinereoargenteus*), bobcat (*Felis rufus*), and the recently reestablished coyote (*Canis latrans*) inhabit coastal scrub and grasslands. Mountain lions (*Felis concolor*) have been sighted in some undeveloped areas of the park. These carnivores feed on a variety of small and large mammals such as the Pacific black-tailed deer (*Odocoileus hemionus columbianus*), broad-footed mole (*Scapanus larimanus*), pocket gopher (*Thomomys bottae*), deer mouse (*Peromyscus maniculatus*), western harvest mouse (*Reithrodontomus megalotis*), California vole (*Microtus californicus*), and brush rabbit (*Sylvilagus bachmani*). Badgers (*Taxidea taxus*) are also infrequently encountered. Some species, such as the western harvest mouse, appear to be restricted to areas where native perennial grasses persist. In addition to many of the mammals listed above, Muir Woods and other forested areas within the planning area support vagrant shrew (*Sorex vagrans*), Trowbridge's shrew (*Sorex trowbridgii*), Sonoma chipmunk (*Tamius sonomae*), western gray squirrel (*Sciurus griseus*), opossum (*Didelphis virginiana*), and dusky-footed woodrats (*Neotoma fuscipes*). Other mammalian carnivores include the raccoon (*Procyon lotor*), striped (*Mephitis mephitis*) and spotted skunks (*Spilogale gracilis*), long-tailed weasel (*Mustela frenata*), and the recently returned river otter (*Lontra canadensis*).

Seventeen species of bats have been detected within the park. Ten species of bats have been documented in Muir Woods, including four federal and/or state species of concern: Townsend's western big-eared bat (*Corynorhinus townsendii townsendii*), fringed myotis (*Myotis thysanodes*), long-legged myotis (*M. volans*), and Yuma myotis (*Myotis yumanensis*). Many of the bats in Muir Woods have been detected using redwood fire-scar cavities for roosting. At the Marin Headlands, several historic World War II structures were found to be occupied by the Townsend's western big-eared bat and the Yuma myotis, both federal species of concern. The Brazilian free-tailed bat (*Tadarida brasiliensis*) forages over coastal scrub habitat within the Marin Headlands.

Isolated coastal rocks, beaches, and lagoon sand flats in the park serve as haul-outs for harbor seals (*Phoca vitulina*) and California sea lions (*Zalophus californianus*). Up to 250 harbor seals haul out in Point Bonita Cove at Marin Headlands. As the northern elephant seal (*Mirounga angustirostris*) population rapidly increases, the seals are encountered more frequently on sandy beaches throughout the region. California gray whales (*Eschrichtius robustus*), humpback whales (*Megaptera novaeagliae*), and harbor porpoises (*Phocoena phocoena*) use offshore waters and young whales occasionally wander into San Francisco Bay. Southern sea otters (*Enhydra lutris nereis*) are infrequently seen offshore with numbers increasing as the population spreads north.

Birds

Located along the Pacific Flyway, GGNRA provides habitat for a great diversity of breeding, overwintering, and migratory birds. Nineteen species of diurnal raptors have been detected in migration over the ridges of the Marin Headlands. Red-tailed hawks (*Buteo jamaicensis*), red-shouldered hawks (*Buteo lineatus*), and great horned owls (*Bubo virginianus*) nest in many of the large nonnative eucalyptus trees in the park. A wide range of other raptors and at least ten owl species occur within the planning area. In addition, federally threatened northern spotted owls (*Strix occidentalis caurina*) nest in coniferous and mixed-hardwood forests surrounding Muir Woods. Muir Woods also contains potential marbled murrelet (*Brachyramphus marmoratus*) habitat, but no breeding murrelets have been detected in two years of surveys. Numerous species of waterbirds also occur within the park in marine and rocky intertidal habitats, cliffs, beaches, and tidal and wetland areas.

Point Reyes Bird Observatory (now PRBO Conservation Science) encountered 83 bird species during 1997 breeding landbird censuses in coastal grassland, coastal scrub, riparian, and mixed hardwood habitats. From point count censuses in 1999 and 2000, white-crowned sparrows (*Zonotrichia leucophrys*), red-winged blackbirds (*Agelaius phoniceus*), savannah sparrows (*Passerculus sandwichensis*), and song sparrows (*Melospiza melodia*) were the most commonly detected species in grasslands. The most abundant species in coastal scrub were white-crowned sparrows, spotted towhees (*Pipilo maculatus*), and wrentits (*Chamaea fasciata*). In forested habitats, bushtits (*Psaltriparus minimus*), chestnut-backed chickadees (*Junco hyemalis*), dark eyed juncos, Pacific-slope flycatchers (*Empidonax difficilis*), and winter wrens (*Troglodytes troglodytes*) were commonly detected. Based on songbird nest monitoring in riparian habitats along Redwood and Lagunitas creeks, the song sparrow, Swainson's thrush (*Catharus ustulatus*), warbling vireo (*Vireo gilvus*), and Wilson's warbler (*Wilsonia pusilla*) were the most commonly observed nesters. The brown-headed cowbird (*Molothrus ater*) is a nest parasite that negatively affects the reproductive success of open-cup nesting songbirds and occurs throughout the planning area. Many of the landbirds in the planning area are Neotropical migrants, with others identified as species of management concern and riparian species of conservation priority by California Partners-in-Flight.

Amphibians and Reptiles

Small populations of the federally threatened California red-legged frog (*Rana aurora draytonii*) occur within the planning area. Within San Mateo County, historic records indicate the presence of the federally endangered San Francisco garter snake (*Thamnophis sirtalis tetrataenia*). More common terrestrial

amphibians in the planning area include ensatina (*Ensatina eschscholtzii*) and California slender salamander (*Batrachoseps attenuatus*). Common species spending a substantial amount of time for breeding or rearing at streams or ponds include California newts (*Taricha torosa*), rough-skinned newts (*Taricha granulosa*), Pacific treefrog (*Hyla regilla*), and California giant salamander (*Dicamptodon ensatus*). Common reptiles include the Western fence lizard (*Sceloporus occidentalis*), northern alligator lizard (*Gerrhonotus coeruleus*), Pacific gopher snake (*Pituophis melanoleusus*), and western terrestrial garter snake (*Thamnophis elegans*).

Fish

The planning area includes both resident and transitory fish species that occupy marine, estuarine, and freshwater habitats. Common, nearshore resident estuarine and marine fish include Pacific staghorn sculpin (*Leptocottus armatus*), arrow goby (*Clevelandia ios*), and topsmelt (*Atherinops affinis*). The brackish Rodeo Lagoon in the Marin Headlands supports a large population of the federally endangered tidewater goby (*Eucyclogobius newberryi*).

Freshwater streams within the planning area are characterized by naturally low species diversity. Perennial streams may include resident fish such as threespine stickleback (*Gasterosteus aculeatus*) and prickly sculpin (*Cottus asper*). Several important anadromous fish species are present in the creeks and watersheds within the planning area. Anadromous species are those that spawn or breed in streams and rivers and then migrate to and mature in the ocean. Anadromous species that breed and rear in streams within the planning area include coho salmon (*Oncorhynchus kisutch*) and steelhead trout (*Oncorhynchus mykiss*). Both species are listed as threatened under the federal Endangered Species Act. Intermittent streams or the intermittent headwater streams may support only steelhead trout.

Invertebrates

Two coastal grassland/scrub areas in the park are known for their high numbers and diversity of butterflies: Marin Headlands and Milagra Ridge. The federally listed endangered mission blue butterfly (*Icaricia icarioides missionensis*) occurs at both sites, while the San Bruno elfin butterfly (*Euphydryas editha bayensis*) is found at Milagra Ridge, where it inhabits rocky outcrops. At least 44 species of butterflies occur in the Marin Headlands and 34 species occur at Milagra Ridge, illustrating the importance of habitat fragments within largely developed landscapes. Various species of skippers, swallowtails, hairstreaks, blues, ladies, admirals, and crescents inhabit these areas. Monarch butterflies (*Danaus plexippus*) are found in clusters overwintering in many areas of the park, often in groves of nonnative trees. Other terrestrial invertebrates have not been well documented.

Limited information is available regarding the freshwater invertebrates that are present within the planning area. Targeted inventories have been conducted in streams such as Redwood Creek. A total of 223 freshwater taxa are known. The only federally listed species is the endangered California freshwater shrimp, which is found within the Lagunitas Creek watershed, an area managed by Point Reyes National Seashore (PRNS). Limited information is also available regarding invertebrates from marine and estuarine habitats within the planning area. A total of 279 marine and estuarine taxa are known.

Nonnative Wildlife

Many species of nonnative wildlife have been identified as problem species within native wildlife habitat in the park. These species negatively affect populations of native animals through competition for resources, predation, and as vectors for disease. Nonnative terrestrial mammals include fallow deer (*Cervus dama*), feral hogs (*Sus scrofa*), red fox (*Vulpes vulpes*), opossum, house cats (*Felis domesticus*), and Norway and black rats (*Rattus norvegicus* and *R. rattus*). Nonnative birds found in the planning area include wild turkeys (*Meleagris gallopavo*), European starlings (*Sturnus vulgaris*), peasows (*Pavo cristatus*), house sparrows (*Passer domesticus*), and rock doves (*Columba livia*). Nonnative invertebrates present in the planning area include Argentine ant (*Iridomyrmex humilis*). Nonnative fish present within various human-made ponds include mosquitofish (*Gambusia affinis*) and various sunfish, while estuarine areas may support yellowfin goby (*Acanthogobius flavimanus*). Nonnative amphibian and reptile species include bullfrog (*Rana catesbeiana*), red-eared slider (*Chrysemys picta*), and the occasional caiman.

Special Status Species

Twenty-five species in GGNRA are protected under the Endangered Species Act as amended (16 USC 1536 [a] [2] 1982) and are managed by the NPS. Within the park's legislative boundary, there are 69 rare or special status wildlife species currently identified as permanent or seasonal residents of the park, or dependent upon park lands and waters for migration. Of these, 12 are listed as federally endangered, 12 are federally threatened, 1 is state endangered, 3 are state threatened, 31 are federal species of concern, and 10 are state designated species of special concern. Numerous other wildlife species (birds in particular) are considered sensitive by the Audubon Society, Partners in Flight, or the California Department of Forestry, or are designated Migratory Nongame Birds of Management Concern by the U.S. Fish and Wildlife Service (USFWS). Nearly all of the native birds documented in the park are protected under the Migratory Bird Treaty Act (16 USC 528-531). Thirty-eight rare or special status plant species are currently identified within GGNRA. Of those species, 9 are federally endangered, 1 is federally threatened, 13 are federal species of concern, and the remaining 15 species are included or proposed for inclusion by the California Native Plant Society.

The USFWS and NOAA Fisheries provided a list of federally threatened, endangered, and proposed species and any designated or proposed critical habitat for consideration during development of the FMP (see Appendix F). Literature reviews, contacts with local biologists and resource agencies, and field surveys were conducted to evaluate the potential occurrence of special status resources in the planning area. For purposes of analysis, special status resources are biological communities, plants, and animals that are (1) identified by state and/or federal agencies as rare, threatened, or endangered or candidates for such designations; or (2) considered sensitive by recognized monitoring agencies and conservation organizations (e.g., California Department of Fish and Game, California Native Plant Society, USFWS). Species listed as species of concern by the USFWS and species of special concern by the California Department of Fish and Game do not have legal protection under the Endangered Species Act but are considered as species that may be candidates for future listing. 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.

Special Status Wildlife Species

To evaluate the effects on special status species, a set of species considered likely or possible to experience impacts from fire management activities was selected for assessment based on the presence of suitable habitat within the project area. Appendix F, Special Status Species, evaluates all listed, proposed, or candidate animal species potentially in the planning area and provides a brief summary of presence/absence of suitable habitat and any distribution notes. Vagrant special status wildlife species (e.g., species where individuals have been documented in the park, but where suitable habitat is lacking within the park) will not be discussed further. In addition, most marine and estuarine species are expected to experience little to no impact from fire management activities, because proposed activities are not planned adjacent to coastal resources. Minor impacts from unplanned wildfire and associated suppression activities could occur if wildland fire facilitates coastal erosion and deposition in coastal waters. These marine and estuarine species will not be discussed further. Brief summaries of federally listed species and any designated critical habitat considered likely or possible to experience impacts from fire management activities are discussed separately in the sections below.

San Bruno Elfin Butterfly (Callophrys mossii bayensis) – Endangered

The larval host plant for San Bruno elfin butterflies is *Sedum spathulifolium*, a succulent that grows on rocky, north-facing slopes along the coast (Lambert 2002). Adults are thought to stay within about 100 meters of host plants. Adults have one generation per year, with flight season from late February to early April. Eggs are laid on the ventral surface on the leaves of host plants. The fourth instar larvae pupate at the base of host plants where they remain through the summer, fall, and early winter. Habitat loss and trampling of host plants, larvae, and pupae are the primary threats to these butterflies. The San Bruno elfin butterfly is known to occur only at Milagra Ridge within the planning area.

Mission Blue Butterfly (Icaricia icaroides missionensis) – Endangered

Mission blue butterflies are closely tied to the lupine larval host plants *Lupinus albifrons*, *L. variicolor*, and *L. formosus*, with *L. albifrons* considered to be the preferred host (Lambert 2001). These host plants tend to occur on grasslands on thin, rocky soils within broader coastal scrub habitats (Rashbrook 2002). Lupine are susceptible to fungal outbreaks, which have been documented to cause rapid contractions of lupine distribution at the Marin Headlands. Competition from nonnative plants, eucalyptus, Monterey pine, gorse, and broom also threatens lupine host plants (Rashbrook 2002). Lupine is a fire-adapted species, and fire may enhance suitable lupine habitat for mission blue butterflies. Adults feed on nectar from numerous plants, though they may prefer wild buckwheat (*Erigonum latifolium*), golden aster (*Chrysopsis vilosa*), blue dicks (*Brodiaea pulchella*), and Ithuriel's spear (*Brodiaea laxa*) (Lambert 2001). Habitat loss is probably the primary threat to mission blue butterflies, with trampling of host and nectar plants, larvae, and pupae also of concern (Lambert 2001). Other threats to mission blue butterflies at various stages of their life cycles include parasites, predators, and desiccation and disease during diapause.

Adults have one generation per year, with a flight period from mid-March to mid-May at the Marin Headlands and late May to mid-June at San Bruno Mountain (Rashbrook 2002). Analyses suggest that warmer air temperatures are associated with higher numbers of adults at the seasonal peak and that

rainfall is not related to the peak number of adults (Rashbrook 2002). Eggs are usually laid on the dorsal surface of larval host plants. Ants (*Prenolepis imparis* and *Formica lasioides*) may tend the later-instar mission blue larvae. Mission blue butterflies occur at the Marin Headlands, Tennessee Valley, Milagra Ridge, and Sweeney Ridge within the planning area.

Northern Spotted Owl (Strix occidentalis caurina) – Threatened

Marin County supports a northern spotted owl population of possibly 75 pairs. This population is isolated from spotted owl populations to the north by large areas of grassland and shrubs and constitutes the southern end of the subspecies range. Genetic analysis has shown low levels of genetic diversity within and low levels of gene flow between spotted owl populations in Marin County and Mendocino National Forest (Henke et al. 2003). The Marin County population supports the highest known density of northern spotted owls rangewide. Threats to spotted owls in the planning area include urbanization, intense recreational pressure, disturbance from wildlife photographers and birders, genetic isolation, West Nile virus, possible catastrophic wildfire, expansion in the range of the barred owl (*Strix varia*), and habitat changes due to Sudden Oak Death (Fehring et al. 2002).

Spotted owls in Marin inhabit coniferous forest, including second growth and remnant stands of Douglas-fir (*Pseudotsuga menziesii*), bishop pine (*Pinus muricata*), coast redwood (*Sequoia sempervirens*), and mixed conifer-hardwood habitats comprised of tanbark oak (*Lithocarpus densiflorus*), coast live oak (*Quercus agrifolia*), and California bay (*Umbellularia californica*) (Fehring et al. 2002). Spotted owls tend to nest in older stands of conifer and hardwood trees that create a tall overstory. Spotted owls often select larger trees with defects, such as broken tops or mistletoe (*Arceuthobium spp*.) infestations, for nesting, but also have been found nesting in young bay trees in smaller stands. Preliminary pellet analyses indicated that spotted owls forage primarily on dusky-footed woodrats (*Neotoma fuscipes*) in addition to other forest dwelling small mammals and songbirds (Chow 1996). Within the planning area, known spotted owl locations are currently limited to Muir Woods and the Stinson Gulch area.

California Red-Legged Frog (Rana aurora draytonii) – Threatened

The California red-legged frog is found primarily in wetlands and streams in coastal drainages of central California (USFWS 1994a). Red-legged frogs found north of the Marin-Sonoma county border exhibit intergrade characteristics of the California red-legged frog and the northern red-legged frog.

The frog requires specific aquatic and riparian features. Adult require a dense, shrubby, or emergent riparian vegetation closely associated with deep (>0.7 meters) still or slow-moving water (USFWS 1994a). The highest densities of California red-legged frogs have been associated with deep-water pools with dense stands of overhanging willows and an intermixed fringe of cattails (USFWS 1994a). Aestivation sites are located up to 26 meters from water in dense riparian vegetation (USFWS 1994a).

A recent court decision has eliminated critical habitat within the planning area by changing the habitat definition. Critical habitat had been defined to include essential aquatic habitat, associated uplands, and dispersal habitat connecting essential aquatic habitat. The primary constituent elements for critical habitat are summarized in Table 3-11.

Table 3-11: Primary Constituents of Critical Habitat for California Red-Legged Frog

Essential Aquatic Habitat	Essential Dispersal Habitat	Essential Upland Habitat
Still/slow water	No barriers	Within 90 meters of aquatic habitat
≥0.5 meter freshwater depth	>90 meters wide upland/aquatic area	
Space, food, cover for all life stages		
≥2 suitable breeding sites and permanent water with no more than 2 kilometers between breeding sites		

Source: USFWS, 2001.

San Francisco Garter Snake (Thamnophis sirtalis tetrataenia) – Endangered

This snake is endemic to the San Francisco peninsula and is currently restricted to localities within San Mateo County. This listed species is primarily threatened by the loss and alteration of suitable wetland habitat due to urban development, freeway and road construction, illegal collection, agricultural practices, and trampling (USFWS 1985). It is considered semi-aquatic and is found along the margins of ponds, lakes, streams, and estuaries (above tidal influx) (Barry 1978). It feeds on small amphibians and fish, especially the federally threatened California red-legged frog (*Rana aurora draytonii*) (USFWS 1985). The planning area contains three sites (Sweeney Ridge, Milagra Ridge, Mori Point/Sharp Park) that appear to have suitable habitat for the San Francisco garter snake; however, recent surveys specifically for the snake and habitat assessments have not been conducted. Only Mori Point/Sharp Park has had a documented occurrence of the San Francisco garter snake; however, no recent population data are available. The NPS and the USFWS are currently planning inventory and enhancement activities for the San Francisco garter snake at Mori Point/Sharp Park.

California Freshwater Shrimp (Syncaris pacifica) – Endangered

The California freshwater shrimp is endemic to 17 coastal streams in Marin, Sonoma, and Napa counties north of San Francisco Bay. The shrimp is found in low-elevation (less than 116 meters), low-gradient (generally less than 1 percent), perennial freshwater streams where banks are structurally diverse with undercut banks, exposed roots, overhanging woody debris, or overhanging vegetation. Existing populations are threatened by introduced fish, deterioration or loss of habitat because of water diversions, impoundments, livestock and dairy activities, agricultural activities and developments, flood control activities, gravel mining, timber harvesting, migration barriers, and water pollution. Within PRNS and GGNRA, reproducing populations are found within the Lagunitas Creek watershed along the mainstem from Shafter Bridge in Samuel P. Taylor Park to roughly 1.6 kilometer below the confluence with Nicasio Creek (Serpa 1991) and in lower Olema Creek (Fong 1999). Recent surveys in 2002 at various coastal streams at PRNS have not found any new populations of the shrimp (LoBianco and Fong 2003). However, all shrimp observations have been restricted to sites managed by PRNS. No shrimp have been found on GGNRA-managed lands despite presence of suitable habitat (Fong 1999).

Tidewater Goby (Eucyclogobius newberryi) – Endangered

The tidewater goby is a small benthic fish that occurs in the upper end of California coastal lagoons in salinities less than 10 parts per thousand (USFWS 1994b). While generally found in coastal embayments, gobies are also known to occur in streams. In San Antonio Creek in Santa Barbara County, the goby is known to occur up to five miles upstream of the lagoon habitat (Irwin and Soltz 1984). Within the planning area, tidewater goby is known only from Rodeo Lagoon in the Marin Headlands.

Coho Salmon, Central California Coast (Oncorhynchus kisutch) – Threatened; Steelhead Trout, Central California Coast (O. mykiss) – Threatened

For most drainages, presence/absence salmonid surveys have been conducted, while in watersheds supporting coho salmon, abundance data on both species are available. The variable life cycle of steelhead makes population analysis more difficult, but also makes steelhead more resilient to adverse environmental conditions. In general, if the habitat requirements for coho were met, steelhead habitat requirements would also be met.

Central California coast coho salmon (hereafter referred to as coho) occur in several creeks within the planning area, as well as the nearshore waters of the Pacific Ocean and estuarine sites such as Bolinas Lagoon and San Francisco Bay. Coho salmon are found in Redwood Creek (Marin County). A single cohort of coho salmon was found in Easkoot Creek (Marin County). Designated critical habitat for coho in GGNRA includes accessible estuarine and stream areas in the coastal watersheds of Marin County except areas above longstanding naturally impassable barriers.

Central California steelhead trout (hereafter referred to as steelhead) occur in several creeks within the planning area. Steelhead are found in Redwood Creek in Marin County, as well as in the drainages to Bolinas Lagoon and Rodeo Lagoon. In San Mateo County, steelhead are found in West Union Creek, a tributary to San Francisquito Creek.

Both species are anadromous species; born and reared in freshwater streams, as juveniles they migrate to estuaries, adjust to saltwater, and then migrate to the ocean to mature into adults. Adult steelhead enter planning area streams in the late winter through spring to reach spawning sites, typically well-aerated areas with small- to medium-size gravel. Most adult coho return to freshwater systems to spawn in fall and winter months after spending 1.5 years in the ocean. Optimal habitat conditions for juvenile coho seem to be deep pools created by rootwads and boulders in heavily shaded stream sections. Habitat preferences for juvenile steelhead are similar, although young-of-the-year steelhead are often forced into shallow-water habitats. Most juvenile coho leave the streams for the estuary and ocean after 1.5 years of residence. The amount of time steelhead rear in freshwater and marine/estuarine habitats is variable, ranging between one to three years.

In April 2002, the U.S. District Court for the District of Columbia approved a NMFS consent decree withdrawing a February 2000 critical habitat designation for steelhead trout. Designated critical habitat for coho includes all accessible estuarine and stream areas in the coastal watersheds of Marin County except areas above longstanding, naturally impassable barriers. Through this designation, NOAA

Fisheries identified ten essential features of critical habitat: substrate, water quality, water quantity, water temperature, water velocity, cover/shelter, food, riparian vegetation, space, and safe passage conditions.

Special Status Plant Species

Within the areas considered under the GGNRA FMP, 26 special status plant species[2] are supported by existing habitat (see Appendix F for species listing status). Three are listed by the federal Endangered Species Act as either threatened or endangered; 20 are listed as federal species of concern or federal species of local concern (species for which the USFWS is collecting additional information to determine if they warrant consideration for future listing) (some of these species are also listed on the California endangered species list); and three species are of management concern to the park and are listed by the California Native Plant Society on List 4 – Plants of Limited Distribution (locally rare). Although these species are not actually listed as threatened or endangered under the federal Endangered Species Act, NPS Management Policies 2001 (NPS 2000a) states that the NPS will inventory, monitor, and manage state and locally listed species in a manner similar to its treatment of federally listed species. The policies also state that the NPS will inventory other species that are of special management concern to parks such as locally rare, declining, sensitive, or unique species.

Federal Threatened, Endangered, Candidate, and Proposed Plant Species that May Occur in Affected Areas

All three federally listed species within the planning area have the potential to be affected by FMP actions. These species are described below, and are included in the Biological Assessment that has been prepared in conjunction with the EIS for review by the U.S. Fish and Wildlife Service and NOAA Fisheries.

Raven's manzanita (*Arctostaphylos hookeri* ssp. *ravenii*) is a perennial prostrate to low-growing shrub. It exists as a single individual east of Lincoln Boulevard (in Area B) of the Presidio on a serpentine outcrop. Clones of this individual have been out planted west of Lincoln Boulevard in suitable serpentine coastal prairie habitat. The management of this species is guided by the Recovery Plan for Coastal Plants of the Northern San Francisco Peninsula (USFWS 2003), which suggests the species is stress-tolerant with sparse competing vegetation, but is relatively intolerant of direct vegetative competition such as shading from shrub or tree canopies. Although most manzanita species benefit from fire – the hard-coated seeds in the soil typically germinate post-fire, and most species also stump sprout – the effects of fire on this one individual and its clones are unknown. Raven's manzanita lacks burls (lignotubers), specialized flattened trunk-like structures that are adapted to rapid vegetative regeneration following fires. There have been no reports of natural seedling establishment around the remnant wild Raven's manzanita nor from the clones, which may indicate a lack of viable seed, seed predation, or lack of sufficient seedling microsites. No data are available on the natural germination ecology of this species, but the Recovery

[2] Additional special status species occur within the park's administrative and legislative boundaries and are managed by other agencies. These agencies include the Presidio Trust for Area B of the Presidio, the City and County of San Francisco for San Francisco watershed lands, the United States Air Force at the Mill Valley Air Force Base on Mount Tamalpais, and the NPS – PRNS for GGNRA lands north of the Bolinas-Fairfax Road that are managed by PRNS staff. These species are monitored regularly by staff at GGNRA and PRNS, but are not included in the following discussion because they are managed by other entities.

Plan suggests that seed germination could be stimulated by burns as with other manzanita taxa farther south on the San Francisco peninsula.

Marin dwarf-flax (*Hesperolinon congestum*) is an annual herb that is found in GGNRA as a small population west of Lincoln Boulevard of the Presidio. It grows within the serpentine coastal prairie-grassland habitat, and is somewhat affected by nonnative plant encroachment and trampling of offtrail use. Population trend monitoring of this and adjacent populations indicates that this species is stable to increasing in numbers in the area, although trends are difficult to interpret due to the wildly fluctuating annual population sizes typical for annual species. Other areas, not under direct management of the NPS, suggest that overall impacts on the species are from nonnative and native plant species encroachment, particularly from shrubs. These species encroach on suitable habitat and limit the annual display of this species. Management of the Marin dwarf-flax is guided by the Recovery Plan for Serpentine Soil Species of the San Francisco Bay Area (USFWS 1998). This plan suggests that primary protection and recovery actions should focus on removing nonnative plant species and minimizing trampling of plants, population areas, and suitable habitat around the population. Key research needs in the plan include the need to determine the effects of burning on the species – an issue being investigated in test populations outside GGNRA-managed lands (Thomas 2004).

San Francisco lessingia (*Lessingia germanorum*) is a low-growing, slender-stemmed annual herb of the sunflower family (Asteraceae). Robust plants have diffusely branched stems and grow up to one foot high, spreading close to the ground. Small plants may be very short and nearly erect, with few or no branches. Leaves are narrowly lance-shaped, lobed and toothed or entire, mostly an inch or less long. The leaves and stems are covered with grayish, wooly, loosely interwoven hairs. San Francisco lessingia is now narrowly associated with either sparse vegetative cover or substantial vegetation gaps, usually related to past artificial disturbance of the substrate or the vegetation. Historic populations were probably associated with early stages of succession following natural dune blowouts, or other local disturbances within coastal dune scrub. The management of this species is also guided by the Recovery Plan for the Coastal Plants of the Northern San Francisco Peninsula (USFWS 2003), which indicates that primary impacts on this species are related to the edge effects of adjacent vegetation, including shading, nonnative plants, and wind blockage. This plan suggests that primary protection and recovery actions should focus on removing nonnative plant species, minimizing edge effects, and increasing or enhancing suitable habitat around the population.

Federal Plant Species of Concern, California-Listed Species, and Additional Plant Species of NPS Management Concern that Occur in Areas that May be Affected by the GGNRA FMP

Twenty-three additional special status plant species occur within areas considered by the FMP. These species are briefly described below in relation to their habitat occurrences.

Chaparral. Marin manzanita, Glory brush, and Mason's ceanothus are evergreen shrubs that grow in the limited chaparral community on Bolinas Ridge south of the Bolinas-Fairfax Road. Threats to these species are excessive shade from overcrowding from high shrub densities, lack of disturbance to trigger seed germination and reproduction, nonnative species encroachment (particularly French broom), and possibly suppression of fire.

Grassland and Coastal Scrub. Coast rock cress is a perennial herb found throughout GGNRA, including the Marin Headlands, Presidio, Milagra and Sweeney Ridges, and Pedro Point. It grows on rocky outcrops and serpentine bluffs in coastal grasslands, where it is relatively common within the park. Habitat loss through urbanization (on a statewide scale), nonnative plant species encroachment, and alteration of coastal grasslands to coastal scrub through the establishment of coyote brush and other scrub species are the primary threats to this species. Oakland star-tulip is a perennial lily that was recently discovered in the vicinity of Muir Woods in non-serpentine grasslands, whereas larger and well-documented populations exist in the San Francisco watershed and on Mount Tamalpais. The species is threatened by nonnative plant species encroachment into suitable habitat. San Francisco wallflower is a short-lived perennial forb and is found throughout the Marin Headlands, and at Fort Point and the Presidio, Fort Funston, Sweeney and Milagra Ridges, and Pedro Point in scattered populations. It is found within coastal grassland and coastal scrub communities, as well as on rocky outcrops and coastal dunes. It thrives on new ground disturbances and is threatened by encroachment of dense shrubs. San Francisco gumplant is a perennial forb endemic to San Francisco County, where it inhabits serpentine coastal bluffs and grasslands. It occurs at the Presidio, where threats are confined to nonnative plant encroachment into suitable habitats and the development of (unplanned) social trails that increase natural erosion rates and increase trampling of individual plants. Arcuate bush-mallow, a small perennial shrub, was last observed on Sweeney Ridge in 1994. It does not occur elsewhere within GGNRA. This plant may not be present, or present in very small numbers due to lack of fire. However, seeds of species in this plant family (Malvaceae) typically lie dormant for decades and germinate vigorously after fire.

Forested Areas. California bottlebrush grass is a perennial bunchgrass that appears to be locally common where it occurs within the planning area, although its overall distribution is restricted in California. It occurs in the Marin Headlands, on moist western slopes of Bolinas Ridge, in Muir Woods, and in Oakwood Valley, where it inhabits the understory of Douglas-fir forests and native hardwood (California bay laurel) stands. Known populations appear to be stable with little threat from surrounding plant species or developments.

Wetlands and Riparian Areas. Choris's popcornflower is a small annual forb found in moist depressions in the coastal grasslands of Sweeney Ridge. It is threatened by the establishment and spread of nonnative plant species, especially oxe-eye daisy (*Leucanthemum vulgare*), and by soil disturbance (such as through trail maintenance) while the plant is growing and flowering. Franciscan thistle is a short-lived perennial herb found in freshwater seeps and drainages in the Marin Headlands, Fort Point, and Presidio coastal bluffs. Primary threats to the species are nonnative plant species encroachment – particularly bull thistle (*Cirsium vulgare*), poison hemlock (*Conium maculatum*), and Cape-ivy (*Delaria odorata*) – and changes in the water table from manipulations to trails, fire roads, and culverts above extant populations.

Coastal Dune and Marsh. The majority of special status species within this habitat are restricted to specific sites on the Presidio in areas unlikely to sustain fire management activities. These species include pink sand verbena, Nuttall's milk-vetch, California saltbush, coast Indian paintbrush, north coast bird's-beak, California croton, San Francisco dune gilia, Kellogg's horkelia, coast rein-orchid, Mission Dolores (San Francisco) campion, and pacific cordgrass. Two additional species – San Francisco spineflower and dune tansy – occur at both the Presidio and Fort Funston in sandy coastal scrub and dune habitats.

3.5 Social Environment

Cultural Resources

The NPS recognizes five categories of cultural resources for management purposes.

Archeological resources are the remains of past human activity and records documenting the scientific analysis of these remains. They are typically buried but may extend aboveground; they are commonly associated with prehistoric peoples but are also commonly products of more contemporary society. They shed light on often otherwise unrecorded questions, such as social organization, and have helped researchers to understand the spread of ideas over time and the development of settlement from place to place.

Cultural landscapes are environmental settings that human beings have created in the world that reveal the fundamental ties between people and the land and reflect the human need to grow food, give form to settlements, meet a need for recreation or work, or bury the dead.

Structures are material assemblies that extend the limits of human capabilities, such as buildings to keep people warm and dry. Bridges to cross barriers, ships and trucks to carry goods over long distances, fortifications for protection, and statues and monuments to commemorate human achievement, all are types of structures.

Ethnographic resources represent basic expressions of human culture and contribute to the continuity of tangible and intangible cultural systems, such as traditional arts, native languages, religious beliefs, and subsistence activities. In parks, they include special places in the natural world, structures with historic associations, and natural materials.

Museum objects are tangible manifestations and records of behavior and ideas that span the breadth of human experience and the depth of natural history. They are evidence of intellectual and technical development, of scientific observation, of personal expression and curiosity, and of common enterprise and daily habits. They are invaluable and irreplaceable samples of the world through time and place and of the multitude of life therein.

Cultural Resource Context for GGNRA

These five categories of cultural resources are the tangible manifestations of human beings interacting with their environment and with each other throughout some 100 centuries of time, up to the present day, in the lands now known as GGNRA. To understand the effects of the alternatives on the cultural resources of the park, it is necessary to concisely trace the contexts within which these interactions occurred and within which they were created.

Native American populations in California were once among the densest in all of North America. The lands around San Francisco Bay were occupied by scores of tiny tribes, each of which held territories some 8 to 12 miles across, that are now grouped into two major communities primarily because of linguistic similarities – the Coast Miwok north of the Golden Gate and the Ohlone to the south of the

Golden Gate. Because they lived off the seeds, fish, and animals of their local environments, details of their lives differed somewhat among coastal, bay shore, riverine, and interior valley homelands. Intermarried extended families grouped together in tribes that protected their tiny territories fiercely against the encroachment of neighbors. But adjacent tribes were also bound together by a complex web of intergroup marriages and trading alliances. Coast Miwoks and Ohlones were integrated so seamlessly into their environment that it is easy to overlook just how sophisticated and extensive were their techniques of managing the lands for food, shelter, and other purposes.

The era of Spanish exploration and settlement brought great disruption to the traditional Native American ways of life. Indeed the interaction between the two cultures decimated native populations and brought an end to the Bay Area tribal world. Motivated by a global rivalry for political, military, and economic dominance, Spain's New World colony in Mexico entered a period of expansion, spurred by news of Russian and British activity in the far northwest. In 1769 the Portola Expedition discovered and claimed San Francisco Bay on behalf of the Spanish Crown, and in 1775-1776 the Anza expedition brought settlers from Sonora overland to found a mission and a presidio.

Spanish colonial settlement followed a rather rigid and complex system that had developed over 200 years of northern expansion beginning in 16th-century Mexico City. The Presidio functioned, here as elsewhere, as the military and civil complex and advance guard of territorial settlement, and shared a social and economic function with the mission (Langellier 1992).

Mexico became independent of Spain in 1822, as one consequence of widespread anti-colonial revolution in Latin America. But outward change came slowly to the isolated, neglected, and poor garrison at the Presidio of San Francisco. Within the decade, the Mexican government had decreed the secularization of the missions, dividing their holdings into self-supporting ranchos and replacing the Franciscan missionaries with regular parish priests. The political center of power thus shifted more and more toward a landed elite, and regional land use patterns still recognized today were set in place. The vast ranchos with their equally vast herds of cattle became the basis for much of the economic activity in the area. Decentralized trade became more common, encouraged by visits from "Boston ships" carrying the American flag, and overland parties from the expanding nation far to the east began to intrude more and more on the Hispanic society of California, culminating with its annexation to the United States in 1848.

The westward expansion of the young United States in the name of "manifest destiny" is reflected in the central role of the Golden Gate as the grand entrance by sea to the Pacific West and all its potential. The California Gold Rush of 1849 transformed that future potential into a very sudden, very busy era of settlement, urbanization, industrial growth, resource extraction in the gold fields and forests, and rapid establishment of a world-renowned city at the tip of the San Francisco peninsula.

To the north of the city, new settlers began to develop a regionally significant dairy industry in the 1850s that thrived for 100 years; a number of the original dairy ranches continue to operate, as cattle ranches, within the park boundaries. These dairy ranches played an instrumental part in the development of the industry in California. They were at the forefront of industry modernization; they led the state in dairy production into the 1890s, they became a primary destination for immigrants from Switzerland and the Azores, and they brought a rich ethnic mix to the area that remains to this day. As the ranch complexes

stayed in use until quite recently, they continue to impart a pastoral, scenic, and distinctive regional flavor to the rural historic landscape of west Marin and the northern lands of GGNRA (Livingston 1995).

As the population and economic development in the San Francisco Bay Area soared in the years following the Gold Rush, the transportation network grew apace in order to move people and goods more efficiently. The growth of the port was paralleled by construction of aids to navigation at crucial points along the Golden Gate and along the coast – lighthouses, fog signal stations, life-saving stations, and Coast Guard stations. On land, ancient trails used by the native tribes sometimes became wagon roads and, eventually, paved roadways; some still survive in the form of contemporary hiking trails. Other farm roads, rural highways, streetscapes, ferry piers, and railroad rights-of-way developed in response to local and regional transportation needs.

San Francisco Bay was described by the first European explorer to see it as wide enough to shelter all the navies of the world. Ever since, it has been an important strategic consideration in the military and political balance of power in the Pacific. The Spanish built the first fortifications at the harbor entrance in 1794, and the Americans began their impressive network of seacoast defenses at Fort Point and on Alcatraz even before the Civil War broke out in 1861. By the turn of the 20th century, the major naval base at Mare Island and the widespread port and industrial facilities throughout the area impelled the U.S. Army to build modern concrete and steel fortifications along the Golden Gate on a scale unmatched in the Pacific. Only the much larger city of New York had fortifications on a scale equaling those at San Francisco Bay.

At the start of the 20th century, as the United States assumed control of territories across the Pacific Ocean in the Philippines, in Hawaii, and in the Panama Canal Zone, Fort Mason became the major port of embarkation for troops and supplies going to these overseas outposts. After the attack on Pearl Harbor propelled the United States into World War II, the West Coast became an official theater of war and its defenses were reinforced accordingly for “the duration.” During the long tense years of the Cold War that followed, the Army deployed Nike anti-aircraft missiles around the Golden Gate hinterlands – the last in a long line of defenses that date back nearly 200 years.

As these great social, political, and economic trends unfolded, they were enabled and enhanced by technological and engineering advances. These are manifested by the great prisms lit by whale oil, then kerosene, at the Point Bonita Lighthouse; the contrast between the seemingly numberless and intricately layed bricks at Fort Point and the massive concrete gun batteries of the Marin Headlands; and, especially, by the turbulent waters of the Golden Gate spanned by the world-famous bridge that bears its name.

The development of architecture and landscape architecture was informed by, and related to, these technological and engineering advances. The park today contains archeological remains of adobe brick structures, utilitarian and ornamental wooden homes and barracks, and brick and concrete buildings; the profusion of historic structures within the park is a veritable catalog of architectural style over some 200 years. The massive warehouses at lower Fort Mason and the curving row of artillery barracks at Fort Winfield Scott vie for the honor of introducing Mission Revival to the architectural palette of northern California’s public structures. The Cliff House at Lands End reflects the early use of reinforced concrete

in the rebuilding of San Francisco after the great earthquake and fire of 1906. The cellhouse on Alcatraz Island was the largest reinforced concrete building in the world when it was completed in 1912.

Great cities require civic amenities, and San Francisco was in the forefront of opening parks and seaside recreational areas for its citizens. Indeed Adolph Sutro's gardens at Sutro Heights overlooking the fanciful Sutro Baths at Nyad Cove are noteworthy in providing healthy and educational outdoor opportunities for people of all social and economic strata. The Presidio in San Francisco and Fort Baker in Marin County also played important roles as pleasant, well-landscaped recreational areas for the local citizenry and for national and international visitors too – presaging their roles in the present national park. Urban areas also have their dark side, and nowhere does that underworld more eloquently speak from the past about prisons, prison life, and penology than at Alcatraz Island.

These diverse and significant historical threads are all related in some way to the land use patterns that developed in the region and to the use of the land for settlement, for production, and for its resource values. The native tribes affected the resources of the area in a sophisticated manner that is perhaps so subtle, compared to what followed, that it appears they had no impact at all upon the "wilderness." Yet the detailed composition of the regional ecosystems was clearly influenced by human beings for thousands of years. Widespread cattle grazing is widely perceived to have brought the earliest broad changes by European peoples to the Bay Area landscape. These changes accelerated dramatically in the American era with widespread logging deforesting most of the timber stands within present park boundaries. Siltation from increased erosion in logged areas affected natural wetlands, while San Francisco Bay on a larger scale was affected by silt-laden runoff from water-cannon mining in the Sierra foothills and by purposeful filling of the shoreline for development projects such as the 1915 Panama Pacific International Exposition. The abundant natural resources of the area, as in the West as a whole, were the fuel for the economic engine that built houses and ships, drove vehicles, watered mouths and fields, and gave mineral riches to the economy. They are the historical foundation of the West that today's generation has inherited.

Where resource exploitation was most egregious, however, it became the rallying point for a small but growing national conservation movement, one that, in many ways, can rightly call the Bay Area its birthplace. In 1908 Congressman William Kent donated the largest old-growth redwood grove in the north bay to the nation as a national park on the condition that it be named for naturalist John Muir. It was one of the first uses of the Antiquities Act, formulated to protect archeological sites, to preserve natural wonders. In 1916, the Sierra Club, founded in the Bay Area, lost its bitter battle to preserve Hetch Hetchy Valley in Yosemite from being filled as a reservoir. But in losing a battle, it may have won a war, for the organization thrived in future years on a crest of national outrage over the outcome. In 1928, Mount Tamalpais State Park was established to preserve some of the most scenic natural acres in the Bay Area. And about the same time, one of the best local park organizations in the country, the East Bay Regional Park District, began to create a greenbelt along the crest of the East Bay hills.

Thus the stage was set for the establishment of GGNRA in 1972. As post-war suburban sprawl threatened the open space in the region, the once-powerful military-industrial complex in the area began to subside. The historic coincidence of the anti-growth movement with a revitalized conservation movement took

advantage of the unparalleled opportunity created by the closure of the large and largely undeveloped Army posts ringing the Golden Gate headlands. Thus was formed GGNRA, as community activism met public need and created a great national park to preserve open space, natural habitat, scenic wonders, and historic values in the San Francisco Bay Area (Rothman 2002).

Cultural Resources by Category

Fire management actions such as prescribed fire, suppression activities, and mechanical treatments have the potential to affect cultural resources such as archeological sites, structures, ethnographic resources, and cultural landscapes within National Landmark and National Register Historic Districts, as well as museum collections and other properties managed by the park as cultural resources. For a listing of historic properties within GGNRA, excluding archeological sites, see Appendix D. Cultural resources in Golden Gate are subject to the provisions of the National Historic Preservation Act (NHPA), which requires identification and assessment of park resources for their eligibility for the National Register of Historic Places (Section 110) and consideration of the effects of any undertaking on resources that are on, or determined eligible for, the National Register (Section 106). It is NPS policy that every effort be made to minimize the effects of such undertakings and avoid adverse effects on historic resources (NPS 2000a).

The environment with potential to be affected – both positively and negatively – by fire management activities at GGNRA may now be discussed by specific resource category with an understanding of their historical context.

Archeological Resources

There are 52 archeological sites included in the Archeological Survey Management Information System for Golden Gate National Recreation Area, and numerous additional sites are presumed to exist. Their significance is assessed through the use of research agendas based upon historical contexts. Archeological resources from indigenous populations of Native Americans within the present boundaries of GGNRA typically consist of sites, such as village sites, camps, rock shelters, procurement sites such as food gathering and hunting spots or quarries for tool making, food processing sites such as shell middens, funerary sites, and trails. Isolated artifacts relating to many of the above functions may appear in areas with greater or lesser association to these sites. Human remains have been identified in association with shell middens within the park, and it may have been a widespread cultural practice to associate the burial of the dead with the activities of the living.

Historic period archeological resources are of a different nature, and consist primarily of two types: remains of buildings and structures, and trash or refuse dumps. Besides the known archeological resources from the prehistoric and historic eras, there are almost certainly numerous archeological resources that remain to be discovered within park boundaries. This is because only a small percentage of the lands within GGNRA have yet been surveyed to professional standard, because archeological sites within surveyed areas are so numerous, and because such resources regularly are brought to the park's attention through maintenance activity, development, visitor use activity, and other means. At present, the park uses a model based upon soil type slope ratio and proximity to sources of water to predict areas of potential archeological sensitivity.

A low-intensity fire may actually be beneficial to the management of archeological resources, in the sense that the removal of dense vegetation may open up previously inaccessible areas for survey and identification. However, removal of ground cover, whether by fire or mechanical methods, may make sites more vulnerable to looting or erosion. In general, quick-moving fires, in which the heat impulse is directed largely upward, have relatively little impact on buried archeological resources, while fires that move slowly and direct heat downward have greater impact, with sites consisting of inorganic material being less sensitive to low and medium temperatures than those containing organic material. Alterations to drainage patterns through ground disturbance or change in vegetative cover may have impacts on archeological and other cultural resources. Archeological sites on the surface or subsurface could be damaged by heat from prescribed burning or wildfires, disturbed by the clearing of containment lines around prescribed burns or wildfires, or damaged by the operation of heavy equipment over sites or into sites if heavy equipment use includes soil disturbance as part of fuel reduction projects. The use of staging areas for fire management activities and equipment also has potential to damage archeological resources if the staging areas are not sited away from areas of known and predicted sensitivity.

Much as they may affect landscape resources in unanticipated ways, the application of fire-retardant chemicals during wildland firefighting may have unforeseen effects upon buried and unburied archeological resources. More research is needed in order to be able to identify these effects at any useful level of detail.

Cultural Landscapes

Parklands contain extensive areas of historic period cultural landscapes, significant in the areas of farm life and agriculture, military affairs, and designed landscape architecture. In particular, many of the dairy ranches of West Marin, the former Army posts along the Marin and San Francisco headlands, and the public parks and recreational complexes along the San Francisco shoreline retain a high degree of integrity relating to their period of historical significance. The most extensive cultural landscapes are the former military lands and the rural agricultural landscapes. These are also the areas where fire management activities will have the most effect on historic landscape resources through wildfires, by prescribed burns, by provision of access for fire equipment and vehicles, and by mechanical fuel load reduction activity.

These landscapes consist of clusters of, and individual, buildings, structures, and small-scale features; the circulation networks connecting them; the land use patterns characteristic of the landscape type; boundaries and boundary markers; water features; depositional features; vegetation patterns and components; and the topography upon which all these lie. Particular activities, lack of activity in some cases, and certain fire conditions have the potential to put at risk a broad range of values that directly affect the integrity of landscape resources. (See Figures 3-12, 3-13, and 3-14.)

The very existence of historic buildings and the safety of their occupants are affected by lack of defensible space, excessive fuel loading nearby, and proximity to sources of water. Creating defensible space and reducing dangerous fuel loads have the obvious beneficial effect of reducing structural fire danger, but must take historic vegetation material, boundary demarcations, and land use patterns into account in order to avoid adverse impacts on these character-defining features of historic landscapes.

Golden Gate National Recreation Area
Cultural Landscape Inventory -- Marin
National Park Service
U.S. Department of the Interior
Bolinas Copper Mines
Wilkins Ranch
Bolinas Lagoon
Stinson Beach
Muir Woods
Dipsea Trail
Camp Monte Vista
Druid Heights
Hill 640 Military Reservation
Camino del Canyon
Miwok Trail
Miwok Trail
Banducci Flower Farm
Miwok Trail
Marin County
Golden Gate Dairy
Sausalito
Pacific Ocean
D Ranch & Rapozo Ranch
Fort Cronkhite
Fort Baker
Fort Barry
Point Bonita Lifesaving Station
Point Bonita Lighthouse Complex
Cultural Landscapes
Area Managed by Golden Gate NRA
Other Public Lands
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0 0.5 1 2 3 Miles

Figure 3-12

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Golden Gate National Recreation Area
Cultural Landscape Inventory -- San Francisco
National Park Service
U.S. Department of the Interior
Alcatraz
San Francisco Bay
Fort Mason Historic District
Presidio of San Francisco
Land's End
Presidio of San Francisco
Fort Miley
Point Lobos
Adolph Sutro Historic District
Ocean Beach
Fort Funston
Pacific Ocean
Cultural Landscapes
Area Managed by Golden Gate NRA
Other Public Lands
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Figure 3-13

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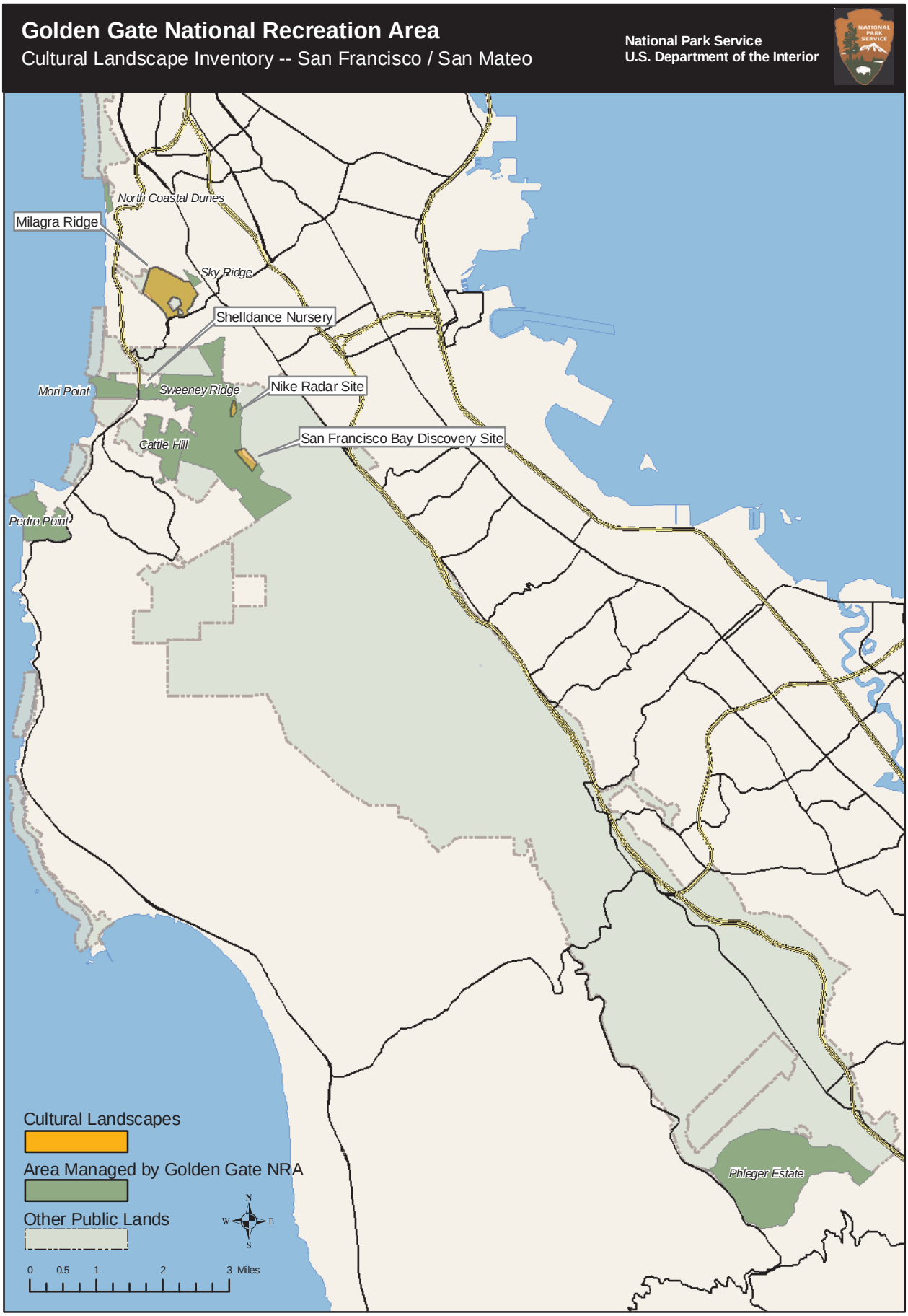
Golden Gate National Recreation Area
Cultural Landscape Inventory -- San Francisco / San Mateo
National Park Service
U.S. Department of the Interior
North Coastal Dunes
Milagra Ridge
Sky Ridge
Shelldance Nursery
Mori Point
Sweeney Ridge
Nike Radar Site
Cattle Hill
San Francisco Bay Discovery Site
Pedro Point
Phleger Estate
Cultural Landscapes
Area Managed by Golden Gate NRA
Other Public Lands
N
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0 0.5 1 2 3 Miles

Figure 3-14

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The use of power tools, motor vehicles, and heavy equipment without careful allowance for the integrity of roads, pathways, tracks and trails, plantings, and drainage features could adversely affect features such as road surfaces, road prism, circulation network alignment, gates, fences, and cattle guards. Properly informed by cultural landscape information, however, such equipment can be of enormous value in providing access to overgrown areas, especially fire roads, and restoring the historic feel of long-neglected areas.

Historic patterns of land use have a tendency to change over time and to be obscured by neglect and by uncultivated vegetation growth. Landmark trees, open vistas, ease of walking, field and garden planting patterns, the open spacing of orchards, evidence of grazing, and specific species composition all diminish without active human management. Fire and fire management activities can have both beneficial and detrimental effects on historic land use patterns. Fire set under proper prescription can keep open fields in grassland, avoid the choking feel and high fire hazard of spreading scrub, and avoid damage to historic fence lines, significant vegetative species, and important trees. Where fire use is not appropriate, mechanical fuel reduction activities can have the same beneficial effect provided cultural resource values are taken into account. Mechanical fuel reduction is particularly beneficial in managing the spread of planted trees, such as eucalyptus, Monterey cypress, and Monterey pine, beyond their intended extent.

Erosion, whether because of the denuding of soil cover after fire or because of human-caused fire management activity, has the potential for major adverse effect on cultural landscape resources such as the quality and alignment of water features, the circulation patterns, roads, paths and trails, the integrity and function of drainage systems, the suitability of the land for historic grazing and growing purposes, and the very feeling of the pastoral landscape.

The application of fire-retardant chemicals during wildland firefighting may have unforeseen effects upon the post-fire growth of vegetation within an historic landscape, but more research is needed in order to be able to identify these effects at any useful level of detail.

Structures

Fire management actions, or lack of action, will clearly affect the safety of many of the park's approximately 700 historic structures. Basic fire safety measures such as regular inspections, provision of emergency exits, and installation of smoke alarms and sprinkler systems have a great deal of positive benefit for the preservation of historic buildings. But these structural fire safety actions, important as they are, lie largely outside the scope of the affected environment for the FMP, and are addressed through NPS Director's Order 58.

The most substantial beneficial impacts of wildland fire management activities can be anticipated from the creation and maintenance of defensible space around historic buildings and structures through pruning or removal of dense, overgrown, and highly flammable vegetation growing nearby. The maintenance of access for firefighting equipment and personnel via fire roads, alleys, and adjacent spaces is also of importance in the preservation of historic building resources. Direct negative impact of such activities on the historic integrity of buildings themselves is unlikely, although indirect adverse effects on nearby landscape elements are possible if activities are not planned and carried out with sensitivity.

Ethnographic Resources

Ethnographic sites within GGNRA that have the potential to be affected by fire management activity are largely considered to be places, landscapes, and features with specific cultural meaning to Ohlone and Coast Miwok peoples. No such sites have presently been identified by the NPS or have been brought to the park's attention to date by Ohlone or Coast Miwok tribal members. However, the NPS is presently developing an ethnohistory study, in association with notable scholars, to better formulate an ethnographic context for Native American cultural associations within GGNRA. In addition, as part of the NEPA process for the FMP FEIS, the GGNRA consulted with representatives of local tribes to determine if such sacred sites are located within GGNRA lands. Through the course of implementing the FMP, the NPS will consult with the tribes as appropriate. Additional ethnographic sites, such as traditional gardens, may be associated with the predominant Azorean culture of the West Marin dairy ranching families.

As ethnographic resources are identified, the effects of fire management activities on those resources will be defined through the disciplines of ethnography, cultural landscapes, archeology, horticulture, and natural sciences, as appropriate. In every case, culturally associated groups will be consulted to the extent feasible and required by law, regulation, and policy. Fire management activities may have positive effects, such as restoring significant vistas or triggering growth in fire-dependent species of interest, as well as negative effects, such as increasing erosion or harm to individual signature trees.

Museum Objects

Structural fire management actions aside, there is little chance for fire management activities to directly affect park museum collections. However, indirect effects of fire management activities on museum collections may include increased curation responsibilities due to additional pre- and post-fire management and fire incident surveys, additional collecting of museum objects revealed during fire management activities, and additional consultation from subject matter experts that may be required in order to properly identify and assess potential museum artifacts.

Human Health and Safety

Public Safety and Wildland Fire Hazard

Marin County lands in the wildland urban interface zone are at risk for catastrophic fire such as a repeat of the Mount Tam fire in 1929, the Oakland Hills fire in 1991, and the Vision Fire in 1995. Approximately 40 percent of the land in Marin County (332,928 acres) is in public ownership, much of it contiguous to privately held properties at the edge of the wildland urban interface (Marin County Civil Grand Jury 2003). GGNRA has an expansive and complex boundary with many Marin County residential areas including Tam Valley, Homestead Valley, Muir Beach, Stinson Beach, Marin City, and Sausalito. In San Mateo County, GGNRA lands border San Bruno, Pacifica, Woodside, and King's Mountain. San Francisco lands are within the boundary of the City and County of San Francisco.

Numerous factors have contributed to the high fire hazard level:

- Wildfire suppression efforts creating current high fuel loads. The natural vegetation in California is adapted to fire and relies on periodic low-intensity fires to maintain a healthy balance. The

removal of fire from the landscape has resulted in huge accumulations of fuel, overcrowded forests, and decadent chaparral stands (MCFD 2000).

- Continued expansion of tracts of highly flammable, nonnative plants such as *eucalyptus globulus* that can successfully out-compete less flammable native plants, especially in disturbed areas.
- Spread of Sudden Oak Death, increasing fuel loads and hazards in the oak woodland forests, especially in Marin County.
- Construction of new housing on the perimeters of developed areas up to the interface with open space.
- Restricted access to communities due to narrow roads and roadside parking.
- Limited funding for vegetation management projects, staffing, and equipment purchases.

In evaluating wildfire risk in 2003, the Marin County Civil Grand Jury cited statistics that a repeat of the 1929 Mill Valley fire, which destroyed 116 homes valued at $1 million, would today destroy 850 homes in approximately the same footprint. Fuel loading prior to the 1929 fire was estimated at 12 tons per acre; the same area and acreage today has an estimated fuel load of 25 tons per acre. The Grand Jury concluded that "Mill Valley, Corte Madera, Larkspur, Kent Woodlands, San Anselmo, Ross, Fairfax, Novato, Woodacre and parts of West Marin especially appear vulnerable, although other communities are also at risk" (Marin County Civil Grand Jury 2003). Many of the risk factors present in Marin County today – narrow roads, restricted access, extensive tracts of blue gum eucalyptus – are similar to those that contributed to the devastating 1991 Oakland Hills fire (Tunnel Fire).

The potential property damage for a fire spreading from the wildland urban interface is equally high. While the 1929 fire caused $1 million damage, the more recent Vision Fire of 1995 resulted in structural damage of $23 million with the loss of 48 homes and damage to 18 others. Utility repairs following the Vision Fire were $1.3 million and rehabilitation of slopes and roads to control erosion cost approximately $1.3 million (MCFD 2004). Suppression of the fire exceeded $6 million.

A new factor is the presence of Sudden Oak Death (SOD), which is widespread in the interface lands of Marin County and recently appeared in both San Mateo and San Francisco counties. SOD has left thousands of trees dead in the oak woodlands adjacent to and within residential areas of Marin, greatly increasing the volume of hazardous fuels and elevating the potential intensity of a wildland fire. The partially collapsed, dead, and weakened trees present areas with higher fuels scattered in the woodlands that can create hot spots as they burn, providing a means for a ground fire to spread to convert to a crown fire – one of the most difficult wildfire types to control (MCFD 2000). As trees become infected with SOD, they become susceptible to secondary insect infestations and pathogens that speed decay. The sudden collapse of SOD-infected trees poses a new and significant threat to the public and firefighters and, if collapse occurs within range of a power line, could present a new source of fire starts as well (Shelley 2002).

Federal Government Response

Fire management planning in the NPS is based on the policies and philosophy set forth in the National Wildland Fire Management Policy (2001), which places public and firefighter safety as the primary goal of federal wildfire management programs. Federal policy acknowledges the public safety hazard existing in critical areas of the wildland urban interface between federal lands and private holdings. In 2001, following a catastrophic wildland fire season in 2000,[3] President Clinton asked the Secretaries of Interior and Agriculture to develop a joint implementation plan for reducing fire hazard and high fuel loading in the wildland urban interface and reintroducing fire back into the environment in federal wildlands as an important ecological element. The ensuing report, *Managing the Impact of Wildfires on Communities and the Environment, A Report to the President In Response to the Wildfires of 2000*, provided an implementation plan based on a cooperative approach to reducing fire hazard, the incremental success of which could be gauged by monitoring the progress of a series of measurable objectives. The report, its accompanying budget request, Congressional direction for substantial new appropriations for wildland fire management for the subsequent fiscal years, and resulting action plans and agency strategies have collectively become known as the National Fire Plan.

The National Fire Plan requires that all Department of the Interior (DOI) and U.S. Forest Service (USFS) areas with burnable vegetation have fire management plans that keep pace with changes in federal wildland policy. This required new FMPs to be developed reflecting changes in federal policy such as the increased emphasis on interagency cooperation and hazard reduction in the wildland urban interface.

To increase progress in implementing the principles of the new federal wildland policy, funding of the Wildland-Urban Interface Initiative of the National Fire Plan was increased and eligible projects expanded to cover both agency and local community projects. This program has allowed homeowners' associations, local fire agencies, and federal land managers to tackle longstanding fire hazards in Marin County, including strategically reducing areas of high fuel loading, improving access for emergency vehicles, and constructing shaded fuel breaks. Funding has also been provided for fire education programs that encourage homeowner participation in reducing fire hazard around their homes and in their communities. Cooperation and communication have been facilitated by the leadership of FIRESafe Marin, a nonprofit agency formed in 1991 in response to the Oakland Hills fire. FIRESafe Marin provides a forum for exchange of information on projects and funding opportunities among federal, state, and local land management and fire agencies and nonprofits such as homeowners' associations. NPS staff has also attended Fire Safe San Mateo County meetings through 2004.

Since fiscal year 2001, the federal government has funded 60 projects in Marin County throughout the interface zone on national parklands, private parcels, water district lands, and state and county parklands (M. Prado 2004). Projects have been located in the interface zone of federal lands and the neighboring communities of the Marin City, Sausalito, Muir Beach, Mill Valley, Tam Valley, Homestead Valley,

[3] The 2000 fire season was one of the worst in 50 years. Approximately 123,000 fires burned more than 8.4 million acres. The total acreage burned was more than twice the 10-year national average. At times, nearly 30,000 personnel were on the fire lines, including the military and firefighters from other countries. More than $2 billion from federal accounts was spent suppressing wildland fires; this amount does not include state and local firefighting suppression costs, direct and indirect economic losses to communities, loss of property, and damage to ecosystems (Waggoner 2004).

Stinson Beach, and Kent Woodlands. Where federal lands adjoin locally managed open space lands, the potential exists for a fire to spread from one area of undeveloped land to another and then into the more developed areas of Marin. Wildland-Urban Interface Initiative funding has been used by the Marin Municipal Water District, the Marin County Open Space District, and the Marin County Fire Department to implement the series of shaded fuel breaks envisioned by the Mount Tamalpais Vegetation Management Plan. Zones of reduced fuels are to created on both sides of ridgetop fire roads to provide firefighters with a defensible space from which to launch fire suppression actions, and lower branches of larger trees are pruned while retaining as much forest canopy as possible (MCFD 2004). Future project proposals may include fuel reduction in national parklands in San Mateo County near the cities of Pacifica and San Bruno and the community of King's Mountain on Skyline Boulevard.

Human Health

The principal impact of FMP activities on public health is the inhalation of particulate matter generated as smoke from prescribed fires and unintended wildland fire. Particulate matter is considered such a significant health hazard that it is one of the six criteria pollutants monitored under the Clean Air Act. (See also the air quality discussion in this chapter.) Particulate matter, found in the air-liquid droplets and small solid particles of minerals and soot, can penetrate deep into the lungs. Studies indicate that 90 percent of all smoke particles emitted during wildland burning are PM_{10}, and 90 percent of PM_{10} is $PM_{2.5}$ (Sandburg et al. 2002).

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, or may cough or feel short of breath. Children and the elderly are generally more susceptible to the harmful effects of smoke (CARB 2003).

Ninety percent of fire emissions are in the form of carbon and water vapor. The portion of carbon not converted to carbon dioxide becomes particulates, carbon monoxide, and volatile organic compounds. Carbon monoxide (CO) is the most abundant air pollutant (Agee 1993) and is a criteria air pollutant under the Clean Air Act and monitored in the Bay Area Air Basin by the Bay Area Air Quality Management District (BAAQMD). The more efficiently a fire burns, the less CO is produced. Impacts of CO on firefighter safety depend on the amount of CO produced, the duration of the exposure, and the level of physical activity. Firefighters working strenuously in a smoldering fire may become dizzy, weak, and disoriented. They can quickly recover by moving to fresher air away from the blaze (DeBano et al. 1998). Volatile organic compounds (VOCs) that are considered a health hazard are polynuclear aromatic hydrocarbons (PAHs). Though not a criteria pollutant, PAHs can have impacts on human health at higher concentrations. Backing fires[4] and smoldering fires produce higher levels of particulates and PAHs since the gases have higher residence times in these types of combustion conditions (DeBano et al. 1998).

BAAQMD is responsible for monitoring PM_{10} and $PM_{2.5}$ levels under the Clean Air Act and issuing permits for stationary sources, such as power plants, that contribute particulates to the ambient air quality

[4] Fires set by firefighters to burn against an advancing fire to deprive it of fuels.

of the Bay Area Air Basin. Smoke from wildfires is inventoried and managed differently from smoke from prescribed fires. Wildfires are natural events and their emissions are addressed by the Environmental Protection Agency (EPA) Natural Events Policy. Emissions from prescribed fire are addressed by EPA's Interim Air Quality Policy on Wildland and Prescribed Fire. The states use these policy documents and other information to develop State Implementation Plans (SIP) and Smoke Management Programs (SMP). In accordance with the California Smoke Management Guidelines, BAAQMD manages smoke emissions from prescribed burning by regulating allowable burn days, reviewing burn plans, and coordinating the number of allowable burns per day. The goal of BAAQMD's smoke management program is to continue prescribed burning as a resource management tool while minimizing smoke impacts on public health in populated areas.

Firefighter safety standards fall under the Occupational Safety and Health Act. Exposure to carbon monoxide and individual particulate matter compounds in wildland fire smoke are of primary firefighter safety interest. Limiting firefighter exposure to smoke is the best way to improve a firefighter's working environment. This is best done by smoke management techniques and crew rotation.

The amount and type of smoke and particulates produced will vary during each phase of combustion of a fire. During pre-ignition, the fuel's temperature is being raised to ignition temperature and all the moisture present in the fuel is being evaporated. During pre-ignition, only small amounts of white smoke are produced by combustion and the white smoke is predominately water vapor. In the flaming phase, fuel reaches the ignition temperature and erupts into flames. The fuel goes through a chemical change and large amounts of heat and gases are released. Rapid oxidation occurs and large amounts of smoke are produced. The smoke is lifted off the ground by the heat that is being produced and begins to disperse. The combustion process is very efficient during this phase. The residual (smoldering) phase occurs when the flaming front has moved on and some of the unconsumed fuel is still going through the combustion process – slowly, with little heat being released. A convection smoke column does not form and smoke is not readily dispersed. Instead it is concentrated close to the ground (PFMT 2004).

Smoke management techniques for prescribed burning include temporary and permanent fuel exclusion, implementation under specific moisture regimes, mass ignition techniques and other means of increasing combustion efficiency, and emissions redistribution. Each strategy is intended to reduce the generation of particulate matter or redistribute emissions. When fire is used to reduce fuel loadings, eliminating an undesirable species, disposing of quantities of biomass waste in advance, and isolating stumps that are prone to smoke can help in meeting state standards and resource management objectives. Conducting prescribed burns when small fuel moisture is low and large fuel and forest floor moisture levels are high can reduce emissions by making less fuel available overall for combustion. Also important is to mop up a prescribed fire quickly and efficiently to reduce smolder. Avoidance and dilution are strategies that direct smoke away from sensitive receptors or dilute the concentration of smoke. Based on the results of pre-fire modeling, prescriptions are set to take advantage of meteorological conditions that maximize mixing and direct smoke away from developed areas (DeBano et al. 1998).

Firefighter equipment can also play a key role in limiting an individual's exposure to fine particulates. Recent studies find that firefighters are exposed to the highest levels of particulate matter during mop-up

when areas of residual burning are controlled. Wearing respiratory protection greatly reduces exposure to particulate matter and air toxins but also makes breathing more difficult under heavy physical exertion, as respirators tend to increase resistance to air flow, making breathing more difficult (R. Bible 2002).

When fire is needed for ecosystem maintenance or restoration, especially in those ecosystems that are fire-adapted or maintained, these strategies are less applicable because they all alter the necessary or ecological fire regime. Altering an ecosystem's fire regime (intensity, frequency, seasonality, or spatial distribution) is manifested by changes in community structure and function and species diversity and distribution to some degree, and is well documented.

Herbicide Use

Fire management and vegetation management projects in GGNRA use herbicides, on a case-by-case approval basis, to control nonnative plant species within specific management areas. The NPS Integrated Pest Management Manual, Director's Order #77-7 (NPS 1991) requires that all park pesticide use be reviewed each calendar year prior to the application season to ensure that the product and the proposed use for it are still legally registered. NPS requests for herbicide use are written for site- and time-specific applications and do not remain valid beyond one yea. The GGNRA IPM program, consistent with NPS Director's Order #77-7, states that the purchase, storage, and application of any herbicide will follow all federal, NPS, state, and local regulations. If California regulations are more stringent than federal, the former will supersede the applicable federal regulations. The potential for multiple applications of herbicides to any one site is considered very low. Historically, the GGNRA has been able to control the target vegetation with only one application.

Various brand names of herbicides containing glyphosate are used to prevent resprouting of cut tree stumps within nonnative evergreen forests or shrub lands, especially on blue gum eucalyptus, acacias, cotoneaster, and various brooms. Foliar applications are approved in limited scenarios where nonnative vine or shrub species create a dense and dominant component of the site, and have included Cape-ivy and eupatory. These species can form dense thickets of impenetrable vegetation near developments and other critical resources, posing a fire hazard.

If there are trees within a grove that are to be retained due to cultural resources issues, application of herbicides to the cut stumps is avoided to avoid spread of the systemic treatment through the roots to the trees that were not to be treated with herbicide. In that case, a thick layer of chips could suppress some proportion of the regrowth, or nailing heavy roofing paper to the stump or applying landscape fabric onto the cut stump could serve to depress resprouting.

The most commonly used herbicide for FMP actions in GGNRA is Roundup Pro, a low-toxicity, general use herbicide. The U.S. Environmental Protection Agency (EPA) has rated it as a Class 3, Caution-labeled herbicide; the EPA registration number is 524-475. Roundup Pro has also been approved and registered for use in California by the California Department of Pesticide Regulation. The active ingredient in Roundup Pro is glyphosate. Glyphosate, when applied to foliage, is absorbed by leaves and stems and rapidly moves through the plant. Glyphosate is a translocating herbicide that moves from the area where it was applied down to the roots of the plant via the active tissue – the cambium. It remains in

the roots. Glyphosate is applied by painting it on the tree stump immediately after the tree is cut. If the trees are in a riparian area, no foliar spraying may occur, especially if the habitat supports anadromous fish. During the dry season (July 1 to November 15), cut stumps of nonnative trees and shrubs may be treated with herbicide.

Foliar herbicide applications beyond the riparian corridor are not approved where saturated soils are present, at wind speeds over 5 miles per hour, or when weather conditions facilitate herbicide movement toward drainages.

If glyphosate is inadvertently dripped or sprayed onto soil, the product will bind with the soil. When used in accordance with label directions, when the product is bound it is no longer available for plant uptake and will not harm offsite vegetation if roots grow into the treatment area or if the soil is transported offsite. The strong affinity of this product to soil particles prevents the product from leaching out of the soil profile and entering groundwater. The affinity between this product and soil particles remain until this product is degraded, involving primarily a biological degradation process carried out under both aerobic and anaerobic conditions by soil microflora. When sprayed on leaves, the half-life for glyphosate is 1.6 to 26.6 days. In water, the half-life is 3.5 to 70 days, In soil, the half-life is 2.8 to 60 days (Badzik 2004).

The surfactant in Roundup has a soil half-half life of less than one week, thus the potential for leaching of the herbicide is low. According to U.S. Forest Service research (Glyphosate fact sheet), the major products from burning vegetation treated with glyphosate are phosphorus pentoxide, acetonitrile, carbon dioxide and water. Phosphorus pentoxide forms phosphoric acid in the presence of water. None of these compounds are known to be a health threat to firefighters or the public at the levels which would be found in a vegetation fire.

All herbicide use is administered through each park's integrated pest management coordinator. All herbicides must be applied by a state-licensed pesticide applicator. The pesticides used on GGNRA lands are registered with EPA and the California Department of Pesticide Regulation and used according to the label directions and federal and state pesticide laws. All use is reported monthly to the coordinator, the county, and the State of California. A review of the current status of all herbicides considered for use is conducted prior to each application season.

Visitor Experience and Visitor Use

GGNRA is unique not only in its diversity and quantity of natural and cultural features, but also in its proximity to a major urban population that also has worldwide status as a tourist destination. This juxtaposition makes GGNRA'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. Park visitors can be local residents who have the park as part of their "backyard" as well as visitors from all over the world who have come to San Francisco to see many different attractions as part of their visit. GGNRA is visited by over 16 million people annually (NPS 2003d). Broken down into the three park units (see Chapter 1, Section 1.3, Planning Area), visitation for 2003 was as follows: Golden Gate National Recreation Area – 13.85 million, Muir Woods National Monument – 719,350, and Fort Point National Historic Site – 1.56 million.

The park exposes visitors to many of the resource values that exemplify America's national park system. Within the park, visitors can touch upon millions of years of natural history and thousands of years of human presence. This landscape evolved from a rugged coastal ecosystem – its sheltered estuaries teeming with waterfowl, bears, bobcats, salmon, and whales – and was the setting for American Indian villages, Spanish missions, Mexican ranches, Gold Rush cities, Civil War to Cold War forts, and today's metropolitan complex. The park contains the largest assemblage of historic buildings and the most complete collection of military resources of any single unit of the national park system.

Equally significant is the park's role in preserving an extraordinary convergence of land and water, city and nature, wildlife and people. The continental and ocean plates of the Earth's crust collide along its miles of ocean coastline, spawning the geological formations of the San Andreas Fault, which runs 40 miles through the park. Rivers flowing from the Sierra Nevada join the sea at the Golden Gate; marine, estuarine, and terrestrial ecosystems overlap; migratory birds and butterflies converge and plants respond to changing seasons.

These special geologic and climatic factors have created 19 distinct ecosystems that sustain nearly 2,500 species of plants and animals. The fragile and fragmented habitats protected by the park constitute a refuge for almost 100 rare, threatened, and endangered species, among them the northern spotted owl, coho salmon, and mission blue butterfly. The natural diversity of the California Biogeographical Province preserved within and near the greater Bay Area's major cities offers stupendous opportunities for learning about and practicing sustainability and stewardship. It was this rich biodiversity that led to the park's inclusion in the Central California Coast International Biosphere Reserve, designated by the United Nations in 1989.

The area supports miles of hiking trails, five campgrounds, hundreds of historic sites/structures and numerous beaches. There are five visitor centers in the park and more than 10 retail facilities run by park concessionaries or the park association. Overnight stays are available at four walk-in campsites in the Marin Headlands, two hostels (one at Fort Mason and another in the Marin Headlands), and local hotels and inns in areas outside the park boundaries. Activities include hiking, water sports, horseback riding, fishing, bike riding, camping, wildlife viewing, dog walking, sun bathing, and interpretive and educational opportunities. Visitors to the park come as individuals, as families, and as part of private and commercial tour groups including – thanks to a very active educational focus in the park – educational groups (schools, summer programs, youth groups, after school programs, etc.). They come to recreate, to learn, and to attend special events.

The park preserves not only natural systems and historic settings, but also a culturally vibrant and recreationally dynamic center consistent with its urban and Pacific Rim context. The miles of coastal and forested trails, ocean and bay beaches, and scenic vistas afford an array of activities, from traditional ranger-led walks, camping, and hiking to boardsailing, hang-gliding, biking, and jogging. Special events range from museum exhibitions and theater to art, music, and cultural heritage festivals.

As a nationally recognized model of park partnerships and public involvement, the park affords opportunities for thousands of people to participate in site stewardship, habitat restoration, and

interpretive activities. The parks continue to expand this interaction through cultural, environmental, and educational programs offered at a variety of sites.

An important benefit of GGNRA is its contribution to Bay Area open space. With over five million inhabitants, each area of open space in the nine Bay Area counties provides opportunities for respite, relaxation, contemplation, and passive recreation for the millions of Bay Area inhabitants. An important function of open space is its soundscape, which is often remote from the noisy influences of urban experience. In place of the high ambient levels of background traffic noise or the irregular and discordant industrial or heavy equipment noise, the sounds in parts of GGNRA are often those that are lost in a city – bird noise, rustling leaves, distant waves, or barking sea lions. While people often need to block out urban sounds to better communicate or concentrate, natural sounds are sought out for their beauty and restorative qualities.

Though much of GGNRA is undeveloped and far from heavily traveled roadways, portions of the park are within line of sight of portions of multilane freeways, including Highway 101 east of the Marin Headlands and Alta Ridge in southern Marin County, Highway 1 west of Milagra and Sweeney Ridges and Cattle Hill and east of Mori Point and Pedro Point, and Interstate 280 east of the Phleger Estate. A community noise map included in the San Mateo County General Plan (1986) indicated that noise levels would exceed 60 dBA CNEL[5] by 1995 within 2,000 feet of Interstate 280. However, only the very eastern edge of Phleger Estate is within 2,000 feet of the interstate and noise levels decrease from the noise source at 6 dB for distance doubled. Noise levels of 75 dBA L_{eq}[6] at 250 feet from the freeway would be attenuated to 69 dBA L_{eq} at 500 feet and 63 dBA L_{eq} at 1,000 feet. At 4,000 feet, within the more interior portion of the Phleger Estate, that noise source would be attenuated to 51 dBA L_{eq} and even further reduced by intervening topography and/or screening vegetation. Since the majority of the Phleger Estate is beyond 4,000 feet of the interstate, traffic noise would therefore have little influence on the interior noise levels of the park. Similar to much of GGNRA, the most prominent sources of noise would be aircraft and jet overflights; other high levels of sound (rather than noise) are generated by the wind and rustling of vegetation.

Noise monitoring to support the Draft Marin Countywide Plan (2004) finds that noise generated by traffic, the primary noise source in the county, has remained relatively stable over the past two decades but that higher noise levels are being generated earlier in the morning, indicating a lengthening commute period. Topographic barriers, as well as ocean and wind sounds, protect much of the GGNRA parklands in southern Marin County from vehicle noise from Highway 101. Alta Ridge, with a clear line of sight to Highway 101, experiences higher noise levels on its east-facing slope. Smaller yet busy roadways within Marin County, such as Panoramic Highway, have lower traffic-generated noise levels. County monitoring for the Countywide Plan update recorded noise levels throughout the county for 24 hours on a summer Sunday in 2001. A monitoring station on Highway 1 north of Stinson Beach recorded elevated noise levels within one or two decibels of 60 dBA L_{eq} from approximately 8 A.M. through 7 P.M. The noise

[5] CNEL, community noise equivalent level, is a noise descriptor used in land use planning that presents a time-weighted average of noise energy over a 24-hour period with 5- and 10-decibel penalties applied to evening and nighttime noise to account for people's sensitivity to higher noise levels in the evening.

[6] L_{eq}, or equivalent noise level, represents the level of steady state noise having the same energy as the time-varying noise measured. $L_{eq\,(h)}$ represents the time-weighted average for a 60-minute (hourly) period.

level meter sited at the Marin City shopping center, adjacent to Highway 101, recorded nearly continual noise levels of 65 dBA L_{eq} during the same period time period. The absence of vehicle traffic at 2 A.M. resulted in readings of 45 dBA L_{eq} and below at both locations. Overflights by jets from both Oakland and San Francisco International Airports have increased in Marin County, producing short-term noise levels of up to 70 dBA.

Without the influence of aircraft and jet overflight, noise levels in the interior of GGNRA would be similar to noise levels recorded in San Mateo open space for the recent annexation study by Midpeninsula Regional Open Space District (2004). That study found that noise levels, without the influence of aircraft and jet overflights, would generally range from 40 to 50 dBA $L_{eq(h)}$ depending on wind, with waves and bird noise as the most prominent natural sound sources. Depending on wind patterns and visibility, jets departing from San Francisco International Airport may be shifted to a pattern near the airspace above Milagra Ridge, dramatically increasing noise. Noise level monitoring conducted for a development project in Pacifica in 1997 demonstrates noise levels readings influenced by both vehicle and jet traffic. CNEL readings are high – higher than recommended for residential areas without special noise dampening insulation and windows. The two stations, approximately 1.5 and 2.0 miles north of Milagra Ridge, recorded 66.7 dBA CNEL and 64.4 dBA CNEL, respectively. Since these readings were recorded, noise levels generated by jet overflights have been dropping as more and more aircraft comply with higher levels of noise reduction standards.

FMP-generated noise would be added to these relatively low noise levels in Marin County and higher noise levels at the Pacifica parks. The decibel levels of common noise environments and noise-generating equipment are as follows (League for the Hard of Hearing 2004).

- 40 – quiet office, library
- 65–95 – power lawn mower
- 74 – front loader
- 85 – hand saw
- 90 – tractor
- 95 – electric drill
- 100 – skidder
- 110 – power saw
- 110 – leaf blower
- 120 – jet plane (at ramp)
- 125 – chain saw
- 130 – jackhammer, power drill
- 130 – percussion section at symphony
- 140 – airplane taking off
- 150 – jet engine taking off
- 150 – artillery fire at 500 feet

During project implementation, FMP actions may involve the use of chain saws, brushcutters, weedships, haul trucks, front loaders, skidders, and chippers. Noise would be heard by visitors to the park and could alter the visitor experience.

Park Operations

GGNRA currently has about 230 full-time employees (FTEs) and an operating budget of approximately $21.4 million, consisting of $20.1 million in base funding as well as $1.3 million in other funding from locally generated reimbursements, lease revenue, permit fees, and cost-recovery programs. In fiscal year 2003, the park also received $10 million in nonrecurring project funding from a variety of sources (fee demonstration, leasing and concession revenues, NPS servicewide special funding), and had over $35 million of multiyear capital improvement projects underway, funded through congressional appropriations.

Visitation to the three national parks in the planning area exceeded 16 million visitors in 2003. In addition to unscheduled daily visitation, the Office of Special Park Uses issued 750 permits in fiscal year 2003 for events ranging from the Dipsea race (Mill Valley to Stinson Beach) to the Alcatraz triathlon. Over 190,000 people per year participate in permitted events in GGNRA.

Muir Woods National Monument, an old-growth redwood forest with unique values, high visitation, and high ignition potential, is located within and managed operationally as a part of the park. Provision of emergency vehicle access and egress routes for evacuation is a primary concern.

Maintenance of the extensive parklands and widespread facilities in Marin, San Francisco, and San Mateo counties is a major, ongoing task. Structures, historic and non-historic, need basic maintenance and repair; utilities must be kept up; trails, roadways, and parking lots are in need of repair. Landscaping and irrigation, tree pruning, fences, gates, restroom cleaning, and trash pick-up give a basic sense of the scope of work needed to maintain park facilities and resources at an acceptable level. Substantial facilities for the Maintenance Division are located at Stinson Beach, Fort Cronkhite, and Fort Baker in Marin County, and at Crissy Field, Fort Mason, and Fort Miley in San Francisco. The environment within which maintenance operations are performed is most affected, in terms of fire management considerations, by the reduction of hazardous fuel loads, the creation of defensible space around structures (or lack thereof), and the condition of main road and fire road access between the widely separated locations of the park.

Law enforcement, search and rescue, emergency medical response, structural firefighting, and wildland firefighting operations are, naturally, extensive in a park in an urban area with such high visitation, essentially open access, a wide range of resources, and nearly unparalleled recreational opportunities from hiking and biking to sail-boarding and hang-gliding. Major firefighting bases are located at Fort Cronkhite and at the Main Post of the Presidio of San Francisco. Law enforcement operations are based primarily at Fort Winfield Scott and the Cavalry Stables at the Presidio and at Fort Cronkhite in the Marin Headlands. The environment within which law enforcement and firefighting operations are carried out is affected in ways similar to those described in the previous paragraph for maintenance operations.

All park operations, but especially maintenance, law enforcement, and structural and wildland firefighting operations, are affected by the state of the roadways that link the widely separated areas of the park. These roads stretch 40 miles from the neighborhood of the coastal Bolinas Lagoon in the north to the Phleger Estate in the hills of San Mateo County in the south. Park roadways are generally two-lane, winding paved roads, with limited pullouts and shoulders. They are not designed for high-speed travel. Certain choke points, such as Highway 1 at Stinson Beach and at Tam Valley, or Frank Valley Road at Muir Woods, can become very crowded during peak visitation periods. Vegetation and fuel loading adjacent to roadways varies widely from managed landscaping to grassland, coastal scrub, and forest – including areas of dense eucalyptus woods. The primary north-south route through the park is Highway 1, the Pacific Coast Highway or Cabrillo Highway. But many locations within the park are nestled within east-west running valleys, and direct access between adjacent locations is often limited to park vehicles using steep, winding, dirt fire roads.

Natural resource specialists research and monitor ecosystems and the physical environment in order to preserve and restore healthy systems and populations. Cultural resource specialists monitor projects and perform research to ensure the stabilization, preservation, and restoration of historic structures, landscapes, and archeological resources.

GGNRA is an acknowledged leader in enlisting organizations into partnerships that leverage the park's ability to preserve resources, educate the public, and provide recreational opportunity to visitors. Many of these partners occupy and maintain park buildings through cooperative agreements and other legal authorities. Partners range from the Marine Mammal Center at Fort Cronkhite to the Bay Area Discovery Museum at Fort Baker. The creation and maintenance of defensible space around partner-occupied buildings are the primary environmental effects on partner operations. Park operations are substantially supplemented by community volunteerism, especially in the areas of habitat restoration, educational programming, and historic preservation at the Nike site in Fort Barry.

Socioeconomics

Regional Setting

The socioeconomic environment affected by GGNRA fire management operations includes San Francisco, San Mateo and Marin counties, each of which encompass GGNRA lands. Table 3-12 provides a summary of selected demographic data for these counties.

As indicated in Table 3-12, the three counties comprise nearly 650,000 acres of land and contain a combined population of over 1.7 million. Total employment for the area is nearly one million jobs. In addition, the region attracts a significant volume of local and international tourists, with 14 million tourists reported per year in San Francisco County and two million in San Mateo County. Marin County Chamber of Commerce does not provide data on countywide visitation rates, however, given the attraction of GGNRA and Point Reyes National Seashore, the county also is a large draw for tourists and local visitors.

Table 3-12: Selected Regional Economic Characteristics

	San Francisco	San Mateo County	Marin County	Total
Total Size (acres) Source (A)	29,890	287,420	332,670	649,980
Population (2001) Source (A)	793,700	720,100	259,400	1,773,200
Employment (2000) Source (A)	435,200	411,300	139,700	986,200
Annual Visitors Source (B)	14 million	2 million	NA	NA
Visitor Spending ($ millions) (2002) Source (C)	$4,645	$1,925	$502	$7,072
Visitor-Related Jobs (2002) Source (C)	48,830	34,850	6,160	89,840

Sources: (A) California Department of Finance, (B) San Francisco and San Mateo Visitors Bureaus, (C) Dean Runyan Associates and the California Division of Tourism.
Note:
NA = not available

According to a 2002 report published by the California Division of Tourism, visitors to the three counties accounted for over seven billion dollars in spending. Associated visitor-related employment totaled approximately 90,000, or nearly ten percent of the area-wide employment.

Golden Gate National Recreation Area

GGNRA encompasses nearly 75,000 acres of land in San Francisco, Marin, and San Mateo counties, or nearly 12 percent of the total three-county land area. The park currently employs 230 full-time equivalent staff. The current GGNRA operating budget is $20.1 million in base funding, $1.3 million in other project funding, and $10 million in non-recurring project funding. The Fire Management Office has an annual operating budget of $400,000 and employs seven full-time staff. Compared to total employment levels in the affected area, the fire management payroll has a relatively minor beneficial impact on the local economy.

In 2003, a total of 13,457,900 people visited GGNRA, representing 84 percent of total visitation to San Francisco and San Mateo counties. In part due to its urban environment, GGNRA has achieved one of the highest volumes of annual visitors in the national park system. Visitation averaged about one million people per month from November through February, and averaged approximately 1.2 to 1.3 million monthly visitors during the spring, summer, and fall months.

As shown in Table 3-13, the vast majority of park visitors are day travelers. An estimated 80 percent of visits are from people residing in the area. An additional 15 percent are day visitors from other regions. Lodging guests and camp visitors make up five and less than one percent of total visitors, respectively. The recreational visitors to GGNRA contribute substantially to the local economy. In 2001, visitor groups

spent an average of $42 per day (visitor groups also called "party days" are based on size of party, length of stay and other factors), resulting in a total of $212.8 million in total spending in the area.

Table 3-13: GGNRA Visitation and Spending by Visitor Segments in 2001

Year 2001	Local Day Visitors	Non-Local Day Visitors	Hotel Visitors	Camp Visitors	Total
Recreation Visits	10,700,470	2,006,339	730,102	20,991	13,457,902
Segment Shares in Recreation Visits	80%	15%	6%	1%	100%
Party Days	4,093,163	767,468	244,286	6,770	5,111,687
Average Spending Per Party Day	$30	$45	$225	$87	$42*
Total Spending ($ millions)	$122.79	$34.54	$54.85	$0.59	$212.77

Sources: GGNRA, NPS Park Visitation Report, MGM2
Note:
* Weighted average.

As shown in Table 3-14, of the total dollars expended by visitors ($212.77 million), an estimated 78 percent ($166.40) was retained in the local economy. The remaining 22 percent of spending is associated with goods and services manufactured and imported from out of the area. Local spending also contributed to $63 million in personal income (wages and salaries), $95.18 million in value added (employee compensation, profits, and indirect business taxes) and 3,859 jobs. The largest share of spending occurred in local restaurants and bars, followed by retail expenditures, admission fees, and overnight accommodations.

Table 3-14: Economic Impacts of Visitor Spending by Sectors

Sectors	Sales (millions)	Personal Incomes (millions)	Jobs	Value Added (millions)
Direct Effects				
Motels, Hotels, B&Bs and Cabins	$ 25.90	$ 9.17	481	$ 13.93
Campsites	$ 0.14	$ 0.05	3	$ 0.08
Restaurants and Bars	$ 59.68	$ 21.19	1,613	$ 29.52
Admissions and Fees	$ 27.98	$ 9.89	764	$ 16.18
Retail	$ 33.04	$ 16.85	810	$ 26.32
Others	$ 19.66	$ 5.87	188	$ 9.15
Total	**$ 166.40**	**$ 63.02**	**3,859**	**$ 95.18**
Secondary Effects	$ 88.63	$ 32.31	1,125	$ 55.10
Total Effects	$ 255.03	$ 95.33	4,984	$ 150.28

Sources: GGNRA, NPS Park Visitation Report

As direct spending dollars circulate through the local economy, they result in secondary beneficial economic effects. Secondary effects measure the spin-off impacts of expenditures as money cycles through the regional and local economy. For example, increased spending by visitors at local restaurants may create additional jobs in those businesses. Business owners may also experience an increase in income, which they then spend locally on ordinary consumer goods and services. The secondary impacts associated with visitor spending account for an additional $88.6 million in local sales, $32 million in personal income, 1,125 jobs and $55 million in value added. In summary, visitors to GGNRA spent $212.8 million in sales in 2001, which supported a total of $255 million in local sales revenues, $95 million in personal income, 4,984 jobs, and $150 million in value added.

Chapter 4 – Environmental Consequences

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4.1 Regulations and Methodologies

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 the type and relative level of impact for each impact topic (e.g., air quality, water quality), 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 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; and
- A conclusion summarizing the findings of the section.

Definition of Terms

Three separate aspects of impacts are described for each impact topic for each alternative: the type of impact, the duration of the impact, and the intensity of the impact. For purposes of this analysis, these descriptors are defined as follows:

Type of impact. The type of impact describes the nature of the overall effect of the impact on the environment. Impacts are described as either beneficial or adverse.

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.

Duration of impact. The duration of impact is the relative length of time the impact would affect a given resource or value. Under NEPA, impacts are either short-term or long-term and are defined for each impact topic either by specific terminology of time or qualitatively by the passage of a condition. 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. Intensity describes the degree of the effect on a resource or value. The intensity of each impact is judged as having a negligible, minor, moderate, or major effect. These four designations are used for beneficial as well as adverse impacts.

Impairment. The NPS Organic Act of 1916 and the NPS General Authorities Act of 1970, as amended, require park managers to ensure that park resources and park values remain unimpaired. The discussion of each type of potential effect has a conclusion statement regarding whether or not implementing the alternative would cause resource impairment. Further information on the NPS policy on impairment can be found in Chapter 1, Section 1.4, under "Legislative and Policy Framework."

Cumulative Impact Scenario

Appendix C lists projects that can be considered part of the context of the impact assessment for cumulative effects. The context can vary from impact topic to impact topic. For example, the context for assessing potential cumulative effects on a creek may be all the past, current, reasonable foreseeable future projects that occur on public or private lands that drain to or would occur in that particular creek. The cumulative impact scenario for an isolated rare plant population may be the other two existing populations of the same plant within a relatively short distance. As a starting point for cumulative impact assessment, projects listed in Appendix C are considered in relation to the impact topic under review. Those projects that could contribute cumulatively to the impact area in question are included in the assessment of cumulative impacts. In certain cases, such as air quality effects, additional actions that generate similar impacts are included in the assessment, such as prescribed burning conducted by other agencies in western Marin County. However, the additional prescribed burning would not be relevant to the cumulative projects list of other impact topics in the FEIS, such as visitor experience or special status species. Effects on the tidewater goby are limited to only the three extant water bodies in Marin County where the goby is still found.

Regulations and Methodologies by Impact Topic

The sections that follow describe applicable regulations, policies, and methods used to assess the environmental consequences of the three alternatives on the following impact topics:

Watershed Processes: Soils, Hydrology, Water Quality, and Aquatic Habitat

Air Quality

Vegetation

Wetlands

Wildlife and Important Habitat

Special Status Species (e.g., Threatened, Endangered, Rare, and Sensitive Species)

Cultural Resources

Human Health and Safety

Visitor Use and Visitor Experience

Park Operations

Socioeconomics

Watershed Processes: Soils, Hydrology, Water Quality, and Aquatic Habitat

Policies and Regulations

Watershed resources and processes, including soils, hydrology, and water quality, receive protection under a series of policies and regulations.

Soil resources are subject to the NPS Management Policies 2001 "no impairment" clause that guides NPS decision making to protect the integrity of the important resources and values within the parks (NPS 2000a). The NPS is directed to protect geologic features from the adverse effects of human activity, while allowing natural processes to continue (NPS 2000a). Management action taken by the parks would prevent, to the greatest extent possible, unnatural erosion, physical removal, contamination, and other potentially irreversible impacts on soil (NPS 2000a).

Hydric soils, which are associated with wetland features such as bogs, marshes, and some wetlands, are afforded special protection by Executive Order 11990, Protection of Wetlands, and 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 Order 77-1, Wetland Protection (NPS 2002a). Assessment of potential FMP impacts on hydric soils and wetlands is addressed in the "Impacts on the Biological Environment" section of this chapter.

NPS Management Policies 2001 states: "The Service [NPS] 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 on watershed and riparian vegetation, and by allowing natural fluvial processes to proceed unimpeded." (NPS 2000a).

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 the NPS Natural Resource Management Guidelines [NPS-77]) requires the NPS to "maintain, rehabilitate, and perpetuate the inherent integrity of water resources and aquatic ecosystems."

Assessment Methodology

Water resources, water quality, and soils are interrelated in their reactions to the treatments proposed by the alternatives. Due to these relationships, the analyses of impacts on these resources have been grouped together. Effects upon soils and watersheds are assessed by considering the likely scale of the effect – whether fire would affect all or part of the watershed, and as a result, the likely effect upon water yield, peak flows, sediment yield, nutrient yield, and/or stream system response.

Watershed impacts range from erosion and sedimentation to hydrology and impaired 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.

Long-term impacts on soils include changes to soil chemistry, creation of subsurface hydrophobic layers, changes in soil particle composition or mixing, or loss of the soil profile that may take two years or decades to recover.

Short-term impacts are defined as effects on soil processes that are abated through natural processes or aided by use of standard protective practices within two years of the action.

Actions with negligible impact are those that are either inherently benign or that have 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 negligible impact would be limited in scope and effect to watersheds. For example, a low-intensity prescribed fire may have several limited effects on watersheds, 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.

Type of Impact

The following terms and definitions apply:

Beneficial: Protects or enhances properties of native soils, promotes or restores natural soil and hydrologic processes, and protects or improves water quality and aquatic habitat.

Adverse: Degrades the characteristics of native soils, exposes soils to accelerated rates of erosion, results in loss of native soils, contributes to slope failure, alters or degrades natural hydrologic conditions, degrades water quality, or degrades aquatic habitat.

Duration of Impact

The following terms and definitions apply:

Short-term: Impacts are limited to the first two years after treatment or wildland fire.

Long-term Impacts persist two years after treatment or wildland fire.

Intensity of Impact

The following terms and definitions apply:

Negligible: Imperceptible or undetectable.

Minor: Slightly perceptible and localized, without the potential to expand if left untreated; correctable by standard practices for erosion and sediment control.

Moderate: Apparent and localized, with limited potential to expand if left untreated; correctable by standard practices for erosion and sediment control.

Major: Substantial, highly noticeable, with the potential for landscape (watershed)-scale effects. Impacts would compound if left untreated. Treatment requires a site-specific engineered solution.

Air Quality

As in many other national parks near urban areas, the response to wildland fire in GGNRA has been full suppression. One of the results of suppression is the buildup of fuels within the park, increasing the potential for a high-intensity wildland fire to occur. Prescribed burning and mechanical fuel reduction, as proposed in the FMP alternatives, both result in the emission of harmful pollutants to the air but are the primary means to reduce fuel loading. A reduction in fuels lessens the potential for a large destructive fire that could generate much higher air pollution emissions and have significant impacts on regional air quality. 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 of the FMP alternatives.

Policies and Regulations

Federal Clean Air Act and the Environmental Protection Agency

The Clean Air Act (CAA) charges the Environmental Protection Agency (EPA) with identifying national ambient air quality standards (NAAQS) 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 CAA 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. If a NAAQS is exceeded within an air basin, the entire air basin is considered a nonattainment area and is then subject to more stringent planning and pollution control requirements. The Bay Area Basin is currently in nonattainment status for state and federal standards for ozone and state standards for particulate matter. The current federal and state ambient air quality standards and the federal and state attainment status for the Bay Area Air Basin are presented in Chapter 3, Table 3-4.

The EPA has developed regional haze regulations to improve visibility or visual air quality in national parks and wilderness areas across the country. In developing these rules, the EPA recognized that both prescribed and wildland fires contribute to regional haze and 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 a fire regime to forest ecosystems to prevent future catastrophic fires that can detrimentally affect an air basin's 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 public health and welfare.

Regional Haze and the Western Regional Air Partnership

On a regional scale, smoke emissions can contribute significantly to haze and degradation of visibility. Regional haze issues in the U.S. are being addressed through a national regional haze process that has set as its goal the restoration of natural visibility conditions by 2064 in Class I areas of the country. Established by the CAA, Class I areas are places where pollution prevention is given a special priority; they include national parks established before 1977 with a total acreage above a certain minimum requirement. The air quality standard and the degree of visibility in Class I areas were established to serve as baseline barometers to track changes in emission levels since 1977. Examples of Class I areas are Point Reyes National Seashore, Grand Canyon National Park, and Yosemite National Park. GGNRA was designated as a Class II area, where some incremental increase in emission levels is allowed based on the proximity of a population center.

To develop solutions on a regional scale, the federal government has set up five regional haze working groups made up of groups of states. California participates in the Western Regional Air Partnership (WRAP) comprising all states west of Kansas. Each state in the WRAP will develop an implementation plan to augment the state's smoke management plan by 2018 – the deadline to adopt control measures that will effectively allow the state to meet the 2064 goal. Effectiveness of the control measures must be supported by modeling the projection of conditions to that date. Because the issue of regional haze is being addressed by this long-term regional process, the assessment of the effects of FMP implementation on visibility is limited in scope to the impairment of local visibility.

California Clean Air Act and the California Air Resources Board

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 ambient air quality standards that are stricter than federal standards. Under the 1988 California Clean Air Act, air basins are designated as attainment, nonattainment, or unclassified for the state standards.

State implementation plans (SIPs) identify measures designed to bring the nonattainment areas into attainment. Basic components of SIPs 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 planning area and has primary responsibility for enforcing and issuing permits under the CAA for prescribed burning. GGNRA prescribed burns must comply with BAAQMD's Regulation 5 and smoke management program, which govern open burning in the Bay Area Air Basin. For all prescribed fires, BAAQMD requires GGNRA to submit an individual smoke management plan at least one month before the proposed burn. BAAQMD then issues a forecast 72 hours before 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 before the burn day to support moving forward on all the logistical planning needed to conduct a prescribed burn.

Federal Policies and NPS Guidance

NPS Management Policies 2001 directs superintendents to comply with all federal, state, and local air quality regulations and permitting requirements when conducting prescribed burns (NPS 2000a). 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 (Interagency Working Group 2001) and the EPA's Interim Air Quality Policy on Wildland and Prescribed Fires (EPA 1998). These policies established the need and requirements for state and tribal smoke management programs to (1) mitigate impacts on air quality (even when below the NAAQS) and public safety (such as visibility on roads and airports) posed by smoke intrusions into populated areas, (2) prevent significant deterioration of air quality and NAAQS violations, and (3) address visibility impacts in Class I areas. With the adoption by a state of a smoke management program, certain PM_{10} exceedances attributable to fires, including some prescribed fires and managed wildland fires, can be excluded from air quality data sets used to determine violations for a state. Through these policies, federal agencies are directed to consider ambient air quality above the NAAQS for $PM_{2.5}$ and PM_{10} as the principal indicator of adverse impacts on public health. Poor visibility is used as the principal indicator of adverse impact on public welfare. The EPA's Natural Events Policy addresses public health impacts from wildland fires (EPA 1996).

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. 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 consideration of the local setting, including demographics, wind patterns, and local climatic conditions.

NPS-77 (Reference Manual 77: Natural Resource Management) 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" (NPS 1991).

Assessment Methodology

Fire management actions could affect air quality in the project area through smoke emissions from wildland and prescribed fires. The impacts of particulate matter and other pollutants on firefighter and public health from exposure to smoke are discussed in this FEIS under "Human Health and Safety" below.

The emission levels generated by the use of machinery for fire management actions (i.e., mechanical fuel reduction projects, site preparation for prescribed burns, etc.) has been determined by the NPS Air Resources Division to be negligible in comparison to levels generated by smoke emissions; therefore, the impact assessment focuses on emissions generated by smoke.

BAAQMD data do not reflect the level of emissions produced by the No Action alternative (Alternative A), as no prescribed burning has occurred in GGNRA parklands recently enough to be accounted for in BAAQMD data sampling used to discuss ambient air quality in the Bay Area.

Method of Estimating Smoke Emission

The First Order Fire Effects Model 5.21 (FOFEM) was used to generate emission factors for PM_{10}, $PM_{2.5}$, VOC (volatile organic compounds), CO (carbon monoxide), NO_x (nitrogen dioxide), and SO_2 (sulfur 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 and 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, GGNRA 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 and vegetation mapping of the planning area. The burn unit cover types were then correlated with the Society of 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 4-1 provides a cross-reference for cover types.

Table 4-1: Vegetation Cover Types Used in Air Quality Emissions Analysis

Fire Management Vegetation Class	SAF[1]/SRM[2] Type
Valley grassland, annual grassland	SRM 208
Ceanothus, mixed chaparral	SRM 215
Pacific Douglas-fir	SAF 229

Notes:
[1]Society of 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 in natural forest, since these typically burn under drier conditions and consume more fuel, particularly crown and branch fuels, and produce higher emissions. NPS Air Resources Division staff provided burn parameters based on recent wildland fires to model these emissions. Emission factors for grassland and coastal scrub are the same for these fuel types in both prescribed burning and wildfires (see Table 4-4). The cover and vegetation type from the PRNS FMP analysis were used as surrogates for the GGNRA analysis.

Pile Burning

A number of assumptions were made to calculate burn pile emissions, as FOFEM provides emission factors in pounds per acre and not in pounds per burn pile. First, the emission factors generated by FOFEM were normalized to tons of fuel load (pre-burn) to give emission factors on a pound-per-ton basis. Second, the tonnage of each burn pile was calculated using assumptions taken from the U.S. Forest Service General Technical Report NW-GTR-364 (USFS 1996), which involves the following steps:

Step 1. Calculating pile tonnage to be equal to pile volume x 30 pounds per square foot x 0.2 (packing ratio).

Step 2. Giving a tonnage of 0.108 ton per burn pile for the four cubic yard piles typically constructed at GGNRA and used in the GGNRA FMP.

Step 3. Modeling the burn piles after Pacific Douglas-fir wood. [Note: FOFEM, a forestry model, does not have built-in emission factors for eucalyptus among the vegetation types considered in the software package. FOFEM does not fully model "pile burns;" rather, it models them like natural burns and may therefore underestimate emissions generated.]

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 GGNRA may be heavier than normal due to decades of fire suppression, the emission factors used here can be considered to better represent GGNRA conditions. Emission factors used for prescribed burning, wildfire, and pile burning are shown in Table 4-2.

Table 4-2: Smoke Emission Factors by Fire Type

GGNRA Cover Type	FOFEM Surrogate	Code	Emission Factors (pounds/acre)						
			Fire Type	PM_{10}	$PM_{2.5}$	VOC	CO	NOx	SO_2
Coastal Scrub	Ceanothus	SRM 208	Prescribed	190	161	49	404	198	62
Grass	Valley Grassland	SRM 215	Prescribed	11	9	3	23	12	4
Native Forest	Pacific Douglas-fir	SAF 229	Prescribed	2863	2445	1480	32319	24	114
Coastal Scrub	Ceanothus	SRM 208	Wild	190	161	49	404	198	62
Grass	Valley Grassland	SRM 215	Wild	11	9	3	23	12	4
Native Forest	Pacific Douglas-fir	SAF 229	Wild	3640	3085	1867	40836	31	145
Nonnative Trees	Pacific Douglas-fir	SRM 229	Pile	2660	2254	1329	28606	162	145

Source: NPS 2004.
Notes:
PM_{10} = suspended particulate matter, $PM_{2.5}$ = fine particulate matter, VOC = volatile organic compounds, CH_4 = methane, CO = carbon monoxide, NOx = nitrogen oxides
Grass = Society for Range Management (SRM) 208 vegetation areas
Brush = SRM 215 vegetation areas
Forest = Society of American Foresters (SAF) 229 vegetation areas

Annual inputs for wildland fire are based on 39 acres burned per year during three to five fire starts, a conservative estimate of wildland fire in GGNRA according to the fire management officer (Naar 2004). The wildfire acreage consists of 25 acres of grassland, 12 acres of shrublands, and 2 forested acres. The low incidence and limited acreage of wildland fire annually in the study area are due primarily to a very low incidence of deliberate and unintentional fire starts by the public and the wetter than usual

summertime conditions in the coastal portions of GGNRA as compared to the hot drier inland summer of the rest of the coast range.

The number of acres of wildfire is consistent throughout the alternatives. Emissions generated by mechanical treatment are also assumed to be consistent and negligible in each alternative (see discussion below under "Emissions from Mechanical Treatment"). Therefore, the difference in estimated annual emissions for the three alternatives is due to the maximum allowable acreage of prescribed fire under each alternative.

Emissions from Mechanical Treatments

Negligible levels of air pollutants would be generated by fuel reduction projects and during preparation of burn units for prescribed burning projects. Motorized equipment used in thinning and site preparation activities could include chain saws, brushcutters, mowers, chippers, excavators, skidders, frontloaders, and haul trucks. The types of equipment shown in Table 4-3 are a representative sample of the types of equipment used in GGNRA. FMPs prepared for other western national parks have consistently found that pollutants generated by equipment contribute a very small amount to overall emissions where plans include prescribed burning. For example, in the emission estimates calculated for equipment use in mechanical fuel treatment and preparation for prescribed burning for the PRNS FMP, emissions from equipment did not exceed 2 percent of the total emissions generated. In most cases, emission levels calculated were less than 1 percent of the total (NPS 2004a). The Yosemite FMP found equipment emissions were consistently less than 1 percent of the total emissions generated by equipment use in all actions. Table 4-3 shows the factors that were used to calculate emissions from equipment use for the PRNS and Yosemite FMP alternatives, which yielded the relatively negligible emission levels from equipment in those assessments. The contribution of vehicle and equipment emissions to total emissions would be of similar equivalence for the GGNRA FMP; therefore, the NPS Air Resources Division considers emissions from equipment use a negligible contributor to air quality impacts from FMP implementation.

Table 4-3a: Emission Factors for Equipment Use in Fire Management Activities

Operating Parameters			Emission Factor (pounds per 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

Source: NPS 2004.
Average HP = average horsepower, CO = carbon monoxide, PM = particulate matter, NOx = nitrogen oxides, VOC = volatile organic compounds (total hydrocarbons) such as methane (CH_4).

Type of Impact

The following terms and definitions apply:

Beneficial: Improves or maintains air quality while lowering the potential for significant short-term pollutant release events.

Adverse: Degrades current air quality.

Duration of Impact

The behavior of a smoke plume from a fire, including the direction and elevation of the plume 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 wildland fire would disperse within a timeframe roughly the same as the duration of the fire management action. An exception to this would be if smoke from a fire became trapped at low altitudes in an inversion layer that can occur in the fall or winter.

The following terms and definitions apply to the analysis:

Short-term Effects on air quality last less than three days beyond the duration of the fire management action.

Long-term Effects on air quality persist beyond the duration of the fire management actions, or are annually recurrent throughout the implementation period of the FMP.

Intensity of Impact

Localized Effects of Smoke (Visibility)

The assessment of effects of FMP actions on regional haze focuses on the impairment of local visibility. Effects of smoke on traffic safety are addressed under “Impacts on Human Health and Safety” below. The following terms and definitions apply:

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, and 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, and would occur in a developed area with a potential hazard to human health or create property damage or lasting effect.

Effects on Bay Area Air Basin Air Quality and Conformance with the State Implementation Plan

When air quality within a region or airshed deteriorates below one or more of the National Ambient Air Quality Standards (NAAQS), a state must develop a State Implementation Plan (SIP) to improve the air quality. The means of achieving the standard is determined largely by the state. The regulators may decide to severely limit prescribed burning, or they may focus on some other pollutant source.

Voluntary Smoke Management Program (SMP) developed by states must then be certified by the EPA. Once the SMP is certified and in use, the EPA will allow two exceedances of the NAAQS for PM2.5 attributable to prescribed burning without declaring the region out of attainment. The states will instead be allowed to review their SMP and make adjustments if it is found inadequate. If fires cause or significantly contribute to a third consecutive NAAQS violation, EPA will call for the SMP to be made part of the SIP and be federally-enforceable. If the area was designated nonattainment previously, EPA will also call on the State to review the effectiveness of the SMP and make appropriate improvements.

The NPS has developed interim guidelines for determining potential airborne pollution impacts on human health and park resources (NPS 2003c). Thresholds set for intensity of effect are based in part on the emission thresholds, which define *de minimus* projects for purposes of providing determination of conformance with national ambient air quality standards and the SIP.

The *de minimus* levels are the minimum thresholds for which a conformity determination must be performed for the various criteria pollutants in nonattainment or maintenance status in the air basin. Federal agencies only need to perform a general conformity analysis if emissions from a proposed action are not accounted for in the air district's State Implementation Plan (SIP) for that emission. The conformity determination shows how the emissions generated by the implementation of a project or plan will conform to the air basin's strategy to control emissions of a criteria pollutant.

Table 4-3b: *De Minimus* Levels for State Implementation Plan Conformance

Pollutant	Area Type	Tons/Year
Ozone (VOC or NOx)	Serious nonattainment	50
	Severe nonattainment	25
	Extreme nonattainment	10
	Other areas outside an ozone transport region	100
Ozone (NOx)	Marginal and moderate nonattainment inside an ozone transport region	100
	Maintenance	100
Ozone (VOC)	Marginal and moderate nonattainment inside an ozone transport region	50
	Maintenance within an ozone transport region	50
	Maintenance outside an ozone transport region	100
CO, SO_2 & NO_2	All nonattainment & maintenance	100
PM-10	Serious nonattainment	70
	Moderate nonattainment and maintenance	100

Source: BAAQMD, 2005

Notes:

NOx = nitrogen oxides, VOC = volatile organic compounds, CO = carbon monoxide, SO_2 = sulfur dioxide, NO_2 = nitrogen dioxide, PM10 = suspended particulate matter

Though the Bay Area Air Basin is now in attainment with national air quality standards for CO, its maintenance status indicates that exceedences of the CO standard have occurred in the past. The air basin is implementing a plan to maintain a lower level of CO generation. According to the BAAQMD CO maintenance plan, urbanized areas of San Mateo and Marin counties are within the Bay Area Air Basin maintenance area for CO.

The Bay Area Air Basin is rated as being in nonattainment with federal standards for ozone precursors (NOx and VOC). For purposes of CAA conformance, the Bay Area Air Basin is not considered a "transport" area – an area that receives pollution from an adjoining air basin. These factors help define the level considered *de minimus* above which projects are considered as contributors to the air basin nonattainment status for ozone precursors.

Federal actions with the potential to produce NOx or VOC emissions exceeding the *de minimus* level must include a conformity determination showing how the action incorporates SIP strategies for reducing the levels of ozone precursors to the federal standard and achieving attainment. Federal actions with the potential to produce emissions below the *de minimus* level are exempt from the conformity requirement. Conformity requirements do not apply to the state standards for emissions. Only federal standards are addressed by the SIP. For federal actions and planning efforts, such as an FMP, where conditions do not involve a new air pollution source but rather are ongoing, impact levels and potential for impairment are assessed relative to the natural condition (attainment status) in addition to incremental change from the No Action alternative (Alternative A).

For considering the potential intensity of effect of the FMP on levels of pollutants with which the Bay Area Air Basin is currently in attainment status (SO_2, PM_{10}, and NOx), the following thresholds apply:

Negligible: Less than 50 tons per year (each pollutant).

Minor: More than 50 tons per year and less than 100 tons per year (each pollutant).

Moderate: More than 100 tons per year.

Major: More than 250 tons per year.

For considering the potential intensity of effect of the FMP on levels of pollutants with which the Bay Area Air Basin is currently in marginal nonattainment status for federal standards on ozone (represented by VOC), the following thresholds apply:

Negligible: Net decrease in emissions from current levels.

Minor: 1 to 50 tons per year.

Moderate: More than 50 tons per year and less than the conformity *de minimus* levels (conformity *de minimus* levels = 100 tons per year).

Major: More than or equal to the conformity *de minimus* levels (conformity *de minimus* levels = 100 tons per year).

Vegetation

Policies and Regulations

NPS Management Policies 2001 states that "the National Park Service will maintain as parts of the natural ecosystems of parks all native plants and animals" (NPS 2000a). The policies go on to state that "all cultural and natural resource values will be considered in defining specific treatment and management goals," and that:

- Flowering plants, ferns, mosses, lichens, algae, fungi, and microscopic plants are included;
- The natural abundances, diversities, dynamics, distributions, habitats, and behaviors of these native species are preserved and protected; and
- The introduction of nonnative species into units of the national park system should be prevented.

The policy manual NPS-77, Natural Resource Management (NPS 1991) also provides general guidelines on vegetation management.

Assessment Methodology

The park's vegetation was interpreted and mapped from 1994 aerial photographs. Plant communities were delineated in this mapping effort using field data collected in 2001, and the classification of alliances and associations (roughly based on Sawyer and Keeler-Wolf 1995) was completed in 2003. For purposes of this document, these alliances and associations have been grouped together into 10 broad "fire management communities" that are described in Chapter 3 (Affected Environment). These fire management communities all share species with similar growth forms, structural attributes, and/or fire behavior characteristics; thus it is assumed that they would respond similarly to treatments that would be applied under the FMP. The grouping of vegetation types into fire management communities and the extent of area covered by each community was conducted using a Geographic Information System (GIS).

The primary assessment of impacts on vegetation considers potential impacts of all fire management activities, regardless of vegetation community. This is followed by special considerations and impacts unique to individual communities, including the following parameters:

- Fire ecology (past and present) of the dominant species in the vegetation community, including fuel loads and potential for vegetation type changes;
- Areal extent and relative abundance or rarity of the vegetation community in the project area and in the region; and
- Abundance and species richness of nonnative plants within or adjacent to the vegetation communities affected.

The abundance, as defined by extent of coverage, of an individual vegetation community is important when considering impacts because the park is mandated to protect and maintain all native plant communities. In a vegetation community that is rare in the FMP area or the region, such as chaparral, adverse impacts may be more significant.

The presence and abundance of nonnative plants in or around the affected vegetation community are an important consideration, as many nonnative plant species are stimulated to grow or reproduce as a result of fire or other disturbance. Some nonnative plant species can have substantial adverse effects on native vegetation, including the following:

- Nonnative plants 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;
- Nonnative plants can degrade the quality of wildlife habitat by out-competing native food sources, or altering nesting or resting habitat;
- Nonnative plants can disrupt the genetic integrity of native plants if crossbreeding occurs; and
- Nonnative plants can change fire regimes by converting habitat types (e.g., converting a shrub or forested landscape with little understory to one that has a continuous herbaceous layer, or converting an open grassland to forest).

Fire can also be used as a tool, in conjunction with other management activities, to control nonnative plant species, and the abundance and density of these plants in comparison to the native plant component can be an important factor in evaluating the potential effects of treatment actions. For example, a site with 100-percent cover of a nonnative grass could benefit from seasonal burning to favor native perennial grass species.

Much of the information on individual vegetation communities focuses on a few dominant or typical species and the effects of fire on these species. Information on individual plant species was largely derived from the Fire Effects Information System (FEIS), available online at http://www.fs.fed.us/database/feis/. This database includes comprehensive bibliographies for each species. Community information was developed from a variety of sources included in Appendix B of this document.

Type of Impact

The following terms and definitions apply:

Adverse: Decreases the areal extent or native species richness of a plant community, results in a native plant community type conversion, or increases nonnative plant species abundance or richness.

Beneficial: Increases the areal extent or native species richness of a plant community, or decreases nonnative plant species abundance or richness.

Duration of Impact

The following terms and definitions apply:

Short-term: Would be measurable for two years or less.

Long-term: Would be measurable for longer than two years.

Intensity of Impact

The following terms and definitions apply:

Negligible: Would result in no measurable changes in plant community areal extent, or in native or nonnative species richness within a plant community.

Minor: Changes in plant community areal extent, or in native or nonnative species richness within a plant community, would be measurable, and would affect less than 5 percent of the total extent of that plant community in the planning area.

Moderate: Changes in areal extent, or in native or nonnative species richness within a plant community, would be measurable, and would affect between 5 and 25 percent of the total extent of that plant community in the planning area.

Major: Changes in areal extent, or in native or nonnative species richness within a plant community, would be measurable, and would affect over 25 percent of the total extent of that plant community in the planning area.

Wetlands

Policies and Regulations

Wetlands are addressed separately from the vegetation analysis because they are defined by unique attributes of vegetation, hydrology, and soils and protected by specific regulations and orders. 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 valuable habitat for animal and plant species.

As a result of these important attributes, wetlands are protected by a specific set of laws and regulations. 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: Wetlands Protection, and Procedural Manual 77-1 (NPS 2002a) provide specific procedures for implementing Executive Order 11990. Director's Order 77-1 states that NPS adopts a goal of "no net loss of wetlands." In addition, the NPS will strive to achieve a longer-term goal of net gain of wetlands Service-wide. For undertakings that could affect wetlands, the NPS will take the following measures:

a) avoid adverse wetland impacts to the extent practicable,

b) minimize impacts that cannot be avoided, and

c) compensate for remaining unavoidable adverse wetland impacts via restoration of degraded wetlands.

If the preferred alternative in an EA or EIS will result in adverse impacts to wetlands, a "Statement of Findings" documenting compliance with Director's Order 77-1 and Procedural Manual 77-1 will be completed. In addition, all applicable permits sought will be consistent with Section 10 of the Rivers and Harbors Act and Section 404 of the Clean Water Act, which authorize the U.S. Army Corps of Engineers (USACE) to grant permits for construction and disposal of dredged material in waters of the United States, including wetlands.

Assessment Methodology

For this assessment, wetlands that could be subject to impacts were identified using the GGNRA vegetation map and field-mapped wetland data, when available. 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 parameters that were considered in the assessment of impacts on wetlands include the following:

- Plant species composition of the wetland;
- Hydrologic features that maintain the wetland; and
- Wetland soils.

These parameters parallel those used by the USACE, the agency granted the authority under the Clean Water Act to regulate 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 of Impact

The following terms and definitions apply:

Adverse: Shifts plant species composition to a higher percentage of nonwetland indicator species or allows invasion by nonnative species; alters hydrologic features/factors that are required to maintain the wetland; alters soil properties that are required to maintain the wetland; or reduces areal extent of wetlands.

Beneficial: Enhances native wetland vegetation, soils, or hydrology, or increases areal extent of wetlands.

Duration of Impact

The following terms and definitions apply:

Short-term: Would be measurable for two years or less.

Long-term: Would be measurable for longer than two years.

Intensity of Impact

The following terms and definitions apply:

No Effect: No measurable changes in the areal extent of wetlands, or in wetland vegetation, soils, or hydrology, would result.

Minor: Changes in the areal extent, or in wetland vegetation, soils, or hydrology, would be measurable but would affect less than 5 percent of the total extent of the wetland type in the FMP project area.

Moderate: Changes in the areal extent, or in wetland vegetation, soils, or hydrology, would be measurable but would affect less than 20 percent of the total extent of the wetland type in the FMP project area.

Major: Changes in the areal extent, or in wetland vegetation, soils, or hydrology, would be measurable and would affect 20 percent or more of the total extent of the plant community in the FMP project area.

Wildlife and Important Habitat

Policies and Regulations

NPS Management Policies 2001 states that “the National Park Service will maintain as parts of the natural ecosystems of parks all native plants and animals” (NPS 2000a). 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 nonnative species into units

of the national park system (NPS 2000a). NPS-77 (Natural Resource Management Guidelines) also provides general guidelines on wildlife management (NPS 1991).

The NPS also is required to comply with the Fish and Wildlife Coordination Act (1934), the Marine Mammal Protection Act (1972), the Bald and Golden Eagles Protection Act (1940), the Convention on International Trade in Endangered Species (1973), and maritime and other international agreements. In addition, the NPS is required to comply with the Migratory Bird Treaty Act (1918) as amended, which prohibits taking, killing, or possessing migratory birds, nests, or eggs. California Department of Fish and Game regulations govern fishing in coastal areas leased by GGNRA.

Assessment Methodology

Many of the impacts of fire management actions on wildlife can be assessed 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, or as isolated refuges for wildlife in areas that have been highly developed by humans.

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 impacts from noise, nonnative species, and human use, can adversely affect habitat quality. Core areas that are more isolated from these impacts generally provide higher quality habitat for wildlife.

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

The following terms and definitions apply:

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

The following terms and definitions apply:

Short-term: Would be expected to last for less than two years.

Long-term: Would last two years or longer.

Intensity of Impact

The following terms and definitions apply:

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 have raised concerns about the species' 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. The NPS also recognizes a number of species as locally rare or of special concern, such as plants listed by the California Native Plant Society (CNPS), even though they are not yet officially protected by legislation. 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, provides that federal agencies will use their authorities by carrying out programs for the conservation of endangered and threatened species. Furthermore, federal agencies are required 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 has provided the species listed under the ESA that must be considered for this EIS.

The Council of Environmental Quality's Regulations for Implementing NEPA (Section 1508.27) requires consideration of whether an action may violate federal, state, or local laws or requirements imposed for

the protection of the environment. For this reason, species listed or proposed for listing as endangered or threatened under the California Endangered Species Act are included in this analysis.

Other applicable legislation, policies, and agreements that provide the authority for NPS policies on management of threatened and endangered species include the following:

- Other state wildlife statutes or agreements pursuant to Section 6 (ESA);
- Migratory Bird Conservation Act (1918);
- Fish and Wildlife Coordination Act (1934);
- Marine Mammal Protection Act (1972);
- Magnuson-Stevens Fishery Conservation and Management Act (as amended 1996);
- Bald and Golden Eagles Protection Act (1940);
- Convention on International Trade in Endangered Species (1973); and
- Maritime and other international agreements.

The USFWS takes lead responsibility for coordinating and implementing provisions of the Endangered Species Act for all terrestrial plants, animals, and freshwater aquatic species listed as endangered, threatened, and candidate species. NOAA Fisheries has lead responsibility under the ESA for listed marine taxa such as *Cetacea* (all whales and porpoises), *Pinnipedia* (Steller sea lions, Hawaiian monk seals, etc.), sea turtles, and anadromous fish (steelhead, coho salmon, etc). NOAA Fisheries is also the lead for the Marine Mammal Protection Act (1972) and Magnuson-Stevens Fishery Conservation and Management Act.

The federal, state, and CNPS categories for special status species are defined as follows:

- Federal endangered: Any species that is in danger of extinction throughout all or a significant portion of its 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 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 within 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: More information needed.
- 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. Mechanical treatments can enhance habitat for special status plant species through removal of fuel loads and forest canopies, or can exacerbate problems through opening previously densely vegetated areas and allowing aggressive nonnative species to become established. Prescribed fires can be beneficial or detrimental, depending on the timing, frequency, and intensity of management-ignited fires. For example, detrimental effects can occur if fires are ignited outside the normal season or beyond the normal intensity 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).

Type of Impact. The following terms and definitions apply:

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 areal extent or density of plants, or an increase in reproduction.

Duration of Impact. The following terms and definitions apply:

Short-term: Would immediately affect the population or species, but would have no long-term effects on 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 areal extent or abundance.

Intensity of Impact. The following terms and definitions apply:

Negligible: Imperceptible or not 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

Like other wildlife species in the planning 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 for a 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, national, 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 subpopulation level.

Type of Impact. The following terms and definitions apply:

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.

Duration of Impact. The following terms and definitions apply:

Short-term: Would result in immediate changes in the abundance and distribution of a special status species, but a return to the original condition would occur 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 more than two generations of that species.

Intensity of Impact. The following terms and definitions apply:

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 farther 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

NPS Management Policies 2001 states that, "all cultural resource and natural resource values will be considered in defining specific treatment and management goals" (NPS 2000a). Furthermore, "The treatment of a cultural landscape will preserve significant physical attributes, biotic systems, and uses when those uses contribute to historical significance… Treatment decisions will consider both the natural and build characteristics and features of a landscape, the dynamics inherent in natural processes and continued use, and the concerns of traditionally associated peoples." Archeological resources are to be "managed in situ, unless the removal of artifacts or physical disturbance is justified by research, consultation, preservation, protection, or interpretive requirements" (NPS 2000a). They will be "maintained and preserved in a stable condition to prevent degradation and loss," and their condition is to be "documented, regularly monitored, and evaluated against initial baseline data."

Section 106 of the National Historic Preservation Act (NHPA) requires federal agencies to consider the effects of their actions on properties listed on, or eligible for inclusion in, the National Register of Historic Places, and to provide the Advisory Council on Historic Preservation with a reasonable opportunity to comment. To fulfill this requirement, consultation with the State Historic Preservation Officer was initiated on May 23, 2003. A programmatic agreement on the GGNRA FMP constituting Section 106 compliance is presently under development among GGNRA, the State Historic Preservation Officer, and the Advisory Council. The NPS also extended an opportunity for consultation with associated American Indian tribes and the public, to take into account the effects of the FMP on historic properties within the park. This programmatic agreement will be modeled upon a nationwide template

developed by the National Association of State Historic Preservation Officers, the Advisory Council, the Department of the Interior, and Department of Agriculture land management agencies.

Impact analysis for the FMP, as a whole, follows procedures as described in the regulations implementing the NHPA (36 CFR 800.4), and is consistent with the requirements of NEPA. These include procedures for identifying historic resources in the area of potential effect, weighing the effects of a proposed undertaking against those qualities that make the historic properties eligible for the National Register, applying the criteria of effect to determine the level of effect, and identifying ways to minimize those effects. Compliance with Section 106 for specific sites and fire management will be carried out on an individual basis according the stipulations of the programmatic agreement on the GGNRA FMP (Appendix J).

Assessment Methodology

This impact analysis methodology includes consideration of the same five categories of cultural resources described in Chapter 3, Affected Environment: archeological resources, cultural landscapes, structures, ethnographic resources, and museum objects.

Cultural resource impacts in this document are described in terminology consistent with the regulations of the Council on Environmental Quality and the Advisory Council for Historic Preservation and in compliance with the requirements of both NEPA and the NHPA.

Type of Impact

Impacts are considered either adverse or beneficial to historic properties when analyzed under NEPA. However, impact type is not viewed in this manner when conducting analysis under Section 106 of the NHPA. For the purposes of assessing effects on historic properties under the NHPA, effects are either adverse or not adverse. Effects under both NEPA and the NHPA are considered adverse when they diminish the significant characteristics of a historic property.

Duration of Impact

Impacts on historic properties could be of short-term, long-term, or permanent in duration. Analysis of the duration of impacts is required under NEPA, but is not required, and is usually not considered separately, in assessing effects under NHPA.

Intensity of Impact

The following terms and definitions apply:

Negligible: Impacts would be barely perceptible.

Minor: Impacts may be perceptible and noticeable, but would remain localized and confined to a single element or significant characteristic of a historic property (such as a single contributing element of a larger historic district).

Moderate: Impacts would be sufficient to cause a noticeable but not substantial change in significant characteristics of a historic property, but not sufficient to compromise its qualifications for the National Register.

Major: Impacts would result in substantial and highly noticeable changes in significant characteristics of a historic property leading to the compromising of its qualifications for the National Register.

Human Health and Safety

Policies and Regulations

As described in the policies and regulations discussion under "Air Quality" above, the 1977 Clean Air Act (CAA) mandates the protection of human health and the prevention of significant deterioration of air quality and establishes acceptable levels of emissions for a range of pollutants. The California Air Resources Board is charged with protecting air quality in the state and developing a State Implementation Plan (SIP) to interpret and enforce the emission standards set by the federal EPA. The Bay Area Air Quality Management District (BAAQMD) is the air management district charged with monitoring and implementing the CAA, including approvals for prescribed burning, in the nine-county Bay Area Air Basin.

According to Section 4.7.1 of the NPS Management Policies, the NPS has a responsibility to protect air quality under both the 1916 Organic Act and the Clean Air Act, both to protect scenic vistas and the visitor experience and to protect public health. Policies direct the superintendents to "make reasonable efforts to notify visitors and employees when air pollution concentrations within an area exceed the national or state air quality standards established to protect public health." (Please refer to the air quality methodology and assessment sections below for more information on air quality policies and regulations.) In considering the potential adverse effects of air emissions on public health, federal agencies are directed to consider the ambient air quality above the national ambient air quality standards (NAAQS) for $PM_{2.5}$ and PM_{10} as the principal indicator of adverse impacts (EPA 1998).

The highest priority for federal firefighting strategy, tactics, and policy is the protection of the lives and promotion of the safety of firefighters and the public. NPS Director's Order 18 (NPS 2003a) states that "…firefighter and public safety must be the first priority in all fire management activities." NPS Management Policies 2001 states that "all wildland fires would be effectively managed, considering resource values to be protected and firefighter and public safety…." and all actions taken involving wildland fire have as their overriding goal providing for firefighter and public safety (NPS 2000a). Firefighter worker safety and right to a safe work environment are protected by the Occupational Safety and Health Act of 1970 (29 USC 651 – 678; PL 91-5969).

In addition to indicating a public health risk, high levels of visible particulates can result in poor visibility and contribute to a traffic safety hazard. Section 4.4.5.3 of NPS Management Policies 2001 addresses herbicide use within the park. Herbicides are a subset of pesticides, which are defined by the Federal Insecticide, Fungicide and Rodenticide Act as any substance or mixture that is used in any manner to destroy, repel, or control the growth of any viral, microbial, plant, or animal pest. Fuel reduction projects

that involve removal of certain nonnative plant species, such as eucalyptus and black acacia, typically involve the use of herbicides to prevent resprouting of cut tree stumps. All proposals to use herbicides in the park must submit a Herbicide Use Request to the GGNRA integrated pest management (IPM) coordinator, who reviews the requests on a case-by-case basis. The proposals are judged on potential environmental effects, cost, staffing, and other considerations. The decision to use herbicides is based on a determination by the IPM coordinator that all other available options are either not acceptable or not feasible.

Assessment Methodology

Fire management activities and the potential for injury, illness, and other direct and indirect impacts are evaluated for their potential to affect the public, park staff, and fire personnel during implementation of fire management activities at GGNRA. The analysis includes the impacts of prescribed fire, suppression, wildland fire use, and mechanical treatment on the health and safety of the public, park staff, and fire personnel. The analysis also assesses the potential exposure of park visitors to high noise levels and impacts of FMP actions on the soundscape of the park.

Type of Impact

The following terms and definitions apply:

Beneficial: Would result in a reduction in human health and safety concerns or improve human health or safety.

Adverse: Would result in additional or exacerbated public health and safety concerns.

Duration of Impact

The following terms and definitions apply:

Long-term: Would have a permanent effect on human health and safety (e.g., contamination of a water source for domestic use would be a long-term impact).

Short-term: Would be temporary and/or intermittent and be associated with the implementation phase of fire management actions (e.g., safety concerns related to smoke from a prescribed burn).

Intensity of Impact

The following terms and definitions apply:

Negligible: Imperceptible or undetectable effect upon the public, staff, or fire personnel.

Minor: Slightly detectable or localized effect upon the public, staff, or fire personnel.

Moderate: Clearly detectable impact that could have a readily perceivable effect on public health and safety and extend over a sizeable area.

Major: Substantial, highly noticeable impact and/or an impact that would extend over a large area of the park. The impact would initiate or resolve a significant public or firefighter safety or health hazard.

Visitor Use and Visitor Experience

The assessment of effects on visitor use and the visitor experience focuses on several aspects of this broad topic that were raised as potential issues during the scoping period for the FMP. The alternatives are assessed for potential to affect viewsheds and the aesthetic aspect of park landscapes, causes changes to public access patterns to parklands, and cause changes to the park soundscape.

Policies and Regulations

NPS Management Policies 2001 makes numerous references to aesthetics and visitor experience as central issues in the considerations that go into resource protection and park planning. Section 1.4.6 describes the "park resources and values" that are subject to the NPS "no impairment" standard, including a park's scenery, scenic features, natural visibility (both in daytime and at night), natural landscapes, natural soundscapes, and smells, which all contribute to the visitor experience. Important national park values also include the opportunity "to experience enjoyment of the above [listed] resources, to the extent that can be done without impairing any of them" (NPS 2000a).

NPS Management Policies 2001 Section 4.7.1, Air Quality, states that the NPS "has a responsibility to protect air quality under both the 1916 Organic Act and the Clean Air Act (CAA)." This responsibility would be reflected in the FMP by discussions of potential effect of FMP actions on air quality, air quality effects on public health and air quality effects on the visitor experience. NPS Management Policies 2001 directs the NPS to "perpetuate the best possible air quality in parks to (1) preserve natural resources and systems; (2) preserve cultural resources; and (3) sustain visitor enjoyment, human health, and scenic vistas" (NPS 2000a).

As discussed under "Impacts on Air Quality" below, scenic resources are extremely sensitive to air pollution. Even a very small amount of fine particulate matter 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. Protection of scenic resources is addressed in Director's Order 77, Natural Resource Management (NPS 1991).

One of the potential effects on visitor access and visitor experience is the need for park staff to close public access to work areas or burn areas due to unsafe conditions during or just following implementation of FMP actions. NPS Management Policies 2001 addresses the need for occasional temporary closures or delays in public passage in order to ensure public safety. Section 8.2.2.1, Management of Recreation Use, advises superintendents to "use their discretionary authority to impose local restrictions, public use limits, and closures, and designate areas for a specific use or activity (see 36 CFR 1.5). Any restriction of appropriate recreational uses will be limited to what is necessary to protect park resources and values, to promote visitor safety and enjoyment, or to meet park management needs" (NPS 2000a).

Director's Order 47 addresses the problem of excessive/inappropriate levels of noise in the park (NPS 2000a). It directs park managers to measure baseline acoustic conditions, determine which existing or proposed human-made sounds are consistent with park purposes, set acoustic management goals and objectives based on those purposes, and determine which noise sources are affecting the park and need to be addressed by management. It also requires park managers to evaluate and address self-generated noise such as FMP actions, and constructively engage with those responsible for other noise sources that affect parks to explore what can be done to better protect parks.

NPS Management Policies 2001, Section 4.9, Soundscape Management, addresses the generation of noise in conjunction with NPS actions in and adjacent to parks:

> "The Service will monitor human activities that generate noise that adversely affects park soundscapes, including noise caused by mechanical or electronic devices. The Service will take action to prevent or minimize all noise that, through frequency, magnitude, or duration, adversely affects the natural soundscape or other park resources or values, or that exceeds levels that have been identified as being acceptable to, or appropriate for, visitor uses at the sites being monitored."

Assessment Methodology

The effects of each alternative were evaluated by analyzing potential impacts on the physical components affected and, using best professional judgment and information from relevant studies, assessing how the change may be experienced by the visitor. The following aspects of the proposed actions under each alternative were assessed:

- **Visual Aspects.** Would fire management actions be readily visible from views within the park or important views of the park? In which areas of the park would landscape modification be most noticeable or intrusive? Could the action affect a scenic vista along a road or a scenic view? Are there any ways in which the effects of the fire management action could be made less visible or restoration accelerated?

- **Visitor Experience and Access.** Would the project intrude on a visitor's park experience? Would the project curtail visitor access to parts of the park? For how long? Are there ways to provide an alternative experience during the closure?

- **Noise.** Would the sounds of the fire management action be readily perceptible within the park? From adjacent properties? In which areas of the park would the sound be most noticeable or intrusive? 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, the assessment will examine effects on the current aesthetic environment, soundscape, and visitor use patterns as well as the effect of modifications to the current condition. While aesthetic considerations can be quantitatively monitored, it is difficult to address potential changes to views. This is perhaps the most subjective of all the environmental impact assessment topics. 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 must 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 and highly intrusive in the context of other actions (one helicopter trip in combination with nine diesel buses and a nearby, audible, and clearly visible vegetation management project).

Visitor experience and aesthetic appreciation are tied closely to actions influencing natural resources. The enhancement or degradation of air quality, vegetation, and cultural resources has a corresponding effect on the quality of the visitor experience. Impacts on these issue areas are assessed under separate headings.

Type of Impact

The following terms and definitions apply:

Beneficial: Would enhance visitor appreciation of the natural landscape, the quality of visitor experience, or the visual quality of the landscape, or promote the native soundscape.

Adverse: Would degrade visitor appreciation of the natural landscape, the quality of visitor experience, or the visual quality of the landscape, or disrupt or intrude upon the native soundscape.

Duration of Impact

The following terms and definitions apply:

Short-term: Action would be temporary, with a duration restricted to the finite time period of project implementation.

Long-term: Action would be associated with a programmatic change or would continue indefinitely, or viewshed disturbance would be readily apparent for more than two years.

Intensity of Impact

The following terms and definitions apply:

Negligible: Would result in little or no noticeable change in visitor experience.

Minor: Would be detectable but localized within a topographically confined area; would result in changes in visitor experience when visitors or park neighbors are close to the project site but would not appreciably alter important landscape or soundscape characteristics.

Moderate: Would be readily noticeable, and/or change the visual character, soundscape, or visitor experience of larger vistas of the park or be seen from the park by modifying one or more secondary features of a vista, but not the keystone features of the vista.

Major: Would be highly noticeable, intrusive to the visitor experience, and/or change the character of the landscape or soundscape in significantly large areas, and/or change

important vistas seen from the park or of the park by modifying the keystone features of the vista.

Park Operations

Policies and Regulations

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 GGNRA include a base operating budget of approximately $21.4 million, which represents about 230 FTE (full-time equivalents, or one person for a full year). This work force is supplemented by over 5 million total volunteer hours each year.

In addition to the above operational funding, the park receives fee revenues and special national park project and program funding for specific maintenance, natural and cultural resources, and other projects. In addition, the park receives approximately $539,000 annually 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 park.

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;
- Research, plan, develop, and ensure regulatory compliance of proposed FMP actions;
- Conduct mechanical treatments to reduce hazardous fuels;
- Conduct prescribed fires to preserve natural and cultural resources and reduce hazardous fuels; and
- Monitor the effects of FMP actions.

The estimates of operational changes were compared to existing staffing levels. It should also be noted that precise impacts on staffing and funding are difficult to project until site-specific projects are

proposed. 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 address operations that would be new, undergo major change, or show susceptibility to increases or decreases in operational activity.

Type of Impact

The following terms and definitions apply:

Adverse: Would represent an increase in operating costs.

Beneficial: Would represent a decrease in operating costs and operational efficiency.

Duration of Impact

The following terms and definitions apply:

Short-term: Would last only until all actions are completed.

Long-term: Would have a permanent effect on operations.

Intensity of Impact

The following terms and definitions apply:

Negligible: There would not be a measurable difference in costs from existing levels.

Minor: Additions or reductions in cost would be less than 15 percent of existing levels.

Moderate: Additions or reductions in cost would be between 16 and 30 percent of existing levels.

Major: Additions or reductions in cost would be more than 30 percent of existing levels.

Socioeconomics

Policies and Regulations

The NPS regulations for NEPA state that "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.

This section examines the socioeconomic environment that might be affected by the fire management activities in and around the park under the three alternatives. Choosing different alternatives may affect the flow of dollars through the local economy.

Impacts of Fire Management Operations

Fire programs affect the economy in several ways. The direct impacts are associated with the core fire management payroll and the amount of local goods and services purchased directly by the department. An increase in staffing would be expected to have a net positive benefit to the area since most of the money paid to fire staff is spent locally in the form of housing, food, services, and local purchases. Spending by the fire management department on supplies and private contracted services also funnels dollars directly into the economy. Any increase or decrease in the core fire management budget spending would thus have some positive or negative effect on the local economy. The extent of the impact is determined, in part, by the amount of spending by the GGNRA fire management unit compared to the overall economy.

Suppression of major fires also affects the local economy. Increases in fire staffing and private contracts to restore burned areas can have a positive net impact on the local economy, while property damage and loss of visitation can have adverse short-term impacts.

Visitor Spending

In addition to the direct economic impact associated with GGNRA's staffing and spending in the area, the indirect impact associated with spending by park visitors is also factored into the analysis. This indirect benefit results from spending on food, lodging, fees, gifts, and other retail items. Modifications in fire operations for prescribed burns and mechanical treatments would have a negative economic impact if park visitation rates and associated spending were reduced by either shortened or rescheduled plans due to road closures, park or facility closures, smoke, or noise.

Fire suppression activities also may affect visitation rates and associated tourist spending depending upon the size, location, and extent of an unplanned fire. To date, most of the temporary area closures that have occurred at GGNRA have resulted from wildland fires and not fuel reduction projects. The loss of spending by visitors in the local economy from larger wildfires is partially offset by increased spending on temporary fire personnel and requirements for structural repairs or replacement, utility repairs, slope rehabilitation, and other activities required to restore the area.

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, on the regional economy and resident/tourist population as a whole.

Type of Impact

The following terms and definitions apply:

Adverse: Would degrade or otherwise negatively alter the characteristics of the existing environment, as the relate to local communities (including minority and low-income), visitor population, regional economics, and concessionaires and contractors.

Beneficial: Would improve on characteristics of the existing social and economic environments, as they relate to local communities (including minority and low-income), visitor population, regional economies, and concessionaires and contractors.

Duration of Impact

The following terms and definitions apply:

Short-term: Temporary and typically transitional impacts associated with implementation of an action.

Long-term: Permanent impacts on the social and economic environments.

Intensity of Impact

The following terms and definitions apply:

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.

4.2 Environmental Impact Analysis

Impacts on the Physical Environment

Impacts on Watershed Processes: Soils, Hydrology, Water Quality, and Aquatic Habitat

Analysis

As described in Chapter 3, fires are natural events that maintain healthy watersheds, but they can also impair watershed processes. Watershed attributes such as water yield, peak flows, sediment yield, nutrient yield, stream system response, and water quality can be affected by fire management activities. These impacts will vary depending on the extent of activity in the watershed, the type of soils and slopes within the watershed, and the proximity of the activity to streams.

Fire management activities can affect soil resources through disruptions to the soil horizon, erosion, compaction, and changes to soil properties. These impacts on soils can in turn affect the hydrology of the watershed by increasing sedimentation, changing the surface flow, and impairing water quality. These impacts will have an effect on the quality of the aquatic habitat within the watershed.

Impacts on Soils

Disruption of the soil horizon can occur from most fire management activities, including the creation of fire lines during suppression and prescribed burning and the removal of plants and their roots during mechanical removal. These activities will disturb or bury the upper soil layers that are rich in nutrients, organisms, and seeds and potentially impair the watershed processes.

Erosion can be accelerated by wildland fires, prescribed burning, and fuel reduction projects that remove the overlying vegetation and duff from surface soils and leave soils exposed to wind and water. 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, and can also create conditions under which nonnative 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.

The severity and duration of 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. 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.

Compaction can likewise lead to increased surface runoff and result in erosion. Activities that compact the soil, such as use of heavy equipment, will decrease the capacity of the soil to infiltrate water and therefore create downstream effects.

Changes in soil characteristics occur during wildfires, and to a lesser extent with cooler prescribed burns. Hydrophobicity can result when fire increases soil temperatures, causing the volatilization of hydrophobic materials into the soil. A hot wildfire, such as those that may occur in forested areas of the park or where fuels have built up, may create hydrophobicity deeper in these soils. 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.

Plant nutrients may also be lost through volatilization during a fire. 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. In a hot wildfire, the loss would be greater than in a prescribed burn, as the effects would extend deeper into the soil and would not leave much organic matter on the surface. 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. Extremely hot fires may also kill beneficial fungi and bacteria that live in soils or wildlife that tunnel near the surface.

Impacts on Watersheds and Water Quality

Water yield in a watershed can increase after a fire or mechanical thinning due to a decrease in both transpiration and water infiltration. Infiltration can be reduced several ways, from increased compaction by heavy equipment to the formation of hydrophobic soils by intense fires. The removal of litter and debris by either method will also lead to decreased infiltration and increased surface flow. The combined effect of these changes can temporarily increase water yield and overland flow, leading to increased peak flows for months or years afterwards. This could exacerbate levels of soil erosion; increase sedimentation levels in streams, wetlands, and other water bodies; and degrade water quality. Increased erosion could also cause changes to surface hydrology, including overland, undirected flow; channelized surface water flow; and flow to drainage infrastructure.

Sediment yields can increase after fires or tree removal due to this increased overland water flow and the associated erosion. Sediments can wash into streams and scour the bank and streambed, or settle on the stream bottom and cover important rock or cobble habitat. This problem becomes more severe if the streamside vegetation has also been burned, since the banks then become even less stable. If a fire is particularly hot, woody debris that helped stabilize the channel may be consumed, increasing water velocity and streambank erosion. Extremely high levels of sediments can injure fish or other aquatic organisms by clogging their gills or obscuring the presence of food.

Nutrient yields increase after fires from the breakdown of plant materials. Some materials will volatize into the atmosphere, while the remainder is left as ash in readily mobile forms on the soil surface. When nitrogen and other nutrients found in ash make their way into the aquatic ecosystem, they can increase production of algae and aquatic plants. Decay of this excessive biomass can deplete water of oxygen and lead to fish kills.

Stream system response, both physical and biological, can change as the result of fire management activities. A stream channel may initially aggrade and widen after a fire in response to higher peak flows

of water, increased sediment, and loss of riparian vegetation. As vegetation becomes reestablished, the channel usually returns to pre-fire size within several years.

Water quality can be affected by sediment and nutrient input as well as inputs from other fire management activities. For example, herbicides used in fuel reduction and wetting agents or saltwater used during suppression actions can degrade water quality.

Most of the impacts on soils have a direct effect on the hydrology of a watershed. Fire management actions that accelerate levels of soil erosion can increase sedimentation levels in streams, watersheds, and other water bodies and degrade water quality. Bare, hydrophobic, or compacted soil can increase the level of surface water flow, create scour, and decrease the amount of infiltration to groundwater. Water quality can be affected by increased sedimentation as well as contamination by saltwater, herbicides used for fuel reduction, and fire-retardant agents. Most fire retardants contain fertilizer type compounds such as ammonia and nitrogen and could cause changes in pristine terrestrial and aquatic ecosystems. 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.

Impacts on Aquatic Habitat

These water quality impacts can lead to impairment of aquatic habitats within a watershed. Aquatic organisms rely on specialized habitats within streams or other water bodies that can be blanketed by a pulse of sediment from upstream. Runoff of herbicides into water bodies could kill the algae at the base of the food chain and lead to food shortages in the small invertebrates that depend on it. High levels of saltwater dropped into a water body could increase the salinity to such an extent that sensitive organisms could be affected. Lastly, the input of fire retardant into a stream could prove fatal for aquatic organisms.

Beneficial Effects of Fire Management Activities

Many of the impacts discussed above are part of natural watershed processes that can create beneficial effects under normal conditions. Disturbances such as erosion and sedimentation can deliver nutrients and woody debris to aquatic habitats and maintain complex and productive ecosystems (Bisson et al. 2003). Modifications to normal watershed conditions, such as the amount of vegetative cover, can alter the natural processes of infiltration and evapotranspiration and lead to a disruption in the water balance. For example, studies from Southeast Asia and Australia have demonstrated rapid reduction of water yield and soil moisture after the planting of eucalyptus trees (Samra et al. 2001). Conversely, actions that remove vegetation can lead to an increase in water yield by decreasing evapotranspiration (loss of water by evaporation from the soil and by transpiration from the plants). In one post-fire study, a 5-percent reduction in evapotranspiration resulted in a 30-percent increase in the annual runoff in a watershed (Zwolinski, 2000). This could be a beneficial effect in a watershed where current flow levels are below historic levels.

Fires can have other beneficial impacts on watersheds. Riparian vegetation can recover quickly from fires, and research indicates that the closer a plant is to the water table, the higher the potential for regeneration after a fire event (Russell and McBride 2001). This suggests that riparian areas are very resilient to fires and could benefit from the mosaic of habitat and regeneration of growth that is created.

Likewise, soil productivity, which is dependent on organic matter, recovers quickly in burned areas that are left undisturbed (Beschta et al. 2004). The short-term decrease in soil productivity in the uplands of a watershed would be accompanied by an increase in nutrients in the downstream aquatic ecosystem (Bisson et al. 2003). Provided that these processes occur in watersheds where aquatic species are healthy and habitats remain productive, diverse, and interconnected, the effects on the ecosystem would be beneficial.

Overall, fire management actions such as prescribed burning and mechanical removal of nonnative vegetation can be an important component of watershed management, in combination with other actions that improve the natural processes and connections. In addition, fire management activities would limit the potential for catastrophic fire that could burn along the entire vertical gradient in the watershed, creating extensive hydrophobic soils resulting in increased sediment loads to watersheds. In the long term, fire management activities would have beneficial effects on watersheds by reducing the severe impacts of a catastrophic fire that could extensively burn an entire watershed.

Actions Common to All Alternatives

Wildland-Urban Interface Initiative

Projects conducted under the Wildland-Urban Interface Initiative would be subject to project review to ensure that they would minimize adverse impact on soils, erosion, or water resources.

Defensible Space/Vegetation Clearing Around Buildings

Clearing around structures could leave soils unvegetated and/or disturbed and vulnerable to erosion. Ensuring that these activities do not denude the soil, or incorporating erosion control measures, would avoid effects on soil or water resources.

Roadside Fuel Reduction

As described in Chapter 2, maintenance standards for existing fire roads would be developed by park staff and would include guidance on grading and vegetation removal. Maintenance standards would include such actions as outsloping of roads to prevent rill and gully erosion. In addition, unnecessary fire roads may be eliminated, and others may be reconfigured or rerouted to address erosion problems. These actions would be conducted to reduce erosion potential, and should have a beneficial impact.

Suppression

Wildland fire and the suppression and restoration actions that follow wildland fire all have the potential to affect watershed resources within the park. Depending on the intensity and duration of a wildland fire, immediate and long-term changes in soil properties and watershed processes can occur.

Suppression activities can cause soil compaction, 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 and bury the fertile topsoil layer and the native seedbed within the topsoil, reducing the success of post-fire native plant revegetation. Removal of covering vegetation and uprooting of plants and tree roots by heavy equipment expose disturbed soils to erosion by water and wind.

Saltwater used for suppression can create an adverse effect on the soil chemistry. The duration and intensity of this effect would depend on the site conditions, the amount of saltwater applied for suppression, and the rainfall and runoff patterns following the fire. Likewise, use of fire retardants for suppression can introduce harmful substances to an aquatic ecosystem.

Based on the average size of historic wildfires in GGNRA annually, the impacts created by suppression activities would create no more than short-term, minor adverse effects in any one watershed. In combination with the applicable mitigation measures listed in Chapter 2, impacts on watersheds from suppression activities would be adverse, short-term, and negligible or minor.

Treatment of Muir Woods FMU

Fire management projects at Muir Woods National Monument would include prescribed burning and mechanical removal. These actions could affect watershed resources by causing erosion, soil compaction, and sedimentation into water bodies. The acreage of proposed projects in Muir Woods National Monument (part of the Redwood Creek watershed) are small in scale compared to the size of the watershed. Therefore, the impact on watershed resources would be minor. The beneficial impacts of these activities would be to restore the natural hydrologic and nutrient cycles in the watershed. Combined with the applicable mitigation measures listed in Chapter 2, the impact of fire management activities at Muir Woods National Monument on watershed resources would be beneficial, long-term, and moderate.

Treatment of San Francisco County Project Area

See “Defensible Space Clearing Around Structures” above. Mechanical removal of nonnative evergreen trees could have short-term adverse impacts on soil and soil erosion. For tree removal actions in areas with highly erosive soils or steep slopes, tree stumps would be left in place and cut as close to ground surface as feasible.

Public Information and Fire Education Programs

Fire information and education actions proposed for all alternatives would have no beneficial or adverse effects on soil or water resources in the planning area.

Fire Cache

For the purposes of this document, it is assumed that the activities performed at the fire cache(s) would be consistent with the surrounding resource objectives and would be done in accordance with best management practices (BMPs) for soil and water quality protection. For example, vehicle washing would be done on a wash rack designed to prevent contamination of surface waters.

Fire Effects Monitoring

Monitoring plans would be reviewed to ensure that fire-related monitoring has no adverse effect on soils or water resources. In general, monitoring and evaluation would benefit watershed resources as it would enable managers to make corrective actions if necessary.

Alternative A

Mechanical Fuel Reduction

Mechanical fuel reduction in Alternative A would occur in nonnative forests along the Wildland Urban Interface. These activities could lead to watershed effects such as erosion and soil compaction and create adverse, short-term, and minor impacts. However, the removal of nonnative trees from within a watershed could help improve the hydrological cycle by restoring natural infiltration and evaporation processes. Combined with the applicable mitigation measures listed in Chapter 2, mechanical treatments in Alternative A would have a beneficial, long-term, and moderate effect on watershed processes.

Pile Burning

Most mechanical removal projects would include pile burning. The piles would be small in size and create very localized compaction and hydrophobic soil. These impacts would be minor on a watershed scale and would not affect soil or hydrology resources.

Prescribed Fire

Prescribed burning under Alternative A would be focused in Marin County and would largely burn grassland and coastal scrub. Prescribed burning activities such as fire line creation and the burn itself could cause watershed impacts such as disruption of the soil horizon and soil properties, erosion, sedimentation, and changes to hydrology. If large-scale burns are planned for one watershed, the burn could potentially disrupt a large enough percentage of the watershed to cause a moderate impact. However, the maximum acreage to be burned under Alternative A during any one year is 100 acres (in Marin County), and the burning is unlikely to occur within one watershed. This acreage is less than 5 percent of most watersheds in Marin County. Given the small scale of the prescribed burning activities, Alternative A would have an adverse, short-term, and minor impact on soil and water quality within a watershed.

Positive effects from burning could be realized in the restoration of watershed processes such as infiltration and evaporation. In addition, the return of a more natural fire interval would prevent fuel buildup and decrease the potential for a catastrophic fire that could have a major impact on watershed processes.

With the inclusion of the applicable mitigation measures listed in Chapter 2, the prescribed burning activities in Alternative A would have beneficial, long-term, moderate impacts on watershed processes.

Research

Alternative A would include an element of research into the effects of fire on vegetation. Part of the research could be to determine the effects of fire on soil, hydrology, and aquatic resources in the watershed. This research would have a beneficial impact, as the results could inform future decision making that prevents future impacts on the watershed. Since these research burns would be synonymous with the burns described above, the possible adverse impacts would be the same.

Cumulative Impacts

Under Alternative A, FMP actions would be occurring in conjunction with the implementation period of several NPS and community projects, particularly in Marin County. For example, several current and proposed projects and plans have components that could affect the 8.9-square-mile Redwood Creek watershed, including:

- The Big Lagoon Restoration Project at Muir Beach, which will explore alternatives for restoring or enhancing ecological processes near the mouth of Redwood Creek, reduce flooding of local infrastructure, restore the creek channel and wetlands, reconfigure facilities to improve hydrologic processes, and provide an visitor access and a range of visitor experiences.
- Ongoing NPS habitat restoration actions along Redwood Creek, including removal of nonnative plants and planting of native plant species.
- Recent floodplain restoration along Redwood Creek on the Banducci property and the continuation of the effort under Phase II improvements.
- Recent work to reduce flooding potential at Pacific Way leading to Muir Beach.
- Roadway improvements and parking lot reconfiguration to reduce resource damage and promote sustainable resource management at Muir Woods National Monument and Muir Beach as part of the Comprehensive Transportation Management Plan.
- Possible improvements to the Coastal Trail in the vicinity of Muir Beach as part of the Trails Forever Project.

These projects should be considered when developing implementation strategies for the various project areas described in the FMP. The combined impacts of unrelated projects and fire management activities within a watershed should not exceed the threshold for minor impacts (i.e., slightly perceptible and localized, without the potential to expand if left alone). For example, fire management planning should ensure that prescribed burning or mechanical treatments create only negligible impacts in the upper reaches of a watershed during the timeframe when a concurrent project is being implemented downstream.

Other watersheds in Marin and San Mateo counties containing NPS lands could be affected by the implementation of projects funded by the Wildland-Urban Interface Initiative on private lands, and by habitat restoration or nonnative plant removal projects or fire management actions conducted by Marin County Fire Department or other local land management agencies. Fire management in the San Francisco project area could affect the drainage of Lobos Creek, which is shared with land managed by the Presidio Trust. PRNS and GGNRA both have lands within the larger watershed draining to Bolinas Lagoon.

To avoid adverse cumulative impacts on the Redwood Creek watershed and other park watersheds in Marin and San Mateo counties, fire management actions should be scheduled, sited, and coordinated with other actions that contribute to stream sedimentation. Consideration should be given to any transportation,

trail improvement, maintenance, habitat restoration, or other project that disturbs the soil or would otherwise affect the hydrology or water quality within a watershed.

Conclusion

Fuel reduction achieved by fire management actions under Alternative A would benefit watershed conditions and hydrologic processes by reducing the risk of catastrophic fire and returning fire intervals. These effects overall would be beneficial, long-term, and moderate. Effects of prescribed fire on water quality due to increased erosion would be adverse, minor, and short-term until vegetation is reestablished. Impacts from soil disturbance by mechanical treatments would be adverse, short-term, and negligible to minor. The effects of the removal of nonnative evergreen forest on the watershed effects within the areas treated by mechanical means would be beneficial, long-term, and minor to moderate.

Suppression activities would adversely affect soils due to compaction and ground disturbance. Because the number of acres burned by wildfires each year remains quite low, impacts on watersheds would be adverse, short-term, and minor.

In sum, actions implemented under this alternative would have adverse, short-term, and minor effects on water quality. In the long term, the actions of Alternative A would have a beneficial, long-term, minor-to-moderate effect in restoring the natural hydrology of the area.

A large-scale unplanned fire could have adverse, potentially long-term, and major impacts on both water quality and features of watersheds, including riparian zones and watercourses.

Impairment

Because the actions under this alternative would have only short-term and minor adverse effects, no impairment of soil and water resources within park watersheds is expected.

Alternative B

Mechanical Fuel Reduction

Alternative B includes mainly mechanical fuel reduction throughout the park, particularly in the WUI FMU. Although the total acreage of projects per year would be greater than in Alternative A, the impacts would not change significantly. With the implementation of the mitigation measures described for Alternative A, the overall impacts on watersheds from mechanical removal under Alternative B would be beneficial, long-term, and minor.

Pile Burning

Impacts would be the same as under Alternative A.

Prescribed Fire

In Alternative B, prescribed burning would occur in the Muir Woods FMU and the Park Interior FMU, with a maximum of 120 acres per year throughout the park. This level of impact is similar to Alternative A. With the implementation of the mitigation measures described for Alternative A, the effects of

prescribed fire on watersheds under Alternative B would be adverse, short-term, and minor for soil and water quality, and beneficial, long-term, and moderate for overall watershed health.

Research

Impacts would be the same as under Alternative A.

Cumulative Impacts

Under Alternative B, nearly twice as much mechanical fuel reduction could occur as compared to Alternative A. The acreage of prescribed burning is nearly identical in the two alternatives. The majority of mechanical fuel reduction under Alternative B would occur on parklands in Marin County close to the park boundary with residential development. Fuels in the interface zone are predominately nonnative evergreen forest and nonnative shrubs such as French or Scotch broom and fennel. Where tree stumps are left in place, surface soil disturbance is limited to compaction or disturbance from skidders or vehicles used to transport cut timber.

Most of the projects included in the consideration of cumulative effects are well away from the WUI zone on the eastern edge of GGNRA lands. Restoration efforts and nonnative plant removal undertaken by park stewards are often focused in the interior of the park, where efforts to contain the spread of nonnative plants can be more effective than on the park's interface. Cumulative impacts from prescribed burning projects would be essentially the same as described for Alternative A and would incorporate the same mitigation measures that require consideration of fire management actions on a watershed scale with emphasis on erosion control.

Cumulatively, effects from other actions when combined with the effects from Alternative B would be short-term, minor, and adverse due to the potential for an increase in the level of erosion from prescribed burning. Many of the projects considered for the cumulative impact assessment, such as the Big Lagoon project and the floodplain expansion on the Banducci property, are focused on resolving long-standing resource problems and enhancing ecological function. Long-term, moderate beneficial impacts would accrue throughout the affected watersheds through the reduced potential for a catastrophic fire to occur in conjunction with the resource benefits gained from other concurrent projects.

Conclusion

Fire management actions under Alternative B, especially the prescribed burns in the park interior, would improve the long-term watershed conditions and natural hydrology by reducing the risk of catastrophic fire and returning fire intervals. These effects overall would be beneficial, long-term, and moderate. Effects of prescribed fire on water quality due to increased erosion would be adverse, minor, and short-term until vegetation is reestablished. Impacts from soil disturbance due to mechanical treatments would be adverse, short-term, and negligible to minor. However, the watershed effects within the areas treated by mechanical means would be beneficial, long-term, and minor to moderate.

The same types of watershed impacts would result from typical wildland fires in the park each year. Suppression activities would affect soils due to compaction and ground disturbance. Mitigation Measure FMP-6 describes the requirements for resource advisors to work with firefighters to minimize the

potential effect of suppression efforts. Mitigation Measure FMP-7 requires burned area rehabilitation teams to be requested for any multiday wildland fire incident. Because the number of acres burned by wildfires each year would remain quite low and a rehabilitation plan would be required to stabilize burned areas and reduce soil erosion and potential damage to adjacent properties, impacts on watersheds would be adverse, short-term, and minor.

A large-scale unplanned fire could have adverse, potentially long-term, and major impacts on both water quality and features of watersheds, including riparian zones and watercourses.

Impairment

Because the actions under this alternative would have at worst short-term, minor adverse effects on watershed resources, no long-term impairment of watersheds would result from this alternative.

Alternative C

Mechanical Fuel Reduction

Alternative C includes more mechanical fuel reduction in Marin County, with the same acreages in San Francisco and San Mateo County as Alternative B. The increased acreage in Marin is located in the park interior areas. Although the total acreage of projects per year would be greater than under Alternatives A and B, the impacts would not be significantly different. With the implementation of the mitigation measures described for Alternative A, the impacts on watershed resources of mechanical removal under Alternative C would be adverse, short-term, and minor for soil and water quality, and beneficial, long-term, and moderate for overall watershed health.

Pile Burning

Impacts would be the same as under Alternative A.

Prescribed Fire

Under Alternative C, prescribed burning would occur mainly in the Park Interior FMU, with a limited amount in the Wildland Urban Interface and Muir Woods FMUs. A maximum of 320 acres per year would be burned throughout the park. While this is an increase in acreage from Alternatives A and B, the intensity of impact would not exceed minor. The size of even the largest anticipated prescribed burn would not be enough to affect more than a small fraction of any watershed. However, the beneficial impacts of prescribed burns would increase with the increased acreage.

With the implementation of the mitigation measures described for Alternative A, the effects of prescribed fire on watersheds under Alternative C would be adverse, short-term, and minor for soil and water quality, and beneficial, long-term, and moderate for overall watershed health.

Research

The impacts of this alternative would be similar to Alternatives A and B. However, the beneficial impacts could be greater due to the opportunity for more research burns.

Cumulative Impacts

Under Alternative C, there is potential for cumulative effects on soils and water resources to occur if fire management actions and construction projects proposed for the same watershed are timed to occur simultaneously. With the application of mitigation measures that address the potential effect on the watershed scale and the project scale, potential project effects would be short-term, minor, and adverse, as in Alternative A. Under Alternative C, long-term, moderate beneficial impacts on the watershed would be achieved by reducing the potential for a catastrophic fire through a faster rate of reduction at key areas of high fuel loading, compared to Alternative A.

Conclusion

Fire management actions under Alternative C, in particular prescribed fire, would improve watershed conditions and natural hydrology by reducing the risk of catastrophic fire and returning more natural fire intervals. This alternative would have the greatest effect on the park's watersheds, and would be beneficial, long-term, and moderate. Effects of prescribed fire on water quality due to increased erosion would be adverse, minor, and short-term until vegetation is reestablished. Impacts from soil disturbance due to mechanical treatments would be adverse, short-term, and negligible to minor. However, the watershed effects within the areas treated by mechanical means would be beneficial, long-term, and minor to moderate.

The same types of watershed impacts would result from typical wildland fires in the park each year. Suppression activities would affect soils due to compaction and ground disturbance. Because the number of acres burned by wildfires each year would remain quite low, impacts on watersheds would be adverse, short-term, and minor.

A large-scale unplanned fire could have adverse, potentially long-term, and major impacts on both water quality and features of watersheds, including riparian zones and watercourses.

Impairment

Because the actions under this alternative would have at worst short-term, minor adverse effects, no impairment of park watershed resources is expected.

Impacts on Air Quality

Analysis

The smoke management techniques listed in Chapter 2, Section 2.7 "Mitigation Measures," will apply to all the proposed FMP alternatives. These and additional strategies are described in the 2002 U.S. Department of Agriculture General Technical Report, Wildland Fire in Ecosystem, Effects of Fire on Air Quality and in the National Wildfire Coordinating Group's Fire Use Working Team publication "The Smoke Management Guide for Prescribed and Wildland Fire: 2001 Edition." Prescribed burns, pile burning, research burning, and flexible suppression strategy actions would be conducted incorporating these mitigation measures to lessen the effects of smoke and other emissions on human health, ecological health, air quality, and visibility. (Note: The effects of air emissions, such as particulates from smoke, on

respiration and roadway visibility are addressed in this FEIS under "Impacts on Human Health and Safety" below.)

Actions Common to All Alternatives

Wildland-Urban Interface Initiative

GGNRA has experience with implementation of the federal Wildland-Urban Interface Initiative program for the past three years. The NPS funds community projects by local fire agencies, local land management agencies, or homeowners' associations for treatment of fire hazard areas within the wildland urban interface. Projects on the federal side of the interface are the responsibility of national parks. The NPS also grants funding to community groups, other land management agencies, and local fire departments for fuel reduction projects on private lands within the interface zone with the national park. These projects are not directly managed by the NPS and will be addressed as part of the cumulative impact assessment.

To date, all projects funded by the Wildland-Urban Interface Initiative within GGNRA have been sited in Marin County. Though this program has also funded public education projects at GGNRA, the majority of the funding has been for mechanical fuel reduction projects near the federal interface with residential communities in Marin County. There are instances where projects involved pile burning to dispose of debris from felled nonnative trees or pruned vegetation. In most cases, it is more cost-effective to chip and distribute woody debris onsite. Where inaccessibility to a chipper or resource constraints or other factors limit or prohibit chips from being broadcast at the site, burn piles are an effective solution to reduce debris. Where projects involve trees infested with pitch pine canker or SOD, the prescribed treatment is to leave all material onsite and avoid transportation. If there is too much debris to leave onsite, burn piles would be used to reduce the amount of downed fuel at the site. For these projects, the construction, ignition, and monitoring of pile burning will be supervised by NPS staff or the Marin County Fire Department and necessary burn approval will be attained from BAAQMD. Occasionally, burn piles may not be practical when residential development is near a park fuel reduction project site and nuisance smoke and soot impacts on property would be difficult to avoid. Experience over the last three years indicates that two to three projects per year may include pile burning. For Alternative A, it is estimated that approximately 25 burn piles would be completed each year. This amount of burn piles is included as part of the project description under each alternative. Emissions are estimated in Table 4-4.

Table 4-4: Emissions from Pile Burning for Projects Funded by Wildland-Urban Interface Initiative under Alternative A

Number of Burn Piles	Emissions (pounds per year)					
	PM_{10}	$PM_{2.5}$	VOC (as methane)	CO	NO_x	SO_2
25	0.03	0.02	0.01	0.3	0.0	0.0

Source: NPS Air Resources Division 2004.

Notes:

PM_{10} = suspended particulate, $PM_{2.5}$ = fine particulate matter, VOC = volatile organic compounds (methane), CO = carbon monoxide, NOx = nitrogen oxides, SO_2 = sulfur dioxide

Defensible Space/Vegetation Clearing Around Structures

Similar to roadway fuel reduction projects, emissions from equipment use during defensible space clearing around structures are considered insignificant in comparison to overall emissions generated by fire management actions and wildland fire, and would have a negligible effect on air quality. Prescribed burning and pile burning are not associated with clearing around structures. These actions would have a short-term, negligible adverse effect on regional air quality and no effect on visibility.

Roadside Fuel Reduction

Roadway fuel reduction primarily involves equipment, including trucks, chippers, chain saws, and brushcutters. Normally, cut vegetation is chipped and redistributed onsite. In certain cases along fire roads, some pile burning may be needed to reduce excess fuels that should not be left onsite. The emissions from pile burning are included in the overall emissions calculations for each alternative. The emissions that would be generated by equipment and vehicle use have been determined to have a negligible effect on air quality according to the NPS Air Resources Division. Roadway fuel reduction would make a short-term, negligible adverse contribution to regional air quality; there would be no effect on visibility.

Suppression

Smoke from unplanned ignitions is a complex mixture of carbon, tars, liquids, and gases. The major pollutants from fire that are monitored by BAAQMD under the Clean Air Act are particulates (PM_{10} and $PM_{2.5}$), volatile organic compounds (VOC), carbon monoxide (CO), and nitrogen oxides (NOx). NOx is produced in relatively small quantities compared to the other pollutants (see Chapter 3, Section 3.3, discussion under “Air Quality”).

As described in the air quality methodology discussion above, the First Order Fire Effects Model (FOFEM) is used to generate the amounts of air emissions representative of a typical annual occurrence of wildland fire in GGNRA. The vegetation types, number of occurrences, and size of occurrences were provided by GGNRA fire management staff (Naar 2004). In order to derive realistic emission totals, the inputs into FOFEM for wildland fire are based on a rough estimate of the occurrence of wildland fire in the principal vegetation types.

The annual wildfire scenario used as the baseline for analysis in this EIS is estimated at 39 acres of annual wildland fire (Naar 2004). Of the 39 total acres, 12 acres (31 percent) contain coastal scrub vegetation, 25 acres contain grasslands (64 percent) and the remaining 2 acres (5 percent) are forested areas. The estimated emissions produced annually by the current level of wildland fire occurring in GGNRA is the same under the three FMP alternatives.

Table 4-5 shows the output of the FOFEM fuel model types and emission factors used to derive emissions for wildland and prescribed fire in grasslands, coastal scrub, and Douglas-fir forest. As there is little difference in the amount and type of emissions produced by prescribed burning in grasslands or coastal scrub compared to wildland fire in grasslands or coastal scrub, the same emission factors are used for both types of fire in these two plant communities. To estimate emissions from wildland fire and prescribed fire in Douglas-fir forest, the same fuel model type was used but specific factors associated with that model

type, such as an increased involvement of the forest canopy, were modified to represent a wildfire and produce more realistic emission levels for this higher-intensity and higher-emission burn.

Table 4-5: FOFEM Emissions Factors for Wildfire, Prescribed Burning, and Pile Burning

FOFEM Inputs				Emission Factors (pounds per year per acre burned)					
GGNRA Cover Type	**FOFEM Surrogate**	**Code**	**Fire Type**	**PM_{10}**	**$PM_{2.5}$**	**VOC**	**CO**	**NOx**	**SO_2**
Coastal Scrub	Cean	SRM 208	Prescribed	190	161	49	404	198	62
Grass	Valley Grassland	SRM 215	Prescribed	11	9	3	23	12	4
Native Forest	Pacific Douglas-fir	SAF 229	Prescribed	2863	2445	1480	32319	24	114
Coastal Scrub	Cean	SRM 208	Wild	190	161	49	404	198	62
Grass	Valley Grassland	SRM 215	Wild	11	9	3	23	12	4
Native Forest	Pacific Douglas-fir	SAF 229	Wild	3640	3085	1867	40836	31	145
Nonnative Trees	Pacific Douglas-fir	SRM 229	Pile Burning	2660	2254	1329	28606	162	145

Source: NPS Air Resources Division 2004.
Notes:
FOFEM = First Order Fire Effects Model, SRM = Society for Range Management, SAF = Society of American Foresters, PM_{10} = suspended particulate, $PM_{2.5}$ = fine particulate matter, VOC = volatile organic compounds (methane), CO = carbon monoxide, NOx = nitrogen oxides, SO_2 = sulfur dioxide

During suppression of unplanned ignitions, transport and fire vehicles such as trucks, engines, and water tenders would be onsite to patrol and stand by on alert at fires. Equipment such as chain saws and graders could be used to clear fuels, provide access, or transport firefighters. Heavy equipment, fire engines, and water tenders would be used to fight the fire. The level of emissions generated by equipment and vehicles during wildland fire suppression is considered a negligible contribution to air emissions relative to the emissions in the wildfire smoke.

The potential annual air emissions from wildland fire in GGNRA are shown in Table 4-6. Emissions generated by this level of wildland fire would have a long-term, negligible, adverse effect on levels of SO, $PM_{10,}$ CO, and NO_x and a long-term, minor, adverse effect on ozone (represented by VOC) levels in the Bay Area Air Basin.

Smoke dispersion during a wildfire would vary depending on weather conditions, elevation of the fire, wind direction, fuel type, and accessibility of the area for firefighting equipment. A fire in blue gum eucalyptus could burn with tremendous intensity and spread extremely fast, producing local winds from rapid convection and heating. Under these conditions, drifting burning material, such as the eucalyptus bark, has great potential to ignite spot fires further spreading the fire (Boyd 1997). Active suppression can affect smoke generation and visibility as a cooling, slower fire produces more smoke than a rapidly burning fire. However, smoke management is typically a secondary concern to overall suppression and containment. Suppression actions are geared to control, containment, and confinement and, while cooling a fire, suppression may actually increase smoke generation over the short term while curtailing the

continued combustion of new fuels and additional smoke. There are too many variables for each fire and each suppression effort to make a definitive conclusion about the effect of suppression on smoke generation, regional air quality, and visibility. As the fire is the primary cause of air emissions, smoke and the pollutants generated as a result of the actual suppression efforts on the part of firefighters can be considered secondary and a minor consequence of the suppression effort. Suppression actions would generally have a short-term, moderate beneficial effect on regional air quality but would not reduce the potential for a large-scale catastrophic wildfire to occur in the future with more severe air quality impacts.

Table 4-6: Projected Annual Emissions for Wildland Fire in GGNRA

County / Cover Type	Wildland Fire Acreage	Emissions					
		PM_{10}	$PM_{2.5}$	VOC (as methane)	CO	NOx	SO2
Marin							
Coastal scrub	10	1,900	1,610	490	4,040	1,980	620
Grass	20	220	180	60	460	240	80
Native forest	2	7,280	6,170	3,734	81,672	62	290
Subtotal		**9,400**	**7,960**	**4,284**	**86,172**	**2,282**	**990**
San Francisco	**0**	**0**	**0**	**0**	**0**	**0**	**0**
San Mateo							
Coastal scrub	2	380	322	98	808	396	124
Grass	5	55	45	15	115	60	20
Native forest	0	0	0	0	0	0	0
Subtotal		**435**	**367**	**113**	**923**	**456**	**144**
Total Acreage	**39**						
Total Wildland Fire Emissions (pounds per year)		**9,835**	**8,327**	**4,397**	**87,095**	**2,738**	**1,134**
Total Wildland Fire Emissions (tons per year)		**4.9**	**4.2**	**2.2**	**43.5**	**1.4**	**0.6**

Source: GGNRA Fire Management Office and NPS Air Resources Division 2004.

Notes:

PM_{10} = suspended particulate, $PM_{2.5}$ = fine particulate matter, VOC = volatile organic compounds (methane), CO = carbon monoxide, NOx = nitrogen oxides, SO_2 = sulfur dioxide

Treatment of Muir Woods FMU

FOFEM is used to estimate the amounts of air emissions generated by the up to 50 acres of understory burning annually in the Muir Woods FMU in burn units of 0.5 to 50 acres. The fuel type used to generate emissions for understory is Pacific Douglas-fir with characteristics indicating low rate of forest canopy involved by the burning. Proposed FMP actions for this FMU also include approximately 5 acres of mechanical treatment, including providing defensible space around structures and preparing burn units for prescribed fires.

The proposed strategy for the Muir Woods FMU is the same under the three FMP alternatives. However, under each alternative, the 50 acres of prescribed burning in the understory of the redwood/Douglas-fir forest at Muir Woods differs in relative importance to the overall program for fuel reduction, in the degree of activity it represents, and the percent of total emissions it produces (see Tables 4-7 and 4-8).

Table 4-7: Relative Importance of Muir Woods Prescribed Burning (PB) Under Each Alternative

Alternative	Muir Woods PB as % of Total Acreage of PB	Muir Woods PB as % of Total Acreage of PB in Native Forest	Muir Woods PB as % of Total $PM_{2.5}$ Emissions	Muir Woods PB as % of Total VOC Emissions	Muir Woods PB as % of Total NOx Emissions
A	45%	100%	96%	98%	16%
B	42%	77%	74%	75%	16%
C	16%	71%	66%	69%	6%

Source: NPS Air Resources Division 2004.
Notes:
$PM_{2.5}$ = fine particulate matter, VOC = volatile organic compounds (methane), NOx = nitrogen oxides

Table 4-8: Projected Annual Emissions from Prescribed Burning in Douglas-Fir Forested Understory at Muir Woods FMU

Action Type	Acres	Emissions (tons per year)					
		PM_{10}	$PM_{2.5}$	VOC	CO	NOx	SO_2
Annual Emissions, Prescribed Fire	50	71.6	61.1	37.0	808.0	0.6	2.9

Source: NPS Air Resources Division 2004.
Notes:
PM_{10} = suspended particulate, $PM_{2.5}$ = fine particulate matter, VOC = volatile organic compounds (methane), CO = carbon monoxide, NOx = nitrogen oxides, SO_2 = sulfur dioxide

Table 4-8 shows the estimated levels of emissions produced by understory burning in the Muir Woods FMU at the annual maximum of 50 acres per year. Given the amount of preparation through mechanical treatment required prior to burning in a mature forest, restrictions on allowable burn days, demands for implementation of competing fire management projects elsewhere in the park, variable coastal climate, and visitation levels at Muir Woods National Monument, NPS fire staff may not be able to complete 50 acres per year or successfully schedule a prescribed burn in the redwood/Douglas-fir forest once each year. In actual practice, understory burning may be accomplished by a series of smaller burns scheduled over several consecutive years. (Estimated daily emissions under this scenario are shown in Table 4-9.) In this respect, the annual emissions estimated for Muir Woods FMU projects, which represents the largest generator of particulate matter and volatile organic compound (VOC) emissions annually for each alternative, may be overstating actual emissions produced by the three alternatives. Nonetheless, the estimate of emissions is a useful conservative estimate to compare the relative impacts for full implementation of the three alternatives.

Table 4-9: Projected Daily Emissions from Prescribed Burning in Douglas-Fir Forested Understory at Muir Woods FMU

Action Type	Total Acres	Burns per Year	Emissions per Burn (tons per day)					
Prescribed Burn Totals	**50 acres**	**3 burns total**	**PM_{10}**	**$PM_{2.5}$**	**VOC**	**CO**	**NO_x**	**SO_2**
Typical Forested Understory Prescribed Burn	16.6	3	23.7	20.3	12.3	268.2	0.2	0.9

Source: NPS Air Resources Division and GGNRA Fire Management Office 2004.
Notes:
PM_{10} = suspended particulate, $PM_{2.5}$ = fine particulate matter, VOC = volatile organic compounds (methane), CO = carbon monoxide, NO_x = nitrogen oxides, SO_2 = sulfur dioxide

The total annual emissions of VOC, for which the air basin is in nonattainment status, is less than 50 tons per year, a level below the *de minimus* threshold and therefore not requiring a determination of conformity with the SIP. The No Action alternative would generate approximately 39.9 tons per year including the 39 acres of wildland fire annually. This level of emissions would have a long-term, moderate adverse effect on air quality, according to the methodology used when assessing those emissions with "nonattainment" status in the air basin. NOx emissions generated would be less than one ton per year and would have a long-term, negligible adverse effect.

Smoke management plans proposed by the NPS for prescribed burning in the Muir Woods FMU or other areas of the park are submitted to BAAQMD for approval at least 30 days before the planned burn day. The approval for ignition by BAAQMD is based on the objective of maintaining Bay Area Air Basin air pollutant emissions within the NAAQS shown in Table 3-4. 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 BAAQMD to coordinate the location and amount of emissions generated simultaneously by prescribed burning in one air basin.

Generally, smoke effects from prescribed burning last only as long as the fire management action. Smoke behavior varies with the amount and type of fuel burned. In areas such as the redwood/Douglas-fir forests at Muir Woods National Monument, the fuel load consists of decades of accumulated duff. Because it tends to smolder, duff produces relatively more particulates than burning vegetation does. In grassland and coastal scrub, a higher percentage of fuels are light fuels that burn in the flaming phase, 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. (See discussion under "Impacts on Human Health and Safety" below.) Most smoke plumes from fire suppression operations disperse at middle to upper elevations and, occasionally, under unfavorable wind conditions, into the more heavily populated areas of Marin County.

Under prevailing wind conditions, smoke generation would generally be confined to the interior of the Marin Headlands, Muir Woods National Monument, Muir Woods Road, and Panoramic Highway, with

short-term, minor adverse effects on the residential areas along Panoramic Highway. Ideal conditions for prescribed burning would push smoke west toward the ocean. Less ideal would be winds or drift to the southwest toward Muir Beach, Highway 1, and the Muir Beach community. However, if burn prescription conditions are met, prescribed burning could proceed under prevailing wind conditions, with potential short-term, minor-to-moderate adverse smoke effects on unincorporated areas of Mill Valley, Marin City, or Sausalito once or twice a year. Under offshore conditions, there could be a short-term, minor, adverse effect on visibility at Highway 1, Muir Beach, and the Muir Beach community

Treatment of San Francisco County Project Area

Fuel reduction projects within San Francisco parklands would involve (1) mechanical fuel reduction projects, primarily along the open space/residential interface where nonnative vegetation has created a fire hazard, and (2) research burns that are strictly limited in size and focus on resource enhancement objectives. Emissions from equipment use and from small research prescribed burn would have negligible effects on air quality. No pile burning is proposed for the San Francisco project area. Actions in the San Francisco project area would have a short-term, negligible adverse effect on regional air quality and no effect on visibility.

Public Information and Fire Education Programs

The public information and education program would be used to notify the public and visitors in advance of prescribed burning and pile burning projects. The program would also be the primary means used to explain the role of prescribed burning in promoting ecosystem health and restoration of the role of fire to the extent possible. In the immediate vicinity of proposed burning, the program would be used to identify any at-risk members of the public in advance of burning and discuss ways to protect their health if smoke drift affects the area or their neighborhood. The program would have no effect on regional air quality or visibility.

Fire Cache

The relocation of the fire cache to one facility would not affect regional air quality or visibility.

Fire Effects Monitoring

Implementation of the fire behavior monitoring program would have no effect on regional air quality or visibility.

Alternative A

Under Alternative A, the No Action alternative, a maximum of 110 acres of prescribed burning, 100 acres of mechanical treatment and limited pile burning (25 burn piles) could occur annually.

All prescribed burning at GGNRA has been, and would continue to be, planned and performed under the auspices of the BAAQMD Smoke Management Program. Prior to igniting a prescribed fire, GGNRA fire management staff must submit a smoke management plan to the BAAQMD Smoke Management Program and obtain meteorological approval to burn from that program. It is the responsibility of BAAQMD to coordinate the number of fires burning in one area. BAAQMD's objective is to ensure that

annual emissions from fire management actions implemented under the GGNRA FMP do not exceed state or federal standards.

Mechanical Fuel Reduction

As discussed earlier, emissions from mechanical treatments generated by equipment used to remove, process, or control vegetation are considered to be insignificant by the NPS Air Resources Division in relation to emissions generated by combustion, and have a negligible contribution to emission levels. For this reason, the low emission levels generated by equipment are not calculated as part of the impact assessment. Mechanical fuel reduction would have a short-term, negligible effect on regional air quality and visibility.

Pile Burning

Emission levels generated by pile burning under Alternative A are shown in Table 4-10. Burning of 25 piles would occur on one to three separate days depending on whether the woody debris was collected at one project site or at several. All pile burning would be coordinated with BAAQMD and a smoke management plan and burn plan would be submitted at least 30 days in advance for BAAQMD approval. Pile burning under Alternative A would have a short-term, negligible-to-minor adverse effect on regional air quality and visibility.

Prescribed Burning

As described earlier, FOFEM is used to estimate the amounts of air emissions that would be generated by the acreage of prescribed burning and number of pile burns proposed under Alternative A. In order to derive realistic emission totals, the inputs into FOFEM are based on the characteristics present at sites in GGNRA that could be proposed for prescribed burning in the future. The total area of the series of the burn sites modeled for each alternative is equivalent to the permissible acreage for prescribed burning annually under that alternative – for example, 110 acres under Alternative A. The vegetation type modeled is based on an estimate of the potential composition of the actual burn sites – roughly 27 percent grassland, 27 percent shrublands, and 45 percent forest understory. This estimate translates into 30 acres of grasslands, 30 acres of shrublands, and 50 acres of understory burns conducted primarily in redwood/Douglas-fir forest in Muir Woods National Monument.

All prescribed burns proposed by GGNRA must be approved for ignition by BAAQMD with the objective of maintaining Bay Area Air Basin air pollutant emissions within the NAAQS shown in Table 3-4. 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 BAAQMD to coordinate the location and amount of emissions generated simultaneously by prescribed burning in one air basin.

Table 4-10: Projected Annual and Daily Emissions for Alternative A

ANNUAL EMISSIONS – TONS PER YEAR

Action Type	Area	Emissions (tons per year)					
		PM_{10}	$PM_{2.5}$	VOC	CO	NO_x	SO_2
Prescribed Fire: Grassland and Scrub	60 acres	3.0	2.6	0.8	6.4	3.2	1.0
Prescribed Fire: Forested Understory	50 acres	71.6	61.1	37.0	808.0	0.6	2.9
Pile Burning	25 burn piles	0.03	0.02	0.01	0.30	0.00	0.00
Annual Emissions From NPS Prescribed Fire		**74.6**	**63.7**	**37.8**	**814.7**	**3.8**	**3.9**
Estimated Annual Occurrence of Wildfire	39 acres	4.7	4.0	2.1	43.1	1.1	0.5
Total All FMP Projects – Alternative A		**79.3**	**67.7**	**39.9**	**857.8**	**4.9**	**4.4**

DAILY EMISSIONS –TONS PER DAY (per burn)

Action Type	Total Acres	Burns per Year	Emissions (tons per day)					
Prescribed Burn Totals	**110**	**7 burns total**	**PM_{10}**	**$PM_{2.5}$**	**VOC**	**CO**	**NO_x**	**SO_2**
Emissions – Typical Prescribed Burn in Grassland	30	2	0.1	0.1	0.0	0.2	0.1	0.0
Emissions – Typical Prescribed Burn in Coastal Scrub	30	2	1.4	1.2	0.4	3.0	1.5	0.5
Emissions – Typical Prescribed Burn in Forested Understory	50	3	23.9	20.4	12.3	269.3	0.2	1.0

Source: NPS Air Resources Division 2004.

Notes:

PM_{10} = suspended particulate, $PM_{2.5}$ = fine particulate matter, VOC = volatile organic compounds (methane), CO = carbon monoxide, NOx = nitrogen oxides, SO_2 = sulfur dioxide

Generally, air quality throughout GGNRA is very good due to prevailing winds and proximity to the Golden Gate and marine influences. Air quality can become degraded when the east Pacific high pressure system becomes displaced, typically in late summer and early fall when 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 prescribed fire, including the direction and elevation of the plume and resulting concentrations at ground level, is highly dependent on elevation and dynamic meteorological conditions at the time. Higher-elevation winds tend to better dilute and disperse smoke at lower concentrations. High-level winds may transport dispersed smoke particles long distances. Complex

geography and weather patterns complicate the ability to predict exactly 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 GGNRA, prescribed burning is normally 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. As discussed below under "Impacts on Human Health and Safety" and "Impacts on Visitor Use and Visitor Experience," care would be taken to site prescribed burns sufficiently distant from residential development and principal roads to avoid direct effects from smoke. GGNRA staff would inform park neighbors and visitors about the scope of prescribed burns and provide roadway assistance if burning results in visibility hazards on adjacent roadways.

Perceptible visibility impacts could occur during the prescribed burn but would be limited to primarily to the project site in the park and to the smoke plume following the prevailing winds; normally the smoke would disperse quickly during the course of the day. Prescribed burning under Alternative A could contribute 37.8 tons of VOC (as methane) and 3.8 tons of NOx annually to the Bay Area Air Basin. These pollutants are precursors to ozone; the air basin is currently in nonattainment for ozone though in attainment status for NOx. The level of VOCs would have a long-term, moderate adverse effect on air basin air quality; particulates (PM_{10} and $PM_{2.5}$) generated by full implementation of Alternative A would have a minor adverse effect recurring annually as additional areas of the park are treated to reduce fuels. The level of NOx and SO_2 would be considered a long-term, negligible adverse effect on air quality (see air quality methodology discussion at the beginning of this section).

Research

Impacts on air quality from the use of prescribed burning for research purposes are included in the overall assessment of effect of the full 110 acres of prescribed burning permitted annually under Alternative A. There is no effect on air quality from research burns distinct from the effect of the larger prescribed burning program. Research burns in the San Francisco project area would be of a very limited size, focusing on resource enhancement objectives in either grassland or coastal scrub and contributing negligible emissions annually.

Cumulative Impacts

Assessment of cumulative impacts for the FMP alternatives includes the effects of pile burning conducted to reduce debris from fuel reduction projects funded by the Wildland-Urban Interface Initiative occurring outside the park boundaries, and other prescribed burning occurring annually in western Marin County. Projects listed in Appendix C were considered in the cumulative impact assessment for air quality but, with the exception of the PRNS FMP, the projects listed would not generate significant emissions compared to those generated by prescribed burning and would have a relatively negligible effect.

Experience over the past three years of implementation of the Wildland-Urban Interface Initiative in the community shows that approximately 25 burn piles can be expected annually from community fuel reduction projects funded by this program. Additional projects considered in the cumulative scenario for air quality impacts (and included in Table 4-11) include the annual fuel reduction program conducted by the Marin County Fire Department, which is estimated at roughly 50 acres of prescribed burning and 50

burn piles annually (Julin 2004). These burns may be conducted on private property or on lands managed by California State Parks, the Marin County Open Space District, or the Marin Municipal Water District. Of the Marin County Fire Department prescribed burns, half of the vegetation affected would be on grasslands with nonnative broom species and half conducted in mixed evergreen forest understory.

Cumulative impacts also include prescribed burning conducted under the recently adopted PRNS FMP, which permits a total of 2,000 acres of prescribed burning annually. The amount of pile burning was not calculated for the PRNS assessment.

Table 4-11 below combines the total emissions levels for Alternative A projects from Table 4-10 with the additional emissions from Wildland-Urban Interface Initiative community projects and Marin County Fire Department burning that could cumulatively contribute to air quality impacts. Nearly all potential emissions would occur in Marin County, as compared to San Mateo County. (Under Alternative A, 91 percent of prescribed burning would occur in Marin County). The cumulative effect of GGNRA and Marin County Fire Department actions would be a long-term, moderate, adverse cumulative impact on ozone and PM_{10} levels, a minor long-term effect on $PM_{2.5}$ levels, and negligible effects on nitrogen oxide and sulfur dioxide levels in the air basin.

Table 4-11: Alternative A Annual Cumulative Air Emissions

Project Type	Acres	Fire Emissions (tons per year)					
		PM_{10}	$PM_{2.5}$	VOC	CO	NOx	SO_2
Total All FMP Projects Alternative A	110-acre PB 25 burn piles 39-acre wildland fire	**79.3**	**67.7**	**39.9**	**857.8**	**4.9**	**4.3**
Pile Burning for Community Projects Funded by Wildland-Urban Interface Initiative	25 burn piles	0.03	0.02	0.01	0.3	0	0
Total GGNRA Actions		**79.33**	**67.72**	**39.91**	**858.1**	**4.9**	**4.3**
Typical MCFD Annual Actions*	50 burn piles 50-acre PB	35.96	30.75	18.53	404.9	0.5	1.5
Total Annual Actions by GGNRA and MCFD		**115.3**	**98.5**	**58.4**	**1,263.0**	**5.4**	**5.8**
PRNS FMP Implementation	Up to 2,000-acre PB	241.3	205	101.3	1801.7	51.5	NG
Total Cumulative Annual Smoke Emissions		**356.6**	**303.5**	**159.7**	**3064.7**	**56.9**	**NG**

Source: PRNS Draft FMP 2004, NPS Air Resources Division and Kent Julin, Ph. D., County Forester, Marin County Fire Department, pers. comm.

Notes:

*Marin County Fire Department (MCFD) actions are meant to be representative of averaged estimated annual accomplishments.

PM_{10} = suspended particulate, $PM_{2.5}$ = fine particulate matter, VOC = volatile organic compounds (methane), CO = carbon monoxide, NOx = nitrogen oxides, SO_2 = sulfur dioxide, NG = not given, PB = prescribed burn

The PRNS FMP assessed the effects of prescribed burning on 2,000 acres annually and 1,500 acres of mechanical treatment. When the emission levels predicted for the selected alternative from the PRNS FMP EIS are added, impact levels of particulate matter and NOx move into the category of a long-term, major adverse cumulative effect on PM_{10}, $PM_{2.5}$, and VOC emission levels. The level of NOx emissions would have a long-term, minor effect and SO_2 emissions would remain at a negligible level of effect.

In the SIP for carbon monoxide, BAAQMD includes an annual level of prescribed burning for vegetation management within the maintenance area as a factor that contributes to annual CO emissions (D. Kolozsvari, BAAQMD, pers. comm.). In developing the SIP, BAAQMD estimated that some 34, 588 tons of woody fuels could be burned annually for non-agricultural, vegetation, and forest management practices in the Bay Area Air Basin. The assumptions of the SIP for CO, provided by BAAQMD, allow 37% of the annual total, or 12,800 tons of woody material, to be allocated to actions in Marin County and 17%, or 5,880 tons, in San Mateo County. This totals 18,680 tons for the two counties (Douglas Kolozsvari, BAAQMD, email 8/24/05).

Using the assumptions provided by BAAQMD, the maximum tonnage of prescribed burning allowed annually under the cumulative scenario, including Alternative A, would represent roughly 80% of the total annual tonnage factored into the SIP for CO for this type of prescribed burning in these two counties. The assumptions include factors for prescribed burning conducted on acreage with heavy fuels, acreage with light fuels, and include maximum allowable acreages on an annual basis from projects by GGNRA, Point Reyes National Seashore (PRNS), local fire agencies, and other land management agencies operating in the two counties.

As a contributor to the cumulative scenario, the park's proposed prescribed burning of the vegetation types at GGNRA under Alternative A would permit the burning of roughly 1,000 tons of vegetation annually; the SIP's full cumulative scenario accounts for approximately 15,000 tons heavy and light fuels annually. The majority of the tonnage included in the cumulative impact assessment can be attributed to the PRNS FMP, which proposes a cap of 2,000 acres of prescribed burning annually (in contrast to the cap of 110 acres under Alternative A of this EIS). With tonnage for the cumulative scenario calculated at 20% less than assumed for Marin and San Mateo counties under the SIP, and the probability that PRNS would not achieve 2000 acres per year of prescribed burning, the NPS believes that prescribed burning emissions under Alternative A are included in the SIP for CO and that no further conformity analysis is warranted.

All prescribed burning at PRNS and GGNRA would continue to be planned and performed under the auspices of BAAQMD's Regulation 5 governing Open Burning, which functions as the air district's smoke management plan. Since 2001, each air district in California must have an individual smoke management plan that meets state and federal requirements as directed by the Federal Interim Air Quality Policy on Wildland and Prescribed Fires. In conformance with Regulation 5 and prior to igniting a prescribed fire, NPS fire management staff must submit a smoke management plan to BAAQMD and must obtain meteorological approval to burn from BAAQMD. It is the responsibility of BAAQMD to coordinate the numbers of fires burning in one area in relation to ambient air quality. The oversight of BAAQMD would ensure that annual emissions from fire management actions implemented under the

PRNS FMP do not exceed state or federal standards. This oversight and the requirement to obtain BAAQMD approval for each individual prescribed burn, plus the availability of the mitigation measures to minimize the effects of prescribed burning, would reduce the level of effect on particulates and NOx to a long-term, moderate adverse cumulative effect.

Other projects and planning efforts listed in Appendix C would not generate nor significantly reduce emission levels on a scale that would be comparable to emissions generated by burning. Both the Comprehensive Transportation Management Plan for Parklands in Southwest Marin County and the Marin Headlands/Fort Baker Roadway Improvement and Transportation Management Plan are anticipated to include alternatives that would produce a slight reduction in vehicle emissions when fully implemented. This level of reduction in ambient air quality would not significantly reduce the effect of prescribed burning under Alternative A.

Conclusion

The largest source of air emissions is prescribed burning of understory fuels in the Douglas-fir/redwood forest in the Muir Woods FMU. This action is considered critical to the success of the FMP and is proposed as common to all alternatives. Understory burning in Muir Woods was initiated under the 1993 FMP and is the primary element held over from the original fire management plan. Under Alternative A, full implementation of prescribed burning in the Muir Woods FMU represents 96 percent of annual emissions while prescribed burning in 60 acres of grassland and coastal scrub vegetation generates the remaining 4 percent of annual emissions. Muir Woods FMU emissions would be generated in 1 to 3 prescribed burns annually depending on available opportunities for burn days, amount of pre-burn mechanical treatment needed to prepare a site for burning, competing demands on staffing and budgeting, and maintenance of prescription conditions through the burn day. (Changes in weather often result in early termination of burning or unsuccessful combustion when conditions are too wet.) The annual target of 50 acres of understory burning per year in each successive year can be considered as a worst-case scenario for air pollution generation under Alternative A with the exception of the occurrence of a catastrophic wildland fire. The intent of full implementation of Alternative A is to reduce the potential of a large-scale wildland fire and its consequent high levels of air emissions.

Alternative A would have a long-term negligible adverse effect on levels of NOx and SO_2, a long-term minor adverse effect on levels of particulates, and a long-term moderate adverse effect on levels of VOCs. Emission levels can be modified with the application of appropriate strategies from among the mitigation measures in consultation with BAAQMD.

The primary contributor to cumulative impacts in this portion of the air basin would be the full implementation of the approved PRNS FMP. Other similar actions in western Marin produce approximately half of the annual emissions estimated for GGNRA. Full implementation of the PRNS FMP and all other actions could produce more than twice the particulates generated by GGNRA and other sources annually (see Table 4-11). In comparison, a large-scale catastrophic wildland fire, such as the 1995 Vision Fire in Inverness Park in western Marin County, could produce nearly 85 times the amount

of particulates (PM_{10}) as Alternative A and nearly 20 times the particulates generated by cumulative projects shown in Table 4-11 (NPS 2004a)[1].

Mitigating the cumulative impact on air quality is the regulatory authority of BAAQMD. BAAQMD has approval authority over all prescribed burns in the air basin and the authority to reduce emissions by assigning Mitigation Measure AIR-1 to any prescribed burn. The oversight authority of BAAQMD to maintain air quality in conformance with the Clean Air Act would reduce the potential cumulative air quality impact to a long-term cumulative, moderate, adverse effect. By gradually lessening the potential for a large-scale wildland fire to occur with consequent high levels of air emissions, Alternative A would also have a long-term, minor, beneficial, cumulative effect on regional air quality.

Impairment

The effects of this alternative on air quality would not represent an impairment of important park resources or values.

Alternative B

Alternative B places a greater emphasis on mechanical fuel reduction, particularly in the WUI FMU. Alternative B would provide for a total of 230 acres of mechanical fuels treatment each year, primarily in Marin County. Approximately 70 acres of the 230 acres would occur as roadside fuel reduction or mowing along access roads and fire roads. Prescribed burning could occur on 120 acres of parkland each year, including the 50 acres at Muir Woods National Monument proposed for each of the alternatives. Higher permissible levels of mechanical fuel treatment under Alternative B than under Alternative A could result in a slight increase of levels of pile burning.

Mechanical Fuel Reduction

Mechanical fuel reduction would be similar to that under Alternative A and would have a short-term, negligible effect on regional air quality and visibility.

Pile Burning

Emission levels generated by pile burning under Alternative B are shown in Table 4-12. Burning of 100 piles annually could occur in Marin and San Mateo counties in either the Park Interior or the WUI FMU depending on where fuels are treated or fuel breaks are constructed. As under Alternative A, pile burning under Alternative B would have a short-term, negligible-to-minor adverse effect on regional air quality and visibility.

[1] FOFEM modeling for the PRNS FMP EIS estimated that a large-scale wildland fire, similar to the 1995 Vision Fire, could generate approximately 6,801 tons of PM_{10} and 3,395 tons of VOCs (NPS 2004a, page 234).

Table 4-12: Alternative B Annual Cumulative Emissions

Action Type	Acres	Emissions (tons per year)					
		PM_{10}	$PM_{2.5}$	VOC	CO	NOx	SO_2
Total All FMP Projects: Alternative B		**100.6**	**86**	**51**	**1,100.7**	**4.8**	**5.1**
Pile Burning for Community Projects Funded by Wildland-Urban Interface Initiative	25 burn piles	0.03	0.02	0.01	0.3	0	0
Total GGNRA Actions		**100.7**	**86.0**	**51.0**	**1,101.0**	**4.8**	**5.1**
Typical MCFD Annual Actions*	50-acre PB 50 burn piles	36.0	30.8	18.5	405	0.5	1.5
Total of Annual Actions by GGNRA and MCFD		**136.7**	**116.8**	**69.5**	**1,506.0**	**5.3**	**6.6**
PRNS FMP Implementation	Up to 2,000-acre PB	241.3	205	101.3	1,801.7	51.5	NG
Total Cumulative Annual Smoke Emissions		**378.0**	**321.8**	**170.8**	**3,307.7**	**56.8**	**NG**

Source: Kent Julin, Ph. D., County Forester, Marin County Fire Department 2004 and NPS Air Resources Division 2004.

Notes:

* Emissions for Marin County Fire Department (MCFD) actions are meant to be representative of averaged estimated annual accomplishments

PM_{10} = suspended particulate, $PM_{2.5}$ = fine particulate matter, VOC = volatile organic compounds (methane), CO = carbon monoxide, NOx = nitrogen oxides, SO_2 = sulfur dioxide, NG = not given, PB = prescribed burn

Prescribed Burning

FOFEM modeling for Alternative B is based on a mock annual work plan of prescribed fire project sites comprised of 27 acres of grasslands, 28 acres of coastal scrub, and 65 acres of forested understory. In addition to 50 acres in the Muir Woods FMU, the remaining acres of prescribed burning would occur in the Park Interior FMU in Marin County. This total of 120 acres of prescribed burning was modeled with the output of 100 burn piles modeled as nonnative wood debris. No prescribed burning, other than very small-scale research burns, are proposed for San Mateo or San Francisco counties. Table 4-13 shows projected annual and daily emissions for this alternative.

Prescribed burning activity under Alternative B is nearly identical in vegetation type to Alternative A. Unlike Alternative A, all prescribed burning, with the exception of pile burning, would be restricted to the Park Interior FMU away from residential areas. The principal difference for purposes of emissions modeling is an additional 15 acres of understory burning in forested areas under Alternative B. On a per-acre basis, the increase in forested areas under Alternative B produces a higher emission rate than did Alternative A. The greater level of mechanical fuel reduction under Alternative B as compared to Alternative A, with a comparable level of prescribed burning, would allow Alternative B to reduce areas of hazardous fuels in the park more quickly and contribute to decreasing the potential risk of a catastrophic wildfire, with accompanying high levels of air emissions, originating near the parklands.

Table 4-13: Projected Annual and Daily Emissions for Alternative B

ANNUAL EMISSIONS – TONS PER YEAR

Action Type	Area	Emissions (tons per year)					
		PM_{10}	$PM_{2.5}$	VOC	CO	NOx	SO_2
Prescribed Fire: Grassland and Scrub	55 acres	2.8	2.4	0.7	6.0	2.9	0.9
Prescribed Fire: Forested Understory	65 acres	93.0	79.5	48.1	1,050.4	0.8	3.7
Pile Burning	100 burn piles	0.1	0.1	0.1	1.2	0.0	0.0
Annual Emissions From Prescribed Fire		**95.9**	**82**	**48.9**	**1,057.6**	**3.7**	**4.6**
Estimated Annual Occurrence of Wildfire	39 acres	4.7	4.0	2.1	43.1	1.1	0.5
Total All FMP Projects: Alternative B		**100.6**	**86**	**51.0**	**1,100.7**	**4.8**	**5.1**

DAILY EMISSIONS –TONS PER DAY (per burn)

Action Type	Total Acres	Burns per Year	Emissions (tons per day)					
Prescribed burn totals	**120**	**6 burns total**	**PM_{10}**	**$PM_{2.5}$**	**VOC**	**CO**	**NOx**	**SO_2**
Emissions – Typical Prescribed Burn in Grassland	27	1	0.1	0.1	0.0	0.3	0.2	0.1
Emissions – Typical Prescribed Burn in Coastal Scrub	28	2	1.3	1.1	0.3	2.8	1.4	0.4
Emissions – Typical Prescribed Burn in Forested Understory	65	3	31.0	26.5	16.0	350.1	0.3	1.2

Source: NPS Air Resources Division 2004.

Notes:

PM_{10} = suspended particulate, $PM_{2.5}$ = fine particulate matter, VOC = volatile organic compounds (methane), CO = carbon monoxide, NOx = nitrogen oxides, SOx = sulfur dioxide

Alternative B would produce approximately 23 percent more fine particulates than Alternative A (82 tons per year of $PM_{2.5}$ compared to 63.7 tons per year of $PM_{2.5}$, respectively) and would have a long-term, minor adverse effect, as under Alternative A. Emissions could occur at the time of prescribed burning, would be visible locally within the park, and would be dispersed quickly during the course of the day. As under Alternative A, Alternative B would have a short-term, minor, adverse effect on visibility locally during prescribed or pile burning.

Alternative B could contribute higher levels of VOC (as methane) than Alternative A (48.9 tons per year compared to 37.8 tons per year for Alternative A). Contributions of NOx are essentially equivalent under

the two alternatives, though slightly less under Alternative B. As in Alternative A, the level of VOCs generated by Alternative B would have a long-term, moderate adverse effect on air basin air quality. NOx emissions are roughly similar under Alternative B as compared to Alternative A and would have a long-term, minor adverse effect by adding 3.7 tons per year of this ozone precursor to the air basin.

Impacts of prescribed fire activity on the surrounding communities, such as reduced visibility and smoke nuisance effects, would be reduced under Alternative B, as prescribed burning would be restricted to more remote parts of GGNRA, with the exception of proposed burning in the Muir Woods FMU and the potential for a higher level of pile burning permitted throughout all FMUs.

Research

Impacts on air quality from the use of prescribed burning for research purposes are included in the overall assessment of effect of the full 120 acres of prescribed burning permitted annually under Alternative B. There would be no effect on air quality distinct from the effect of the larger prescribed burning program.

Cumulative Impacts

The combined emissions of FMP actions under Alternative B and other GGNRA fire-related emission sources are shown in Table 4-12. As in Alternative A, other GGNRA emission sources include pile burning through Wildland-Urban Interface Initiative grants and emissions generated by wildland fire occurring in the park. With the addition of the typical annual burn program supervised by Marin County Fire Department (MCFD) staff in the county, the emission levels would increase but remain within the moderate intensity threshold. As discussed earlier, the threshold for criteria pollutants that are in attainment in the air basin is considered moderate up to 250 tons per year. The cumulative effect of all GGNRA actions plus the annual MCFD work program would create long-term, moderate, adverse cumulative impacts on $PM_{2.5}$ levels and ozone precursors NOx and VOC.

Annual tonnage of vegetation treated under the cumulative scenario in Alternative B is similar to that in Alternative A by both acreage and fuel type (110 tons in Alternative A and 120 tons in Alternative B of this EIS). As in Alternative A, the NPS concludes that the emissions of CO from prescribed burning that would be generated annually under Alternative B are included in the SIP for CO and that no further conformity analysis is warranted.

When considered in conjunction with the level of prescribed burning assessed in the PRNS FMP FEIS, air quality impacts under Alternative B would be similar to those under Alternative A. The emission levels for PM_{10}, $PM_{2.5}$, and VOC meet and exceed the threshold for a long-term, major, adverse cumulative effect on air basin emissions. The level of NOx emissions would have a long-term, minor adverse cumulative effect on air basin air quality.

As with Alternative A, the oversight of BAAQMD, the requirement to obtain BAAQMD approval for each individual burn plan, and the implementation of Mitigation Measures AIR-1 through AIR-6 to minimize the effects of prescribed burning would reduce the impact of particulates and NOx to a long-term, moderate adverse cumulative effect (see Appendix I).

By gradually lessening the potential for a large-scale wildland fire to occur, Alternative B would have a long-term, minor, beneficial, cumulative effect on regional air quality.

Conclusion

Air quality impacts of Alternative B would be greater than those estimated for Alternative A, as a larger acreage could be treated annually under Alternative B. Though more emissions would be produced annually, the level of effect based on NAAQS status would be essentially the same. The effects of particulate generation would be long-term (annually occurring), minor, and adverse, as under Alternative A. Similar to Alternative A, VOC emissions would be a long-term, moderate, and adverse, and NOx and SO2 emissions would be long-term, negligible, and adverse contributions to air basin air quality. The highest amount of emissions would be produced by one to three prescribed burns in the Muir Woods FMU, which represents approximately 75 percent of the particulate and VOC emissions produced under Alternative B. The full implementation of prescribed burning in Muir Woods is the same under each alternative and, as under Alternative A, the ability to achieve the full 50 acres annually in that FMU would depend on many constraining factors, such as availability and timing of burn days and demands on staff.

The cumulative air quality effects of Alternative B would be very similar to those of Alternative A. Full implementation of the PRNS FMP and all other actions could produce more than twice the particulates generated by GGNRA and other sources annually and would be a long-term, major adverse effect.

Impairment

The effects of this alternative on air quality would not represent an impairment of important park resources or values.

Alternative C

Alternative C provides for a total of 275 acres of mechanical fuels treatment each year. Approximately 70 acres of that treatment would occur as roadside fuel reduction or mowing along access roads and fire roads. Prescribed burning could occur on 320 acres of parkland each year, including the 50 acres in the Muir Woods FMU proposed for each of the alternatives. For purposes of air quality assessment, pile burning is estimated at 100 piles of 64 cubic feet each.

Mechanical Fuel Reduction

Alternative C would allow for a greater amount of mechanical fuel treatment than under Alternatives A and B. Equipment and vehicle use during mechanical fuel reduction projects would have a negligible, short-term, adverse effect on air quality and visibility in the opinion of the NPS Air Resources Division staff.

Pile Burning

Emission levels generated by pile burning under Alternative C are shown in Table 4-14. The same estimate for pile burning is used for Alternative B and Alternative C. As under Alternative A, pile burning under Alternative C would have a short-term, negligible-to-minor adverse effect on regional air quality and visibility.

Table 4-14: Alternative C Annual Cumulative Emissions

Action Type	Acres	Emissions (tons per year)[a]					
		PM_{10}	$PM_{2.5}$	VOC	CO	NOx	SO_2
Total All FMP Projects: Alternative C		**112.8**	**96.2**	**55.7**	**1,178.6**	**11.4**	**7.4**
Pile Burning for Community Projects Funded by Wildland-Urban Interface Initiative	25 burn piles	0.1	0.1	0.1	1.2	0	0
Total GGNRA Actions		**112.9**	**96.3**	**55.8**	**1,179.8**	**11.4**	**7.4**
Typical MCFD Annual Actions*	50-acre PB 50 burn piles	36.0	30.7	18.5	404	0.4	1.5
Total of Annual Actions by GGNRA and MCFD		**148.9**	**127.0**	**74.3**	**1,583.8**	**11.8**	**8.9**
PRNS FMP Implementation	Up to 2,000-acre PB	241.3	205	101.3	1,801.7	51.5	NG
Total Annual Smoke Emissions		**390.2**	**332.0**	**175.6**	**3,385.5**	**63.3**	**NG**

Source: Kent Julin, Ph. D., County Forester, Marin County Fire Department 2004 and NPS Air Resources Division 2004.

Notes:

* Emissions for Marin County Fire Department (MCFD) actions are meant to be representative of averaged estimated annual accomplishments.

PM_{10} = suspended particulate, $PM_{2.5}$ = fine particulate matter, VOC = volatile organic compounds (methane), CO = carbon monoxide, NOx = nitrogen oxides, SO2 = sulfur dioxide, NG = not given, PB = prescribed burns.

Prescribed Burning

Alternative C is based on a representative annual work plan totaling 320 acres of prescribed burning each year, divided among 86 acres of coastal scrub (27 percent of the total), 165 acres of grassland (52 percent), and 69 acres of understory burning in redwood/Douglas-fir forest (22 percent). Understory burning produces very high emission levels compared to prescribed burns in grass or coastal scrub. Table 4-15 shows projected annual and daily emissions for this alternative. Emission levels for fine particulates would be 92.2 tons per year under Alternative C, compared to 63.7 tons per year under Alternative A. Alternative C would therefore produce more fine particulate emissions than Alternative A. Though it could result in more frequent prescribed fires and pile burning, Alternative C would still have a short-term, minor adverse effect on visibility in the local region. VOC emissions would be higher under Alternative C, compared to Alternative A. The increase in the estimated level of NOx would be 10.3 tons per year under Alternative C, compared to 3.8 tons per year under Alternative A. This would be an increase of 63 percent over Alternative A. The increase represented by emissions produced under Alternative C would have a long-term, moderate adverse effect on levels of these ozone precursors and on air basin air quality.

Table 4-15: Projected Annual and Daily Emissions for Alternative C

ANNUAL EMISSIONS – TONS PER YEAR

Action Type	Area	Emissions (tons per year)					
		PM_{10}	$PM_{2.5}$	VOC	CO	NOx	SO_2
Prescribed Fire: Grassland and Scrub	251 acres	9.1	7.7	2.4	19.3	9.5	3.0
Prescribed Fire: Forested Understory	69 acres	98.9	84.4	51.1	1,115.0	0.8	3.9
Pile Burning	100 burn piles	0.1	0.1	0.1	1.2	0.0	0.0
Annual Emissions From Prescribed Fire		**108.1**	**92.2**	**53.6**	**1,135.5**	**10.3**	**6.9**
Estimated Annual Occurrence of Wildfire	39 acres	4.7	4.0	2.1	43.1	1.1	0.5
Total All FMP Projects: Alternative C		**112.8**	**96.2**	**55.7**	**1,178.6**	**11.4**	**7.4**

DAILY EMISSIONS – TONS PER DAY (per burn)

Action Type	Total Acres	Burns Per Year	Emissions (tons per day)					
Prescribed Burn Totals	**320 acres**	**6 burns total**	**PM_{10}**	**$PM_{2.5}$**	**VOC**	**CO**	**NOx**	**SO_2**
Emissions – Typical Grass Prescribed Burn	165	4	0.2	0.2	0.1	0.5	0.2	0.1
Emissions – Typical Scrub Prescribed Burn	86	4	2.0	1.7	0.5	4.3	2.1	0.7
Emissions – Typical Forested Understory Prescribed Burn	69	4	24.7	21.1	12.8	278.8	0.2	1.0

Source: NPS Air Resources Division 2004.

Notes:

PM_{10} = suspended particulate, $PM_{2.5}$ = fine particulate matter, VOC = volatile organic compounds (methane), CO = carbon monoxide, NOx = nitrogen oxides, SOx = sulfur dioxide

Impacts of prescribed fire activity on the surrounding communities could be more widespread under Alternative C and have greater potential for smoke to drift to nearly residential areas, as prescribed burning would be allowed in the WUI FMUs to some degree in both San Mateo and Marin counties. Only 5 acres of prescribed burning would take place in the WUI FMU in San Mateo County.

Research

Impacts on air quality from the use of prescribed burning for research purposes are included in the overall assessment of effect of the full 320 acres of prescribed burning permitted annually under Alternative C. There would be no effect on air quality distinct from the effect of the larger prescribed burning program.

Cumulative Impacts

When considering the cumulative impact scenario under Alternative C, the total annual tons of vegetation treated by prescribed burning would be 20% less than the SIP assumption for these two counties. As a contributor to the cumulative scenario, Alternative C would permit burning of roughly 2,000 tons of woody fuels annually. The majority of the tonnage to be treated annually by prescribed burning under the cumulative scenario can be attributed to the PRNS FMP which proposes a cap of 2,000 acres of prescribed burning annually in contrast to a 320-acre annual cap proposed under Alternative C of this EIS. With tonnage for the cumulative scenario calculated at 20% less than assumed for Marin and San Mateo counties under the SIP, and the probability that PRNS would not achieve 2000 acres per year of prescribed burning, the NPS concludes that prescribed burning emissions from Alternative C are included in the SIP for CO and that no further conformity analysis is warranted.

Cumulative impacts from just the GGNRA fire-related actions under Alternative C (NPS projects, Wildland-Urban Interface Initiative community projects, suppression of wildland fires) would have a long-term, cumulative, moderate, adverse effect on PM_{10} and VOC emissions generation and a long-term moderate, adverse cumulative effect on emissions of ozone precursors, NOx and VOC. This is the same outcome as was determined for Alternatives A and B.

As in Alternatives A and B, when MCFD's annual program is added to GGNRA fire-related actions, the level of cumulative effect on particulate matter is raised to a long-term, moderate and adverse effect, as more than 100 tons per year of $PM_{2.5}$ would be generated from the combined actions. Levels of NOx and VOC would also represent long-term moderate and adverse cumulative effects.

And finally, with the addition of emissions from the PRNS maximum annual program, threshold levels for particulates and NOx would exceed the threshold for a long-term major adverse effect. This impact could be minimized to a level of long-term, moderate adverse effect, as in Alternatives A and B. Mitigation Measures AIR-1 through AIR-6 could be applied and BAAQMD's authority and oversight would ensure that emission levels and the attainment status in the air basin are not compromised by excessive production of emissions through prescribed burning. Strategies to reduce air emissions are listed in Appendix I.

Alternative C follows a more accelerated regimen to reduce high fuel loading as compared to Alternatives A and B. Alternative C would result in a long-term, moderate, beneficial effect on cumulative air quality.

Conclusion

On an annual basis, Alternative C would generate the highest levels of particulate emissions among the three alternatives. This is a result of the greater number of acres treated each year by prescribed burning and the higher percentage of understory burning represented in Alternative C. Depending on the size of the prescribed burn in the forested area, levels of fine particulates generated per burn day would range from approximately 21 to 26.5 tons per burn with roughly three to four understory burns per year. On an annual basis, Alternatives A and B would result in a long-term, minor adverse effect on regional visibility. The impact is considered long-term as the effect would recur annually during the life of the FMP. The Bay Area Air Basin is in attainment for federal standards for particulate matter. Alternatives A

and B would contribute between 50 and 100 tons of additional PM_{10} annually. Alternative C would contribute approximately 110 tons per year of PM_{10}, a level of effect that is considered long-term, moderate, and adverse.

Emissions of NOx and SO_2 generated under the three alternatives would have a long-term, negligible effect.

Alternative C would annually produce the highest amount of the ozone precursor VOC at levels representing a long-term, moderate adverse effect on air basin air quality, as would Alternatives A and B. The effect is determined to be long-term due to the continued annual contribution of the FMP over the life of the planning effort (approximately 15 years). The effect is judged as moderate because the additional emissions of 53.6 tons per year are more than 5 tons per year and less than the conformity *de minimus* levels of 100 tons per year for VOC .

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. Under Alternative B, and more so under Alternative C, fuel reduction efforts would begin to reduce the potential for a catastrophic wildfire to occur near GGNRA lands with resultant high levels of air pollutant emissions. All alternatives would have a long-term, beneficial effect on air quality by reducing this potential for a large fire. Under Alternatives A and B, the effect would be long-term, minor and beneficial; under Alternative C, it would be long-term, moderate and beneficial.

Other FMP actions are considered to have minor or negligible effects or no effect on air quality.

Impairment

The effects of this alternative on air quality would not represent an impairment of important park resources or values.

Impacts on the Biological Environment

Impacts on Vegetation

Analysis

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 on individual plants include direct mortality or physical damage resulting from burning, or from mowing or cutting vegetation for fire line. A plant community-level impact would occur if cutting fire line or prescribed burning led to the establishment or spread of nonnative plants, which could alter plant community species diversity and function. Mitigation such as monitoring and the removal of nonnative plants would limit these effects. This analysis is intended to reflect NPS Management Policies 2001, which states that “All cultural resource and natural resource values will be considered in defining specific treatment and management goals (NPS 2000a).

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 of 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.

Post-fire plant communities, at least for the first few years following the fire, are 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. Seedlings that establish on a burned site are derived from seeds that were dispersed from plants that survived the fire (usually trees), were dispersed onto the site from adjacent unburned areas, were in the soil seed bank that were stimulated to germinate by the fire, or 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, and wind speed. 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 addressing suppression of unplanned wildland fire. These impacts, however, would be less substantial with prescribed fire because fire would be carefully planned to minimize impacts and 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 nonnative plant species. However, in burned areas where a high percentage of trees survive and native understory vegetation resprouts, it can be difficult to determine that a fire has recently occurred.

Actions Common to All Alternatives

Wildland-Urban Interface Initiative

The emphasis of the Wildland-Urban Interface Initiative at GGNRA is to reduce the density of hazardous fuels that create a risk to lives or property on parklands adjacent to the park boundary. Most projects would continue to focus upon the mechanical removal of nonnative and highly flammable eucalyptus and acacia trees and nonnative shrubs (cotoneaster, brooms) from areas where parklands are adjacent to neighboring properties. The removal of these nonnative species would have two primary long-term benefits: reducing the chances for large, high-intensity burns, and promoting or allowing for the reestablishment of more compatible native vegetation close to developments. For example, native species of oak and California bay laurel, which typically inhabit sites where eucalypts have invaded, provide key habitat for wildlife species and patchy year-round shade for the development of diverse and less flammable native plant assemblages, including coastal scrubland and hardwood forests. Mechanical removal activities would remove vegetation, disturb soil and forest litter, and change shade and moisture characteristics through loss of overstory cover. With mitigations, including development and implementation of revegetation and weed efforts in conjunction with Wildland-Urban Interface Initiative projects, these short-term adverse impacts would result in minor long-term beneficial impacts on vegetation.

Defensible Space/Vegetation Clearing Around Structures

The creation of defensible spaces around structures would remove vegetation and disturb soil and litter, with the possibility of increasing cover of nonnative plant species following soil disturbance. However, these species could easily be removed due to their proximity to frequently used areas of the park, and new invasions would be detected early enough to avoid spread into adjacent wildlands. Impacts would be minor to negligible, adverse, and long-term because treatments would need to be repeated.

Roadside Fuel Reduction

Fire road maintenance would remove vegetation adjacent to road edges, creating open and available habitat for the invasion of nonnative plant species. Efforts already underway in the park to mitigate these effects (e.g., minimizing soil and ground litter disturbance by increasing the height of mower blades) have seen some reduction in this predictable incursion of nonnative plant species. A number of studies have shown that roads serve as vectors for intrusion of new nonnative plants, which can “hitch a ride” on passing vehicles, pedestrians, and other fire road users. Therefore, identification of needed fire roads is critical, and downgrading of unnecessary fire roads to trails or complete road obliteration should be a priority for fire management personnel. Annual roadside surveys, an action common to all alternatives, can help detect and stop the spread of new nonnative species. Maintaining fire roads would have greater impacts on vegetation than clearing defensible space around buildings because some portions of fire roads run through interior, relatively intact vegetation communities in the park. Impacts would be minor to moderate, depending on the integrity of the surrounding vegetation; adverse; and long-term because treatments would be repeated.

Suppression

Activities associated with suppression of wildland fire can kill or damage native vegetation. Adverse effects on vegetation can result from fire suppression activities such as construction and use of staging areas, helispots, or spike camps; construction of fire lines using hand tools or bulldozers; cutting of snags; and mop-up. 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 during wildland fire suppression. The impacts of hand line construction in association with managed wildland fire, in conjunction with mitigation measures, would be adverse, short-term, and negligible given the present limited amount of wildland fire that occurs and the relatively limited use of prescribed fire called for in the GGNRA FMP alternatives.

Individual plants and plant communities can be damaged or destroyed when vehicles are traveling to sites or staging areas or when bulldozers are constructing fire lines, creating avenues for nonnative plant establishment through soil disturbance, loss of native vegetation cover, and changes in light and moisture conditions. It is anticipated that in most cases these impacts would occur infrequently. Similar effects could result from removal or trampling of vegetation in temporary staging areas and helispots used for suppression activities. Spills of fuel, oil, hydraulic fluid, antifreeze, and other toxic chemicals at staging areas and helispots could adversely affect vegetation though changes in soil chemistry, hydrophobicity, and water uptake properties, especially if spills occur in wetter environments such as riparian forest and scrub and herbaceous wetland communities. All landing areas will meet the standards outlined in the Interagency Helicopter Operations Guide, and safe landing spots identified in the GGNRA Aviation Management Plan mitigations would be used. These mitigations, in addition to limiting helispot construction and locating helispots away from sensitive resources, would reduce these impacts.

Use of water or retardant drops during suppression activities can have both a direct adverse impact – from the sheer force of the physical impact – and a longer-term chemical impact due to the chemical composition of the materials used. Most fire retardants contain 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 nonnative species that favor higher nutrient levels, or can stimulate unnatural growth spurts during drought-stressed periods of the year (when fires are most common), causing longer-term stress to individual plants. Impacts can be mitigated by avoiding use of retardant or by using “clear” retardant that has minimal active nutrients within the mix. Retardants can cause short-term impacts on the overall health and reproductive ability of some species, although fall and winter rains leach these chemicals out of the system and long-term effects are not detectable.

The proximity of saltwater to most areas of GGNRA means there is a high likelihood for the use of saltwater or brackish bay water during suppression actions. Short-term die-back in annual species can result if salts are concentrated in drainages and swales. Again, these impacts are generally short-term as the annual rains flush salts out of the system. In addition, most vegetation communities in the park are adapted to some salt deposition from fog cover, so overall impacts are negligible from the chemical standpoint, and minor to negligible from the direct impact (force of water/retardant falls) on plants. The advantage of water and retardant drops is that in some circumstances they can take the place of hand lines

("wet-lining") to control fire movement. This tactic results in less physical impact on soils, forest litter, and vegetation than hand line construction.

Personnel at fire camps or on suppression crews have the potential to transport weed seeds with their equipment and tools, which may have long-term adverse impacts on vegetation composition. They also cause trampling and loss of vegetation cover, which could have short- to long-term, negligible, adverse impacts. However, locating spike camps away from sensitive resources such as shrub lands and riparian/wetlands areas would help minimize these impacts.

Hand line construction would remove vegetation and disturb soil and forest litter, leading to soil erosion and loss of native seedbanks and soil structure. In all cases, minimum impact suppression tactics (MIST) would be used to minimize ground disturbance, including use of wet lines and construction of minimal hand lines through the use of mowers to break up fuel continuity and retain vegetation stems on the ground surface (see Appendix G).

Mop-up, or the churning of soil and forest litter to extinguish residual hot spots along the periphery of a fire, would cause additional impacts on soil integrity and the soil seedbank, creating an increased potential for introduction and establishment of nonnative plant species within native plant stands. These actions could also stimulate sprouting of hard-coated seeds including French broom, Scotch broom, cotoneaster, and other species typically found in grasslands, coastal scrub, and the understory of nonnative evergreen forests. Although "flushes" of weedy species would occur after ground-disturbing activities, these actions would also speed up the removal of weed seed in the seedbank, which, in conjunction with ongoing vegetation management of post-fire areas (to prevent sprouted seeds from reaching maturity and gong to seed again), would gradually eliminate these species from the burn area.

The use of a flexible suppression strategy wherever possible can help mitigate potential adverse impacts, as discussed above. Use of indirect fire lines to take advantage of either natural firebreaks (rock outcrops, bodies of water) or roads or otherwise devegetated areas would have a substantial beneficial effect on natural vegetation areas by minimizing ground disturbance through the construction of direct fire lines with hand tools and machinery. This flexible strategy would allow fire personnel to direct wildland fires toward areas of lower fuel loads, such as previously thinned or cleared WUI sites, such that suppression fire lines could be smaller and less intrusive on the landscape. (This is because line width and extent change based on the fuel that the line is being cut through; lines through grass are minimal, whereas control lines through forested areas can be substantial, with large areas of ground disturbance and vegetation loss.) Using this strategy would reduce the level of effect to a negligible-to-minor adverse impact on vegetation, with long-term effects.

Treatment of Muir Woods FMU

Fire actions for Muir Woods FMU would include a mix of prescribed fire, mechanical fuel reduction, and understory thinning projects. Prescribed burning would be conducted to reduce fuel loading and restore vegetation structure and composition to areas with high nonnative plant components, as well as to restore the disturbance role fire plays within the coastal scrub and chaparral, grassland, and redwood/Douglas-fir ecosystem. Burns would range in size from 0.5 to 50 acres annually in a variety of vegetation

communities. Research burns would be conducted to investigate how fire affects the spread and control of the Sudden Oak Death (SOD) pathogen, *Phytophthora ramorum*.

Adverse impacts on vegetation from fire management actions would largely be associated with undesired changes in vegetation composition and structure. This could include introductions or increases in existing nonnative plant species and cover, alterations of vegetation communities to conditions that will not sustain the native species components (such as removal of overstory trees in riparian corridors), and substantially increased fuel loads that could support higher-intensity wildland or prescribed fires. Careful consideration of fire management activities, including adherence to sound prescribed burn prescriptions, review of burn objectives with natural resources staff, and adequate planning and implementation of pre- and post-burn weed treatments, would mitigate these impacts. Fire actions in forest and woodland areas typically produce an initial increase in fuel loads (due to understory mortality), but should not adversely affect long-term vegetation characteristics. The adverse impacts of fire management actions in most cases would be minor and short-term due to the limited areas that would be affected, and negligible with inclusion of all mitigation measures. Long-term beneficial impacts would result from fire actions that restore and enhance native plant communities and vegetation structure.

Fire management activities in nonforested areas (grassland, coastal scrub, and chaparral) would have similar long-term beneficial effects by restoring native plant communities and vegetation structure. Adherence to specific mitigation measures, such as minimizing ground disturbance activities during implementation of fire actions, using carefully designed prescriptions and adhering to those prescriptions, and developing and evaluating specific project objectives, would result in minor-to-major beneficial effects, depending on the condition of the site prior to the action. For example, a prescribed burn implemented in an area with a dominant nonnative grass cover, such as Harding grass, that was converted to native grassland through careful burn implementation would have a major beneficial effect on the park's grassland community. Sites with little to no nonnative component that were maintained at those same levels through fire actions, such as burning in hardwood forest understory areas, would have a minor beneficial effect. Actions that enhance the opportunity for coast redwoods within Muir Woods National Monument to out-compete encroaching Douglas-fir saplings, either through removal of encroaching trees or improved redwood regeneration, would have a moderate beneficial impact with long-term effects.

Fire management actions would have many long-term benefits in Muir Woods National Monument. Reducing the chances for catastrophic fire would prevent the loss of the last contiguous stand of old-growth coast redwood forest in the region, as well as protect portions of the Redwood Creek watershed. Research on fire effects on SOD may lead to ways to control the pathogen and prevent excessive loss of the tan oak understory, which provides cover and acorns for wildlife. Removal of nonnative plants and restoration of natural stand structures and ground litter load would foster the reestablishment of native plant species.

Treatment of San Francisco County Project Area

The fuel reduction strategy for San Francisco lands focuses upon maintaining defensible spaces around buildings (see discussion above) and removing nonnative trees, with small research burns in association

with listed threatened and endangered plant species. These actions would remove vegetation and could disturb soil and litter, possibly increasing the potential for establishment of nonnative plant species. Adverse effects would be long-term and minor.

Public Information and Fire Education Programs

Impacts associated with public information and education would largely be indirect and 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 education efforts can be more controversial since resources are often damaged. However, public information and education could have an indirect positive effect on vegetation. For example, education can be used to enforce a closure of an area to ensure quick habitat recovery or to increase recruitment of stewardship volunteers for revegetation or weeding projects associated with fire management activities.

Fire Cache

Centrally locating the fire cache and management personnel within GGNRA allows for faster response time to wildfires, implying less potential for higher-intensity and larger fires, as well as less intensive suppression activities. The use of existing buildings for the fire cache would avoid impacts on vegetation from construction activities. Fire cache relocation would have indirect, beneficial, long-term effects on vegetation.

Fire Effects Monitoring

There would be some trampling and disturbance effects associated with onsite monitoring of vegetation and fuels, although these would be relatively minor. The timing of monitoring would influence the intensity of these effects. For example, conducting field work during early spring growth when herbaceous species are easily crushed and soils are wet and erodible would have a very localized minor adverse effect. The knowledge gained, however, through monitoring and subsequent data analysis would be beneficial to vegetation. By gaining a better understanding of how fire behaves in different vegetation communities and in different weather and climatic conditions, park fire specialists would be better able to avoid catastrophic fire events and use fire management actions to enhance vegetation structure and composition. Overall, the impacts associates with monitoring fire effects would be minor to moderate, long-term, and beneficial.

Alternative A

Mechanical Fuel Reduction

Approximately 100 acres of vegetation would be mechanically treated under this alternative, reflecting the current level of park practices. Work would continue to be focused on the removal of nonnative, highly flammable vegetation in Marin, San Francisco, and San Mateo counties; the second-growth redwood/Douglas-fir at Muir Woods National Monument; and the grassland and coastal scrub in all three counties, with an emphasis on Marin County. The focus of treatment would be removal of eucalyptus, Monterey pine and cypress, acacia, and other flammable trees along the urban interface, with some

removal of Scotch and French broom to reduce fire hazards and limit the potential spread of these nonnative species through reduction of mature plants. Some mechanical fuel reduction work would take place under this alternative in the second-growth redwood/Douglas-fir FMU to reduce fire hazards and facilitate implementation of prescribed burns. Some soil disturbance would occur during this work due to the use of chipping and hauling equipment, with associated potential for nonnative plant species establishment or spread. Follow-up nonnative plant monitoring and removal would be conducted to remove new recruits that come into the site in years following mechanical treatments.

Coastal Scrub and Chaparral. Under Alternative A, mechanical treatments would be used to remove individual trees and tree patches, and stands of broom. Access to these sites would be along maintained fire roads. Most actions would be done in conjunction with follow-up pile or prescribed burn treatments. Short-term adverse negligible-to-minor impacts could result from these actions due to immediate trampling and soil disturbance impacts. Long-term effects of mechanical treatments on this community would be beneficial because the continuity and ecological integrity of scrub and chaparral would be improved through management of nonnative shrubs and Douglas-fir trees that have encroached into both communities, but the overall effect would be negligible to minor due to the very limited nature of this type of action under Alternative A.

Grasslands. Where Scotch and French broom occur in grasslands, mechanical treatment with hand tools would be used to help control the spread of these species and reduce fire hazards. Overall impacts would be similar to those for the coastal scrub and chaparral vegetation community; short-term adverse negligible-to-minor impacts could result from these actions due to immediate trampling and soil disturbance impacts. Long-term effects of mechanical treatments on this community would be beneficial, but negligible to minor due to the very limited nature of this type of action under Alternative A.

Herbaceous Wetlands. No mechanical treatment would occur within herbaceous wetlands under this alternative, aside from nonnative nonhistoric tree and shrub removal to restore wetland integrity. With mitigations listed in Chapter 2, the effects of these actions would be long-term, minor, and beneficial

Riparian Forest and Scrub. No mechanical treatment would occur within riparian woodland under this alternative, aside from nonnative nonhistoric tree and shrub removal to restore riparian forest and scrub integrity. With mitigations listed in Chapter 2, the effects of these actions would be long-term, minor, and beneficial.

Native Hardwood Forest. No mechanical treatment would occur within native hardwood forests under this alternative, aside from nonnative nonhistoric tree and shrub removal. With mitigations listed in Chapter 2, the effects of these actions would be long-term, minor, and beneficial.

Douglas-Fir and Coast Redwood. Mechanical treatments in this community would focus on removal of understory fuel accumulations, including dead and down trees and shrubs and nonnative shrubs (cotoneaster, brooms). These actions would help reduce the possibility of high-intensity fires facilitated by ample ladder fuels, and would also prepare areas for future prescribed burns. Most mechanical fuel efforts would have follow-up pile burns. Since these actions would potentially occur over larger areas within this community (as opposed to isolated stands in grassland and coastal scrub/chaparral), short-term

impacts would be more obvious, with increased impacts on soils and understory herbaceous vegetation having minor adverse effects. There would be a decrease in nonnative species abundance, with an increased potential for the establishment of native understory plant species more characteristic of these stands, a decreased potential for unnaturally high-intensity burns, and an increased likelihood of restoration of these stands to a more sustainable condition. Long-term impacts would be beneficial and minor.

Nonnative Evergreen Forest. Mechanical treatments under Alternative A would be focused on this plant community throughout the park. Short-term impacts would be adverse due to ground and soil disturbance, but long-term impacts would be beneficial and minor to moderate, depending on the extent of work on an annual basis. Current park operations in this community are focusing on lands in Marin County, and this area would receive the greatest benefit from mechanical treatments for the reasons mentioned above. Follow-up removal of nonnative species would be a necessary mitigation to ensure that these initial efforts are successful in reducing fire hazards, changing overall vegetation structure to less flammable conditions, and restoring sites to appropriate vegetation communities (including coastal scrub, native hardwood forests, and grasslands). Any existing cultural, as well as natural, resource values would be considered in defining specific treatment and management goals for this vegetation type.

Pile Burning

Piles of cut vegetation could be burned following mechanical treatments as a means to reduce fuel loading in an area. These piles would be constructed away from sensitive resources, such as wet areas and sensitive species habitat, to prevent impacts from heat intensity that occur when piles are burned. Piles would be limited in size, and would be burned during seasons when the potential for fire spread and impacts on adjacent native vegetation would be minimal, such as during the fall after the first rains. This timing means live fuel moistures would be increased and rain-induced seed germination or resprouting of senescent perennial plant species would not yet have begun, so impacts would be minimal. Timing as a mitigation to reduce impacts from pile burning can thus ameliorate the direct-burning impacts on soils and vegetation. Pile burns under this alternative would focus only on those plant communities mentioned above in association with mechanical treatments: coastal scrub and chaparral, grasslands, Douglas-fir and coast redwood, and nonnative evergreen forests. Pile burning, with associate applicable mitigations, would result in short-term direct impacts on the underlying soils, with negligible effects. Long-term impacts would be minor and beneficial in that overall vegetation structure and composition would be improved through the removal of nonnative species and the restoration of native species habitat.

Prescribed Burning

The FMUs or plant communities that could be treated with prescribed fire under this alternative are the grassland and coastal scrub, broadleaf evergreen forest, old-growth redwood forest, and second-growth redwood and Douglas-fir. The chaparral FMU would not be treated with prescribed fire under this alternative. As noted in Chapter 2, Alternatives, of this EIS, the primary focus of treatment would be to manage hazardous fuels in strategic locations such as along the wildland urban interface, to mimic the effects of natural fires, and to aid in controlling nonnative plant species including Scotch broom, French broom, eucalyptus, and cotoneaster.

Coastal Scrub and Chaparral. Prescribed fire would be used to continue efforts to reduce the extent and density of nonnative plant species including Scotch broom and French broom, which are common inhabitants of the GNNRA coastal scrub community. Burning would also be used as a follow-up to mechanical treatments for these species and nonnative trees such as eucalyptus and pine within the coastal scrub community.

Control of broom species through fire has been achieved by meeting specific temperatures to kill broom seeds. Heat greater than 150 degrees Celsius (C) for more than two minutes kills the majority of the Scotch broom seeds, and heat greater than 100 degrees C for one minute increases susceptibility of this species to fungal pathogens. Cooler burns have resulted in significantly increased Scotch broom seed germination. French broom seeds are killed when soil temperatures reach 125 degrees C for one minute. Effective control of both species, as proven by multiyear efforts at Point Reyes National Seashore and at Redwood national and state parks in northern California, involves a combination of cutting at the end of the dry season to decrease the rate of resprouting (the plants are stressed due to summer drought conditions), and a later fall burn repeated every other year for several years. This combination of actions removes reproducing broom plants and either kills the seeds or induces seed germination. Follow-up burns (or mechanical removal) kill the newly sprouted plants, preventing new additions of seed into the seedbank. Over time, seeds are either killed or flushed from the soil and adult plants are removed, leading to a gradual shift in species cover to native perennial grasses and forbs.

Repeated burning to manage broom also prevents coastal scrub species such as *Artemisia* and ceanothus from surviving, since the mechanism for removal of broom works equally well on native shrubs. Current practices with prescribed burning in the coastal scrub community are extremely limited, and generally occur in areas that have recently transitioned from grassland to coastal scrub. Therefore, these treatments would have a long-term, minor-to-negligible, adverse impact on coastal scrub, since the scrub extent would be reduced, but the nonnative species component within the grassland-scrub transition would be eliminated over time.

Low-intensity prescribed burns in scrub or chaparral may include isolated, single, nonnative trees or small stands of nonnatives. If the trees are historically significant, they may be limbed up to prevent the spread of fire into the canopy and maintained in the burn unit where a low-intensity fire is anticipated. If nonnative trees are not historically significant, they would be cut before the burn and, if necessary, the stump would be treated with herbicide. Repeat applications of fire would not be needed with subsequent survival of the coastal scrub component. These actions would have long-term minor beneficial effects on the coastal scrub community due to the increase in available habitat for coastal scrub vegetation.

Lack of burning within the chaparral community could have short-term adverse impacts on the fire-adapted plant species within the chaparral, some of which are locally rare. Fire stimulates regeneration, and impedes the continued encroachment of Douglas-fir trees into the chaparral. The continually increasing fuel load in the chaparral along Bolinas Ridge and near Muir Woods National Monument would eventually support a planned or unplanned ignition, and the vegetation within these stands would recover in accordance with their species-specific adaptations. Therefore, the chaparral communities would incur negligible, adverse effects under Alternative A.

Grasslands. Prescribed burns could occur in both Marin and San Mateo county grasslands under Alternative A. In keeping with NPS and GGNRA objectives to reduce the overall extent of nonnative plant species and encourage native plant species under prescribed fire would be used in combination with mechanical treatments and/or herbicides. Dominant nonnative plant species in grasslands include velvet grass, annual wild rye, perennial ryegrass, small fescue, foxtail fescue, erharta grass, and Harding grass. Dominant native grass species include California purple needlegrass, tufted hairgrass, California brome, Pacific reedgrass, California oatgrass, and meadow barley. Many of the native species are either undamaged by prescribed fire or appear to be stimulated by it, either because seeds are buried and remain 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. The nonnative species may or may not be negatively affected by burning. Harding grass, for example, appears to be stimulated by fall burns, but is effectively killed by early spring burning. A recent analysis of monitoring data from the PRNS prescribed burning program did not identify any one strategy that consistently favored native species relative to nonnative species (Twedt 2003). 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 highly invasive purple velvet grass may be increasing its abundance.

Efforts to study the effects of prescribed burns on specific species and grassland communities would continue under this alternative. The effects of prescribed burning on grasslands would be carefully monitored to assess post-burn plant species cover and composition. If monitoring shows undesirable effects, such as an increase in nonnative plant cover or distribution, either the prescription would be changed (e.g., burn during different seasons) or combined with other treatments (such as seeding of native plant species), or other strategies would be tried. All applicable mitigation measures would be applied to these burns, including continued monitoring, adherence to site-specific prescriptions, development and analysis of specific burn objectives, and alteration of prescriptions based on those monitoring results. Prescribed burns in the grassland and coastal scrub communities would result in a long-term negligible-to-minor beneficial impact on the grassland community because of the expected increased extent of grassland species and control of specific nonnative species. Continued studies and adjustment of burn prescriptions could result in moderate beneficial impacts on this community over time.

Herbaceous Wetlands. Herbaceous wetland vegetation grows alongside rivers, streams, and creeks. In GGNRA, herbaceous wetlands would not be treated with prescribed fire, and a suitable buffer would be maintained if fire management activities were to occur in the vicinity of wetlands supporting special status species. The buffer would be created through use of a wet line or other means to avoid use of a scraped hand line, so that impacts on herbaceous wetland species would be avoided.

Riparian Forest and Scrub. Riparian vegetation grows alongside rivers, streams, and creeks. In GGNRA, riparian woodlands and shrublands would not be treated with prescribed fire, and a suitable buffer would be maintained if fire management activities were to occur in the vicinity of riparian areas supporting special status species. The buffer would be created through use of a wet line or other means that avoid use of a scraped hand line, so that direct impacts on riparian species would be avoided.

Native Hardwood Forest. Hardwood forests occur in the broadleaf evergreen forest FMU under Alternative A. Limited prescribed burning could be conducted in small areas supporting hardwood forests, but only where such forest borders grasslands or stands of Scotch or French broom, or where specific research plots are located. Under current park practices (as represented by Alternative A) specific burns within the hardwood forest community are not projected to occur except where these actions would reduce fuel loads or help control nonnative plant species. Mitigations applicable to this vegetation type would include follow-up nonnative plant monitoring and removal, and development of stabilization plans to prevent new recruits following prescribed burning. Therefore, prescribed fire effects on species dominant in hardwood forests would have negligible beneficial long-term impacts on these forests, resulting in improved forest health.

Douglas-Fir and Coast Redwood. This vegetation type occurs in both Marin and San Mateo counties, within the old-growth redwood and second-growth redwood and Douglas-fir FMUs. Numerous prescribed burns have taken place within this vegetation type in Marin County, but none has occurred under the 1993 FMP in San Mateo County. As described in Chapter 3, Affected Environment, of this document, fire can have both beneficial and adverse impacts on this vegetation type depending on season, mitigation measures applied, and follow-up treatments to control invading nonnative plant species. The primary objectives of past burn efforts have been to reduce fuel loads where hazardous accumulations have occurred, and to reintroduce fire as a disturbance process into the redwood forest ecosystem. These general objectives have been successfully met, and actions under Alternative A would continue to improve the overall condition of these forests. The encroachment of Douglas-fir trees into coast redwood-dominated stands would be impeded through prescribed burns, and the overall extent of the coast redwood stands would either remain stable or slightly increase as competition from Douglas-fir trees is reduced.

The only stands of this vegetation type on GGNRA lands in San Mateo County are at the Phleger Estate. These second-growth forests are a mix of both Douglas-fir and coast redwood, with a sub-overstory of old hardwood trees that became established following logging of the site in the late 1800s. This area has never been treated with prescribed burning under the current FMP. Research burns within second-growth stands would contribute to the body of knowledge regarding the effectiveness of using prescribed fire to restore old-growth stand characteristics to second-growth coast redwood forests. Some work has been done in this regard at Big Sur State Park south of Monterey, and park staff would work closely with state park personnel if research actions were proposed for this area.

Prescribed burning would have positive effects on coast redwood forest with the inclusion of applicable mitigations, including adherence to specific prescriptions, development of specific burn objectives and post-fire analysis to determine achievement of objectives, and minimization of ground-disturbing activities during burn site preparation, implementation, and clean-up. Prescribed burning within this vegetation type under Alternative A would have long-term negligible-to-minor beneficial effects due to the limited acreage allotted to burning in San Mateo County and the limited annual burn window.

Research

Research projects would examine the role of fire in enhancing natural resources and the effects of fire on specific natural resources to determine the effectiveness of various treatment strategies. For example, research would continue on Harding grass and Scotch and French broom to help ecologists refine burning prescription parameters to control these species. This could have substantial benefits to the coastal scrub and grassland communities both within the park and regionally where these vegetation-based species continue to expand. Alternative A would allow for additional research or test plots in each of the six FMUs, and specific research questions would be formulated for these other areas. Research into the effects of fire on SOD would potentially help manage this pathogen and reduce its impacts on the native hardwood Douglas-fir and coast redwood forests of the park. The overall impact of research on vegetation communities under Alternative A would be a long-term, negligible benefit.

Cumulative Impacts

Primary among the past actions that have influenced vegetation at GGNRA are fire suppression (especially in areas that were sustained by fire), urban development and loss of habitat continuity, and the establishment and overall dominance of many areas by nonnative plant species.

Suppression of periodic fires has favored fire-intolerant species and nonnative species, and allowed the unnatural buildup of both dead and live fuels. Shrub and grassland habitats are experiencing encroachment by fire-intolerant conifers and nonnative trees. The buildup of fuels, or change in fuel density from grasses- and forbs-dominated communities to tree- and shrub-dominated communities, generally increase the risk of a high-intensity wildfire.

Urban development has also contributed to changes in composition and density of key species. For example, redwood forest is estimated to have covered 1,976, 000 acres 200 years ago. Today, approximately 85,000 acres are left. Four percent of the original old-growth forest remains. In 1986, aerial photo interpretation estimated 1.26 million acres of second growth redwood forest covering 63 percent of the former range. At that time, old-growth redwood was confined to 208,000 acres, of which 54 percent was in public ownership. Nearly 60 percent (53,000 acres) of the old-growth forest in private ownership was harvested in the next 10 years (1986-1996). So in the decade of 1986-1996, 25 percent of the remaining old-growth coast redwood forest was cut. Muir Woods National Monument contains 300 acres of old growth forest (Fox 1996). Analysis of pollen from coast live oak (the dominant tree of the park's hardwood forests) shows 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, perhaps facilitating the spread and effect of the nonnative Sudden Oak Death pathogen. Monterey pine, Monterey cypress, and eucalyptus have all been imported by European-American settlers for lumber or other purposes. Eucalyptus in particular has been a prolific "weed tree" over much of California. Coastal sage scrub is present in about 15 percent of its former habitat, primarily because of agricultural, industrial, and residential development. Grasslands in California have been invaded by nonnative species in part because of the displacement of native tule elk by domestic livestock, the introduction of nonnative plant species adapted to livestock grazing, and the clearing and plowing of land for agriculture. Scotch and French broom are escaped ornamental shrubs brought from Europe, and most of the park's nonnative grasses are imported from

Eurasia. All are highly invasive species that occur in grasslands and coastal scrub in the park, and all are adapted to the area's Mediterranean climate.

Current and reasonably foreseeable future actions positively affecting vegetation in the park are activities such as the Big Lagoon, Redwood Creek, and mission blue butterfly habitat restoration projects. These projects take into account the natural processes of the site and incorporate nonnative plant removal and establishment of native plant communities (through planting and weed removal) into their efforts. Potentially adverse impacts could occur with development projects both within the park and adjacent to park boundaries, including the various transportation plans and trails plans. These efforts will involve ground disturbance activities that could add to or exacerbate existing nonnative plant problems along road and trial corridors. However, ongoing efforts to identify mitigations for these projects, such as pre-project weed control, post-project planting and weeding, and use of weed-free products (soils, fill material, and clean equipment), would reduce the potential for these type of impacts. These projects would have an overall long-term negligible-to-minor beneficial impact on vegetation as a whole.

Conclusion

Limited prescribed burning and mechanical fuel treatments would have negligible-to-minor beneficial long-term impacts on coastal scrub and chaparral communities due to continued work to control nonnative species with increased available habitat for native scrub species. Prescribed burning and research within the native hardwood forests would create a minor beneficial impact in these stands, resulting in improved forest health. Removal of individual nonnative trees would have a localized minor-to-moderate long-term beneficial impact on native vegetation, but these beneficial impacts would only persist if follow-up activities to remove new recruits were carried out after prescribed burning or mechanical treatments. Adverse, minor, short-term impacts could occur as a result of application of fire management activities if other nonnative plant species invade or spread into treated sites. Prescribed burns in grasslands could have negligible-to-beneficial impacts, and more study is necessary to determine the overall effects if this treatment is to be used on a large-scale basis in the park.

The average annual occurrences of wildfires and their suppression could have minor, short-term adverse or beneficial impacts on vegetation. Benefits may result from stimulation of fire-adapted native species, or from the destruction of nonnative plants. Adverse impacts may come from the loss of native species with subsequent establishment of nonnative plant species in newly available habitat, as well as from crushing, removal, or other physical impacts of suppression actions.

Mechanical fuel reduction in Douglas-fir and hardwood forests would result in negligible-to-minor short-term adverse impacts. Minor-to-moderate benefits to coastal scrub and grasslands from the continued removal of Scotch broom and French broom would result from the combination of mechanical and prescribed burning techniques. The continuation of research and wide application of its results would increase these benefits over a wider geographic area. Riparian and wetland areas would be minimally affected under this alternative due to the use of buffers and appropriate mitigation measures.

Overall, the cumulative effects of past, present, and reasonably foreseeable future actions in conjunction with actions called for in this alternative would have long-term negligible-to-minor and adverse effects on vegetation, due to the extent of nonnative plant species dominance in many areas of the park, the lack of

current fire management actions in many areas of the park, and lack of actions focused on nonurban interface areas.

Impairment

Overall, Alternative A would have a short term, minor, adverse effect on vegetation. As the level of intensity of impacts would not exceed moderate, no impairment of vegetation resources would result.

Alternative B

Mechanical Fuel Reduction

Under this alternative, up to 230 acres of vegetation would be mechanically treated on an annual basis. Work would focus on the WUI FMU in Marin, San Francisco, and San Mateo counties, the Muir Woods FMU in Marin County, and the Park Interior FMU. Hazardous fuel reduction treatments would include removal of eucalyptus, Monterey pine and cypress, acacia, and other flammable trees along the urban interface. Scotch and French broom and other nonnative plant species would be removed where they pose a fire hazard. Some soil disturbance would occur during this work due to the use of chipping and hauling equipment, with associated potential for nonnative plant species establishment or spread. Follow-up nonnative plant monitoring and removal would be conducted to remove new recruits that come into the site in years following mechanical treatments.

Coastal Scrub and Chaparral. Treatment of coastal scrub and chaparral areas under Alternative B would focus primarily on those areas where fuel buildups pose a threat to developments, such as adjacent to developments at Sweeney Ridge, Tam Valley, and Stinson Beach. These treatments would generally be within the WUI FMU, although some lower priority sites within the Park Interior FMU could be treated. The overall number of acres to be treated would be more than double the area treated in Alternative A, but the distribution of those treatment actions would be more confined along the wildland urban interface. Access would continue to be via maintained fire roads. Most actions would be done in conjunction with follow-up pile burns. Due to the expanded number of acres that could be treated under this alternative, short-term adverse impacts would increase to minor due to more concentrated trampling and soil disturbance impacts. There would be minimal to no increases in overall habitat continuity and ecological integrity of scrub and chaparral stands due to the focus on interface lands, and an increased likelihood of invasion of nonnative plants into the treated strips along the boundary and road edges, further affecting the overall integrity of these stands. Long-term effects of mechanical treatments on the coastal scrub and chaparral community would be negligible and adverse due to the focus on strips of habitat adjacent to development.

Grasslands. In contrast to Alternative A, the purpose of mechanical treatments under Alternative B would be twofold. A priority would be placed on reducing fire hazards and secondarily on restoring integrity to grassland communities through elimination of nonnative species and management of native encroaching coastal scrub and tree species in some sites. Positive effects resulting from this secondary priority would be limited, since Alternative B would (1) focus on the developed area/urban interface with minimal to no increases in overall habitat continuity and ecological integrity of grasslands, and (2) increase the likelihood of nonnative plant invasions into the treated strips, further affecting the overall integrity of these stands. Therefore, the overall impacts would be similar to that for the coastal scrub and

chaparral vegetation community; short-term adverse minor impacts could result from these actions due to immediate trampling and soil disturbance impacts. Long-term effects of mechanical treatments on grasslands would be negligible and adverse due to the primary focus on the strips of habitat adjacent to development.

Herbaceous Wetlands. Impacts under Alternative B would be the same as under Alternative A.

Riparian Forest and Scrub. Impacts under Alternative B would be the same as under Alternative A.

Native Hardwood Forest. Impacts under Alternative B would be the same as under Alternative A.

Douglas-Fir and Coast Redwood. Mechanical treatments in this community within the WUI and Park Interior FMUs in San Mateo and Marin counties would double from the acreage in Alternative A. (Actions in the Muir Woods FMU are described in the "Actions Common to All Alternatives" discussion above.) There would be an increased focus on removal of understory fuel accumulations including dead and down trees and shrubs and nonnative shrubs (cotoneaster, brooms). These treatments would further reduce the possibility of high-intensity fires facilitated by existing ladder fuel conditions, and most of these mechanical fuel efforts would have follow-up pile burn treatments, further reducing hazards to adjacent developments and to the vegetation itself. Under Alternative B, no prescribed burning would occur in San Mateo County, and mechanical treatments would be the sole means by which vegetation structure within this community is restored and maintained over time. Short-term impacts would be more obvious than within the grassland and coastal scrub/chaparral communities due to the size of equipment used to remove the cut fuel and litter, with increased impacts on soils and understory herbaceous vegetation, resulting in minor adverse effects. Over the long term, the proportion of nonnative species would remain the same due to ongoing mechanical disturbances. There would be a decreased potential for high-intensity burns, and a low but slightly increased potential for restoration of these stands to a more sustainable condition when done in conjunction with mitigation measures. Long-term impacts would be beneficial and negligible to minor.

Nonnative Evergreen Forest. As with Alternative A, mechanical treatments under Alternative B would be focused on this plant community throughout the park, although priority staffing and funding would be in stands adjacent to developed areas, with a lower priority placed on stands isolated within the Park Interior FMU. As a result, restoration of these sites to native vegetation communities (including coastal scrub, native hardwood forests, and grasslands) would be less likely under this alternative, since the native communities could harbor undesirable fuel loads that would have to be managed as well. The use of a phased implementation plan to piece together restored patches could, however, eventually create long-term benefits. Short-term impacts would be minor to moderate and adverse due to ground and soil disturbance, but long-term impacts would be beneficial and negligible to minor, depending on the extent of work on an annual basis, use of mitigation measures, and adherence to an overall phased implementation and site stabilization plan.

Pile Burning

Piles of cut vegetation could be burned following mechanical treatments, and the overall strategy, implementation, mitigations, and effects would be the same as in Alternative A. These piles would be

constructed away from sensitive resources – wet areas, sensitive species habitat, etc. – to prevent impacts from the concentrated heat effects that occur when piles are burned. Piles would be limited in size, and would be burned during seasons when the potential for fire spread and impacts on adjacent native vegetation would be minimal, such as during the fall after the first rains. Pile burns under Alternative B would increase substantially from the number called for under Alternative A, in association with increased mechanical treatments under Alternative B. Pile burning, with applicable mitigations, would result in short-term direct impacts on the underlying soils, with negligible effects. Long-term impacts would be minor and beneficial (same as Alternative A) in that overall vegetation structure and composition would be improved through the removal of nonnative species and the restoration of native species habitat.

Prescribed Burning

The areas that could be treated with prescribed fire under Alternative B are limited to the Park Interior and Muir Woods FMUs in Marin County. The Muir Woods FMU treatments and impacts are described above in the "Actions Common to All Alternatives" section above. Compared to Alternative A estimates (see Table 2-4 in Chapter 2), prescribed burn acres within the Park Interior FMU would increase slightly, with potential actions in the coastal scrub and chaparral, grasslands, native hardwood forest, and Douglas-fir and coast redwood communities. As noted above, the primary focus of prescribed burn treatments would be to manage hazardous fuels in strategic locations closer to the WUI FMU, and adjacent to developments within the park interior areas.

Coastal Scrub and Chaparral. Prescribed fire would be used to reduce fuel buildups and restore and maintain the integrity and continuity of the coastal scrub and chaparral communities in Marin County. There would be a continued effort to reduce the extent and density of nonnative plant species through follow-up to mechanical treatments for Scotch and French broom and nonnative trees, using strategies and mitigations similar to those outlined in Alternative A. Burning would be conducted to manage broom buildup and control the rapid spread of native shrub species into adjacent grasslands. The scrub extent and the nonnative species component within the grassland-scrub transition would be reduced over time. Individual nonnative, historically significant trees or small groves may be included in the burn unit though limbed up to protect the canopy and prevent tree mortality. Alternative B, unlike Alternative A, would allow burning within the limited chaparral community in Marin County. This could have short-term moderate-to-major beneficial impacts on the fire-adapted species within the chaparral if burns were implemented to best meet the regeneration requirements of these species. Since the continually increasing fuel load within the chaparral stands along Bolinas Ridge and near Muir Woods would eventually support a planned or unplanned ignition, and the vegetation within these stands would recover according to their species-specific adaptations, the long-term impacts of allowing prescribed burns would have a minor beneficial impact on chaparral. Overall, the actions proposed under Alternative B would have long-term minor beneficial effects on coastal scrub and chaparral communities in Marin County, but restrictions on prescribed burning in San Mateo County under Alternative B would result in long-term negligible benefits parkwide.

Grasslands. Prescribed burns could occur only in the Marin County grasslands in Alternative B. Therefore, isolated stands of native perennial grasses – such as purple needlegrass – in San Mateo County

would continue to be affected by encroaching native coastal scrub species and nonnative shrubs, forbs, and grasses. Nonnative patches of Harding and African rice grasses would either remain untreated or would require treatment with mechanical or chemical methods, with associated impacts on soils and adjacent native species. Efforts to study the effects of prescribed burns on specific species and grassland communities in Marin County would continue, however, and would ideally be applied to future planning efforts more inclusive of the park's grassland ecosystems at Sweeney and Milagra Ridges. All applicable mitigation measures would be applied to these burns, including continued monitoring, adherence to site-specific prescriptions, development and analysis of specific burn objectives, and alteration of prescriptions based on those monitoring results. Prescribed burn actions in the grassland community would result in a long-term negligible beneficial impact because of the increased extent of grassland species and control of specific nonnative species in Marin County. Continued studies and adjustment of burn prescriptions could result in moderate beneficial long-term impacts on this community in later years.

Herbaceous Wetlands. Impacts under Alternative B would be the same as under Alternative A.

Riparian Forest and Scrub. Impacts under Alternative B would be the same as under Alternative A.

Native Hardwood Forest. Hardwood forests in the Marin County Park Interior FMU would receive limited prescribed burning under Alternative B. These actions would occur only where such forests border developed or wildland urban interface areas and where these actions would reduce fuel loads or help control nonnative plant species, or within the Muir Woods FMU discussed above. Prescribed fire effects on the native hardwood forests under Alternative B would have negligible beneficial long-term impacts on these forests due to the limited potential extent of area to be treated.

Douglas-fir and Coast Redwood. Although this vegetation type occurs in both Marin and San Mateo counties, only stands in Marin County would be treated under Alternative B. Extant stands at the Phleger Estate would continue to grow without the benefits of understory clearing and forest litter recycling that occurs with prescribed fires. Prescribed burn implementation in the Muir Woods FMU is described in the "Actions Common to All Alternatives" section above. Remaining stands in Marin County outside of Muir Woods would experience long-term negligible-to-minor beneficial effects due to the limited nature of the areas available for burning, their relative isolation and lack of overall habitat continuity, and lower priority for treatment based on the development focus of this alternative. Overall, the impacts would be minor and adverse for this community parkwide, due to the exclusion of stands in San Mateo County.

Research

As under Alternative A, research projects would examine the role of fire in enhancing natural resources and the effects of fire on key natural resources to determine the effectiveness of various treatments. For example, research burns on Harding grass and Scotch and French broom would continue helping ecologists refine burning prescription parameters to control these species and creating the potential for substantial benefits to the park's native coastal scrub and grassland communities. Research into the effects of fire on SOD could potentially help manage this nonnative pathogen and reduce its impacts on bays and tan oaks in the native hardwood Douglas-fir and coast redwood forests of the park. Alternative B only allows for burning within Marin County in the Park Interior and Muir Woods FMUs, and in San Francisco for specific objectives of recovery plans for listed threatened or endangered plant species,

limiting applicable research questions. The overall impacts of research on vegetation communities under Alternative B would be long-term and minor benefits.

Cumulative Impacts

Vegetation at GGNRA has been affected by past fire suppression actions, urban development and loss of habitat continuity, and the establishment and overall dominance of many areas by nonnative plant species. Current and reasonably foreseeable future actions positively affecting vegetation in the park are activities such as the Big Lagoon, Redwood Creek, and mission blue butterfly habitat restoration projects. These projects take into account the natural processes of these sites and are incorporating nonnative plant removal and reestablishment of native plant communities into the project objectives. Potentially adverse impacts could occur with development projects both within the park and adjacent to park boundaries, since they involve ground disturbance activities that could add to or exacerbate existing nonnative plant problems along road and trial corridors. However, ongoing efforts to mitigate these impacts through pre-project weed control, post-project planting and weeding, and use of weed-free products (soils, fill material, and clean equipment) would reduce negative impacts.

Conclusion

As with Alternative A, unplanned wildfires and their suppression could have minor, short-term adverse or beneficial impacts on vegetation. Benefits may result from stimulation of fire-adapted native species or from the destruction of nonnatives. Adverse impacts would result from the loss of native species with subsequent invasion by nonnative species, as well as from crushing, removal, or other physical impacts of suppression actions.

The increased mechanical fuel treatments (and associated pile burning) that would occur with Alternative B would have negligible-to-minor beneficial long-term impacts on the affected vegetation communities overall, as compared to Alternative A. Beneficial effects would be minimized due to the focus of this alternative on developed and wildland urban interface areas, with the potential for creating “strips” of treated vegetation rather than larger, continuous, ecologically sustainable stands, particularly within the coastal scrub and grassland communities. In the forest communities, the long-term proportion of nonnative species would remain the same due to ongoing mechanical disturbances. There would be a decreased potential for unnaturally high-intensity wildland fire, and a low but slightly increased potential for restoration of these stands to more sustainable conditions. Long-term impacts would be beneficial and negligible to minor.

The prescribed burn actions proposed under Alternative B would have long-term minor beneficial effects on coastal scrub, chaparral, and grassland communities in Marin County. Prescribed fire effects on the native hardwood forests under Alternative B would have negligible beneficial long-term impacts on these forests due to the limited potential extent of area to be treated. Continued studies and research, along with adjustment of burn prescriptions, could result in moderate beneficial long-term impacts in later years and would increase these benefits over a wider geographic area. Riparian and wetland areas would be minimally affected under this alternative due to the use of buffers and appropriate mitigation measures. However, the restrictions on using prescribed fire within the WUI FMU or in San Mateo County under

this alternative would minimize long-term benefits, since larger-scale restoration of continuous stands of native vegetation would not be achieved.

Overall, the cumulative effects of past, present, and reasonably foreseeable future actions in conjunction with actions called for under Alternative B would have long-term negligible-to-minor and adverse effects on vegetation, due to the extent of nonnative plant species dominance in many areas of the park, restrictions on fire management actions in many areas of the park (San Mateo County and the WUI FMU for prescribed burning), and more limited geographic extent as compared to Alternative A, with the primary focus on areas with the highest fire risk and limited integration of natural and cultural resource objectives.

Impairment

Overall impacts of Alternative B on vegetation would be slightly adverse. No impairment of vegetation would result.

Alternative C

Mechanical Fuel Reduction

Under this alternative, up to 275 acres of vegetation would be mechanically treated annually. Work would continue, as with Alternative B, in the WUI FMU in Marin, San Francisco, and San Mateo counties, in the Muir Woods FMU in Marin County, and in Marin and San Mateo counties within the Park Interior FMU. Work in the Park Interior FMU would be nearly double that allowed under Alternative B. Hazardous fuel reduction treatments would again include removal of eucalyptus, Monterey pine and cypress, acacia, and other potentially flammable trees along the urban interface, as well as removal of fuel loads threatening the integrity of vegetation or landscapes in more remote areas of the park. Scotch and French broom and other nonnative plant species would be removed. Some soil disturbance would occur during this work due to the use of chipping and hauling equipment, with associated potential for nonnative plant species establishment or spread. Follow-up nonnative plant monitoring would occur on a regular basis with removal of new recruits that come into the site in years following mechanical treatments.

Coastal Scrub and Chaparral. Treatment of coastal scrub and chaparral areas under Alternative C would spread the work effort out to areas where fuel buildups pose both a threat to developments and to the vegetation character of the site (such as from catastrophic fire events or crowding out of native species). The overall number of acres to be treated would be more than double the area treated in Alternative A, and the distribution of those treatment actions would be roughly two-thirds in the WUI FMU and one-third in the Park Interior FMU. Access would continue to be via maintained fire roads. Most actions would be done in conjunction with follow-up pile burns. Under Alternative C, short-term adverse impacts would remain minor (same as Alternative B) due to concentrated trampling and soil disturbance. In setting priorities for and carrying out treatment efforts, however, emphasis would be more on ecosystem health than simply fire hazard abatement, with a focus away from the development strip treatments of Alternative B. This increased opportunity for mechanical treatment (by increasing the number of acres that could be treated annually) and subsequent restoration of habitat continuity and integrity would result in long-term minor beneficial impacts on larger scrub and chaparral stands.

Grasslands. As with Alternative B, mechanical treatments in grassland would be focused on both reducing fire hazards and restoring grassland integrity through the removal of nonnative plant species including Scotch and French broom. The increased opportunities for treating large patches of vegetation under Alternative C would result in short-term adverse negligible to minor impacts from trampling and soil disturbance, with long-term minor-to-moderate beneficial effects.

Herbaceous Wetlands. Impacts under Alternative C would be the same as under Alternative A.

Riparian Forest and Scrub. Impacts under Alternative C would be the same as under Alternative A.

Native Hardwood Forest. Impacts under Alternative C would be the same as under Alternative A.

Douglas-Fir and Coast Redwood. As with Alternative B, mechanical fuel treatments would occur within the Douglas-fir and coast redwood stands with a continued focus on removal of understory fuel accumulations, including dead and down trees and shrubs and nonnative shrubs (cotoneaster, brooms). These treatments, paired with follow-up pile burns and the potential implementation of prescribed burns in both Marin and San Mateo counties, would increase the potential for (1) restoration of sustainable forest structure and integrity, (2) minimal nonnative plant species components, and (3) establishment of native understory plant species more characteristic of these stands. Short-term adverse impacts would be negligible to minor due to site disturbance and soil impacts. Long-term impacts on these stands parkwide, however, would be beneficial and minor to moderate, due to the increased availability of all treatment options.

Nonnative Evergreen Forest. As with Alternative A, mechanical treatments under Alternative C would occur in this plant community throughout the park. The focus of efforts under this alternative, however, would be spread out to cover both those stands adjacent to developed areas as well as treatments within isolated stands in the Park Interior FMU. As a result, restoration of these sites to appropriate self-sustaining native vegetation communities (including coastal scrub, native hardwood forests, and grasslands) would be more likely under this alternative than under either Alternatives A or B. The larger number of acres of allowable treatment under this alternative would speed up overall restoration efforts, which would result in greater short-term minor-to-moderate adverse impacts due to ground and soil disturbance. Long-term impacts would be beneficial and minor to moderate since this alternative would allow for consistent treatment of these nonnative stands over the lifetime of the FMP, taking into consideration both natural and cultural resource values.

Pile Burning

Piles of cut vegetation could be burned following mechanical treatments, and the overall strategy, implementation, mitigations, and effects would be the same as in Alternative A. These piles would be constructed away from sensitive resources – wet areas, sensitive species habitat, etc. – to prevent impacts from the concentrated heat effects that occur when piles are burned.

Piles would be limited in size, and would be burned during seasons when the potential for fire spread and impacts on adjacent native vegetation would be minimal, such as during the fall after the first rains. Due to increased mechanical treatments, pile burns under Alternative C would increase substantially from the

number called for under Alternatives A or B. Pile burning, with applicable mitigations, would result in short-term direct impacts on the underlying soils, with negligible effects. Long-term impacts would be minor-to-moderate and beneficial in that larger vegetated areas would be improved through the removal of nonnative species and the restoration of vegetation continuity and native species habitat.

Prescribed Burning

The areas that could be treated with prescribed fire under Alternative C would include all areas and FMUs of the park except San Francisco, and the number of potential acres that could be treated annually would be substantially higher than under the other alternatives. (The Muir Woods FMU treatments and impacts are described above in the "Actions Common to All Alternatives" section.) The opportunity for conducting small-scale research burns and studies within the WUI FMU, in conjunction with larger broadcast burns in the Park Interior FMU, would help create a more seamless blend of management strategies across vegetation types rather than along management zone boundaries. Potential prescribed burn actions would occur in the coastal scrub and chaparral, grassland, native hardwood forest, and Douglas-fir and coast redwood communities.

Coastal Scrub and Chaparral. Prescribed fire would be used to manage coastal scrub and chaparral communities within both Marin and San Mateo counties. There would be an increased effort to reduce the extent and density of nonnative plant species, where possible, through a combination of management actions including burning. For example, mechanical treatments for Scotch and French broom and nonnative tree removal could be followed up with broadcast burns, where appropriate, using strategies and mitigations similar to those outlined for Alternatives A and B. Alternative C would also allow burning within the park's small chaparral stands, with short-term moderate-to-major beneficial impacts on the fire-dependent species. The broader flexibility of treatment options (size, location, and extent), and the dual focus of treatment rationale under Alternative C would result in long-term moderate beneficial effects within the coastal scrub and chaparral communities parkwide.

Grasslands. Prescribed burns could occur on grasslands in both Marin and San Mateo counties under Alternative C, and the actions and approaches would be similar to the actions described for Alternative A. The larger number of total acres of annual burning under Alternative C would translate to the potential for increased acres of grassland treatments under this alternative, as compared to Alternative A, with the potential for larger gains in nonnative plant species control and eradication, removal of encroaching scrub species, retention of larger intact stands of grassland unconfined by the FMU boundary restrictions of Alternative B, and an opportunity to conduct additional research to answer species-specific or habitat-specific restoration questions. The overall effects of Alternative C on grasslands within the park would therefore be long-term, beneficial, and moderate to major.

Herbaceous Wetlands. Impacts would be the same as under Alternative A.

Riparian Forest and Scrub. Impacts would be the same as under Alternative A.

Native Hardwood Forest. The park's native hardwood forests, which are found throughout the park in the WUI, Park Interior, and Muir Woods FMUs, could be treated through a combination of actions under Alternative C. Specific burns could occur with objectives to restore forest structure and integrity through

the removal of nonnative species, unnaturally high fuel loads, and restoration of fire as a process within the forest understory. In contrast to Alternative A, these actions would not be restricted to areas of hardwood forest adjacent to broom stands or grasslands, and would therefore offer the potential to create a richer mosaic of vegetation communities transitioning from Douglas-fir and redwood forests at more mesic sites to coastal scrub and grassland ecotones at drier sites. The opportunity to use a broader range of management actions within this community and apply those actions to more areas of the park would have long-term minor-to-moderate beneficial impacts on these forests.

Douglas-fir and Coast Redwood. The inclusion of prescribed burning as an option for treatment and management of the Douglas-fir and coast redwood stands in San Mateo County, in addition to those in Marin County, would increase the ecological integrity of this limited community in the park. (Prescribed burn implementation in the Muir Woods FMU is described in the "Actions Common to All Alternatives" section above.) Extant stands at the Phleger Estate would benefit from phased implementation of burns to clear understory fuels, recycle forest litter, and restore or create natural stand structure. The overall impacts of Alternative C would be long-term, minor to moderate, and beneficial.

Research

As with Alternatives A and B, research burns would examine the role of fire in enhancing natural resources and the effects of fire on key natural resources to determine the effectiveness of various treatments. Research on a variety of nonnative species would continue, helping ecologists refine burning prescription parameters that could help control these species. Research could also be conducted throughout the park to investigate the effects of fire treatments on the SOD pathogen, with possible reductions in SOD's impacts on the native hardwood, Douglas-fir, and coast redwood forests of the park. Research opportunities under this alternative would include the WUI FMU, with the potential for investigation, for example, into the effects of buildup (and control of) native soil pathogens on special status species that occur within this management unit, and small research burns in San Francisco in support of federally listed threatened and endangered species. The overall impacts of research on vegetation communities under Alternative C would be long-term, beneficial, and minor.

Cumulative Impacts

The vegetation at GGNRA has been affected by past fire suppression actions, urban development and loss of habitat continuity, and the establishment and overall dominance in many areas by nonnative plant species. Current and reasonably foreseeable future actions positively affecting vegetation in the park are activities such as the Big Lagoon, Redwood Creek, and mission blue butterfly habitat restoration projects, as well as ongoing park operations of the Habitat Restoration Team and Site Stewardship Program. These projects and programs take into account the natural processes of treated sites and incorporate nonnative plant removal and reestablishment of native plant communities into site objectives. Potentially adverse impacts could occur with development projects both within the park and adjacent to park boundaries, since they involve ground disturbance activities that could add to or exacerbate existing nonnative plant problems along road and trial corridors. However, ongoing efforts to mitigate these impacts through pre-project weed control, post-project planting and weeding, and use of weed-free products (soils, fill material, and clean equipment) would reduce negative impacts. The overall cumulative impact on

vegetation with past, present, and reasonably foreseeable future actions both in and adjacent to the park would be minor, long-term, and beneficial.

Conclusion

Unplanned wildfires and associated suppression activities would have minor, short-term adverse or beneficial impacts on vegetation, depending on the vegetation community in which the fire occurred, the timing of the event, and the immediate and long-term impact mitigation measures applied to the site.

The substantially increased potential for mechanical fuel treatments (and associated pile burning) that would occur with Alternative C (as compared to Alternatives A or B) would have minor beneficial long-term impacts on the affected vegetation communities overall. These beneficial effects would be applied to all areas of the park as appropriate, and would integrate both natural and cultural resource values into management of the vegetation, rather than focusing simply on the developed and wildland urban interface areas of the park. In the forest communities, there would be a decreased potential for unnaturally high-intensity burns, and a moderately increased potential for restoration of these stands to more sustainable conditions. Long-term impacts would be beneficial and minor.

The prescribed burn actions proposed in Alternative C, in conjunction with mechanical and pile burn treatments, would have long-term minor-to-moderate beneficial effects on the coastal scrub, chaparral, and grassland communities. There would be a greater potential for creation and maintenance of continuous ecologically sustainable stands, and an increased opportunity for larger-scale restoration of continuous stands of native vegetation. Prescribed fire actions on the native hardwood forests in Alternative C would increase the potential to create a richer mosaic of vegetation communities. The opportunity to use a broader range of management actions within this community, and apply those actions to more areas of the park would have long-term minor-to-moderate beneficial impacts on these forests. Continued studies and research, along with adjustment of burn prescriptions, would result in moderate beneficial long-term impacts throughout the park in all affected vegetation communities. As in Alternatives A and B, riparian and wetland areas would be minimally affected under this alternative due to the use of buffers and appropriate mitigation measures.

Overall, the cumulative effects of past, present, and reasonably foreseeable future actions in conjunction with actions called for under Alternative C would have long-term minor-to-moderate beneficial effects on vegetation.

Impairment

The overall impacts of Alternative C on vegetation would be beneficial and would not result in impairment of vegetation.

Impacts on Wetlands

Analysis

The major adverse impacts of fire management activities on wetlands include sedimentation, hydrological alteration, soil compaction, disturbance of vegetation, and contamination by saltwater, herbicides, or fire

retardant. Beneficial impacts of fire on wetlands include the continuation of natural processes as well as the eradication of nonnative species.

Sedimentation can occur when fire activities upslope of the wetland result in erosion. Excess sediment levels in a wetland can adversely affect the wetland by altering the hydrology and in turn the vegetation composition. These effects could be major and permanent depending on the percentage of the wetland that is affected.

Increased runoff from compacted or hydrophobic soils upstream could affect wetland hydrology by causing scour or forming new drainage channels that deplete the site of water. This may lead to a change in the hydrology, soils, and vegetation of the site that could be both major and permanent.

Soil compaction requires special consideration in wetlands, since wetlands have wetter soils year-round. Fire management activities such as cutting hand line or dozer line in wetlands can be very destructive if conducted when soils are wet. Soil compaction could lead to a change in the hydrology of the site, but would likely affect only a portion of the site and thus be considered moderate in intensity.

Wetland vegetation can be affected by burning or vegetation removal activities. A certain degree of burning through a wetland could be beneficial, since wetlands are included in a landscape that has evolved with fire. Research described by the Point Reyes National Seashore (PRNS) FMP (2004) suggests 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. However, high-intensity impacts such as an uncontrolled fire or disruptive fire lines through a wetland could make the area more susceptible to invasion by nonnative plants.

Impacts from fire management actions could also occur during fire suppression from aerial drops of saltwater into freshwater wetlands or the use of foam or wetting agents. These could have the effect of killing salt-intolerant plants or smothering vegetation with fire retardant. These effects would likely be short-term and minor, except if the area is subsequently invaded by nonnative species that present a long-term threat to native vegetation.

Actions Common to All Alternatives

Wildland-Urban Interface Initiative

The cooperative Wildland-Urban Interface Initiative would continue under all the alternatives, and would consist of reducing fuels along the park boundary. Mechanical removal of trees and brush in the upper reaches of the watersheds could create soil compaction and erosion that increase surface flow and sedimentation in the lower-lying wetlands. These effects would be localized and minor, and with the applicable mitigation measures listed in Chapter 2 would be negligible.

Defensible Space/Vegetation Clearing Around Structures

Mechanical removal of trees and brush throughout the watersheds could create soil compaction and erosion that increase surface flow and sedimentation in the lower-lying wetlands. These effects would be localized and minor, and with the applicable mitigation measures listed in Chapter 2 would be negligible.

Roadside Fuel Reduction

Maintenance or upgrading of fire roads could create ground disturbance and runoff and cause a sedimentation problem in wetlands. However, many fire roads in the park are currently in substandard condition, and maintenance activities and drainage improvements could actually correct a current problem. With current best management practices (BMPs) for the maintenance of fire roads and trails incorporated, these activities would have a beneficial, long-term, and minor effect on wetlands.

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 (see discussion under "Impacts on Vegetation" above). Due to increased moisture levels often present in wetlands, however, such impacts can be more severe.

GGNRA has had an average of 8 unplanned fires annually, with each fire generally burning less than 5 acres. 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 nonnative 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 nonnative 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 can involve clearing all vegetation within an 18- to 24-inch-wide swath down to bare mineral soil. In emergency situations, bulldozers can be used to create fuel breaks to stop wildfire. Vegetation clearing can disturb wetland soils as well as create conditions that are favorable for the establishment of nonnative plant species.

Aerial drops of water or retardant are means of releasing liquids onto burning or unburned areas. 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 on areas if nonnative plants become established or spread.

These effects on wetlands would be minor, short-term, and adverse. However, if the applicable mitigation measures listed in Chapter 2 are applied during or following suppression, the wetland could receive a beneficial, long-term, and minor effect from the wildland fire.

Treatment of Muir Woods FMU

Prescribed fire, mechanical thinning, and understory thinning would occur in Muir Woods FMU in all the alternatives. These projects could affect wetlands adjacent to Redwood Creek through sedimentation, compaction, and disturbance of vegetation. This would create an adverse, short-term minor effect. However, prescribed burning could have a beneficial impact on wetlands by maintaining the natural processes of the watershed. Likewise, mechanical removal of nonnative species such as French broom would prevent encroachment of these species into wetlands.

If the applicable mitigation measures listed in Chapter 2 are followed for actions at Muir Woods FMU, there would be beneficial, long-term, minor impacts on the wetlands.

Treatment of San Francisco County Project Area

Fire management activities in San Francisco lands would consist only of mechanical treatment and small research burns for implementation of Recovery Plan objectives for federally listed plant 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 roads or to remove nonnative vegetation, a buffer would be maintained around wetland areas where fire management activities would be restricted. Staging and vehicle use would occur outside of the buffer area, and nonnative vegetation removal would occur under tightly controlled conditions. Any impacts that occur in the buffer area must be correctable by site-specific actions, and must be confined to short-term, minor (or less), adverse effects. In many cases, clearing of dense nonnative vegetation could result in increased growth or establishment of native wetland species by creating gaps or openings in canopy cover. These impacts would be considered beneficial, minor, and long-term.

Unplanned fires in San Francisco would be suppressed immediately. Fire suppression activities, as described above, could have adverse, short-term, minor effects on wetlands.

With the applicable mitigation measures listed in Chapter 2, fuel reduction measures in San Francisco lands would result in beneficial, minor, and long-term effects on wetlands.

Public Information and Fire Education Programs

The public information and education program would have no beneficial or adverse effects on wetlands.

Fire Cache

Fire cache relocation would have no beneficial or adverse effects on wetlands.

Fire Effects Monitoring

The fire effects monitoring program excludes wetlands from analysis since these habitats are not targeted for treatment with prescribed fire. Therefore, negligible impacts on wetlands would occur with continued implementation of this program.

Alternative A

Mechanical Fuel Reduction

Alternative A allows for a maximum of 100 acres of mechanical treatments throughout the park. Mechanical treatment would be focused near structures or high-value areas, largely through the Wildland-Urban Interface Initiative. Mechanical treatments would avoid wetland areas to the greatest extent possible to minimize adverse impacts on soils, hydrology, and vegetation. If such treatments in wetlands were deemed necessary to ensure fire safety around structures or roads or to remove nonnative vegetation, a buffer would be maintained around wetland areas where fire management activities would be restricted. Staging and vehicle use would occur outside of the buffer area, and nonnative vegetation removal would occur under tightly controlled conditions. Any impacts on wetland soils, hydrology, or vegetation that

occur in the buffer area must be correctable by site-specific actions, and must be confined to short-term, minor (or less), adverse effects. In many cases, clearing of dense nonnative vegetation could result in increased growth or establishment of native wetland species by creating gaps or openings in canopy cover. These impacts would be considered beneficial, minor, and long-term.

With the applicable mitigation measures listed in Chapter 2, the impacts on wetlands from mechanical treatments under Alternative A would be beneficial, long-term, and minor.

Pile Burning

Most mechanical removal projects would include pile burning. The piles would be small in size and create very localized compaction and hydrophobic soil. The piles would not be located in wetlands, and would otherwise have a negligible impact on the park's wetlands.

Prescribed Fire

This alternative focuses on prescribed burning for resource management, but does not specify wetlands as a target resource. Seasonal wetlands are often located adjacent to grasslands and scrub communities throughout the park, and therefore could be affected by prescribed burns in these plant communities. These would be low- to moderate-intensity burns, which generally burn near or around moist wetland soils rather than in the wetlands themselves. 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.

In general, a buffer would be maintained around wetland areas where fire management activities would be restricted. Staging, fire line construction, and vehicle use would occur outside of the buffer area, and prescribed burning inside the buffer area would occur under tightly controlled conditions. Any impacts on wetland soils, hydrology, or vegetation that occur in the buffer area must be correctable by site-specific actions, and must be confined to short-term, minor (or less), adverse effects. The sites will be monitored after prescribed burning to ensure that the species composition favors native wetland species and does not promote the growth of nonnative species.

Under these circumstances, the prescribed burns would have minor-to-moderate long-term beneficial impacts on wetland vegetation by stimulating growth and reproduction of native wetland species. Even if the wetland vegetation was too wet to burn, the wetland would benefit from native plant stimulation in the surrounding buffer area. One benefit would be a reduced chance of encroachment by nonnative plants into the wetland area.

By following the applicable mitigation measures listed in Chapter 2 during prescribed burning, the impacts on wetlands from Alternative A would be beneficial, long-term, and moderate.

Research

Alternative A could include elements of research into the effects of fire on vegetation, hydrology, soils, and other features. It is possible that some research could focus on the effects of fire on wetlands. If this is the case, there is a chance that the research could show that fire has an adverse effect on wetlands. These

effects, however, would likely be short-term and minor. Research would more likely show that fire has a beneficial effect on wetlands by maintaining the natural processes in the wetlands.

The applicable mitigation measures listed in Chapter 2 would ensure that only short-term, minor effects occur as a result of fire effects research.

Cumulative Impacts

As previously described in this chapter, cumulative impacts are those that would occur not only as a direct result of this planning effort or actions proposed under the alternative, but in conjunction with other activities within the same project areas. These projects should be considered when developing fire management plans for the various project areas. The combined impacts of unrelated projects and fire management activities within a project area should not exceed the threshold for minor impacts on wetlands (i.e., changes in the areal extent, or in wetland vegetation, soils, or hydrology, would be measurable but would affect less than 5 percent of the total extent of the wetland type in the project area). For example, the Big Lagoon restoration in the Redwood Creek watershed is a large-scale restoration that could temporarily disrupt wetland function in the area while natural processes are restored. Fire management planning for the upper reaches of the watershed should create only minor impacts such as erosion and sedimentation so that the wetland restoration is successful. Similar consideration should be given to any transportation, trail improvement, maintenance, habitat restoration, or other project that creates sedimentation or other impacts on wetlands.

Conclusion

Fire management activities would avoid wetland areas to the greatest extent possible to minimize adverse impacts on soils, hydrology, and vegetation. If such treatments in wetlands were deemed necessary to ensure fire safety around structures or roads or to remove nonnative vegetation, an appropriate buffer would be maintained around wetland areas where fire management activities would be restricted. Staging and vehicle use would occur outside of the buffer area, and nonnative vegetation removal would occur under tightly controlled conditions. Any impacts on wetland soils, hydrology, or vegetation that occur in the buffer area must be correctable by site-specific actions, and must be confined to short-term, minor (or less), adverse effects.

Mechanical treatments and prescribed fire could have adverse, short-term, minor impacts on wetland soils, hydrology, and vegetation. Overall, the fire management activities would have minor-to-moderate long-term benefits to wetland communities through reduction of nonnative plant species and stimulation of growth in native species. Furthermore, the minor adverse impacts could be offset by the beneficial effect of preventing a large-scale wildfire. An unplanned, excessively hot fire could have major, long-term, adverse impacts on wetlands by destroying vegetation and allowing invasion by nonnative species, creating hydrophobic soils, and increasing runoff.

Impairment

No impairment of wetlands would result from this alternative.

Alternative B

Mechanical Fuel Reduction

Alternative B relies largely on mechanical fuel reduction throughout the park, particularly in the WUI FMU. Although the total acreage of projects per year would be greater than under Alternative A, the impacts would not be significantly different. With the implementation of the mitigation measures described for Alternative A, and in Chapter 2, the impacts on wetlands from mechanical removal under Alternative B would be beneficial, long-term, and minor.

Pile Burning

Impacts would be the same as under Alternative A.

Prescribed Fire

Under Alternative B, prescribed burning would occur in the Park Interior FMU, and Muir Woods FMU, covering a maximum of 120 acres per year throughout the park. This would be a level of impact similar to Alternative A. With the implementation of the mitigation measures described for Alternative A, the effects of prescribed fire on wetlands under Alternative B would be beneficial, short-term, and minor.

Research

Impacts would be the same as under Alternative A.

Cumulative Impacts

Impacts would be the same as under Alternative A.

Conclusion

Impacts would be the same as under Alternative A. 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 wetland vegetation, hydrology, and soils. Clearing vegetation also could have minor benefits to wetland species if native species establishment is enhanced.

Minor adverse impacts are possible from prescribed fires burning near and into wetlands in dry years. If fire intensity is low to moderate, minor-to-moderate benefits on wetland vegetation are possible due to reduction of nonnative plant species or stimulation of germination and resprouting in native species.

These minor adverse impacts could be offset by the beneficial effect of preventing a large-scale wildfire. An unplanned, excessively hot fire could have major, long-term, adverse impacts on wetlands by destroying vegetation and allowing invasion by nonnative species, creating hydrophobic soils, and increasing runoff.

Impairment

No impairment of wetlands would result from this alternative.

Alternative C

Mechanical Fuel Reduction

Alternative C would involve more mechanical fuel reduction in Marin County, with the same acreages in San Francisco and San Mateo counties as Alternative B. The increased acreage in Marin would occur in the park interior areas. Although the total acreage of projects per year would be greater than under Alternatives A and B, the impacts would not be significantly different. With the implementation of the mitigation measures described for Alternative A and in Chapter 2, impacts on wetlands under Alternative C would be beneficial, long-term, and minor.

Pile Burning

Impacts would be the same as under Alternative A.

Prescribed Fire

Under Alternative C, prescribed burning would occur mainly in the Park Interior FMU, with a limited amount in the WUI FMU and Muir Woods FMU. A maximum of 320 acres per year would be burned throughout the park. While this is an increase in acreage from Alternatives A and B, the intensity of impact would not exceed minor. With the implementation of the mitigation measures described for Alternative A, the effects of prescribed fire on wetlands under Alternative C would be adverse-to-beneficial, long-term, and minor.

Research

The adverse impacts of this alternative would be similar to those of Alternatives A and B. However, the beneficial impacts could be increased due to the opportunity for more research burns.

Cumulative Impacts

Impacts would be the same as under Alternative A.

Conclusion

Impacts would be the same as under Alternative A. 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 wetland vegetation, hydrology, and soils. Clearing vegetation also could have minor benefits to wetland species if native species establishment is enhanced.

Minor adverse impacts are possible from prescribed fires burning near and into wetlands in dry years. If fire intensity is low to moderate, minor-to-moderate benefits on wetland vegetation are possible due to reduction of nonnative plant species or stimulation of germination and resprouting in native species.

These minor adverse impacts could be offset by the beneficial effect of preventing a large-scale wildfire. An unplanned, excessively hot fire could have major, long-term, adverse impacts on wetlands by destroying vegetation and allowing invasion by nonnative species, creating hydrophobic soils, and increasing runoff.

Impairment

No impairment of wetlands would result from this alternative.

Impacts on Wildlife and Important Habitat

Analysis

Wildlife impacts from fire management actions primarily involve modifications of habitat and disturbance from actions, such as noise from mechanical removal of trees. Quantifying or accurately predicting the effects of wildfire and prescribed burns is difficult because fire is inherently unpredictable. For example, fire intensity (which strongly influences the degree of impacts) varies substantially in response to the season, wind speed, 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 planning area are limited.

Generally, the effects depend on the characteristics of the fire management actions (e.g., intensity of fire, duration of activity, frequency, size, shape, season, and time); the characteristics of the vegetation or habitat treated or affected; and species characteristics (e.g., size, mobility, and habitat preferences). Modification of habitat, including breeding sites, food resources, water sources, and cover, are factors that determine whether wildlife populations persist, thrive, or decline in response to fire actions. Changes in the structure and composition of understory and overstory vegetation, as well as resultant changes in microclimates within and adjacent to fire treatment units, will affect wildlife species (McMahon and deCalesta 1990).

The impacts of fire management actions on wildlife can be direct or indirect. Direct impacts include incineration, asphyxiation, injury, disturbance from noise or movement, and/or avoidance of an area. Direct injuries and death from fire management actions may primarily affect less mobile species or life stages. Wildlife may also experience indirect effects from fire actions. 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 is a possible adverse indirect impact from fire management actions that can be short- or long-term in duration. Changes in vegetation structure and composition, down and dead woody material, and snag availability that occur due to fire management actions can all affect wildlife. In particular, the loss of down and dead woody material and snags during a prescribed burn removes essential structural habitat components for a variety of wildlife and reduces species diversity (McMahon and deCalesta 1990). Depending on the season, fire actions can also have adverse effects on a species' nesting or reproductive success. The nature of the action (e.g., the intensity and size of a controlled burn or the area of mechanical tree removal) will also determine whether ground-dwelling or canopy-dwelling species are affected. Fire management actions that are larger in area and involve more complete habitat modification could affect entire populations or subpopulations of wildlife.

Wildlife would also benefit from fire management actions as most native species evolved in ecosystems within the park that were subject to periodic fire. For instance, populations of species dependent on early seral stage vegetation may increase following a burn or mechanical treatments. Vegetation that grows in the first two to ten years after a burn often contains higher levels of nitrogen, offering higher quality forage for herbivores. In addition, decreased cover associated with mechanical removals and prescribed fire can improve the growth of forage and can improve predator hunting success. Enhanced foraging opportunities may lead to decreased parasite loads and increased dispersion, which may reduce the spread of some diseases. Fire management actions can either increase or decrease the availability of tree snags that are used by many species for nesting, shelter, and foraging. However, management actions can be planned to leave snags in place or create new snags. Mechanical removal of nonnative trees and weeds and any associated follow-up seeding or planting would enhance native plant communities, providing better habitat for native wildlife. For example, native oak trees provide many wildlife species with the important resource of acorns. In addition, prescribed fire and/or mechanical treatments could be used to enhance disturbance-adapted plant communities and the wildlife that they support.

Fire management actions that are patchy – those that result in a mosaic of treated and untreated areas and those that differ in intensity – will maintain heterogeneous environments that support a broad faunal diversity. A primary goal of the GGNRA FMP is to avoid high-intensity, stand-replacing fires, which become more likely with increased fuel loads. Intense, hot fires can change vegetation types (e.g., a forest to brush/grassland or native coastal scrub to nonnative shrubs lower in wildlife habitat values) over large areas, or the areas may take decades to recover. Patchy, low-intensity fire management actions would not dramatically alter landscapes, allowing the remaining untreated native vegetation to continue providing habitat for existing wildlife. Impacts from these actions would tend to be relatively minor and short-term. Lack of fire and the resultant late seral stage vegetation 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 that mimic the natural patchy patterns of fires of GGNRA would ensure the highest levels of wildlife biodiversity (Nichols and Menke 1984).

Mammals

Adverse impacts on mammals from fire management actions would largely be associated with vegetation change and disturbance. Most mammals are capable of escaping immediate injury or death from fire management actions because of their mobility. Seventeen species of bats, four of which are federally sensitive species, are known to occur in the park, with some species making use of tree cavities, fire scars, and loose bark for roosting. Fire actions that destroy maternity roosts may have substantial impacts on bats because of their low reproductive rates. Some species of rodents, including the western harvest mouse, brush mouse, and woodrat species, are known to decrease after stand-replacing fires (Schwilk and Keeley 1998). Other species, including pocket gophers and deer mouse species increase after fires (Sims and Buckner 1973, Kaufman et al. 1988). Carnivores that depend on any of these species as prey would be similarly affected. Reduced vegetation cover associated with most of the fire management actions would increase risks for prey species while potentially increasing hunting opportunities for predators. Some small mammals would benefit from increased availability or foraging efficiency for seeds with reduced vegetation. During the first few growing seasons after a fire, improved vegetation growth usually

provides increased food for herbivorous mammals (Ahlgren and Ahlgren 1960). Black-tailed deer would benefit from the increased nutritional quality of recently burned vegetation, with positive impacts decreasing in five or more years post-burn. Prescribed fire and other fire actions 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). Brush rabbits, black-tailed deer, and other herbivores are expected to be positively affected by fire and regrowth of vegetation. Dusky-footed woodrats, western harvest mouse shrews, and other small mammals are expected to experience short-term, minor, adverse impacts. The adverse impacts of fire management actions would range from short- to long-term and be minor in intensity due to the limited areas affected. Long-term beneficial impacts would result from fire actions that restore and enhance native plant communities.

Birds

The main effects of fire management actions on birds are changes in habitat and disturbance occurring during the nesting season, March 1 through July 31. Adult birds are highly mobile and can escape direct injury or death from fire management actions, but eggs, nestlings, and recently fledged birds are unlikely to be able to escape these actions. Fire in California shrublands and forests has been shown to maintain or increase avian species diversity, and also to alter species composition. Populations of some species, such as California quail, Swainson's thrush, scrub jay, and certain owls, may 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 abundance after fires (USDA 2000). Species adapted to early seral stages would benefit from fire management actions that set back successional processes. Ground-dwelling birds in the park, such as California quail, northern harrier, and savannah sparrow, would be negatively affected in the short term by most fire management actions, but may benefit from patches of more open habitat in the longer term. Canopy-nesters, such as red-tailed hawks, white-tailed kites, sparrow hawks, ravens, and many songbirds, would be affected by tree removals and fires that reach into the canopy. Impacts from prescribed fire and mechanical removals would be long-term and minor as these actions would be conducted outside the nesting season. However, vegetation regrowth would begin within months, and long-term beneficial impacts would result from fire actions that restore and enhance native plant communities. The consequences of fire management actions on snag numbers and their locations would result in variable impacts on cavity-nesting birds and other species of birds that feed on wood-boring insects (USDA 2000). Conducting snag surveys prior to fire management actions would allow for better planning to protect these resources and determination of whether snags should be created as part of a particular project.

Amphibians and Reptiles

Fire management actions have the potential to cause more direct mortality on less mobile species, including amphibians, and some reptiles. 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). Because fire actions would be

limited in size and location under the GGNRA FMP, the overall impact on invertebrates, amphibians, and reptiles would be adverse, minor, and short-term. The impact on amphibians would be minor because effects would be localized and non-emergency fire management actions would not take place within 100 feet of riparian areas.

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 fire is associated with the loss of streamside forest (McMahon and de Calesta 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. However, work in riparian and streamside areas would be carefully managed to ensure that impacts are mitigated to an acceptable level

Invertebrates

At least 44 species of butterflies occur in the Marin Headlands and 34 species occur at Milagra Ridge. Other terrestrial invertebrates are not well inventoried for the park. Fire management actions may have considerable lethal effects on invertebrates in localized areas, because many invertebrates, particularly ground and soil-dwelling species and larval stages of flying invertebrates, are relatively immobile. While most invertebrates that live in the surface soil layers and invertebrate eggs are likely to be killed by prescribed fire, some ants and flying surface insects may increase in numbers after a fire. In addition, fire may create snags, which attract a variety of wood-boring insects. Monarch butterflies (*Danaus plexippus*) make use of nonnative Monterey cypress and pine and eucalyptus trees as overwintering sites, often using the same trees or groves year after year. Overwintering monarchs may be adversely affected by fire actions that remove important clustering sites. Monarch larvae feed almost exclusively on native milkweed plants that may benefit from prescribed fire that preserves grassland areas where it occurs.

Actions Common to All Alternatives

Wildland-Urban Interface Initiative

The emphasis of the Wildland-Urban Interface Initiative at GGNRA is to reduce the density of hazardous fuels that create a risk to lives or property on parklands adjacent to the park boundary. Most projects would continue to focus upon the mechanical removal of nonnative vegetation and highly flammable fuels from areas where parklands adjoin neighboring properties. Removal of nonnatives, followed by application of a strategy promoting the reestablishment of native vegetation, can provide more habitats needed by native wildlife. For example, native species of oak provide both structure for breeding and roosting as well as food sources, such as acorns, which can be a valuable source of forage. Mechanical removals would remove vegetation and disturb soil and forest litter, affecting small mammals, reptiles, amphibians, invertebrates, and terrestrial landbirds. In addition, work crews would be a disturbing

element for wildlife in project areas. Impacts would be adverse, short-term, and minor until the area is revegetated. In the long term, moderate beneficial impacts would be gained as a diversified, native habitat type is reestablished.

Defensible Space/Vegetation Clearing Around Structures

The creation of defensible spaces around structures would remove vegetation and disturb soil and litter, possibly affecting small mammals, reptiles, amphibians, invertebrates, and terrestrial landbirds. However, many of the species found close to buildings, particularly in developed zones of the park, are human-associated and relatively common, as opposed to many sensitive species that are more disturbance-intolerant. Impacts would be adverse, long-term (because treatments would need to be repeated), and minor.

Roadside Fuel Reduction

Fire road maintenance would remove vegetation and disturb soil and litter, possibly affecting small mammals, reptiles, amphibians, invertebrates, and terrestrial landbirds. Maintaining fire roads could have larger impacts than clearing defensible spaces around buildings because some portions of fire roads run through interior sections of the park. Habitat along these road/trail corridors is already disturbed by human activity, however, and may be of lower quality for some species. Impacts would be adverse, long-term (because treatments would be repeated), and minor.

Suppression

Adverse effects on wildlife can result from fire suppression activities, such as construction and use of staging areas, helispots, or spike camps; construction of fire lines using hand tools or bulldozers; cutting of snags; and mop-up. 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 during wildland fire suppression.

Small species of mammals, reptiles, or amphibians can be injured or killed when vehicles are traveling to 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 inadvertently provide food sources to wildlife through improperly disposed garbage, 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 on 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. Organisms caught when water is obtained are likely to be killed when the water is dropped.

Transfer of water from one area to another can also have impacts on 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 noninfected populations of frogs. In GGNRA, the use of multiple water bodies to fight a wildfire could result in the spread of nonnative bullfrogs, which prey heavily on native frog species, or contribute to the spread of unknown pathogens or other nonnative species.

The physical impact of a water drop could adversely affect individual animals through crushing. One advantage of water drops is that in some circumstances they can take the place of hand lines ("wet-lining") to control fire movement. This tactic would result in less impact on soil, forest litter, and vegetation than hand line construction and, therefore, would have less impact on wildlife, both in intensity and duration. Using saltwater for fire suppression actions may harm plants and soils. This could have adverse impacts on wildlife, particularly amphibians and butterflies tied to specific host plants in localized areas. The impact of water drops on wildlife would be adverse, long-term, and minor based upon possible impacts on aquatic ecosystems, especially in relation to amphibians. Impacts from saltwater drops would be short-term, adverse, and minor. The potential impact would be minor because the historic occurrence of unplanned ignitions has been infrequent and most do not involve water drops. If they did occur, however, 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 as water drops, 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. The impact on wildlife from retardant drops is expected to be negligible, adverse, and short-term because of their limited application in the park and protocols for their use designed to protect aquatic resources, including applicable mitigation measures.

Construction of helispots can result in the felling of trees and snags, which are potential wildlife habitat. Snags are particularly important wildlife habitat. In addition, the noise from helicopter traffic would likely disturb wildlife, such as nesting raptors. The impact of helispots on wildlife is expected to be adverse, long-term, and minor, since they would likely be used on a very limited basis (if at all). All landing areas would meet the standards outlined in the Interagency Helicopter Operations Guide, and safe landing spots identified in the GGNRA Aviation Management Plan Mitigations would be used. These mitigations, in addition to limiting helispot construction and locating helispots away from sensitive resources, would reduce impacts.

Fire crews staying in spike camps can have an adverse effect on wildlife by providing sources of human food and trash. This could lead to certain wildlife becoming conditioned to human foods, potentially resulting in human-wildlife conflicts. In some cases, habituated animals must be killed to protect human safety. Presence of hand crews in more remote areas also would introduce an element of disturbance, which could affect sensitive species such as nesting raptors. Impacts on wildlife from spike camps are

expected to be adverse, short-term, and minor. However, locating spike camps away from sensitive resources and providing strict control of food and trash at camps can reduce these impacts.

Hand line construction would remove vegetation and disturb soil and forest litter, possibly affecting 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 discussion of 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. Impacts of hand line construction in association with managed wildland fire and prescribed fire would be adverse, short-term, and negligible given the present limited amount of wildland fire and the limited use for prescribed fire.

Snags provide extremely valuable habitat for some wildlife (Brown and Bright 1997), particularly cavity-nesting birds and mammals. The loose bark also serves as a nesting and roosting site for some species, as well as a foraging site for species that prey upon wood-boring insects. Any suppression actions that require the felling of snags to protect human safety and the integrity of fire lines 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. Snag removal associated with fire suppression activities would potentially have minor, long-term, and adverse impacts because of the relatively small areas that would be affected. On the other hand, wildfires often create snags by killing trees.

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 fossorial and semi-fossorial organisms (e.g., broad-footed moles [*Scapanus latimanus*] and Botta's pocket gophers [*Thomomys bottae*]) by exposing them to heat and flames. Such an impact, however, would be along short sections of the lined perimeter and affect few species. The impact of mop-up would therefore be adverse, short-term, and negligible for both prescribed burn and wildfires.

Treatment of Muir Woods FMU

Fire actions for Muir Woods FMU include a mix of prescribed fire, mechanical fuel reduction, and under-story thinning projects. Prescribed burning has been used to reduce fuel loading as well as to restore the role that fire plays in the ecosystem. Burns would range in size from 0.55 to 50 acres, with 50 acres total as a target for annual burning. Research burns would be conducted to investigate how fire affects SOD.

Adverse impacts on mammals from fire management actions would largely be associated with vegetation change and disturbance. Most mammals are capable of escaping immediate injury or death from fire management actions because of their mobility. Ten species of bats have been documented in Muir Woods National Monument, including four federal species of concern: Townsend's western big-eared bat (*Corynorhinus townsendii townsendii*), fringed myotis (*Myotis thysanodes*), long-legged myotis (*M. volans*), and Yuma myotis (*M. yumanensis*). Many of the bats in Muir Woods National Monument have been detected using redwood fire-scar cavities for roosting, particularly in the riparian corridor. Prescribed fire could destroy maternity roosts, which would be a substantial adverse impact on bats

because of their low reproductive rates. However, fire could also be used as a tool to create new fire scars for bats and other wildlife. The adverse impacts of fire management actions in most cases would be minor and short-term due to the limited areas that are being affected. Long-term beneficial impacts would result from fire actions that restore and enhance native plant communities.

At least 69 species of birds are known to occur within Muir Woods National Monument. The main effects of fire management actions on birds would be changes in habitat and disturbance occurring during the nesting season, March 1 through July 31. Impacts from prescribed fire and mechanical removals would be short-term and minor as these actions would be conducted outside the nesting season, with vegetation regrowth beginning within months. Long-term beneficial impacts would result from fire actions that restore and enhance native plant communities. The consequences of fire management actions on snag numbers and their locations would result in variable impacts on cavity-nesting birds and other species of birds that feed on wood-boring insects (USDA 2000). Conducting snag surveys prior to fire management actions would allow for better planning to protect these resources and determination of whether snags should be created as part of a particular project.

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 fire is associated with the loss of streamside forest (McMahon and deCalesta 1990). Loss of riparian vegetation can lead to elevated water temperatures, reducing the ability of the water to hold dissolved oxygen. However, adequate stream buffers would be left along creek areas to ensure that impacts are mitigated to an acceptable level.

Fire management actions would have mixed impacts on invertebrates in Muir Woods FMU. While most invertebrates that live in the surface soil layers and invertebrate eggs are likely to be killed by prescribed fire, some ants and flying surface insects may increase in numbers after a fire. In addition, fire may create snags, which attract a variety of wood-boring insects. 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). Because fire actions would be limited in size and location within Muir Woods FMU, the overall impact on invertebrates, amphibians, and reptiles would be adverse, minor, and short-term. The impact on amphibians would be minor because effects would be localized and the riparian area around Redwood Creek would be protected.

Fire management actions would have many benefits in Muir Woods National Monument. Reducing the chances for catastrophic fire would prevent the loss of the last contiguous stand of old-growth coast redwood forest in the region, as well as protect portions of the Redwood Creek watershed. Research on fire effects on SOD may lead to ways to control the pathogen and prevent excessive loss of the tan oak understory, which provides cover and acorns for wildlife. Removal of nonnative plants would foster the reestablishment of native plant species.

Treatment of San Francisco County Project Area

The fuel reduction strategy for San Francisco lands focuses upon maintaining defensible spaces around buildings (see discussion above) and removing nonnative trees. Mechanical removal would cover

between 5 and 10 acres a year. Both of these actions would remove vegetation and disturb soil and litter, possibly affecting small mammals, reptiles, amphibians, invertebrates, and terrestrial landbirds. Adverse effects would be long-term and minor.

Public Information and Fire Education Programs

Impacts associated with fire information and education would largely be indirect and 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. However, public information and education usually do not have a direct effect – positive or negative – on wildlife. In some cases, education can be used to enforce a closure of an area to ensure that wildlife habitat quickly recovers.

Fire Cache

Having the fire cache and management personnel located centrally within GGNRA would allow for faster response time to wildfires, implying less potential for higher-intensity and larger fires, as well as less intensive suppression activities. The use of existing buildings for the fire cache would avoid impacts on wildlife from construction activities. Fire cache relocation would have indirect, beneficial, long-term effects on wildlife.

Fire Effects Monitoring

There would be some trampling and disturbance effects associated with fuel and vegetation sampling, although these should be relatively minor. The timing of monitoring would influence the intensity of these effects. For example, conducting monitoring outside of peak bird nesting and butterfly flight season would lessen the overall impacts. The knowledge gained through fire behavior monitoring would be beneficial to wildlife. Through gaining a better understanding of how fire behaves in different vegetation communities and in different weather and climatic conditions, park fire specialists would be better able to avoid situations that lead to catastrophic fire events that would be devastating to certain wildlife. Overall, impacts would be long-term, beneficial, and minor.

Alternative A

Mechanical Fuel Reduction

Mechanical fuel reduction projects would focus upon the removal of highly flammable eucalyptus, French broom, and native plants to reduce fuel loads and keep fire roads accessible, particularly to protect communities adjacent to the park from wildfires. The most common method of mechanical fuel reduction is the use of chain saws to thin or remove targeted vegetation, which is then either piled to be chipped, removed, or burned at a later date through the use of pile burns. In some instances, the materials would be left in place, potentially creating cover for some amphibians and reptiles and a source of woody debris that would benefit wood-boring insects and insectivorous birds. Other equipment used during mechanical fuel reduction may include weedwackers, mowers, and masticaters. Herbicides would only be applied according to the approval and guidelines of the park’s Integrated Pest Management Program and the Washington Office coordinator for herbicide application. If goats or other animals are used as a type of

mechanical treatment, they would be closely monitored and contained by electric fences to control grazing and prevent contamination of sensitive watersheds and wetlands. Under Alternative A, no more than 100 acres per year would be treated mechanically.

Mechanical fuel reduction techniques, such as mowing, brush clearing and tree removal, would have some adverse impacts on wildlife. Local mechanical treatments may affect ground, brush, and tree-dwelling species by direct mortality or injury to individuals and their nests, eggs, and offspring, or by altering cover and food sources. Mitigations to protect breeding migratory birds would also provide protections to a wide range of species that breed during the spring and summer seasons in the park. Short-term adverse impacts on wildlife during hand-thinning, mowing, and chipping operations include human presence and use of chain saws and other tools during operations. These actions may disturb wildlife, although such disturbance would only be during the period that crews were working.

Conversely, mechanical removal of trees and brush to attain target conditions would enhance habitat for native wildlife and reduce the threat of catastrophic fire, especially from human-caused ignitions that occur in developed areas. Brush clearing can also increase foraging opportunities for some herbivores and predators. The opening of dense forest habitats would benefit some aerial foragers such as bats and flycatchers. Perhaps the largest benefit from mechanical removals of nonnative trees and shrubs would be the benefit to native wildlife from restored native plant communities.

Goats could spread disease to park wildlife, potentially having the greatest impact on black-tailed deer, which are the only other native ungulate in the park. Goats may also trample vegetation and compact soil. Finally, goats would forage on both native and nonnative species, potentially removing native host and nectar plants for butterflies. The impacts on the park's wildlife from goats would be short-term, adverse, and minor.

When cut vegetation cannot be burned onsite 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. In the case of specific wildlife species of interest to the NPS, chipping could be applied at decreased depths to avoid these impacts. Impacts on wildlife from chipping would therefore be negligible, adverse, and short-term.

Pile Burning

Piling and burning of downed trees and shrubs may have an adverse effect on some wildlife. Some species, such as small rodents, reptiles, and invertebrates, 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. The pile-burning methodology should prevent overly hot fires that could sterilize soils and could have long-term impacts. In addition, mitigation to light piles so as to allow wildlife an escape route will be applied when pile burning. Pile burning could also be used to create fire scars or tree cavities that would benefit some species such as bats. Impacts from pile burning would be short-term, adverse, and minor.

Prescribed Burning

The primary use of prescribed burning under this alternative would be to reduce hazard fuels in strategic locations, restore fire to the park landscape for the benefit of native species, and aid in the control of nonnative plant species. Under Alternative A, prescribed burns would be conducted in coastal prairies, coastal scrub, oak woodlands, and redwood forest. Prescribed fire could be used to meet the objectives of lowering the fuel hazard in the historic groves of eucalyptus trees if first treated mechanically to maintain a low-burning fire. Prescribed fire would be applied to determine fire effect on nonnative plants and the restoration of native plant communities. Benefits from prescribed fire would include an increased regulation of forest density, the release of nutrients into the soil, the creation of a favorable reproductive environment for fire-adapted species, and the creation of improved habitat for wildlife. Prescribed burning would also allow for fuel modification in large areas away from structures and high-value areas.

As noted above, fire can be used to improve the 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 on some wildlife species by providing open or early seral stage habitat in areas of GGNRA most severely altered by fire suppression, and by continuing to reduce the risk of catastrophic fire. Conversely, species that depend on down wood, dense forests, and ground cover, such as salamanders, some small mammals, and ground-nesting birds, would experience localized adverse impacts in the treated areas from displacement – although prescribed fire would also create some new sources for downed dead wood. These adverse effects would be localized, as an abundant supply of down wood and more closed canopy woodlands would remain in the park, providing habitat for the species dependent on those habitats. Control actions at the boundaries of prescribed fires, such as the removal of vegetation to construct fire lines, would have adverse, long-term, and minor impacts on wildlife in those areas.

Prescribed fires would be started when conditions are favorable. Wildfires and the intentional setting of fire by Americans Indians and ranchers tended to occur when vegetation was dry enough to carry a fire, in the late summer and early fall. Prescribed fires outside of this seasonal timeframe would have an adverse effect on species of wildlife that are adapted to a “natural” timing of fires. Also, high levels of fuel loading in some areas of GGNRA may cause prescribed fires to burn at higher than usual intensities, even when fire prescriptions are designed to minimize intensity. Unnatural seasonality, and in some cases intensity, of prescribed fires could result in greater direct lethal impacts for immobile wildlife (USDA 2000), such as invertebrates, amphibians, or small mammals, than under the pre-suppression fire regimes for the park landscape. Because the areas to be burned are small, impacts on species in the park from these effects of prescribed fire would be no more than minor.

Research

Research under this alternative would lead to better management of plant communities through the use of fire as a tool to move toward desired conditions. Enhanced native plant communities would provide better habitat for most native wildlife. Impacts would be long-term, beneficial, and minor.

Cumulative Impacts

Primary among the past actions that have influenced wildlife at GGNRA are alterations in habitat from fire suppression (in areas that were sustained by fire), urban development and loss of habitat continuity, and the establishment and overall dominance of many areas by nonnative plant species that either exclude wildlife or change distributions of wildlife species over the landscape.

Suppression of periodic fires allowed the unnatural buildup of both dead and live fuels. The buildup of fuels generally increased the risk of wildfire. Development of land in the region, extirpation of some species (California grizzly, tule elk), introduction of species competing for limited habitats, and fragmentation of available habitat have also contributed to changes in occurrence and population sizes of some species. For example, coastal sage scrub is present in about 15 percent of its former habitat, primarily because of agricultural, industrial, and residential development, directly affecting mammal and bird species that use this habitat. Grassland habitats supporting rodents and their raptor predator base have been declining through loss of these habitats to agricultural use or urban development. Regional loss of forest stands through logging, catastrophic fire events, and urbanization have led to fragmented, isolated stands suitable for monarch butterfly and winter roosting sites for numerous bat species.

Current and reasonably foreseeable future actions positively affecting wildlife in the park are activities such as the Big Lagoon, Redwood Creek, and mission blue butterfly habitat restoration projects. These projects take into account the natural processes of the site and incorporate nonnative plant removal and reestablishment of native plant communities (through planting and weed removal) into their efforts, with subsequent direct benefits to wildlife species. Potentially adverse impacts could occur with development projects both within the park and adjacent to park boundaries, including the various transportation plans and trails plans. These efforts will involve ground disturbance activities that could add to or exacerbate existing habitat fragmentation problems along road and trial corridors. However, ongoing efforts to identify mitigations for these projects, such as pre-project coordination with nesting seasons, development and implementation of post-project site stabilization plans, and evaluation of fire management efforts through monitoring and research, would reduce the potential for these type of impacts. These projects would have an overall long-term negligible-to-minor beneficial impact on wildlife as a whole.

Conclusion

The flexible fire suppression strategy has the potential for numerous short-term, adverse impacts on wildlife. These adverse impacts are expected to be minor based on the limited number of wildfires that occur annually in the park. Compared with less sensitive suppression actions, however, preventing a catastrophic fire in the park probably offers greater long-term benefit to the park’s wildlife. Having the flexibility to burn in portions of the park to enhance natural resources would benefit wildlife through long-term enhancement of habitat. The fire management strategy for Muir Woods National Monument would provide long-term benefits to wildlife, mainly by restoring fire to the ecosystem, which would outweigh some of the adverse impacts of mechanical removals and prescribed fire. The impacts of in-park and community projects funded by the federal Wildland-Urban Interface Initiative would be beneficial, long-term, and minor. Clearing defensible space around structures and reducing roadway fuel would have long-term, adverse, minor impacts on wildlife. Fuel reductions for San Francisco lands, the public

information and education program, the fire cache relocation, and the fire behavior monitoring program all would have beneficial, long-term, and minor impacts on the park's wildlife.

The effects of mechanical removals on wildlife would be beneficial, long-term, and minor. The benefits of mechanical removals for wildlife – enhancing native habitats and reducing chances for catastrophic fires – outweigh the adverse impacts of vegetation removal and the associated disturbance. Prescribed fire would also have a beneficial long-term minor impact on wildlife by enhancing native habitats and reducing the risk of catastrophic fire. These benefits would outweigh the temporary loss of habitat and possibilities for direct injuries or death associated with prescribed fires. Research under Alternative A also would have a long-term, beneficial, but minor impact. Pile-burning effects would be adverse, short-term, and minor. Only a small portion of the land area of the park would be subject to treatment under Alternative A, and treatment sizes would be small. Overall, the effects of fire management activities on wildlife and important habitat as presented in Alternative A would be long-term, beneficial, and minor.

Impairment

As no long-term, major adverse effects on wildlife would occur, park wildlife resources would not be impaired under Alternative A.

Alternative B

Mechanical Fuel Reduction

Impacts would be similar to those of Alternative A, with a slight increase in the extent of impacts as the amount of land that could be treated under Alternative B would be about twice that of Alternative A. The amount of land treated under Alternative B would remain a small percentage of the total within the park.

Pile Burning

Impacts would be similar to those of Alternative A.

Prescribed Burning

A maximum of 120 acres would be subject to prescribed burning under Alternative B, although fires would not be used in wildland urban interface areas. Impacts would be similar to those of Alternative A.

Research

Impacts would be similar to those of Alternative A.

Cumulative Impacts

Impacts would be the same as under Alternative A.

Conclusion

Overall, impacts on wildlife under Alternative B would be very similar to those under Alternative A. The major change would be more areas subject to mechanical treatments, and some additional restrictions on the use of prescribed fire.

Impairment

No impairment of the park's wildlife would occur under Alternative B.

Alternative C

Mechanical Fuel Reduction

Impacts would be similar to those of Alternative A, though greater in extent with an increase in the amount of land that could be treated under Alternative C. The amount of land subject to treatment under Alternative C on an annual basis would remain a small percentage of the park.

Pile Burning

Impacts would be similar to those of Alternative A, though slightly greater in extent as up to three times as much material would need to be burned under Alternative C.

Prescribed Burning

Impacts on wildlife from prescribed fire would be similar to those of Alternative A, although slightly greater in extent as nearly three times as much area could potentially be burned annually. Burns would still tend to be small in size. The amount of land subject to treatment under Alternative C would remain a small percentage of the park.

Research

Impacts would be similar to those of Alternative A, though greater opportunities for research would exist under Alternative C than under the other two alternatives because there would be more burning occurring.

Cumulative Impacts

Impacts would be the same as under Alternative A.

Conclusion

Overall, impacts on wildlife under Alternative C would be similar to those under Alternatives A and B. However, Alternative C would allow for the greatest and most flexible use of mechanical treatments and prescribed fire to meet fire objectives, including reducing chances of a catastrophic fire and enhancing habitat for wildlife. Alternative C also would allow for more research to occur, providing the most opportunities for park staff to learn adaptively about the use of fire for managing natural resources.

Impairment

No impairment of the park's wildlife would occur under Alternative C.

Impacts on Special Status Species

Analysis

The planning 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 (ESA), 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 planning 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.

The U.S. Fish and Wildlife Service and NOAA Fisheries sent lists of federally listed threatened and endangered animal and plant species that may occur in the planning area dated July 2, 2003 and February 27, 2003, respectively. Appendix F and Chapter 3, Affected Environment, of this document list the species that may occur as well as whether or not they are likely to be adversely affected by fire management plan activities, based on the best professional judgment of GGNRA natural resource staff.

The following sections discuss probable impacts on species listed as threatened or endangered by the federal government that may occur from implementing actions in the FMP alternatives. All plant or animal species on this list and present in the planning area were considered in the analysis. Refer to Chapter 3 for a description of the species included in this analysis, and to Appendix F for the complete list of species considered for analysis.

Special Status Plant Species

Federally Listed Species

Raven's manzanita, Marin dwarf-flax and San Francisco lessingia would be affected by unplanned ignitions and associated suppression activities, mechanical fuel reduction actions, or small research burns at the Presidio in San Francisco. The limited extent of these species within the FMP planning area and their location within the summer fog zone and within low-growing serpentine coastal scrub and rock outcrops where fuel loads are minimal to absent make unplanned fire-related impacts on these species unlikely. The species and their locations are monitored on an annual basis, and this information would be used to help mitigate any impacts on individuals or populations in the event of a wildfire.

Other Species Considered in this Analysis

Coast rock cress, Oakland star-tulip, Franciscan thistle, San Francisco wallflower, San Francisco gumplant, arcuate bush-mallow, and Choris's popcornflower could be affected by fire management actions within coastal scrub and grassland communities. Marin manzanita, Glory brush, and Mason's ceanothus could all be affected by actions within the limited chaparral community of the Marin County portion of the Park Interior FMU.

California bottlebrush grass could be affected by actions within native hardwood forests, Douglas-fir and coast redwood forests, and nonnative evergreen.

The large number of coastal dune, salt marsh, and coastal bluff species described in Chapter 3 would only be affected by wildland fires or mechanical treatments at the Presidio in San Francisco. The limited actions planned for the San Francisco lands, and the typical habitat of these species in coastal dunes and sandy areas within the summer fog zone where fuel loads are minimal to absent make unplanned fire-related impacts on these species unlikely, and they will not be discussed further in this analysis.

Actions Common to All Alternatives

Wildland-Urban Interface Initiative. The emphasis of the Wildland-Urban Interface Initiative at GGNRA is to reduce the density of hazardous fuels that create a risk to lives or property on and immediately adjacent to the park boundary. Most projects would continue to focus upon the mechanical removal of nonnative and highly flammable eucalyptus and acacia trees and nonnative shrubs (cotoneaster, brooms) from areas where parklands adjoin neighboring properties. The removal of these nonnative species would have two primary long-term benefits: reducing the chances for large, high-intensity burns, and promoting or allowing for the reestablishment of more compatible native vegetation close to developments. Mechanical removal activities would remove vegetation, disturb soil and forest litter, and change shade and moisture characteristics through loss of overstory cover. With mitigations, including development and implementation of revegetation and weed efforts in conjunction with Wildland-Urban Interface Initiative projects, these short-term adverse impacts would result in minor long-term beneficial impacts on vegetation.

A number of special status plant species, including the coast rock cress, Franciscan thistle, California bottlebrush grass, and San Francisco wallflower, could be affected by these actions. Specific Wildland-Urban Interface Initiative projects would take into account the known and potential populations of these and any other special status plant species, and efforts would be made (through avoidance, or timing or actions) to minimize direct adverse impacts. The purposes of the Wildland-Urban Interface Initiative to remove nonnative plant species and reestablish compatible native vegetation would have long-term minor-to-moderate beneficial effects on the special status plant species that currently occur, and could become reestablished, within these sites.

Defensible Space/Vegetation Clearing Around Structures. The creation of defensible spaces around structures would remove vegetation and disturb soil and litter, with the possibility of increasing cover of nonnative plant species following soil disturbance. However, these species could easily be removed due to their proximity to frequently used areas of the park, and new invasions would be detected early enough to avoid spread into adjacent wildlands. Special status plants and populations within the vicinity of structures would be avoided, and the removal of newly established nonnative plant species in cleared areas would prevent adverse impacts on adjacent populations. Impacts would be negligible with these mitigations, but adverse and long-term because treatments would need to be repeated.

Roadside Fuel Reduction. Fire road maintenance would remove vegetation adjacent to road edges, creating open and available habitat for the invasion of nonnative plant species. Annual special status plant species surveys along roadsides, as well as surveys to detect and stop the spread of new nonnative plant species, can help minimize the potential impacts of these annual actions. Impacts on special status plant

species would be long-term, adverse, and negligible to minor, depending on the extent of populations affected by the activity and the integrity of the surrounding vegetation.

Suppression. The direct effects of unplanned wildland fires on special status plant species could be substantial, and could include long-term, possibly permanent changes in plant species composition or percent cover and the introduction or spread of nonnative plant species. Adverse effects on species can result from fire suppression activities such as construction and use of staging areas, helispots, or spike camps; construction of firelines; and mop-up. As with vegetation overall, individual special status plants and the plant communities that they inhabit can be injured or killed when vehicles are traveling to sites or staging areas or when bulldozers are constructing line, creating avenues for nonnative plant establishment through soil disturbance, loss of native vegetation cover, and changes in light and moisture conditions. It is anticipated that in most cases these impacts would occur infrequently.

Similar effects could result from removal or trampling of vegetation in temporary staging areas and helispots used for suppression activities. Spills of fuel, oil, hydraulic fluid, antifreeze, and other toxic chemicals at staging areas and helispots could directly affect special status plant species though changes in soil chemistry, hydrophobicity, and water uptake properties. All landing areas would meet the standards outlined in the Interagency Helicopter Operations Guide, and safe landing spots identified in the GGNRA Aviation Management Plan Mitigations would be used. These mitigations, in addition to limiting helispot construction and locating helispots away from known special status plant species populations, would reduce these impacts.

Use of water or retardant drops during suppression activities can have both a direct adverse impact – from the sheer force of the physical impact – and a longer-term chemical impact due to the chemical composition of the materials used. Retardants can cause short-term impacts on the overall health and reproductive ability of some species, although long-term effects are not detectable.

The proximity of saltwater to most areas of GGNRA means there is a high likelihood for the use of saltwater or brackish bay water during suppression actions. Short-term die-back in annual or perennial species can result if salts are concentrated in drainages and swales, affecting such species as Franciscan thistle and Choris's popcornflower. Again, these impacts are generally short-term and undetectable over the long-term. The overall long-term impact would be negligible, and the direct impact (force of water/retardant falls) on plants would be minor to negligible. The advantage of water and retardant drops is that in some circumstances they can take the place of hand lines ("wet-lining") to control fire movement. This tactic results in less physical impact on soils, forest litter, and vegetation than hand line construction.

Personnel at fire camps or on suppression crews have the potential to transport weed seeds with their equipment and tools. They would also cause trampling and loss of vegetation cover, which could have short- to long-term adverse impacts. However, locating spike camps away from specials status plant species populations and habitats, such as riparian/wetland swales or chaparral areas, and keeping tools and equipment as clean as possible would help minimize these impacts.

Hand line construction would remove vegetation and disturb soil and forest litter, leading to soil erosion and loss of native seedbanks and soil structure. In all cases, minimum impact suppression tactics (MIST) would be used to minimize ground disturbance; MIST would include use of wet lines and construction of minimal hand lines such as through the use of mowers to break up fuel continuity and retain vegetation stems on the ground surface. Mop-up, or the churning of soil and forest litter to extinguish residual hot spots along the periphery of a fire, would cause additional impacts on soil integrity and the soil seedbank, increasing the potential for introduction and establishment of nonnative plant species within native plant stands. These mechanical actions could also stimulate sprouting of both native and nonnative species in the chaparral communities, which could serve to "flush" weedy species. If continued actions were taken to remove sprouted nonnative species after ground-disturbing activities, there would be a gradual change in species composition with possible beneficial effects on the special status species occurring in these sites.

The use of a flexible suppression strategy and application of the mitigation measures to protect sensitive plant species wherever possible would help mitigate potential adverse impacts. Use of indirect fire lines to take advantage of either natural firebreaks (rock outcrops, bodies of water) or roads or otherwise devegetated areas would have a beneficial effect on natural vegetation areas by minimizing ground disturbance through the construction of direct fire lines with hand tools and machinery. This flexible strategy would allow fire personnel to direct wildland fires toward areas of lower fuel loads, such as previously thinned or cleared wildland urban interface sites, such that the ultimate suppression fire lines would be smaller and less intrusive on the landscape. The level of impact on special status vegetation associated with suppression would be a short-term, minor, adverse impact, with long-term effects.

Treatment of Muir Woods FMU. Fire actions for Muir Woods FMU would include a mix of prescribed fire, mechanical fuel reduction, and understory thinning projects under all alternatives. Of the special status species considered in this analysis, Coast rock cress, Oakland star-tulip, and California bottlebrush grass would potentially be affected by these fire management actions.

Coast rock cress occurs on rocky outcrops within the coastal scrub and grassland communities of Muir Woods FMU where fire is unlikely to carry, although radiant heat from adjacent burns could affect the species. These populations could also be subject to direct impacts associated with implementation of fire actions, such as holding lines or staging areas, but would be avoided through integration of known populations during the project planning process. Impacts on this species in the Muir Woods FMU are likely to be negligible to somewhat beneficial (minor) and long-term where encroaching scrub species are mechanically removed through fire management actions, opening habitat for these plants.

Oakland star-tulip was recently discovered within Muir Woods National Monument and is limited to the grassland areas of the site. The primary threats that if faces are from nonnative plant encroachment. The actions called for in the Muir Woods FMU – prescribed burning and research burns to control nonnative species and reestablish native species composition and structure – could benefit this species. Adherence to specific mitigation measures, such as minimizing ground disturbance activities during implementation of fire actions in grasslands, using carefully designed prescriptions and adhering to those prescriptions, and developing and evaluating specific project objectives, would result in minor-to-major beneficial effects on

this species, depending on the condition of the site prior to the action. For example, a prescribed burn, timed during the dormant phase of the bulb's life cycle and implemented in an area with a dominant nonnative grass cover, could be converted to native grassland supporting Oakland star-tulip. This would have a major beneficial effect on this species.

The proposed fire actions in the forest and woodland areas of Muir Woods FMU would potentially affect California bottlebrush grass, which inhabits understory areas of Douglas-fir and native hardwood forests. Stands and populations of this species appear to be stable, and actions associated with mechanical thinning, pile burning, and prescribed burning could temporarily affect these populations. Long-term alterations in overstory cover, such as through management of Douglas-fir stands within coastal scrub areas, could adversely affect populations found in those areas. However, this native perennial bunchgrass may respond favorably to fuel reductions and thinning, which would clear out new areas of habitat in some areas of the FMU. The adverse impacts of fire management actions in most cases would be minor and short-term due to the limited areas that would be affected, and negligible with inclusion of all mitigation measures. Long-term beneficial impacts would result from fire actions that restore and enhance native plant communities and vegetation structure.

The fire management actions proposed in the FMP would have many long-term benefits in Muir Woods National Monument, including reducing the chances for catastrophic fire in this last contiguous stand of old-growth coast redwood forest in the region. The associated benefits of restoring natural fuel loads and native species composition within the varied vegetation communities would have long-term moderate beneficial impacts on these special status plant species.

Treatment of San Francisco County Project Area. Fuel reduction strategies for San Francisco lands focus on maintaining defensible spaces around buildings (see discussion above) and removing nonnative trees. Mechanical removal would cover between 5 and 10 acres a year, and would be coordinated with specific objectives identified in the Presidio Vegetation Management Plan/Environmental Assessment. The special status plant species that could potentially be affected by these actions are the three federally listed species (Raven's manzanita, Marin dwarf-flax, and San Francisco lessingia), as well as coast rock cress, Franciscan thistle, San Francisco wallflower, and San Francisco gumplant.

All of these species are located within low-growing serpentine coastal scrub, grassland, and rock outcrops where fuel loads are minimal to absent. All occur, however, within the vicinity of nonnative trees that could be considered for removal. Nonnative tree removal could have both direct adverse impacts on individual plants during fuel reduction actions and long-term beneficial impacts through restoration of available habitat for these species. Trees in these areas capture moisture from fog, shade normally sunny or exposed sites, and change soil chemistry through the addition of tannins and oils from leaf and bark litter. Removal of trees, with follow-up site management to control other nonnative species, could restore the physical attributes of these coastal sites to conditions more favorable for each of the special status plant species.

The limited population extent of each special status plant species within the GGNRA-managed lands of San Francisco, along with annual mapping and monitoring of each population within the FMP planning area, enable fire managers to avoid these populations during fire management actions. These projects

would require careful planning and consideration of all potential changes in habitat conditions prior to any trees being removed from the vicinity of a special status plant species site. Further consultation with the USFWS would be required before conducting small research burns specified in the objectives of approved recovery plans for these species. This consultation would evaluate the potential for habitat enhancement through burning, which could have a beneficial effect. The potential associated impacts related to tree removal in the vicinity of Raven's manzanita, Marin dwarf-flax, and San Francisco lessingia would also require further consultation. While unlikely, these direct impacts could be extremely damaging and must be avoided

Overall, the fuel reduction actions for San Francisco lands, in association with careful planning and implementation of these projects when in the vicinity of special status plant species, would have a long-term minor beneficial impact on these species due to the elimination of competing plants and their increased fuel load, resulting in a reduction of risk of unplanned fire effects, as well as removal of nonnative trees and their effects.

Public Information and Fire Education Programs. No impact on any plant special status species is expected from the distribution of fire information or education.

Fire Cache. Centrally locating the fire cache and management personnel within GGNRA would allow for faster response time to wildfires, implying less potential for higher-intensity and larger fires and smaller associated impacts from suppression activities. The use of existing buildings for the fire cache would avoid impacts on special status plant species from construction activities. Fire cache relocation would have indirect, minor beneficial impacts on all special status plant species within the planning area.

Fire Effects Monitoring. There would be some direct trampling and disturbance effects associated with onsite monitoring of vegetation and fuels, although these would be relatively minor and the timing of monitoring would influence the intensity of these effects. For example, conducting fieldwork during early spring growth when herbaceous species are easily crushed and soils are wet and erodible would have a very localized minor adverse effect. The knowledge gained, however, through monitoring and subsequent data analysis would be beneficial to vegetation overall, and to special status plant species through a better understanding of how fire behaves and affects different vegetation communities. Overall, the impacts associated with monitoring fire effects would be minor to moderate, long-term, and beneficial.

Alternative A

Mechanical Fuel Reduction. Mechanical treatment would continue in the nonnative forests in Marin, San Francisco, and San Mateo counties; the coast redwood and Douglas-fir stands at Muir Woods National Monument; and the grassland and coastal scrub, and chaparral communities in all three counties, with an emphasis on Marin County. The focus of mechanical treatments – removal of eucalyptus, Monterey pine and cypress, acacia, and other flammable trees along the urban interface, with some removal of Scotch and French broom and other nonnative shrubs – would be to reduce fire hazards and limit nonnative species spread through reduction of mature plants. Some work would take place to reduce fire hazards and facilitate implementation of prescribed burns in the Douglas-fir and coast redwood forests of Muir Woods. Soil disturbance would occur during this work due to the use of chipping and hauling equipment, with associated potential for nonnative plant species establishment or spread.

The impacts on special status plant species would be mostly beneficial. Potentially direct short-term adverse impacts on individual plants or populations from mechanical damage through trampling, dragging, and use of heavy equipment would be avoided by incorporating known locations and habitats of each species into the project planning process, and timing work to avoid affecting species in critical phenological periods (flowering, setting seed) within the project area.

Removal of nonnative shrubs in the coastal scrub and grassland and areas of Marin and San Mateo counties would potentially have long-term minor to moderate beneficial impacts on San Francisco wallflower, arcuate bush-mallow, and Choris's popcornflower at Sweeney Ridge, and Oakland star-tulip, coast rock cress, and Franciscan thistle in Marin County through restoration of available habitat, removal of overshading and competing shrubby vegetation, and removal of fuels that could lead to wildland fires with associated suppression impacts that could harm these species. Within the limited chaparral areas of the park, removal of nonnative shrubs and fire road clearing could have direct adverse impacts on Marin manzanita, Glory brush, and Mason's ceanothus, since these species are difficult to distinguish, except when in flower, from the more dominant and widespread chaparral plants. Project planning in this area would include surveys to detect these rare species within proposed thinning areas, and individual plants should be tagged and avoided to prevent inadvertent cutting and removal, such that impacts would be, at worst, adverse and minor to negligible.

California bottlebrush grass would benefit from the same effects within the Douglas-fir and native hardwood forests of Marin, with potentially short-term minor adverse impacts resulting from direct damage to plants, and longer-term beneficial impacts from restoration of understory structure within these stands. Continued efforts to remove nonnative trees along the wildland urban boundary with follow-up reestablishment of native vegetation communities including coastal scrub and grasslands could increase the available habitat for some of these plant species.

The overall effects of mechanical fuel reduction on special status plant species under this alternative would be minor to moderate, long-term, and beneficial.

Pile Burning. Piles of cut vegetation could be burned following mechanical treatments. To prevent impacts from the concentrated heat effects that occur when piles are burned, the piles would be constructed away from sensitive resources, including special status plant species populations. Piles would be limited in size, and would be burned during seasons when the potential for adverse impacts on adjacent native vegetation would be minimal. Pile burns under this alternative would focus only on those plant communities mentioned above in association with mechanical treatments: coastal scrub and chaparral, grasslands, Douglas-fir and coast redwood, and nonnative evergreen forests. The effects on special status plant species, with mitigations (timing, placement, avoidance of known populations), would be the same as those described for mechanical fuel reduction.

Prescribed Burning. The plant communities that could be treated with prescribed fire under this alternative are the grassland and coastal scrub, broadleaf evergreen forest, old-growth redwood forest, second-growth redwood and Douglas-fir, and nonnative forests. Chaparral would not be treated with prescribed fire under this alternative. The primary focus of treatment would be to manage hazardous fuels in strategic locations such as along the wildland urban interface, to mimic the effects of natural fires, and

to aid in controlling nonnative plant species including Scotch broom, French broom, eucalyptus, and cotoneaster.

As with mechanical fuel reduction, the effects of prescribed burns on special status plant species would be variable depending on timing, mitigations, and the species involved. Short-term adverse impacts could occur from direct burning of individual plants, damage associated with soil disturbance from construction of holding lines for burn implementation or mop-up after the burn, and immediate postburn sprouting of nonnative seedlings. However, post-fire (manual) management of these nonnative species, along with direct removal of nonnative competitors and in conjunction with the beneficial role fire plays in maintaining open areas and clearing out unnaturally dense, stimulating reproduction of native species, would ameliorate these effects. Even though individuals of some special status species could be killed by prescribed fire, the removal of competitors has a long-term beneficial effect, as fire-adapted native species return while the competitors often do not (U.S. Geological Survey, National Biological Service 1995).

Lack of prescribed burning within the chaparral areas of the park and within the habitat for three of the park's chaparral-specific locally rare species – Marin manzanita, Glory brush, and Mason's ceanothus – would have long-term minor-to-moderate adverse impacts on these plants and populations. These three species are all fire-adapted, and may be dependent on the heating, seed scarification, and epicormic sprouting that fires create. In particular, glory brush, a small-statured shrub prone to overcrowding and shading by more common ceanothus and manzanita shrubs, could be completely crowded out in a short number of years. Sole reliance on mechanical means to manage this vegetation type would result in a continued decline in the overall health and abundance of these species, despite the continued survival of chaparral structure through both unintentional fires and mechanical thinning.

Although prescribed fires under this alternative would result in direct, long-term benefits on the special status species within burnable areas, the prescribed fires would be limited in scope, would not involve a large component of the total population of each special status species, and would exclude the chaparral-dependent species. As a result, the overall effects would be negligible to minor and beneficial for special status plant species.

Research. Research burns on Harding grass and Scotch and French broom would continue, helping ecologists refine burning prescription parameters to control these species. The research burns could have substantial benefits to the natural coastal scrub and grassland communities both within the park and in the region, with potentially beneficial effects through greater knowledge of fire effects on San Francisco wallflower, arcuate bush-mallow, and Choris's popcornflower at Sweeney Ridge, and Oakland star-tulip, coast rock cress, and Franciscan thistle in Marin County. Alternative A allows for additional research or test plots in each of the six FMUs, although specific research questions have not been formulated for these areas. Research into the effects of fire on SOD would potentially reduce SOD's impacts on the native hardwood Douglas-fir and coast redwood forests of the park, with beneficial effects on California bottlebrush grass. Research burns could also be conducted in San Francisco for federally listed plant species, in concurrence with recovery plan objectives. The overall impacts of research on special status plant species under Alternative A would be long-term, beneficial, and negligible to minor.

Cumulative Impacts. Primary among the past actions that have influenced special status plant species at GGNRA are urban development and loss of habitat continuity, the establishment and overall dominance by nonnative plant species, and fire suppression (in areas that were sustained by fire). Suppression of periodic fires has favored fire-intolerant and nonnative plant species, and allowed the unnatural buildup of both dead and live fuels. Shrub and grassland habitats are experiencing encroachment by fire-intolerant conifers and nonnative trees, with associated impacts on locally rare plant populations with specific habitat requirements. Urban development and landscaping have also reduced the available habitat for these species, with the gradual creation of "islands" of intact vegetation surrounded by infrastructure and associated nonnative species. Populations of rare plants have become isolated from each other, with minimal opportunity for cross-pollination or seed movement. This gradually causes a reduction in the overall adaptability or elasticity of populations to respond to changing environmental conditions, resulting in long-term adverse impacts on population sizes and overall species survival.

Current transportation, trail, and development planning efforts within the park and beyond NPS-managed boundaries would have direct short-term effects on special status plant species within the disturbance area, and long-term direct and indirect effects on vegetation as a whole through potential creation of habitat (through ground disturbance activities) for nonnative plant species encroachment and establishment. However, ongoing efforts to identify mitigations for these projects, such as pre-project weed control, post-project planting and weeding, and use of weed-free products (soils, fill material, and clean equipment), would reduce the potential for these type of impacts. Since special status plants are mapped and monitored on a regular basis, and are considered during site design and avoided wherever possible, these impacts would be minor to negligible. Other ongoing programs, including nonnative plant removal projects within the park, Wildland-Urban Interface Initiative projects on private lands and lands managed by other agencies adjacent to GGNRA-managed lands, and implementation of the Point Reyes National Seashore Fire Management Plan and the Vegetation Management Plan for the Presidio, would beneficially affect the park's vegetation and associated rare plant species.

Conclusion. Limited prescribed burning and mechanical fuel treatments would have minor-to-moderate beneficial long-term impacts on the special status plant species growing within the coastal scrub, grassland, and forested areas of the park. Removal of individual nonnative trees would have a localized minor-to-moderate long-term beneficial impact on the federally listed Raven's manzanita and Marin dwarf-flax, as well as other locally rare species in the Presidio. These beneficial impacts would only occur and persist if mitigation measures for species-specific protection were followed and continued efforts were put forward to remove new nonnative plant recruits after treatments. Average unplanned wildfires and their suppression could have minor, short-term adverse or beneficial impacts on special status plant species. Benefits may result from stimulation of fire-adapted native species, or from the destruction of nonnative plants. Adverse impacts may come from the loss of native species, as well as from crushing, removal, or other physical impacts of suppression actions. Mechanical fuel reduction in Douglas-fir and hardwood forests would result in negligible-to-minor short-term adverse impacts on California bottlebrush grass. The continuation of research and wide application of its results would increase these benefits over a wider geographic area. Reliance on mechanical treatments to manage chaparral areas would have adverse impacts on the rare plants within this community.

Overall, the cumulative effects of past, present, and reasonably foreseeable future actions in conjunction with actions called for in this alternative would have long-term negligible-to-minor and beneficial effects on special status plant species, due in large part to the lack of current fire management actions in many areas of the park, extent of nonnative plant species dominance, and lack of actions focused on nonurban interface areas.

Impairment. No impairment of special status plant species would result from this alternative.

Alternative B

Mechanical Fuel Reduction. Under this alternative, up to 230 acres of vegetation would be mechanically treated. Work would focus on the WUI FMU in Marin, San Francisco, and San Mateo counties (170 acres), the Muir Woods FMU in Marin County (5 acres), and the Park Interior FMU (55 acres). Although the total acreage of mechanical fuel reduction projects per year would be greater than under Alternative A, the direct impacts on special status plant species would be reduced due to the limited nature of actions, with a reduced focus on restoring and sustaining native habitat in the park interior portions of the park in Marin and San Mateo counties. Thus, with the implementation of the mitigation measures described for Alternative A, the impacts on special status plant species under Alternative B would be negligible to minor, long-term, and beneficial.

Pile Burning. The overall effects of pile burning on special status plant species, with mitigations (timing, placement, avoidance of known populations), would be the same as described for Alternative A, but beneficial impacts would be reduced because the scope of Alternative B would be limited to the WUI FMU and developed areas of the park. Impacts would be negligible to minor, long-term, and beneficial.

Prescribed Burning. The areas that could be treated with prescribed fire under Alternative B are limited to the Park Interior and Muir Woods FMUs in Marin County. The Muir Woods FMU treatments and impacts are described above in the “Actions Common to All Alternatives” section. For the Park Interior FMU, acreage that could be treated with prescribed burning under Alternative B would be slightly higher than under Alternative A, with potential actions in the coastal scrub and chaparral, grasslands, native hardwood forest, Douglas-fir and coast redwood, and nonnative evergreen forest communities. As noted above, the primary focus of prescribed burn treatments would be to manage hazardous fuels in strategic locations such as along the interface with the WUI FMU, and adjacent to developments within the park interior areas.

The species-specific effects of prescribed burning in Alternative B would be the same as those described for Alternative A. The primary differences would be the elimination of the opportunity to conduct prescribed burns in San Mateo County, and the addition of conducting burns within the chaparral community of Marin County. Burning in chaparral would have minor, short- and long-term benefits to the chaparral-specific locally rare species – Marin manzanita, Glory brush, and Mason’s ceanothus. These three species are all fire-adapted, and may be dependent on the heating, seed scarification, and epicormic sprouting that fires create. However, limiting management of San Mateo County lands to solely mechanical means could result in the eventual loss of arcuate bush-mallow and other species dependent on open, unshaded rocky outcrops and grasslands. Although prescribed fires under this alternative would result in direct, long-term benefits to the special status species within burnable areas, they would continue

(as with Alternative A) to exclude a large component of the total population of each special status species, and would be limited in scope much as with Alternative A. Despite the benefits within the areas that could be burned, the overall impacts on special status plant species would be the same as described for Alternative A – negligible to minor and beneficial.

Research. Alternative B only allows for burning within Marin County in the Park Interior and Muir Woods FMUs, and in San Francisco for research purposes specific to the federally listed species. This limits applicable research questions that would inform management and protection of all of the park's special status plant species. The overall impacts of research on these species under Alternative B would be beneficial, long-term, and negligible to minor.

Cumulative Impacts. Cumulative impacts would be the same as described for Alternative A.

Conclusion. Overall impacts would be the same as described for Alternative A – long-term, negligible to minor, and beneficial – although burning and its associated benefits could occur within the chaparral areas of the park. Alternative B's confined focus on the urban interface and developed areas of the park and on hazard fuel reduction, and lack of fire as an option within San Mateo County and the WUI FMU, would limit the beneficial effects of fire management actions on special status plant species throughout the park.

Impairment. No impairment of special status plant species would result from this alternative.

Alternative C

Mechanical Fuel Reduction. Despite the increase in acreage of mechanical fuel reduction called for in Alternative C and application of the mitigation measures described for Alternative A, the overall effect on special status plant species under Alternative C would continue to be minor to moderate, long-term, and beneficial (same as Alternative A).

Pile Burning. Piles of cut vegetation could be burned following mechanical treatments, and the overall strategy, implementation, mitigations, and effects would be the same as described for Alternative A. In association with increased mechanical treatments, pile burns under Alternative C would increase substantially over the number called for in Alternatives A or B. Pile burning, with applicable mitigations, would result in short-term direct impacts on the underlying soils, with negligible effects on special status plant species, which would be specifically avoided. Long-term impacts would be minor to moderate and beneficial, in that this work could be conducted throughout the park with overall improvement of vegetation and rare plant habitat through the removal of nonnative species and restoration of vegetation continuity.

Prescribed Burning. The areas that could be treated with prescribed fire under Alternative C would include all areas and FMUs of the park , and the number of potential acres that could be treated annually would increase substantially over the other alternatives. (The Muir Woods FMU treatments and impacts, and the San Francisco research burns, are described above in the "Actions Common to All Alternatives" section.) The opportunity for conducting small-scale research burns and studies within the WUI FMU, in conjunction with larger broadcast burns in the Park Interior FMU, would help create a more seamless blend of management strategies across the park rather than along management zone boundaries. Potential

prescribed burn actions would occur in all vegetation types, and could be used to study and manage special status plant species within these areas of the park. The overall impacts would be minor to moderate, beneficial, and long-term.

Research. As with Alternatives A and B, research burns on a variety of nonnative species would continue, helping ecologists refine burning prescription parameters that could help control these species. Research on the effects of fire treatments on the SOD pathogen could also be conducted throughout the park, with possible reductions in SOD's impacts on the native hardwood, Douglas-fir, and coast redwood forests of the park. Research opportunities under this alternative would include the WUI FMU, with the potential for investigation, for example, into the effects of buildup (and control of) native soil pathogens on special status species that occur within this management unit. Research burns could also be conducted in San Francisco for federally listed plant species, in concurrence with recovery plan objectives. The overall impacts of research on special status plant species under Alternative C would be long-term, beneficial, and minor.

Cumulative Impacts. Cumulative impacts would be the same as described for Alternative A.

Conclusion. Unplanned wildfires and associated suppression activities would continue to have minor, short-term adverse or beneficial impacts on special status plant species, depending on the location of the fire, the timing of the event, and the immediate and long-term impact mitigation measures applied to the site. The substantially increased potential for mechanical fuel treatments (and associated pile burning) that would occur with Alternative C (as compared to Alternatives A or B) would have minor-to-moderate, long-term and beneficial impacts on special status plant species. These beneficial effects would be applied to all areas of the park, rather than focusing simply on the developed and wildland urban interface areas of the park.

The prescribed burn actions proposed under Alternative C, in conjunction with mechanical and pile burn treatments, would have minor-to-moderate, beneficial, and long-term impacts. There would be a greater potential for creation and maintenance of continuous ecologically sustainable stands of native vegetation through the increased opportunity to use a broader range of management tools. Continued studies and research, along with adjustment of burn prescriptions, would result in minor beneficial long-term impacts throughout the park.

Overall, the cumulative effects of past, present, and reasonably foreseeable future actions in conjunction with actions called for under Alternative C would have long-term, moderate, beneficial effects on special status plant species.

Impairment. No impairment of special status plant species would result from this alternative.

Special Status Wildlife Species

Wildlife Species Included in Analysis

The following federally listed wildlife species are included in this analysis.

San Bruno Elfin Butterfly (*Callophrys mossii bayensis*) – Endangered. Fire management actions may have considerable lethal effects on San Bruno elfin butterflies in localized areas in San Mateo County, particularly during the egg and larval stages of their life cycles. Eggs, larvae, and adults would likely be killed during a wildfire or prescribed fire, although the patchy habitat distribution on rocky outcrops may limit the extent of mortality. It is not known whether fire has the potential to enhance habitat for the San Bruno elfin butterfly. It is unlikely that mechanical treatments would occur in San Bruno elfin habitat, but the host plant (*Sedum spathulifolium*) could easily be avoided during treatment.

Mission Blue Butterfly (*Icaricia icaroides missionensis*) – Endangered. Fire management actions may have considerable lethal effects on mission blue butterflies in localized areas, particularly during the egg and larval stages of their life cycles. While most eggs and larvae would be killed during prescribed fire or mechanical removals, the disturbance from these actions may lead to habitat enhancements for the butterfly. These benefits may include increasing the abundance and spatial distribution of *L. albifrons* or other preferred nectar plants, or reducing the incidence of fungal infections on the lupine by killing fungal spores.

Tidewater Goby (*Eucyclogobius newberryi*) – Endangered. Within the planning area, tidewater goby is known only from Rodeo Lagoon in the Marin Headlands. On November 20, 2000, critical habitat for the southern California populations was designated (65 FR 69693), although no critical habitat was designated for northern California.

The USFWS has determined that the principal threats to the tidewater goby include loss and modification of habitat, water diversions, predatory and competitive introduced fish species, habitat channelization, and degraded water quality. Unlike listed salmonids, tidewater gobies are resident fish, and therefore all life history stages could potentially be affected by project activities. Because tidewater gobies are currently only found in Rodeo Lagoon, impacts of fire management activities are restricted to this location.

Coho Salmon, Central California Coast (*Oncorhynchus kisutch*) and Steelhead Trout, Central California Coast (*O. mykiss*) – Threatened. Central California coast coho salmon and Central California steelhead (hereafter referred to as coho and steelhead) occur in several creeks in GGNRA as described in Chapter 3.

To determine the effects of the proposed action on listed salmonid species and designated critical habitat, NPS staff compared habitat potential in absence of the particular actions with the habitat conditions resulting from the proposed actions and mitigation measures. As guidance, staff used essential habitat features for the comparison. The essential features of critical habitat include substrate, water quality, water quantity, water temperature, water velocity, cover/shelter, food, riparian vegetation, space, and safe passage (NOAA Fisheries 1999).

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 for coho salmon and Central California coast steelhead have narrow valley floors, steep hillsides, and abundant rainfall, they are particularly sensitive to the effects that fire can have (e.g., removing vegetation, 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 with applicable mitigations these impacts would be minimized.

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 that 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 Chapter 2, 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 that 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 runoff 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 both to 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.

California Red-Legged Frog (*Rana aurora draytonii*) – Threatened. The planning area supports breeding populations of California red-legged frogs. Past surveys of aquatic and wetland (including riparian) habitats have found red-legged frogs using such habitats in Marin and San Mateo counties. Known breeding populations have been found in the Park Interior and WUI FMUs.

Lands in GGNRA comprise one of the 57 core areas for focused recovery of red-legged frogs established in the Final Recovery Plan for the species (USFWS 2001). Although breeding populations of frogs are present in GGNRA, there are far fewer breeding localities and generally lower abundance than what has been documented in lands managed by PRNS. The significance is that fire management activities could have a more significant impact on the long-term viability of frogs at GGNRA than at PRNS. The planning area has few sites that fall within the definition of proposed critical habitat, which includes essential

aquatic habitat, associated uplands, and dispersal habitat connecting essential aquatic habitat (USFWS 2001).

The types of impacts that fire management activities could have on red-legged frog aquatic habitats are summarized in Table 4-16. These findings are based on the Draft Recovery Plan and proposed critical habitat.

Table 4-16: Potential Impacts on California Red-Legged Frog Habitats from Fire Management Activities

Impact	Habitat Affected and Potential Effect
Emergent vegetation removal	**Breeding/Foraging Habitat** Emergent vegetation is necessary for amplexus and anchoring egg masses. Excessive levels of water may reduce sunlight needed for growth of algae, which is chief larvae food.
Shading vegetation (emergent and bank side) removal	Harmful to adults, mostly, for whom shaded refugia may be critical in drier inland areas during the summer.
Insect habitat vegetation removal	**Foraging Habitat** Harmful to adults and juveniles that mainly feed on invertebrates for which bank side vegetation is prime habitat.
Excess water drawdown in ponds	**Breeding/Foraging Habitat** Leaves egg masses stranded on vegetation. Temporary loss of nonbreeding areas if adults and juveniles are displaced.
Changes to hydrological regime	**Breeding/Foraging Habitat** Pools may dry before metamorphosis is completed. Temporary loss of nonbreeding areas if adults and juveniles are displaced.

Source: NPS, 2004.

A variety of mitigation measures would be used to reduce intensity of adverse impacts to a minor level. All prescribed burn plans and plans for mechanical treatment in a given year would be reviewed and any important riparian areas or other habitat for red-legged frogs would be carefully considered during the planning phase. Under all alternatives, fire management actions would adhere to the mitigation measures outlined in Chapter 2.

San Francisco Garter Snake (*Thamnophis sirtalis tetrataenia*) – Endangered. The San Francisco garter snake is known to occur at Mori Point in San Mateo County, and potentially suitable habitat may be found at other GGNRA localities in San Mateo County. No critical habitat has been designated for the garter snake.

Unlike anadromous fish, the garter snake is a resident species, and all life stages could be potentially affected by project actions. Because San Francisco garter snakes are found only in San Mateo County lands (for the purposes of this project), impacts of fire management activities would be restricted to this location. The recovery plan for the species identifies the alteration and isolation of habitats as the principal reason for the decline of the species (USFWS 1985). These impacts include loss of wetlands and adjacent upland habitat, stream and creek channelization, removal of emergent riparian vegetation, and riprapping of streambanks and shorelines (USFWS 1985). Because California red-legged frogs are an important prey item for this species, effects on red-legged frogs from fire management activities are expected to have cascading effects on the snake.

Marbled Murrelet (*Brachyramphus marmoratus marmoratus*) – Threatened. Marbled murrelets would not be directly affected by fire management activities. However, potential old-growth habitat (in Muir Woods National Monument) may be adversely affected by catastrophic wildfire or beneficially affected by prescribed fire or mechanical treatments that enhance old-growth forest characteristics.

Western Snowy Plover (*Charadrius alexandrinus nivosus*) – Threatened. Snowy plovers, present on Ocean Beach in San Francisco from July through April, could be adversely affected by disturbance from rare fire suppression activity on or near sand dunes at Ocean Beach. Any effects would be minor and of short duration.

California Brown Pelican (*Pelecanus occidentalis californicus*) – Endangered. Large numbers of roosting brown pelicans could be adversely affected by fire management activities, particularly in the Rodeo Beach, Rodeo Lagoon, and Bolinas Lagoon areas during summer and fall, as a result of disturbance from air support and water drafting activities related to fire suppression.

Northern Spotted Owl (*Strix occidentalis caurina*) – Threatened. Northern spotted owls occupy all evergreen forested habitat north of Highway 1 in Marin County. Some forested areas, including Oakwood Valley, have not been adequately surveyed to determine occupancy. Spotted owls in Marin County are known to nest in very small (less than 10 inches diameter at breast height [dbh]) to very large evergreen trees, including California bay, coast live oak, tanbark oak, Douglas-fir, coast redwood, and bishop pine. Spotted owls forage on a variety of small mammals and birds in forested habitat, including riparian areas, as well as in scrub and grassland bordering forested areas. A wide range of fire management activities have the potential to affect spotted owls. Impacts may include habitat alteration from wildfire, prescribed fire, and mechanical treatment; noise associated with suppression activities and mechanical treatment; and potential for widespread habitat destruction from catastrophic wildfire.

Salt Marsh Harvest Mouse (*Reithrodontomys raviventris*) – Endangered. The salt marsh harvest mouse may occur in wetland habitats at Rodeo Lagoon and Bolinas Lagoon and could be affected by wildfire or fire management activities, including prescribed fire; staging; construction of fire lines; use of saltwater, foam, or retardants; and post-fire invasion by nonnative plants.

Actions Common to All Alternatives

Wildland-Urban Interface Initiative. The cooperative Wildland-Urban Interface Initiative would occur under all alternatives and would consist of reducing fuels along the park boundary, inside the park. Most

projects would continue to focus on mechanical fuel removal, understory thinning, and pile burning of flammable trees (primarily nonnative eucalyptus and pines) and brush from areas where lives and property are at risk. The program would affect special status wildlife species as follows.

- **San Bruno Elfin Butterfly.** The removal of nonnative trees could lead to long-term benefits for San Bruno elfin butterflies in some areas by reducing the chances for large, high-intensity burns, and promoting or allowing for the reestablishment of native vegetation communities. Since most of the areas with dense stands of nonnative trees do not currently support San Bruno elfin butterflies, there would no impacts from these actions.

- **Mission Blue Butterfly.** The removal of nonnative trees could lead to long-term benefits for mission blue butterflies in some areas by reducing the chances for large, high-intensity burns, and promoting or allowing for the reestablishment of native vegetation communities. Since most of the areas with dense stands of nonnative trees do not currently support mission blue butterflies, there would not be adverse impacts from these actions, and long-term impacts would be minor and beneficial.

- **Coho Salmon and Steelhead.** Potential adverse impacts may result from Wildland-Urban Interface Initiative activities at locales where listed salmonids and their habitat are present. Mitigation measures, including the requirement for an adequate setback from habitat, would be applied and site-specific correlations developed as needed on a project-by-project basis. Potential impacts would be short-term, minor, and adverse. Long term beneficial effects would occur, however, if removal of nonnative species and native plants were restored.

- **California Red-Legged Frog.** Potential short-term, negligible, adverse impacts may result from Wildland-Urban Interface Initiative activities at locales where red-legged frogs and their habitat are present. Mitigation measures would require pre-approval surveys of all potential habitat areas that could be disturbed and the protection of critical habitat values, with long-term negligible beneficial impacts.

- **San Francisco Garter Snake.** Potential short-term, negligible, adverse impacts may result from Wildland-Urban Interface Initiative activities at locales where San Francisco garter snakes and their habitat are present. Mitigation Measures SS-5, SS-6, and SS-19 would reduce potential for inadvertent take or habitat disturbance, and direct impacts would be short-term and negligible. Long-term, beneficial, minor-to-moderate impacts would occur with habitat restoration.

- **Marbled Murrelet.** Marbled murrelet critical habitat exists on adjacent state park lands in Marin County and on San Francisco watershed and county park lands in San Mateo County. Removal of nonnative trees in forested habitat may have long-term beneficial effects on marbled murrelet habitat by providing long-term enhancement and protection of potential marbled murrelet habitat through reduced risk of catastrophic wildfire in adjacent coast redwood/Douglas-fir forests. Avoidance of impacts on murrelets is addressed by Mitigation Measures SS-20 and SS-21.

- **Northern Spotted Owl.** The removal of eucalyptus and other nonnative trees would have two primary long-term benefits for spotted owls: reducing the chances for large, high-intensity burns, and promoting or allowing for the reestablishment of native vegetation, which may increase the abundance of their preferred prey. Work crews would be a disturbing element for owls in project areas, so Mitigation Measure SS-14 restricts project work during the nesting period. Adverse effects would be short-term and minor. Beneficial impacts would be long-term and minor to moderate.

Defensible Space/Vegetation Clearing Around Structures. These actions would affect special status wildlife species as follows.

- **San Bruno Elfin Butterfly.** Most San Bruno elfin butterfly habitat is located well away from structures. However, there are historic coastal defense structures at Milagra Ridge near elfin butterfly habitat. Clearing of defensible space around coastal defense structures at Milagra Ridge would not occur in San Bruno elfin butterfly habitat (Mitigation Measure SS-28). Since no actions would occur, no impacts would result.

- **Mission Blue Butterfly.** Most mission blue butterfly habitat is on ridgetops well away from most structures. However, there are historic batteries and buildings at Fort Baker, the Marin Headlands, and Milagra Ridge in or adjacent to mission blue butterfly habitat. Clearing defensible space around batteries and buildings could result in the direct take of mission blue butterflies or essential habitat, including host and nectaring plants. Since these buildings are not common, impacts would be minor, although they would be long-term as treatments would be repeated.

- **Coho Salmon and Steelhead.** Coho salmon and steelhead would not be affected by clearing of defensible space around buildings unless work occurred in wetlands along streams or near Rodeo Lagoon. Mitigation measures require adequate buffer and erosion control measures when work is near streams or water bodies.

- **California Red-Legged Frog.** The California red-legged frog would not be affected by clearing of defensible space around buildings unless work occurred in wetlands in or adjacent to red-legged frog habitat. When work is near wetlands, surveying as required by Mitigation Measure SS-33 will occur and identify potential habitat, with short-term, negligible, adverse impacts.

- **Marbled Murrelet.** Marbled murrelets and their potential habitat at Muir Woods National Monument would not be significantly affected by clearing of defensible space unless breeding birds were present and disturbed by increased noise. Mitigation Measure SS-20 restricts noise-generating projects during the breeding season.

- **Northern Spotted Owl.** The creation of defensible spaces around structures would remove vegetation and disturb soil and litter, possibly affecting spotted owl prey. Although spotted owls are known to nest relatively close to roads, trails, and some buildings, much or their home range is typically in less developed areas of the park. Since there are typically not very many buildings located within spotted owl activity centers, impacts from prey reductions or disturbance would be

minor. Impacts would be minor, adverse, and long-term because treatments would need to be repeated. Mitigation Measure SS-14 restricts project actions within the range of nesting northern spotted owls, reducing long-term impacts to negligible.

- **Salt Marsh Harvest Mouse.** The salt marsh harvest mouse would not be affected by clearing of defensible space around buildings unless clearing occurred in potential habitat in wetlands at Rodeo or Bolinas Lagoons.

Roadside Fuel Reduction. Roadside fuel reduction would affect special status wildlife species as follows.

- **San Bruno Elfin Butterfly.** Fuel reduction along fire roads would not occur in San Bruno elfin butterfly habitat. Mitigation Measure SS-28 prohibits fire management actions in elfin butterfly habitat and no impacts would occur.

- **Mission Blue Butterfly.** Mission blue butterfly habitat occurs along several roads and trails in GGNRA. Reducing fuels along fire roads could result in the direct take of mission blue butterflies or essential habitat, including host and nectaring plants. Impacts would be adverse, long-term (because treatments would be repeated), and minor to moderate in extent. Mitigation Measure SS-22 would restrict roadside fuel reduction actions to outside the flight season. All lupine would be avoided year-round.

- **Tidewater Goby.** Indirect impacts on the tidewater goby may occur from increased sedimentation associated with improper maintenance of fire roads and trails in watersheds. Increased sedimentation may lead to the gradual conversion of estuarine habitat to upland habitats. With mitigation measures addressing erosion and site stabilization, such adverse impacts would be minor and these activities would have a beneficial, long-term, and minor effect on wetlands that support the tidewater goby by correcting existing sources of sediments.

- **Coho Salmon and Steelhead.** Improper maintenance of fire roads and trails in watersheds with listed salmonids may result in indirect, adverse impacts on salmonid habitat. Failure of plugged culverts may lead to debris flows in creeks that scour the channels. Fine sediments from fire roads may result in deposition in stream channels and reduce invertebrate productivity and the quality of spawning habitat. With mitigation, such adverse impacts would be addressed and would be short-term and minor to negligible.

- **California Red-Legged Frog.** Potential adverse impacts may result from roadside fuel treatment at locales where red-legged frogs and their habitat are present. These direct impacts may include injury or mortality if red-legged frogs are present during vegetation removal, mowing, and other related activities. With mitigation, which requires pre-approval surveys, flagging of habitat, and retention of vegetative cover, impacts would be reduced to a negligible level.

- **San Francisco Garter Snake.** Potential adverse impacts on San Francisco garter snakes and their prey (red-legged frogs) may result from roadside fuel reduction along fire roads and trails in parts

of San Mateo County. These direct impacts may include injury or mortality if red-legged frogs are present during vegetation removal, mowing, and other related activities. Use of fire roads and trails by motorized vehicles may also result in injury or mortality to snakes found on roads. With Mitigation Measures SS-5, SS-6, and SS-19, impacts would be reduced to a negligible level.

- **Northern Spotted Owl.** Roadside fuel reduction would remove vegetation and disturb soil and litter, possibly affecting the abundance of spotted owl prey. Habitat along these road/trail corridors is already disturbed by human activity and may be of lower quality for some prey species. Fire roads do occur within known spotted owl activity centers. Impacts would be adverse, long-term (because treatments would be repeated), and minor. Activity would be restricted to the non-breeding season and would not substantially alter canopy cover. Smaller-diameter trees would be removed to reduce fuels and woodrat nests would be avoided where feasible.

Suppression. Suppression actions would affect special status wildlife species as follows:

- **San Bruno Elfin Butterfly.** Disturbance from suppression activities could have adverse impacts on San Bruno elfin butterflies. Actions that can result in impacts include construction of fire lines, removal of vegetation, and water or retardant drops from aircraft, and staging. Creating fire lines could result in the direct take of San Bruno elfin butterflies or essential habitat, including host and nectaring plants. In addition, San Bruno elfin butterflies, their eggs, larvae, or host plants could be killed by water or retardant drops. Nonnative plants may adversely affect habitat following fire and/or ground disturbance. It is anticipated that applicable mitigations, which recommend avoidance of elfin butterfly habitat, would result in impacts occurring infrequently and would be short term in duration. Through Mitigation Measure SS-30, local fire agency staffs would be informed about areas of the park that support San Bruno elfin butterfly, with negligible long-term impacts.

- **Mission Blue Butterfly.** Disturbance from suppression activities could have adverse impacts on mission blue butterflies. Actions that can result in impacts include construction of fire lines, removal of vegetation, water or retardant drops from aircraft, and staging. Creating fire lines could result in the direct take of mission blue butterflies or essential habitat, including host and nectaring plants. In addition, mission blue butterflies, their eggs, larvae, or host plants could be killed by water drops. Saltwater drops could adversely affect mission blue butterfly habitat. It is anticipated that impacts would occur infrequently and be short-term in duration. Ground disturbance from wildfire and suppression activities could enhance mission blue butterfly habitat, or could result in adverse impacts on habitat as a result of nonnative plant response to fire and ground disturbance. Post-fire erosion could also have similar adverse or potentially beneficial impacts on mission blue butterfly habitat as a result of increased bare ground and substrate for establishment of host plants. Applicable mitigations such as Mitigation Measure SS-24, which informs local agencies about mission blue butterfly habitat, would minimize adverse impacts, and long-term impacts would be minor and beneficial with rehabilitation of habitat.

- **Tidewater Goby.** Current policies at GGNRA call for suppressing all unplanned ignitions using minimum impact suppression tactics as defined by National Wildfire Coordinating Group (NWCG). Potential adverse impacts may result from unmitigated wildland fire suppression activities. Actions that can result in impacts include water drafting, construction of fire lines, removal of vegetation, and staging. Mitigation measures addressing the tidewater goby (Mitigation Measure SS-32) are described in Chapter 2. With this mitigation, which recommends that local fire agencies avoid using Rodeo Lagoon water if possible, adverse impacts would be negligible and of short-term duration.

  Water drafting in Rodeo Lagoon could result in direct collection of gobies by either hoses or aerial buckets. Mortality would be expected once water is used to extinguish fires. The impacts would be greatest if drafting occurred along the shallow shorelines (water depths of less than 1 meter) where gobies typically concentrate.

- **Coho Salmon and Steelhead.** Current policies at GGNRA call for suppressing all unplanned ignitions using minimum impact suppression tactics as defined by National Wildfire Coordinating Group (NWCG). Potential adverse impacts on listed salmonids may result from unmitigated wildland fire suppression activities. The small streams that provide habitat for coho salmon and central California coast steelhead in the planning area are particularly vulnerable to the effects of fire because they are located in steep confined valleys. Actions that can result in impacts include water drafting, construction of fire lines, removal of woody debris and vegetation, and staging.

  Many of the GGNRA streams supporting salmonids are being used for municipal water supply. During dry years, naturally low summer and fall base flows plus water withdrawals have resulted in loss of juvenile salmonids. Additional water drafting to suppress fires could result in adverse impacts on juvenile salmonids.

  General measures to mitigate suppression impacts on critical habitat and listed salmonids are described in Chapter 2. These mitigations address water drawdown in salmonid streams if possible for suppression actions and post-suppression rehabilitation to avoid soil erosion. Impacts would be minor, adverse, and of short-term duration.

- **California Red-Legged Frog.** Potential adverse impacts on red-legged frogs may result from wildland fire suppression activities and are listed in Table 4-16. Actions that can result in impacts include water drafting, construction of fire lines, removal of woody debris and vegetation, and staging. Although these actions may have adverse effects on red-legged frogs, because of the small amount of acreage of wildfire each year, the effects are expected to be short-term and minor.

- **San Francisco Garter Snake.** San Francisco garter snakes may be adversely affected by fire suppression activities, including staging, fire line construction using heavy equipment, and operation of vehicles off established fire roads, that may crush individual snakes and burrows, particularly during fall and winter. Mitigation Measure SS-19 was developed in consultation with

the USFWS. Local fire agencies would be advised against vehicle use in red-legged frog habitat if at all possible in order to avoid these potential impacts on individual snakes and their habitat.

- **Marbled Murrelet.** Potential marbled murrelet habitat may be adversely affected during suppression activities by the felling of large coast redwood or Douglas-fir trees that could provide future nesting habitat. Impacts would be minor, long-term and adverse. Impacts would be reduced by Mitigation Measure SS-21, which calls for avoidance of tree felling in murrelet habitat. Long-term impacts would be negligible.

- **Western Snowy Plover.** Wildfire suppression activities on Ocean Beach could result in minor temporary impacts due to disturbance of snowy plovers as a result of an increase in the number of vehicles or aircraft above the beach or use of heavy equipment on the beach to reach remote areas or draw water.

- **California Brown Pelican.** Roosting brown pelicans could be adversely affected by disturbance from aircraft operations related to fire suppression, particularly in the Rodeo Beach (Bird Island), Rodeo Lagoon, and Bolinas Lagoon areas. Effects, with the application of Mitigation Measure SS-36, would be minor, short-term, and adverse.

- **Northern Spotted Owl.** Areas of high fuel loading make hotter fires or hot spots within lower-intensity prescribed burns more likely. These hotter fires can have adverse impacts on habitat by reducing canopy closure or destroying owl prey or their habitat. A large catastrophic wildfire in forested habitat could have long-term adverse impacts on spotted owls, their habitat, and potentially their prey base. Disturbance from suppression activities could have adverse impacts on spotted owls, particularly during the breeding season when suppression activities could cause spotted owls to abandon nesting attempts. In the recent past, the average annual acreage burned from wildfires in the park has been quite low, however, and any more than minor adverse impacts from the suppression of wildland fires would be unlikely.

  Small mammals, particularly the dusky-footed woodrat, that are important prey items for the northern spotted owl can be injured or killed when vehicles are traveling to sites or staging areas, or when bulldozers are constructing line. In addition, spotted owls or their prey could be injured or killed by water drops. It is anticipated that in most cases these impacts would occur infrequently. Personnel at fire camps or on suppression crews could provide a source of human food to wildlife, possibly attracting corvids or other nest predators that may depredate spotted owl nests. Impacts on spotted owls from spike camps are expected to be adverse, short-term, and minor. However, locating spike camps away from spotted owl activity centers and providing strict control of food and trash at camps can reduce these impacts. A natural resource advisor present at wildland fires, and incorporation of other applicable mitigation measures described in Chapter 2, would help avoid or reduce impacts from suppression activities.

- **Salt Marsh Harvest Mouse.** The salt marsh harvest mouse, if present at Rodeo or Bolinas Lagoons, could be adversely affected by wildland fire or fire suppression activities from drifting

smoke or actions that affect wetland habitat in these areas. Potential long-term impacts would be negligible.

Treatment of Muir Woods FMU. The fire management strategy for this FMU would affect special status wildlife species as follows:

- **Coho Salmon and Steelhead.** The Muir Woods FMU would be treated by a mix of prescribed fire, mechanical fuel reduction, and understory thinning projects. Both steelhead trout and coho salmon use Redwood Creek within the Muir Woods FMU for summer and winter rearing habitat as well as spawning habitat. Activities that could have adverse impacts include water drafting, construction of fire lines, removal of woody debris and vegetation, and staging actions. Impacts would be minor and short-term in duration with implementation of Mitigation Measures SS-11 through SS-13.

- **California Red-Legged Frog.** The Muir Woods FMU would contain a mix of prescribed fire, mechanical fuel reduction, and understory thinning projects. No red-legged frogs are known to use the Muir Woods FMU, although it is possible that it may be used by dispersing juveniles and adults during the nonbreeding season. No impacts are anticipated.

- **Marbled Murrelet.** Potential marbled murrelet habitat only occurs within the Muir Woods FMU. Fire management activities, including prescribed burning and mechanical fuel reduction, would not adversely affect these species over the long term since these actions would be focused on protecting and enhancing the coast redwood and Douglas-fir trees and forest stands that provide nesting habitat for this species With applicable mitigation measures regarding burn timing to avoid nesting seasons, avoiding felling large trees during suppression activities, and minimizing noise generation in the summer from mechanized equipment, overall impacts on this species would be beneficial, minor, and long-term (see Mitigation Measures SS-20 and SS-21 in Chapter 2).

- **Northern Spotted Owl.** As long as fire actions are conducted outside the breeding season and fall within the constraints listed in Mitigation Measures SS-14 through SS-18 in Chapter 2, fire actions would not have significant adverse impacts, and could have beneficial impacts on the northern spotted owl. Spotted owls would benefit from the reduced risk of catastrophic fire. In addition, spotted owls may benefit from the opening of densely forested areas that may enhance their foraging efficiency or the abundance of their preferred prey, with resultant long-term, negligible-to-minor beneficial impacts.

Treatment of San Francisco County Project Area. There would be no beneficial or adverse effect on any special status wildlife species from fuel reduction strategies for San Francisco lands. Only the western snowy plover occurs in San Francisco, and no fuel reduction activities are proposed for Ocean Beach.

Public Information and Fire Education Programs. There would be no direct beneficial or adverse effect on any special status wildlife species from the public information and education program.

Fire Cache. There would be no beneficial or adverse effect on special status wildlife species from the fire cache relocation.

Fire Effects Monitoring. Fire effects monitoring would affect special status wildlife species as follows.

- **San Bruno Elfin Butterfly.** Some trampling and disturbance would be associated with fire effects monitoring, although these would be infrequent, of short duration, and minor in intensity. Monitoring would likely be conducted during San Bruno elfin flight season since that is the active growing season, but its host plant's habit of growing on rocky outcrops in dense stands of poison oak would limit the likelihood and intensity of impacts, since rock outcrops and barren areas are excluded from consideration when Fire Monitoring Handbook (FMH) plots are being established. *Sedum spathulifolium* is easily identified and trampling avoided. The knowledge gained through fire effects monitoring would be beneficial to developing increased knowledge of San Bruno elfin butterfly habitat and its response to wildfire or prescribed fire. This information would be used to guide future fire management activities in elfin butterfly habitat.

- **Mission Blue Butterfly.** Some trampling and disturbance would be associated with vegetation sampling, although these would be infrequent and of short duration and minor intensity. Vegetation sampling would likely be conducted during mission blue butterfly flight season, since that is the active growing season. Host plants are easily identified during the active growing season and trampling of lupine is easily avoided. The knowledge gained through fire effects monitoring would be beneficial to developing better understanding of mission blue butterfly habitat and its response to wildfire or prescribed fire. This information would be used to guide future fire management activities in mission blue butterfly habitat.

- **Northern Spotted Owl.** The knowledge gained through fire effects monitoring would be beneficial to developing better understanding of spotted owl habitat and its response to wildfire or prescribed fire. This information would be used to guide future fire management activities in spotted owl habitat. No adverse impacts on the northern spotted owls or their habitat are anticipated from fire effects monitoring activities.

Alternative A

Mechanical Fuel Reduction. Under Alternative A, mechanical fuel reduction would affect special status wildlife species as follows.

- **San Bruno Elfin Butterfly.** Mechanical fuel reduction techniques, such as mowing, brush clearing and tree removal, could have some adverse impacts on San Bruno elfin butterflies. Removing vegetation could result in the direct take of San Bruno elfin butterflies or essential habitat, including host and nectaring plants.

  Conversely, mechanical removal of trees and brush to attain target conditions may enhance habitat for San Bruno elfin butterflies by reducing threats from nonnative plants and catastrophic fire, especially from human-caused ignitions that occur in developed areas. When cut vegetation cannot be burned onsite or removed, it may be chipped and distributed over the site. When chips

are spread deeply enough to affect the growth of native plants, San Bruno elfin butterfly foraging may be adversely affected. Goats would eat *Sedum spathulifolium* and other plants that serve as nectar sources. Mitigation Measure SS-28 restricts planned fire management action from areas supporting San Bruno elfin butterfly habitat. Mitigation Measure SS-29 restricts fire management actions from potential San Bruno elfin butterfly habitat. With mitigation, adverse impacts would be minor and short-term, and potential beneficial impacts from reduced risk of catastrophic wildfire and removal of nonnative vegetation would be minor and long-term.

- **Mission Blue Butterfly.** Mechanical fuel reduction techniques, such as mowing, brush clearing and tree removal, could have some adverse impacts on mission blue butterflies. Removing vegetation could result in the direct take of mission blue butterflies or essential habitat, including host and nectaring plants. Conversely, mechanical removal of trees and brush to attain target conditions would enhance habitat for mission blue butterflies by promoting open, unshaded, grassland/coastal scrub habitat and reducing the threat of catastrophic fire, especially from human-caused ignitions that occur in developed areas. When cut vegetation cannot be burned onsite or removed, it may be chipped and distributed over the site. When chips are spread deeply enough to affect the growth of native plants, mission blue butterfly foraging may be adversely affected. Goats would eat lupine and other plants that serve as nectar sources, but the grazing disturbance may benefit lupine in the long term. A maximum of 95 acres would be treated mechanically under Alternative A in Marin and San Mateo counties. Adverse impacts from site disturbance and vegetation removal would be minor and short-term, with long-term beneficial impacts through expansion of mission blue butterfly habitat in the Marin County.

- **Tidewater Goby.** Mechanical fuel reduction techniques, such as mowing, brush clearing and tree removal, could have negligible adverse impacts on tidewater goby as a result of increased sedimentation and vegetation removal in riparian areas and stream corridors. Few acres would be treated in or adjacent to tidewater goby habitat at Rodeo Lagoon. With mitigation, adverse impacts would be negligible. Only hand treatment (no large mechanized equipment) would be used to conduct vegetation removal (e.g., removal of individual trees) in riparian habitat to minimize soil disturbance.

- **Coho Salmon and Steelhead.** Mechanical fuel reduction techniques, such as mowing, brush clearing and tree removal, could have some adverse impacts on coho salmon and steelhead as a result of increased sedimentation and vegetation removal in riparian areas and stream corridors. Only hand treatment (no large mechanized equipment) would be used to conduct vegetation removal (e.g., removal of individual eucalyptus trees) in riparian habitat to minimize soil disturbance. Only a very small proportion of acres to be treated would be in or adjacent to salmonid habitat. With mitigation, impacts would be minor and short-term, with long-term beneficial impacts from restoration of riparian habitat.

- **California Red-Legged Frog.** Mechanical fuel reduction activities such as mechanical tree removal, vegetation clearing, and understory thinning could disturb frogs or alter their habitat. However, the majority of mechanical fuel reduction activities would be conducted outside areas

typically considered as either breeding or non-breeding habitat (e.g., emergent marshes and stream riparian corridors). This treatment would be used in very small areas of potential red-legged frog habitat near buildings to create defensive space; otherwise, breeding habitat of red-legged frogs would not be treated. 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 that could back into wetland and creek habitats. Mechanical treatments may inadvertently kill red-legged frogs, an impact that would be adverse but short-term and minor. With Mitigation Measures SS-5, SS-6, and SS-33 through SS-35, impacts would be reduced to a negligible level.

- **San Francisco Garter Snake.** San Francisco garter snakes may be adversely affected by mechanical fuel reduction activities, including vegetation removal in wetland habitat and operation of heavy equipment and vehicles off of established fire roads, that may crush individual snakes and burrows, particularly during fall and winter. It is expected that only a small proportion of the acres treated would be in or adjacent to San Francisco garter snake habitat. With Mitigation Measures SS-5, SS-6, and SS-19, adverse impacts would be minor and short-term.

- **Marbled Murrelet.** Marbled murrelet potential habitat only occurs within Muir Woods. Mitigation Measures SS-20 and SS-21, which address concerns about noise generation and the felling of trees, would apply under all alternatives and was addressed in the "Actions Common to All Alternatives" section. Long-term, minor, beneficial impacts would result.

- **California Brown Pelican.** The only actions potentially associated with mechanical fuel reduction that may adversely affect California brown pelican roosting areas at Rodeo or Bolinas Lagoons would be potential use of helicopters for tree removal. Mitigation Measure SS-38 recommends that aircraft avoid pelican roosting areas seasonally. Impacts would be short-term, minor, and adverse.

- **Northern Spotted Owl.** Mechanical fuel reduction techniques, such as mowing, brush clearing, and tree removal, could have adverse impacts on spotted owls and their prey species. With mitigation, adverse impacts on their primary food source, the dusky-footed woodrat, would be short-term and minor. Adverse impacts from disturbance to nesting spotted owls would be negligible following mitigation.

  When cut vegetation cannot be burned onsite or removed, it may be chipped and distributed over the site. When chips are spread deeply enough to affect the growth of native plants, spotted owl prey species could be adversely affected. Standard practice for chipping directs chips to be spread as thinly as possible on the site – usually to a depth of not more than 1 inch. Impacts on spotted owls from chipping would therefore be negligible, adverse, and short-term.

  Mechanical removal of trees and brush to attain target conditions would have beneficial impacts on spotted owls by enhancing native habitat and reducing the threat of catastrophic fire, especially from human-caused ignitions that occur in developed areas. Brush clearing may also increase foraging opportunities for spotted owls. Restoration of native plant communities would

also have beneficial indirect impacts on spotted owls by improving conditions for native prey species.

- **Salt Marsh Harvest Mouse.** Mechanical fuel reduction techniques, such as mowing, brush clearing, and tree removal, could have minimal adverse impacts on potential salt marsh harvest mouse habitat as a result of increased sedimentation and vegetation removal in wetland areas. Only a small portion of GGNRA acreage is expected to be in or adjacent to potential salt marsh harvest mouse habitat at Rodeo or Bolinas Lagoons. With mitigation, adverse impacts would be negligible. To minimize soil disturbance, only hand treatment (no large mechanized equipment) would be used to conduct vegetation removal (e.g., removal of individual trees) in riparian habitat.

Pile Burning. Pile burning under Alternative A would affect special status wildlife species as follows.

- **San Bruno Elfin Butterfly.** Piling and burning of downed trees and shrubs could have adverse impacts on San Bruno elfin butterflies. Fire crews, or the actual piles, could kill *Sedum spathulifolium* host plants, including San Bruno elfin butterfly eggs or larvae. Mitigation Measure SS-28 prohibits fire management actions within San Bruno elfin butterfly habitat, so no impacts would occur.

- **Mission Blue Butterfly.** Piling and burning of downed trees and shrubs could have adverse impacts on mission blue butterflies. Fire crews, or the actual piles, could kill lupine host plants, including mission blue butterfly eggs or larvae. The pile-burning methodology should prevent overly hot fires that could sterilize soils and have long-term impacts. With Mitigation Measure SS-23, pile burning would be restricted to barren, disturbed soils, and impacts would be negligible.

- **Coho Salmon and Steelhead.** Pile burning would result in bare areas and ash. If located next to a creek channel, ash would be delivered to streams under wet weather conditions. General mitigation measures for water quality would provide protection along the channel and minimize the areal extent of bare area caused by burn piles. With mitigation, impacts would be short-term, adverse, and negligible.

- **California Red-legged Frog.** Frogs may shelter in piles and be killed when the piles are burned. The impact on the park's frog population would be no more than negligible, however, because breeding areas and adjacent non-breeding areas would be identified and avoided before any pile burning is undertaken. Although pile burning would occur in both Marin and San Mateo counties, none would occur in wetland habitat. With mitigation, impacts would be negligible.

- **San Francisco Garter Snake.** San Francisco garter snakes may shelter in piles and be killed when the piles are burned. The impact on the park's San Francisco garter snake population would be negligible, however, because San Francisco garter snake and red-legged frog habitat would be identified and avoided before any pile burning is undertaken. Although pile burning would occur

in both Marin and San Mateo counties, none would occur in wetland habitat. With mitigation, impacts would be negligible.

- **Northern Spotted Owl.** Piling and burning of downed trees and shrubs may have an adverse effect on some spotted owl prey. Some species, such as small rodents, may take up residence in burn piles between the time the piles 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. The pile-burning methodology described in Mitigation Measure WIL-4 should prevent overly hot fires that could sterilize soils over larger areas, and have long-term impacts. Impacts from pile burning would be short-term, adverse, and minor.

Prescribed Burning. Prescribed burning under Alternative A would affect special status wildlife species as follows.

- **San Bruno Elfin Butterfly.** Prescribed fire would reduce the threat of catastrophic unplanned wildfire and the potential for long-term destruction of San Bruno elfin butterfly habitat. Fires would kill San Bruno elfin eggs and larvae in the burn area. Control actions at the boundaries of prescribed fires, such as the removal of vegetation to construct fire lines, would have adverse, long-term, and minor impacts on San Bruno elfin butterfly habitat. Because very little is known about the response of San Bruno elfins to fire, no prescribed burns would be conducted in San Bruno elfin butterfly habitat and a buffer will be maintained around potential habitat. Prescribed fires in adjacent habitat would have negligible short-term impacts.

- **Mission Blue Butterfly.** Prescribed fire may be an effective tool in protecting and improving mission blue butterfly habitat in the park by helping to reduce unnatural accumulations of fuels, by preventing the encroachment of shrubs into coastal grasslands, and possibly by providing a disturbance that benefits host lupine plants. Prescribed fire would reduce the threat of catastrophic unplanned wildfire and the potential for long-term destruction of mission blue butterfly habitat. Fires would directly kill mission blue butterfly eggs and larvae in the burn area. Because very little is known about the response of mission blue butterflies to fire, only research burns would be conducted in existing mission blue butterfly habitat. With mitigation, any prescribed fires in lands adjacent to habitat would have negligible short-term adverse impacts and long-term moderate beneficial impacts.

- **Tidewater Goby.** Prescribed burning could increase the amount of exposed bare ground that is susceptible to erosion and deposition into Rodeo Lagoon. Only a very small proportion of those acres would be close to Rodeo Lagoon. With mitigation for erosion control, adverse impacts would be short-term and minor.

- **Coho Salmon and Steelhead.** GGNRA would adhere to the mitigation measures described in Chapter 2 when working in salmonid habitat. Despite these mitigation measures, 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

are 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 minimize impacts from erosion and assure that anadromous salmonid species are protected, Mitigation Measure SW-1 would be implemented. This mitigation measure requires that subject matter experts ensure that associated erosion control plans are 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 on salmonids from erosion or impacts on 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 on soils are to avoid steep slopes, time burns to maximize favorable environmental conditions, and use erosion control devices during burns.

Coho salmon and steelhead trout appear to be stable under the current GGNRA management, including fire management actions that have been conducted over the past several years and that 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.

Potential adverse impacts from prescribed burning may result from staging activities, construction of fire lines, and removal of woody debris and vegetation through burning. With mitigation, impacts would be minor and short-term in duration and adverse.

- **California Red-legged Frog.** 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 that would be burned annually under 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. Hotter fires, or fires that may more readily burn unintended areas, could burn riparian habitat. Higher-intensity burns could also result in increased sedimentation in frog habitat. With mitigation, adverse impacts associated with prescribed burning would be short-term and minor. Improvement of habitat through prescribed burning would result in a long-term, beneficial effect.

- **San Francisco Garter Snake.** 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 San Francisco garter snakes, their habitat, and their primary prey, red-legged frogs. San Francisco garter snakes may be adversely affected by prescribed fire activities, including burning of vegetation and operation of heavy equipment and vehicles off of established fire roads, that may crush individual snakes and burrows, particularly during fall and winter. It is expected that only a small proportion of the acres treated would be in or adjacent to potential San Francisco

garter snake habitat. With Mitigation Measures SS-5, SS-6, and SS-19, adverse impacts would be minor and short-term. Long-term impacts would be negligible, beneficial effects due to reduction of wildfire hazard risk.

- **Marbled Murrelet.** Marbled murrelet potential habitat only occurs within Muir Woods. Treatment of Muir Woods would be the same under all alternatives and was addressed in the "Actions Common to All Alternatives" section.

- **California Brown Pelican.** No prescribed fire is planned to occur within areas used by brown pelicans for roosting at Rodeo Lagoon or Bolinas Lagoon. Negligible impacts on roosting birds may occur as a result of drifting smoke.

- **Northern Spotted Owl.** 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). Prescribed fire would reduce the threat of catastrophic unplanned wildfire and the long-term destruction of spotted owl habitat. Under Alternative A, prescribed fire would have beneficial, long-term, and minor impacts on some wildlife species by providing patchy open or early seral stage habitat that may enhance spotted owl foraging in areas of GGNRA most severely altered by fire suppression. Conversely, some spotted owl prey that depend on down wood, dense forests, and ground cover, such as small mammals and ground-nesting birds, would experience localized adverse impacts in the treated areas from displacement – although prescribed fire would also create some new sources for downed dead wood. Any prescribed burning would be conducted outside of the nesting period per Mitigation Measure SS-14. Control actions at the boundaries of prescribed fires, such as the removal of vegetation to construct fire lines, would have short-term, minor, adverse effects, though overall this alternative would have a long-term, minor, beneficial effect on northern spotted owl habitat.

- **Salt Marsh Harvest Mouse.** Prescribed burning could increase the amount of exposed bare ground that is susceptible to erosion and deposition into Rodeo and Bolinas Lagoons. Only a small proportion of those acres would be close to Rodeo or Bolinas Lagoons. With mitigation, adverse impacts would be short-term, negligible, and adverse.

Research. Alternative A would include an element of research into the effects of fire on natural resources. Research under this alternative would lead to better management of native plant communities through the use of fire as a tool to move toward desired conditions. Overall, research would have a beneficial impact, as the results could inform future decision making related to management of habitat for threatened and endangered wildlife species. Since these research burns would be synonymous with the prescribed burning described above, the same mitigations would be applied to protect threatened and endangered wildlife, and the possible adverse impacts would be the same. Overall impacts on threatened and endangered wildlife would be beneficial, long-term, and minor to moderate.

Cumulative Impacts. Other actions combined with Alternative A would have the following effects on special status wildlife species.

- **San Bruno Elfin Butterfly.** The Trails Forever projects, habitat restoration programs, maintenance operations, and potentially some Wildland-Urban Interface Initiative projects adjacent to the park would have the potential to affect the San Bruno elfin butterfly and its habitat in San Mateo County. Since San Bruno elfin butterfly habitat in the park is mapped and monitored on a regular basis, the habitat would be considered and avoided during in-park projects and operations, particularly since it occurs primarily in relatively inaccessible patches on rocky outcrops. Cumulative adverse impacts would be short-term and negligible to minor. Other ongoing programs, including nonnative plant removal projects within the park as well as Wildland-Urban Interface Initiative projects on adjacent parklands, may result in long-term beneficial effects by preventing nonnative vegetation from displacing San Bruno elfin habitat.

- **Mission Blue Butterfly.** The Marin Headlands/Fort Baker Roadway Improvement and Transportation Management Plan, Trails Forever projects, the Fort Baker EIS, Marin County fire management activities, San Francisco Watershed Plan implementation, Wildland-Urban Interface Initiative projects, habitat restoration programs, and maintenance operations all have the potential to affect the Mission blue butterfly and its habitat in Marin and San Mateo counties. The Fort Baker EIS and habitat restoration programs will have significant long-term beneficial effects through restoration and expansion of mission blue butterfly habitat and control of nonnative vegetation. Trails Forever projects, the Transportation Management Plan, maintenance operations, and other agency projects may have moderate-to-major short and/or long-term adverse impacts associated with them that would require substantial mitigation to minimize effects to mission blue butterfly habitat in Marin and San Mateo counties.

- **Tidewater Goby.** The Marin Headlands/Fort Baker Roadway Improvement and Transportation Management Plan, Trails Forever projects, habitat restoration programs, maintenance, structural fire operations, and the proposed Giacomini wetlands restoration project have the potential to affect the tidewater goby and its habitat. The transportation plan may beneficially affect the tidewater goby through slight increases in habitat and substantially reduced sediment and contaminant input into Rodeo Lagoon. Habitat restoration programs are restoring riparian and wetland vegetation along the shoreline. Implementation of best management practices for park maintenance operations and improved facilities for vehicle washing at the fire station at Rodeo Beach will also reduce sedimentation and improve water quality in the lagoon. Tidewater gobies were recently rediscovered on the Giacomini Ranch in areas proposed for tidal wetland restoration. Studies are ongoing to determine habitat requirements and protect and expand the population during the restoration project.

- **Coho Salmon and Steelhead.** Big Lagoon restoration (Redwood Creek watershed), interim flood control actions in Muir Beach, the Comprehensive Transportation Management Plan (CTMP), Trails Forever projects, implementation of the PRNS FMP, Wildland-Urban Interface Initiative projects, habitat restoration programs, and maintenance operations all have the potential to affect coho salmon and/or steelhead and critical habitat.

- **California Red-Legged Frog.** Big Lagoon restoration (Redwood Creek watershed), interim flood control actions in Muir Beach, the Comprehensive Transportation Management Plan (CTMP), Trails Forever projects, implementation of the PRNS FMP, the proposed Giacomini wetland restoration project, Wildland-Urban Interface Initiative projects, habitat restoration programs, and maintenance operations all have the potential to affect the California red-legged frog and its habitat. Interim flood control actions at Muir Beach resulted in unauthorized take of red-legged frogs; formal Section 7 consultation and mitigation measures are currently being initiated to address this take and prevent future occurrences. The Big Lagoon restoration project is proposing to create additional red-legged frog habitat in advance of project implementation. Habitat restoration and maintenance operations seek to avoid impacts on red-legged frogs. The Giacomini wetland restoration project is carefully evaluating alternatives for protection/enhancement of red-legged frog habitat during project planning.

- **San Francisco Garter Snake.** Trails Forever projects, habitat restoration programs (including a proposed project to enhance wetlands at Mori Point for the garter snake and California red-legged frogs), maintenance operations, illegal poaching, interim planning for new GGNRA lands in San Mateo County, as well as the importation of sand and proposed repairs to the Sharp Park golf course by the San Francisco Recreation and Park Department, all have potential to affect San Francisco garter snake habitat in San Mateo County. Trails Forever projects, habitat restoration activities, and interim planning for new lands in San Mateo County are actively working to protect and enhance San Francisco garter snake habitat in cooperation with the U.S. Fish and Wildlife Service.

- **Marbled Murrelet.** Catastrophic wildfire and increasing populations of corvids (ravens, crows, and jays) – all likely related to human-induced changes in the environment – may adversely affect potential marbled murrelet habitat in Marin County. Fire management activities are planned to reduce the risk of catastrophic wildfire.

- **Western Snowy Plover.** Maintenance operations, continued expansion of European beach grass, illegal off-leash dogs, and the Ocean Beach erosion control/managed retreat proposed project have the potential to affect the western snowy plover and its non-breeding habitat on Ocean Beach. The impact of erosion control/managed retreat measures on snowy plovers will be evaluated during project planning. GGNRA continues to enforce the leash law on Ocean Beach but the vast expanse of beach makes this a challenging task.

- **California Brown Pelican.** Intense visitor use of Rodeo Beach, the CTMP, Trails Forever projects, recreational boating on Bolinas Lagoon and near Bird Island, illegal off-leash dogs, the proposed Bolinas Lagoon ecological restoration project, and aircraft overflights have the potential to affect important California brown pelican roosting sites at Bird Island, Rodeo Beach and Lagoon, and Bolinas Lagoon. The CTMP is considering trail reroutes to reduce disturbance to brown pelicans on Rodeo Beach. The Bolinas Lagoon ecological restoration project will include consideration of pelican roosting and foraging habitat needs, and Marin County Open Space District rangers and the Sheriff Department monitor recreational boating on Bolinas Lagoon to

minimize wildlife impacts. The future Air Tour Management Plan to be prepared by the Federal Aviation Administration for GGNRA will consider impacts of air tours on park wildlife.

- **Northern Spotted Owl.** The CTMP, Trails Forever projects, implementation of the PRNS FMP, Wildland-Urban Interface Initiative projects, habitat restoration programs, and maintenance operations all have the potential to affect the northern spotted owl in Marin County. All of these plans, projects, and activities consider spotted owls in their planning and implementation, thus minimizing impacts, particularly during breeding season. Catastrophic wildfire, Sudden Oak Death (caused by an introduced pathogen), increasing populations of corvids (ravens, crows, and jays), expansion in the range of barred owls – all likely related to human-induced changes in the environment – may adversely affect spotted owls in Marin County. Fire management activities and research into fire effects on Sudden Oak Death may reduce the threat from these sources. Corvids and barred owls are more difficult to manage effectively.

- **Salt Marsh Harvest Mouse.** The Marin Headlands/Fort Baker Roadway Improvement and Transportation Management Plan, Trails Forever projects, habitat restoration programs, maintenance operations, and the proposed Bolinas Lagoon ecological restoration project may affect potential salt marsh harvest mouse habitat at Rodeo and Bolinas lagoons. The transportation plan may beneficially affect the availability of salt marsh harvest mouse through slight increases in habitat and substantially reduced sediment and contaminant input into Rodeo Lagoon. Habitat restoration programs are restoring riparian and wetland vegetation along the shoreline.

Conclusion. In summary, Alternative A would have the following effects on special status wildlife species.

- **San Bruno Elfin Butterfly.** Flexible fire suppression has the potential for numerous short-term, adverse impacts on San Bruno elfin butterflies. These adverse impacts are expected to be minor based on the limited number of wildfires that have occurred annually in the park. Compared with suppression actions, however, preventing a catastrophic fire in the park probably offers a greater long-term benefit to the park's San Bruno elfin butterflies. The impacts of community projects funded by the federal Wildland-Urban Interface Initiative would be beneficial, long-term, and minor. The public information and education program and fire behavior monitoring program would have beneficial, long-term, and minor impacts on the park's San Bruno elfin butterflies.

  Mechanical fuel reduction, prescribed burning, pile burning, and research burns would not occur directly in areas supporting San Bruno elfin butterfly habitat, but may occur in adjacent habitat. With mitigation, adverse impacts would be negligible to minor and short-term. Potential beneficial impacts from reduced risk of catastrophic wildfire and removal of nonnative vegetation would be minor and long-term.

- **Mission Blue Butterfly.** Flexible fire suppression has the potential for numerous short-term, adverse impacts on mission blue butterflies. These adverse impacts would be minor based on the limited number of wildfires that occur annually in the park. Compared with suppression actions,

however, preventing a catastrophic fire in the park probably offers a greater long-term benefit to the park's mission blue butterflies. Having the flexibility to allow some wildfires in the park interior to burn to enhance natural resources would benefit wildlife, but is not a feasible option with the proximity of neighboring communities to all areas of the park. The impacts of community projects funded by the federal Wildland-Urban Interface Initiative would be beneficial, long-term, and minor. Clearing defensible space around structures and roadway fuel reductions would have long-term, adverse, and minor-to-moderate impacts on mission blue butterflies. The public information and education program, fire cache relocation, and fire behavior monitoring program all would have beneficial, long-term, and minor impacts on the park's mission blue butterflies.

Adverse impacts mission blue butterflies and their habitat from site disturbance and vegetation removal associated with mechanical fuel reduction and prescribed fire would be minor and short-term following mitigation, with moderate, long-term, beneficial impacts through protection and expansion of mission blue butterfly habitat. Pile burning would not be conducted in mission blue butterfly habitat; impacts would be negligible. Only research burns would be conducted in mission blue butterfly habitat supporting host plants. Research burns conducted in existing mission blue butterfly habitat would have short to long-term adverse impacts on mission blue butterflies by killing their eggs or larvae. Burning less than 5 percent of existing habitat in any one year, under an approved research plan, would minimize impacts. Research burns may result in long-term beneficial effects on mission blue butterflies by returning the site to a more favorable early seral stage and potentially reducing fungal pathogens that periodically cause significant die-back of host plants.

- **Tidewater Goby.** Adverse impacts from mechanical fuel reduction, prescribed burning, pile burning, and fire research would be short-term and negligible to minor following mitigation, since none of these activities would occur directly within tidewater goby habitat.

- **Coho Salmon and Steelhead.** Mechanical fuel reduction would result in short-term, minor adverse impacts resulting from potential disturbance to soils and vegetation in riparian areas, with long-term beneficial impacts from restoration of riparian habitat through removal of nonnative trees. Potential adverse impacts of prescribed burning and research burns would be reduced to minor and short-term through appropriate mitigation. Pile burning would not be conducted in riparian areas, thus resulting in negligible impacts on coho and steelhead.

- **California Red-Legged Frog.** Mechanical fuel reduction, prescribed fire, and research burns may result in short-term, negligible-to-minor adverse impacts related to disturbance in or adjacent to red-legged frog habitat, and long-term, minor beneficial impacts by reducing the threat of catastrophic wildfire that could adversely affect wetland habitat. Pile burning would not be conducted in wetland habitat; associated impacts would be negligible.

- **San Francisco Garter Snake.** Mechanical fuel reductions, use of prescribed fire, research burns, associated vegetation removal, and heavy equipment operation have the potential for adverse, minor, short-term impacts on the San Francisco garter snake following mitigation. Long-term,

minor beneficial impacts would result from these actions by reducing the threat of catastrophic wildfire that could adversely affect garter snake habitat. Pile burning would not be conducted in wetland habitat and San Francisco garter snake habitat would be avoided; associated impacts would be negligible.

- **Marbled Murrelet.** Impacts on marbled murrelets are addressed in the "Actions Common to All Alternatives" section above. Impacts would be mitigated by Mitigation Measure SS-20, which limits actions to non-nesting months and less sensitive periods of the day. Mitigation Measure SS-21 preserves large diameter trees in murrelet habitat. Impacts are limited to projects in the Muir Woods FMU and would be negligible.

- **Western Snowy Plover.** The only potential impacts on western snowy plovers would be from suppression activities that are common to all alternatives. Plovers would not be affected by any other actions in Alternative A.

- **California Brown Pelican.** By avoiding use of helicopters for mechanical fuel reduction in areas adjacent to Bird Island and Rodeo and Bolinas Lagoons, impacts on roosting brown pelicans would be negligible. Impacts from drifting smoke during prescribed burns, pile burning, or research burns would also be negligible, adverse, and short-term.

- **Northern Spotted Owl.** Flexible fire suppression has the potential for numerous short-term, adverse impacts on spotted owls. These adverse impacts are expected to be minor based on the limited number of wildfires that occur annually in the park. Compared with suppression actions, however, preventing a catastrophic fire in the park probably offers a greater long-term benefit to the park's wildlife. Having the flexibility to allow some wildfires in the park interior to burn to enhance natural resources would benefit wildlife, but is not a feasible option with the close proximity of neighboring communities to all areas of the park. The fire management strategy for Muir Woods would provide long-term benefits to spotted owls, mainly associated with restoring fire to the ecosystem, which outweigh some of the adverse impacts of mechanical removals and prescribed fire. The impacts of community projects funded by the federal Wildland-Urban Interface Initiative would be beneficial, long-term, and minor. Clearing defensible space around structures and reducing roadway fuel would have long-term, adverse, minor impacts on spotted owls. The public information and education program, fire cache location, and fire behavior monitoring program all would have beneficial, long-term, and minor impacts on the park's spotted owls.

  Adverse impacts associated with vegetation removal and disturbance during mechanical fuel reduction, prescribed fire, and research burns, as well as pile burning, would be minor and short-term following mitigation. Long-term, minor beneficial impacts on spotted owls and their prey would result from native habitat restoration and enhancement and the reduced threat of catastrophic wildfire.

- **Salt Marsh Harvest Mouse.** Adverse impacts from mechanical fuel reduction, prescribed burning, pile burning, and fire research would be short-term and negligible to minor following

mitigation, since none of these activities would occur directly within potential salt marsh harvest mouse habitat.

Impairment. No impairment to any threatened and endangered species would occur under Alternative A.

Alternative B

Mechanical Fuel Reduction. Under Alternative B, mechanical fuel reduction would affect special status wildlife species as follows.

- **San Bruno Elfin Butterfly.** Impacts would be similar to those described for Alternative A. No areas supporting San Bruno elfin butterfly habitat would be targeted for mechanical fuel reduction per mitigation measure SS-28. Impacts and mitigations would be the same as described for Alternative A.

- **Mission Blue Butterfly.** Impacts would be similar to those described for Alternative A, with a slight increase in the extent of impacts as the amount of land that could be treated under Alternative B is more than twice that of Alternative A. Adverse impacts from site disturbance and vegetation removal would still be minor and short-term, with potential for greater long-term beneficial impacts through expansion of mission blue butterfly habitat in the Marin County. Mitigations would be the same as described for Alternative A.

- **Tidewater Goby.** Of the acres identified to be treated mechanically in Marin County annually under Alternative B, little to none are expected to be in or adjacent to tidewater goby habitat at Rodeo Lagoon. Impacts and mitigations would be the same as described for Alternative A.

- **Coho Salmon and Steelhead.** Impacts would be similar to those described for Alternative A, with a slight increase in the extent of impacts as the amount of land that could be treated under Alternative B is more than twice that of Alternative A. However, only a small proportion of the treated acres would include or adjoin salmonid habitat. Adverse impacts from site disturbance and vegetation removal would still be minor and short-term, with potential for greater long-term beneficial impacts through restoration of riparian habitat by removal of nonnative vegetation. Mitigations would be the same as described for Alternative A.

- **California Red-Legged Frog.** The majority of mechanical fuel reduction activities called for in Alternative B would be conducted outside areas typically considered as either breeding or nonbreeding habitat (e.g., emergent marshes and stream riparian corridors). Impacts and mitigations would be the same as described for Alternative A.

- **San Francisco Garter Snake.** It is expected that only a small proportion of the acres to be treated in Alternative B would include or adjoin San Francisco garter snake habitat. Impacts and mitigations would be the same as described for Alternative A.

- **Marbled Murrelet.** Potential marbled murrelet habitat only occurs within Muir Woods. Treatment of Muir Woods would be the same under all alternatives and is addressed in the

"Actions Common to All Alternatives" section above. With the identified mitigations, adverse impacts on marbled murrelets and their habitat would be negligible, and long-term impacts would be beneficial because the risk of catastrophic wildfire in old-growth forest would be reduced.

- **California Brown Pelican.** The only actions potentially associated with mechanical fuel reduction that may adversely affect California brown pelican roosting areas at Rodeo or Bolinas Lagoons would be use of helicopters for tree removal. Impacts and mitigations would be the same as described for Alternative A.

- **Northern Spotted Owl.** Impacts would be similar to those described for Alternative A, with a slight increase in the extent of both adverse and beneficial impacts as the amount of land that could be treated under Alternative B is about twice that of Alternative A. Mitigations would be the same as described for Alternative A.

- **Salt Marsh Harvest Mouse.** Under Alternative B, little to none of the acreage to be treated is expected to include or adjoin salt marsh harvest mouse habitat at Rodeo Lagoon. Impacts and mitigations would be the same as described for Alternative A.

Pile Burning. Pile burning under Alternative B would affect special status wildlife species as follows.

- **San Bruno Elfin Butterfly.** Impacts and mitigations would be the same as described for Alternative A.

- **Mission Blue Butterfly.** Impacts and mitigations would be the same as described for Alternative A.

- **Coho Salmon and Steelhead.** Impacts and mitigations would be the same as described for Alternative A.

- **California Red-Legged Frog.** Impacts and mitigations would be the same as described for Alternative A.

- **San Francisco Garter Snake.** While the acreage subject to mechanical fuel reduction and pile burning under Alternative B would be double that under Alternative A, most of it would occur in Marin County. The objectives of fuel reduction and pile burning suggest that San Francisco garter snake habitat is unlikely to be targeted for these activities. Any adverse impacts would be minor and short-term, while some long-term beneficial impacts may result from concurrent restoration of native habitats. Mitigations would be the same as described for Alternative A.

- **Marbled Murrelet.** Potential marbled murrelet habitat only occurs within Muir Woods. Treatment of Muir Woods would be the same under all alternatives and is addressed in the "Actions Common to All Alternatives" section above.

- **California Brown Pelican.** Pile burning would not be conducted within California brown pelican roosting habitat. Effects from drifting smoke would be negligible.

- **Northern Spotted Owl.** Impacts would be similar to those of Alternative A, with a slight increase in the extent of adverse impacts from disturbance and drifting smoke, since the amount of pile burning under Alternative B could be double the amount under Alternative A. Impacts and mitigations would be the same as described for Alternative A.

Prescribed Burning. Prescribed burning under Alternative B would affect special status wildlife species as follows.

- **San Bruno Elfin Butterfly.** No prescribed burning is planned in San Mateo County under Alternative B, so the San Bruno elfin butterfly would not be affected.

- **Mission Blue Butterfly.** Prescribed fire would not be used in Wildland-Urban Interface Initiative areas. No prescribed burning would occur in San Mateo County. Impacts and mitigations would be the same as described for Alternative A.

- **Tidewater Goby.** Only a very small proportion of acres subject to prescribed burning would be close to Rodeo Lagoon. Impacts and mitigations would be the same as described for Alternative A.

- **Coho Salmon and Steelhead.** Prescribed fire would not be used in Wildland-Urban Interface Initiative areas. No prescribed burning would occur in San Mateo County. Impacts and mitigations would be the same as described for Alternative A.

- **California Red-Legged Frog.** Prescribed fire would not be used in Wildland-Urban Interface Initiative areas. No prescribed burning would occur in San Mateo County. Impacts and mitigations would be the same as described for Alternative A.

- **San Francisco Garter Snake.** No prescribed burning is planned in San Mateo County under Alternative B, so the San Francisco garter snake would not be affected.

- **Marbled Murrelet.** Potential marbled murrelet habitat only occurs within Muir Woods. Treatment of Muir Woods would be the same under all alternatives and is addressed in the "Actions Common to All Alternatives" section above.

- **Western Snowy Plover.** The western snowy plover would not be affected by research burns in San Francisco.

- **California Brown Pelican.** No prescribed fire is planned to occur within areas used by brown pelicans for roosting at Rodeo Lagoon or Bolinas Lagoon. Negligible impacts on roosting birds may occur as a result of drifting smoke.

- **Northern Spotted Owl.** The majority of prescribed burning in spotted owl habitat would be within Muir Woods National Monument. Impacts and mitigations would be the same as described for Alternative A.

- **Salt Marsh Harvest Mouse.** Only a very small proportion of acres subject to prescribed burning would be close to Rodeo Lagoon. Impacts and mitigations would be the same as described for Alternative A.

Research. Alternative B would include an element of research into the effects of fire on natural resources only in the Muir Woods and Park Interior FMUs in Marin County. Research under this alternative would lead to better management of native plant communities through the use of fire as a tool to move toward desired conditions. Overall, research would have a beneficial impact, as the results could inform future decision making related to management of habitat for threatened and endangered wildlife species. Since these research burns would be synonymous with the prescribed burning described above, the same mitigations would be applied to protect threatened and endangered wildlife, and the possible adverse impacts would be the same. Overall impacts on threatened and endangered wildlife would be beneficial, long-term, and minor to moderate.

Cumulative Impacts. Cumulative effects on special status wildlife species resulting from other actions combined with Alternative B would be the same as described for Alternative A.

Conclusion. In summary, Alternative B would have the following effects on special status wildlife species.

- **San Bruno Elfin Butterfly.** Impacts would be similar to those for Alternative A, with the potential for a slight increase in the extent of impacts as the amount of land that could be treated mechanically under Alternative B is about twice as much as in Alternative A. With mitigation, adverse impacts would still be minor and short-term. Beneficial impacts would be the same as in Alternative A.

- **Mission Blue Butterfly.** Adverse impacts from mechanical fuel reduction in Alternative B would be slightly greater than in Alternative A since more than twice the acreage would be treated mechanically, but still minor and short-term following mitigation. The long-term beneficial impacts from potential expansion of mission blue butterfly habitat would be greater in Alternative B. Impacts from prescribed burning, pile burning, and fire research would be the same as in Alternative A.

- **Tidewater Goby.** Impacts would be the same as described for Alternative A.

- **Coho Salmon and Steelhead.** Impacts would be similar to those for Alternative A, with a slight increase in the extent of impacts as the amount of land that could be treated mechanically under Alternative B is more than twice the amount in Alternative A. With mitigation, adverse impacts from site disturbance and vegetation removal would still be minor and short-term, with potential for greater long-term beneficial impacts through restoration of riparian habitat by removal of nonnative vegetation.

- **California Red-Legged Frog.** Impacts would be the same as described for Alternative A.

- **San Francisco Garter Snake.** Even though twice as many acres may be treated mechanically in San Mateo County, impacts associated with mechanical fuel reduction and pile burning would be the same as in Alternative A since San Francisco garter snake habitat is unlikely to be targeted for these activities. Prescribed burning and research burns would not occur in San Mateo County under Alternative B, so there would be no associated impacts.

- **Marbled Murrelet.** Impacts on marbled murrelets are addressed in the "Actions Common to All Alternatives" section, since the only potential nesting habitat occurs within Muir Woods National Monument.

- **Western Snowy Plover.** Impacts would be the same as described for Alternative A.

- **California Brown Pelican.** Impacts would be the same as described for Alternative A.

- **Northern Spotted Owl.** Impacts from mechanical fuel reduction and pile burning would be similar to those described for Alternative A following mitigation, with a slight increase in the extent of both adverse and beneficial impacts, as the amount of land that could be treated mechanically under Alternative B is about twice as much as in Alternative A. Impacts associated with prescribed burning and fire research would be the same as in Alternative A.

- **Salt Marsh Harvest Mouse.** Impacts would be the same as described for Alternative A.

Impairment. No impairment of any threatened and endangered species would occur under Alternative B.

Alternative C

Mechanical Fuel Reduction. Under Alternative C, mechanical fuel reduction would affect special status wildlife species as follows.

- **San Bruno Elfin Butterfly.** Impacts and mitigations would be the same as described for Alternative A.

- **Mission Blue Butterfly.** Impacts would be similar to those of Alternative A, though greater in extent, with a moderate increase in the amount of land that could be treated compared to Alternative A. Adverse impacts from site disturbance and vegetation removal would still be minor and short-term because most mechanical fuel reduction would not occur in areas mapped as existing or potential mission blue butterfly habitat. Alternative C has the potential to result in minor-to-moderate long-term beneficial impacts through potential expansion of mission blue butterfly habitat in Marin and San Mateo counties. Mitigations would be the same as described for Alternative A.

- **Tidewater Goby.** Little to no acres treated are expected to include or adjoin tidewater goby habitat at Rodeo Lagoon. Impacts and mitigations would be the same as described for Alternative A.

- **Coho Salmon and Steelhead.** Impacts would be similar to those of Alternative A, though greater in extent, with a moderate increase in the amount of land that could be treated under Alternative C. Adverse impacts from site disturbance and vegetation removal would still be minor and short-term, since only a small proportion of those acres would include or adjoin salmonid habitat. Alternative C has the potential for the greatest long-term beneficial impacts through restoration of riparian habitat affected by nonnative vegetation. Impacts and mitigations would be the same as described for Alternative A.

- **California Red-Legged Frog.** The majority of mechanical fuel reduction activities would be conducted outside areas typically considered as either breeding or non-breeding red-legged frog habitat (e.g., emergent marshes and stream riparian corridors). Impacts and mitigations would be the same as described for Alternative A.

- **San Francisco Garter Snake.** Impacts and mitigations would be the same as described for Alternatives A.

- **Marbled Murrelet.** Potential marbled murrelet habitat only occurs within Muir Woods. Treatment of Muir Woods FMU would be the same under all alternatives and is addressed in the "Actions Common to All Alternatives" section above.

- **California Brown Pelican.** The only actions potentially associated with mechanical fuel reduction that may adversely affect California brown pelican roosting areas at Rodeo or Bolinas Lagoons would be use of helicopters for tree removal. Impacts and mitigations would be the same as described for Alternative A.

- **Northern Spotted Owl.** Impacts would be similar to those of Alternative A, with a slight increase in the extent of both adverse (short-term, minor) and beneficial impacts (long-term, minor) as the amount of land that could be treated under Alternative C is greater than under Alternative A. Mitigations would be the same as described for Alternative A.

- **Salt Marsh Harvest Mouse.** Few to none of the acres to be treated under this alternative are expected to be in or adjacent to salt marsh harvest mouse habitat at Rodeo Lagoon. Impacts and mitigations would be the same as described for Alternative A.

Pile Burning. Pile burning under Alternative C would affect special status wildlife species as follows.

- **San Bruno Elfin Butterfly.** Impacts and mitigations would be the same as described for Alternative A.

- **Mission Blue Butterfly.** Impacts and mitigations would be the same as described for Alternative A.

- **Coho Salmon and Steelhead.** Although significantly more areas would be treated mechanically and subject to pile burning under Alternative C compared to Alternative A, riparian habitat

mitigations would adequately protect salmonid habitat. Impacts and mitigations would be the same as described for Alternative A.

- **California Red-Legged Frog.** Although significantly more areas would be treated mechanically and subject to pile burning under Alternative C compared to Alternative A, wetland habitat mitigations would adequately protect red-legged frog habitat. Impacts and mitigations would be the same as described for Alternative A.

- **San Francisco Garter Snake.** The acreage in San Mateo County that would be subject to mechanical treatment and subsequent pile burning annually under Alternative C would be the same as under Alternative A. Impacts and mitigations would be the same as described for Alternative A.

- **Marbled Murrelet.** Potential marbled murrelet habitat only occurs within Muir Woods. Treatment of Muir Woods FMU would be the same under all alternatives and is addressed in the "Actions Common to All Alternatives" section above.

- **California Brown Pelican.** Pile burning would not be conducted within California brown pelican roosting habitat. Effects from drifting smoke would be negligible.

- **Northern Spotted Owl.** Impacts would be similar to those of Alternative A, with a slight increase in the extent of short-term, minor adverse impacts from disturbance and drifting smoke as the amount of pile burning under Alternative C would be greater than the amount under Alternative A. Mitigations would be the same as described for Alternative A.

Prescribed Burning. Prescribed burning under Alternative C would affect special status wildlife species as follows.

- **San Bruno Elfin Butterfly.** Alternative C would allow prescribed burning on almost three times the acreage called for in Alternative A. However, prescribed burns would not occur directly within existing or potential San Bruno elfin butterfly habitat. Impacts and mitigations would be the same as described for Alternative A.

- **Mission Blue Butterfly.** Only research burns would be conducted in existing mission blue butterfly habitat (habitat supporting host plants). Adverse impacts would be the same as described for Alternative A, while long-term, moderate, beneficial impacts may potentially be much greater due to use of fire to control nonnative plants and to manage adjacent grassland/scrub habitat to improve and restore habitat for the mission blue butterfly. Mitigations would be the same as described for Alternative A.

- **Tidewater Goby.** Only a very small proportion of the acres proposed for treatment in Alternative C would be close to Rodeo Lagoon. Impacts and mitigations would be the same as described for Alternative A.

- **Coho Salmon and Steelhead.** Impacts would be similar to those described for Alternative A, with a slight increase in the extent of adverse (short-term, minor) impacts, and an increase in beneficial impacts (long-term, moderate) as the overall amount of land that could be treated under Alternative C by prescribed burning is almost three times that of Alternative A. However, it is expected that only a small proportion of the acres treated would include or adjoin salmonid habitat. Mitigations would be the same as described for Alternative A.

- **California Red-Legged Frog.** Impacts and mitigations would be the same as described for Alternative A.

- **San Francisco Garter Snake.** It is expected that only a small proportion of the acres treated would include or adjoin potential San Francisco garter snake habitat. Impacts and mitigations would be the same as described for Alternative A.

- **Marbled Murrelet.** Potential marbled murrelet habitat only occurs within Muir Woods. Treatment of Muir Woods FMU would be the same under all alternatives and is addressed in the "Actions Common to All Alternatives" section above. Impacts would be negligible.

- **Western Snowy Plover.** No prescribed burning, aside from research burns associated with federally listed plant species, is planned in San Francisco County under Alternative C, so the western snowy plover would not be affected.

- **California Brown Pelican.** No prescribed fire is planned to occur within areas used by brown pelicans for roosting at Rodeo Lagoon or Bolinas Lagoon. Negligible impacts on roosting birds may occur as a result of drifting smoke.

- **Northern Spotted Owl.** Impacts would be similar to those of Alternative A, with a slight increase in the extent of both adverse (short-term, minor) and beneficial impacts (long-term, minor) as the overall amount of land that could be treated under Alternative C is nearly three times that of Alternative A. However, the majority of prescribed burning in spotted owl habitat would be within Muir Woods National Monument. Mitigations would be the same as described for Alternative A, and the impacts would be the same.

- **Salt Marsh Harvest Mouse.** Only a very small proportion of those acres that would be treated by prescribed burning would be close to potential salt marsh harvest mouse habitat at Rodeo or Bolinas Lagoons. Impacts and mitigations would be the same as described for Alternative A.

Research. Alternative C would include an element of research into the effects of fire on natural resources in both Marin and San Mateo counties in both the WUI and Park Interior FMUs. Research under this alternative would lead to better management of native plant communities through the use of fire as a tool to move toward desired conditions. Overall, research would have a beneficial impact, as the results would inform future decision making related to management of habitat for threatened and endangered wildlife species. Since these research burns would be synonymous with the prescribed burning described above, the same mitigations would be applied to protect threatened and endangered wildlife, and the possible

adverse impacts would be the same. Overall impacts on threatened and endangered wildlife would be long-term, beneficial, and minor to moderate.

Cumulative Impact. Cumulative impacts would be the same as described for Alternative A.

Conclusion. In summary, Alternative C would have the following effects on special status wildlife species.

- **San Bruno Elfin Butterfly.** Impacts associated with fire management actions would be the same as described for Alternative A.
- **Mission Blue Butterfly.** Impacts associated with mechanical fuel reduction and pile burning would be similar to those described for Alternative A, though greater in extent, with a moderate increase in the amount of lands that could be treated under Alternative C. Adverse impacts from site disturbance and vegetation removal would still be minor and short-term. Alternative C has the greatest potential to result in minor-to-moderate long-term beneficial impacts, since it incorporates the most extensive use of mechanical treatment, prescribed fire, and research burns that could be used to improve and expand mission blue butterfly habitat.
- **Tidewater Goby.** Impacts would be the same as under Alternative A.
- **Coho Salmon and Steelhead.** Overall impacts of mechanical fuel treatment, pile burning, use of prescribed fire, and fire research would be similar to those for Alternative A, with a slight increase in the extent of both adverse (short-term, minor) and beneficial impacts (long-term, moderate), as the amount of land that could be treated and habitat restored under Alternative C is greater than under Alternative A.
- **California Red-Legged Frog.** Impacts would be the same as under Alternative A.
- **San Francisco Garter Snake.** Impacts would be the same as under Alternative A.
- **Marbled Murrelet.** Impacts on marbled murrelets are addressed in the “Actions Common to All Alternatives” section above, since the only potential nesting habitat occurs within Muir Woods National Monument.
- **Western Snowy Plover.** Impacts would be the same as under Alternative A.
- **California Brown Pelican.** Impacts would be the same as under Alternative A.
- **Northern Spotted Owl.** Impacts of mechanical fuel reduction and pile burning would be similar to those for Alternative A, with a moderate increase in the extent of both adverse (short-term, minor) and beneficial (long-term, moderate) impacts as the amount of land that could be treated under Alternative C is greater than under Alternative A. Impacts of prescribed fire would be similar to those for Alternative A, with an increase in the extent of both adverse (short-term,

minor) and beneficial (long-term, minor) impacts as the acreage subject to burning under Alternative C is nearly three times that under Alternative A.

- **Salt Marsh Harvest Mouse.** Impacts would be the same as under Alternative A.

Impairment. No impairment of any threatened and endangered species would occur under Alternative C.

Impacts on the Social Environment

Impacts on Cultural Resources

Analysis

The NPS recognizes five categories of cultural resources for management purposes.

Archeological resources are the remains of past human activity and records documenting the scientific analysis of these remains. They are typically buried but may extend aboveground; they are commonly associated with prehistoric peoples but are also commonly products of more contemporary society. They shed light on often otherwise unrecorded questions, such as social organization, and have helped researchers to understand the spread of ideas over time and the development of settlement from place to place.

Cultural landscapes are environmental settings that human beings have created in the world that reveal the fundamental ties between people and the land and reflect the human need to grow food, give form to settlements, meet a need for recreation or work, or bury the dead.

Structures are material assemblies that extend the limits of human capabilities, such as buildings to keep people warm and dry. Bridges to cross barriers, ships and trucks to carry goods over long distances, fortifications for protection, and statues and monuments to commemorate human achievement all are types of structures.

Ethnographic resources represent basic expressions of human culture and contribute to the continuity of tangible and intangible cultural systems, such as traditional arts, native languages, religious beliefs, and subsistence activities. In parks, they include special places in the natural world, structures with historic associations, and natural materials.

Museum objects are tangible manifestations and records of behavior and ideas that span the breadth of human experience and the depth of natural history. They are evidence of intellectual and technical development, of scientific observation, of personal expression and curiosity, and of common enterprise and daily habits. They are invaluable and irreplaceable samples of the world through time and place and of the multitude of life therein.

Actions Common to All Alternatives

Wildland-Urban Interface Initiative

In 2001, the NPS began implementing provisions of the federal Wildland-Urban Interface 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 across federal lands and neighboring properties.

The emphasis of this program at GGNRA as evaluated here, is to reduce the density of hazardous fuels that create a risk to lives or property on parklands. This program would continue under all alternatives. Effects of this program are beneficial, long-term, and major, since avoidance of catastrophic fire in areas along the park boundary clearly lessens the risk to park cultural resources.

Defensible Space/Vegetation Clearing Around Structures

The protection of all buildings from wildfire within GGNRA would continue under all alternatives. NPS staff or private contractors would continue to clear vegetation around all park structures. Individual structures would be assessed to determine the appropriate vegetation treatment based on fuel type and slope, building construction type, and potential sources of ignition. The defensible space required usually ranges from 30 to 50 feet around each structure. 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. Fuel type and fuel loading are also factors considered in determining these types of projects. 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 an individual assessment; pruning and removal actions must be in conformance with approved cultural landscape preservation plans and bird nesting season restrictions. If the landscape is potentially historic, then cultural resources staff would be consulted and the project would proceed to consultation under Section 106 of the NHPA, with the goal of minimizing adverse effects. The effect of this program on park cultural resources is beneficial, short-term, and major.

Roadside Fuel Reduction

The park 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. An assessment of road conditions is typically performed in early spring, and then a work plan is developed and priorities for vegetation clearing are set. Designated fire roads would continue to be maintained to allow for safe and efficient access and egress by emergency vehicles.

Maintenance standards for existing fire roads would be developed by park staff and would include guidance on such actions as grading of all surfaces when necessary, removal of vegetation to a specified width based on fuel type and slope, and mowing and cutting techniques. For road clearing, trees along the sides of the roadways would be limbed, trees less than 4 inches in diameter removed, downed trees in or near the roads cleared, and grass growing up within the roads cut or mowed. Tools used for these tasks would include weed whackers, chain saws, pole saws, and a chipper towed onsite. Debris can be cut up and broadcast in the immediate area, piled and burned, or chipped and hauled offsite. Regrading would occur where rills and gullies have formed. Where necessary, regrading should follow standard local practices established by the park. This would include outsloping of roads to prevent rill and gully erosion.

The park will evaluate, on an ongoing basis, the condition of fire roads for direct and safe access conditions. As a result of this evaluation, unnecessary fire roads may be eliminated, and the sites restored

to address erosion problems. In some cases, existing roads may be reconfigured or rerouted to address erosion and/or maintenance concerns.

In all cases, cultural resource staff would be consulted to identify the existence of historic roads, trails, and other historic properties within the project area. If cultural resources are found to exist, then the project will proceed to consultation under Section 106, with the goal of minimizing adverse impact.

The effect of this program, with proper mitigations applied, would be beneficial, long-term, and minor.

Suppression

Due to often-extreme fire behavior, the direct effects of wildfires on cultural resources can be substantial and can include adverse damage. In this regard, the pre-action mitigation measures described in Chapter 2 will measurably contribute to minimizing adverse impacts from the operational and indirect effects of wildland fire suppression activities.

Much of the park has not been fully inventoried; cultural resources inventories and surveys to date have concentrated in areas with known, or predicted sensitivity for, cultural resources. Wildfires may thus affect cultural resources in ways that cannot be fully anticipated, but would, in the worst-case scenario, be adverse, long-term, and major. It would logically follow that suppressing such fires would minimize the potential adverse effects.

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.

Operational effects associated with wildfire suppression can often be adverse, major, and permanent. The acts of constructing fire lines either by hand or with a dozer, using helispots, creating 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 use of MIST (see Appendix G), the placement of fire lines and related phenomena 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 park 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. These adverse impacts would be minor at known sites where most archeological resources have been recorded and surface artifacts removed, but potentially more serious at previously unknown and unrecorded sites. NPS resource advisors would be onsite quickly after a burn to ensure that looting and vandalism do not occur.

During suppression activities, some cultural landscape elements may be altered. However, many would be altered only temporarily and could be restored, and most suppression activities would not alter a significant number of characteristics of a particular cultural landscape. Therefore, suppression activities would have short-term, moderate, adverse effects on cultural landscapes because a small percentage of the historic landscapes would likely be lost and the effect should not last more than 10 years.

In summary, uncontrolled wildfire could have permanent, adverse, major effects on historic buildings due to loss during the wildfire. Archeological sites may experience permanent, adverse, major effects from suppression efforts because heavy equipment such as a tractor and blade may inadvertently affect an archeological or historical site. Because of the regenerative nature of vegetation, the effects on cultural landscapes may only be medium-term, moderate, and adverse because a small percentage of the historic landscapes would likely be lost and the effect should not last more than 10 years.

Treatment of Muir Woods FMU

Preservation of the pristine character of Muir Woods National Monument is a management priority (1993 FMP). Many species contribute to this ecosystem, and the variety of communities in Muir Woods National Monument calls for a variety of prescription parameters. A fire management project strategy for Muir Woods National Monument included in the 1993 FMP includes a mix of prescribed burning, mechanical fuel reduction, and understory thinning projects. Prescribed burning would be used to reduce fuel loading and to reintroduce fire into the diverse plant communities in the monument.

Established trails, roads, and natural features would be used as much as possible as fire lines. Burns would be from 0.5 to 50 acres. Implementation of this strategy would continue under all alternatives. This strategy of both fuel reduction and resource enhancement in coast redwood forests has proven effective throughout the range of redwood forests, and would continue within Muir Woods National Monument. A public awareness program would be necessary to carry out any prescribed burning; burning in Muir Woods National Monument can be a sensitive issue and requires staff to inform and educate the public, other interested parties, and neighboring agencies about prescribed burning in that area.

Muir Woods National Monument is presently the subject of an historic resource study, and it has potential for designation as a National Historic Landmark for its park design and its place in the national conservation movement. In this regard, the fire management activities at Muir Woods National Monument will be developed with the participation of park cultural resource staff, and the public awareness program will include information about Muir Woods National Monument as an historic resource.

The effect of this fire management strategy, with application of specific mitigations and developed in conjunction with Section 106 consultation, is beneficial, short-term, and moderate.

Treatment of San Francisco County Project Area

The primary actions for the parklands within San Francisco County would be maintenance of defensible space around buildings adjacent to wildland fuels and limited mechanical fuels removal elsewhere. Impacts of these actions on cultural resources, with standard mitigations applied, would be beneficial, short-term, and moderate.

Public Information and Fire Education Programs

Impacts associated with fire information and educational efforts 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 inform people about cultural resources and to demonstrate the effectiveness of cultural resources compliance to local American Indian 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

The construction of a centralized fire cache in GGNRA 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.

No adverse or beneficial indirect effects are anticipated with the construction of the new fire cache.

If an historic structure is selected as the location of the fire cache, the 1992 Golden Gate Programmatic Agreement with the State Historic Preservation Officer (SHPO) can be used as the vehicle for consultation that can ensure that there is no adverse effect as a result of the undertaking.

Fire Effects Monitoring

No adverse or beneficial effects on cultural resources are anticipated from the continued implementation of the fire effects monitoring program. All historic structures and archeological sites are excluded during FMH plot location and selection and treated areas would be located away from any known sites.

Mitigation Measures

Mitigation measures are actions that reduce the impact of the planned activities on a particular resource. In this case, all of the measures listed in Chapter 2, Section 2.7, Mitigation Measures, would be employed, as appropriate, at GGNRA, and would be identified in programmatic agreements among state and federal cultural resource protection agencies and the NPS. They are divided into measures that would be taken before project implementation (prescribed fire or mechanical thinning, suppression of unplanned ignitions), during these actions, and after implementation. Because appropriate mitigations are mandatory, the alternatives are analyzed assuming each would be put into place as warranted during review of individual fire management activities under a programmatic agreement or under 36 CFR 800. The effects on cultural resources would be considered during all fire management planning efforts. Section 106 review of individual projects is performed according to the Advisory Council's regulations for implementing the National Historic Preservation Act, 36 CFR 800.

Alternative A

Analysis

The 1993 GGNRA FMP is primarily a tool for prescription and use of fire as an integral factor influencing park ecosystems. Although the goals of the plan address the need to protect both natural and

cultural resources from unacceptable impacts attributable to wildland fire and fire management activities, the proactive programs consist entirely of activities designed to enhance natural ecosystems. Cultural resources are addressed in the plan primarily in terms of protection of archeological resources from the direct and indirect effects of prescribed burns. The existence of numerous historic structures within the park is acknowledged, and their protection from the adverse effects of fire management activities is implied. There is no substantive mention of other cultural resources in the plan, and the assumption is that all effects of fire management activities are adverse ones. Thus no opportunities are raised for the use of such activities for the preservation or enhancement of cultural landscapes, ethnographic resources, or archeological sites.

Direct effects of fire management actions on cultural resources could well be adverse, especially during extreme fire behavior, such as the suppression of unplanned wildfires. Such actions are often carried out with relatively little pre-planning and without consultation or supervision by a cultural resource specialist. Risk of adverse effect may be particularly high for archeological resources, historic structures, and potential museum objects. Direct effects of wildfire may also be likely to adversely affect ethnographic resources and cultural landscapes. The degree to which heating plays a role is complex and not fully understood, but in general, the longer a resource is exposed to heat and the higher the temperature, the greater the likelihood of damage. Fire can result in the complete elimination of an artifact or feature through consumption, or can alter attributes of an artifact or feature (e.g., obsidian hydration rinds, residues on pottery, bone burning) such that important research is hindered, or traditional values (e.g., Native American spiritual sites) are affected.

Running surface and crown fires occur primarily during wildfires, whereas ground or creeping active surface fires are usually associated with prescribed burns. Very generally, cultural resources located at or above the ground surface (e.g., lithic scatter, masonry or wood surfaces of historic structures, landmark trees) are most vulnerable to direct fire effects during crown and active surface fires, while ground and creeping surface fires threaten resources found just below the ground surface (e.g., shell middens, refuse deposits, foundations). Because of this, the chances of adversely affecting a high percentage of cultural resources found exclusively on or just beneath the ground surface are often as great as are the chances of affecting the aboveground resources. This is significant because cultural resources generally considered to have high data potential, such as Native American middens, 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 midden 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.

Fire management activities, especially carefully applied prescribed fire and mechanical fuel reduction treatments, can also be highly beneficial, however, and can be used to stabilize, preserve, maintain, and restore cultural resources. For example, mechanical thinning can effectively remove hazardous fuels from cultural resources and their vicinity, as well as restore, enhance, or maintain ethnographic resources and cultural landscapes, in cases where the risk of direct effect from the application of fire is too high. Historic field patterns may be restored in pastoral ranching landscapes where former grassland is being succeeded by scrub. In regard to ethnographic resources, some plants important for basketmaking benefit

from the careful application of fire. In addition, the removal of dense ground cover may lead to the revelation of previously unknown archeological sites.

Direct effects on cultural resources are also likely to occur as a result of fire management operations associated with wildfires, prescribed burns, and mechanical thinning. These operational effects on cultural resources have been quantified in only relatively few cases. However, several generalizations can be made, as follows.

Impacts resulting from the operation of heavy equipment on and close 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, aviation landing areas, large camps, and staging areas in previously undisturbed locations would not be used except to support wildfire suppression, since their effect is overwhelmingly likely to be adverse.

With the exception of operations that result in more intense fire behavior (e.g., slash piles, firing techniques), fire management operations will generally produce impacts that are less intense than the direct impacts resulting from wildland fire itself. Existing fire roads would usually be used; any new firebreaks could be carefully located. An obsidian projectile point displaced by construction of a fire line would probably retain its hydration rind, morphology, and other attributes, if not its provenience and stratigraphy. However, this does assume the application of operational techniques in a manner that is sensitive to cultural resources. Otherwise, loss of significant historic characteristics, such as boundary fence lines or signature plantings, or the encouragement of erosion, could be serious. Except in rare situations, operational effects are likely to be most pronounced when they involve cultural resources found on and near the ground surface.

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 that 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 Chapter 3, cultural resource surveys at GGNRA are not 100-percent complete. The areas that are less likely to have been surveyed are newly acquired areas, such as in San Mateo County; areas where predictive modeling indicates less sensitivity; and areas that are difficult to reach 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. Settlement in the area has by and large taken place where topography is less steep, along fresh and saltwater sources, and where vegetation is not dense, and it is these areas where cultural resource data are more likely to have been recorded. The combination of less dense vegetation and more intense surveys in these areas means that these resources are not as likely to suffer more than minor or moderate impacts, even in a wildland fire.

Mechanical Treatment

Under this alternative, 100 acres per year throughout the park would be treated by mechanical means.

Operational effects present the greatest concern in regard to the potential impacts of mechanical treatment. Ground disturbance could result in substantial impacts on cultural resources. Mechanical treatments offer the benefit of pre-planning, however, 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 adequately surveyed due to thick vegetation, a cultural resource 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 cannot be discounted, these effects could be minimized through a combination of education and avoiding known resources. Together, these activities would prevent impacts on cultural 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 damage them or leave them vulnerable to looting. Again, however, the ability to perform pre-treatment surveys means that sensitive resources can be identified, mitigations set in place, equipment excluded from or near cultural resources, and vegetation 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 providing the opportunity for survey or inventory in previously unrecorded areas, and 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. The cumulative effect of mechanical treatments would be moderate, long-term, and beneficial.

Pile Burning

Prescribed burning of vegetation piles would be undertaken as a follow-up to mechanical fuels treatment activities. Fuel loads in these piles would be substantial and would tend to burn at very high intensities. Pile locations would be sited to minimize impacts from intensive soils heating, and pile sizes would be limited to 4 cubic yards. However, since the ability to pre-plan is inherent in the activity of pile burning, input from cultural resource specialists, surveying and testing as appropriate, and proper location of piles would ensure that piles are not created on or near cultural resources, and any effects would thus be no more than minor and short-term, and not adverse.

Prescribed Burning

Under this alternative, a maximum of 110 acres per year would be burned using prescribed fire. As already described in the beginning of this section, prescribed burning may offer benefits to cultural resources. For example, areas to be burned would be surveyed and staff could locate and evaluate the significance of cultural resources they would not otherwise have an opportunity 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 would be used to direct post-burn surveys 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 cannot be assumed that significant unknown archeological or historic resources would be found in these areas. In addition, prescribed burns could be conducted in areas to achieve 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 restore grasslands and open up an historic viewshed (part of a cultural landscape) that has been lost because of vegetation growth.

Prescribed burns could also be used to improve conditions at, or safety of, a cultural resource, and in particular 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 used on or immediately adjacent to a particular cultural resource such as an 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 on those cultural resources close 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 participation of a cultural resource specialist when there is a possibility of cultural resources being affected. The cultural resource specialist would provide input into the planning of the burn, monitor fire behavior and the effectiveness of mitigation measures during the burn, and assess the aftermath for future reference. The specialist would also be available in case of fire escape to help mitigate or minimize potential adverse effects of suppression.

A cultural resource specialist may also monitor preparation activities, such as fire line construction. 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 on archeological sites from these activities low, so they would be no more than minor and short-term.

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 could be made to reduce the number of trees in proximity to a cultural resource. Some indirect effects such as erosion are exacerbated by intense fire behavior, the type that is unlikely to occur over large areas during prescribed burns.

The cumulative effects of prescribed burning with proper mitigations would be moderate, beneficial, and long-term.

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 individual impacts on cultural resources. Because of the underlying philosophy of the 1993 FMP, the selection of the projects is primarily

motivated by the goal of restoring the benefits of fire to natural ecosystems. Nevertheless, many of the projects listed also have beneficial effects on cultural resources. However, a large-scale, high-intensity, uncontrolled fire such as the 1995 Vision Fire at Point Reyes National Seashore would dramatically increase all impacts on cultural resources (see impacts above). Extremely high fire temperatures can be expected, with the implication that even the most durable cultural resources would be vulnerable to major, permanent damage. A large number of significant historic structures could be lost and soil erosion from hydrophobic soils could severely damage archeological resources. Large fires would often encompass a large number of cultural resources including historic structures, cultural landscapes, and archeological sites, resulting in permanent, major, adverse cumulative effects. It is reasonable to assume that the cumulative impacts of all proposed fire management activities would help restore healthy ecosystems, reduce dangerous fuel loads, maintain historic landscapes, and provide opportunities for resource surveys – provided, of course, that proper mitigations are applied. Thus these impacts would be beneficial, moderate, and short- to long-term.

Conclusion

Alternative A would have short-term, moderate, beneficial effects on historic buildings by reducing fuels around these structures, both through prescribed burns and mechanical treatment. Moderate, long-term beneficial effects on cultural landscapes from their restoration or maintenance through prescribed fire or mechanical treatments are also likely. Mitigation measures would keep impacts on 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-sized wildfires could have negligible to major permanent major adverse effects on cultural resources because no pre-planning occurs and suppression, rather than resource protection, is the top priority. Archeological sites could experience permanent adverse major effects from suppression efforts because heavy equipment such as a tractor and blade may inadvertently affect an archeological or historical site. Cultural landscapes would experience only medium-term, moderate, adverse effects from average wildfires because of the regenerative effects of vegetation that should not last more than 10 years.

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

A large-scale uncontrolled wildfire as described in the “Cumulative Impacts” section above could have long-term, major, adverse effects on historic buildings and cultural landscapes due to significant loss of numerous historic features and structures.

Impairment

Alternative A would not result in long-term impairment of cultural resources.

Alternative B

Analysis

Under Alternative B, fire management actions would focus on the use of mechanical treatment to reduce fire hazards and fuel loads in areas with the highest risks. However, natural and cultural resource goals and objectives would be integrated into the design and implementation of these projects. The use of prescribed fire would occur primarily at Muir Woods National Monument (as described in the "Actions Common to All Alternatives" section above) and in the Park Interior FMU for limited research purposes. Pile burning associated with mechanical treatments would be allowed within the WUI FMU.

The individual nature of mechanical treatment, pile burning, prescribed fire, and wildland fire suppression activities would not change, and neither would their individual effects or recommended mitigations. What would change under Alternative B would be the goals that inform the selection of the individual projects, different acreages associated with each treatment type, and thus the cumulative effects on cultural resources. Under Alternative B, 230 acres would be subject to mechanical treatment and 120 acres would be subject to prescribed burning each year.

Mechanical Treatment

The same types of impacts as described for Alternative A, both beneficial and adverse, would occur as a result of mechanical treatments. However, an additional 130 acres per year would be treated. Although the benefits to cultural landscapes and historic structures would be substantially greater in percentage terms than under Alternative A, they would still be considered short-term and moderate. Also, although impacts on subsurface archeological resources from operations associated with mechanical treatment would potentially cover a wider area than under Alternative A, impacts would remain minor and short-term because of the implementation of the mitigation measures described above.

Pile Burning

Impacts would be the same as under Alternative A.

Prescribed Burning

Impacts would be the same as under Alternative A, except that 10 additional acres per year would be treated by prescribed fire. Therefore, beneficial effects on cultural landscapes and historic structures would be slightly greater. Regarding archeological resources, the potential for a minor, short-term, adverse effects from inadvertent burning of an archeological site would be slightly greater.

Cumulative Impacts

Additional cumulative impacts beyond those described above for Alternative A are expected due to the resource-related goals of this alternative and the additional acres treated. However the level of impact would not change; it would still be beneficial, long-term, and moderate.

Conclusion

Alternative B would have short-term, moderate, beneficial effects on historic buildings by reducing fuels around these structures, both through prescribed burns and mechanical treatment. These benefits would be

greater than under Alternative A, but would remain in the moderate category. Moderate long-term benefits to cultural landscapes would be similar to but greater than under Alternative A, due to the restoration or maintenance of these landscapes through resource-based project criteria and the likelihood of additional acreages receiving mechanical treatments. As under Alternative A, mitigation measures would keep impacts on 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 would treat more acres.

A large-scale uncontrolled wildfire could have long-term, major, adverse effects on historic buildings and cultural landscapes. Suppression and/or mop-up of such a fire could have long-term, major, adverse effects on archeological resources. Suppression activities associated with more average wildfires could also have negligible-to-major impacts on cultural resources. The likelihood of such a wildfire is somewhat reduced by the increased scale of fire management activities, however.

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

Impairment

Alternative B would not result in long-term impairment of cultural resources.

Alternative C

Analysis

Alternative C proposes use of a broad range of fire management strategies throughout the park – mechanical treatment, pile burning, and prescribed burning – as a means to reduce fuel loading near developed areas and achieve natural and cultural resource enhancement goals. Mechanical treatments, complemented by prescribed fire in all FMUs, would be employed to assist with restoration and maintenance of the park's natural and cultural resources. This alternative would allow for the greatest number of acres to be treated on an annual basis to achieve fire management objectives.

The individual nature of mechanical treatment, pile burning, prescribed fire, and wildland fire suppression activities would not change from Alternative A, and neither would their individual effects or recommended mitigations. What would change under Alternative C would be the goals that inform the selection of the individual projects, different acreages associated with each treatment type, and thus the cumulative effects on cultural resources.

Mechanical Treatment

The same types of impacts as described in Alternative A, both beneficial and adverse, would occur as a result of mechanical treatments. A total of 275 acres per year would be treated. Although the benefits to cultural landscapes and historic structures would be substantially greater in percentage terms than under Alternative A, they would still be considered short-term and moderate. Also, although impacts on subsurface archeological resources from operations associated with mechanical treatment would potentially cover a wider area than under Alternative A, the impacts would remain minor and short-term because of the implementation of the mitigation measures described above.

Pile Burning

Impacts would be the same as under Alternative A.

Prescribed Burning

This alternative would have the same individual effects as Alternative A, except that 210 additional acres per year could be treated by prescribed fire. Therefore, beneficial effects on cultural landscapes and historic structures would be substantially greater. Regarding archeological resources, the potential for a minor, short-term, adverse effect from inadvertent burning of an archeological site would be somewhat greater.

Cumulative Impacts

Additional cumulative impacts beyond those described above for Alternative A are expected due to the resource-related goals of this alternative and the additional acres treated. Although Alternative C would have an overall beneficial effect on cultural resources, the overall level of impact for Alternative C would still be beneficial, long-term, and moderate.

Conclusion

Alternative C would have short-term, moderate, beneficial effects on historic buildings by reducing fuels around these structures, both through prescribed burns and mechanical treatment. These benefits would be greater than under Alternative A, but would remain in the moderate category. Moderate long-term benefits to cultural landscapes would be similar to but greater than under Alternative A, due to the restoration or maintenance of these landscapes through resource-based project criteria and the likelihood of additional acreages receiving mechanical treatments. As under Alternative A, mitigation measures would keep impacts on 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 would treat more acres.

A large-scale uncontrolled wildfire could have long-term, major, adverse effects on historic buildings and cultural landscapes. Suppression and/or mop-up of such a fire could have long-term, major, adverse effects on archeological resources. Suppression activities associated with more average wildfires could also have negligible-to-major impacts on cultural resources. The increased scale of fire management activities significantly reduces the likelihood of such a wildfire, however.

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

Impairment

Alternative C would not result in long-term impairment of cultural resources.

Impacts on Human Health and Safety

Actions Common to All Alternatives

Wildland-Urban Interface Initiative

Public and Firefighter Safety. The overriding purpose of the National Fire Plan's Wildland-Urban Interface Initiative is to reduce the potential for a catastrophic wildland fire to spread from federal wildlands to adjacent residential communities. At GGNRA, many entities such as local homeowners' associations, fire departments, and local and state land management agencies have received funding for fuel reduction projects outside of the park boundary along the interface zone with GGNRA. The NPS provides funding and compliance services for these projects funded for non-NPS lands. These projects will be addressed as part of the cumulative impact scenario for the FMP.

The NPS also funds projects wholly within the park by granting funding directly to the GGNRA Fire Management Program. One of these projects can be readily seen along Highway 1 in the Tam Valley area, where eucalyptus trees have been thinned along both sides of the highway. Several acres of eucalyptus were also removed from GGNRA lands on Alta Avenue above Marin City and just below a Tamalpais Valley condominium complex on GGNRA lands above Tennessee Valley Creek. Park projects funded by the Wildland-Urban Interface Initiative have also occurred in several areas of the park near Tamalpais Valley and Homestead Valley development. Mechanical fuel reduction was funded to provide limbing up and general fuel reduction for an overly dense stand of Monterey cypress and pine trees at Fort Baker off the main parade grounds adjacent to the historic structures. This project also served to restore a portion of the historic landscape of the parade ground by thinning and removing vegetation back to its original and historic area of planting. Wildland-Urban Interface Initiative funding has also thinned and reduced the eucalyptus woodland around the residences and potentially historic structures at the end of Camino del Canyon Road, where a small community is reached by a single-lane unpaved road with only one access point.

Where Wildland-Urban Interface Initiative projects remove partial stands of nonnative trees, there could be an increased potential for windthrow (tree failure) or windbreak (partial failure such as branches) to occur, posing a safety hazard to visitors. If stands of trees are close to adjacent residences, hazards could be posed to these properties. Under these conditions, Mitigation Measure PHS-1 would ensure that these hazards are considered when projects are evaluated through project review.

To date, the Wildland-Urban Interface Initiative program has had moderate, short- to long-term, beneficial effects on public safety in the wildland urban interface of Marin County. In areas of dense broom and other rapidly regenerating vegetation, the effect is short-term and requires scheduled maintenance to assure that the benefits of the fuel reduction and road improvements will persist. In areas where sizeable stands of eucalyptus and other nonnative trees have been removed, the effect is more long-term, as at least a decade would be needed to fully replace the basal area of the trees that have been removed. Even in areas where eucalyptus trees have been fully removed, maintenance is required for several years to prevent newly sprouted trees from replacing the fuels just removed though application of herbicides or shade cloth to the cut tree stumps, which normally reduce the incidence of resprouting. With

continued funding, the extent of the Wildland-Urban Interface Initiative program will likely be broadened to include projects in the parklands along the interface zone in San Mateo or San Francisco counties.

Public and Firefighter Health. Continued funding of Wildland-Urban Interface Initiative fuel projects within the park could involve a limited amount of pile burning under the direction of NPS staff or the Marin County Fire Department. Smoke generation can be controlled to a certain extent by manipulating the intensity of the piles and the type and structure of the fuel. The amount of pile burning associated with Wildland-Urban Interface Initiative projects within the park has been very low, as much of the cut material is chipped and broadcast onsite. Continued Wildland-Urban Interface Initiative funding for in-park projects would result in a short-term, negligible adverse effect on public and firefighter health.

Much of the fuel reduction accomplished to date on private parcels or locally managed public open space has involved treatment of nonnative plants. Several of these nonnative plants require the direct application of an herbicide to the cut trunk or stalk to produce a better "kill" ratio and to discourage resprouting. All projects within the park are required to use staff or a contractor who is a state-licensed pesticide applicator for this task, to select the proper and least toxic herbicide for the precise project needs, and to protect public health against unnecessary broadcast spraying, unsafe storage, or mixing or application of herbicides under incorrect environmental conditions. Mitigation Measure VEG-6 reinforces the requirement for licensed personnel and requires herbicide use to be administered through the park's integrated pest management (IPM) coordinator, and to report all herbicide use monthly to the GGNRA IPM coordinator.

With the requirement to comply with state law and federal conditions of approval connected to Wildland-Urban Interface Initiative funding, all herbicide application would be completed by a state-licensed applicator and reported to the GGNRA IPM coordinator. There would be no effect on public and firefighter health from herbicide use during community projects.

Defensible Space/Vegetation Clearing Around Structures

Public and Firefighter Safety. The California Public Resource Code (PRC-4290 and 4291) sets a minimum of 30 feet of defensible space around structures to provide the minimum adequate protection from fires. Under the FMP, however, the appropriate clearance around structures would be dictated by the siting of each structure, including slope, vegetation type, construction materials, and potential ignition sources. Providing the required defensible space provides both needed refuge for firefighters and an area from which to safely launch suppression actions. Providing effective defensible space around structures would have a long-term, moderate, beneficial effect on the safety of firefighters and the public.

Public and Firefighter Health. There would be no effect on public or firefighter health by clearing around structures for defensible space.

Roadside Fuel Reduction

Public and Firefighter Safety. A zone of reduced fuels would be maintained along all park roadways that would serve as likely evacuation routes for the public or ingress/egress for emergency vehicles. The width of the zone would be determined by roadway width, roadway composition, vegetation type, slope, and line of sight, among other factors. Vegetation would be cleared to allow unobstructed access for fire

trucks and other large vehicles. Roadsides would be inspected for standing snags or weakened trees that could fall and block roadways during fires. Where roadways cross steep drainages, additional roadside clearance and limbing up of ladder fuels may be required to reduce the potential for the drainage to act as a chimney and accelerate a fire up the drainage toward the roadway. Where appropriate, roadside fuel reduction projects should have a water tender or water pump mounted in a truck available to respond to accidental sparking that can occur with fuel reduction projects when temperatures are very warm. Roadway fuel reduction and the maintenance of the roadside zones of reduced fuel would have a long-term, moderate beneficial effect on firefighter and public safety.

Public and Firefighter Health. There would be no effect on public or firefighter health from roadside fuel reduction.

Suppression

Public and Firefighter Safety. GGNRA lands are sited within the three western counties of the nine-county San Francisco Bay Area, with nearly a 40-mile interface between federal wildlands and residential communities. All wildfires in GGNRA will be suppressed by employing a flexible suppression policy that causes the minimum of resource damage while accomplishing effective control. U.S. Department of the Interior (DOI) wildland fire policy states that all fires are to be classified either as wildland fires or as prescribed burns and all wildland fires must be suppressed. Prescribed fire can be either naturally caused or set to fulfill a prescription. Unplanned human-caused fires will always be suppressed at GGNRA. Although DOI policy states that “prescribed fire, designed to accomplish the management objective of allowing naturally occurring fire to play its role in the ecosystem, will be allowed to burn if provided for in a Fire Management Plan, a valid prescription exists, and the fire is monitored” (National Interagency Fire Center 2001), the risks to life and property are too great to consider allowing unplanned fires to burn.

While federal policy recognizes that wildfire, as a critical natural process, must be reintroduced into the natural environment for the benefit of ecosystem health, the protection of human life must be the first priority for wildland fire management. Property and natural/cultural resources jointly become the second priority, with protection decisions based on values to be protected and other considerations. The bottom line for DOI policy is that no wildfire situation, with the possible exception of threat to human survival, requires the exposure of firefighters to life-threatening situations.

Many larger national parks and forests are in more remote settings farther from large-scale urbanization than is GGNRA. In these larger, more remote parks, naturally occurring fires can burn in areas fully contained within the park and adequately staffed by park firefighters. GGNRA, with many cultural landscapes, hundreds of historic structures, its 40-mile interface zone, and limited fire crew, has few areas where a wildfire could be fully contained. Population and development densities are very high in the park’s interface area. The park is spread from north to south at the edge of residential development, so it is often the local fire departments who provide the initial fire response and make initial decisions.

With the initiation of a flexible suppression strategy, the park would engage in an exchange of information and cooperative agreements with local fire agencies. Developing strong relationships would allow the park to share information with area firefighters about the important resources and values in the park. Flexible suppression would allow a response that is the most appropriate to protect park resources

and values while providing the highest protection possible for firefighters, park staff, visitors, and park neighbors, and private property. The park would use methods to suppress wildland fires that minimize impacts of the suppression action without jeopardizing firefighter safety. Another important benefit of a flexible suppression strategy would be the options available to firefighters to use the terrain and resource constraints when crafting a suppression strategy that can incorporate some degree of containment and strategizing in place of direct and immediate suppression being the automatic first response. For example, Mitigation Measure WET-1 calls for fires to be allowed to back into, around, or through wetlands and meadows to avoid suppression damage. The measure specifies that where wetlands are used as a natural boundary to help contain a fire, the control line will be sited outside the wetland area. Trample lines (rather than dug lines) may be used if it is necessary to site the control line in the wetland. This strategy avoids or reduces impacts on the wetland area and reduces the degree of hazard placed on the responding firefighters.

The effect on public safety from flexible fire suppression would be a long-term, moderate, beneficial effect that would acquaint area firefighters with the information they will need to respond safely to a wildfire in GGNRA while meeting the goals for natural and cultural resource protection.

Public and Firefighter Health. Firefighters can be exposed to high levels of particulates, a human health concern, while fighting a wildfire. One control measure for exposure to particulates and other pollutants is controlled crew rotation. If terrain and exertion levels allow, respirators can greatly reduce exposure to particulates and toxins, though they are difficult to use when heavy physical exertion is required. Respirators can be used effectively when firefighters are monitoring one section of a fire to knock down smoldering areas. It is during smolder that the highest levels of particulates are produced, so respirators worn during this period would provide important protection. During suppression action, the health of local residents can be protected by local evacuation and/or announcements to the community at large for people with respiratory problems to remain indoors. The effect on the public from a flexible suppression strategy depends on the severity of the wildland fire. Typically, the fire would produce a short-term, minor, adverse effect on public health in areas subject to smoke. Firefighter working conditions are regulated by the Occupational Safety and Health Act but exposure to particulates from smoke is unavoidable. Impacts on firefighter health would be short-term, adverse, and negligible to minor depending on the hours worked with direct smoke exposure by the firefighter.

Treatment of Muir Woods FMU

Public and Firefighter Safety. The fire management strategy for Muir Woods FMU was developed to strategically reduce the high fuel loading within the park after more than a century of fire suppression. Muir Woods National Monument lies west and downslope from residential development in Homestead Valley on the western fringe of Mill Valley. A very small community at the end of Camino del Canyon is sited within a eucalyptus grove on a dead-end, one-lane, mile-long dirt road on the southern side of Muir Woods Road. Summer visitors to Muir Woods National Monument are wedged into parking lots at the base of a canyon reached by a narrow two-lane road. In case of wildland fire, a rapid evacuation for visitors heading to and already in the park would be a challenge.

Several prescribed burns were completed at Muir Woods National Monument from 1996 to 1999. Continued careful planning of additional prescribed burns, improvement of the defensible space provided around structures in Muir Woods, combined with understory thinning in areas with high incidence of tree mortality caused by SOD, would reduce risks to both the visitors in Redwood Creek Canyon and residents along Panoramic Highway and in Homestead Valley. Prescribed burns would incorporate measures to reduce emissions of particulates that could impede visibility on roadways serving Muir Woods National Monument. The execution of any prescribed burning incorporates a certain level of risk of fire escape; however, reducing fuel loading by implementing the FMP would reduce the overall risk of a large-scale fire that could have major adverse impacts. Prescribed burning at Muir Woods FMU would constitute slightly less than 50 percent of the annual prescribed burning program under Alternative A. The implementation of the combination strategy for Muir Woods FMU would provide a long-term, moderate benefit to public and firefighter safety by reintroducing fire into the redwood ecosystem and by consequently reducing the degree and the potential for a large-scale wildland fire to occur in Muir Woods National Monument by reducing fuel loading.

Public and Firefighter Health. Measures to reduce the health risks to the public and firefighters are discussed under “Alternative A,” “Prescribed Burning,” below. These measures would be implemented for all prescribed burns executed by GGNRA. Muir Woods FMU would be the site of at least one or two prescribed fires annually. Public and firefighter exposure to particulate matter and other toxins would be limited and would constitute a short-term, adverse, negligible effect on public and firefighter health with health protection measures incorporated.

Treatment of San Francisco County Project Area

Public and Firefighter Safety. Much of the lands in GGNRA within the City and County of San Francisco contain heavily used coastal scrub and nonnative vegetation or beach sand and bluff. In a few areas, very dense, nonnative evergreen forest poses a high fire hazard to the public and firefighters. For example, an area of mature cypress trees on the southern end of Sutro Heights and a dense stand of blackwood acacia near the Lobos Creek channel in the southwestern edge of Area A in the Presidio adjoin residential properties and would benefit from mechanical fuel treatment. Clearing dense vegetation from historic structures throughout the San Francisco parklands would benefit public safety and help preserve the structures in case of a wildfire or structural fire in the area. The fuel reduction strategy for the San Francisco lands would improve firefighter safety by providing areas of defensible space and reducing the risk of a fire spreading from federal lands to the adjacent dense residential neighborhoods. Small research burns in Area A of the Presidio would be explored for implementation in line with recovery plan objectives for threatened or endangered plant species. These burns would be restricted to the relatively undeveloped areas where these species occur. Normally, a water tanker would be sited in the work locations to address unexpected fire behavior. These FMP actions would result in a long-term, moderate beneficial effect on firefighter and public safety.

Public and Firefighter Health. There would be no effect on public or firefighter health from implementation of the strategy for San Francisco lands.

Public Information and Fire Education Programs

Public and Firefighter Safety. Programs that raise the awareness of fire prevention and personal safety and protection would increase awareness within the interface area and with visitors and staff within the park. The exchange of information between park staff and local fire agencies and adjacent residents would help inform park staff about existing fire hazards along the complex interface boundary. An exchange of ideas and cooperation with local fire agencies on prescribed burns, suppression actions, and fuel reduction project planning would improve the level of training and knowledge of both NPS and local agency staffs. The provision of a larger fire education program would have a long-term, moderate beneficial effect on firefighter and public safety.

Public and Firefighter Health. Information on the health effects associated with wildfires and air pollution emissions would be provided as part of public information and education. Alerting those members of the population who would be sensitive to the respiratory effects of high levels of particulates and other toxins would be important. The dissemination of information on how the members of the public may protect themselves would result in a long-term, moderate beneficial effect on public and firefighter health.

Fire Cache

Public and Firefighter Safety. Centralizing and reorganizing the fire suppression equipment in one location in the park would improve public safety by improving the response of NPS firefighting staff and benefit firefighting staff by organizing training facilities and facilitating regular maintenance of equipment and vehicles. The relocation of the fire cache would have a long-term, minor beneficial effect on public and firefighter safety.

Public and Firefighter Health. There would be no effect on public or firefighter health from consolidating the fire cache equipment.

Fire Effects Monitoring

Public and Firefighter Safety. The continuation and expansion of fire effects monitoring at GGNRA contributes to professional knowledge of outcomes of the prescribed burn program and, to a lesser extent, the success of mechanical fuel reduction treatments. Many of the parameters monitored refer to the reaction of natural resources to the application of prescribed burning and do not relate directly to public safety concerns. However, where monitoring addresses the efficacy of prescribed burning in reducing fuel loading and tracking fire behavior, the knowledge base contributing to improve public safety is expanded and benefited. Continuation of the fire effects monitoring program would have a long-term, minor beneficial effect on public and firefighter safety.

Public and Firefighter Health. There would be no effect on public or firefighter health from implementation of the fire effects monitoring program.

Alternative A

Mechanical Fuel Reduction

Public and Firefighter Safety. Mechanical fuel reduction projects would play a relatively small role in the implementation of Alternative A. The principal focus of Alternative A would continue to be the reintroduction of fire into the ecosystem of the park to accomplish natural resource benefits. Though a total of 100 acres would be mechanically treated throughout GGNRA, the majority of the acreage (approximately 70 acres) represents annual roadside fuel brushing and mowing along dirt fire roads and paved access roads in San Mateo and Marin counties. Roughly five acres would be accomplished in San Francisco, continuing to treat dense stands of flammable nonnative plants at critical interfaces with private residential areas or providing defensible space around park structures. Five acres of mechanical treatment would occur at Muir Woods National Monument through understory thinning, as part of shaded fuel break construction, to treat nonnative plants or to the reduce density of nonnative plants such as broom.

The remaining 25 acres would focus on fuel reduction projects in San Mateo and San Francisco counties, targeting dense stands of flammable nonnative plant species, such as eucalyptus or areas with high fuel loading of native plants, e.g., SOD-infected woodlands. The eucalyptus groves in all three counties would continue to be gradually thinned, contained, and/or reduced.

Alternative A proposes relatively gradual reduction in fire hazard in GGNRA. The 1993 FMP did not focus on fuel reduction or the wildland urban interface, concepts that are key to the current federal wildland fire management policy. In the past five years, the National Fire Plan has been funding fuel reduction projects in GGNRA that have primarily been sited in the wildland urban interface near the park boundary. This level of effort would continue under Alternative A, providing a gradual reduction in high fuel loading in the park along the roughly 39-mile interface in the three counties.

Due to the potential hazard of an accidental spark occurring and setting fire to dry vegetation during mechanical fuel reduction, measures assigned through the project review process (Mitigation Measure FMP-1a) may require a water tender, truck-mounted water pump, or backpack pump to be kept at the project site when weather conditions warrant. In addition, the fire management officer, who stays informed on the current daily fire hazard rating, may terminate all mechanical fuel reduction projects when ratings reach a Red-Flag Day or have work stop in the afternoon on high fire hazard days – all to reduce the potential for equipment to cause sparking and ignite a fire.

The mechanical fuel reduction component of Alternative A would have both short-term and long-term, minor beneficial effects on public and firefighter safety through the gradual reduction of areas of high fuel loading and the continued maintenance of zones of reduced fuels along the park fire road network.

Public and Firefighter Health. Mechanical fuel reduction projects contribute significantly fewer pollutants and particulates to the atmosphere than either prescribed burning or wildland fire. Under conditions of poor air quality, a mechanical fuel reduction project could serve as a substitute for prescribed burning as a means to reduce fuel loading. In this respect, mechanical fuel reduction projects release lower levels of air pollutants into the air basin per acre cleared than prescribed burning projects

and contribute fewer adverse effects on air quality. Mechanical fuel reduction also contributes to a reduction of the potential for a large-scale wildfire with its correspondingly large adverse air quality impacts.

Compared to the levels of emissions produced during prescribed fire or wildland fire, the emissions from mechanical fuel reduction (using chain saw, brush-cutters, chippers, etc.) are considered a negligible, short-term adverse effect on public and firefighter health (NPS 2004a, NPS 2004c).

Pile Burning

Public and Firefighter Safety. Pile burning is one of the most important techniques for reducing generation of emissions. The objective of piling debris for burning is to prolong the timeframe that debris will be ignited so that larger materials can be fully consumed by the fire. A greater amount of consumption occurs in the flaming phase and the smoke emission factor is lower.

Burn piles must be carefully constructed, especially on slopes, to prevent failures of the pile and scattering of the ignited fuel. An adequate distance around the pile should be cleared of burnable vegetation to discourage the fire from spreading and provide defensible space for fire monitors. Burn piles should not be left to smolder during the night to avoid the generation of heavy smoke under cooler nighttime conditions. Because of the time restriction, burn piles need to be constructed of the correct volume and materials ideally need to be consumed during the portion of the day allowed for burning. Slightly erratic winds help to disperse and dilute the smoke plume from the piles, but very erratic winds present a safety problem.

When heavy smoke is produced by incorrectly constructed burn piles, they burn more slowly. Without a rising heat column to convey smoke higher into the atmosphere, much of the smoke remains relatively cool and close to the ground. This can result in a smoky fog if moist humid air, such as in coastal fog, makes contact with the smoke plume. This smoky fog can be a significant traffic hazard and require reduced speeds and traffic control to prevent accidents. Conformance with BAAQMD Regulation 5 addressing open burning can reduce the potential for impacts on visibility to occur. As with any prescribed burn, pile burning presents a potential for a fire to escape and cause greater damage. The following are standard best practices employed by GGNRA fire crews for pile burning:

- To minimize impacts on air quality, chipping is the first choice for disposal of fuel reduction debris. Burn piles are selected only where chipping is infeasible.
- All burning, including burn piles, requires the preparation of an NPS burn plan and submittal of a smoke management plan to BAAQMD. The burn plan includes the results of a fire behavior model (BEHAVE) run to simulate fire behavior in the vegetation surrounding the burn pile. The fire behavior model sets staffing and equipment requirements to address that contingency based on predictive fire behavior. The burn plan directs how that level of staffing and equipment would be used to monitor the burn piles or suppress any fire that should spot from or creep from the burn pile. The burn plan describes the environmental setting of the site; how staff and equipment will be deployed prior to, during, and after the fire; how hoses will be deployed; and what the appropriate response is to a change in fire behavior and/or weather.

- Burn piles are encircled by a scratch line, when necessary, to prevent fire creep through duff and vegetation.
- Burn piles are continually tended.
- As piles burn, fuel is pushed into the center of the pile, reducing the combustion area and increasing heat and smoke lift.
- During the course of pile burning, one crew member acts as the dedicated fire monitor who is responsible for updating site-specific weather conditions every half hour to assure that the fire stays within prescription.
- The smoke management plan is based on the results of an emissions generation model and smoke dispersion model. The outcomes of modeling are the amount of emissions from the burn piles and a prediction of smoke dispersal based on the most current weather predictions.
- Changes in weather, including wind speed and direction, and changes in the lift (convection current skyward) of smoke are factors that inform the decision to extinguish burn piles ahead of schedule.

Due to NPS experience and training and BAAQMD requirements for pile burning, the potential for risk of a loss of control of the burn pile is considered a potential short-term, negligible, and adverse effect. The potential for smoke to impede traffic flow and safety is also is considered short-term, negligible, and adverse.

Public and Firefighter Health. The biggest deterrent to pile burning is the relatively high percentage of smoke complaints received from the public because of poorly burning debris piles. Burn piles do not achieve the necessary heat if they are packed too tightly, if material is freshly cut and not yet cured, if too much soil is in the pile, or if the material is too wet. If constructed under these conditions, burn piles can smolder for days producing large amounts of smoke and particulates, a public health concern. Because the pile burns cool when poorly constructed, insufficient heat is produced to draw smoke up above developed areas and roadways. Smoke stays near the ground and even drifts down into other cool areas. If the cool smoke mixes with warm moist air, a smoky fog may form, greatly reducing visibility on roadways. Pile burning produces fewer pounds of particulate per ton of fuel burned.

BAAQMD Regulation 5, Open Burning, requires woody materials to be pile-burned to be set aside to dry a minimum of 60 days prior to ignition. The BAAQMD regulations and training have helped to develop best practices for the construction of burn piles to reduce the generation of pollution emissions. It is best to use low-impact techniques to construct burn piles because heavy equipment can result in mixing large amounts of soil in with the debris to be burned. Soil mixed in with the debris can impede some areas of the pile from fully drying out. Densely packing debris piles with fine fuels can prevent air from circulating and also keep the pile from drying out more quickly after rains. The more that air can circulate during the burn, the greater the heat generated in the pile. This results in fewer particulates generated and more smoke dilution and dispersion by convection away from the ground and sensitive receptors. Burning

when the atmosphere is either still or slightly unstable will also encourage smoke dilution without creating control problems. Freshly cut woody debris must be allowed to cure first and to dry after rain. Freshly cut materials should not be piled when green or wet as this will impede the center of the pile from fully drying.

With the implementation of best practices and conformance with BAAQMD Regulation 5, the potential effect of pile burning on public and firefighter health would be short-term, negligible, and adverse. The public could experience short-term yet negligible adverse effects if the wind shifted from the prescription to an unwanted area.

Prescribed Burning

Public and Firefighter Safety. The primary focus of Alternative A is the prescribed burning of approximately 110 acres annually to achieve resource benefits and secondarily to reduce fuel loading. Limited-scale research burns may be developed for GGNRA lands in San Francisco or San Mateo counties under Alternative A. Research burns would focus on meeting resource enhancement objectives. The primary focus of prescribed burning in Alternative A is to gain natural resource benefits – converting coastal scrub to grassland, confining the spread of Douglas-fir forest into coastal scrub, or treating nonnative plant species. Fuel reduction accomplishments would be a secondary benefit of the burns in most cases.

Public and firefighter safety can be jeopardized when smoke from prescribed fires reduces roadway visibility in the vicinity of the fire. Particulates and other emissions present a public health concern for firefighters, park visitors, and adjacent residents (see “Public and Firefighter Health” below). In addition to health and safety effects, nuisance effects from smoke that result in material damage and soiling can have large economic costs.

Minimization of the effects of smoke can be achieved by careful planning and development of a smoke management plan for each prescribed burn. The requirements for the smoke management plan are detailed in BAAQMD’s Regulation 5-408. The plan must be submitted to BAAQMD’s Air Pollution Control Officer for review at least 30 days prior to receiving approval to proceed with a burn. The NPS also requires a smoke management plan for each prescribed burn or pile burn proposed for national parklands. In 2001, a Guide for Smoke Management of Prescribed and Wildland Fires was developed by the Fire Use Working Team of the National Wildfire Coordinating Group (NWCG) to help publicize new techniques for reducing smoke and emissions.

Prescribed burns generally produce less particulate matter than hotter, more intense wildland fires. Some studies have shown that prescribed burns produce only about one tenth as many particulates as a wildland fire (Biswell 1989). The amount of particulate matter emitted from a fire is directly proportional to the amount of fuel burned. The amount of fuel burned depends on the fuel moisture. Any moisture released from the fuels absorbs some heat energy from the fire, limiting combustion temperatures (Ryan and McMahon in Sandberg 1978). If larger size classes of fuels have high moisture content, most or all of the heat released by flames will be expended evaporating water, and little consumption of large-diameter fuels occurs.

Even a small prescribed fire with low emissions can produce large ground-level impacts if the smoke plume does not disperse but stays close to the ground. Greater smoke plume dispersion can occur when there are mild but erratic winds pushing the plume over ground features that help break up the flow of the plume. In any type of fire, it is the smoldering phase that emits the greatest amounts of particulates and smoke. Because a smoldering fire produces less heat, smoke and particulates are not conducted up into the atmosphere and tend to stay near ground level. When fires burn with a lower intensity, they tend to smolder and burn longer. Smoke plumes trapped by surface temperature inversions can pool in low-lying areas. (BWCAW 2001, Section 3.3). When cool, smoky air encounters patches of moist, warmer air, a heavy smoky fog can result. Poor visibility resulting from the fog can shut down vehicle traffic on adjacent roads (Sandberg et al. 2002).

Mitigation Measure AIR-3 would reduce the generation of smoke by scheduling or rescheduling prescribed burns during seasons when particulate emissions would be reduced. For example, spring prescribed fires would occur when fuels are moister, so less fuel would be consumed and fewer particulates would be emitted. Summer and fall fires tend to burn when fuels are drier, so more fuel is consumed and more particulates are emitted.

Another smoke management technique is to increase the efficiency of combustion during the prescribed fire by increasing combustion of fuels or limiting the amount of fuels. Combustion can be increased through the use of a slower-moving, higher-heat, backing fire. Heading fires, in which the flaming front moves ahead rapidly, burns with a high intensity from one fuel to another but without fully burning most of the larger fuels. A heading fire leaves behind a large area of smoldering fuels that generate large amounts of smoke. Backing fires, used in prescribed burns or to gain control of wildfires, are set to burn more slowly into the wind or downslope, consuming a higher proportion of fuel in the flaming front fire. Backing fires leave less smoldering fuel and residue after passage. For similar burns under similar conditions, use of a heading fire would result in much more total smoke than use of a backing fire, as more fuel would be consumed in the initial burning phases rather than the smoldering phase of combustion.

Mitigation measures to minimize effects on air quality are listed in Chapter 2 (see Mitigation Measures AIR-1 through AIR-6). These same mitigation measures would also minimize potential effects on the health and safety of the public and firefighters by reducing the potential for smoke to adversely affect roadway visibility and reducing production of particulates and other pollutants harmful to humans. The following are standard operating procedures employed by NPS fire staff to reduce the risk of fire escape and address public safety when executing prescribed burns:

- All burning, including burn piles, requires the preparation of an NPS burn plan. Prescribed burns also require submittal of a smoke management plan to BAAQMD. The burn plan includes the results of a fire behavior model run to simulate fire behavior in the vegetation within and surrounding the burn unit of the prescribed burn. This scenario represents a worst-case scenario and it is at that level of readiness that fire planning proceeds. Staffing and equipment is retained to be able to respond to the worst-case model for the conditions of that day in that environment. The burn plan directs how that level of staffing and equipment would be deployed to monitor a

fire and respond to the fire if it were to spread beyond the original burn unit. The burn plan also describes the environmental setting of the site, how the site will be prepared, important resources at the site that should be protected, how hoses and water supplies will be deployed, and the appropriate responses to a change in fire behavior/and or weather.

- The smoke management plan addresses the anticipated production of emissions from the burn piles and a prediction of smoke dispersal based on the most current weather predictions.
- In preparing for a prescribed burn, hose is typically laid along the fire line parallel to the line. Every 200 feet a perpendicular hose lay is placed that can be deployed by the crew for 100 feet on each side of the lateral. The parallel hose lay is charged with water prior to beginning the burn. The laterals can be connected to each section of hose with a T connection to respond to changes in fire behavior.
- During the course of pile burning or a prescribed burn, one crew member acts as the dedicated fire monitor who is responsible for updating site-specific weather conditions to assure that the fire stays within prescription. The fire monitor also gauges the flame length and rate of spread of the fire in real time to determine if the fire is staying within prescription.
- Fire engines with sufficient water to extinguish all piles or a water tender(s) remain onsite throughout the burn period.
- Preparation for a prescribed burn includes establishment of a fire line around the perimeter of the primary burn unit and subunits. Fire lines are developed to minimize impacts on park resources while reducing risk of spread.
- The prescribed fire team is always ready to convert to a suppression team if the conditions shift toward the upper extreme of the prescription.
- A scratch line of exposed bare mineral soil 6 to 8 inches wide is constructed at the edge of the burn unit when necessary, to prevent a fire from creeping through duff into the surrounding vegetation.
- Fire engines and water tenders are recruited to be on duty at the fire based on the outputs of the fire behavior model. Helicopters and other support services are alerted also based on the worst-case scenario predictions of the model.
- Changes in site-specific weather (wind speed, wind direction, relative humidity, fuel moisture, and temperature), changes in the smoke dispersion (reduction of lift, formation of a temperature inversion that could trap smoke close to the ground), and changes in fire behavior (flame length, rate of spread) are factors that inform the decision to extinguish prescribed burns ahead of schedule.
- A large burn unit is often split into smaller burn units, and also can be bordered by a fire line. If conditions warrant, a fire may be stopped ahead of schedule by restricting the spread to a subunit.

- Mop-up is continued until all visible smoke is gone within approximately 150 feet of the fire line.
- Notice of upcoming prescribed burning is posted on adjacent roadways for several days in advance of the prescribed burn. If smoke from the prescribed burn affects visibility and traffic safety on adjacent roadways, sufficient staff will be reassigned to direct traffic. Signs are placed in advance of the areas of poor visibility to warn drivers of the hazard ahead. If roadway visibility becomes too low, traffic may be halted until smoke is dispersed enough to permit safe passage. Also see Mitigation Measures AIR-2 (Smoke Communication Strategy), AIR-4 (avoiding days with the highest visitation) and AIR-5 (selecting meteorological conditions that reduce the potential for smoke drift).

There remains a small but potential level of risk of fire escape with any prescribed burn. With implementation of mitigation measures and best practices, prescribed burning under Alternative A would have a short-term, minor adverse effect on firefighter and public safety during the course of the burn. Over the long-term implementation of the FMP, a minor, beneficial impact would accrue to public and firefighter safety from the overall reduction of fuels.

Public and Firefighter Health. Firefighters are exposed to particulate matter and other pollutants during prescribed burning. The health effects of this exposure have only recently begun to be monitored. During prescribed burns, firefighters work in significantly smoky conditions 5 percent of the time, especially when holding line, attacking spot fires, and supervising these actions (Reinhardt et al. 2000). In the early 1990s, dosimeter monitoring of firefighters working prescribed burns in the Pacific Northwest found that some individuals had been exposed to emission levels exceeding occupational hazard limits (Reinhardt et al. 2000). The chief hazards identified by the dosimeter monitoring were inhalation of carbon monoxide, aldehydes, benzene, and particulate matter of less than 3.5 micrograms ($PM_{3.5}$). Exposure to aldehydes (of which formaldehyde is the most familiar) and $PM_{3.5}$ can cause immediate eye and upper respiratory irritation even at distance of one mile. The levels of carbon monoxide measured at prescribed burns can cause disorientation, nausea, and headache. Exposure to benzene was highest among workers using drip torches and levels observed were low enough to make adverse effects unlikely, though the result of long-term occupational exposure is unknown.

A study of NPS fire crews by the National Institute for Occupational Health and Safety found a slight decline in lung function over the course of a fire season in those crew members who had reported working the most hours. This and several studies of other crews have pointed to some decline in lung function but no long-term studies have been completed. A review of studies conducted to date by Reinhardt et al. for the U.S. Forest Service (USFS) recommends that fire managers of prescribed burns focus concern on exposure of their crews to carbon monoxide and $PM_{3.5}$ (Reinhardt et al. 2000). The exposure levels to benzene did not appear to be significant.

Reinhardt et al. includes the following recommendations for reducing exposure of firefighters to CO, aldehydes, and particulates while working prescribed fires by reducing the time needed to be spent in heavy smoke situations:

- Avoid placing fire lines in difficult-to-defend locations, such as midway up a steep slope.

- Pretreat critical areas that need to be held with water.
- Accept some minor "slopovers" across lines until conditions abate and there is less potential for smoke exposure.
- Use light-weight half-mask respirators during medium- to heavy-smoke situations to limit respiratory exposure to particulates and aldehydes when there are real-time CO monitors available to alert firefighters to hazardous CO levels. (No respirator, except for a self-contained breathing apparatus, offers protection against CO.)
- Reduce time on the fire line and, therefore, exposure to CO for at-risk workers, including those in poor health or suffering from angina or heart conditions, pregnant firefighters, and smokers.

Exposure of firefighters to pollutants in smoke during the course of a prescribed burn would have a short-term, negligible, adverse effect on health. The impact on the public, affected when winds, inversions, or fires out of prescription bring more smoke into residential areas, would be short-term, negligible, and adverse. People with existing respiratory conditions would be advised prior to the prescribed burn to remain inside their homes with the windows closed until the air clears.

Research

Public and Firefighter Safety. The effects of research burns would be similar to those of prescribed burning. There would be a short-term, negligible adverse effect on safety of firefighters working the prescribed burn due to reduced visibility from smoke emissions.

Public and Firefighter Health. There would be a short-term, negligible adverse effect on firefighter health from prescribed burning for research purposes due to inhalation of particulates in smoke from emissions generated during these smaller prescribed burns. Research burns would have no effect or a negligible effect on public health.

Cumulative Impacts

Appendix C lists projects that have potential to contribute to a cumulative impact on the environment when considered in conjunction with the effects of the FMP's implementation. Some of the listed projects could add to the effects on public and firefighter health and safety that could occur under Alternative A. The Fort Baker Plan EIS includes a limited program that would also achieve some level of fuel reduction and enhance public and firefighter safety at the site. The areal extent of nonnative trees that have extended beyond original plantings would be reduced under the EIS and subsequent planning processes. Trees and dense undergrowth in the residential areas would be mechanically removed to improve defensible space around these structures. Additional acreage of mission blue butterfly habitat will be enhanced under an agreement with USFWS; the possibility of using prescribed burning for this enhancement will be investigated. Two recent fires in 2004 show that the area can be affected by arson or illegal campfires. Smoke from wildfires at Fort Baker could have a traffic safety impact on the heavily traveled US 101 at the top of the Fort Baker slope.

The implementation of the PRNS FMP would cumulatively benefit firefighter and public safety, especially in the vicinity of GGNRA lands near Bolinas Ridge. Both parks are strategically reducing fuels in areas of high fuel loading near their common interface. This would improve public and firefighter safety and reduce fuel risk along common boundaries near the town of Bolinas and farther north on the approach to Olema.

The Marin County Fire Department (MCFD) has been very active in developing, proposing, and implementing wildland urban interface projects for homeowners' associations and land management agencies such as the Marin Municipal Water District (MMWD) and the Marin County Open Space District (MCOSD). These two agencies are implementing the Mt. Tamalpais Area Vegetation Management Plan (MT VMP), a comprehensive approach to vegetation management and fire hazard reduction on 20,150 acres of publicly owned open space, parkland, and watershed with an extensive wildland urban interface boundary bordering parts of Mill Valley, Corte Madera, Larkspur, Kentfield, Ross, San Anselmo, and Fairfax in western Marin County. The western boundary of the study area borders GGNRA lands and Mt. Tamalpais State Park. The primary purpose of the MT VMP is reduction of existing fire hazards. Hundreds of detailed prescriptions for treating areas of high fuels were developed to reduce the potential of fire spreading into neighboring communities or damaging watershed resources. GGNRA has had opportunities to date to participate in implementation of some of the detailed prescriptions within the open space by funding projects for MMWD and MCOSD. GGNRA has also funded projects on the private property side of the MT VMP interface by providing funding to the Kent Fire Protection District and MCFD, which have hired local contractors for mechanical fuel reduction projects where residential areas meet the MT VMP study area in Kentfield and Mill Valley. Developed in response to the 1991 Oakland Hills Fire, the MT VMP proposes the construction of zones of reduced fuels totaling roughly 5 percent of the total study area or treatment of 1,100 acres.

The San Francisco Watershed Plan completed in January 2001 called for the development of a fire management plan for the 23,000-acre watershed. The planning area borders part of Sweeney Ridge in San Mateo County east of Pacifica.

Smaller-scale projects in and around GGNRA lands that would contribute to the cumulative effect under Alternative A include habitat restoration efforts throughout the park that sometimes replace more flammable nonnative vegetation with native plants grown in the park nursery from seed collected on parklands. Routine roadside maintenance by park staff is conducted annually and maintains areas of reduced fuels along park roads, fire roads, and trails.

There are some limited opportunities under Alternative A for joint projects across boundaries between GGNRA and MMWD, Marin County Fire Department (MCFD), or other local fire agencies that would result in larger-scale fuel reduction accomplishments. Budgets for all agencies involved have typically limited the scope of annual fuel reduction projects. Nearly every project also requires a revegetation and/or maintenance plan to maintain a treated area in lower fuels for a few years until weeds are controlled. Given the relatively small total of fuel reduction projects that would be accomplished annually under Alternative A, the cumulative impact of all the vicinity fuel reduction efforts would result in a long-

term, minor beneficial effect on public and firefighter safety by lowering the overall risk of a catastrophic fire to occur in the vicinity of GGNRA.

MCFD conducts approximately 50 acres of prescribed burning and burns roughly 50 piles of vegetation debris annually. Occasionally, MCFD will oversee pile burning to reduce debris from community fuel reduction projects funded by the Wildland-Urban Interface Initiative. Dispersed over a wide area in western Marin and occurring within a roughly six-month period, smoke effects from these additional sources would not be sufficiently concentrated to result in a cumulative effect to firefighter or public health under Alternative A.

Conclusion

The assessment considers public and firefighter safety and public and firefighter health for each of the proposed actions in Alternative A. The assessment of public safety focuses on three areas of effects: (1) reducing the existing public safety hazard posed by high fuel loading, (2) the potential for prescribed burns to spread outside of the burn plot and threaten park resources or developed areas, and (3) the potential traffic hazard from reduced visibility due to smoke. The public health assessment focuses on the potential health hazards to firefighters from extended exposure to smoke.

The assessment found that the set of actions common to all alternatives would primarily result in long-term minor benefits to public and firefighter safety by reducing the level of risk posed by a catastrophic fire. Best management practices and mitigation measures for reducing smoke generation found that the principal actions of prescribed burning, pile burning, and mechanical fuel reduction would have short-term, negligible or minor effects on firefighter and public safety, demonstrating the intensive preparation required to enter into prescribed burning with confidence that the fire will be maintained within prescription and under strict control. Projects that remove partial stands of nonnative trees could increase the risk of tree failure from changes in wind strength and direction in the stand. This potential hazard will be included in the review of each such project for NEPA conformance. The conclusion of short-term, negligible and adverse effects on firefighters and public safety illustrates the relatively low level of risk that a prescribed burn or pile burn will escape control.

Cumulative effects would be long-term, minor, and beneficial as all sources work to reduce existing fuel levels and the potential level of risk. Best management practices for limiting the amount of firefighter exposure to particulates are listed and the effects are considered short-term, negligible, and adverse with incorporation of these practices. The distances between the sites generating levels of particulates as part of the cumulative impact scenario are great and no cumulative effect on public health would be incurred from implementation of Alternative A.

Alternative B

Mechanical Fuel Reduction

Public and Firefighter Safety. Compared to the No Action alternative, Alternative B places a greater emphasis on the reduction of high fuel loads and existing fuel hazards in the WUI FMU, especially in Marin and San Mateo counties. Compared to Alternative A, the acreage that can be treated more than doubles under Alternative B, up to 230 acres annually. As is common to all three alternatives, 70 acres

would be accomplished through roadside mowing and fuel reduction, 10 acres by San Francisco projects, and 5 acres in Muir Woods National Monument, a separate FMU. Not including these elements common to all alternatives, 145 acres of hazardous fuels can be treated and reduced per year.

It is assumed that 130 acres, which includes some roadside mowing, would occur in the long, complex interface with residential communities in Marin County. Within the WUI FMU in San Mateo County, 30 acres would be treated annually (including roadside mowing) at the Phleger Estate and Pacifica lands. Over the life of the program, these acreage totals would include some parklands that require regularly scheduled maintenance projects or retreatment. For example, areas with dense stands of broom along fire access roads may require annual treatment for three to five years before roadside fuels are converted to a lower-statured vegetation type. Roadside areas of dense native chaparral with a minimum of nonnative and less invasive vegetation may require a three- to five-year retreatment interval. Of the 130 acres treated annually, in Marin County, a certain proportion of those acres may have already been treated one or more times previously before a vegetation type conversion to less dense and flammable native plant community is achieved. The emphasis on Marin County demonstrates the added risk of wildfire posed to public and firefighter safety by the high incidence of SOD within Marin woodlands. Alternative B would allow more annual treatment of thinning woodlands of SOD-infected fuels and reducing densities of tan oak overall.

Approximately 55 acres in the Park Interior FMU would also be treated, including some roadside fuel reduction. The work in the Park Interior FMU would focus on improving the defensible space provided along fire roads; reducing, containing, and removing stands of nonnative evergreen forest, some of which connect to stands in the Interior FMU; and providing defensible space for cultural and natural resources that are vulnerable to the effects of fire.

An objective of Alternative B is to expedite the reduction of fuels in the WUI FMU of GGNRA in all three counties. With the accelerated fuels treatment scenario in Alternative B that focuses additional effort on the reduction of hazardous fuel in the wildland urban interface, implementing mechanical treatment would have a long-term, moderate beneficial effect on public and firefighter safety.

Public and Firefighter Health. Alternative B more than doubles the number of acres that can be mechanically treated on an annual basis as compared to Alternative A. Alternative B would accelerate the risk reduction of the potential for a large-scale wildfire by more aggressively treating areas with high fuel loading close to residential communities.

Fuel reduction projects contribute significantly fewer pollutants and particulates to the atmosphere than either prescribed burning or wildland fire. Modeling the levels of emissions produced by mechanical fuel reduction projects (using tools such as chain saws, brushcutters, chippers, etc. and vehicles) has consistently shown this activity to contribute a negligible, short-term adverse effect on air quality and on public and firefighter respiratory health (NPS 2004a, NPS 2004c).

Pile Burning

Public and Firefighter Safety. With over twice as much annual acreage that could be treated to reduce fuels, there is a potential for a correspondingly higher level of pile burning to occur as compared to

Alternative A. Pile burning could occur wherever mechanical fuel reduction projects are sited and would occur primarily in Marin County in both the WUI and Park Interior FMUs. With carefully constructed burn piles that conform to the requirements of BAAQMD Regulation 5 and Mitigation Measures AIR-1 through AIR-6 (see Chapter 2), the potential for fire escape or visibility impacts on roadways from pile burning would be short-term, negligible in intensity, and adverse.

Public and Firefighter Health. With a potentially greater number of pile burns occurring annually, there is a greater potential for effects on firefighters from breathing emissions while monitoring pile burns. With the implementation of best practices and conformance with BAAQMD Regulation 5, the potential effect of pile burning on firefighter health would be short-term, minor, and adverse. The public could experience short-term yet negligible adverse effects if the wind shifted from the prescription to an unwanted area.

Prescribed Burning

Public and Firefighter Safety. Alternative B prescription burning is comprised of 70 acres of research-focused prescribed burning sited in the Park Interior FMU in Marin County. In addition, as in Alternative A, the approximately 50 acres of prescribed and research burning in the Muir Woods FMU would also occur under Alternative B. However, unlike Alternative A, prescribed burning in Alternative B would not be sited in the WUI FMU but restricted mainly to the Park Interior FMU and focused on research objectives. Like in Alternative A, no large-scale prescribed burning is proposed for San Francisco or San Mateo counties. Small-scale research burns for resource enhancement objectives may be developed for special habitats or plant species in these two counties.

With prescribed burning limited to the Park Interior FMU and Muir Woods FMU in Marin County, there would be less potential for smoke from prescribed research burns to affect roadway visibility, although Muir Woods Road could potentially be affected. There would also be fewer sensitive receptors for nuisance effects of smoke such as soiling that could result in material damage and have large economic costs.

Minimization of the effects of smoke can be achieved by careful planning and development of a smoke management plan and review and compliance with requirements set by BAAQMD. Mitigation measures to minimize effects on air quality are listed in Chapter 2 (see Mitigation Measures AIR-1 through AIR-6). These mitigation measures would be applied to Alternative B. The mitigation measures would minimize potential effects on the health and safety of the public and firefighters by reducing the potential for smoke to adversely affect roadway visibility. Prescribed burning under Alternative B would have a short-term, negligible, and adverse effect on public and firefighter safety while prescribed burning is implemented due to the unavoidable risk of fire escape. Over the long-term implementation of the FMP, a minor, beneficial impact would accrue to public and firefighter safety from the overall reduction of fuels.

Public and Firefighter Health. The acreage of prescribed burning allowed under Alternative B is essentially the same as under Alternative A. The difference in effect is that under Alternative A, prescribed burning could occur closer to residential communities in the WUI FMU. Under Alternative B, prescribed burning would occur in the Park Interior FMU with less potential for pollutant emissions to affect residential areas on the park boundary. Effects on health of firefighters and visitors as a result of

prescribed burning would be essentially the same in Alternative B as in Alternative A and would therefore be short-term, negligible, and adverse.

Research

Public and Firefighter Safety. Research burns under Alternative B would be more restricted than under Alternative A. Under Alternative B, research burns could be conducted only in the Park Interior FMU in Marin County. There is always a certain potential for a prescribed fire to escape control, and therefore conducting burns for research purposes under Alternative B can be considered to have a potential for a short-term, negligible adverse effect on safety of firefighters and the public.

Public and Firefighter Health. Impacts on firefighter health from research burning under Alternative B would be essentially the same as under Alternative A. In Alternative B, all research burns would be conducted in the Park Interior FMU and remote from members of the public. Burns would not be conducted in the vicinity of residential areas adjacent to the WUI FMU, so neighbors of the park would not be affected by research burning. The public would only be incidentally exposed to smoke from research burns and would not be measurably affected. There would be a short-term, negligible adverse effect on firefighter health from respiration of emissions while working at the site of the research burns.

Cumulative Impacts

Under Alternative B, efforts would be focused on increasing the rate of mechanical fuel reduction as compared to Alternative A. Though the same number of acres is proposed for prescribed burning under Alternative B compared to Alternative A, prescribed burning would be permitted only for small research burns within the Park Interior FMU in Marin County. Under Alternative B, there would be more opportunities to build upon the fuel reduction efforts of outside agencies and homeowner groups with the larger amount of acreage that could be treated for fuel reduction annually. Working with PRNS, more fuel reduction and prescribed burning in the Park Interior FMU could occur near the interface of the two national parks. Thirty acres of mechanical treatment could occur in San Mateo County in the WUI FMU and ten acres could be treated in the Park Interior FMU in San Mateo County. Sweeney Ridge has some boundary area with both the San Bruno residential developments and San Francisco watershed lands, which could present an opportunity for cooperative strategic fuel reduction.

In five years, Alternative B projects could treat and maintain approximately 1,150 acres in reduced fuels. That is more than twice as much area as allowed under Alternative A for mechanical treatment in the same period. Working cooperatively, MCFD, MMWD, MCOSD, California State Parks, and GGNRA could make important progress toward treating some of the most critical areas in Marin County. Given the progress that the other projects will be making concurrently, implementation of Alternative B could result in a long-term, moderate beneficial effect on public safety.

Few of the projects in the cumulative scenario would involve broadcast burning with the exception of approximately 50 acres annually burned by MCFD. Under Alternative B, roughly the same amount of acreage allowed for Alternative A for prescribed burning would be permitted under Alternative B. With winds dispersing smoke, the implementation of Mitigation Measures AIR-1 through AIR-6, and the

oversight of regional requests for burning coordinated and approved by BAAQMD, the project would not have a cumulative impact on public health.

Conclusion

Potential effects of the actions common to all alternatives on the safety and health of firefighter and the public are the same for Alternative B as were described in Alternative A. Alternative B would treat nearly twice the amount of acreage as Alternative A primarily through increased mechanical fuel reduction. The effect on public and firefighter safety from the resultant reduction in overall risk would be a long-term, moderate beneficial effect. As levels of prescribed burning are essentially similar under Alternative B as compared to Alternative A, the level of effect is essentially the same. The effects on firefighter and public safety would be short-term, negligible, and adverse recognizing there is some potential but very limited risk of a fire escaping control, especially in light of the extensive preparations undertaken for any prescribed burn and described under Alternative A. As in Alternative A, the long-term effects accrued by the continual treatment of additional acres would result in a long-term, minor beneficial effect on firefighter and public safety.

Cumulative effects demonstrate the more rapid progress in reducing fuels gained under Alternative B. The cumulative effect on firefighter and public safety would be long-term, moderate, and beneficial compared to minor benefits under the more restricted Alternative A. There would be no cumulative effect on public and firefighter health under Alternative B.

Alternative C

Mechanical Fuel Reduction

Public and Firefighter Safety. Compared to Alternative A, this alternative allows nearly three times as much mechanical fuel reduction (275 acres compared to 100 acres) and 20 percent more than in Alternative B. Of the 275 total acres, 70 acres would be primarily roadside mowing and fuel reduction projects along fire roads and roads used for emergency ingress and egress. Projects would primarily be sited in the Park Interior and WUI FMUs of Marin County with up to 40 acres sited in San Mateo County (including some of the roadside fuel reduction acreage). Fuel reduction projects, and therefore, benefits to public and firefighter safety, would accrue at essentially the same pace in Alternatives B and C. The difference in Alternative C is that greater fuel reduction would be achieved in the Park Interior FMUs in Marin County. Fuel projects that treat roadside stands of dense nonnative flammable plants and that seek to contain, reduce, and thin stands of highly flammable nonnative evergreen trees in the Park Interior FMU would proceed more quickly toward conversion to less flammable or smaller-statured native plant communities. Compared to Alternative A, Alternative C would have a long-term, moderate, and beneficial effect on increasing public and firefighter safety by reducing potential fire risk to park resources and residential communities on the boundary of the park.

Public and Firefighter Health. Similar to Alternative B, Alternative C would more than double the number of acres that could be mechanically treated on an annual basis as compared to Alternative A. Alternative C would accelerate the risk reduction of the potential for a large-scale wildfire by more aggressively treating areas with high fuel loading close to residential communities.

Fuel reduction projects contribute significantly fewer pollutants and particulates to the atmosphere than either prescribed burning or wildland fire. Modeling the levels of emissions produced by mechanical fuel reduction projects (using tools such as chain saws, brushcutters, chippers, etc. and vehicles) has consistently shown that fuel reduction actions under Alternative C would have a negligible, short-term, adverse effect on air quality and on public and firefighter respiratory health (NPS 2004a NPS 2004c).

Pile Burning

Public and Firefighter Safety. With over twice as much annual acreage that could be treated to reduce fuels in Alternative C, there is a potential for a correspondingly higher level of pile burning to occur as compared to Alternative A. Pile burning could occur wherever mechanical fuel reduction projects are sited and would be located primarily in Marin County in both the WUI and Park Interior FMUs. Mechanical treatments in the Park Interior FMU in Marin and San Mateo counties may be preliminary to broadcast burns, in which case no additional pile burning would be needed. With carefully constructed burn piles that conform to the requirements of BAAQMD Regulation 5 and Mitigation Measures AIR-1 through AIR-6, the potential for fire escape or visibility impacts on roadways from pile burning under Alternative C would be short-term and of negligible intensity though adverse.

Public and Firefighter Health. With a potentially greater number of prescribed burns and pile burns occurring annually under Alternative C as compared to Alternative A, there is a greater potential for effects on firefighters from breathing emissions while monitoring burn piles. With the implementation of best practices and conformance with BAAQMD Regulation 5, the potential effect of pile burning on firefighter health would be short-term, minor, and adverse. The public could experience short-term yet negligible adverse effects if the wind shifted from the prescription to an unwanted area.

Prescribed Burning

Public and Firefighter Safety. Up to 320 acres of prescribed burning would be allowed under Alternative C. As in Alternatives A and B, approximately 50 acres of prescribed and research burning in the Muir Woods FMU would occur. Up to 50 acres of prescribed burning could occur in the WUI FMU in Marin County. Under Alternative C, up to 5 acres of burns could be planned for the WUI FMU lands in San Mateo County, while the maximum under Alternative A for all FMUs in San Mateo County is 10 acres.

Prescribed burning in Alternatives A and C would have similar impacts on public and firefighter safety. However, Alternative C also includes an additional 210 acres parkwide than Alternative A. This is where the difference in objectives and effects becomes evident. The total of 320 acres of treatment by prescribed burning permits a large amount of resource-driven projects to occur annually. Because the majority of projects (215 acres) are proposed for the Park Interior FMU, the potential for prescribed burns to escape control and cross into private parcels or properties of other land management agencies remains limited due to the distance from the park boundary. With prescribed burning primarily concentrated in the Park Interior FMU, there is less potential for smoke from prescribed research burns to affect roadway visibility. There are also fewer sensitive receptors in the Park Interior FMU for nuisance effects of smoke such as soiling that could cause material damage and have large economic costs.

As in Alternative A, minimization of the effects of smoke can be achieved by careful planning and development of a smoke management plan and review and compliance with requirements set by BAAQMD. Mitigation measures to minimize effects on air quality are listed in Chapter 2 (see Mitigation Measures AIR-1 through AIR-6) and would also be applied to Alternative C. Prescribed burning under Alternative C would have a short-term, negligible, and adverse effect on public and firefighter safety during the prescribed burn due to the unavoidable risk of fire escape. Over the long-term implementation of the FMP, a moderate, beneficial impact would accrue to public and firefighter safety from the overall reduction of fuels achieved in tandem with cultural and natural resource objectives.

Public and Firefighter Health. The acreage of prescribed burning allowed under Alternative C is nearly triple that under Alternative A. The difference in effect is that under Alternative C prescribed burning could occur close to residential communities in the WUI FMU. In Alternative C, the majority of prescribed burning would occur in the Park Interior FMU where there is less potential for emissions to affect residential areas on the park boundary. However, effects on the health of firefighters would be greater due to the greater number of fires worked during the fire season. The initial studies of respiratory impacts on firefighters appear to infer that the greater the number of hours worked on a fire, the more a firefighter is exposed to smoke, particulates, and other potentially harmful emissions. The studies appear to indicate that the long-term effects are not known but that seasonal effects appear to resolve after the fire season. The effects on firefighter health under Alternative C would be short-term, minor, and adverse.

Research

Public and Firefighter Safety. Research burns under Alternative C would be essentially the same as under Alternative A. Since there is always a certain potential for a prescribed fire to escape control, the conducting of burns for research purposes under Alternative C can be considered to have a potential for a short-term, negligible adverse effect on safety of firefighters and the public.

Public and Firefighter Health. Parameters for research burns would be essentially the same as under Alternative A. There would be a short-term, negligible adverse effect on firefighter health from respiration of emissions while working the research burns.

Cumulative Impacts

Under Alternative C, FMP efforts would be more evenly split between mechanical fuel reduction projects and prescribed burning than Alternative B. The pace of work would allow the quickest results for reducing fuels in critical areas around the park; almost 1,375 acres could be mechanically treated on an annual basis. There would be more opportunities to plan joint projects to strategically reduce fuels across jurisdictional boundaries than in Alternatives A or B. Alternative C would result in a long-term, moderate beneficial and cumulative effect on public safety. Impacts on public health would be similar to those under Alternatives A and B. Prescribed burns conducted by PRNS or MCFD are distant enough from GGNRA lands to avoid a cumulative impact on public health. NPS firefighters assigned to prescribed burns in both parks would rely on best management practices to rotate crews out of areas of heavy smoke.

Conclusion

Flexible fire suppression, treatment of the Muir Woods FMU, and Wildland-Urban Interface Initiative funded projects within the park would all have a long-term, moderate beneficial effect on firefighter and public safety. Firefighters could experience short-term, adverse, negligible-to-minor health effects from exposure to emissions while fighting wildland fires, undertaking prescribed burning, and conducting pile burning for Wildland-Urban Interface Initiative funded projects within the park.

The application of herbicides to cut tree or shrub stumps by a licensed pesticide applicator would have no effect on firefighter or public health with the oversight ensured by the Integrated Pest Management coordinator. The remaining actions common to all alternatives, including relocation of the fire cache, roadside fuel reduction, fire education, fire effects monitoring, and others, would result in long-term, minor-to-moderate beneficial effects.

Under all three alternatives, the comparatively low levels of emissions produced by mechanical fuel reduction would be much more easily dispersed and would result in only short-term, negligible adverse effects on firefighter health. Alternative A, which includes very limited mechanical treatment, would result in a short- to long-term, minor benefit to firefighter and public safety by reducing the overall potential risk of a large-scale wildfire. Alternatives B and C treat nearly the same amount of acreage by mechanical fuel reduction and would result in long-term, moderate benefits to public and firefighter safety.

All three alternatives would result in short-term, negligible adverse effects on firefighter health due to the effects of emissions on respiratory health of the firefighters. All prescribed burning projects include some degree of hazard that the fire could escape from the control of the firefighters. Because Alternative C is significantly larger in scale than the other alternatives, prescribed burning for Alternative C would result in a long-term, moderate beneficial effect on public and firefighter safety.

The three alternatives would result in short-term, negligible, and adverse effects on public and firefighter safety as a level of risk that the fire could escape control, however unlikely, is inherent with any prescribed burn.

Under all alternatives, firefighter health effects were recognized for those actions involving burning. The greatest impacts were found with tending burn piles. Alternatives B and C involve a larger number of burn piles compared to Alternative A. Pile burning, research burns, and prescribed burns would have a short-term, negligible adverse effect on firefighter health due to firefighter exposure to particulates and other emissions while working these fires. No health effects are anticipated for the public from these prescribed burns.

The cumulative impact of all the vicinity fuel reduction efforts would be a long-term, minor beneficial effect on public and firefighter safety under Alternative A but a moderate beneficial cumulative effect under Alternatives B and C due to the increased participation on the part of GGNRA in lowering fuel loading within the WUI FMU. There would be no cumulative impact on public or firefighter health.

Impairment

The effects of the FMP on firefighter and public health and safety would not represent an impairment of important park resources or values.

Impacts on Visitor Use and Visitor Experience

Actions Common to All Alternatives

Wildland-Urban Interface Initiative

The National Interagency Fire Center (NIFC) has granted Wildland-Urban Interface Initiative funding to projects inside GGNRA's boundaries and had funded fuel reduction efforts in communities on the park's interface zone. The project sites within the interface area typically have high fuel loading or require roadside clearance to meet state and local fire code requirements. The Fire Management Office has worked closely with the local community to hold public meetings and develop flyers and posters explaining the scope of the park's projects to park neighbors and visitors prior to the beginning of work. Community groups, park fire staff, and representatives from local fire agencies typically work together to iron out aesthetic issues and determine if modifications can be made to respond to individual's concerns of potential project effects.

Each fire management action would be reviewed for conformance to this EIS Record of Decision by the GGNRA Project Review Committee. This committee will determine the appropriate level of NEPA analysis and assign appropriate routine management practices and mitigation measures as conditions that need to be followed for project implementation. For example, the committee may recommend that fuel reduction be achieved by concentrating on removing nonnative plant species first before cutting less flammable native plants.

Community groups and homeowners' associations have a vested interest in maintaining an aesthetically pleasing landscape in the park when viewed from their privately held or commonly held parcels or when hiking in the park itself. The scope of park projects within the interface area to date has been such that no project has resulted in sizable modifications to park viewsheds. Projects have involved roadside fuel reduction, understory thinning, removal of stands of nonnative evergreen trees, removal of individual trees, and construction of shaded fuel breaks. With the exception of removal of stands of trees, project implementation has not produced easily noticed changes to park viewsheds. In some instances, the removal of dense nonnative vegetation, such as 10- to 12-foot-high French broom, has recovered former viewsheds. Roadside fuel reduction creates a buffer from the edge of the roadway in which grasses and shrubs have been cut and trees have been limbed up. These buffers parallel the road, an established landscape feature, and do not appear as nonconforming elements in the viewshed.

The implementation of Wildland-Urban Interface Initiative-funded projects within the park in the interface zone would have a short-term, negligible-to-minor, adverse effect on aesthetics, access, and soundscape for the duration of project implementation. Trail access to working sites would be closed when conditions may compromise public safety. Efforts would be made to provide detour routes and spotters to escort visitors across the work area, and to allow access to the project sites before and after the work day. Projects close to the park boundary may generate noise that is perceptible at adjacent parcels.

Noise from the cutting, chipping, or hauling of cut vegetation could result in a short-term, minor adverse effect on the park soundscape. Mitigation Measures VUE-1 through VUE-4 would be applied where appropriate (see Chapter 2, Section 2.7, Mitigation Measures).

Defensible Space/Vegetation Clearing Around Structures

Routine annual maintenance includes reestablishing defensible space around park structures to establish an area of low fuels to prevent fire spread to the structure and to provide firefighters with an area from which to launch suppression actions. Once all structures have been treated in GGNRA, clearing defensible space would become largely a maintenance function, with actions at each structure limited to mowing low vegetation, pruning dead branches, and removing hazard trees. Only a short period of time would be spent at each structure once defensible space has been established. Hand tools, such as chain saws and gasoline-driven mowers, would be the most common noise sources. Clearing of defensible space does not involve manipulation of the landscape to the extent that views would be altered. The defensible space component of the FMP alternatives would have no effect on aesthetics, no effect on visitor access or activities, and a short-term, negligible adverse effect on the park soundscape.

Roadside Fuel Reduction

To create zones of reduced fuels adjacent to park fire roads and access roads, a fuel crew or contractor uses chain saws, brushcutters, and pole pruners to selectively cut vegetation within 10 to 15 feet of the road edge. The return interval for maintenance depends on the type of vegetation. Mowers may make a pass over grassy roadside areas to maintain grasses at a low height to discourage bird nesting. Nonnatives, such as French or Scotch broom, may be brushcut to ground level annually before their seed sets to discourage continued sprouting. At GGNRA, the full broom plant, including the roots, is often pulled from the ground, using a weedwrench during the winter when the soils are saturated and the plant pulls out more easily. Tree branches that impede passage of emergency vehicles are limbed as needed using a chain saw. Dead wood within the roadside buffer is cut and laid flat on the ground. After pruning a stretch of road, the crew backtracks and feeds all cut material into the chipper and blows the chips back onto the roadside. The completed project often resembles a shaded fuel break as specimen native shrubs and trees are usually limbed up but left in place.

Roadside clearance widens the appearance of the built environment in the landscape by widening the cleared area represented by the road. The shaded fuel break approach helps feather the outer edge of the roadside fuel zone into the area of undisturbed vegetation, so that the feature has a more natural appearance. Debris generated by brushcutting and pruning is cleared and chipped by the crew and larger sections of trees are laid flat on the ground where felled to decay. In areas that were nearly 100-percent broom, the plants are pulled free, leaving a cleared road edge that revegetates from the existing seed bank with the next rains or is partially planted with native stock from the park nursery. In areas cleared of other nonnative plants, stubble at ground height may be apparent along the road edge until seed bank revegetation with the next rains. Areas with a high proportion of nonnative plants may be treated several years in a row until sprouting from the existing seed bank becomes exhausted.

The aesthetic impact on visitors hiking on treated roads and fire roads would be a short-term, negligible-to-minor adverse impact until less flammable and often less densely-growing native plant species

reestablish. In the long term, the impact on aesthetics would be minor-to-moderate beneficial effects as new viewsheds are revealed and native plants eventually revegetate an area providing more diversity and improved wildlife habitat along the road or trail. Roadside fuel reduction would not normally require road closures, although occasionally a visitor would be asked to wait at the edge of the worksite until a task is completed. A longer delay of 10 to 30 minutes may be required for tree felling. Temporary road closure could be required to ensure visitor safety in the event that regular truck or heavy equipment traffic was needed to move large amounts of chipped materials or felled trees at the site. If a closure is required, notice would be posted a minimum of seven days in advance and an alternate route recommended if at all feasible. Roadside fuel reduction projects would have a short-term, negligible, adverse effect on visitor access.

Noise generation is regular but intermittent as cut brush is gathered and piled. The whine of brushcutters and chain saws has a high nuisance factor. Chain saws and brushcutters typically each generate 110 dBA at close range, resulting in a cumulative noise level of 113 dBA at close range. When noise disturbance is greater than 110 dBA, oral communication between two people is impossible even when shouting.

Without consideration of other dampening or diverting factors, noise attenuates (reduces in sound energy) from a stationary noise source at 6 dB each time the distance from the noise source is doubled. However, it is more realistic to consider the absorption and reflective effect of a vegetated ground surface or a dirt road in reducing noise energy over distance. The attenuation figure normally used is 7.5 dB for a doubling of the distance between source and receptor (Hendriks 1998).

Park visitors hiking on a trail who have a clear line of sight to a fuel reduction crew in the distance using a chain saw and brushcutters would clearly hear the two members of the crew working one half mile distant on a relatively windless day in the interior of the park. To be readily distinguishable, the noise source would need to be at least 5 dB greater than background noise at the point where the visitors are walking. Wind and soft ground further dampen noise levels, but the varying frequencies of these types of tools are readily perceived above ambient noise even at a distance. However, rarely is there a situation in the park without intervening terrain, screening vegetation, wind, or other noise sources over a half mile along a trail. When topography provides line of sight barriers between a noise source and a receptor, noise levels are greatly reduced. Taken as a worst-case situation, however, hikers approximately 300 feet from the work crew would have to raise their voices to communicate. With a 600-foot-long stretch of trail affording a clear line of sight to the crew working, the visitors would experience very high noise levels for approximately 0.1 mile or (at 1 mile per 30 minutes) roughly 3 minutes. At 0.6 mile, the crew's equipment should be imperceptible above background noise in most areas of the park given the additional attenuation of atmosphere and soft ground. A worst-case scenario for noise propagation would have the hikers on a flat, straight trail with no intervening trees or topography and a hard road surface. In this worst case, natural soundscape would be disturbed for 30 minutes as they approached and receded from the noise source.

The previous scenario is presented to illustrate the scale of impact on the park soundscape of one working crew. More realistically, the weekday GGNRA ambient or background noise environment would include

wind noise, aircraft and jet flyovers, and in the WUI FMU where most fuel reduction work would occur, other construction noise and vehicle noise emanating from the adjacent residential neighborhood.

Fuel reduction work would result in short-term, negligible-to-minor adverse impacts on local noise levels on weekdays during normal work hours, especially within the WUI FMU and close to fire and access roads within the park. Nearly all noise generation would occur between mid-August and March 1 to avoid disturbance to birds nesting in the park's vegetation.

Suppression

A flexible suppression strategy uses methods that cause minimum resource damage while accomplishing effective control. The strategy allows for the choice of a range of approaches to confine, contain, or control a wildland fire, based on the actual conditions faced, with input from the park, suppression forces, and adjacent landowners. Flexible suppression incorporates minimum impact suppression tactics (MIST) guidelines (see Appendix G). During suppression, resource management objectives and long-term effects are constantly being reconsidered, and strategies change to respond to wildfire behavior. Tactics that reduce the need for extensive rehabilitation or regrading are preferred. Whenever possible, fires are allowed to burn to natural barriers. This tactic results in the least impact on landscape and vistas in areas with low vegetation such as coastal scrub and grasslands. Use of tracked vehicles such as bulldozers is discouraged in favor of wheeled vehicles such as excavators and skidders if needed.

Wildfire clearly affects the visitor experience, but it can have beneficial effects through reintroduction of fire into the natural landscape, along with potential interpretive and stewardship opportunities. For a flexible suppression strategy to succeed, preparation of information on important resources is required. With the implementation of Mitigation Measure FMP-6 (see Chapter 2, Section 2.7, Mitigation Measures), a flexible suppression strategy would have a long-term, moderate beneficial impact on the visitor experience by potentially reducing the degree of landscape and resource damage incurred during suppression by limiting the most damaging suppression tactics to the least sensitive areas of the park. Fire suppression using MIST tactics and considering site-specific strategies could leave vegetation blackened and burned but topographic features and soils intact rather than trenched or bulldozed. The resource recovery should be significantly shortened if resource values are considered an important factor in the development of an on-the-ground suppression strategy. Mitigation Measures FMP-2, FMP-3, and FMP-6 through FMP-8 would apply (see Chapter 2, Section 2.7).

Treatment of Muir Woods FMU

The goal of the Muir Woods FMU strategy is to make the visitor experience an important part of the fire management actions. Interpretive programs developed by NPS staff have made the fire-adaptive aspects of the coast redwood forest a key element in the story of Muir Woods and its survival, both past and future. Park visitors quickly become familiar with the large, ubiquitous fire scars at the tree's base and the visitor's eye level. Park staff stress that the woods is not a museum but a vital ecosystem adapted to thrive within a certain range of fire conditions. A cherished part of the Muir Woods visit is the opportunity to take a photo of friends or family posed within the fire scar.

Prescribed burning of up to 50 acres annually could be carried out in Muir Woods under all alternatives. A prescribed burn of the Redwood Creek floodplain through the principal old-growth groves would require meticulous planning and consultation with resource agencies. Important issues to consider in principal areas of the park are avoiding degradation of contributing elements of the cultural landscape; avoiding adverse effects on rare or listed plant, fish, or wildlife species; avoiding significant damage to park infrastructure (much of it wooden walkways); and providing an interpretive program for visitors during the preparation, execution, mop-up, and any necessary rehabilitation of the burn area.

A closure of one or more of the principal trails through the old-growth groves may be required for public safety. Monument staff has experience with temporary closure for either safety or resource requirements. Either an alternate route to the grove is established or an independent program is developed for an alternate part of the park. NPS staff for Muir Woods, has found that visitors are very adaptive to changed conditions encountered at the monument provided that care is taken to inform them of the story behind the closure and an alternative program is in place. During the preparation, execution, mop-up, and rehabilitation stages of the fire, it may become necessary to use noise-generating equipment, such as chain saws, that would disrupt the soundscape of the old-growth forest. While use of loud equipment would be kept to a minimum to remain as unobtrusive as possible, interpretive staff at a distance could use the noise as an interpretive opportunity. Noise generation during prescribed burning would be a short-term, negligible adverse impact lasting only as long as crews were present rehabilitating the burn unit.

Visitation to the monument is typically lowest from December 1 to the March 1 each year. However, conditions at the monument are too wet for a successful burn during this period. Prescribed burns have been successfully implemented at Muir Woods in the months of October and November prior to the annual rainy season. These are months with lower, but still significant, visitation (approximately 40,000 to 60,000 visitors per month). October and November prior to winter storms is also a time period when prescribed burning would not affect nesting or breeding activities of rare and endangered animal species found at the monument.

To reduce potential effects on the visitor experience, staff at Muir Woods routinely places notices on Panoramic Highway, informs adjacent residents, and issues press releases when scheduling prescribed burns or significant changes in park access to warn about smoke impacts. Staff will set up staging areas at the entry to the woods to gather visitors in groups, explain the current project, and answer questions. To facilitate visitation during a prescribed burn in the old-growth groves, a staging area could be set up at the intersection of Panoramic Highway and Muir Woods Road to discuss health effects of smoke and warn at-risk visitors of the prescribed burn. If needed, shuttle service could be provided from this intersection to reduce the number of vehicles using the park road in case of an emergency or need to evacuate. Frank's Valley Road is also available as an alternate ingress/egress for emergency vehicles and supporting fire equipment.

Defensible space of up to 5 acres per year would be mechanically cleared in Muir Woods. Dead branches and SOD-affected trees would be limbed up, chipped, and left onsite in accordance with state SOD guidelines. Defensible space would be cleared around structures in the historic residence area above the

administration office and around the structures on Conlin Avenue. Roadside acres of broom species would also be mowed or cut and maintained on a regular schedule.

Based on the standard procedures currently employed to maintain a valuable program for visitors at the monument even during occasional closures, the staging of prescribed burns at Muir Woods and its interpretation is so integrated into the Muir Woods interpretive program that prescribed burning would result in a short-term, moderate beneficial effect on the visitor experience, and a short-term, negligible adverse effect on public access and park soundscape.

Treatment of San Francisco County Project Area

San Francisco fuel reduction projects would occur primarily near the interface of the park boundary with residential areas, with the objectives of fuel reduction along those boundaries. Nearly all fuel reduction would involve thinning, removal, or limbing of nonnative tree species in dense groves or brushcutting nonnative shrubs or grasses. Areas with particularly aggressive nonnative species may need annual treatment over several years and receive out-plantings from the GGNRA native plant nursery. Certain areas are weedy, littered paths providing not only local access to the park but also screening for illegal camping or nighttime gatherings that could become ignition sources for wildfire.

Where fuel reduction projects occur on the park boundary, park neighbors may experience a reduction in screening vegetation along the boundary as dense stands of nonnative plants are removed. Removal of screening vegetation would reduce fire hazard, eliminate hidden illegal campsites, and remove or reduce fire hazards presented by thick stands of nonnative plants. If plants from the GGNRA native plant nursery are available, the park staff would work with neighbors in developing a palette of suitable replacement native plants for the treated area that could provide some screening and increased security, and be less flammable. The effects and treatment of these areas would be similar to roadside fuel reduction. The impact on aesthetics by reducing fuel loading and cleaning out the screening vegetation from these littered areas would be a long-term, minor-to-moderate benefit to park visitors and park neighbors. Projects would not be expected to impede access to any official trails or recreation areas, as there are numerous options and social trails available for detours in the San Francisco lands in the event of a temporary closure of one area. Fuel reduction projects in the San Francisco lands would have a short-term, negligible adverse effect on public access and the visitor experience. Power tool use would result in short-term, negligible-to-minor adverse effects on the park soundscape in the project vicinity for the duration of work.

Mitigation Measure VUE-1 recommends the limitation of project work hours to those typical of construction work, wherever feasible. The fuel reduction projects in San Francisco lands would have short-term, negligible-to-minor adverse noise impacts on adjacent residents and park visitors during implementation.

Public Information and Fire Education Programs

Studies show that public perception and acceptance of fire as a management tool are partially influenced by prior experience and knowledge, and that the public is supportive of the use of fire to achieve management goals (Machlis et al. 2002, citing Carpenter et al. 1986). Surveyed subjects supported

government actions to reduce risk and find a solution, rather than solutions that required the public to change their behaviors to obviate the risk. These preliminary studies indicate that education and interpretive programs in the park, community meetings on wildland urban interface projects, and public meetings on park projects and plans contribute to communication about fire risk. This pre-emergency risk communication educates the public about the risks of wildland fire and ways they can prepare to protect their families, possibly change behaviors, and work cooperatively with fire agencies to develop solutions.

The public information and education program would provide the public with the information necessary to understand the need and strategy behind fire management practices. The program would also serve as a conduit between the public and the Fire Management Office, informing staff of concerns important to visitors and park neighbors. GGNRA staff can inform park neighbors and visitors about the scope of fuel reduction projects and prescribed burns, giving specifics regarding purpose and need, duration, scope, anticipated noise levels, and outcomes prior to the start of work. The public would have a means to convey feedback regarding proposed modifications to projects, problems they see in the field, general questions, and areas of concern. This information exchange would promote the development of a collaborative approach to fuel reduction, which is as important to residents of the interface as it is to GGNRA and its staff.

The public information and education program would have a long-term, minor, beneficial effect on the visitor experience by informing visitors about fire management planning and fire risk reduction. This component of the FMP would have no effect on noise levels, aesthetics, or public access in GGNRA. The information program would also inform the public about the scope of proposed work plans, anticipated outcomes, potential noise levels, and temporary closures and other factors that influence the visitor experience.

Fire Cache

Relocation of the fire cache would not be distinguishable to visitors from other routine park actions and would have no effect on any aspect of the visitor experience.

Fire Effects Monitoring

In many cases, the staff working in the field for the fire behavior monitoring program would be indistinguishable to visitors from other routine park field operations but would impart a sense to visitors that staff, researchers, or volunteers (depending on the uniform worn) are caring for the park and its resources. Field work provides a means for communication between the park and the public and an opportunity to exchange information and insights. Specifically for fire behavior monitors, the interaction provides an opening for increased fire education. The effect of fire effects monitoring on the visitor experience would be a short-term, minor beneficial impact.

Alternative A

Mechanical Fuel Reduction

Roughly 70 percent or 70 acres of the total acreage treated annually by mechanical fuel reduction under Alternative A would involve roadside mowing and fuel reduction projects. This could occur in Marin and/or San Mateo counties along unimproved fire roads and paved access roads. Defensible space around

structures and areas with highly flammable nonnative plants would be treated in Muir Woods (5 acres) and in San Francisco (5 acres) on an annual basis. The remaining acres of mechanical treatment annually could occur in either Marin or San Mateo counties and could be focused on fuel reduction in the interface area between the park and residential communities. Projects and impacts on the visitor experience would be similar to those described for roadside fuel reduction, defensible space around structures, and public information and education in the previous section, "Actions Common to All Alternatives." Projects could involve reducing roadside fuel, clearing defensible space, creating shaded fuel breaks, or containing, thinning, or removing stands of eucalyptus trees or other highly flammable nonnative trees and shrubs or thinning of areas severely affected by SOD. Projects would be sited to strategically reduce fire hazard to sensitive resources, park values, and residential development inside and outside the park.

Noise levels for smaller-scale projects, such as thinning small-diameter trees from woodlands to reduce fuel loading, would be similar to those discussed for roadway fuel reduction under "Actions Common to All Alternatives" above. Projects that propose containment, thinning, or removal of nonnative trees and shrubs could require the use of heavy equipment such as front-loaders, excavators, and skidders to move felled trees into trucks for off-hauling. This creates a more complex noise environment replete with a variety of intrusive noise sources that range in frequency, such as metal clanging or scraping, which has a high nuisance factor.

A worst-case scenario for noise generation is to consider the types of equipment that could be used for the various phases of a tree removal project working simultaneously, for example, one or two chain saws, a skidder, a wood chipper, a diesel haul truck, and an excavator for loading onto the haul truck. Noise levels produced by this activity would be shifting moment to moment depending on which piece of equipment was operating and dominant. Chain saws and chippers produce the highest noise levels, from approximately 100 dBA L_{eq} to 106 dBA L_{eq} at 10 feet (de Hoop and Lalonde 2003). Chain saws are operated in bursts for short periods of time but over several hours. A trailered wood chipper produces nearly the same noise level but could run continuously for an hour as it is continuously fed wood debris.

The staging area for operations for tree removal projects should be selected carefully to place natural barriers and screening vegetation between the noise sources and sensitive receptors such as residential areas on the park boundary and popular trails. As discussed in Mitigation Measure VUE-2, natural barriers to noise such as hills and ridges, and screens such as dense stands of vegetation and wood piles, can be very effective in reducing noise as perceived by sensitive receptors (Hendriks 1998). Wind speed, wind direction, humidity, and air temperature also play an important role in the transmission of sound over distances. Siting a staging area downwind of sensitive receptors would further attenuate noise levels heard by the receptors, except on windless days or days with offshore winds. Work hours would be limited to daytime weekdays when construction-type noise and higher traffic levels are anticipated in residential areas. Without accounting for the noise reduction effect of barriers and screens, noise levels as high as 110 dBA Leq at 10 feet from equipment (chain saws, chipper, haul truck) would be barely perceptible above weekday ambient noise levels at approximately 0.5 mile from the worksite. With topography barriers shielding equipment, noise would be barely perceptible at 0.25 mile. Fuel reduction projects would be limited to July 31 through March 1 to avoid disturbance to nesting birds (see Mitigation

Measures WIL-1 and WIL-2). To date, the typical length of larger projects has been two to three months of weekday work performed primarily by contracting with state-licensed arborists.

Mechanical fuel reduction projects, particularly projects proposed close to the residential areas, have the potential for a short-term, minor-to-moderate, adverse impact on the soundscape of GGNRA. The following mitigation measures would apply.

With the exception of routine hazard tree removal and limited thinning, park fire management staff would avoid temporary closures of areas of the park during fuel reduction projects and attempt to keep visitors, park residents, and the public informed of the scope of larger proposed projects for fuel reduction and any need for temporary closures (see Mitigation Measure VUE-3). Efforts would be made to secure the site at the close of the workday so that closures around a site could be lifted prior to and after working hours (see Mitigation Measure VUE-4).

With the inclusion of Mitigation Measures VUE-3 and VUE-4, fuel reduction project impacts on visitor access would be reduced to short-term, minor adverse effects.

If requested by the public, complex, larger fuel reduction projects in the interface zone that that could affect mid- to close-range viewsheds for residents on the park boundary, would be discussed at a meeting held in the project vicinity and arranged by the park fire management staff. The project scope and schedule would be presented and comments or questions offered by the public for consideration by park staff (see Mitigation Measure VUE-5).

Mechanical fuel reduction projects, depending on the type of resultant visual change, could have a short- to long-term, minor-to-moderate adverse impact on viewsheds in the aftermath of a fuel reduction project that results in large-scale changes to vegetation communities and views from private homes adjacent to the park.

Pile Burning

The effects of pile burning on the visitor experience are primarily visual. Prior to, during, and after the burn, there are opportunities for park staff to be present at the site and conduct ad hoc public information sessions explaining why burning woody debris is necessary, and to discuss alternative treatments and how the site would be stabilized. For public health and safety, on the day of the burn, access to the area where the burn piles are located would be restricted to minimize public exposure to concentrated smoke and particulates.

The primary visual effect is restricted to the area directly around the burn pile. Since pile burning can cause many changes on soil properties, it is important for the area to be stabilized following the burn, if necessary. The seed bank immediately under the burn pile may have been largely incinerated during pile burning, along with much of the organic matter in the very upper soil horizon. The park hydrologist would determine if any amendments are necessary to prepare the area. If available, plants from the GGNRA native plant nursery could be used to revegetate the burn pile sites if the seed bank proves not to be viable.

If necessary, a temporary closure would be posted at access points to the site for reasons of public health and safety. Burn piles would be constructed and ignited to maximize combustion and minimize smoke and particulate emissions. Beyond the immediate area, noise levels would not be perceptibly elevated; little equipment would be needed so no effect on the park soundscape would be expected beyond the area already closed for reasons of public safety.

Pile burning under Alternative A would have a short-term, minor adverse effect on aesthetics and a short-term, negligible adverse effect on public access. There would be no effect on the park soundscape.

Prescribed Burning

Alternative A allows prescribed burning of 110 acres annually, primarily to achieve resource objectives and secondarily to reduce high fuel loading. The effects of prescribed burning in the Muir Woods FMU would be the same under each alternative and are discussed under "Actions Common to All Action Alternatives," "Fire Management Strategy for the Muir Woods FMU" above.

Roughly 100 acres of prescribed burning under Alternative A would be sited in Marin County of which up to 50 acres would be at Muir Woods National Monument. Prescribed burning would focus on meeting natural resource management goals, which could include vegetation conversion, control of nonnative plants, reintroduction of fire back into an ecosystem for resource benefits, or a series of research burns. If the burn unit supports dense stands of nonnative plant species, such as French broom, a consecutive series of annual burns may be required to begin to exhaust the accumulated broom seed bank. Areas with a mix of native plants and nonnative species may be left following a burn to revegetate from the native seed bank and then weeded of nonnative plants for several years to promote the success of native species.

Prior to the prescribed burn, the fire management staff may post notices on trails leading to the site of the proposed prescribed burn and on the GGNRA fire website. NPS staff phone numbers would be included in notices for the public to contact for additional information.

Brief closure of the burn unit would be needed during site preparation, burning, mop-up, and rehabilitation and stabilization. GGNRA would place special effort on maintaining area access to the greatest extent possible while assuring public safety. Long-term stewardship opportunities may be available to the public to help in the successful revegetation of the burn site following stabilization of the project site.

Prior to conducting the prescribed burn, the GGNRA Fire Management Office would submit a smoke management plan to the BAAQMD for approval to burn at least 30 days in advance of the desired burn date. Many prescribed burns are proposed for late summer or early autumn – at the end of bird nesting season and just before the winter rains begin. BAAQMD grants approval for burns based on the estimated emissions that would be produced by the fire in relation to other applications they have received and the weather forecast. If weather conditions shift out of prescription or smoke begins to accumulate close to the ground after the prescribed fire has been ignited, the burn is shut down and the fire is contained, controlled, and mopped-up. (See discussion under "Human Health and Safety," Prescribed Burning" and "Pile Burning.").

Under Alternative A, prescribed burning would have a minor adverse impact on aesthetics and the visitor experience over the short term from the effects of the prescribed fire on the landscape and vegetation as the visitor experiences firsthand the reintroduction of fire into grassland and shrublands. The long-term effect on aesthetics and the visitor experience would be minor and beneficial, as winter rains and revegetation follow the prescribed burn.

Elevated noise levels from park staff using equipment and vehicles during the preparation and execution of the prescribed fire could be perceivable to park visitors at close range to the burn unit. A temporary closure of roads and trails leading to the burn unit would be put into effect for the day of the burn. Elevated noise levels from speech and vehicle and equipment use would be noticeable through the rehabilitation period for the burn unit when the closure for public access would be lifted.

A negligible short-term adverse effect on soundscape and public access would occur restricted to the implementation period of the burn.

Research

Research topics include enhancement of endangered species habitat, effects of fire on SOD-infected woodlands, effects of SOD on fire behavior due to increase tree mortality, and effects of fire on vegetative type conversion. Under Alternative A, a proportion of these acreages subject to prescribed burning could be used for smaller, more focused research burns. Though smaller in scale, research burns require a burn plan, including a smoke management plan, to be prepared. These must be submitted to BAAQMD for approval at least 30 days prior to the proposed burn date, as with any other burns.

Conducting limited size research burns under Alternative A would allow the reintroduction of fire into areas where burning has long been suppressed. Most prescribed burns are conducted just prior to winter rains, and the burned landscape would be quickly replaced in the spring by grassland and shrublands with a flush of new growth and annuals. The short-term, minor adverse aesthetic effect of the burned landscape would be replaced by a long-term minor beneficial aesthetics impact in the spring when the area is revegetated from the seed bank. Similar to prescribed burning, conducting the research burns would have a short-term, negligible adverse effect on public access and no effect on the park soundscape.

Cumulative Impacts

The effects of fuel reduction projects or prescribed burns sited in the background of a viewshed may appear indistinct with time and blend in readily with surrounding features as regrowth occurs in the winter and spring. Wildland-Urban Interface Initiative-funded projects in the community have typically been limited in scope to shaded fuel breaks or roadside fuel reduction projects and have involved very limited ground disturbance or topographic change. The context for assessment of effects on visitor use and visitor experience has a smaller areal extent than many other environmental effects. Unlike air quality, based in a nine-county air basin, impacts on the soundscape rarely penetrate a distance of a quarter mile (with the exception of propelled noise sources such as explosions, gunshots, and aircraft). Noise generated by projects and routine actions listed in Appendix C would need to be within earshot during part of the day when a visitor also passes close to a noisy fuel reduction project in order to result in a cumulative effect on visitor experience. This could occur under the scenario where a fuel reduction project outside the park

boundary is occurring at the same time as a project inside the park. The adverse effect would diminish as the visitor moves away from the noise source. Mitigation Measure VUE-1 recommends that fuel reduction projects adhere to normal work hours of 8 A.M. to 5 P.M. Monday through Friday to the extent possible in light of other constraints and limitations. Fuel reduction projects would generally be sited near or in the urban interface area and would be unlikely to occur within quieter, more remote areas of the park where fire hazard is relatively low. The effect on visitors would be a short-term, negligible or minor cumulative effect lasting only as long as the visitor stayed in the interface area. A long-term effect on the park soundscape could result if a wildland urban interface project on the park boundary removed a stand of nonnative trees or dense vegetation that served to buffer noise levels from a nearby busy street or highway. The effect would be long-term, but only when close to the edge of the park. As the visitor moved away from the interface boundary, the traffic noise would be attenuated with distance. Alternative A would have a short-term, negligible, adverse cumulative impact on soundscape within the park.

Mechanical fuel reductions under Alternative A would be primarily roadside fuel reduction and would rarely require road closures. It would be unusual for several projects in the same area to result in a closure to the public unless one project had inherent hazards that required public closure. Certain projects, as listed in Appendix C, propose construction and would necessitate some level of park closure to allow safe completion. It is possible that a fuel reduction project or prescribed burn could occur in close proximity to an area closed for construction, thereby expanding the closed area. Closures due to FMP actions are generally short – less than a day. If longer closures are required, Mitigation Measure VUE-4 would encourage the park to secure the site so that it could be opened when fuel reduction, construction, or other hazardous activities are not occurring. Cumulative impacts on public access under Alternative A would be short-term, negligible, and adverse.

The alteration of viewsheds through fuel reduction and prescribed burning could occur where more than one FMP project site is within the view of visitors using trails, roads, or other facilities. The view of more than one area blackened by prescribed burning, whether or not both sites are inside the park or not, could be a short-term, minor adverse effect on the visitor experience. Where the risk of fire hazard is too great to permit the temporal spacing of project implementation, and multiple areas must be disturbed within a viewshed over a short time period, a moderate adverse effect on the visitor experience would result. This effect would be unavoidable due to the more compelling risk to public safety or park resources or private property.

Impairment

Impacts on the visitor use and experience would be short-term, if adverse, and would not constitute an impairment of park resources or park values.

Alternative B

Mechanical Fuel Reduction

Mechanical fuel reduction in the WUI FMU in Marin and San Mateo counties is the primary focus of Alternative B. Alternative B presents the park with an aggressive work plan and imperative to reduce fire hazard along park boundaries or stands of vegetation in the Park Interior FMU of the park that could burn into the interface. Approximately 230 acres would be treated annually, including 70 acres of roadside fuel

reduction and mowing along fire and access roads in the two counties. The majority of fuel reduction acreage would be in Marin County in the WUI FMU and to a lesser extent in the Park Interior FMU in Marin County. Approximately 30 acres, of which some proportion would be roadside fuel reduction, is reserved for San Mateo County WUI FMU for the Phleger Estate and the Pacifica lands adjacent to residential development.

As discussed under Alternative A, fuel reduction projects close to residential development have the potential to affect viewshed and screening provided by park vegetation. However, the park has an overriding responsibility to reduce fire hazard along the wildland urban interface. Dense stands of flammable vegetation may screen views into the park or contribute to viewsheds but also greatly influence the degree of risk posed to those residents who live near to public open space. Large-scale fuel reduction projects that would change vegetation communities in areas where vegetation provides foreground viewsheds or screening could be presented and discussed at a community meeting arranged by park fire management staff where public comments could be heard. Impacts on viewsheds could be short-term to long-term depending on the type of vegetation removed. Adverse effects could be minor to moderate depending on the type of regrowth that spontaneously revegetates the site.

Permitting more acreage to be treated annually would not necessarily affect the visitor experience. More acreage does not imply larger projects but rather a greater number of individual projects in distinct and strategic areas in the Marin, Pacifica, or the Kings Mountain interface. Fuel reduction projects would have a short-term, minor adverse impact on aesthetics as perceived by park neighbors and/or park visitors. With incorporation of Mitigation Measure VUE-2, short-term noise impacts of fuel reduction projects would be attenuated to the degree feasible by careful siting of the staging areas. Noise impacts would be short-term, minor, and adverse as in Alternative A. Impacts on public access to park lands would be short-term, minor, and adverse.

Pile Burning

The effects of pile burning on the visitor experience would be similar to those under Alternative A. Though there may be greater incidence of pile burning under Alternative B due to higher levels of mechanical fuel treatment permitted, the disparate locations where burning could occur would be at considerable distances and scattered around the park. The actual area affected would be relatively restricted and should respond to natural soil amendments, if required, as well as out-plantings. The aesthetic effects of pile burning under Alternative B would be the same as under Alternative A. There would be limited closure to allow the pile burning to proceed and no noticeable effect on the park soundscape.

Prescribed Burning

Prescribed burning is restricted 120 acres in the Park Interior FMU in Marin County and the Muir Woods FMU. Prescribed burning of up to 50 acres in Muir Woods is discussed under “Actions Common to All Alternatives,” above. An additional 70 acres of prescribed burning could occur in the Park Interior FMU in Marin County. Because the prescribed burning would be restricted to the Park Interior FMU and Muir Woods FMU, it would be far enough away from the residential areas to avoid aesthetic impacts. Implementation of the burns would require closure of the burn units until just prior to the burn, during

implementation, and through rehabilitation. Depending on competing demands on staff time, park staff would place notices advertising the upcoming prescribed burn at access points to the burn unit at least one week in advance of the period requested for burning and a reminder one day in advance of the burn.

Prescribed burning in GGNRA lands in the Park Interior FMU and Muir Woods FMU in Marin County would result in a short-term, minor, adverse effect on the visual qualities of the landscape. When the winter rains stimulate revegetation and wash ash and burnt material into the soil, effects of prescribed burn would convert to a long-term minor beneficial effect on aesthetics. In addition to the interpretive opportunities this would present, the burn area should experience a flush of new growth and flowers in the spring following the burn. Prescribed burning would have no effect on the park soundscape and a short-term negligible effect on public access due to closure of the burn area prior to, during, and after the burn.

Research

The effects on the visitor experience from prescribed burning for research purposes would be similar to Alternative A. Under Alternative B, all research burns would occur in the Park Interior FMU in Marin County. Research burns would not be restricted to fuel reduction issues but could be focused on natural and/or cultural resource objectives. Alternative B would present opportunities to reintroduce prescribed fire into grassland and shrubland habitats to enhance endangered species habitat, discourage nonnative grasses, and restore cultural landscapes to the period of significance.

The aesthetic effect of the reintroduction of fire into areas that have undergone long periods of suppression would be a minor, adverse effect over the short term. Following revegetation in the spring, the aesthetic effect of the research burns would convert to a long-term, minor beneficial impact. There would be no effect on the park soundscape from conducting the research burns; the effect on public access would be short-term, negligible, and adverse as under Alternative A.

Cumulative Impacts

Cumulative impacts under Alternative B would be similar to those discussed under Alternative A. Alternative B permits more fuel reduction within the WUI FMU than Alternative A. This provides for more projects and/or larger projects per year within the WUI FMU but does not necessarily produce cumulative effects unless other actions in the same vicinity compound the effects. Impacts on the visitor experience from one project occurring in one area would not affect soundscape, viewshed, or access unless the projects are in close proximity.

Impacts on soundscape generally last as long as the visitor remains within the vicinity of the noise sources or, in the case of a park neighbor, as long as the project or projects are ongoing in close vicinity to the residential area. Cumulative project effects on soundscape under Alternative B could result in more neighboring communities being affected by noise during the same period, but this would not compound the noise effect as the project site would be distributed throughout the WUI FMU in the three counties. Impacts on soundscape could be mitigated by Mitigation Measure VUE-2, which directs siting of staging areas to take advantage of natural barriers to noise transmission. Cumulative impacts on soundscape would be short-term, negligible to minor, and adverse.

Cumulative impacts on public access would be the same as under Alternative A and would be short-term, negligible, and adverse.

Impairment

Impacts on visitor use and experience would be short-term, if adverse, and would not constitute an impairment of park resources or values.

Alternative C

Mechanical Fuel Reduction

Allowable acreages for mechanical fuel treatment projects under Alternative C would be similar to Alternative B. The principal difference between Alternatives B and C is that 45 more acres of mechanical treatment would be permitted in the Park Interior FMU in Marin County under Alternative C. As a result of the increased acreage in Marin, fuel reduction projects that would span FMUs in Marin County and be generally larger in scale could be implemented. Projects spanning FMUs would by necessity be sited farther from the actual interface area boundary and nearby residential neighborhoods. There would be less potential for these larger projects to directly affect vegetation that provides views or screening to neighboring homes. In all other respects, the potential effects of Alternative C on aesthetics, soundscape, and public access would be the same as Alternatives A and B. Large-scale fuel reduction projects in the WUI FMU in Marin County or San Mateo FMU that would change vegetation communities in areas where vegetation provided the foreground viewshed or screening vegetation could conform to Mitigation Measure VUE-5 and be discussed at a public meeting. The larger allowable acreage for fuel reduction projects raises the potential for one or more projects to have short-term moderate adverse effects until vegetation greens up with the next rains.

Pile Burning

Impacts on the visitor experience, specifically effects on the park soundscape, public access opportunities, and aesthetics, from pile burning would be the same under Alternative C as under Alternative A.

Prescribed Burning

Impacts from prescribed burning in the WUI FMU under Alternative C could extend into Marin County and to a lesser extent (5 acres allowed annually) San Mateo County. This alternative would provide an important opportunity for visitors to experience preparation, execution, and rehabilitation of a prescribed burn within areas that are used daily for short hikes and dog-walking and that serve as viewshed for adjacent communities. Alternative C would also bring the changed landscape, higher activity level, increased noise level, and temporary access restrictions that accompany the preparation, execution, and rehabilitation around a prescribed burn.

Alternative C would permit larger broadcast burns to occur in the Park Interior FMU in Marin County. Scheduled just prior to the rains in the low grasslands of the Marin Headlands or Tennessee Valley, a broadcast burn could bring a flush of new growth after the winter rains. The visitor experience could be heightened by additional opportunities for exciting interpretative and education programs and site stewardship recruitment for the period after the burn. The effect would be a short-term, moderate, adverse impact on aesthetics and the visitor experience. Preparation and execution of the prescribed burn would

result in increased activity at the proposed burn site and temporarily elevated noise levels from chain saws, vehicle traffic, and human conversation. This would be a short-term negligible adverse impact on the park soundscape. Public access could be curtailed during a one-week period before and after the burn until the site is made secure for public access. This would be a short-term, negligible adverse effect on public access. Over the long term, the reintroduction of fire into a landscape long subject to suppression would result in a long-term, moderate, beneficial effect as the burn unit rebounds with lush regrowth following the winter rains.

Research

The effects on the visitor experience from prescribed burning for research purposes would be similar to Alternatives A and B. Under Alternative C, larger research burns could occur in the Park Interior FMU in Marin County and on a smaller scale in San Mateo County. Research burns would focus on natural and/or cultural resource objectives, such as restoring landscape surrounding military bunkers and other structures. As in Alternatives A and B, Alternative C would reintroduce fire into grassland and shrubland habitats where fire has been suppressed for decades. With research burns timed to occur in early or mid-autumn just before restorative rains, a flush of new growth and flowers could be expected in the spring. Prescribed burning would also present many opportunities for interpretation of cultural and natural resource topics with firsthand evidence of the results. Aesthetic effects immediately following the burn would have a short-term, moderate adverse impact on the visitor experience. Impacts on the soundscape and public access from implementing the research burn would be short-term, negligible, and adverse as under Alternative A.

Cumulative Impacts

Impacts on the visitor experience and visitor use patterns would be equivalent to Alternatives A and B. As in Alternative A, impacts on soundscape would be short-term, adverse negligible effects on park visitors. But the potential exists for a short-term, minor adverse cumulative effect on park neighbors who are stationary receptors of construction noise and/or noise from fuel reduction projects. Public access could be maintained by implementing Mitigation Measures VUE-3 and VUE-4. As in Alternative A, impacts on public access would be short-term, negligible, and adverse, and impacts on viewsheds would be short-term, adverse, and negligible to moderate.

Conclusion

Adoption of a flexible fire suppression strategy would have a long-term, moderate beneficial effect on the visitor experience and aesthetics by incorporation of recommended mitigation that provides trained NPS staff to implement the strategy. The beneficial effect is gained through the application of minimal impact suppression tactics, which could result in significantly less disturbance to parklands during wildfire suppression actions. Implementation of the proposed strategy for Muir Woods National Monument would have a short-term, moderate beneficial effect on interpretation, aesthetics, and the visitor experience, and a short-term negligible adverse effect on public access and the park soundscape. The effect of fire effects monitoring on the visitor experience would be a short-term, minor beneficial impact gained from the interaction between the monitors and park visitors.

The proposed roadside fuel reduction actions and San Francisco fuel reduction strategy would result in a long-term, minor-to-moderate benefit to aesthetics and the visitor experience by clearing out dense stands of flammable, nonnative plants in favor of a lower fuel type along fire roads, access roads, and the city/parkland interface areas in San Francisco, parts of which are frequently used as illegal campgrounds. These actions would have a short-term, negligible-to-minor adverse effect on the vicinity soundscape during normal work hours on weekdays with the incorporation of recommended mitigation.

The implementation of the proposed public information and education program would educate the visiting public and Bay Area residents about the need for fire risk reduction efforts in federal wildlands and residential subdivisions near the park boundaries. Implementation of this program would have a long-term, minor beneficial effect on the visitor experience.

The proposed mechanical fuel reduction of 100 acres annually under Alternative A would have a short-term, minor adverse effect on the visitor experience, public access, and the park soundscape with the incorporation of recommended mitigation measures that make recommendations regarding the siting of staging areas, noticing of trail closures, and provisions for a forum to discuss fuel reduction projects that affect the viewshed and screening of neighboring homes.

The limited prescribed burning and research burning proposed under Alternative A would have a short-term, minor adverse aesthetic impact directly after the fire and a long-term, minor beneficial aesthetic impact with revegetation.

The potential effects of Alternative B are similar to Alternative A even though Alternative B permits more mechanical fuel reduction acreage. The fuel reduction projects would be situated throughout the park interface and, to some extent, in the Park Interior FMU. Impacts on the visitor experience, access, and soundscape would likewise be dispersed so that even if more projects occur, the effect on the visitor experience at one location in the park would not change with the number of locations or the size of project unless the nature of the project changed.

Because Alternative B allows more mechanical fuel reduction than Alternative A, more pile burning could also potentially occur to dispose of the debris from the fuel reduction projects. This would leave more areas aesthetically degraded in the short term where piles are burned, resulting in a short-term, minor, and adverse aesthetic impact that would be remedied by revegetation.

Many of the actions proposed under Alternative C would have similar effects to Alternative A. For example, the effects of mechanical fuel reduction under the two alternatives would be similar. Prescribed burning and research burning, however, would have a larger program under Alternative C and could result in larger broadcast burns in the Park Interior FMU and smaller fuel reduction burns in the WUI FMU closer to residential areas and trail heads. The effects of prescribed burning would be short-term, moderate, and adverse, but following the spontaneous revegetation at the site within one year effects would be long-term, moderate, and beneficial. Because prescribed burning is proposed closer to trailheads and adjacent neighborhoods, the activity leading up to and during a burn could result in a short-term, minor, and adverse effect on the soundscape during implementation.

All other actions that were assessed for effect on the visitor experience and visitor use patterns were determined to have a negligible effect or no effect.

Impairment

Impacts on the visitor experience and visitor use would be short-term if adverse and would not constitute an impairment of park resources or important park values.

Impacts on Park Operations

Analysis

Impacts were evaluated by assessing changes to operations that would be needed to meet the various operational requirements inherent in each of the actions described below. Relative impacts were evaluated for the action alternatives using staff estimates of the funding and labor required for implementation, and these costs were compared to the existing operations, staffing, and funding described in Alternative A. These cost levels were developed using the professional judgments of staff members who are most knowledgeable about the operational activities of the park and most able to anticipate the operational changes needed under each action. The discussion concentrates upon those operations that would be new, undergo major change, or show susceptibility to increases or decreases in operational activity.

The major operational impacts of fire management activities on park operations are most apparent in the arena of the Wildland Fire Office itself and its parent Division of Resource and Visitor Protection, and in the functions of park maintenance, natural resources management, cultural resources management, interpretation and public affairs. It should be noted that in most cases, existing staffing and funding levels are already lower than knowledgeable staff believe necessary to support even the operations needed to fully implement Alternative A. This is largely attributed to (1) the addition of new lands for the park to manage without addition to the operational funding base; (2) assignment of responsibilities in wildland urban interface areas adjacent to, but outside of, park boundaries; (3) the fact that fire program funding for individual projects does not cover all operational funding needs; and (4) more generally, the steady state of overall park operational funding in spite of wage inflation.

Actions Common to All Alternatives

Wildland-Urban Interface Initiative

In 2001, the NPS began implementing provisions of the federal Wildland Urban Interface 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 GGNRA is to reduce the density of hazardous fuels that create a risk to lives or property. Working cooperatively with FIRESafe Marin, Inc., Fire Safe San Mateo, neighboring communities, local, county, and state land management fire agencies, and the NPS, through the National Fire Plan, the program has been funding numerous projects that interface with park boundaries to reduce fuel hazards and increase fire prevention, public safety, and fire education. This program would continue under all alternatives.

The emphasis of the program is to reduce the density of hazardous fuels that create a risk to lives or property on the parklands along the interface zone. Some of the functions that park staff perform to support the program are (1) reviewing project proposals submitted for funding; (2) soliciting, processing, and prioritizing community projects; (3) completing necessary surveys and investigations to support NPS compliance findings for community projects; (4) monitoring community projects during implementation; and (5) administering tasks associated with the full program. The effects of implementation of Wildland Urban Interface Initiative projects outside the park that occur on private lands or those managed by local agencies are addressed as part of the cumulative impact scenario.

Additional responsibilities for lands not within the park boundaries cause moderate, short-term adverse effects on park operations. However, since decreased risk to lives and property adjacent to parklands also decreases the risk to the park, the overall effect of this program on park operations is moderate, long-term, and beneficial.

Defensible Space/Vegetation Clearing Around Structures

The protection of all buildings from wildfire within the park would continue under all alternatives. NPS staff or private contractors will continue to reduce fuel loads around park structures in accordance with California Public Resource Code (PRC-4290 and 4291). Individual structures will be assessed to determine the appropriate vegetation treatment base on fuel type, slope, and historic values that may be present.

The protection of all buildings within the park through the creation of defensible space will have a moderate, short-term adverse effect on park operations through increased workload for maintenance staff, diversion of effort from other maintenance needs, and increased workload for park administration if contracted labor is used instead. However, since decreased risk to lives and property is the result of this program, and maintaining defensible space is less work-intensive than is creating it, the long-term effect of this program to park operations is beneficial and major.

Roadside Fuel Reduction

The reduction of hazardous fuels along park roadways will have a short-term, moderate adverse effect on park maintenance operations and park administration for reasons identical to those for the creation of defensible space. However, moderate, beneficial long-term effects on park operations may be anticipated from this program, as these projects are implemented, schedules are established, and selected roads are treated to allow improved access for emergency vehicles and improved egress for evacuation when necessary.

Suppression

The park cooperates with the Marin County Fire Department, the California Department of Forestry, and other local fire agencies for wildland fire protection. The park's Presidio Fire Department takes the lead in structural fire incidents. Because the No Action alternative would continue this arrangement and level of effort, no additional funding or staffing is needed. Therefore no beneficial or adverse impacts are anticipated.

Treatment of Muir Woods FMU

Special consideration of an FMU for Muir Woods, an old-growth redwood forest and a national monument, is based on the area's unique values at risk (first-growth redwoods), the area's high visitation (ignition potential), and an ongoing fire management program for this area that would continue under all alternatives.

During implementation of individual actions, trail closures, relocation or rescheduling of interpretive programs, or stewardship projects may be necessary. During implementation of prescribed burning, red-carded staff from many GGNRA and PRNS divisions may be asked to participate, creating temporary staff shortages in those divisions. Therefore there would be a short-term, moderate, adverse effect on staffing for the other divisions called to assist with prescribed burns, and on natural and cultural resources staff to assess and monitor effects of these burns, comply with regulatory requirements, arrange for possible revegetation and erosion control as well as possible program modifications for the park interpretive program, and trail closures to monitor during prescribed burning in the park. However, over time, as fire hazards are lessened at Muir Woods and operational demands consequently decrease, the long-term effect of this program on park operations is expected to be minor and adverse. These actions and their effects are determined to be the same across all the alternatives.

Treatment of San Francisco County Project Area

Fuel reduction activities in the San Francisco lands of the park will concentrate on mechanical fuel reduction projects and be coordinated with the program to create defensible space around buildings. There are moderate, short-term adverse effects on park operations in the areas of maintenance, resource management, interpretation, and public affairs; however, moderate, beneficial effects on park operations can be anticipated over the long term.

Public Information and Fire Education Programs

The NPS manages an active fire information and education program within the park that also serves local communities. This program assists in teaching NPS employees, volunteers, park partners, other agencies, park visitors and the general public about fire management goals and policies. The effect of this program on park operations is neither beneficial nor adverse since it is a continuation of an existing program.

Fire Cache

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. Ideally the fire cache will be housed in a single location at some time in the near future. This will involve a facility strategically located with engine bays for at least two wildland fire engines, including one Type 3 engine. Sufficient office space will be required in addition to areas for crew members and equipment. This cache/wildland station could potentially be an interagency facility in conjunction with the Marin County Fire Department or one of the city fire organizations. In the past, GGNRA has operated a regional mobilization center. As this program could possibly be reactivated it should be given some consideration in planning for future cache needs.

The planning, regulatory compliance, and administrative workload for the creation of a fire cache will be a moderate, short-term adverse effect on park operations. However, the creation of a centralized fire cache at GGNRA would have a beneficial, long-term, major effect on park operations.

Fire Effects Monitoring

The primary purposes of fire effects monitoring are to ensure that fire management activities meet management objectives, to provide guidance to the fire protection agencies within the park, and to ensure that the park collects at least the minimum information necessary to evaluate the park fire management program. Fire effects monitoring is funded from the national fire office, and continued implementation of monitoring can be accomplished with existing staff and expanded to include additional plots on a limited basis. The effects of this program are moderate, beneficial, and long-term.

Alternative A

Analysis

The Golden Gate Wildland Fire Office is staffed for 2004 at the level of 9 full-time-equivalent employees (FTEs). Fire funding for operations is primarily from the National Fire Program. For the last three years, GGNRA has received approximately $700,000 annually for prescribed burns and for wildfire suppression and mechanical treatments in wildland urban interface projects. Nevertheless, for reasons stated at the beginning of the analysis of park operations, the staffing and funding currently available is insufficient to fully carry out the existing fire management program. The Golden Gate Wildland Fire Office would need 4 additional FTEs to provide park-specific fire ecology and fire education outreach expertise, and to manage projects through contracting and oversight. Furthermore, the natural resource staff presently finds itself deficient by 2.25 FTEs in the areas of habitat restoration and planning and the physical science of erosion. Similarly, the cultural resource staff has a deficit of 3.5 FTEs in order to provide necessary survey, monitoring, and assessment of fire management activities to fully implement the existing program, with a total shortfall of 9.75 FTEs for the park.

Mechanical Treatments

Under this alternative, 100 acres per year throughout the park would be treated by mechanical means: 75 in Marin, 5 in San Francisco, and 20 in San Mateo counties. The reduction of hazardous fuels around park facilities would reduce the risk of a catastrophic fire; thus the potential loss of structures, resources, and therefore potential demand on park maintenance, public affairs, and public safety personnel would all be reduced accordingly. The effects of this program on park operations would be moderate, beneficial, and long-term as firefighting emergencies and disruptions are gradually reduced. There will be no direct effects of this program on park operations, however, since the staffing and budget levels for the Wildland Fire Office are assumed to stay the same and mechanical treatments actually carried out in recent years approach the maximum envisioned in Alternative A.

Pile Burning

Since, under this alternative, pile burning would continue to be used in association with mechanical fuel treatments, there would be minor, short-term adverse effects on park operations from this program. The

NPS has been assisted by staff from other parks and local fire agencies, and this assistance would continue to occur under Alternative A.

Prescribed Burning

Under this alternative, a maximum of 110 acres per year, 100 of which would be in Marin County and the remainder in San Mateo County, would be burned using prescribed fire. This is the same maximum limit already in force. The effect of prescribed fire on park operations under this alternative would be to decrease the overall risk of a catastrophic wildland fire damaging park facilities and causing a major disruption to park operations through diversion of personnel and funding. Nevertheless, there would be moderate, long-term adverse effects on park operations from fully implementing this alternative, assuming staff and budget levels for the Wildland Fire Office remain the same. Any kind of burning has a greater impact on all fire-qualified staff and on law enforcement, interpretation, and public affairs operations than does any mechanical treatment.

Research

Additional FTEs would be required to perform research and evaluation under this alternative, particularly in the natural resources, science, and cultural resources divisions. Since this program has not been fully carried out, nor has the full amount of acres been treated in past years, a moderate, long-term adverse effect upon park operations is anticipated in order to address the shortfall.

Cumulative Impacts

The cumulative impacts of fully implementing the projects associated with Alternative A would have a moderate, adverse, long-term effect on park operations. The intensity of this adverse impact may be lessened to minor by scaling back full implementation of Alternative A to the activity levels of recent years.

Conclusion

Staffing and funding currently available to the park are insufficient to fully carry out the existing fire management program described in Alternative A. Moderate, long-term adverse effects on park operations can be anticipated from the full implementation of this alternative due to provision of red-carded employees from other divisions, the need for monitoring, regulatory compliance and restoration, additional interpretive and public affairs workload expected from prescribed burns, and the additional needs of the fire management program to fully carry out the recommended treatments. If implementation of Alternative A is scaled back to conform to existing staff and fiscal limitations, then the adverse effects on park operations may be reduced to minor. Staffing limitations could result in reduced accomplishments and a longer time period needed to achieve FMP goals. The construction of a new fire cache would have a short-term moderate adverse impact on the park's operations and budget, but would have long-term minor benefits by creating new efficiencies in fire management operations. Under any scenario, the suppression of a large-scale wildfire would have a short-term adverse major effect on park operations, management, and budget.

Impairment

This alternative would not result in long-term impairment to park resources and values.

Alternative B

Analysis

Under Alternative B, fire management actions would focus on the use of mechanical treatment to reduce fire hazards and fuel loads in areas with the highest risks. Both natural and cultural resource goals and objectives would be integrated into the design and implementation of these projects. The use of prescribed fire would occur primarily at Muir Woods and in the Park Interior FMU for limited research purposes. Pile burning associated with mechanical treatments would be allowed within the WUI FMU.

The individual nature of mechanical treatment, pile burning, prescribed fire, and wildland fire suppression activities would not change, and neither would their individual effects. What would change in Alternative B would be the goals that inform the selection of the individual projects, different acreages associated with each treatment type, and thus the cumulative effects on park operations. Under Alternative B, 180 acres in Marin County, 10 acres in San Francisco County, and 40 acres in San Mateo County would be subject to mechanical treatment, and 120 acres in Marin County would be subject to prescribed burning.

Mechanical Treatments

Twenty more acres in San Mateo County and 105 more acres in Marin would be treated mechanically under this alternative, compared to Alternative A. It is likely that demands on the park's native plant nursery program would increase, since more acres would be treated and would need post-treatment planting and stabilization. Other effects would be the same as described in Alternative A for prescribed fire, and for the same reasons.

Pile Burning

Increased use of pile burning under this alternative in conjunction with increased mechanical treatments would increase the workload on park staff, with minor-to-moderate, short-term, adverse impacts, but long-term negligible impacts.

Prescribed Burning

In Alternative B there would be a similar amount of acres treated by prescribed burns as in Alternative A, but no burns in San Mateo County. The distinction between this alternative and Alternative A, in this regard, would be a minor and short-term adverse effect on park operations as more park operational resources are deployed to provide maintenance, public information, and public safety support to these efforts. Moderate, long-term adverse effects on park operations can be anticipated from the full implementation of this alternative due to provision of red-carded employees from other divisions, the need for monitoring, regulatory compliance and restoration, increased demands on the native plant nursery for seedlings, additional interpretive and public affairs workload expected from prescribed burns, and the additional needs of the fire management program to fully carry out the recommended treatments.

Research

Because additional areas would be treated, more one-time research projects would be necessary. Thus there would be an additional impact on the park's budget, demands upon park staff, and an increased intensity of effect, though still a long-term, moderate, adverse effect.

Cumulative Impacts

No cumulative impacts beyond those described above for Alternative A would occur. The cumulative impacts of all the projects listed with this proposed action (except large-scale wildfire) would have a long-term moderate, adverse effect on park operations.

Conclusion

Alternative B is somewhat constrained in the types of treatments that can be applied in certain areas, especially in the use of prescribed fire (i.e., no prescribed fire in the WUI FMU, research burning only in the Park Interior FMU and San Francisco). In that regard, it can be assumed that relatively costly mechanical treatments would constitute a greater proportion of the treatment actions than would be the case in either Alternatives A or C, where the use of prescribed fire is less constrained.

Increases in the budget would be required to fully implement Alternative B and conduct additional somewhat larger prescribed burning and thinning. Associated impacts on park operations and management would remain moderate, long-term, and adverse, as in Alternative A. This alternative would require an additional 3.25 FTEs to the 13 FTEs identified in Alternative A in the Wildland Fire Office alone. The one-time funding of a new fire cache would have a short-term, moderate, adverse impact on park operations, but would have long-term minor benefits by creating new efficiencies in fire management operations. Suppression of a large-scale wildfire would have a short-term, adverse, major effect on park operations, management, and budget.

Impairment

The alternative would not result in long-term impairment to park resources and values.

Alternative C

Analysis

Alternative C proposes the utilization of a broad range of fire management strategies throughout the park – mechanical treatment, pile burning, and prescribed burning – as a means to reduce fuel loading near developed areas and achieve natural and cultural resource enhancement goals. Mechanical treatments, complemented by prescribed fire in all FMUs, would be employed to assist with restoration and maintenance of the park's natural and cultural resources. Full implementation of this alternative would allow for the greatest number of acres to be treated on an annual basis to achieve fire management objectives.

The individual nature of mechanical treatment, pile burning, prescribed fire and wildland fire suppression activities would not change from Alternative A, and neither would their individual effects or recommended mitigations. What would change in Alternative C would be the goals that inform the selection of the individual projects, greater acreages associated with each treatment type, and thus the cumulative effects on natural and cultural resources. Under Alternative C, 225 acres in Marin County, 10 acres in San Francisco County, and 40 acres in San Mateo County would be subject to mechanical treatment; 280 acres, less than one acre, and 35 acres, respectively, would be subject to prescribed burning.

Mechanical Treatments

Twenty more acres in San Mateo County and 150 more acres in Marin County would be treated mechanically under this alternative, compared to Alternative A. Effects would be the same as described in Alternative B for prescribed fire, and for the same reasons.

Pile Burning

This alternative would result in the greatest potential use of pile burning over the greatest geographical extent. Short-term impacts on park operations would be moderate and adverse, but long-term impacts would be negligible to minor and beneficial as fuel treatment actions would result in less long-term need to construct burn piles.

Prescribed Burning

In Alternative C there would be 25 additional acres of prescribed burns in San Mateo County and 185 more acres in Marin County, compared to Alternative A. The effects of Alternative C on park operations would be moderate, long-term, and adverse for the same reasons described for Alternative B, only more so, as additional park operational resources would be deployed to support these efforts.

Research

Because substantial additional areas would be treated, more one-time research projects would be necessary. Thus there would be an additional long-term, moderate, adverse impact on the park's operations, as compared to Alternative A, especially in the areas of the Wildland Fire Office and the natural and cultural resource staff.

Cumulative Impacts

No cumulative impacts except those described above for Alternative A would occur. The cumulative impacts of all the projects listed with this proposed action (except large-scale wildfire) would have a long-term, moderate, adverse effect on park operations.

Conclusion

Alternative C is the least constrained alternative in terms of the types of treatments that can be applied in individual areas. Park staff would have more opportunity to learn from field experience and apply those lessons to subsequent projects, and, as additional acres are treated, fire hazard conditions would be improved in more areas of the park. Treating more acres each year would reduce the time necessary to meet FMP goals.

Nevertheless, the additional treatments and acres treated would inevitably have additional impact on the operations of the park if Alternative C is implemented. For the Wildland Fire Office alone, an additional 5 FTEs, compared to the 13 FTEs required by Alternative A, would be needed under Alternative C to conduct prescribed burning and mechanical fuel removals. Alternative C would have a moderate, long-term adverse impact on park operations. These impacts are greater than in Alternative B. However, the benefits of providing fire protection for park facilities would be greater than for Alternatives A and B. The one-time funding of a new fire cache would have a short-term, moderate, adverse impact on park operations, but would have long-term minor benefits by creating new efficiencies in fire management

operations (same as Alternatives A and B). Suppression of a large-scale wildfire would a short-term major adverse effect on park operations (same as Alternatives A and B).

Impairment

The alternative would not result in long-term impairment to park operations and management.

Impacts on Socioeconomics

Impacts Common to All Alternatives

Prescribed Fire and Mechanical Treatments

Prescribed burns and mechanical treatment actions are intended to reduce fuel buildup and enhance the NPS-managed local ecology. Out of a total of about 75,000 total acres within the GGNRA legislative boundary, about 15,000 acres are targeted for fire management activities. The vast majority of land targeted totals 11,000 acres in Marin County, followed by 3,200 acres in San Mateo County (see Chapter 2, Table 2-2). Less than 1,000 acres of land in San Francisco would be affected by prescribed fire and mechanical treatment in any of the project alternatives.

In spite of variations in the level of prescribed burns and mechanical treatment under the three alternatives, the size of the fire management payroll for all alternatives is expected to remain the same or increase only slightly compared to current levels. It is anticipated that economies of scale, use of existing fire suppression units, and other factors would limit the need to increase budgeting or staffing to implement these programs, except as identified in the preceding “Park Operations” section. There may be minor beneficial impacts on the local economy through the use of private contractors to implement selected mechanical fuel reduction efforts; however this is not currently anticipated.

Suppression

The economic impact of fire suppression efforts varies widely depending upon the severity of the ignition. In past years, few fires have been large enough to have a substantial impact on property values or tourism. However, under any of the alternatives, a large-scale fire at infrequent intervals is possible. Socioeconomic impacts of such a fire can be compared with the most recent event in the subject area – by way of example, the Point Reyes National Seashore Vision Fire in 1995. The total economic loss associated with this fire is estimated at $40.15 million according to data included in the Point Reyes Fire Management Plan. Property damage included the loss of 48 homes and damage to an additional 18, resulting in property damage to structures estimated at $37 million. The estimate for public service recovery (road and utility repairs, debris removal and restoration) was $1.8 million. Total suppression costs were estimated at $6.4 million (Marin County Fire Department 1995). Reductions in spending at local businesses were estimated at approximately $1.36 million.

Offsetting the moderate-to-severe short-term adverse impacts of a major unplanned fire are the potential long-term benefits associated with implementing more comprehensive fire treatment activity to restore fuels to more manageable levels. These efforts are being initiated, in part, to reduce the incidence or severity of major wildfires, resulting in a long-term minor-to-moderate beneficial impact on the economy.

Impacts on Tourism

The majority of prescribed burns or mechanical treatments are not expected to result in major road or park closures. Where a temporary, short-term closure is required, alternate routes or park areas are expected to be available. Individual fires would typically be limited in size and completed in a day. In addition, the majority of prescribed burns would be implemented outside of the prime tourist season. From March (and in some cases from January) until the end of July, prescribed burns would be minimized as they overlap with the bird nesting season. Some heavily visited areas may have short-term closures due to smoke, noise, or safety; however, an array of recommended mitigations to address recreation and health impacts would likely result in nominal, if any, impact on overall visitation rates and associated spending. Relevant mitigations include Mitigation Measure VUE-1 regarding work hours, Mitigation Measure VUE-5 to address outreach and education, Mitigation Measure VUE-2 to reduce noise generators; and safety measures included in Mitigation Measures VUE-3 and VUE-4.

Finally, reports provided by NPS indicate that few complaints have been registered in connection with current prescribed burns or mechanical treatments at GGNRA. Given the magnitude, location, and timing of fire management projects, these efforts are not expected to diminish park visitation. Visitors who want to avoid fires or smoke or the noise of mechanical thinning, or are diverted for safety reasons, would likely relocate to an unaffected area within the park rather than alter their travel plans by leaving or shortening their stay.

Impacts on Minority or Low-Income Populations

The actions proposed under all of the alternatives, including prescribed fire, mechanical treatment, and suppression of small or large fires, would have no disproportionate impact on minorities or low-income populations as the majority of nearby lands in the three counties are comprised of middle and upper-middle class residential neighborhoods.

Comparison of the Alternatives

Three levels of prescribed burns and mechanical treatment are established for the project alternatives. Alternative A involves the smallest amount of acreage for treatment by fuel management practices. Alternative B has comparable acreage designated for prescribed burns, but over twice the amount of land targeted for mechanical treatment. Alternative C employs the highest level of fuel management practices, with 275 acres targeted for mechanical treatment and 320 acres targeted for prescribed burns.

Alternative A

Under this alternative, the fire management program would continue to generate negligible long-term beneficial impacts on the local economy in terms of the park's direct transactions with local businesses that supply goods and services for fire management activities, in addition to local spending by fire program employees on housing, food, and goods and services.

As noted previously, Alternative A is associated with the smallest acreage targeted for prescribed burns and mechanical treatments. This level of fuel management would not be expected to change GGNRA's operating budget nor affect local visitation rates. The majority of unplanned ignitions would be small, and would not affect the local economy through staffing changes or decreases in park visitation. The

cumulative socioeconomic impacts associated with larger, periodic fires may have short-term moderate adverse impacts. Over the long term, spending on fire restoration projects would tend to offset the initial loss in revenue attributable to decreases in visitation.

Alternative B

While Alternative B has a larger number of acres targeted for fuel management practices than Alternative A, it is anticipated that the park operating budget and staffing would require negligible or minor increases. Hence, the direct socioeconomic impacts would be comparable with Alternative A.

Visitation rates are also not expected to change noticeably compared to Alternative A, even with the increased areas of treatment. Hence no additional indirect socioeconomic impacts, adverse or beneficial, are projected.

The potential short-term adverse impacts associated with a major fire event would be comparable to Alternative A. Over time, Alternative B may result in slightly fewer wildland fires, as the fuel reduction efforts are more aggressive.

Alternative C

Alternative C would have the largest level of fuel management treatment. As with Alternative B, there would be a nominal increase to the payroll and operating budget required to implement this alternative. Hence, ongoing socioeconomic benefits with GGNRA operating and staff budget would be comparable to Alternative A, with no additional beneficial or adverse impacts on areawide socioeconomics.

Visitation rates are also not expected to change noticeably compared to Alternative A, even with the increased areas of treatment. Hence, there are no additional projected adverse or beneficial indirect socioeconomic impacts associated with Alternative C.

The potential short-term adverse impacts associated with a major fire event would be comparable to Alternatives A and B. Over time, however, Alternative C may result in somewhat fewer unplanned wildland fires as the fuel reduction efforts would be the most aggressive and would be partially aimed at reducing the risk of a catastrophic fire.

Conclusions

Overall, socioeconomic impacts associated with the planned mechanical treatments and prescribed fire activities could be characterized as negligible, short-term benefits under all three alternatives. The budget and payroll associated with fire management practices would be roughly comparable under the three alternatives. Further, while prescribed burns and mechanical fuel removal may result in some short-term closures and restrictions, with the proposed set of mitigations, these fire management activities are not anticipated to have a noticeable impact on tourism to the park.

Unplanned ignitions could result in a range of impacts from wildland fire to large events where life and property are at risk. Catastrophic fires would reduce visitation, which in turn would reduce spending on lodging, food, and travel. However, there would likely be beneficial effects to the same entities, partially offsetting impacts, as a result of increased demand for similar services by fire and other employees

involved in fire suppression and restoration. Hence, the economic impacts of these larger events may have both beneficial and adverse short-term and minor effects.

4.3 Mandatory Sections

NEPA requires that all environmental impact statements address three specific types of environmental effect. The first section below 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 resources an alternative would require. The final section is a summary of any moderate or major adverse impacts that cannot be further mitigated.

Short-Term Use Versus Long-Term Enhancement of Resources

Alternative A

Prescribed burning, mechanical fuel reduction, routine mowing, and roadside fuel reduction would result in mortality of native and nonnative vegetation within the project area and direct or consequent mortality to wildlife that rely on these areas for habitat or that are killed as a result of project implementation. Wildlife prone to areas of dense fuels would be displaced from sites where vegetation would be modified to reduce fire hazard. With the exception of localized, immediate mortality of vegetation and wildlife, and short-term reduction in habitat, the FMP alternatives are focused on promoting sustainability and long-term resource enhancement with minimal short-term resource damage or use. No permanent change to park resources is intended other than reduction in vegetation density, reduction in overall flammability near sensitive resources, and enhancement of native plant communities and habitat through reintroduction of fire or more natural environmental conditions with fire management actions.

The primary objective of the No Action alternative is the long-term enhancement of natural resources through the reintroduction of fire, a vital component of the ecological processes to native plant communities in GGNRA that have evolved with regimes of naturally occurring wildfire at varying frequencies. Alternative A would incrementally contribute to the reintroduction of fire under as near-to naturally-occurring conditions as permitted today with the constraints of using prescribed fire near urbanized areas. Alternative A includes prescribed fire and mechanical fuel reduction actions that would contribute to the long-term enhancement of natural resources by continuing to reduce high levels of fuels that have accumulated throughout the park during the past century of strict fire suppression. Alternative A would promote the long-term enhancement of many critical park resources.

The long-term benefits accrued to natural resources by fire management actions include:

- Reduction in the potential for a higher-intensity, larger-scale wildfire to severely affect or devastate scarce native plant communities and wildlife habitat protected within the park;
- Improvement of wildlife habitat values;
- Enhancement of park soils through nutrient cycling;
- Reduction of overabundance of damaging bacteria and fungi, etc.;

- Fostering of mosaics of plant community types or limiting type conversion due to the absence of fire;
- Protection of listed wildlife species and habitat from higher-intensity wildfire resulting from higher fuel loading; and
- Limitation of the spread or reduction in the acreage of highly flammable nonnative plants that dominate native plant communities that are important park resources.

Alternative A also includes mechanical fuel reduction and prescribed burning activities that would reduce fuel loading and promote life safety and property protection. Fuel reduction projects have a secondary benefit in reducing wildfire threat to important cultural resources in GGNRA. Projects to protect life and safety, reduce fuel loading, and promote the reintroduction of fire into fire-suppressed landscapes would also reduce fuel loading near historic structures, promote the open grassland and low vegetation of pastoral landscape associated with early ranchlands and dairies in Marin County, and promote more open cultural landscapes that were prevalent when the coastal fortifications were in use in Marin, San Francisco and San Mateo counties.

Prescribed fire use and mechanical fuel reduction projects under Alternative A would promote the long-term enhancement of important park viewsheds by reducing encroachment of nonnative forests and converting the perimeter area of the expanding Douglas-fir forest into low-growing native plant communities.

The protection of the park's natural and cultural resources and viewsheds would in turn protect important recreational resources and park aesthetics by enhancing the values that attract visitors. A high-intensity wildfire fed by higher than normal fuel loading and acres of highly flammable nonnative vegetation could significantly alter the quality and composition of the natural and cultural resources that contribute to the park's significance.

Long-term adverse impacts are acceptable due to the beneficial impacts that would be 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 would be offset by (1) the implementation of best practices, as adopted by the NPS in applying prescribed fire; and (2) the reduced risk of a higher-intensity fire occurring that could severely damage or destroy significant park resources and threaten life and property both within and outside the park boundaries.

Alternative B

Alternative B focuses on the reduction of hazardous fuels within the WUI FMU and the reintroduction of fire for natural and cultural resource benefits in the Muir Woods FMU, and to a lesser degree in the Park Interior FMU. Fuel reduction efforts under Alternative B would affect over twice as many acres each year than under Alternative A and would, therefore, more quickly and effectively implement a long-term enhancement program for park resources. Treating more acreage annually would allow for a more aggressive maintenance program to occur in conjunction with treatment of new acres. With a much

smaller annual program, the efforts of maintenance staff under Alternative A would need to focus on a greater percentage of already treated areas to assure establishment of lower fuel types in place of more flammable, weedy vegetation. Under the more expansive fuel reduction program in Alternative B, regular maintenance projects could account for a smaller percentage of annual treatments while more and more acres would be incrementally and progressively brought into conditions of lower fuel loads each year.

Alternative B has similar long-term enhancement and short-term use effects for prescribed fire as Alternative A, since the acreages involved are nearly the same (120 acres for Alternative B and 110 acres for Alternative A). Prescribed burning under Alternative B would be restricted to the Muir Woods FMU and research burns in the Park Interior FMU, but these burns would have the added advantage of including the restoration or enhancement of cultural landscapes as a project objective.

Short-term impacts related to project activity would result in mortality of native vegetation during initial treatments. Mortality of wildlife in a treatment areas would also occur and habitat values may decrease in the short term, following project implementation. However, this short-term use of resources would be offset by the reduced risk of wildland fire ignition, the spreading of high-severity wildland fires into adjacent residential areas, and the potential for severely damaging important park resources. The short-term use would also benefit the long-term health of native ecosystems by reintroducing fire as a recurrent process under conditions that would mimic the natural regime as much as possible. Implementation of Alternative B would more quickly convert park acres to a more natural and/or reduced fire hazard condition than under Alternative A. Alternative B would therefore be more sustainable than Alternative A and would provide for greater long-term enhancement and long-term protection of resources.

Alternative C

Compared to Alternative A, Alternative C would provide nearly three times as much mechanical fuel reduction and prescribed burning annually. Under Alternative C, the FMP goals would be achieved in a productive, effective, and sustainable manner through a broad scope of treatments and treatment areas allowed annually for fire management actions. Strategic areas of high fuel loading on the park’s urban interface could be treated and maintained over a shorter period of time than under Alternatives A and B. Areas of nonnative plants would be treated earlier in the implementation of the FMP and would therefore be treated before populations of nonnative species could expand to affect larger areas. Long-term maintenance schedules could be developed to sustain vegetation management objectives for areas of the park and avoid the accumulation of high fuel loading on the park’s perimeter.

Irreversible/Irretrievable Commitments of Resources

Alternative A

No irreversible/irretrievable commitments of resources would occur under Alternative A other than the use of fuels for heavy equipment, vehicles, and tools.

Alternative B

No irreversible/irretrievable commitments of resources would occur under Alternative B other than those described for Alternative A – the use of fuels for heavy equipment, vehicles and tools.

Alternative C

No irreversible/irretrievable commitments of resources would occur under Alternative C other than those described for Alternative A – the use of fuels for heavy equipment, vehicles and tools.

Unavoidable Adverse Impacts

Alternative A

The majority of adverse effects from implementation of Alternative A would be short-term and reduced to a negligible-to-minor level by the application of best management practices or mitigation measures. These effects include the potential for increased erosion following prescribed fire and the resulting potential increase in sedimentation in nearby water resources. Mechanical treatments would result in negligible-to-minor disturbances to soils over limited areas. Suppression actions could result in soil compaction, ground disturbance, and potentially minor, adverse effects on habitat of special status species. The degree of effect is relative to the level of suppression action taken, proximity to the interface, and sensitive resources. Recent wildfires have been limited in scale and have resulted in short-term, minor effects on soils and water quality within watersheds. Parklands recently affected by recent wildfires contained mostly nonnative vegetation and these fires did not affect sensitive native plant or wildlife species.

Some native vegetation would be removed to reduce fuel levels and suppress wildland fires. This would indirectly affect wildlife, especially with the construction of shaded fuel breaks in areas of native vegetation or roadside fuel reduction. During especially dry years, some wetland areas could be affected by prescribed burning, but some beneficial effects, such as the stimulation of the native seed bed, could also occur.

Fuel reduction and prescribed burning would result in short-term, minor adverse impacts on the visitor experience. These would specifically be through short-term impacts on aesthetics from freshly cut areas, burned and blackened landscapes, and short-term trail closures for public safety and health during implementation of a burn plan or use of heavy equipment in constricted areas where safe detours cannot be provided. Short-term adverse, minor effects on the park’s soundscape would occur when visitors or residents are in close proximity to heavy equipment or gas-powered tool use.

The potential for a prescribed burn to escape and become a wildfire is an unavoidable impact under Alternative A. However, the NPS employs the use of best management practices, including planning for suppression of a larger fire, into each NPS burn plan.

Mitigation measures for air quality, in conjunction with coordination and approval for burning by BAAQMD, would avoid meteorological conditions that are most conducive to prescribed fire control

problems and public health and safety concerns. Effects on public and firefighter safety from prescribed burning would be short-term, negligible, and adverse.

Implementation of Alternative A would incrementally reduce the potential for a catastrophic wildfire to occur within GGNRA, consequently reducing the potential for the generation of high levels of air pollutants from wildfire. Mitigation measures for air quality, and the requirement for approval of all prescribed burns by the BAAQMD, would minimize the amount of pollutants generated and avoid the periods when these pollutants would have the most potential for harmful effect on Bay Area air quality. However, implementation of Alternative A would have an unavoidable, long-term, minor adverse effect on Bay Area air quality due to levels of particulate matter affecting regional visibility and NOx, as a precursor to ozone; and an unavoidable, long-term moderate effect due to levels of VOC, also a precursor to ozone. The impacts are considered long-term as the effect would recur annually during the FMP's implementation. The actual duration of the effect would be short-term, due to rapid dispersal during typical periods planned and approved for prescribed burning activities.

The use of heavy equipment by persons suppressing wildfires has the potential to damage archeological resources on the soil's surface or subsurface. Flexible suppression tactics would be employed whenever possible, under all alternatives, to reduce the potential for adverse effect, and heavy equipment operators would be directed to less sensitive, previously disturbed areas of the park to control and contain the fire. However, where wildfire is a threat to public safety or important park resources, or private property, it may be necessary to use heavy equipment in areas that have not been previously surveyed for cultural resources; under these circumstances, the potential would exist for long-term, adverse major impacts on cultural resources.

Alternative B

Unavoidable adverse impacts under Alternative B would be similar to those under Alternative A. The effects of prescribed burning would involve roughly the same amount of acreage as under Alternative A. Short-term, negligible-to-minor adverse impacts on soil erosion, sedimentation, and wetlands would occur in conjunction with prescribed burning and mechanical fuel reduction activities.

Effects of suppression actions would be the same as under Alternative A. Potential long-term, adverse major effects on archeological and wetland resources, due to the use of heavy equipment during suppression actions, could also occur under Alternative B. As in Alternative A, suppression actions could also have short-term, minor effects on soils and habitat for the mission blue butterfly and northern spotted owl.

Prescribed burning under Alternative B would have less of an effect on the visitor experience than Alternative A since all prescribed burning would be restricted to small research burns to the Park Interior FMU and Muir Woods FMU. These burn areas would be located away from many of the regularly visited sites adjacent to the WUI FMU that often receive daily use from nearby residents. Fuel reduction actions would most likely be sited nearer to these developed areas and frequently used trails, which would result in short-term, minor adverse effects on the visitor experience (specifically access, aesthetics, and soundscape) for areas closer to the WUI FMU.

As Alternatives A and B would treat roughly the same amount of acreage, and half of that acreage would be the same area/same treatment (i.e., Muir Woods FMU understory burning) the air quality effects would be essentially the same under each. As in Alternative A, Alternative B would result in a long-term, minor adverse effect on regional visibility through generation of particulate matter. (The Bay Area Air Basin is in attainment for federal standards for particulate matter.) Similar to Alternative A, implementation of Alternative B would produce less than 5 tons per year of NOx – a long-term, minor, adverse effect – and higher relative levels of VOC, resulting in a long-term, moderate adverse effect on air basin VOC emissions. Effects would be considered long-term due to the roughly 15-year implementation period of the FMP.

The annual acreage treated under Alternative B would appreciably and strategically reduce the potential for a wildland fire to occur or to spread to adjacent residential areas, in comparison to Alternative A.

Alternative C

Adverse effects of suppression actions on soils, cultural resources, and wetlands would be similar under Alternatives A and C. Effects of prescribed burning and mechanical treatments on soils, water quality, and special status species would be similar in these two alternatives.

Implementation of Alternative C would have a greater effect on the visitor experience than Alternative A. Larger prescribed burns would be allowed in parklands in San Mateo and Marin counties, and larger burns could exacerbate the short-term adverse effects to a minor-to-moderate level in areas of important access and aesthetics. Firefighter health effects would be short-term, minor, and adverse as firefighters would be exposed to more smoke over the course of a fire season under Alternative C.

On an annual basis, Alternative C would generate higher levels of particulate emissions compared to Alternative A. This would be a result of the treatment of a greater number of acres each year by prescribed burning, as well as the higher percentage of understory burning that would occur under in Alternative C. Alternative C would contribute approximately 110 tons per year of PM_{10}, a level of effect that is considered long-term, moderate, and adverse on regional visibility. The effect would be considered long-term over the FMP's 15-year implementation period. Effects would occur annually over that period.

On an annual basis, Alternative C would produce the highest amount of ozone precursors (VOC and NOx) at levels representing a long-term, moderate adverse effect on air basin air quality for each of these pollutants.

The annual acreage treated under Alternative C would appreciably reduce the potential size or severity of a catastrophic wildfire, compared to Alternative A.

Chapter 5 – Consultation and Coordination

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5.1 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. Public scoping for the FMP EIS began on August 8, 2003, with publication in the Federal Register of the Notice of Intent to Prepare an Environmental Impact Statement for the Golden Gate National Recreation Area Fire Management Plan. 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 scoping workshops. Scoping comments were solicited from August 8, 2003, to December 5, 2003.

Three public scoping open house meetings were held for the GGNRA FMP. The open house meetings featured displays and offered attendees the opportunity to discuss the planning process with staff. Park staff made a presentation on the FMP and oral comments were received from the public and recorded by a court reporter at each of the three meetings. The first and third meetings were part of regularly scheduled bimonthly GGNRA public meetings. The first meeting was held in Pacifica at the Pacifica City Council Chambers on September 16, 2003. The second public scoping meeting focused solely on the FMP and was held at the U.S. Army Corps of Engineers, Bay Model Building Meeting Room on September 24, 2003. The third meeting was held November 18, 2003, at Fort Mason, Building 201 in San Francisco.

On August 5, 2003, and on August 14, 2003, 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 GGNRA and PRNS staff. On October 10, 2003, the NPS presented an overview of the scope of the FMP to local fire management agencies in Marin County as part of the FIRESafe Marin meeting. Following the presentation, NPS staff consulted on issues and concerns about the plan with the attendees.

Among the major issues raised during the scoping meetings were the need for monitoring fire management activities and the use of wildland fire and pesticides as fire management tools. In addition, the development of an education component for fire hazard reduction in adjacent communities was mentioned. Other concerns raised at the meetings included ongoing changes in land use as the relate to fire; the potential for changes in wind patterns and wind strength due to tree removal; public access limitations; use of native plant species to restore habitat; changes to visitor experience and aesthetics; increased fire risk and life safety; and effects on cultural resources, vegetation, wildlife, hydrology, water quality, soils, and air quality. These comments are previously described in more detail in Chapter 1, Section 1.5, under the heading of Issues and Concerns Raised During Scoping Relevant to the FMP EIS.

A notice of availability for the DEIS was published in the Federal Register and the document made available for public review and comment on March 21, 2005. The NPS also provided the notice of availability of the DEIS through a direct mailing and posting on the park's web site. The DEIS was made available for review at park headquarters, park visitor centers, local and regional libraries, and on the park's website. The Federal Register noticed a 60-day public comment period ending on May 17, 2005 but this was extended to May 27, 2005 to ensure adequate review time. Notification to the public of the

extended deadline was made on the park website and through announcements at public presentations. The NPS made two public presentations to provide an informational overview about the DEIS to the public. Twelve comment letters were received and they are addressed in Appendix H - Response to Comments on the Draft Environmental Impact Statement.

5.2 Compliance Status

Documentation of NPS compliance with federal and state laws and regulations is incorporated into the text of the FEIS. Compliance with ten of the 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 FEIS provides disclosure of the planning and potential environmental consequences of the proposed action and alternatives, as required by NEPA. A Notice of Availability for the DEIS was published in the Federal Register and the document made available for public review and comment on March 18, 2005. The NPS also provided the Notice of Availability of the DEIS through a direct mailing and posting on the park's web site. The DEIS was made available for review at park headquarters, park visitor centers, local and regional libraries, and on the park's website. The Federal Register noticed a 60-day public comment period ending on May 17, 2005 but this was extended to May 27, 2005 to ensure adequate review time. Notification to the public of the extended deadline was made on the park website and through announcements at public presentations.

Agency and public comments were reviewed, considered, and the DEIS was revised in light of those comments. The Fire Management Plan FEIS responds to all substantive comments (Appendix H). An alternative is also identified as preferred in the FEIS. A Record of Decision will be published 30 days following publication of the Notice of Availability for the FEIS in the Federal Register. The selected alternative will be identified in the Record of Decision and will define the overall strategy for the park's new FMP. The FMP will be supplemented by operational procedures and plans such as preparedness plans, preplanned dispatch plans, prescribed fire plans, and prevention plans. The FMP will be a separate stand-alone document that will be completed following selection of the preferred alternative in the Record of Decision.

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 (USFWS), from unauthorized take, and directs federal agencies to ensure that their actions do not jeopardize the continued existence of listed species. Section 7 of the act defines federal agency responsibilities for consultation with the USFWS and National Oceanic and Atmospheric Administration (NOAA) Fisheries and requires preparation of a Biological Assessment to identify any threatened or endangered species that are likely to be affected by the proposed action.

The NPS initiated informal consultation with the USFWS on June 18, 2003. Upon request, the USFWS sent the NPS a species list, dated July 2, 2003, for the GGNRA FMP covering Marin, San Francisco, and San Mateo counties, as well as for the specific United States Geological Survey (USGS) quads within those counties in which NPS fire management activities will take place. The NOAA sent a list (dated

February 27, 2003) of threatened and endangered fish under its jurisdiction that may be affected by the FMP. These lists include plant and animal species that may occur within, or be affected by activities within, the FMP area.

The NPS sent a biological assessment to the USFWS on March 16, 2005 to determine if formal consultation under Section 7 of the Endangered Species Act would be required for the GGNRA FMP. In the assessment, the NPS asked the USFWS to concur with its conclusions on the potential effect of the FMP on federally-listed species. The USFWS issued a Final Biological Opinion on the GGNRA FMP on October 7, 2005 (see Appendix K). In the Final Biological Opinion, the FWS concurred with the NPS that FMP actions are not likely to adversely affect the salt marsh harvest mouse, tidewater goby, California brown pelican, the San Bruno elfin butterfly, northern spotted owl, marbled murrelet, and the Pacific Coast population of the western snowy plover due to one or more of the following:

1. the mitigation measures included in the FMP EIS would avoid the effect;
2. the FMP planning area is outside of the range of the particular species; or,
3. the FMP planning area, though within the range of the species, does not contain suitable habitat for the particular species.

The USFWS concluded that “take” of the mission blue butterfly, California red-legged frog, and the San Francisco garter snake may be unavoidable in implementing FMP projects and has issued “incidental take” permits to the NPS for the GGNRA FMP. “Take” is defined in the Endangered Species Act as to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or to attempt to engage in any such conduct. “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 Endangered Species Act, [Section 7(b)(4) and Section 7(0)(2)], taking that is incidental to and not intended as part of the agency action is not considered to be prohibited if the agency is conforming to the conditions of an incidental take permit. In the Biological Opinion, the USFWS explains that issuing a permit for incidental take is a conservative approach as it may be difficult to verify whether take of these three species has occurred during an action due to their elusive nature, relatively small size, and cryptic coloration which make the finding of a dead specimen unlikely. The USFWS concluded that mitigation measures proposed by the NPS and additional mandatory measures in the Biological Opinion would substantially reduce the incidence or occurrence of take but could not fully eliminate the potential.

The USFWS concluded that implementation of Alternative C, the preferred alternative, is not likely to jeopardize the continued existence of the mission blue butterfly, California red-legged frog, the San Francisco garter snake, Raven's manzanita, San Francisco lessingia, Presidio clarkia, and the Marin dwarf flax. 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 mission blue butterfly, San Francisco garter snake, Raven's manzanita, San Francisco lessingia, Presidio clarkia, and the Marin dwarf flax, therefore, none will be affected.

The NPS is continuing informal consultation with NOAA Fisheries and completion of the consultation will be documented and included in the Record of Decision for the FMP EIS.

The Magnuson-Stevens Fishery Conservation and Management Act as amended by the Sustainable Fisheries Act of 1996 (PL 104-267). This requires all federal agencies to consult with NOAA Fisheries on all actions or proposed actions permitted, funded, or undertaken by the agency that may adversely affect Essential Fish Habitat (EFH). NOAA Fisheries would provide recommendations to conserve EFH to federal or state agencies for activities that would adversely affect EFH. Consultation with NOAA Fisheries is still underway and will be completed concurrent with the preparation of the Record of Decision.

Section 404 of the Clean Water Act (33 USC 1344) and Section 10 of the Rivers and Harbors Act of 1899 (33 USC 403). All proposed work and/or structures extending bayward or seaward of the line on shore reached by (1) mean high water in tidal water, or (2) ordinary high water in nontidal waters designated as navigable water of the United States must be authorized by the U.S. Army Corps of Engineers pursuant to Section 10 of the Rivers and Harbors Act. Section 404 of the Clean Water Act establishes a program to regulate the discharge of dredged and fill material into waters of the United States, including wetlands. The NPS intends to avoid impacts on waters that would be considered jurisdictional by the U.S. Army Corps of Engineers. In response to a request from the NPS for comments on the FMP, the Corps of Engineers sent a letter dated August 27, 2003, stating that the project may involve impacts on a water of the U.S. and that the Corps of Engineers will need to review portions of the project. If impacts cannot be avoided, the NPS will work with the Corps of Engineers to obtain a general or individual permit for project activities within waters of the U.S. and receive authorization under Section 10 if necessary.

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 American Indian lands and fosters increased cooperation and exchange of information among the private, government, and professional community in order to facilitate the enforcement and education of present and future generations. It regulates excavation and collection on public and American Indian lands. It requires notification of American 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 proposed in the FMP FEIS.

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) that allow agencies to develop agreements for consideration of these historic properties. The NPS, in consultation with the California State Historic Preservation Officer (SHPO), has developed a Programmatic Agreement (see Appendix J – Programmatic Agreement) for the FMP based upon an existing draft Department of the Interior Fire Management Plan Programmatic Agreement. The NPS invited the participation of the Advisory Council, affected American Indian tribes, and the public in

this consultation process. This Programmatic Agreement provides a process for compliance with the National Historic Preservation Act and includes stipulations for identification, evaluation, treatment, and mitigation of adverse effects for actions affecting historic properties. The NPS initiated consultation on the GGNRA FMP by letter to the SHPO dated May 23, 2003. Consultation was completed with the signing of the Programmatic Agreement on September 30, 2005.

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 NPS, as a matter of policy, will be as nonrestrictive as this act in permitting American Indian 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 evaluated in the FMP DEIS 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; to 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 evaluated in the FMP FEIS are consistent with this executive order.

Executive Order 13112: Invasive Species. This executive order prevents the introduction of invasive species and directs federal agencies not to authorize, fund, or carry out actions that they believe are likely to cause or promote the introduction or spread of invasive species. Actions evaluated in the FMP FEIS include measures to prevent the introduction and spread of invasive species.

California Coastal Zone Management Act. This act protects coastal environments. While the 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 FMP FEIS will be submitted to the California Coastal Commission for federal consistency determination.

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5.4 Participating Agencies

The following are agencies and organizations to whom copies or notice of the FEIS are being sent.

Federal Agencies

Federal Emergency Management Agency
Presidio Trust
U. S. Army Corps of Engineers
U. S. Coast Guard
U.S. Environmental Protection Agency
U. S. Department of Commerce, NOAA Fisheries
U. S. Geological Survey
U. S. Fish and Wildlife Service
U. S. Department of Agriculture, Forest Service
U. S. Department of Agriculture, Natural Resources Conservation Service

Federal Advisory Groups

Advisory Council for Historic Preservation

Elected Officials

U. S. Senator Barbara Boxer
U. S. Senator Dianne Feinstein
Representative Lynn Woolsey, District 6

Representative Nancy Pelosi, District 8
Representative Tom Lantos, District 12
Representative Anna Eshoo, District 14
State Senator Carol Migden, District 3
State Senator Jackie Speier, District 8
State Senator Joe Simitian, District 11
State Assembly Member Joe Nation, District 6
State Assembly Member Leland Yee, Ph.D., District 12
State Assembly Member Mark Leno, District 13
State Assembly Member Gene Mullin, District 19
State Assembly Member S. Ira Ruskin, District 21
City of San Bruno, Mayor, Larry Franzella
City of Pacifica, Mayor Julie Lancelle
City and County of San Francisco Office of the Mayor, Attn: Mayor Gavin Newsom
Town of Woodside, Mayor Paul Goeld
Marin County Board of Supervisors, Attn: Harold C. Brown, Jr., President
San Mateo County Board of Supervisors, Attn: Richard S. Gordon, President
San Francisco County Board of Supervisors, Attn: Aaron Peskin, President

State Agencies

Bay Area Air Quality Management District
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 Research, State Clearinghouse
State Historic Preservation Officer

Regional, County, and Municipal Agencies

Marin County Community Development Agency
Marin County Fire Department
Marin County Cultural Services Department
Marin County Parks and Open Space Department
Marin County Public Works Department
Marin County Sheriff's Office
Marin County Resource Conservation District
Marin Municipal Water District
San Francisco Environment Department
San Francisco Fire Department
San Francisco Mayor's Office of Community Development
San Francisco Open Space Advisory Committee

San Francisco Planning Department
San Francisco Sheriff's Department
San Mateo Environment and Land Use Department
San Mateo Sheriff's Department
San Francisco Regional Water Quality Control Board

American Indian Tribes

Federated Indians of Graton Rancheria
Various nonrecognized Ohlone tribes and individual descendants

A complete list of names, including nongovernmental organizations, nonprofit organizations, and interested citizens, is in the project file and is available from the NPS. A notice will be mailed to all individuals who have indicated interest in GGNRA planning and management activities.

Libraries

The following is a list of libraries where the public can review the FEIS onsite:

San Francisco

Civic Center Branch, San Francisco Public Library
Marina Branch, San Francisco Public Library
Merced Branch, San Francisco Public Library
Richmond Branch, San Francisco Public Library
Sunset Branch, San Francisco Public Library

Marin County

Bolinas Branch, Marin County Free Library
Civic Center Branch, Marin County Free Library
Marin City Branch, Marin County Free Library
Mill Valley Public Library
Fairfax Branch, Marin County Free Library
Point Reyes Station Branch, Marin County Free Library
San Geronimo Valley Branch, Marin County Free Library
Sausalito Public Library
Stinson Beach Branch, Marin County Free Library

San Mateo County

John D. Daly Branch, Daly City Public Library
Westlake Branch, Daly City Public Library
Half Moon Bay Branch, San Mateo County Library
Pacifica Library
San Mateo County Library

East Bay

Berkeley Public Library
Oakland Public Library

The FEIS will be placed on the PEPC website at http://parkplanning.nps.gov/goga

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Appendices

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Appendix A – Glossary of Terms and Acronyms

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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 that 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. The 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 the 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 American 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 the 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.

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 interdisciplinary team (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, the 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 on 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 on 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) time 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 those impacts, 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 indicating that an EIS will be prepared. It describes the proposed action and alternatives, identifies a contact person at the 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 or EA stage. 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 the NPS has a goal and is 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. The NEPA process 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

BAAQMD	Bay Area Air Quality Management District
CDF	California Department of Forestry and Fire Protection
CE	categorical exclusion
CEF	categorical exclusion form
CEQ	President's Council on Environmental Quality
CEQA	California Environmental Quality Act
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
FCMA	Magnuson-Stevens Fishery Conservation and Management Act
FMUs	fire management units
FONSI	finding of no significant impact
FTE	Full-time equivalent or one full-time employee for one year
GGNRA	Golden Gate National Recreation Area
GMP	general management plan
IDT	interdisciplinary team
NAAQS	National Ambient Air Quality Standards
NEPA	National Environmental Policy Act
NHPA	National Historic Preservation Act
NMFS	National Marine Fisheries Service (New name is NOAA Fisheries)
NOA	Notice of availability
NOAA	National Oceanic and Atmospheric Administration
NOI	Notice of intent

NPS	National Park Service
PDO	Pacific Decadal Oscillation
PRNS	Point Reyes National Seashore
REO	regional environmental officer
ROD	Record of Decision
SAFZ	San Andreas Fault Zone
SFPUC	San Francisco Public Utilities Commission
SHPO	California State Historic Preservation Officer
SOD	Sudden Oak Death
SSO	system support office
USFWS	United States Fish and Wildlife Service
USGS	United States Geological Survey
VMP	vegetation management plan
WASO	Washington, D.C., Office of the National Park Service
WUI	wildland urban interface

Fire Terms and Definitions

AFFIRMS (Administrative and Forest Fire Information Retrieval and Management System). A user-oriented interactive computer program that permits entry of fire weather observations and fire weather forecasts and that computes danger indices.

Amplexus. The copulating embrace of frogs and toads, during which the male fertilizes the eggs that are released by the female.

Anadromous. Fish that migrate up rivers from the sea to breed and spawn in fresh water.

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).

Blacklining. 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 that 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 line. 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.

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 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 weather. Weather conditions that influence fire ignition, behavior, and suppression.

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.

Fossorial. Adapted for or used in burrowing or digging, such as the forepaws of a burrowing mammal.

Fuel. The materials that 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 breaks. Generally wide (10- to 1,000-foot) strips of land on which native vegetation has been permanently modified so that fires burning into them can be more readily controlled. Some fuel breaks contain fire lines (e.g., roads, handlines) that 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.

Genotype. The genetic makeup, as distinguished from the physical appearance, of an organism or a group of organisms.

Hazardous fuels. Fuels that, if ignited, could threaten park developments, human life and safety, or 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).

Live fuel moisture. Moisture content of living fuels that has been found to be important to fire starts and fire spread.

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.

Mesic. Of, characterized by, or adapted to, a moderately moist habitat.

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 qualification system that 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 that 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).

Phenological. The scientific study of periodic biological phenomena, such as flowering, breeding, and migration, in relation to climatic conditions.

Pitch Pine Canker. A disease that causes die-back of individual pine branches leading to a general decline in tree death and, in some cases, early death.

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, including overall 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.

Red Card. Fire qualification card issued to fire-rated persons showing their training needs and their qualifications to fill specified fire suppression positions in a large fire suppression or incident organization.

Refugia. An area that has escaped ecological changes occurring elsewhere and so provides a suitable habitat for species.

Rehabilitation. The activities necessary to repair damage or disturbance caused by wildfire or the fire suppression activity.

Senescent. Growing old, aging.

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.

Special status species. For purposes of this EIS, any species listed or proposed for listing under the state or federal endangered species acts, or recognized as locally rare by recognized authorities.

Stand-replacement fire. A fire that burns with sufficient intensity to kill the majority of living vegetation over a given area.

Sudden Oak Death. A disease caused by a plant pathogen *phythopthoraramounum*, found in 13 coastal California counties and one Oregon county since the 1990s when first identified. It has caused substantial mortality in tan oaks and oaks.

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 percent of the difference between its initial moisture content and its equilibrium moisture content. Providing conditions remain unchanged, a fuel will reach 95 percent of its equilibrium moisture content after four timelag periods.

Wildland urban interface. Line, area, or zone where structures and other human development meet or intermingle with undeveloped wildland or vegetation fuels.

Wildland-Urban Interface Initiative. A program authorized by Congress in conjunction with the National Fire Plan to reduce hazardous fuels on federal lands and assist communities with wildland fire protection.

WIMS (Weather Information Management System). Computerized system that replaced the AFFIRMS program in 1992.

Wet line. A line of water, or water and chemical retardant, sprayed along the ground, that 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 – Literature Cited

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Appendix B – Literature Cited

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Appendix C – Cumulative Actions

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Appendix C – Cumulative Actions

The cumulative project list was developed by an interdisclipinary team of GGNRA staff assigned to prepare the FMP. The team looked for past, present, and reasonably foreseeable future projects that could affect the same resources as the FMP. NPS NEPA guidance states that cumulative actions considered should be those that would have additive impacts on a particular environmental resource to allow for reasonable decision-making about the management of that resource. The list should be limited to projects that would clearly have potential effects and are far enough along in the planning process make some level of analysis feasible. As a general rule, the farther removed an action is from the project area or the project start date, the less need there is for detailed and exact analysis of the action's cumulative impacts.

Implementation of the FMP would have the greatest impact on resources within the federal parklands and on visitors to those parks. In addition, the FMP's implementation would affect air basin air quality and shared watersheds. Most projects in the cumulative actions list share the same affected area as the FMP or would impact similar receptors, whether they are park visitors or park neighbors. Some similar, non-park actions are also included in the cumulative list, such as vegetation management projects or prescribed burns conducted by other land management agencies, the Marin County Fire Department, and the California Department of Forestry and Fire Protection.

No known large scale development projects are currently proposed for western Marin, Woodside or Pacifica; all three areas are largely built out and have restrictive zoning requirements on remaining vacant parcels due to steep, unstable slopes, seismic hazard, viewshed impacts, or to protect the agricultural base of western Marin.

Big Lagoon Restoration (Redwood Creek Watershed). An environmental impact analysis of alternatives for creek and wetland restoration/enhancement in lower Redwood Creek at Muir Beach is being initiated by GGNRA. The project site is located at the mouth of the Redwood Creek watershed, which drains an 8.9-square-mile area on the southwestern slopes of Mt. Tamalpais in coastal Marin County. Historically, the entire area of Muir Beach and the adjacent lowland pastures were part of the Redwood Creek floodplain. The creek meandered across the valley floor and, during floods, deposited sediment across the floodplain area. Today, the creek has been confined and much of the floodplain eliminated due to the combined effects of road and levee construction, channeling projects, and placement of the NPS parking lot and picnic area. The project will restore or enhance ecological conditions and processes at the site, reduce flooding of local infrastructure, and continue to provide public access to the beach and restored wetland and creek. Project alternatives will consider the need to restore ecosystem conditions and functions, reduce flooding of local infrastructure, provide appropriate visitor access, and support suitable visitor experiences at the site.

Marin Headlands/Fort Baker Roadway Improvement and Transportation Management Plan. The purpose of the proposed action is to provide greater access to and within the Marin Headlands and Fort Baker for a variety of users, and to initiate these improvements in a way that minimizes impacts on the rich natural diversity and cultural resources of the Marin Headlands and Fort Baker. The project will provide infrastructure improvements to meet the following needs: (1) promote public transit, pedestrian,

and bicycle travel to and with the park to improve visitor experience and enhance environmental quality; (2) rehabilitate the Marin Headland/Fort Baker transportation road and trail infrastructure in a manner that protects resources and improves safety and circulation; and (3) reduce traffic congestion at key park locations and connecting roads. An EIS was initiated in December 2001 to develop alternatives for multimodal transportation in and to the park.

Comprehensive Transportation Management Plan (CTMP) for Parklands in Southwest Marin County. The CTMP brings together Marin County, the NPS, California State Parks, the California Department of Transportation, other participating agencies, and the public in southern Marin County to identify and evaluate the development of recreational travel model options to reduce traffic impacts of visitors on gateway communities and the parks. Heavy volumes of traffic and parking impacts on roadways leading to national park areas in GGNRA (Muir Woods National Monument, Tennessee Valley, Muir Beach, and Stinson Beach), and Mount Tamalpais State Park have resulted in a need to evaluate alternative access to the parks other than continued reliance on automobile passenger travel.

Trails Forever Projects. These projects focus on the rehabilitation, physical improvement, and provision of additional enhancements for public enjoyment along the Coastal Trail. The Coastal Trail is a major, scenic pedestrian route through the park, stretching from Muir Beach in the north to Fort Funston and beyond in the south. Physically improved trail sections, enhanced vehicular access to trail segments, and vegetation management along selected trail segments are expected to have impacts on fire management operations within GGNRA.

Fort Baker EIS. Implementation of the Fort Baker EIS will include the creation of a retreat and conference center, major infrastructure upgrades, waterfront improvements, and native habitat restoration. Cultural landscape work authorized under this approved plan includes removal of hazard trees in the vicinity of buildings and roadways and the reduction of eucalyptus and Monterey pine groves that have escaped their historic boundaries. These projects would allow for the reestablishment of a compatible historic scene and to provide critical habitat for mission blue butterfly. The NEPA process for this project has been completed.

Wildland-Urban Interface Initiative-Funded Community Projects. The NPS provides funding to local fire departments, homeowners' associations, and public land management agencies to conduct fuel reduction projects (vegetation treatment and pile burning) in the interface zone with GGNRA to reduce the potential risk of a fire spreading from the park into residential areas or vice versa. The program began in 2001 and has funded projects from Sausalito north to Stinson Beach in Marin County. In the future, projects could be sited anywhere with a high fire risk along the roughly 40-mile interface zone of GGNRA lands and residential development. For purposes of cumulative air quality impact assessment, the typical work year includes 25 burn piles.

GGNRA Habitat Restoration Programs. Native plant habitat restoration projects occur throughout the park, led by both NPS natural resources staff (the Habitat Restoration Team and the Presidio Park Stewards) as well as the Golden Gate National Parks Conservancy (Site Stewardship Program). Many restoration projects also occur in Muir Woods National Monument. A separate program exists solely to remove Cape-ivy from areas throughout the park.

GGNRA and Presidio Trust Remediation Projects in the Presidio of San Francisco. Site investigation and remediation projects are planned for certain contaminated lands transferred from the U.S. Army to the NPS. After remediation, the areas are typically revegetated with native plants, where appropriate.

GGNRA Maintenance Operations. The maintenance division conducts many ongoing operations throughout the park. Operations that may create cumulative impacts with fire management activities include road, trail, and stormwater system maintenance.

Other Agency Projects. Other agency projects with the potential to create cumulative impacts:

- PRNS FMP implementation;
- Presidio VMP implementation;
- Marin County Fire Department fuel management actions carried out on private lands, Marin Municipal Water District lands, and Marin County Open Space District lands; and
- San Francisco Watershed Fire Management Plan implementation.

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Appendix D – GGNRA Historic Resources

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Appendix D – GGNRA Historic Resources (Not Including All Archeological Resources)

NATIONAL HISTORIC LANDMARKS

The Presidio of San Francisco
Fort Point National Historic Site
San Francisco Port of Embarkation
Alcatraz Island
San Francisco Bay Discovery Site

NATIONAL HISTORIC LANDMARKS (NOMINATIONS IN DRAFT)

Coastal Fortifications
Golden Gate Bridge

PROPERTIES ON THE NATIONAL REGISTER OF HISTORIC PLACES (NRHP)

Forts Baker, Barry, and Cronkhite
Fort Mason Historic District
Point Lobos Archeological Sites
Six-Inch Gun No. 9 (Baker Beach)
Fort Mason Archeological District
Fort Miley
Muir Beach Archeological District
Point Lobos Marine Exchange Lookout Stations
S.S. Tennessee Shipwreck site and remains
King Phillip/Reporter site and remains
Camera Obscura
Point Bonita Light Station
Sara Seaver Randall House
Fort Funston
Hill 640 Military Reservation
Crissy Field
Olema Valley Historic District

CULTURAL LANDSCAPES WITHIN GGNRA

Adolph Sutro Historic District
Banducci Flower Farm
Bolinas Copper Mines
Camino del Canyon
D Ranch (Tennessee Valley)
Dipsea Trail
Golden Gate Dairy
Miwok Trail
Milagra Ridge
Point Bonita Lifesaving Station
Rancho Corral de Tierra
Sweeney Ridge

GOLDEN GATE ARCHEOLOGICAL SITES REGISTERED IN NPS DATABASE

1853 SS Tennessee Shipwreck	CA-MRN-506H
1864 Black Point: East Battery	
1864 Black Point: West Battery	
Battery Chamberlin: Six-Inch Gun No. 9	CA-SFR-56H
Crissy Field Prehistoric Site	CA-SFR-129
Dias Ranch Site	CA-MRN-567H
Fan Site	
Fire Control Stations: Batteries Saffold and Chamberlin	CA-SFR-132H
Fort Mason – Battery Road Site (NRHP)	CA-SFR-31
Fort Mason – Community Garden Site (NRHP)	CA-SFR-30
Fort Mason – Second Community Garden Site (NRHP)	CA-SFR-29
Fort Mason – Yerba Buena Midden One (NRHP)	
Fort Mason – Yerba Buena Midden Two (NRHP)	
Fort Point Lighthouse Keeper's House Site	CA-SFR-131H
Fort Point National Historic Site	CA-SFR-48H
King Philip and Reporter Shipwreck Site (NRHP)	
Lime Point	CA-MRN-648
Marin Headlands – Big Rock Overlook	CA-MRN-599
Marin Headlands – Black Rock	
McKennan Gulch North	
McKennan Gulch South	
Morses Gulch Site	CA-MRN-336
Muir Beach Archeological Site (NRHP)	CA-MRN-333
Ocean Beach Shipwreck	CA-SFR-108H
Old Muir Woods Inn	CA-MRN-568H
Old Slide Ranch	CA-MRN-572H
Pelican Site	
Point Lobos Archeological Sites (NRHP)	CA-SFR-5
Point Lobos Archeological Sites (NRHP)	CA-SFR-21
Presidio of San Francisco – DeRussey Residence Refuse Dump	CA-SFR-109H
Presidio of San Francisco Quartermaster Landfills	
Presidio of San Francisco Quartermaster Wharf Site	
Presidio of San Francisco: Battery East	
Presidio of San Francisco: Lancaster Cantonment Dump	
Presidio of San Francisco: Sea Plane Ramp	
Presidio of San Francisco: West Battery	
Refuse Dump 1	
Refuse Dump 2	
Rodeo Lagoon	
Rodeo Lagoon – Shelf Site	
San Francisco Fire Department Pumping Station 2	CA-SFR-84H
Slide Ranch Midden	CA-MRN-199
SS Rio de Janeiro Shipwreck	
Stinson Gulch	CA-MRN-334
Tennessee Point Ammunition Demolition Area	
Wagon fragments	
Wolf Ridge Anti-Aircraft Battery #1	

Appendix E – Fire Hazard Model

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Appendix E – Fire Hazard Model

The GGNRA Fire Hazard Model defines fire hazard as areas where steep slopes, south-facing aspects, and high-danger fuels exist in close proximity to urban or developed areas. The analysis was conducted to help visualize and differentiate parklands in terms of wildland fire hazard. The model takes into consideration potential fire behavior should a fire start (fuels and topography) and values at risk (wildland urban interface). The model was conducted using a Geographic Information System (GIS) with input from fire management, natural resource, and cultural resource experts.

Methodology

Using a GIS, GGNRA lands affected by the Fire Management Plan (approximately 15,000 acres) were divided into a grid of 100 meter^2 cells. Five variables were analyzed for each cell (see below). Each variable was assigned a common rating scale of 1 (low), 2 (moderate), and 3 (high), representing the level of hazard. Zero was assigned where the hazard or factor did not exist. The factors were then weighted according to their influence on fire hazard and added together. The calculation resulted in a numeric scale representing the hazard value for each cell. The scale is unit-less and has no absolute meaning; rather, it is intended to show wildland fire hazard relative to other cells.

Model Inputs

Five variables were analyzed: fuels, slope, aspect, proximity to urban areas, and the presence of nonnative evergreen trees. Each variable is described below. Table E-1 summarizes the hazard rating system and input variable weighting. The level of analysis was based on the availability of staff resources, existing data, and time. Some factors such as response time to a fire and weather were omitted due to insufficient data; however, the NPS understands the importance of these factors and is working to fill in these data gaps. Fire hazard analysis for the park will continue to be refined as data and modeling techniques become available.

1. Fuels

Fuels are considered any organic material (live and dead vegetation, litter, and duff) that may combust during a fire. Fuel models are a numeric description of the quantity and arrangement of fuels and were developed to allow easy input of environmental parameters and fuel characteristics into fire behavior prediction models. A fuel model describes potential fire behavior for a given fuel loading (weight per area) and arrangement (surface versus crown fuels), which generally correspond to vegetation type (Rothermel 1972). GIS specialists, fire ecologists, botanists, and local fire experts from GGNRA, PRNS, and the NPS Fire Program Analysis team convened to assign local vegetation types a fuel model consistent with the Anderson framework (Anderson 1982). Park vegetation maps from 1994 aerial photography were assigned fuel models based on the alliance-association vegetation type and field plot information. Table E-2 gives a description of fuel models assigned to GGNRA.

Fuel models were rated in terms of fire hazard in accordance with the Marin County Fire Plan (2000*)*. Fuel models 1, 2, 4, 9 and 10 were identified as extreme hazards during severe fire-weather conditions

(dry and windy). Fuel types 3, 5, 7, and 8 were ranked moderate. Fuel types 98 and 99 (water and barren) were ranked low.

2. Slope

Slope affects fire behavior characteristics and the ability of firefighters to suppress a fire. Fire typically burns faster up steeper slopes due to the arrangement of fuels in relation to the flaming front and pre-heating of fuels by fire below. Steep slopes and difficult terrain affect the ability to safely combat a fire.

3. Aspect

Aspect refers to the geographic orientation of the slope. Slopes facing south and southwest receive more sun than slopes in other orientations. Consequently, vegetation on these slopes tends to dry out faster. In late summer and fall warm, easterly winds tend to dry fuels on east and northeast slopes as well.

4. Proximity to Urban Areas

The GGNRA boundary includes approximately 40 miles of border along residential areas. A wildland fire near this boundary could threaten homes and private property. Furthermore, urban areas that border the park could serve as ignition sources for a wildland fire. Parklands within 400 meters of an urban area including structures within the park were ranked highest in terms of hazard.

5. Nonnative Evergreen Forest

Fire that burns through the tree canopy is termed crown fire and is an indication of extreme fire behavior. Crown fire potential in GGNRA and surrounding lands is high in only a few fuel types. Therefore, areas where these trees exist and are represented in the vegetation map were given a 5-percent weighting in the hazard calculation in addition to the weighting assigned in the fuel model input.

Results

Several iterations of analysis were conducted with input variables weighted differently before park staff settled on the final process that resulted in distinguishable hazard differences. The final analysis relies heavily on the hazard created by fuel types and proximity to the wildland urban interface. It comes as no surprise that areas along the park boundary rank high in terms of fire hazard due to their close proximity to development and the fact that many of these areas contain heavy fuels, nonnative forest, and hilly terrain. Maps of the results of the analysis are represented in Figures E-1 and E-2.

Table E-1: Fire Hazard Ratings
(1 = Low, 2 = Moderate, 3 = High)

Input Variable	Data Value	Hazard Rating	Weight
Fuels	Models 1-10, 98, 99	Fuel Model 1, 2, 4, 9, 10 = **3** Fuel Model 3, 5, 6, 7, 8 = **2** Fuel Model 98, 99 = **1**	40%
Slope	Degrees	>40° = **3** 21° - 40° = **2** 0° - 20° = **1**	15%
Aspect	Degrees	135° - 270° = **3** 46° - 135°, 271° - 315° = **2** 0° - 45°, 316° - 360° = **1**	5%
Proximity to Urban Areas	Meters	0 – 400m = **3** 401-1200m = **2** >1200m = **1**	35%
Nonnative Evergreen Forest	Presence vs. Non-presence	Present = **3** Not Present = **0**	5%

Source: NPS, GGNRA Fire Management Office, 2004.

Table E-2: GGNRA Fuel Models

Fuel Model	Description
1	Short grasses (1 foot)
2	Timber with grass understory
3	Tall grasses (2.5 feet)
4	Chaparral (6 feet)
5	Brush (2 feet)
8	Closed timber litter
9	Hardwood litter
10	Timber (litter and understory)
98	Water
99	Unburnable / Barren / Developed

Source: NPS, GGNRA Fire Management Office, 2004.

Note:

For a detailed description of fuel models, see Anderson 1982.

References

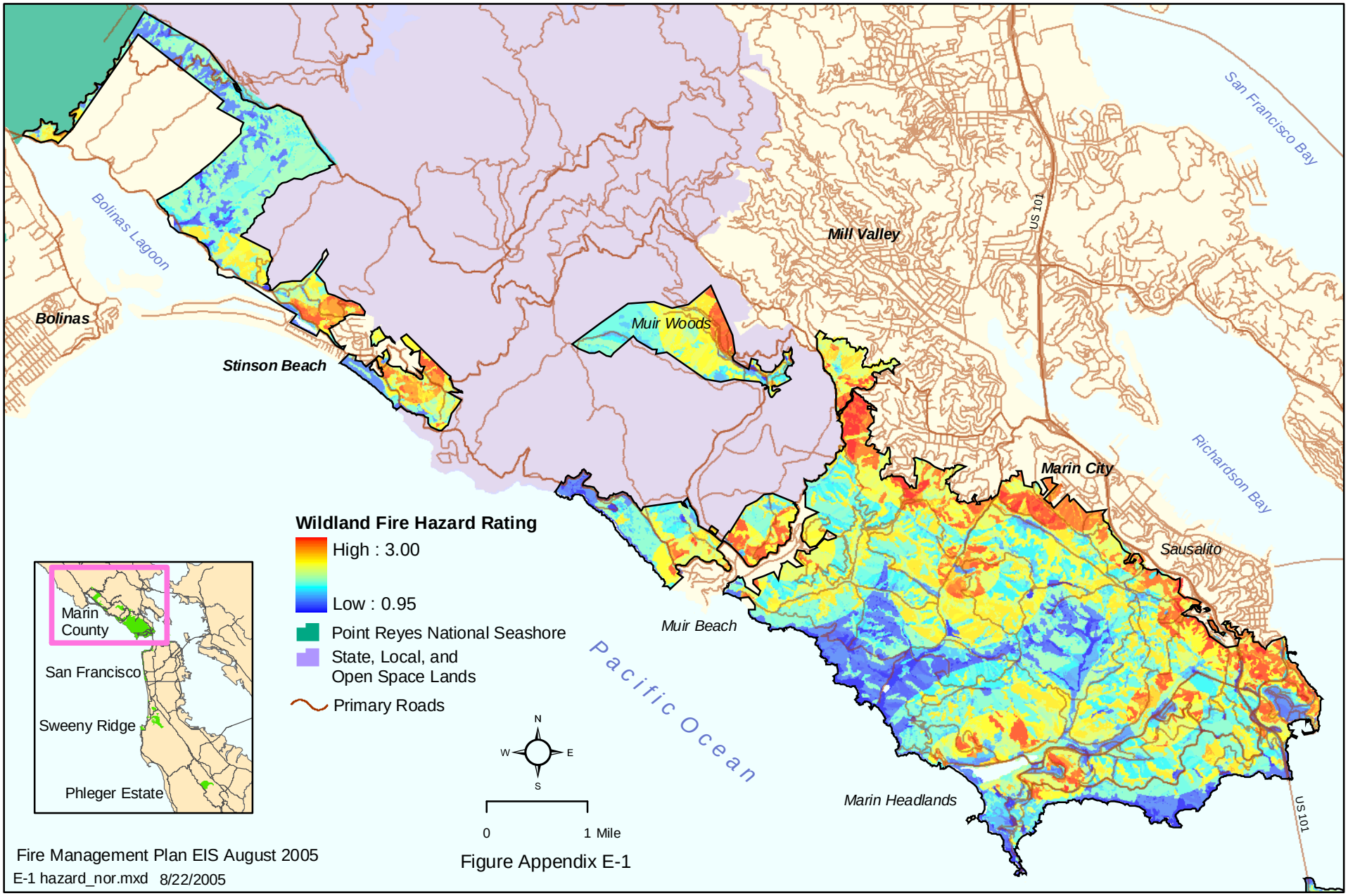
Anderson, H. E. 1982. Aids to Determining Fuel Models for Estimating Fire Behavior. Ogden, UT: United States Department of Agriculture, Forest Service, Intermountain Research Station.

Rothermel, R. C. 1972. A Mathatical Model for Prediction Fire Spread in Wildland Fuels. Ogden, UT: United States Department of Agriculture, Forest Service, Intermountain Research Station.

Wildland Fire Risk Hazard Assessment

Marin County

National Park Service
U.S. Department of the Interior
Golden Gate National Recreation Area



Fire Management Plan EIS August 2005

E-1 hazard_nor.mxd 8/22/2005

Figure Appendix E-1

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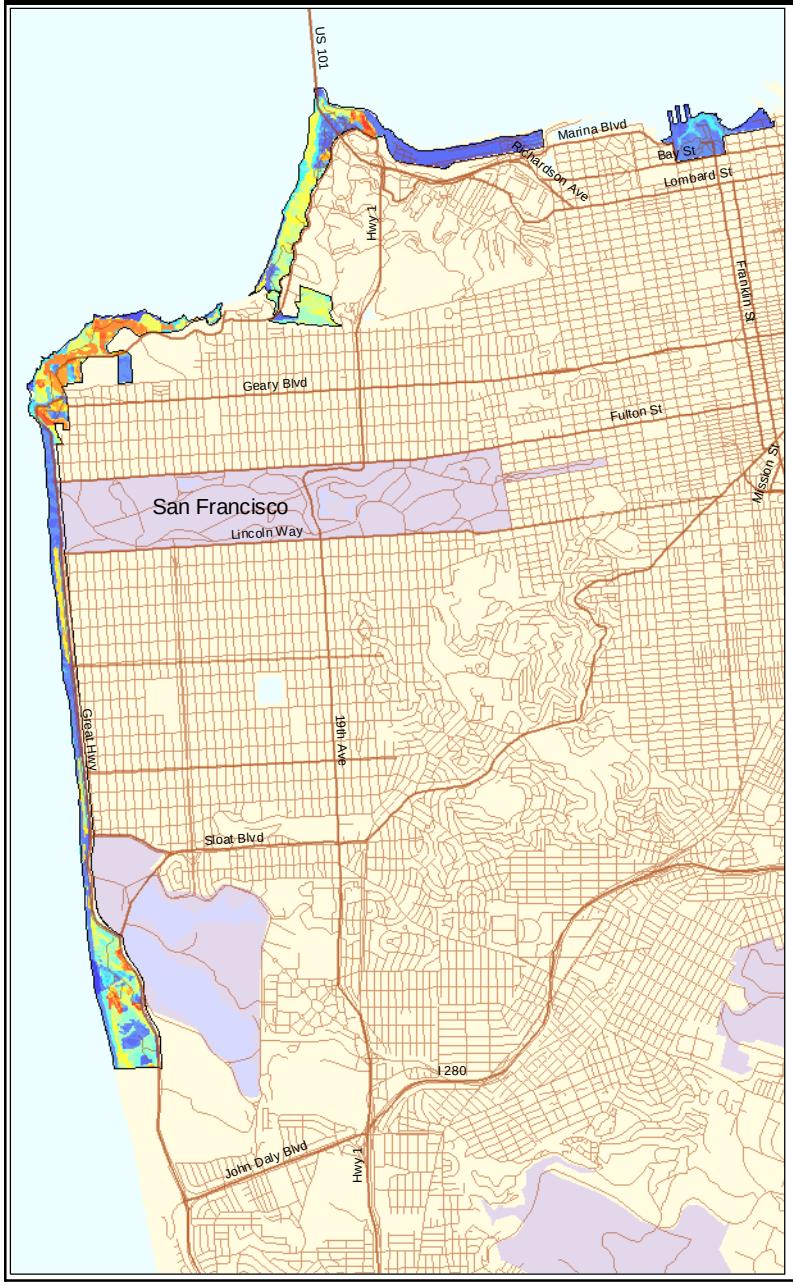
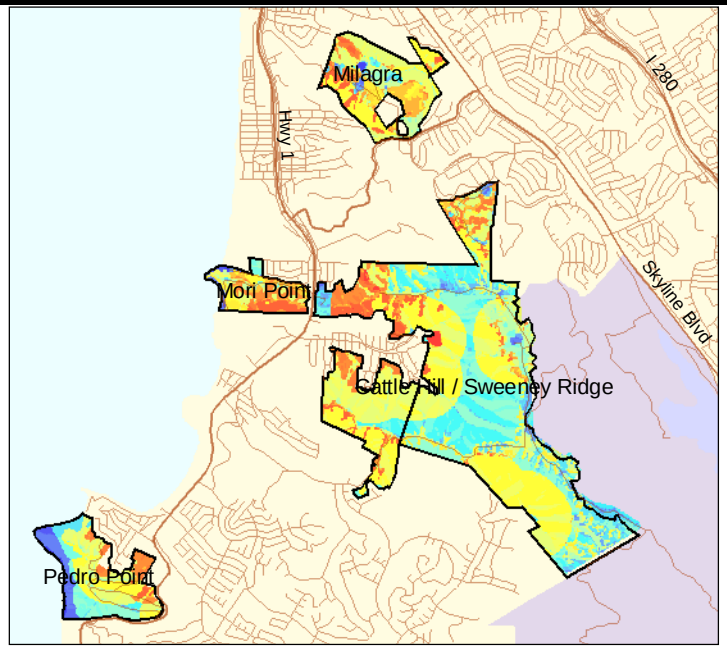
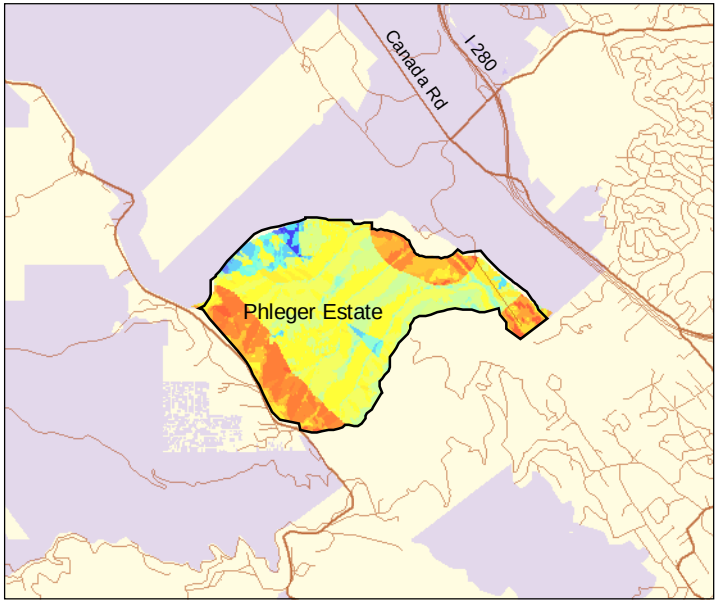
Wildland Fire Risk Hazard Assessment

San Francisco and San Mateo County

National Park Service
U.S. Department of the Interior
Golden Gate National Recreation Area







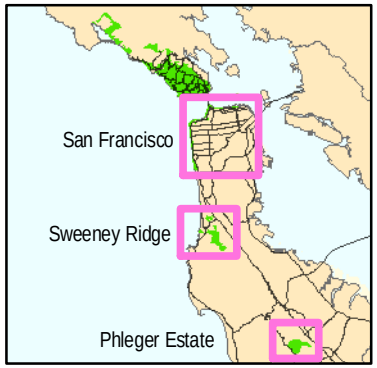
Hazard Rating

High : 3.00

Low : 0.95

GGNRA Boundary

State, Local, and Open Space Lands



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W E
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0 1 Mile

Figure Appendix E-2

Fire Management Plan EIS August 2005

E-2 Hazard_south.mxd 8/23/2005

Appendix F – Special Status Species

Scientific Name	Common Name	Legal Status			Noted in GGNRA Records	GGNRA management concern not on USFWS list	Habitat requirement and/or association	Micro habitat	Habitat Present in Planning Area	Occurrence known in FMU/ Project Unit				Potential Effect that Could Result from FMP Actions[1]				County Distribution			Species Distribution / Range	Comments
		Federal	CNPS	State						None	Muir Woods	WUI	Interior	Benefical	Negative	No affect	Unknown	San Francisco	San Mateo	Marin		
PLANTS																						
Abronia umbellata ssp. breviflora	Pink sand-verbena	FSLC	1B				Coastal dunes and coastal strand.	Foredunes and interdunes with sparse cover. A. Umb. Breviflora is usually the plant closest to the ocean. 0-12m.	X			X				X		X	X	X	North Coast, Central Coast (Marin Co.)	Species occurences are documented in foredune habitat at Crissy Field (Recovery Plan for Coastal Plants of the Northern San Francisco Peninsula, USFWS, 2003). It is anticipated that coastal foredune habitat would be unaffected by FMP actions
Acanthomintha duttonii	San Mateo thornmint	FE	1B	E	X		Chaparral, valley and foothill grassland, coastal scrub. Serpentine grasslands.	Endemic to San Mateo County.extant populations only known from very uncommon serpentinite vertisol clays; in relatively open areas. 50-200m.											X		Central Coast, San Francisco Bay Area (San Mateo Co.)	Only occurrs in the San Francisco Watershed District. Special Status Vascular Plant Species Monitoring Report GGNRA 2001.
Agrostis blasdalei	Blasdale's bentgrass	FSC	1B				Coastal dunes, coastal bluff scrub, coastal prairie.	Includes agrostis blasdalei var. Marinensis, state-listed rare.sandy or gravelly soil close to rocks; often in nutrient-poor soil with sparse vegetation. 5-150m.	X	X										X	s North Coast, n Central Coast, n San Francisco Bay Area	Per communication with Marin CNPS (2004), no populations exist in GGNRA. CNDDB (2004): Marin occurance in Pt. Reyes, San Mateo-Franklin Pt. Quad
Allium peninsulare var. franciscanum	Franciscan onion	FSLC	1B				Cismontane woodland, valley and foothill grassland.	Clay soils; often on serpentine. Dry hillsides. 100-300m.											X		Central Coast, San Francisco Bay Area .	
Alopecurus aequalis var. sonomensis	Sonoma alopecurus	FE	1B				Freshwater marshes and swamps, riparian scrub.	Wet areas, marshes, and riparian banks with other wetland species. 5-360m. Known from a few occurrences in sonoma and marin counties.	X	X										X	Central Coast	Four occurrences of this species are currently known on the Point Reyes peninsula, all occurring within pastures on agricultural permit lands (Point Reyes FMP, 2004). No populations exist in the GGNRA (CNDDB, 2004)
Amorpha californica var. napensis	Napa false indigo	FSLC	1B				Broadleafed upland forest, chaparral, cismontane woodland.	Openings in forest or woodland or in chaparral. 150-2000m												X	s North Coast Ranges (Napa, Sonoma cos.), n San Francisco Bay Area (Marin Co.)	
Amsinckia lunaris	Bent-flowered fiddleneck	FSLC	1B				Cismontane woodland, valley and foothill grassland.	Disturbed areas, areas with low vegetation cover in grasslands and open-canopied woodlands. 50-500m.											X	X	Inner North Coast Ranges, west-central Great Central Valley, San Francisco Bay Area .Heterostylous or anthers in upper and lower group. Fl size variable.	
Arabis blepharophylla	Coast rock-cress	FSLC	4		X		Broadleafed upland forest, coastal prairie, coastal scrub.	Prefers rocky coastal bluffs and ridges with thin soils. Often on serpentine soils. 15-500m.	X			X	X	X				X	X	X	Outer North Coast Ranges, San Francisco Bay Area .	Special Status Vascular Plant Species Monitoring Report GGNRA 2001.
Arctostaphylos andersonii	Santa Cruz manzanita	FSLC	1B				Broadleaved upland forest, chaparral, north coast coniferous forest.	Known only from the Santa Cruz Mtns.open sites, redwood forest. 180-800m.											X		w San Francisco Bay Area (Santa Cruz Mtns)	
Arctostaphylos hookeri ssp. Franciscana	San Francisco manzanita	FSC	1A				Chaparral.	Formerly Endemic To San Francisco Area; Now Exists Only In Cultivation. Coastal Hillsides, Serpentine Outcrops In Chaparral. 60-300m.	X	X								X			Central Coast (San Francisco Peninsula)	Species is extinct in the wild (Recovery Plan for Coastal Plants of the Northern San Francisco Peninsula, USFWS, 2003).
Arctostaphylos hookeri ssp. montana	Tamalpais manzanita	FSC	1B		X		Chaparral, valley and foothill grassland.	Known from fewer than 20 occurrences in the Mt. Tamalpais area, Marin County.serpentine slopes in chaparral and grassland. 160-760m.												X	n Central Coast, nw San Francisco Bay Area (Mount Tamalpais, Marin Co.)	Special Status Vascular Plant Species Monitoring Report GGNRA 2001. Population monitored at Mill Valley Air Force Base.

Scientific Name	Common Name	Legal Status			Noted in GGNRA Records	GGNRA management concern not on USFWS list	Habitat requirement and/or association	Micro habitat	Habitat Present in Planning Area	Occurrence known in FMU/ Project Unit				Potential Effect that Could Result from FMP Actions[1]				County Distribution			Species Distribution / Range	Comments
		Federal	CNPS	State						None	Muir Woods	WUI	Interior	Benefical	Negative	No affect	Unknown	San Francisco	San Mateo	Marin		
Arctostaphylos hookeri ssp. ravenii	Presidio (Raven's) manzanita	FE	1B	E	X		Chaparral, coastal prairie, coastal scrub.	Formerly endemic to s.f. area; only one wild plant plus clones remain.open, rocky serpentine slopes. 20-215m.	X			X		X			X	X			n Central Coast (San Francisco Presidio) .Plants apparently belong to a single clone	The USFWS Recovery Plan suggests that seed germination could be stimulated by burns (Kelley, 1987). The limited population would also be enhanced by invasive species control and management (Recovery Plan for Coastal Plants of the Northern San Francisco Peninsula, USFWS, 2003). The fuel reduction actions for San Francisco lands may need further USFWS consultation to reduce direct affects during vegetation removal and to maximize long-term benefits.
Arctostaphylos imbricata	San Bruno Mountain manzanita	? CA	1B	E			Chaparral, coastal scrub.	Known from a handful of occurrences near San Bruno Mtn., San Mateo County.mostly known from a few sandstone outcrops in chaparral. 275-365m.											X		w San Francisco Bay Area (San Bruno Mtn)	
Arctostaphylos montaraensis	Montara manzanita	FSC	1B		X		Chaparral, coastal scrub.	Endemic to San Mateo County.slopes and ridges. 150-500m.											X		w San Francisco Bay Area (San Bruno, Montara mtns)	Only occurrs in the SFWD. Special Status Vascular Plant Species Monitoring Report GGNRA 2001.
Arctostaphylos regismontana	King's Mountain manzanita	FSLC	1B				Broadleaved upland forest, chaparral, north coast coniferous forest.	Endemic to Sacramento and San Mateo counties.granitic or sandstone outcrops. 305-730m.											X		w San Francisco Bay Area (n Santa Cruz Mtns) .	
Arctostaphylos virgata	Marin manzanita	FSLC			X		Broadleafed upland forest, closed-cone coniferous forest, chaparral, north coast coniferous forest.	Only known from about 20 eos in Marin County. On sandstone or granitic soil. 60-700m.	X				X	X						X	n Central Coast, nw San Francisco Bay Area (Marin Co.)	Known populations occur along Bolinas Ridge. Threatened by fire suppression. "GGNRA fire managers should be made aware of this potential threat from fire suppressions and include this with any future FMP". Special Status Vascular Plant Species Monitoring Report GGNRA 2001.
Arenaria paludicola	Marsh sandwort	FE	1B	E			Marshes and swamps.	Hist. From scattered coll. In ca and in wa; now known from one site in slo & appar. Also in mexico.growing up through dense mats of typha, juncus, scirpus, etc. In freshwater marsh. 10-170m										X			s Central Coast (Nipomo Mesa, San Luis Obispo Co.), South Coast (Santa Ana River)	
Astragalus nuttallii var. virgatus	Nuttall's milk-vetch	FSLC	4				Coastal bluff scrub, coastal dunes.	3-70m.	X			X					X	X	X	X	c&s Central Coast	Occurs in the Presidio coastal bluffs (pers. comm. Michael Chasse (NPS) 2004)
Astragalus pycnostachyus var. pycnostachyus	Marsh milkvetch	FSLC	1B				Coastal dunes, coastal salt marshes.	Mesic sites in dunes or along streams or coastal salt marshes. 0-30m.											X	X	North Coast, n Central Coast .	
Astragalus tener var. tener	Alkali milk-vetch	FSC	1B				Alkali playa, valley and foothill grassland, vernal pools.	Low ground, alkali flats, and flooded lands; in annual grassland, playas, and vernal pools. 1-170m.										X			s. Sacramento Valley, n. San Joaquin Valley, east SF Bay Area	
Atriplex californica	California saltbush	FSLC					Coastal strand, coastal salt marsh, coastal sage scrub, sea bluffs. North of Monterey this species generally occurs on the upper edges of sandy salt marshes and on coastal sandstone bluffs.		X			X				X		X	X	X	s North Coast, Central Coast, South Coast, Channel Islands	Occurs in the Presidio (pers. comm. Ling He (NPS), 2004). It is anticipated that edges of the coastal salt marsh and sandstone bluff habitat would not be unaffected by FMP actions

Scientific Name	Common Name	Legal Status			Noted in GGNRA Records	GGNRA management concern not on USFWS list	Habitat requirement and/or association	Micro habitat	Habitat Present in Planning Area	Occurrence known in FMU/ Project Unit				Potential Effect that Could Result from FMP Actions[1]				County Distribution			Species Distribution / Range	Comments
		Federal	CNPS	State						None	Muir Woods	WUI	Interior	Benefical	Negative	No affect	Unknown	San Francisco	San Mateo	Marin		
Blennosperma nanum var. robustum	Point Reyes stickyseed	FSC	1B				Coastal prairie, coastal scrub.	Endemic to Marin and Mendocino Counties. On open coastal hills in sandy soil. 10-145m.												X	Central North Coast (Fort Bragg, Mendocino Co.), North Central Coast (Point Reyes peninsula, Marin Co.) .Fls late spring. Some populations on Point Reyes peninsula are intermediate to *var. nanum* in fruit length, pollen color	
Calamagrostis crassiglumis	Thurber's reed grass	FSC	2				Coastal scrub, freshwater marsh.	Usually in marshy swales surrounded by grassland or coastal scrub. 10-45m.												X	Central Coast	
Calochortus tiburonensis	Tiburon mariposa lily	FT	1B	T			Valley and foothill grassland.	Narrowly endemic to ring mountain, Marin County. On open, rocky, slopes in serpentine grassland. 50-150m.												X	nw San Francisco Bay Area (Ring Mtn, Marin Co.)	Per communication with Marin CNPS (2004), no populations occur within GGNRA. CNDDB (2004): Marin occurance in Pt. Reyes, San Mateo-Franklin Pt. Quad
Calystegia purpurata ssp. Saxicola	Coastal bluff morning-glory	FSLC	1B				Coastal dunes, coastal scrub.	15-105m.	X	X										X	s&c North Coast, n Central Coast (Brooks Island, Contra Costa Co.), n San Francisco Bay Area	Per communication with Marin CNPS, No populations exist within GGNRA. CNDDB-Marin occurance in Pt. Reyes.
Campanula californica	Swamp harebell	FSC	1B				Bogs and fens, closed-cone coniferous forest, coastal prairie, meadows, freshwater marsh, n coast coniferous forest.	Bogs and marshes in a variety of habitats; uncommon where it occurs. 1-405m.												X	s North Coast, n Central Coast	
Castilleja affinis ssp. neglecta	Tiburon paintbrush	FE	1B		X		Valley and foothill grassland.	Known only from Marin, Napa, and Santa Clara Counties. Rocky serpentine sites. 75-400m.												X	s Inner North Coast Ranges (Napa Co.), San Francisco Bay Area (Marin, Santa Clara cos.)	Occurs on Nicassio Ridge only. Special Status Vascular Plant Species Monitoring Report GGNRA 2001.
Castilleja affinis var. affinis	Coast Indian paintbrush	FSLC					Chaparral, coastal scrub.	Sandy soils. <1200m.	X			X		X				X	X	X	c North Coast (Mendocino Co.), n Outer North Coast Ranges (Humboldt Co.), s Outer North Coast Ranges, n Cascade Range Foothills, Sierra Nevada Foothills, Central Western California, Southwestern California	Castilleja sp. (wightii or affinis ssp. affinis) occur in the Presidio coastal bluffs (pers. comm. Michael Chasse (NPS), 2004).
Castilleja ambigua ssp. ambigua	Salt marsh owl's-clover	FSLC					Coastal bluffs, grassland.	<100m.	X	X								X	X	X	North Coast, s North Coast Ranges, n&c Central Coast .	Occurred in 2002 at Crissy Field, but has not been observed since (pers. comm, Ling He (NPS) 2004).
Castilleja ambigua ssp. Humboldtiensis	Humboldt Bay owl's-clover	FSC	1B				Coastal salt marsh.	Known only from humboldt and marin counties. In coastal saltmarsh with spartina, distichlis, salicornia, jaumea. 0-3m.												X	n North Coast (Humboldt Bay), n Central Coast (Point Reyes)	Species is not documented in GGNRA. Special Status Vascular Plant Species Monitoring Report GGNRA 2001.
Castilleja exserta ssp. Latifolia	Purple owl's-clover	FSLC					Coastal bluffs, dunes.	<200m.	X	X								X	X	X	North Coast, n&c Central Coast	Per communication with Marin CNPS (2004), no populations occur within GGNRA. In San Francisco, it is apparently either rare, intermittent(emerging only some years), or extirpated in coastal bluffs and dunes (Recovery Plan for Coastal Plants of the Northern San Francisco Peninsula, USFWS, 2003).
Castilleja subinclusa ssp. franciscana	Indian paintbrush		4		X		Coastal scrub	<100m.	X				X	X							South North Coast (s Mendocino, Sonoma cos.), n Central Coast (to Santa Cruz Co.), w San Francisco Bay Area	Per communication with Marin CNPS (2004), populations occur within Marin Headlands (including Wolfback Ridge)

Scientific Name	Common Name	Legal Status			Noted in GGNRA Records	GGNRA management concern not on USFWS list	Habitat requirement and/or association	Micro habitat	Habitat Present in Planning Area	Occurrence known in FMU/ Project Unit				Potential Effect that Could Result from FMP Actions[1]				County Distribution			Species Distribution / Range	Comments
		Federal	CNPS	State						None	Muir Woods	WUI	Interior	Benefical	Negative	No affect	Unknown	San Francisco	San Mateo	Marin		
Ceanothus gloriosus var. porrectus	Mount Vision ceanothus	FSC	1B				Closed-cone coniferous forest, coastal prairie, coastal scrub, valley and foothill grassland.	Low shrub in a variety of habitats on Pt. Reyes; sandy soils. 25-305m.												X	San Francisco Bay Area (Point Reyes)	
Ceanothus masonii	Mason's ceanothus	FSC	1B	R	X		Chaparral.	Endemic To Marin County. Serpentine Ridges Or Slopes In Chaparral Or Transition Zone. 180-460m.	X	X			X							X	San Francisco Bay Area (Bolinas Ridge, sw Marin Co.) . Closely related to *C. gloriosus.*	Species is documented on southern Bolinas Ridge (Special Status Vascular Plant Species Monitoring Report, GGNRA 2002).
Chenopodium californicum	California goosefoot	FSLC					Occurs in a wide range of plant communities in relatively dry and open conditions. In San Francisco it typically occurs in stabilized rear dune systems.	Sandy to clay soils. Dryish plains and slopes below 5000'.	X	X								X	X	X	s North Coast, Outer North Coast Ranges, c&s Sierra Nevada Foothills, Tehachapi Mountain Area, Great Central Valley, Central Western California, Southwestern California, s East of Sierra Nevada, w Mojave Desert	Occurs in the Presidio (Area B - interior) (pers. comm. Michael Chasse (NPS), 2004)
Chorizanthe cuspidata var. cuspidata	San Francisco Bay spineflower	FSC	1B		X		Coastal bluff scrub, coastal dunes, coastal prairie, coastal scrub.	Closely related to c. Pungens. Coastal strand & coastal scrub communities. Sandy soil on terraces and slopes. 5-550m.	X			X		X				X	X	X	not found in Jepson	Occurs within rear dune systems at the Presidio and Fort Funston. Special Status Vascular Plant Species Monitoring Report, GGNRA 2001. Colonizes areas that have been recently disturbed, and spreads in dynamic dune systems.
Chorizanthe cuspidata var. villosa	Woolly-headed spineflower	FSC	1B				Coastal scrub, coastal dunes, coastal prairie.	Endemic to coastline from Bodega Bay to Pt. Reyes.sandy places near the beach. 3-60m.												X	not found in Jepson	
Chorizanthe robusta var. robusta	Robust spineflower	FE	1B				Cismontane woodland, coastal dunes, coastal scrub.	Sandy terraces and bluffs or in loose sand. 3-120m.											X	X	Bay region, south to Monterey	
Chorizanthe valida	Sonoma spineflower	FE	1B	E			Coastal prairie.	Known only from Marin and Sonoma Counties; extinct in Sonoma County.sandy soil. 10-50m.												X	n Central Coast (Point Reyes Peninsula, Marin Co.) .One extant population known; threatened by cattle. Closely related to *C. pungens*	
Cirsium andrewsii	Franciscan thistle	FSC	1B		X		Coastal bluff scrub, broadleaved upland forest, coastal scrub.	Sometimes serpentine seeps. 0-135m.	X			X	X	X				X	X	X	s North Coast, n Central Coast	Occurs in the Marin Headlands and Fort Point. Special Status Vascular Plant Species Monitoring Report. GGNRA 2001. It is not anticipated that this species would be directly affected by FMP actions as populations occur primarily in seep and wetland habitat
Cirsium fontinale var. fontinale	Fountain thistle	FE	1B	E	X		Valley and foothill grassland, chaparral.	Endemic to San Mateo County. Serpentine seeps and grassland. 90-180m.											X		sw San Francisco Bay Area (San Mateo Co.)	Only occurrs in the SFWD. Special Status Vascular Plant Species Monitoring Report GGNRA 2001.
Cirsium hydrophilum var. vaseyi	Mount Tamalpais thistle	FSC	1B				Broadleafed upland forest, chaparral.	Endemic to Marin County. Serpentine seeps and streams in chaparral and woodland. 265-620m.												X	n San Francisco Bay Area (Mount Tamalpais)	
Cirsium occidentale var. compactum	Compact cobweb thistle	FSC	1B				Chaparral, coastal dunes, coastal prairie, coastal scrub.	On dunes and on clay in chaparral; also in grassland. 5-155m.										X			Central Coast (n San Luis Obispo, Monterey cos., formerly San Francisco) .Some inland plants suggest weak separation from var. *occidentale*	
Clarkia concinna ssp. raichei	Tomales clarkia	FSC	1B				Coastal bluff scrub.	Known only from one occurrence near Tomales, Marin County. Highly exposed rocky bluffs with a near-vertical slope. 15m.												X	n Central Coast (known only from type locality near Tomales, Marin Co.) .	

Scientific Name	Common Name	Legal Status			Noted in GGNRA Records	GGNRA management concern not on USFWS list	Habitat requirement and/or association	Micro habitat	Habitat Present in Planning Area	Occurrence known in FMU/ Project Unit				Potential Effect that Could Result from FMP Actions[1]				County Distribution			Species Distribution / Range	Comments
		Federal	CNPS	State						None	Muir Woods	WUI	Interior	Benefical	Negative	No affect	Unknown	San Francisco	San Mateo	Marin		
Clarkia davyi	Davey's clarkia	FSLC					Coastal grassland, bluffs.											X	X		North Coast, n Central Coast, n Channel Islands (Santa Rosa Island).	
Clarkia franciscana	Presidio clarkia	FE	1B	E	X		Coastal scrub, valley and foothill grassland.	Endemic to Alameda and San Francisco Counties. Serpentine outcrops in grassland or scrub. 20-335m.	X	X								X			San Francisco Bay Area (Presidio, San Francisco; Oakland hills)	Occurs in the interior area of the Presidio, not the FMP Study Area. Special Status Vascular Plant Species Monitoring Report. GGNRA 2001
Collinsia corymbosa	Round-headed Chinese houses	FSC	1B				Coastal dunes, coastal prairie.	Dunes and coastal priairie. 10-30m.										X		X	North Coast (scattered) formerly n CCo, where transitional to *C. bartsiifolia* .	
Cordylanthus maritimus ssp. palustris	North Coast bird's-beak	FSC	1B		X		Coastal salt marsh.	Usually in coastal salt marsh with salicornia, distichlis, jaumea, spartina, etc. 0-15m.	X			X				X			X	X	n North Coast (Humboldt Co.), n Central Coast (Marin, Sonoma cos.)	Occurs at Crissy Field (pers. comm. Ling He (NPS), 2004). Occurs west of Hwy 1 b/w Hamlet & Nick's Cove. Special Status Vascular Plant Species Monitoring Report. GGNRA 2001. It is anticipated that coastal marsh habitat would be unaffected by FMP actions
Cordylanthus mollis ssp. mollis	Soft bird's-beak	FE	1B	R			Coastal salt marsh.	In coastal salt marsh with distichlis, salicornia, frankenia, etc. 0-3m.												X	n Central Coast .	
Croton californicus	California croton	FSLC					Coastal sage scrub, chaparral.	Dry sandy soils, dunes, washes to 4000'.	X			X					X	X			Central Coast, South Coast, s Channel Islands (Santa Catalina Island), Desert	Occurences found on the Presidio (NPS, 2004)
Cupressus abramsiana	Santa Cruz cypress	FE	1B	E			Closed-cone coniferous forest, lower montane coniferous forest.	Narrow endemic from Santa Cruz and Santa Clara Co's. Restricted to the Santa Cruz mountains, on sandstone & granitic-derived soils; often w/p. Attenuata, redwoods. 300-800m.											X		San Francisco Bay Area (Santa Cruz Mtns) .Threatened by development, agriculture.	
Cypripedium fasciculatum	Clustered lady's-slipper orchid	FSC	4				North coast coniferous forest, lower montane coniferous forest.	In serpentine seeps and moist streambanks. 100-1980m.											X		Northwestern California, Cascade Range, n Sierra Nevada, sw San Francisco Bay Area	
Delphinium bakeri	Baker's larkspur	FE, PCH	1B	R			Coastal scrub, grasslands.	Only site occurs on nw facing slope, on decomposed shale. Hist. Known from grassy areas along fencelines too. 90-205m.												X	n San Francisco Bay Area, n Central Coast, (s Sonoma Co.)	
Delphinium luteum	Yellow larkspur	FE, PCH	1B	R			Chaparral, coastal prairie, coastal scrub.	Endemic to a couple of occurrences hanging on in Sonoma County. North-facing rocky slopes. 0-100m.												X	n Central Coast (Marin, Sonoma cos.) . Hybridizes with *D. decorum* , *D. nudicaule* .	
Dirca occidentalis	Western leatherwood	FSLC	1B		X		Broadleafed upland forest, chaparral, closed-cone coniferous forest, cismontane woodland, north coast coniferous forest, riparian forest, riparian woodland.	On brushy slopes, mesic sites; mostly in mixed evergreen & foothill woodland communities. 30-550m.	X										X	X	San Francisco Bay Area	Occurs in the GGNRA along Devils Gulch Rd & in the SFWD. Special Status Vascular Plant Species Monitoring Report. GGNRA 2001
Erigeron supplex	Supple daisy	FSC	1B				Coastal bluff scrub, coastal prairie.	Usually in grassy sites. 5-50m.												X	n&c North Coast .Threatened by coastal development.	
Eriogonum luteolum var. caninum	Tiburon buckwheat	FSLC			X		Chaparral, valley and foothill grassland, coastal prairie.	Known from the greater bay area.serpentine soils. 10-500m.											X	X	c Inner North Coast Ranges (Colusa Co.), n Central Coast, n San Francisco Bay Area (Marin, formerly Alameda cos.)	Occurs only at MVAFB. Special Status Vascular Plant Species Monitoring Report. GGNRA 2001.
Eriophyllum latilobum	San Mateo woolly sunflower	FE	1B	E	X		Cismontane woodland.	Endemic to San Mateo County.often on roadcuts; found on and off of serpentine. 45-150m.											X		cw San Francisco Bay Area (San Mateo Co.) .Probable derivative of *E. lanatum var. arachnoideum* X *E. confertiflorum* . Threatened by development	Occurs only in the SFWD. Special Status Vascular Plant Species Monitoring Report. GGNRA 2001

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		Federal	CNPS	State						None	Muir Woods	WUI	Interior	Benefical	Negative	No affect	Unknown	San Francisco	San Mateo	Marin		
Erysimum ammophilum	Coast wallflower	FSC	1B				Chaparral (maritime), coastal dunes, coastal scrub.	Soils, sandy openings in coastal habitats. 0-130m.											X		c Central Coast (Monterey Bay), n Channel Islands (Santa Rosa Island) .Threatened by development. Plants intermediate to *E. capitatum* formerly in s SCo	
Erysimum franciscanum	San Francisco wallflower	FSC	4		X		Coastal dunes, coastal scrub, valley and foothill grassland.	Endemic to the greater s.f. bay area. Often occurs on serpentine soils or outcrops; sometimes granite. Occasionally on grassy, rocky slopes. 0-500m.	X			X	X	X				X	X	X	North Coast, n&c Central Coast, San Francisco Bay Area .Fleshy, coastal plants have been called *var. crassifolium* Rossbach; inland plants approach *E. capitatum*	Occurs in the Marin Headlands, Sweeney Ridge, Fort Funston, and the SFWD. Special Status Vascular Plant Species Monitoring Report. GGNRA 2001.
Fissidens pauperculus	Fissidens moss	FSLC	1B				North coast coniferous forest.	Moss growing on damp soil along the coast. 10-100m.												X		
Fritillaria agrestis	Stinkbells	FSLC	4				Cismontane woodland, chaparral, valley and foothill grassland.	Sometimes on serpentine; mostly found in nonnative grassland or in grassy openings in clay soil. 10-1555m.											X		Outer North Coast Ranges (Mendocino Co.), Sierra Nevada Foothills, Great Central Valley, Central Western California	
Fritillaria biflora var. ineziana	Hillsborough chocolate lily	FSC	1B				Cismontane woodland, valley and foothill grassland.	Endemic to San Mateo County. Probably on serpentine; most recent site is in serpentine grassland. 90-160m.											X		San Francisco Bay Area (Hillsborough, San Mateo Co.) .	
Fritillaria lanceolata var. tristulis	Marin checker lily	FSC	1B		X		Coastal bluff scrub, coastal scrub, coastal prairie.	Endemic to Marin County. Occurrences reported from canyons and riparian areas as well as rock outcrops; often on serpentine. 30-300m.	X	X							X			X	Endemic to Marin County	** Referenced as *Fritillaria affinis var. tristulis* One population located in the GGNRA Northern District (Special Status Vascular Plant Species Monitoring Report, GGNRA 2001).
Fritillaria liliacea	Fragrant fritillary	FSC	1B		X		Coastal scrub, valley and foothill grassland, coastal prairie.	Often on serpentine; various soils reported though usually clay, in grassland. 3-410m.										X	X	X	Sacramento Valley (Solano Co.), Central Western California.	Occurs at Nicasio Ridge and in the SFWD. Special Status Vascular Plant Species Monitoring Report, GGNRA 2001.
Gilia captitata ssp. Chamissonis	San Francisco dune gilia	FSC	1B		X		Coastal dunes, coastal scrub.	2-200m.	X			X		X				X		X	n Central Coast	Located in rear dune habitat on the Presidio (Special Status Vascular Plant Species Monitoring Report, GGNRA 2001). Colonizes areas that have been recently disturbed, and spreads in dynamic dune systems.
Gilia captitata ssp. Tomentosa	Woolly-headed gilia	FSC	1B				Coastal bluff scrub.	Rocky outcrops on the coast. 15-155m.												X	North Coast .Intergrades with *subsp. capitata* in ne SnFrB	
Gilia millefoliata	Yarrow-leaf gilia	FSLC	1B				Coastal dunes.	2-20m.										X		X	North Coast, n Central Coast	
Grindelia hirsutula	San Francisco gumplant	FSC	1B		X		Coastal scrub, coastal bluff scrub, valley and foothill grassland.	Ocean bluffs and coastal hillsides, sandy or serpentine slopes, sea bluffs. 15-400m.	X			X		X			X	X	X	X	North Coast Ranges, n&c Sierra Nevada Foothills, Sacramento Valley, Central Western California, Western Transverse Ranges, Peninsular Ranges, Sonoran Desert	Occurs on Presidio coastal area. **Special Status Vascular Plant Species Monitoring Report GGNRA 2001. Forest Service indicates that *G. squarrosa* although it may be top-killed by fire, it may resprout and seedlings colonize and increase after a fire (www.fs.fed.us/database/feis)
Helianthella castanea	Diablo helianthella	FSC					Broadleaved upland forest, chaparral, cismontane wdlnd, coastal scrub, riparian woodland, valley & foothill grassland.	Usually in chaparral/oak woodland interface in rocky, azonal soils. Often in partial shade. 25-1150m.										X	X	X	n San Francisco Bay Area	

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		Federal	CNPS	State						None	Muir Woods	WUI	Interior	Benefical	Negative	No affect	Unknown	San Francisco	San Mateo	Marin		
Hesperolinon congestum	Marin dwarf-flax "Marin Western Flax"	FT	1B	T	X		Chaparral, valley and foothill grassland.	Known only from Marin, S.F., and San Mateo Counties. In serpentine barrens and in serpentine grassland and chaparral. 30-365m.	X			X		X			X	X	X	X	nw San Francisco Bay Area. Occurs on Presidio coastal area. **Special Status Vascular Plant Species Monitoring Report GGNRA 2001. It requires openings in grassland habitat with limited thatch and vegetation cover and open soil/outcrops's.	Its decline is attributable to invasive by invasive non-native vegetation; the population would be enhanced by invasive species control and management. The fuel reduction actions for San Francisco lands may need further USFWS consultation to reduce direct affects during vegetation removal and to maximize long-term benefits.
Holocarpha macradenia	Santa Cruz tarplant	FT	1B	E			Coastal prairie, valley and foothill grassland.	Light, sandy soil or sandy clay; often with nonnatives. 10-260m.												X	n Central Coast (n&c Monterey Bay), sw San Francisco Bay Area .Threatened by development, agriculture.	
Horkelia cuneata var. sericea	Kellogg's horkelia	FSLC	1B		X		Closed-cone coniferous forest, coastal scrub, chaparral.	Old dunes, coastal sandhills; openings. 10-200m.	X			X		X				X			Central Coast .Remaining plants less distinct from *subsp. cuneata* than those formerly near San Francisco. Threatened by coastal development	Re-introduced into Presidio dune habitat (pers. comm. Peter Brastow (NPS) 2004)
Horkelia marinensis	Point Reyes horkelia	FSC	1B				Coastal dunes, coastal prairie, coastal scrub.	Sandy flats and dunes near coast; in grassland or scrub plant communities. 5-30m.											X	X	c North Coast (Fort Bragg), n Central Coast (Point Reyes to Santa Cruz)	
Horkelia tenuiloba	Thin-lobed horkelia	FSLC	1B				Coastal scrub, chaparral.	Sandy soils; mesic openings. 45-500m.												X	c&s North Coast, c&s Outer North Coast Ranges, nw San Francisco Bay Area	
Lasthenia macrantha ssp. bakeri	Baker's goldfields	FSLC	1B				Closed-cone coniferous forest, coastal scrub.	Grasslands, woods, near coast. Openings in forests and scrublands. 60-520m.												X	c&s North Coast (Mendocino, Sonoma cos.)	
Lasthenia macrantha ssp. macrantha	Perennial goldfields	FSLC	1B				Coastal bluff scrub, coastal dunes, coastal scrub.	5-520m.	X	X									X	X	North Coast, Central Coast (2 stations)	CNDDB (2004)- Occurences in Marin are all Pt. Reyes, San Mateo is at Pigeon Point. Per communication with Marin-CNPS (2004) Marin populations located in Point Reyes only
Lathyrus jepsonii var. jepsonii	Delta tule-pea	FSC	1B				Freshwater and brackish marshes.	Most of distribution restricted to the Sacramento/San Joaquin River Delta. Often found w/ Typha, Aster lentus, Rosa calif., Juncus spp., Scirpus, etc. Usually on marsh and slough edges.												X	Great Central Valley, especially San Francisco Bay Area .	
Layia carnosa	Beach layia	FE	1B	E			Coastal dunes.	On sparsely vegetated semi-stabilized dunes, usually behind foredunes. 0-75m.	X	X								X		X	n North Coast, Central Coast	No occurences present in GGNRA (Lpers. Comm. Ling He (NPS), 2004). Seeds of species was re-introduced to Crissy Field in 1998-9, however did not establish)
Legenere limosa	Legenere	FSC	1B				Vernal pools.	Many historical occurrences are extirpated. In beds of vernal pools. 1-880m.											X		s North Coast Ranges, s Sacramento Valley, n San Joaquin Valley, San Francisco Bay Area (Santa Cruz Mtns, Mount Hamilton Range) .	
Leptosiphon parviflorus var. rosaceus (Linanthus rosaceus)	Rose linanthus	FSC					Coastal bluff scrub.	0-100m.	X	X								X	X	X	California Floristic Province	Per communication with Marin-CNPS (2004), no populations have been observed outside of PORE & near Dillon Beach.

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		Federal	CNPS	State						None	Muir Woods	WUI	Interior	Benefical	Negative	No affect	Unknown	San Francisco	San Mateo	Marin		
Lessingia arachnoidea	Crystal Springs lessingia	FSC	1B		X		Coastal sage scrub, valley and foothill grassland, cismontane woodland.	Known only from Santa Cara & Sonoma Counties. Grassy slopes on serpentine; sometimes on roadsides. 60-200m.											X		sw San Francisco Bay Area (San Mateo Co., near Crystal Springs Reservoir)	Occurs only in San Mateo Co. near Crystal Springs Reservoir. Special Status Vascular Plant Species Monitoring Report, GGNRA 2001
Lessingia germanorum	San Francisco lessingia	FE	1B	E	X		Coastal scrub.	Known only from San Francisco and San Mateo counties. From remnant dunes. Open sandy soils relatively free of competing plants. 20-125m.	X			X		X			X	X	X		San Francisco Bay Area. Species located in the coastal habitat region of the Presidio (Special Status Vascular Plant Species Monitoring Report, GGNRA 2001).	It is anticipated that the rear dune population located at Crissy Field would be unaffected by FMP actions. Species colonizes areas that have been recently disturbed, resulting in possible long-term benefit. The limited population would also be enhanced by invasive species control and management. The fuel reduction actions for San Francisco lands may need further USFWS consultation to reduce direct affects during vegetation removal and to maximize long-term benefits.
Lessingia micradenia var. micradenia	Tamalpais lessingia	FSC	1B				Chaparral, valley and foothill grassland.	Endemic to Marin County. Usually on serpentine, in serpentine grassland or serpentine chaparral. Often on roadsides. 100-305m.												X	n San Francisco Bay Area (Mount Tamalpais, Marin Co.)	
Lilaeopsis masonii	Mason's lilaeopsis	FSC	1B	R			Freshwater and brackish marshes, riparian scrub.	Tidal zones, in muddy or silty soil formed through river deposition or river bank erosion. 0-10m.	X	X										X	s Sacramento Valley, ne San Francisco Bay Area . Locally abundant; threatened by development, flood control, agriculture	CNDDB (2004) - Closest occurrence in Marin -Inverness. Populations unknown to central and southern Marin, pers. comm, with Marin CNPS (2004).
Lilium maritimum	Coast lily	FSC	1B				Closed-cone coniferous forest, coastal prairie, coastal scrub, broadleaved upland forest, north coast coniferous forest.	Historically in sandy soil, often on raised hummocks or bogs; today mostly in roadside ditches. 10-335m.										X	X	X	s North Coast (extirpated in n Central Coast) . Hybridizes with *L. pardalinum* .	
Limnanthes douglasii ssp. sulphurea	Point Reyes meadowfoam		1B	E			Fresh. Marsh, vernal pools, coastal prairie, meadows & seeps, cismontane woodland.	Only known from San Mateo and Marin Counties. Vernally wet depressions in open rolling, coastal prairies & meadows; typically in dark clay soil. 10-120m.											X	X	North Coast (Marin Co.), Central Coast (San Mateo Co.)	
Linanthus grandiflorus	Large-flowered linanthus	FSC					Open, grassy flats, generally in sandy soil.											X	X	X	North Coast, Central Coast, San Francisco Bay Area	
Lupinus arboreus var. eximius	San Mateo tree lupine	FSLC			X		Coastal bluffs, dunes, or more inland.	<100m.											X		Known from San Mateo County and Sonoma County.	Occurrs in the SFWD. Special Status Vascular Plant Species Monitoring Report GGNRA 2001.
Lupinus tidestromii	Tidestrom's lupine	FE	1B	E			Coastal dunes.	Includes lupinus tidestromii var.tidestromii, state-listed endangered. Partially stabilized dunes, immediately near the ocean. 0-35m.												X	s North Coast (Sonoma Co.), n&c Central Coast (Marin, Monterey cos.) . Shaggier plants from n NCo have been called *var. layneae* (Eastw.) Munz, Point Reyes lupine.	
Malacothamnus arcuatus	Arcuate bush mallow	FSLC	1B				Coastal sage scrub, chaparral	Prefers rocky soils, openings in scrub, gravelly alluvium. 80-355m.	X	X									X		INNER No. Coast range, Mendocino County, interior SF Bay Area	Occurred on Sweeney Ridge more than 10 years ago. Occurs in San Mateo Co. Special Status Vascular Plant Species Monitoring Report, GGNRA 2001. Seeds respond to fire.
Microseris paludosa	Marsh microseris (silverpuff)	FSLC	1B				Closed-cone coniferous forest,cismontane woodland, coastal scrub, valley and foothill grassland.	5-300m.										X	X	X	Central Coast, San Francisco Bay Area .Like *M. laciniata subsp. leptosepala* except pappus.	CNDDB- SF occurrence extirpated. Several Marin occurrences in San Rafael, Mt. Tamalpias and Point Reyes (communication with Marin-CNPS, 2004).

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		Federal	CNPS	State						None	Muir Woods	WUI	Interior	Benefical	Negative	No affect	Unknown	San Francisco	San Mateo	Marin		
Monardella undulata	Curley-leaved monardella	FSC	4				Chaparral, coastal dunes, coastal scrub, lower montane coniferous forest.	Ponderosa pine sandhills; sandy soils. 0-300m.										X	X	X	Central Coast, San Francisco Bay Area	
Mondardella villosa ssp. globosa	Robust monardella	FSLC	1B				Broadleaved upland forest, chaparral, cismontane woodland, valley and foothill grassland.	Openings. 30-300m.											X		Outer North Coast Ranges, San Francisco Bay Area	
Navarretia leucocephala ssp. bakeri	Baker's navarretia	FSC	1B				Cismontane woodland, meadows and seeps, vernal pools, valley and foothill grassland, lower montane coniferous forest.	Vernal pools and swales; adobe or alkaline soils. 5-950m.												X	Inner North Coast Ranges, w Sacramento Valley .Intermediate between subspp. *leucocephala* and *plieantha*	
Navarretia rosulata	Marin County navarretia	FSLC	1B				Closed-cone coniferous forest, chaparral.	Known only from Marin and Napa counties. Dry, open rocky places; can occur on serpentine. 200-635m.												X	s Inner North Coast Ranges (Napa Co.), n San Francisco Bay Area (Marin Co.)	
Navarretia squarrosa	Skunkbush	FSLC					Sandy alluvium, roadsides, dryer winter pools, open wet gravelly flats, slopes.	Dunes, sandy soils	X	X								X			North Coast Ranges, n Sierra Nevada Foothills (Sacramento, Amador cos.) San Francisco Bay Area, South Coast Ranges	Rare in San Francisco area, with one site located in the interior of the Presidio (Area B) (Recovery Plan for Coastal Plants of the Northern San Francisco Peninsula, USFWS, 2003).
Orobanche californica ssp. californica	California broomrape	FSLC					Coastal bluff grassland, and occassionally in dunes.	Numerous forested habitats, california floristic province sandy or heavy soils, locally on serpentine substrate. Plant is root parasite generally on grindelia species. <150m	X	X								X			North Coast, n&c Central Coast	Per communication with Marin-CNPS (2004), "not known except on PORE growing in association with Grindelia". NO CNDDB occurrences
Pedicularis dudleyi	Dudley's lousewort	FSC	1B	R			Chaparral, north coast coniferous forest, valley and foothill grassland, coast redwood forests.	Deep shady woods of older coast redwood forests; also in maritime chaparral. 100-490m.											X		Central Western California (except Outer South Coast Ranges) .Widely scattered. Plants from c CCo (Arroyo de la Cruz, San Luis Obispo Co.) warrant further study (smaller, leaves < inflorescence, anthers often exserted with bases somewhat acuminate); also like *P. semibarbata* but filaments glabrous	
Pentachaeta bellidiflora	White-rayed pentachaeta	FE	1B	E	X		Valley and foothill grassland.	Open dry rocky slopes and grassy areas, often on soils derived from serpentine bedrock. 35-620m											X	X	San Francisco Bay Area	Occurrs in the SFWD. Special Status Vascular Plant Species Monitoring Report GGNRA 2001.
Perideridia gairdneri ssp. gairdneri	Gairdner's yampah	FSC					Broadleafed upland forest, chaparral, coastal prairie, valley and foothill grassland, vernal pools.	Adobe flats or grasslands, wet meadows and vernal pools, under pinus radiata along the coast; mesic sites. 0-350m.											X	X	s North Coast (Sonoma Co.), Central Coast (scarce s of Monterey Co.), South Coast	
Phacelia insularis var. continentis	North Coast phacelia	FSC	1B				Coastal bluff scrub, coastal dunes.	Known only from Mendocino and Marin counties. Open maritime bluffs, sandy soil. 10-160m.	X	X										X	North Coast	Per communication with Marin-CNPS (2004), Marin populations found in PORE only. CNDDB (2004) - Closest occurrence in Marin: Pt. Reyes & Inverness.
Piperia elegans	Coast rein-orchid	FSLC					Coniferous forests, scrub, coastal bluffs, headlands.	Numerous habitats, prefers moist soils, shade in forested and scrub habitat.	X			X				X					North Coast, w Klamath Ranges, Outer North Coast Ranges, Central Coast, San Francisco Bay Area	It is uncommon and local on sandy coastal bluff grassland and scrub in the Presidio, and under blue gum eucalyptus growves in remnant dunes near Baker Beach (GGNRA, unpub. data)

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		Federal	CNPS	State						None	Muir Woods	WUI	Interior	Benefical	Negative	No affect	Unknown	San Francisco	San Mateo	Marin		
Piperia elegans ssp. Decurtata	Point Reyes rein orchid	FSC	1B				Coastal bluff scrub.	15-185m.												X	known only from two small populations at the tip of the Pt. Reyes peninsula, California, and separated from P. elegans subsp. elegans by only 14 km.	
Plagiobothrys chorisianus var. chorisianus	Choris's popcornflower	FSLC	1B		X		Chaparral, coastal scrub, coastal prairie.	Mesic sites. 15-100m.	X				X	X			X		X		Central Coast, sw San Francisco Bay Area	Occurs at Sweeney Ridge and on SFWD. Special Status Vascular Plant Species Monitoring Report, GGNRA, 2001. The 2001 draft USFWS recovery plan for rough popcorn flower (*P. hirtus*) states that fire suppression is a threat to the species resulting in encroaching native oaks and ash trees which shade the popcorn flower.
*Plagiobothrys diffusus***	San Francisco popcornflower		1B	E			Valley and foothill grassland, coastal prairie.	Historically from grassy slopes with marine influence. 60-485m.	X	X								X				** The treatment of Plagiobothrys in the Jepson manual interpreted the endemic San Francisco (Presidio) population of Greene's popconfornflower (*Plagiobothrys diffusus*) as a variant with *Plagiobothrys reticulatus* var. *rossianorum* .
Plagiobothrys glaber	Hairless allocarya	FSC	1A				Meadows and seeps, marshes and swamps.	Coastal salt marshes and alkaline meadows. 5-180m.												X	Central Coast, s San Francisco Bay Area (especially near Hollister) .Perhaps a var. of *P. stipitatus* .	
Plagiobothrys reticulatus var. rossianorum	Greene's popcorn flower	FSC					Forests, grasslands.	gen <300m.	X	X								X			Northwestern California, Has been extirpated from San Francisco Bay Area. (Recovery Plan for Coastal Plants of the Northern San Francisco Peninsula, USFWS, 2003)	Per communication with Marin-CNPS (2004), Marin occurences known only in PORE. NO CNDDB occurrences.
Pleuropogon hooverianus	North Coast semaphore grass	FSC	1B	T			Broadleafed upland forest, meadows and seeps, north coast coniferous forest.	Wet grassy, usually shady areas, sometimes freshwater marsh; associated with forest environments; 10-1150m.												X	s North Coast, n Central Coast .	
Polygonum marinense	Marin knotweed	FSLC	3				Marshes and swamps.	Coastal salt marshes and brackish marshes. 0-10m.												X	San Francisco Bay Area (especially Marin Co.) .Related to *P. aviculare* , taxonomic status uncertain: possibly = *P. robertii* Loisel.; if so, alien, native to w Medit. Endangered by salt marsh development. Merits immediate study.	Per comm. With Marin CNPS, Possible weed! And existes on Tomales Bay. CNDDB-Occurrences in Marin: Pt. Reyes and San Rafael.
Potentilla hickmanii	Hickman's potentilla = Hickman's cinquefoil	FE	1B	E			Coastal bluff scrub, closed-cone coniferous forest, meadows and seeps, marshes and swamps.	Freshwater marshes, seeps, and small streams in open or forested areas along the coast. 5-125m.											X		n&c Central Coast. Greene's popcorn flower is extirpated in San Francisco.	Per communication w/ Marin-CNPS, no Marin pops known. CNDDB - Occurences in San Mateo County - Montara Mountain Quad
Rhynchospora californica	California beaked-rush	FSC	1B				Bogs and fens, marshes and swamps, lower montane coniferous forest, meadows and seeps.	Freshwater seeps and open marshy areas. 45-1000m.												X	s Northwestern California (Sonoma Co.), n&c Sierra Nevada Foothills (Butte, Mariposa? cos.), n San Francisco Bay Area .Mariposa Co. plants not recently collected, may be undescribed.	
Rosa pinetorum	Pine rose	FSLC					Closed-cone coniferous forest.	2-300m.											X		west-central Central Western California . Possibly hybrids of *R. spithamea* , *R. gymnocarpa* , or others; further study essential	

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		Federal	CNPS	State						None	Muir Woods	WUI	Interior	Benefical	Negative	No affect	Unknown	San Francisco	San Mateo	Marin		
Sagittaria sanfordii	Valley sagittaria (Sanford's arrowhead)	FSC	1B				Marshes and swamps.	In standing or slow-moving freshwater ponds, marshes, and ditches. 0-610m.												X	n North Coast (Del Norte Co.), Great Central Valley (where mostly extirpated), n South Coast (Ventura Co.)	
Sanicula maritima	Adobe sanicle	FSC	1B	R			Meadows and seeps, valley and foothill grassland, chaparral, coastal prairie.	Coastal grassey areas, wet meadows, playas, prefers moist clay or ultramafic soils. 30-240m.										X			SF Bay Area, Central Coast, San Lusi Obispo	Per communication with Marin-CNPS, no known Marin pops. CNDDB- SF occurrence: Protrero Hills, possibly extirpated. Next closest occurrence in Monterey.
Sidalcea calycosa ssp. Rhizomata	Point Reyes checkerbloom	FSLC	1B				Marshes and swamps.	Freshwater marshes near the coast. 5-75(245)m.												X	c&s North Coast (Mendocino, Sonoma cos.), n Central Coast (Marin Co.)	
Sidalcea hickmanii ssp.viridis	Marin checkermallow (checkerbloom)	FSLC	1B				Chaparral.	Serpentine Or Volcanic Soils; Sometimes Appears After Burns. 0-430m.											X	X	s North Coast (Sonoma Co.), n Central Coast (Marin, San Francisco, San Mateo cos.)	
Sidalcea malviflora ssp. Purpurea	Purple-stemmed checkerbloom	FSLC	1B				Broadleafed upland forest, coastal prairie.	15-65m.											X	X	c North Coast (n Sonoma, s Mendocino cos.), n Central Coast (San Mateo Co.)	
Silene verecunda ssp. verecunda	Mission Delores (San Francisco) campion	FSC	1B		X		Coastal scrub, valley and foothill grassland, coastal bluff scrub, chaparral, coastal prairie.	Often on mudstone or shale; one site on serpentine. 30-645m.	X			X		X				X	X		n Central Coast, San Francisco Bay Area	Population located on the coastal section Presidio (pers. comm. Peter Brastow (NPS), 2003).
Spartina foliosa	Pacific cordgrass	FSLC					Coastal salt marsh	Baja to northern california	X			X	X			X		X	X	X	North Coast, Central Coast, South Coast	It is anticipated that this coastal salt marsh habitat would be unaffected by FMP actions.
Stebbinsoseris decipiens	Santa Cruz microseris (silverpuffs)	FSC	1B		X		Broadleafed upland forest, closed-cone coniferous forest, chaparral, coastal prairie, coastal scrub.	Open areas in loose or disturbed soil, usu. Derived from sandstone, shale or serp., on seaward slopes. 10-500m.	X	X										X	n&c Central Coast	Past occurences found at Stinson Beach, however not found in 2001 survey. Special Status Vascular Plant Species Monitoring Report, GGNRA 2001.
Stellaria littoralis	Seashore starwort	FSC	4				Bogs and fens, coastal bluff scrub, coastal dunes, coastal scrub, marshes and swamps.	5-40m.										X		X	North Coast, Central Coast	
Streptanthus glandulosus	Tamalpais jewel-flower	FSC	1B		X		Closed-cone coniferous forest, chaparral.	Endemic to Marin County. Talus serpentine outcrops. 410-650m.	X	X										X	s North Coast Ranges, San Francisco Bay Area, n&c South Coast Range	Occurs at Mill Valley Air Force Base on Mount Tamalpias, and Nicasio Ridge. Special Status Vascular Plant Species Monitoring Report, GGNRA 2001.
Streptanthus glandulosus ssp. Pulchellus	Mount Tamalpais jewelflower	FSC	1B				Chaparral, valley and foothill grassland.	Endemic to Marin County. Serpentine slopes. 150-800m.												X	nw San Francisco Bay Area (Marin Co.)	
Streptanthus niger	Tiburon jewelflower	FE	1B	E			Valley and foothill grassland.	Endemic to Marin County. Serpentine outcrops in grasslandsshallow, rocky serpentine slopes. 30-150m.												X	n Central Coast (Tiburon Peninsula, Marin Co.)	
Suaeda californica	California seablite	FT			X		Coastal salt marshes.		X	X								X			Central Coast .	Species was re-introduced into Crissy Field marsh (1999) however no transplants survived (pers. comm. Ling He (NPS) 2004).
Tanacetum camphoratum	Dune tansy	FSC			X		Coastal dunes.	Prefers sandy soils, brackish water. Oregon to northern Central Coast of California. <30m	X			X					X	X	X	X	North Coast, n Central Coast	Occurs at Fort Funston and the Presidio in the GGNRA. Special Status Vascular Plant Species Monitoring Report, GGNRA 2001. It is anticipated that this coastal foredune habitat would be unaffected by FMP actions

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Trifolium amoenum	Showy Indian clover	FE	1B				Valley and foothill grassland, coastal bluff scrub.	Moist heavy soils and disturbed areas sometimes on serpentine soil, open sunny sites, swales. Most recently sited on roadside and eroding cliff face. 5-560m.	X	X										X	s North Coast Ranges, n Central Coast, San Francisco Bay Area .Probably belongs to *T. albopurpureum* complex.	Per communication with CNPS-Marin (2004) only Marin population located on private land near Dillon Beach. CNDDB (2004) - Occurrences in Marin, Valley Ford Quad.
Trifolium depauperatum var. hydrophilum	Saline clover	FSC	1B				Marshes and swamps, valley and foothill grassland, vernal pools.	Mesic, alkaline sites. 0-300m.											X		Sacramento Valley, Central Western California	
Triphysaria floribunda	San Francisco owl's-clover	FSC	1B		X		Coastal prairie, valley and foothill grassland.	On serpentine and nonserpentine substrate (such as at Pt. Reyes). 10-160m.	X	X								X	X	X	n Central Coast, w San Francisco Bay Area	Populations occur in the Fort Scott and the serpentine bluff/grassland habitat east of Lincoln Blvd (NPS, 2004).
Triquetrella californica	California triquetrella moss	FSLC	1B				Coastal bluff scrub, coastal scrub.	Known in calif. From about 10 small occs, and in oregon from one occurrence. Moss growing on soil. 10-100m.										X			Occurs in San Diego, Contra Costa, San Francisco, Marin, Mendocino, & Del Norte Counties.	
INVERTEBRATES																						
Adela oplerella	Opler's longhorn moth	FSC	n/a		X		Coastal grassland and serpentine grasslands.	All but Santa Cruz site is on serpentine grassland. Larvae feed on Platystemon californicus.	X				X				X	X	X	X	Marin County & the Oakland area on the Inner coast ranges south to Santa Clara Co. One record from Santa Cruz Co.	CNDDB.
Calicina diminua	Marin blind harvestman	FSC	n/a				Serpentine rock outcrops, serpentine grasslands.		X	X							X			X	Known only from Burdell Mountain in Marin County	
Calicina minor	Edgewood blind harvestman	FSC	n/a				Open grassland in areas of serpentine bedrock.	Found on the underside of moist serpentine rocks near permanent springs.	X	X							X		X		San Mateo & Santa Clara Counties (occurrences).	CNDDB
Callophrys mossii bayensis	San Bruno elfin butterfly	FE	n/a		X		Rocky outcrops and cliffs in coastal scrub habitat.	The larval host plant for san bruno elfins is S*edum spathulifolium* , a succulent which grows on rocky, north-facing slopes along the coast.	X			X	X	X				X	X	X	Found in coastal mountains near San Francisco Bay, in the fog-belt of steep north facing slopes that receive little direct sunlight.	Species occurences at Milagra Ridge and Sweeney Ridge (NPS, 2004)(USFWS). Potential temporary impacts would be minimized to be insignificant.
Carterocephalus palaemon magnus	Sonoma arctic skipper	FSC	n/a				Redwood forest.	Most specimens collected in deep shade or at the edge of forested clearings.	X	X							X			X	Sonoma County (occurrences).	CNDDB
Cicindela hirticollis gravida	Sandy beach tiger beetle	FSC	n/a		X		Inhabits areas adjacent to non-brackish water along the coast of california from San Francisco Bay to northern Mexico.	Clean, dry, light-colored sand in the upper zone. Subterranean larvae prefer moist sand not affected by wave action.	X							X		X	X	X	Ventura, Santa Barbara, San Diego, & Los Angeles Counties (occurrences).	CNDDB. It is anticipated that this species would be unaffected by FMP actions as habitat will not be affected.
Cicindela ohlone	Ohlone tiger beetle	FE	n/a				Coastal terraces supporting remnant patches of native grasslands.		X	X							X		X		Santa Cruz County (occurrences).	
Coelus globosus	Globose dune beetle	FSC	n/a		X		Inhabitant of coastal sand dune habitat, from Bodega Head in Sonoma County south to Ensenada, Mexico.	Inhabits foredunes and sand hummocks; it burrows beneath the sand surface and is most common beneath dune vegetation.	X							X		X	X	X	Monterey, Santa Cruz, Ventura, Santa Barbara, San Diego, Los Angeles, & Counties (occurrences).	CNDDB. It is anticipated that the habitat supporting this species would be unaffected by FMP actions.
Euphydryas editha bayensis	Bay checkerspot butterfly	FT, CH	n/a		X		Serpentine soil grasslands that support larval host plants: owl's clover, Castilleja densiflorus, C. excerta, and erect plantain.	Serpentine soil grasslands that support larval host plants Orthocarpus densiflorus and Plantago erecta.	X	X							X		X		Known only from San Mateo and Santa Clara counties.	Not observed in GGNRA, not likely to be present in study area (NPS, 2004)
Haliotis cracherodii	Black abalone	FC	n/a				Intertidal to subtidal marine habitat		X	X							X	X	X	X	Santa Barbara & Ventura Counties (occurrences).	It is anticipated that the habitat supporting this species would be unaffected by FMP actions.

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Haliotis sorenseni	White abalone	FE	n/a				Subtidal marine habitat		X	X							X	X	X	X	Southern California especially near Channel Islands (occurrences). Historic distribution from Pt. Conception, CA to Baja California, Mexico.	San Mateo and Santa Clara. It is anticipated that the habitat supporting this species would be unaffected by FMP actions.
Helminthoglypta arrosa williamsi	William's bronze shoulderband snail	FSC	n/a				Known only from Hog Island, a small islet in Tomales Bay, Marin County.			X										X	Hog Island, a small islet in Tomales Bay, Marin County.(occurrences)	CNDDB
Helminthoglypta nickliniana awania	Nicklin's Peninsula Coast Range snail	FSC	n/a				Known only from exposed granitic headlands of the Point Reyes Peninsula, Marin County.	Inhabits coastal scrub habitat & weedy pastures; uniquely adapted to high winds, salt fogs, and variable precipitation.	X	X							X			X	Drakes Bay Quad in Marin County (Point Reyes) (occurrences)	CNDDB
*Hydrochara ricksecker*i	Ricksecker's water scavenger beetle	FSC	n/a		X		Various water bodies.	Aquatic; known from the San Francisco Bay area.	X							X		X	X	X	Marin, San Mateo, Sonoma & Solano County (occurrences)	CNDDB. It is anticipated that the habitat supporting this species would be unaffected by FMP actions.
Hydroporus leechi	Leech's skyline diving beetle	FSC	n/a				Aquatic.	Known to inhabit permanent ponds in northern San Mateo County.	X	X						X			X		Known to inhabit permanent ponds in the North end of San Mateo County. (occurrences)	CNDDB. It is anticipated that the habitat supporting this species would be unaffected by FMP actions.

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Icaricia icarioides ssp. missionensis	Mission blue butterfly	FE	n/a		X		Mission blue butterflies are closely tied to three lupine larval host plants—Lupinus albifrons, L. variicolor, and L. formosus. These host plants tend to occur on grasslands on thin, rocky soils within broader coastal-scrub habitats.		X			X	X	X				X	X	X	Marin Headlands, the coastal ridges in San Mateo County, San Bruno Mountain, and possibly Twin Peaks in San Francisco	Found in Tennessee Valley, Marin Headlands, Milagra, and Sweeney Ridges (NPS, 2004). Potential temporary impacts would be minimized to be insignificant and long-term effects would be beneficial.
Icaricia icarioides ssp. Parapheres	Point Reyes blue butterfly	FSC	n/a				Coastal Dunes	Stabilized sand dunes with the common bush Lupinus arboreus & L. variicolor. L. Variicolor is the likely foodplant.	X	X							X			X	Confined to the Pt. Reyes Peninsula, from Pt. Reyes proper north to Tomales Pt.	Not observed in GGNRA, not likely to be present in study area (NPS, 2004)
Incisalia mossii marinensis	Marin elfin butterfly	FSC	n/a		X		Coastal grassland, coastal scrub.	Marin elfin butterfly are closely tied to a single larval host plant-broadleaf stonecrop (Sedum spatulifolium) which occurs in coastal grasslands on thin rocky soils within coastal scrub grassland habitats.	X	X							X		X	X	San Bruno mtn., Montara mtn., Mt. Diablo, and Alpine lake. Steep North facing slopes, and coastal mountains of SF Bay Area.	Not observed in GGNRA, not likely to be present in study area (NPS, 2004)
Lichnanthe ursina	Bumblebee scarab beetle	FSC	n/a		X		Inhabits coastal sand dunes from Sonoma County south to San Mateo County.	Usually flies close to sand surface near the crest of the dunes.	X							X		X	X	X	Sonoma, San Francisco, Marin & Pacific Ocean counties. (occurrences)	CNDDB. It is anticipated that the habitat supporting this species would be unaffected by FMP actions as habitat
Microcina edgewoodensis	Edgewood microblind harvestman	FSC	n/a				Serpentine grassland, serpentine scrub.	Found under serpentine rocks.	X	X							X		X		Edgewood County Park and a site west of Interstate Highway 280 in San Mateo County, California	
Microcina tiburona	Tiburon microblind harvestman	FSC	n/a				Open hilly grassland habitat in areas of serpentine bedrock.	Found on the undersides of serpentine rocks near permanent springs.	X	X							X			X	Marin County (occurrences).	CNDDB.
Speyeria adiaste adiaste	Unsilvered fritillary butterfly	FSC	n/a				Openings in redwood and coniferous forests, oak woodlands, chaparral.	Very local, restricted range in california: San Luis Obispo County north to San Mateo County; east to north Los Angeles County and Kern County.	X	X							X		X		Santa Cruz & Santa Clara counties	CNDDB
Speyeria calippe ssp. calippe	Calippe silverspot butterfly	FE	n/a				Coastal grasslands, opening in coastal scrub.	Native grassland and adjacent habitats that support the larval foodplant, johnny-jump-up (Viola pedunculata)	X	X									X		Sonoma, Alameda, Solano & San Mateo counties	Not observed in GGNRA, not likely to be present in study area (NPS, 2004)
Speyeria zerene myrtleae	Myrtle's silverspot butterfly	FE	n/a				Coastal dunes, scrub, and grassland.	Closely associated with larval and food plants violet (Viola adunca) in areas sheltered from the wind below 820 feet within 3 miles of the coast.	X	X							X			X	Western Marin & southwest Sonoma Counties	Not observed in GGNRA, not likely to be present in study area (NPS, 2004)
Syncaris pacifica	Californian fresh water shrimp	FE	n/a	SE	X		Streams of 12 -36 inches in depth with exposed live roots of trees along under cut banks >6" with over hagning woody debris		X	X						X				X	Tributary streams in the lower Russian River drainage westward to the pacific Ocean	Found in Lagunitas Creek watershed. Surveys outside watershed have not identified other localities, although potential habitat present (NPS, 2004).
FISH																						
Acipenser medirostris	Green sturgeon	FC	n/a		X		Spawn in the Sacramento River and the Klamath River.	Spawn at temps between 8-14 c. Preferred spawning substrate is large cobble, but can range from clean sand to bedrock.	X							X		X	X	X	Aleutian Islands and the Gulf of Alaska to Ensenada, Mexico. Considered vulnerable in Canada.	A mostly marine-estuarine species that is only known to spawn in large CA rivers (Sacramento and Klamath)

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Eucyclogobius newberryi	Tidewater goby	FE	n/a		X		Brackish water habitats along the CA coast from Agua Hedionda Lagoon, San Diego Co. to the mouth of the Smith River.	Found in shallow lagoons and lower stream reaches, they need fairly still but not stagnant water & high oxygen levels.	X			X	X			X		X	X	X	Eastern Pacific: Del Norte County in northern California, USA to Del Mar in southern California.	Found in Rodeo Lagoon. Additional suitable habitat in GGNRA-managed areas unlikely. It is anticipated that this tidewater goby habitat would be unaffected by FMP actions. Potential impacts would be minimized to be insignificant.
Hypomesus transpacificus	Delta smelt	FT	n/a				Spawning and rearing mostly in Sacramento-San Joaquin Delta.	Brackish water in the Sacramento-San Joaquin Delta.										X	X	X	North America: Sacramento-San Joaquin Delta region in central California, USA.	
Lampetra ayresi	River lamprey	FSC	n/a				Lower Sacramento River, San Joaquin River & Russian River. May occur in coastal streams north of San Francisco Bay.	Adults need clean, gravelly riffles, ammocoetes need sandy backwaters or stream edges, good water quality & temps < 25 c										X	X	X	Eastern Pacific: Tee Harbor, Alaska to Sacramento-San Joaquin drainage in California, USA. Freshwater resident population in Morrison Creek, Vancouver Island, British Columbia	Uncertain whether in park
Lampetra tridentata	Pacific lamprey	FSC	n/a		X		Freshwater streams.	Pacific lamprey spend most of their life in freshwater streams before entering the ocean as adults to feed	X	X								X	X	X	Range in California, Oregon, Washington and Idaho with the most precipitous documented declines in the upper Columbia, Snake and North Umpqua River basins.	No occurences of this anadromous species have been observed in GGNRA-managed streams, however likely exists in Lagunitas Watershed (NPS, 2004)
Oncorhynchus kisutch	Coho salmon--Central California coast	FT,SE, CH	n/a	SE	X		Coastal streams draining to ocean (including those to S.F. Bay) with spawning, juvenile rearing habitat, and migratory corridor		X		X	X				X		X	X	X	Point Hope, Alaska south to Chamalu Bay, Baja California, Mexico.	Present in Muir Woods, Redwood Creek (NPS, 2004)
Oncorhynchus mykiss	Steelhead — Central California Coast	FT	n/a		X		Coastal streams draining to ocean (including those to s.f. bay) with spawning , juvenile rearing habitat, and migratory corridor		X		X	X				X		X	X	X	California streams from the Russian River to Aptos Creek, and the drainages of San Francisco and San Pablo Bays eastward to the Napa River (inclusive),	Present in Muir Woods, Redwood Creek (NPS, 2004)
Oncorhynchus mykiss	Steelhead — Central Valley	FT	n/a		X		Spawning and juvenile rearing habitat in Sacramento and San Joaquin Rivers and their tributaries		X*					X		X		X	X	X	Sacramento and San Joaquin Rivers and their tributaries.	*Adult and juvenile migratory corridor along S.F. Bay portion of GGNRA lands. It is anticipated that the habitat supporting this species would be unaffected by FMP actions (Darren Fong (NPS), pers. comm. 2004). Potential temporary impacts would be minimized to be insignificant and long-term effects would be beneficial.
Oncorhynchus tshawytscha	Chinook salmon — Sacramento River winter run	FE, CH	n/a	SE	X		Spawning and juvenile rearing habitat in Sacramento River and tributaries		X*					X		X		X	X		Arctic and Pacific: drainages from Point Hope, Alaska to Ventura River, California, USA; occasionally strays south to San Diego in California, USA.	*Adult and juvenile migratory corridor along S.F. Bay portion of GGNRA lands. Critical habitat includes Bay waters to the Golden Gate Bridge. It is anticipated that the habitat supporting this species would be unaffected by FMP actions (Darren Fong (NPS), pers. comm. 2004). Potential temporary impacts would be minimized to be insignificant and long-term effects would be beneficial.
Oncorhynchus tshawytscha	Chinook salmon — California coastal	FT	n/a				Spawning and juvenile rearing in large coastal stream and rivers draining to ocean.													X	Arctic and Pacific: drainages from Point Hope, Alaska to Ventura River, California, USA; occasionally strays south to San Diego in California, USA.	Spawning, juvenile rearing habitat, and migratory corridor only in Lagunitas Creek (managed by PRNS)

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Oncorhynchus tshawytscha	Chinook salmon — Central Valley spring run	FT	n/a	ST	X		Adult nos depend on pool depth & volume, amount of cover, & proximity to gravel. Water temps >27 c lethal to adults	Federal listing refers to pops spawning in Sacramento River & tributaries.	X*					X		X			X	X	Arctic and Pacific: drainages from Point Hope, Alaska to Ventura River, California, USA; occasionally strays south to San Diego in California, USA.	*Adult and juvenile migratory corridor along S.F. Bay portion of GGNRA lands. Spawning, juvenile rearing habitat, and migratory corridor only in Lagunitas Creek (managed by PRNS). It is anticipated that the habitat supporting this species would be unaffected by FMP actions (Darren Fong (NPS), pers. comm. 2004). Potential temporary impacts would be minimized to be insignificant and long-term effects would be beneficial.
Oncorhynchus tshawytscha	Chinook salmon — Central Valley fall/late fall run	CH, FC	n/a		X		Populations spawning in the Sacramento & San Joaquin Rivers and their tributaries.												X	X	Arctic and Pacific: drainages from Point Hope, Alaska to Ventura River, California, USA; occasionally strays south to San Diego in California, USA.	Spawning, juvenile rearing habitat, and migratory corridor only in Lagunitas Creek (managed by PRNS)
Pogonichthys macrolepidotus	Sacramento splittail	FT	n/a				Endemic to the lakes and rivers of the Central Valley, but now confined to the Delta, Suisun Bay & associated marshes.	Slow moving river sections, dead end sloughs. Require flooded vegetation for spawning & foraging for young.										X	X	X	North America: formerly known throughout the Sacramento-San Joaquin River drainage in California, USA; now restricted to San Francisco Bay Delta and lower Sacramento River.	Found in San Joaquin-Sacramento Delta
Spirinchus thaleichthys	longfin smelt	FSC	n/a				Euryhaline, nektonic & anadromous. Found in open waters of estuaries, mostly in middle or bottom of water column.	Prefer salinities of 15-30 ppt, but can be found in completely freshwater to almost pure seawater.										X	X	X	North Pacific: Prince William Sound, Alaska to Monterey Bay, California, USA. Landlocked in Washington and Union Lakes in Washington, USA	found in S.F. Bay and embayments
REPTILES/AMPHIBIANS																						
Ambystoma californiense	California tiger salamander	FPT	n/a				Vernal pool grasslands.	Use stock ponds, vernal pools, & swales for breeding. Upland grasslands (rodent burrows) for estivations.		X									X	X	Foothills & valleys, Central Valley and Coast Ranges. Santa Barbara Co. & the Santa Rosa plains in Sonoma Co.	
Caretta caretta	Loggerhead turtle	FT	n/a				Offshore marine	Continental shelves, bays, estuaries, and lagoons in temperate, tropical, and subtropical climates.	X	X						X		X	X	X	Circum global, Alaska to Chile. Juveniles ... off coast of California	Marine migratory species, unlikely to be affected by FMP actions (NPS, 2004)
Chelonia mydas	Green turtle	FT	n/a				Offshore marine	Continental shelves, bays, estuaries, and lagoons in temperate, tropical, and subtropical climates.	X	X						X		X	X	X	Alaska to Baja.	Marine migratory species, unlikely to be affected by FMP actions (NPS, 2004)
Clemmys marmorata marmorata	Northwestern pond turtle	FSC	n/a		X		Slow moving waterways, lakes and ponds.	Aquatic turtle: requires ponds, slow-moving waterways such as creeks and irrigation ditches where water ponds. Prefers habitats with basking sites, aquatic vegetation, and suitable upland habitats for egg-laying.	X		X		X			X		X	X	X	north of the San Francisco Bay-Delta Estuary (the western pond turtle occurs on suitable aquatic habitats throughout California west of the Sierra Nevada and in parts of Oregon and Washington).	Limited numbers found at Rodeo Lake, Tenn. Valley and Muir Beach (Redwood Creek). It is anticipated that the wetland and riparian habitats supporting populations would be unaffected by FMP actions (NPS, 2004)
Clemmys marmorata pallida	Southwestern pond turtle	FSC	n/a		X		Slow moving waterways, lakes and ponds.	Aquatic turtle: requires ponds, slow-moving waterways such as creeks and irrigation ditches where water ponds. Prefers habitats with basking sites, aquatic vegetation, and suitable upland habitats for egg-laying.	X	X						X		X	X		found south of the San Francisco Bay (the western pond turtle occurs on suitable aquatic habitats throughout California west of the Sierra Nevada and in parts of Oregon and Washington).	No occurences have been observed in Project Study Area (Darren Fong, pers. comm., 2004)

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Dermochelys coriacea	Leatherback turtle	FE	n/a				Offshore marine		X	X						X		X	X	X	Cape Sable Nova Scotia to Puerto Rico. Commonly sighted in Hawaii	Marine migratory species, unlikely to be affected by FMP actions (NPS, 2004)
Lepidochelys olivacea	Olive ridley sea turtle	FT	n/a				Offshore marine	Open ocean, continental shelves, bays, and estuaries.	X	X						X		X	X	X	Pacific Coast, nesting concentrated from Mexico to Costa Rica.	Marine migratory species, unlikely to be affected by FMP actions (NPS, 2004)
Phrynosoma coronatum frontale	California horned lizard	FSC	n/a		X		Frequents a wide variety of habitats, most common in lowlands along sandy washes with scattered low bushes.	Open areas for sunning, bushes for cover, patches of loose soil for burial, & abundant supply of ants & other insects.	X	X							X				Shasta County, Southwest along the Sacramento valley south Coast Ranges, San Joaquin Valleys, and Sierra Nevada foothills.	
Rana aurora aurora	Northern red-legged frog	FSC	n/a		X		Found in humid forests, woodlands, grasslands, and streamsides in northwestern california.	Generally near permanent water, but can be found far from water, in damp woods and meadows, during non-breeding season.	X	X										X	Mendocino Co., Oregon, and Washington. Range overlaps with R.a. draytonii in Pt. Arena, Mendocino Co.	Project Study Area outside known range of species
Rana aurora draytonii	California red-legged frog	FT	n/a		X		Ponds and other permanent slow-moving waterbodies: lakes, reservoirs, slow streams, marshes, and bogs.	Adult require a dense, shrubby or emergent riparian vegetation closely associated with deep (>0.7 meters) still or slow-moving water.	X			X		X				X	X	X	California red-legged frogs are still locally abundant within portions of the San Francisco Bay area (including Marin County) 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.	Present at various localities within Marin and San Mateo Counties (NPS, 2004). Potential temporary impacts would be minimized to be insignificant and long-term effects would be beneficial.
Rana boylii	Foothill yellow-legged frog	FSC	n/a		X		Partly-shaded, shallow streams & riffles with a rocky substrate in a variety of habitats.	Egg clusters attached to downstream side of submerged rocks. Need at least some cobble-sized substrate for egg-laying. Need at least 15 weeks to attain metamorphosis.	X	X						X		X	X	X	West of crest of Cascade mts., Ore., south in coastal mts. Of CA to San Gabriel River, Los Angeles County. Sierra Nevada foothills to about 6000'; Baja California.	Historic occurrence in Redwood Creek (Darren Fong, pers. comm., 2004).
Spea hammondii	Western spadefoot toad	FSC	n/a				Occurs primarily in grassland habitats, but can be found in valley-foothill hardwood woodlands.	Vernal pools are essential for breeding and egg-laying.	X	X							X			X	North-central California, Central Valley, and foothills south to Baja.	Distribution maps do not show presence in S.F. Bay coastal areas.
Thamnophis sirtalis tetrataenia	San Francisco garter snake	FE	n/a	SE	X		Freshwater habitats are primary foraging sites. Adjacent uplands for basking and hibernaculae.	Prefer densely vegetated ponds with adjacent plants for basking. Preferred prey species is red-legged frogs. Estivates in burrow holes.	X			X	X	X					X		Historically San Francisco peninsula currently known from South San Francisco near airort and Mori Point near Pacifica. Known occurrence at Mori Pt.	Potential temporary impacts would be minimized to be insignificant and long-term effects would be beneficial.
BIRDS [2]																						
Ageliaus tricolor	Tricolored blackbird	FSC	n/a		X		(Nesting colony) highly colonial species, most numerous in Central Valley & vicinity. Largely endemic to California.	Requires open water, protected nesting substrate, & foraging area with insect prey within a few km of the colony.	X							X		X	X	X	Gregarious; found year-round in large flocks in open country and dairy farms; nests in large colonies in marshes.	Mechanical removal and other FMP actions would occur outside of nesting season, and limited number of acres burned each year, therefore it is anticipated that the effects on populations of these species would be minor, with potential benefical impacts from invasive species control and restoration of ecosytem processes.

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Amphispiza belli belli	Bell's sage sparrow	FSC	n/a		X		(Nesting) nests in chaparral dominated by fairly dense stands of chamise. Found in coastal sage scrub in south of range.	Nest located on the ground beneath a shrub or in a shrub 6-18 inches above ground. Territories about 50 yds apart.	X							X		X	X	X	Western U.S. to n. Mexico	Mechanical removal and other FMP actions would occur outside of nesting season, and limited number of acres burned each year, therefore it is anticipated that the effects on populations of these species would be minor, with potential benefical impacts from invasive species control and restoration of ecosytem processes.
Arenaria melanocephala	Black turnstone	FSC	n/a				Breeds in coastal Alaska. Winters on rocky coasts.	Strictly coastal species.	X							X		X	X	X	Breeds in western Alaska and winters along the entire stretch of Pacific Coast from southern Alaska to Baja California.	It is anticipated that the coastal habitat supporting this species would not be affected by FMP actions
Athene cunicularia hypugaea	Western burrowing owl	FSC	n/a		X		(Burrow sites) open, dry annual or perenial grasslands, deserts & scrublands characterized by low-growing vegetation.	Subterranean nester, dependent upon burrowing mammals, most notably, the California ground squirrel.	X							X			X		Western U.S. into northern Mexico. In California, largely in Central Valley and southern and southeastern portions of state. A small area south of San Francisco Bay is considered part of the current breeding range.	Species such as raptors and some owl species (burrowing, western screech) have been shown to increase in numbers after fires (USDA, 2000), and could be beneficially affected because raptors in general are unaffected or respond favorably to burned habitat (Smith, 2000).
Botaurus lentiginosus	American bittern	FSC	n/a		X		Freshwater and slightly brackish marshes. Also in coastal saltmarshes.	Dense reed beds.	X							X		X	X	X	Breeds from southeastern Alaska, Manitoba, and Newfoundland south to California, New Mexico, Arkansas, and Carolinas.	It is anticipated that the coastal habitat supporting this species would not be affected by FMP actions
Brachyramphus marmoratus marmoratus	Marbled murrelet	FT, CH	n/a	SE	X		Old growth forest for breeding and sheltered waters/open coast for foraging.		X	X				X					X	X	Nests inland, usually in trees. Fairly common in breeding range; rare in Southern California.	Habitat present in Muir Woods, but no detections in 2 years of surveys (NPS, 2004). Potential temporary habitat impacts would be minimized to be insignificant and long-term effects would be beneficial to habitat.
Buteo regalis	Ferruginous hawk	FSC	n/a		X		(Wintering) open grasslands, sagebrush flats, desert scrub, low foothills & fringes of pinyon-juniper habitats.	Mostly eats lagomorphs, ground squirrels, and mice. Population trends may follow lagomorph population cycles.	X							X		X	X	X	Sw. Canada, Western U.S.. Winters SW. U.S., N. Mexico	Species such as raptors and some owl species (burrowing, western screech) have been shown to increase in numbers after fires (USDA, 2000), and could be beneficially affected because raptors in general are unaffected or respond favorably to burned habitat (Smith, 2000).
Calidris canutus	Red knot	FSC	n/a				Breeds on tundra; during migration, on tidal flats, rocky shores, and sandy beaches.	Often breeds with dowitchers.	X							X		X	X	X	Breeds on islands in High Arctic of Canada. Winters along coasts from California and Massachusetts southward to southern South America. Also in Eurasia.	It is anticipated that the coastal habitat supporting this species would not be affected by FMP actions

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Calypte costae	Costa's hummingbird	FSC	n/a				Fairly common in desert washes, dry chaparral, and successional scrub.		X						X				X		Occurs mainly in Southern California, Arizona, Baja California, and western Mexico, but also extends into Nevada, extreme southeastern Utah, and southeastern New Mexico. Their range is expanding into new and historically occupied areas in parts of Arizona and California.	Mechanical removal and other FMP actions would occur outside much of nesting season, and limited number of acres burned each year, therefore it is anticipated that the effects on populations of these species would be minor, with potential benefical impacts from invasive species control and restoration of ecosytem processes.
Carduelis lawrencei	Lawrence's goldfinch	FSC	n/a				(Nesting) nests in open oak or other arid woodland & chaparral, near water. Nearby herbaceous habitats used for feeding	Closely associated with oaks.	X										X		Breeds n. California to n. Baja California. Winters sw. U.S.	Mechanical removal and other FMP actions would occur outside of nesting season, and limited number of acres burned each year, therefore it is anticipated that the effects on populations of these species would be minor, with potential benefical impacts from invasive species control and restoration of ecosytem processes.
Chaetura vauxi	Vaux's swift	FSC	n/a				(Nesting) redwood, douglas fir, & other coniferous forests. Nests in large hollow trees & snags. Often nests in flocks.	Forages over most terrains & habitats but shows a preference for foraging over rivers and lakes.	X								X	X	X	X	Western N. America to Venezuela	Per comm. With PRBO (Tom Gardali), potential habitat exists in Marin County. Breeds in Bolinas. Does not occur in MUWO.
Charadrius alexandrinus nivosus	Western snowy plover	FT, CH	n/a		X		Coastal beaches, sand spits, dune-backed beaches, beaches at river mouths, salt pans at lagoons and estuaries, mud flats, and man-made salt ponds.		X			X				X		X	X	X	breeds primarily on coastal beaches from southern Washington to southern Baja California, Mexico.	Overwintering population on Ocean Beach. Periodically sighted at other beaches. It is anticipated that foredune and beach habitat supporting this species would be unaffected by actions defined under the FMP. Potential temporary impacts from suppression activities would be minimized to be insignificant; other activities are not anticipated in plover habitat.
Coccyzus americanus occidentalis	Western yellow-billed cuckoo	FC	n/a	SE			(Nesting) riparian forest nester, along the broad, lower flood-bottoms of larger river systems.	Nests in riparian jungles of willow, often mixed with cottonwoods, w/ lower story of blackberry, nettles, or wild grape.	X	X										X	S. Canada to Mexico, W. Indies. Winters to Argentina	Per comm. with PRBO, species does not occur in the GGNRA & does not breed on coast.
Contopus cooperi	Olive-sided flycatcher	FSC	n/a				(Nesting) nesting habitats are mixed conifer, montane harwood-conifer, douglas-fir, redwood, red fir & lodgepole pine.	Most numerous in montane conifer forests where tall trees overlook canyons, meadows, lakes or other open terrain.	X							X		X	X	X	Breeds in Alaska, east across Canada to northern New England, and south to mountains of California, Arizona, and New Mexico, and in northern New York and New England. Winters in tropics.	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.
Cypseloides niger	Black swift	FSC	n/a				(Nesting) coastal belt of Santa Cruz & Monterey Co; central & southern Sierra Nevada; San Bernardino & San Jacinto Mtns.	Breeds in small colonies on cliffs behind or adj to waterfalls in deep canyons and sea-bluffs above surf; forages widely	X							X			X	X	Breeds from southern Alaska south to southern California, Montana, and Colorado. Winters in tropics.	It is anticipated that the coastal habitat supporting this species would not be affected by FMP actions

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Diomedea albatrus	Short-tailed albatross	FE	n/a				Marine and near shore habitats for foraging. Breeds in south pacific		X	X						X		X	X	X	Breeds on Bonin Island off Japan. Formerly ranged from Bering Sea to Baja California, may again do so.	It is anticipated that the coastal habitat supporting this species would not be affected by FMP actions. Near extinction in 1956, now over 250 birds. Per comm. With PRBO, species rarely comes inland
Diomedia nigripes	Black-footed albatross	FSC	n/a				Seen year-round off west coast; most common in spring, summer. Chiefly breeds on hawaiian islands									X		X	X	X	Ranges weel offshore from Bering Sea and Aleutians to Baja California.	It is anticipated that the coastal habitat supporting this species would not be affected by FMP actions. Per comm. with PRBO (Tom Gardali), species rarely comes on shore.
Elanus leucurus	White-tailed kite	FSC	n/a		X		(Nesting) rolling foothills/valley margins w/scattered oaks & river bottomlands or marshes next to deciduous woodland	Open grasslands, meadows, or marshes for foraging close to isolated, dense-topped trees for nesting and perching.	X					X	X			X	X	X	Resident in coastal and interior California, Arizona, and southern Texas. Also in American tropics.	White-tailed kites could be beneficially affected because raptors in general are unaffected or respond favorably to burned habitat (Smith, 2000). However, white-tailed kites, and other canopy nesters could be be subject to short-term negatives affects as a result of crown fires.
Empidonax traillii brewsteri	Little willow flycatcher		n/a	SE	X		Breeds in shrubby vegetation in meadow and riparian woodlands, typically where there are mature, dense stands of willows, cottonwoods, or alders.		X	X						X		X	X	X	Breeds in wet meadows & montane riparian habitas from 2,000 -8,000 feet in elevation.	It is anticipated that the riparian and other habitat supporting this species would not be affected by FMP actions
Falco peregrinus anatum	American peregrine falcon	DM	n/a	SE			(Nesting) near wetlands, lakes, rivers, or other water; on cliffs, banks, dunes, mounds; also, human-made structures.	Nest consists of a scrape on a depression or ledge in an open site.	X				X			X		X	X	X	breeds from non-Arctic portions of Alaska and Canada south to Baja California (except on the coast of southern Alaska and in British Columbia), central Arizona and Mexico (locally)	The endangered American peregrine falcon (Falco peregrinus anatum)has historically nested at three sites in GGNRA (Walton pers. comm. 1991). It has been released from hack sites at Muir Beach from 1983 to 1987 and in 1998. (GGNRA, RMP 1999). It is anticipated that the wetland coastal habitat supporting this species would not be affected by FMP actions
Geothlypis trichas sinuosa	Saltmarsh common yellowthroat	FSC	n/a		X		Resident of the San Francisco Bay region, in fresh and salt water marshes.	Requires thick, continuous cover down to water surface for foraging; tall grasses, tule patches, willows for nesting.	X							X		X	X	X	Canada to s. Mexico. Winters s. U.S. to W. Indies, Panama.	It is anticipated that the salt marsh and coastal habitat supporting this species would not be affected by FMP actions
Haematopus bachmani	Black oystercatcher	FSC	n/a		X		Resident on rocky shores and islands along the Pacific Coast from the Aleutians to Baja California		X							X		X	X	X	Resident from w. Aleutians , east and south along coast to Morro Bay, CA; on offshore islands to Baja California	It is anticipated that the coastal habitat supporting this species would not be affected by FMP actions. Per comm. with PRBO, Tom Gardali, species occurs in the Presidio along rocky beaches. A few pairs breed on Alcatraz Island each year.
Haliaeetus leucocephalus	Bald eagle	FT	n/a	SE	X		Large trees near lakes, rivers, or estuaries for foraging. Disturbance intolerant.		X							X		X	X	X	Alaska, Canada, to s. U.S.	Has been observed to over-winter in the San Francisco Watershed. An occasional bald eagle is observed during the fall raptor migration by the Golden Gate Raptor Observatory.It is anticipated that the coastal habitat supporting this species would not be affected by FMP actions
Histrionicus histrionicus	Harlequin duck	FSC	n/a		X		(Nesting) breeds on west slope of the sierra nevada, nesting along shores of swift, shallow rivers.	Nest often built in a recess, sheltered overhead by stream bank, rocks, woody debris, usually within 7 ft of water	X							X		X	X	X	Ne. Asia, Alaska, Canada, w. U.S., Greenland, Iceland	It is anticipated that the wetland habitat supporting this species would not be affected by FMP actions

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Lanius ludovicianus	Loggerhead shrike	FSC	n/a		X		(Nesting) broken woodlands, savannah, pinyon-juniper, joshua tree, & riparian woodlands, desert oases, scrub & washes.	Prefers open country for hunting, with perches for scanning, and fairly dense shrubs and brush for nesting.	X								X	X	X	X	S. Canada to s. Mexico	Per comm. with PRBO, species occurs within the GGNRA.
Laterallus jamaicensis coturniculus	Black rail		n/a	ST	X		Mainly inhabits salt-marshes bordering larger bays.	Occurs in tidal salt marsh heavily grown to pickleweed; also in fresh-water and brackish marshes, all at low elevation.	X							X		X	X	X	Ne and central U.S. and central California south locally to W. Indies, Chile	It is anticipated that the salt marsh and coastal habitat supporting this speceis would be relatively unaffected by FMP actions
Limosa fedoa	Marbled godwit	FSC	n/a				Common on west coast in winter, fairly common on texas gulf coast and in florida; rare but regular in the east.		X	X						X		X	X	X	N. Great Plains; locally sw. Alaska. Winters s. U.S. to north South America.	It is anticipated that the salt marsh and coastal habitat supporting this speceis would be relatively unaffected by FMP actions. Per comm. with PRBO, species occurs at Crissy Field in the GGNRA. Fairly common on many GGNRA beaches during winter.
Melospiza melodia pusillula	Alameda (South Bay) song sparrow	FSC	n/a				Resident of salt marshes bordering south arm of San Francisco Bay.	Inhabits salicornia marshes; nests low in grindelia bushes (high enough to escape high tides) and in salicornia.	X	X								X	X		Alaska, Canada to cen. Mexico.	It is anticipated that the salt marsh habitat supporting this species would be relatively unaffected by FMP actions. Per comm. with PRBO, species is only specific to the localized Alameda/South Bay area.
Melospiza melodia samuelis	San Pablo song sparrow	FSC	n/a				Resident of salt marshes along the north side of San Francisco and San Pablo Bays.	Inhabits tidal sloughs in the salicornia marshes; nests in grindelia bordering slough channels.	X	X										X	Alaska, Canada to cen. Mexico.	It is anticipated that the salt marsh habitat supporting this species would be relatively unaffected by FMP actions. Per comm. with PRBO species only occurs in the localized San Pablo Bay area.
Numenius americanus	Long-billed curlew	FSC	n/a		X		(Nesting) breeds in upland shortgrass prairies & wet meadows in northeastern california.	Habitats on gravelly soils and gently rolling terrain are favored over others.	X							X	X	X	X	X	Sw. Canada, W. U.S. Winters s. U.S. to Guatemala.	It is anticipated that the salt marsh habitat supporting this species would be relatively unaffected by FMP actions. Per comm. With PRBO, species occurs in the GGNRA, particularly Crissy Field
Numenius phaepus	Whimbrel	FSC	n/a				Breeds on arctic tundra, especially near coasts; coastal salt meadows, mudflats, and grassy shoreline slopes during migration.		X							X		X	X	X	Arctic, circumpolar. Winters to s. S. America	It is anticipated that the salt marsh habitat supporting this species would be relatively unaffected by FMP actions. Per comm. With PRBO, species occurs at Crissy Field in the GGNRA.
Oceanodroma homochroa	Ashy storm-petrel	FSC	n/a				(Rookery site) colonial nester on off-shore islands. Usually nests on driest part of islands. Forages over open ocean.	Nest sites on islands are in crevices beneath loosely piled rocks or driftwood, or in caves.	X							X		X	X	X	At sea from n. California (Pt. Reyes) to Baja California.	It is anticipated that the coastal habitat supporting this species would not be affected by FMP actions.
Otus flammeolus	Flammulated owl	FSC	n/a				Common in oak and pine woodlands, especially ponderosa. Sometimes nests in loose colonies. Highly migratory. Accidental east to Louisiana and Florida.		X								X		X		Southern British Columbia, w. U.S. to Guatemala.	Mechanical removal and other FMP actions would occur outside much of nesting season, and limited number of acres burned each year, therefore it is anticipated that the effects on populations of these species would be minor, with potential benefical impacts from invasive species

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Pelecanus occidentalis californicus	California Brown pelican	FE	n/a	SE	X		Forage over near shore marine areas including open coast, San Francisco Bay, and rodeo lagoon. Utilize islands, rocks, cliffs, and some protected beach areas for roosting.		X							X		X	X	X	Coasts; s. U.S. to n. Brazil and Chile. Northern extent of breeding is southern CA, Channel Islands.	The endangered California brown pelican has significant roost areas in GGNRA (NPS 1982). Pelicans have been observed roosting at Seal Rocks, Alcatraz Island, the Hyde Street Pier, Bird Island, and Kent Island in Bolinas Lagoon. (GGNRA, RMP, 1999) This species does not breed within the Study Area, and it is anticipated that coastal habitats used for roosting would not be affected by FMP actions. Potential impacts would be either be discountable or minimized to be insignificant.
Ptychoramphus aleuticus	Cassin's auklet	FSC	n/a				Nests in colonies on islands and on isolated coastal cliffs and headlands.		X	X						X		X	X	X	Pacific Coast, breeds locally in Aleutians.	It is anticipated that the coastal habitat supporting this species would not be affected by FMP actions.
Rallus longirostris obsoletus	California clapper rail	FE	n/a	SE			Salt marsh with tidal channels.		X	X						X		X	X	X	Coasts of e. U.S. and California to n. S. America	It is anticipated that the salt marsh supporting this species would not be affected by FMP actions.
Riparia riparia	Bank swallow	CA	n/a		X		(Nesting) colonial nester; nests primarily in riparian and other lowland habitats west of the desert.	Requires vertical banks/cliffs with fine-textured/sandy soils near streams, rivers, lakes, ocean to dig nesting hole.	X			X				X		X	X	X	Widespread in N. Hemisphere. Winters in S. America, Africa, s. Asia.	Species nest in the Fort Funston cliffs. It is anticipated that this bluff habitat would not be affected by FMP actions.
Rynchops niger	Black skimmer	FSC	n/a				(Nesting colony) nests along the north & south ends of the salton Sea; also, on salt pond dikes of south San Diego Bay.	Nests on gravel bars, low islets, and sandy beaches, in unvegetated sites. Nesting colonies usually less than 200 pairs.	X							X		X	X	X	Cape Cod, s. California, south to s. S. America. A recently established resident of s. California, nesting at Salton Sea and near San Diego. Occasional elsewhere on California coast; casual, Arizona, New Mexico.	It is anticipated that the habitats supporting this species would not be affected by FMP actions.
Selasphorus rufus	Rufous hummingbird	FSC	n/a		X		(Nesting) breeds in transition life zone of northwest coastal area from oregon border to southern Sonoma County.	Nests in berry tangles, shrubs, and conifers. Favors habitats rich in nectar-producing flowers.	X								X	X	X	X	Breeds in nw. N. America; winters in Mexico.	Per communication with PRBO, species passes through the GGNRA during migration.
Selasphorus sasin	Allen's hummingbird	FSC	n/a		X		Mixed evergreen, riparian woodlands, eucalyptus and cypress groves, oak woodlands, and coastal scrub areas in breeding season.		X								X	X	X	X	Breed in coastal California; winters in nw. Mexico	Per communication with PRBO, species may be affected by
Sphyrapicus ruber	Red-breasted sapsucker	FSC	n/a				Common in coniferous or mixed forests in coastal ranges, usually at lower elevations and in moister forests than Williamson's sapsucker. Most migrate south or move to lower elevations in winter.		X	X							X	X	X	X	Se. Alaska to Baja California	Mechanical removal and other FMP actions would occur outside much of nesting season, and limited number of acres burned each year, therefore it is anticipated that the effects on populations of these species would be minor, with potential benefical impacts from invasive species control and restoration of ecosytem processes.

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Sterna antillarum browni	California least tern	FE	n/a	SE	X		Diked ponds or ditches along shorelines.		X			X	X			X			X	X	Temperate and tropical oceans. Winters south of U.S.	The endangered California least tern does not nest in the park, but uses abandoned piers for roosting and nearshore waters for foraging (GGNRA, RMP, 1999). It is anticipated that shoreline habitat supporting this species would not be affected by FMP actions.
Sterna elegans	Elegant tern	FSC	n/a		X		(Nesting colony) only known breeding colony in u.s. located in the salt work dikes at the south end of San Diego Bay.	Nests on dikes between salt ponds in association with caspian tern.	X	X								X	X	X	Breeds on islands off Baja California. Winters Peru to Chile. Wanders irregularly (Aug-Oct.) north to San Francisco Bay; recently even to Washington. Breeds near San Diego.	Per communication with PRBO, species exists in estuaries throughout the GGNRA. Habitat unlikely to be affected by FMP actions.
Strix occidentalis caurina	Northern spotted owl	FT	n/a		X		Utilizes coniferous and mixed-hardwood forest areas for breeding in the project area, often in drainages.		X	X		X	X	X						X	The range encompasses an area from southwestern British Columbia south through the coastal mountains arid Cascade Range (both west and east sides) of Washington and Oregon, south into southwestern Oregon and northwestern California north of San Francisco	Potential temporary impacts would be minimized to be insignificant and long-term effects would be beneficial.
Synthliboramphus hypoleucus	Xantu's murrelet	FSC	n/a	ST			Forages over most terrains & habitats but shows a preference for foraging over rivers and lakes.	Nests in rock crevices, under bushes, in old burrows and among man-made debris.	X	X						X		X	X	X	Breeds s. California (Anacapa and Santa Barbara Is.) to central Baja. Some winter north to Monterey; asually to Washington.	It is anticipated that the habitats supporting this species would not be affected by FMP actions.
Toxostoma redivivum	California thrasher	FSC	n/a		X		Chaparral, foothills, valley thickets, parks, gardens.	The thrasher breeds from sea level to the higher parts of the montane chaparral. It will breed in adjacent oak woodlands and pine-juniper scrub as well as occasionally in parks and gardens, but only if dense cover is available. Its dispersal is very limited.	X	X							X		X	X	California, n. Baja California	Per communication with PRBO, species may be affected by the FMP plan. It is known to breed in Marin County, including the GGNRA.
MAMMALS[2]																						
Aplodontia rufa phaea	Point Reyes Mountain Beaver	FSC	n/a				Coastal area of Point Reyes in areas of springs or seepages.	North facing slopes of hills & gullies in areas overgrown with sword ferns and thimbleberries.	X								X			X	110 square miles in the Point Reyes area of Marin County	
Arctocephalus townsendi	Guadalupe fur seal	FT	n/a	ST			Protected haul out sites.		X							X		X	X	X	Breeds along the eastern coast of Guadalupe Island, approximately 200 km west of Baja California. In addition, individuals have been sighted in the southern California Channel Islands, including two males who established territories on San Nicolas Island.	Offshore marine species (e.g., whales, pelagic birds) are expected to receive little to no impact from fire management activities

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Balaenoptera borealis	Sei whale	FE	n/a				Offshore marine		X							X		X	X	X	Worldwide, but favors warm waters.	Offshore marine species (e.g., whales, pelagic birds) are expected to receive little to no impact from fire management activities
Balaenoptera musculus	Blue whale	FE	n/a				Offshore marine		X							X		X	X	X	Worldwide and highly migratory. Summers in North Pacific. Not common in coastal waters when in our latitudes.	Offshore marine species (e.g., whales, pelagic birds) are expected to receive little to no impact from fire management activities
Balaenoptera physalus	Finback whale	FE	n/a				Offshore marine		X							X		X	X	X	Worldwide. Migrates to Bering Sea in summer and winters south to the Gulf of California.	Offshore marine species (e.g., whales, pelagic birds) are expected to receive little to no impact from fire management activities
Corynorhinus townsendii townsendii	Pacific western big-eared bat	FSC	n/a		X		Humid coastal regions of northern & central california. Roost in limestone caves, lava tubes, mines, buildings etc.	Will only roost in the open, hanging from walls & ceilings. Roosting sites limiting. Extremely sensitive to disturbance	X		X		X	X	X			X	X	X	Washington, Oregon, California, Nevada, Idaho, and possibly southwestern Montana and northwestern Utah	Minor short-term impacts could be both beneficial (creates food sources) and adverse (some mortality may occur in roosting sites).
Enhydra lutris nereis	Southern sea otter	FT	n/a		X		Near shore marine		X							X			X		Central Californian coast from Pigeon Point near Santa Cruz in San Mateo County, south to Purisma Point north of Point Conception in Santa Barbara County. Individuals sometimes observed farther north (e.g. Tomales Bay).	No large kelp forests present in Project Study Area. Observed at Fitzgerald Marine Reserve. Marine habitat unlikely to be affected by FMP actions.
Eschrichtius robustus	Gray whale	DM	n/a				Offshore marine		X							X		X	X	X	North Pacific: summers far north to Bering Sea and Arctic Ocean, breeds in winter in Gulf of California, Baja.	Offshore marine species (e.g., whales, pelagic birds) are expected to receive little to no impact from fire management activities
Eubalaena glacialis	Right whale	FE	n/a				Offshore marine		X							X		X	X	X	Summers in Gulf of Alaska and Aleutians. Winter range not well known, but observations in Baja and Hawaiian Islands. Right whales prefer coastlines and sometimes large bays, but may spend a lot of time on the open sea. Northern and Southern hemisphere right whale sub-species are separated by the "tropical belt" roughly between the latitudes of 20°N and 20°S.	Offshore marine species (e.g., whales, pelagic birds) are expected to receive little to no impact from fire management activities
Eumetopias jubatus	Steller sea lion	FT, CH	n/a		X		Protected haul out sites.		X							X		X	X	X	Breeds from northern Channel Islands north to Aleutians and Pribilofs. Breeding colony on Ano Nuevo Island.	Historic haul-out at Seal Rock, San Francisco. It is anticipated that FMP actions would not affect habitat supporting Steller's sea-lions, as they are more likely to use rocky shorelines as haulouts.

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Eumops perotis californicus	Greater western mastiff-bat	FSC	n/a		X		Many open, semi-arid to arid habitats, including conifer & deciduous woodlands, coastal scrub, grasslands, chaparral etc	Roosts in crevices in cliff faces, high buildings, trees & tunnels.	X						X			X	X	X	central California, southward to central Mexico. In California, they have been recorded from Butte County southward in the western lowlands through the southern California coastal basins and the western portions of the southeastern desert region	Available records indicate that Mastiff Bats were widespread in the San Joaquin Valley, Salinas Valley, and Coastal lowlands from the San Francisco Bay area southward to San Diego
Megaptera novaeangliae	Humpback whale	FE	n/a		X		Offshore marine		X							X		X	X	X	Worldwide. Migrates to Bering Sea and Gulf of Alaska in summer and winters south to California and Hawaii.	Offshore marine species (e.g., whales, pelagic birds) are expected to receive little to no impact from fire management activities
Myotis evotis	Long-eared myotis	FSC	n/a		X		Found in all brush, woodland & forest habitats from sea level to about 9000 ft. Prefers coniferous woodlands & forests.	Nursery colonies in buildings, crevices, spaces under bark, & snags. Caves used primarily as night roosts.	X					X	X			X	X	X	Southwestern Canada, south through California into Baja, eastward through northern Arizona and New Mexico and north into the Dakotas.	Minor short-term impacts could be both beneficial (creates food sources) and adverse (some mortality may occur in roosting sites).
Myotis thysanodes	Fringed myotis bat	FSC	n/a		X		In a wide variety of habitats, optimal habitats are pinyon-juniper, valley foothill hardwood & hardwood-conifer.	Uses caves, mines, buildings or crevices for maternity colonies and roosts.	X		X			X	X			X	X	X	western North America from southern British Columbia, Canada, south to Chiapas, Mexico and from Santa Cruz Island in California, east to the Black Hills of South Dakota.	Minor short-term impacts could be both beneficial (creates food sources) and adverse (some mortality may occur in roosting sites).
Myotis volans	Long-legged myotis bat	FSC	n/a		X		Most common in woodland & forest habitats above 4000 ft. Trees are important day roosts, caves & mines are night roosts.	Nursery colonies usually under bark or in hollow trees, but occasionally in crevices or buildings.	X		X			X	X			X	X	X	found from the Tongas National Forest in Alaska, south, through all of the western U.S. and into the Baja peninsula, and also along the Sierra Madre Occidental in Mexico.	Minor short-term impacts could be both beneficial (creates food sources) and adverse (some mortality may occur in roosting sites).
Myotis yumanensis	Yuma myotis bat	FSC	n/a		X		Optimal haabitats are open forests and woodlands with sources of water over which to feed.	Distribution is closely tied to bodies of water. Maternity colonies in caves, mines, buildings or crevices.	X		X				X			X	X	X	Throughout western North America, from British Columbia through Washington, Idaho, and western Montana, southern Wyoming, Colorado, New Mexico, West Texas and into Mexico.	
Neotoma fuscipes annectens	San Francisco dusky-footed woodrat	FSC	n/a		X		Forest habitats of moderate canopy & moderate to dense understory. Also in chaparral habitats.	Constructs nests of shredded grass, leaves & other material. May be limited by availability of nest-building materials.	X						X			X	X		Inhabits forest and chapparal throughout the S.F. Bay Area. Prefers a moderate canopy and brushy understory.	
Physeter catodon	Sperm whale	FE	n/a				Offshore marine		X							X		X	X	X	Worldwide, but favors warm waters. Females avoid polar waters.	Offshore marine species (e.g., whales, pelagic birds) are expected to receive little to no impact from fire management activities
Reithrodontomys raviventris	Salt marsh harvest mouse	FE	n/a	SE	X		Salt marsh, wetland.		X			X	X			X		X	X	X	There are two known subspecies divided in two ranges: Northern: found in Marin, Sonoma, Napa, Solano and norhtern Contra Costa counties; Southern. Found in San Mateo, Alameda and Santa Clara counties. Some isolated populations occur in Marin and Contra Costa.	Found in inventory at Rodeo Lagoon (USGS), although this identifcation is in question. Not captured in Big Lagoon Study Area (NPS, 2004). It is anticipated that the salt marsh habitat supporting this species would not be affected by FMP actions. Potential impacts would be discountable or minimized to be insignificant; some activities would not occur in harvest mouse habitat.

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Sorex vagrans halicoetes	Salt marsh vagrant shrew	FSC	n/a				Salt marshes of the south arm of San Francisco Bay.	Medium high marsh 6-8 ft above sea level where abundant driftwood is scattered among salicornia.	X	X						X		X	X		Limited to the salt marshes of the south arm of San Francisco Bay	It is anticipated that the salt marsh habitat supporting this species would be relatively unaffected by FMP actions.
Zapus trinotatus orarius	Point Reyes Jumping Mouse	FSC	n/a		X		Bunch grass marshes on the uplands of Point Reyes in areas safe from continuous inundation.	Eats mainly grass seeds w/ some insects & fruit taken. Builds grassy nests on ground under vegetation, burrows in winter	X	X							X			X	Confined to a small area on the Point Reyes Peninsula.	

KEY: FE (federally endangered), FT (federally threatened), FC (federal candidate), FSC (federal species of concern), CH (designated critical habitat)

[1] "Potential Affect" was determined considering the full implementation of all proposed conservation measures. Although habitat may be present in vicinity of project actions for certain species, marine and estuarine species were considered to have "No affect" from fire management activities as the proposed activities are not planned adjacent to coastal resources.

[2] For bird and mammal species found within the GGNRA, FMU/Project Unit Occurrence were not notated. Birds and mammals occurring in the GGNRA are assumed to migrate throughout the FMU/Project Units.

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GGNRA (not FWS)																						
BIRDS																						
Accipiter cooperi	Cooper's hawk		n/a	SC	X	X	(Nesting) Woodland, Chiefly of open, interrupted or marginal type.	Nest site mainly in riparian growths of deciduous trees, as in canyon bottoms on river flood-plains; also, live oaks.	X		X	X	X	X				X	X	X	All California	Species such as raptors and some owl species (burrowing, western screech) have been shown to increase in numbers after fires (USDA, 2000), and could be beneficially affected because raptors in general are unaffected or respond favorably to burned habitat (Smith, 2000). However, canopy-nesters such as great egrets, red-tailed hawks, white-tailed kites, sparrow hawks, and ravens could be be subject to short-term negatives affects as a result of crown fires.
Accipiter striatus	Sharp-shinned hawk			SC	X	X	(Nesting) ponderosa pine, black oak, riparian deciduous, mixed conifer & jeffrey pine habitats. Prefers riparian areas.	North-facing slopes, with plucking perches are critical requirements. Nests usually within 275 ft of water.	X		X	X	X	X				X	X	X	All California	Species such as raptors and some owl species (burrowing, western screech) have been shown to increase in numbers after fires (USDA, 2000), and could be beneficially affected because raptors in general are unaffected or respond favorably to burned habitat (Smith, 2000). However, canopy-nesters such as great egrets, red-tailed hawks, white-tailed kites, sparrow hawks, and ravens could be be subject to short-term negatives affects as a result of crown fires.
Aquila chrysaetos	Golden Eagle		n/a	SC	X	X	(Nesting & wintering) Rolling foothills mountain areas, sage-juniper flats, desert.	Cliff-walled canyons provide nesting habitat in most parts of range; Also, large trees in open areas.	X	X				X				X		X	All California	
Ardea alba	Great egret (rookery)		n/a		X	X	(Rookery) Colonial nester in large trees.	Rookery sites located near marshes, tide-flats, irrigated pastures, and margins of rivers and lakes.							X			X	X	X	Western half of California into Mexico.	Canopy-nesters such as great egrets, red-tailed hawks, white-tailed kites, sparrow hawks, and ravens - could be be subject to short-term negatives affects as a result of crown fires.
Buteo swainsoni	Swainson's hawk			T	X	X	Breeds in riparian systems adjacent to suitable foraging habitats, mainly open grasslands and agricultural fields. Swainson's hawks require large, open grasslands with abundant prey in association with suitable nest trees. Suitable foraging areas include native grasslands or lightly grazed pastures, alfalfa and other hay crops, and certain grain and row croplands. Winters in Mexico and South America.		X					X							Currently, Swainson's hawks in California are restricted to portions of the Central Valley and Great Basin regions where suitable nesting and foraging habitat is still available. Central Valley populations are centered in Sacramento, San Joaquin, and Yolo counties.	Current breeding range is outside of FMP project area.

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Callipepla californica	California quail				X	X	Primarily inhabits chapparal, coastal scrub, and grassland oak habitats; however, adaptable to riparian, woodlands, and some agricultural lands. Often forage on open or disturbed lands.		X		X	X	X		X						Much of California.	A common breeder in Marin and San Mateo Counties that will be protected by breeding season restrictions on FMP actions. The Presidio supports the largest known remaining breeding population in San Francisco County: currently estimated to be 20 or so individuals.
Catharus ustulatus	Swainson's thrush		n/a		X	X	In western mountains and along Pacific coast, often in dense riparian willows or alders. They may be found in both undisturbed or disturbed woodlands with dense understory, often near canopy gaps produced by fallen trees or other disturbances.		X		X		X		X			X	X	X	Breeding range is from Alaska through central Canada and portions of the northern U.S. Breeding range extends south into the Rocky Mountains into Utah, Colorado, and New Mexico. Distinct population on Pacific slope from British Columbia to southern California. Neotropical migrant.	Some species, such as California quail and Swainson's thrush are known to decline in the first few years after shrubland and forest fires (Lawrence, 1966, Lyon and Marzluff, 1985).
Chamaea fasciata	Wrentit		n/a		X	X	Varied habitat types in California that provide low, dense cover.		X		X	X	X				X		X	X	Pacific coast from Oregon through California to northern Baja California. Birds in the northern part of the range (Oregon) were recently described as defining a distinct subspecies.	Definite concern about this apecies in San Francisco County, where remaining birds in Golden Gate Park are thought to be declining or extirpated.
Chondestes grammacus	Lark Sparrow		n/a		X	X	Grasslands.										X		X	X	Grasslands and sagebrush areas in western U.S.	
Circus cyaneus	Northern harrier			SC	X	X	(Nesting) coastal salt & fresh-water marsh. Nest & forage in grasslands, from salt grass in desert sink to mtn cienagas.	Nests on ground in shrubby vegetation, usually at marsh edge; nest built of a large mound of sticks in wet areas.	X							X				X	All California	It is not anticipated that the habitat utliized by this speceis would be affected by FMP actions
Columba fasciata	Band-tailed pigeon		n/a		X	X	Hardwood and coniferous forests.		X								X			X	Forested habitat in California.	
Contopus borealis	Olive-side flycatcher		n/a		X	X	Hardwood and coniferous forests.				X	X	X	X				X	X	X	Forested habitat in California.	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.
Dendroica nigrescens	Black-throated gray warbler		n/a		X	X	Forested habitat.				X		X			X			X	X	Forested habitat in California.	It is anticipated that riparian habitats supporting this species would be relatively unaffected by FMP actions, therefore it is anticipated that the effects on populations of these species would be minor, with potential benefical impacts from invasive species control and restoration of ecosytem processes.
Dendroica occidentalis	Hermit Warbler		n/a		X	X	(Nesting) coast redwood forests & interior mixed deciduous & coniferous forests farther inland.	Require cool, dark, moist forests for breeding.	X		X		X			X				X	Forested areas of California.	It is anticipated that riparian habitats supporting this species would be relatively unaffected by FMP actions, therefore it is anticipated that the effects on populations of these species would be minor, with potential benefical impacts from invasive species control and restoration of ecosytem processes.

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Dendroica petechia brewsteri	Yellow warbler		n/a	SC	X	X	(Nesting) riparian plant associations. Prefers willows, cottonwoods, aspens, sycamores, & alders for nesting & foraging.	Also nests in montane shrubbery in open conifer forests.	X							X		X	X	X	Neotropical migrant. Breeds in riparian habitat and wet meadows in California.	It is anticipated that riparian habitats supporting this species would be relatively unaffected by FMP actions, therefore it is anticipated that the effects on populations of these species would be minor, with potential benefical impacts from invasive species control and restoration of ecosytem processes.
Empidonax difficilis	Pacific-slope flycatcher		n/a		X	X	Coniferous and hardwood forests.				X		X	X					X	X	Neotropical migrant. Breeds in forested habitat in California.	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.
Eremophila alpestris actia	California horned lark			SC	X	X	Coastal regions, chiefly from Sonoma Co. to San Diego co. Also main part of San Joaquin valley & east to foothills.	short-grass prairie, "bald" hills, mountain meadows, open coastal plains, fallow grain fields, alkali flats.	X								X			X	Found in short grass and disturbed lands.	Mechanical removal and other FMP actions would occur outside much of nesting season, and limited number of acres burned each year, therefore it is anticipated that the effects on populations of
Falco columbarius	Merlin			SC	X	X	(Wintering) seacoast, tidal estuaries, open woodlands, savannahs, edges of grasslands & deserts, farms & ranches.	Clumps of trees or windbreaks are required for roosting in open country.	X								X		X	X	Breeds in Canada and northern Rocky Mountains. Often in California coastal areas in winter.	Mechanical removal and other FMP actions would occur outside much of nesting season, and limited number of acres burned each year, therefore it is anticipated that the effects on populations of
Larus occidentalis	Western Gull		n/a		X	X	Nests on rocky cliffs and nearshore and offshore islands.		X				X			X		X	X	X	Coastal areas of California. Large breeding colony on Farallones Islands, and colony on Alcatraz is about 1,000 breeding pairs.	Offshore marine species (e.g., whales, pelagic birds) are expected to receive little to no impact from fire management activities
Oporornis tolmiei	MacGillivray's warbler		n/a		X	X	Riparian habitats and wet meadows.		X							X			X	X	Throughout state in riparian and wet meadow habitat.	It is anticipated that riparian habitats supporting this species would be relatively unaffected by FMP actions, therefore it is anticipated that the effects on populations of these species would be minor, with potential benefical impacts from invasive species control and restoration of ecosytem processes.
Otus kennicottii	Western screech owl				X	X	Hardwood and coniferous forests.		X					X				X	X	X	Hardwood and coniferouse forestes in western U.S.	Species such as raptors and some owl species (burrowing, western screech) have been shown to increase in numbers after fires (USDA, 2000), and could be beneficially affected because raptors in general are unaffected or respond favorably to burned habitat (Smith, 2000).
Pandion halaetus	Osprey			SC	X	X	(Nesting) ocean shore, bays, fresh-water lakes, and larger streams.	Large nests built in tree-tops within 15 miles of good fish-producing body of water.	X							X			X	X	California coast, Pacific NW, etc.	Species such as raptors and some owl species (burrowing, western screech) have been shown to increase in numbers after fires (USDA, 2000), and could be beneficially affected because raptors in general are unaffected or respond favorably to burned habitat (Smith, 2000).
Phalacrocorax penicillatus	Brandt's cormorant		n/a		X	X	Rocky cliffs on outer coast and into S.F. Bay.		X							X		X	X	X	Coastal areas of California. Large breeding colony on Farallones Islands, and colony on Alcatraz is about 700 breeding pairs.	Offshore marine species (e.g., whales, pelagic birds) are expected to receive little to no impact from fire management activities

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Pheucticus melanocephalus	Black-headed grosbeak		n/a		X	X	Riparian habitat and some forests.		X								X		X	X	Riparian and forested areas of California.	Mechanical removal and other FMP actions would occur outside much of nesting season, and limited number of acres burned each year,
Picoides nuttallii	Nuttall's woodpecker		n/a		X	X	Forested habitat.		X								X	X	X	X	Forested areas of California.	Mechanical removal and other FMP actions would occur outside much of nesting season, and limited number of acres burned each year, therefore it is anticipated that the effects on populations of these species would be minor, with potential benefical impacts from invasive species control and restoration of ecosytem processes. Rare in San Francisco.
Poecile rufescens	Chestnut-backed chickadee		n/a		X	X	Forested habitat.		X								X	X	X	X	Forests habitats in northwestern portion of California, up into Northwest U.S.	Mechanical removal and other FMP actions would occur outside much of nesting season, and limited number of acres burned each year, therefore it is anticipated that the effects on populations of these species would be minor, with potential benefical impacts from invasive species control and restoration of ecosytem processes. Rare in San Francisco.
Progne subis	Purple martin		n/a	SC	X	X	(Nesting) inhabits woodlands, low elevation coniferous forest of douglas fir, ponderosa pine, & monterey pine.	Nests in old woodpecker cavities mostly, also in human-made structures. Nest often located in tall, isolated tree/snag.	X								X		X	X	Low elevation forested habitat in California.	Mechanical removal and other FMP actions would occur outside much of nesting season, and limited number of acres burned each year, therefore it is anticipated that the effects on populations of these species would be minor, with potential benefical impacts from invasive species control and restoration of ecosytem processes.
Vireo gilvus	Warbling vireo		n/a		X	X	Shows a strong association with mature mixed deciduous woodlands especially along riparian corridors throughout range. Found at edges or openings (both natural and human-made) as well as forest interiors. In general, overall habitat structure consists of large trees with a semi-open canopy; apparently indifferent to density of undergrowth. Other habitats include urban parks and gardens; orchards; farm fencerows; campgrounds; deciduous patches in pine forests; mixed hardwood forests; and, rarely, pure coniferous forests.		X		X	X	X				X	X	X	X	Currently, the breeding range extends from the Canadian border south to the Santa Ana mountains (Orange County), San Bernadino mountains (San Bernadino County), Tehachapi mountains (Kern County), and east-central White and Inyo mountains (Inyo County), exclusive of the entire Central Valley.	Mechanical removal and other FMP actions would occur outside much of nesting season, and limited number of acres burned each year, therefore it is anticipated that the effects on populations of these species would be minor, with potential benefical impacts from invasive species control and restoration of ecosytem processes.

Scientific Name	Common Name	Legal Status			Noted in GGNRA Records	GGNRA management concern not on USFWS list	Habitat requirement and/or association	Micro habitat	Habitat Present in Planning Area	Occurrence known in FMU/ Project Unit				Potential Effect that Could Result from FMP Actions[1]				County Distribution			Species Distribution / Range	Comments
		Federal	CNPS	State						None	Muir Woods	WUI	Interior	Benefical	Negative	No affect	Unknown	San Francisco	San Mateo	Marin		
MAMMALS																						
Antrozous pallidus	Pallid bat				X	X	Pallid bats roost in rock crevices, buildings, and bridges in arid regions. The pallid bat is known for its unique habit of feeding almost entirely from the ground. Its most common prey include crickets, beetles, grasshoppers, and even scorpions		X					X	X						They are found from Mexico and the southwestern United States north through Oregon, Washington, and western Canada.	Minor short-term impacts could be both beneficial (creates food sources) and adverse (some mortality may occur in roosting sites).
FISH																						
Lavinia symmetricus ssp. 2	Tomales roach				X	X			X							X						
INVERTEBRATES																						
Anodonta californiensis	California floater (mussel)	FSC	n/a		X	X	Freshwater lakes and slow moving streams and rivers.	Generally in shallow water	X													It is anticipated that the habitat supporting this species would be unaffected by FMP actions as habitat
Caecidotea tomalensis	Tomales asellid	FSC	n/a		X	X	Inhabits localized freshwater ponds or streams with still or near-still water in several bay area counties.		X													It is anticipated that the habitat supporting this species would be unaffected by FMP actions as habitat
Danaus plexippus	Monarch butterfly				X	X	Utilize eucalyptus and Monterey cypress and pine trees for clustering sites during winter.		X			X	X		X			X	X	X	Southern Canada south through all of the United States, Central America, and most of South America. Also present in Australia, Hawaii, and other Pacific Islands. Overwinters mainly in Mexico and California.	Mitigations would reduce impacts to monarchs to less than significant.
PLANTS																						
Calochortus umbellatus	Oakland star tulip		4		X	X	Chaparral, lower montane coniferous forest, broadleafed upland forest, valley and foothill grassland.	Often on serpentine. 100-700m.	X		X						X				s Outer North Coast Ranges, San Francisco Bay Area .	Occurrs in the SFWD, MVAFB, & Nicasio Ridge. Special Status Vascular Plant Species Monitoring Report GGNRA 2001. Recently discovered in the vicinity of Muir Woods in non-serpentine grasslands (NPS, 2004)
Ceanothus gloriosus var. exaltatus	Glory Bush		4		X	X	Chaparral.	100-610m.	X				X	X						X	North Coast, Outer North Coast Ranges, n San Francisco Bay Area	Occurs on south Bolinas Ridge only. Special Status Vascular Plant Species Monitoring Report GGNRA 2002.
Ceanothus gloriosus var. gloriosus	Point Reyes ceanothus		4		X	X	Closed-cone coniferous forest, coastal dunes, coastal scrub, coastal bluff scrub.	Usually on bluffs along the coast in sandy soils, but also known from more inland sites. 5-500m.	X	X										X	s North Coast, n Central Coast (Marin Co.)	
Elymus californicus	California bottle-brush grass	FSC	4		X	X	North coast coniferous forest, cismontane woodland, riparian woodland.	In sandy humus soils. 15-455m.	X				X	X							North Coast, Outer North Coast Ranges, n Central Coast, San Francisco Bay Area (Santa Cruz Mtns)	Occurs in the GGNRA, Muir Woods, and SFWD. Special Status Vascular Plant Species Monitoring Report. GGNRA 2001
Malacothamnus fasciculatus var. nesioticus	Santa Cruz island bush mallow	FE	1B	SE	X	X	Coastal scrub, chaparral.	Steep slopes and outcrops. 30-215m.	X	X											Inner North Coast Ranges (Mendocino Co.), interior San Francisco Bay Area, Outer South Coast Ranges, Southwestern California, sw edge Mojave Desert	Occurs in SFWD, no occurences in Project Study Area. Special Status Vascular Plant Species Monitoring Report. GGNRA 2001

Appendix G – Minimum Impact Suppression Tactics (MIST) Guidelines Implementation

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Appendix G – Minimum Impact Suppression Tactics (MIST) Guidelines Implementation

Keep this question in mind: What creates the greater impact, the fire suppression effort or the fire?

Safety

- Apply principles of LCES to all planned actions.
- Constantly review and apply the 18 Watchout Situations and 10 Standard Firefighting Orders.
- Be particularly cautious with:
    - Burning snags allowed to burn.
    - Burning or partially burned live and dead trees.
    - Unburned fuel between you and the fire.

Escape Routes and Safety Zones

- In any situation, the best escape routes and safety zones are those that already exist. Identifying natural openings, existing roads, and trails and taking advantage of safe black will always be a preferred tactic compatible with MIST. If safety zones must be created, follow guidelines similar to those for helispot construction.
- Constructed escape routes and safety zones in heavier fuels will have a greater impact and will be more time-consuming, labor-intensive, and ultimately less safe.

General Considerations

- Consider the potential for introduction of noxious weeds and mitigate by removing weed seed from vehicles, personal gear, cargo nets, etc. Equipment should be washed down prior to leaving the incident in order to prevent the spread of noxious weeds.
- Consider impacts on riparian areas when setting up water handling operations.
    - Use longer draft hoses to place pumps out of sensitive riparian areas.
    - Plan travel routes for filling bladder bags to avoid sensitive riparian areas.
- Ensure adequate spill containment at fuel transfer sites and pump locations. Stage spill containment kits at the incident.
- Select tactics, tools, and equipment that least affect the environment.
    - Give serious consideration to use of water or foam as a firelining tactic.
    - Use alternative mechanized equipment such as motor patrols, disks, rubber-tired skidders, etc., when available and appropriate rather than dozers when constructing mechanical line.

When constructed fire line is necessary, use only the width and depth to prevent the fires spread.

- Allow fire to burn to natural barriers and existing roads and trails.
- Monitor and patrol fire lines to ensure continued effectiveness.

Ground Fuels

- Use cold-trail, wet line, or combination when appropriate. If constructed fire line is necessary, use minimum width and depth to stop fire spread.
- Consider the use of fire line explosives (FLE) for line construction and snag falling to create more natural-appearing fire lines and stumps.
- Burn out and use low-impact tools like swatters and gunny sacks.
- Minimize bucking to establish fire line: preferably move or roll downed material out of the intended constructed fire line area. If moving or rolling out is not possible, or the downed log/bole is already on fire, build line around it and let the material be consumed.

Aerial Fuels – Brush, Trees, and Snags

- Adjacent to fire line: limb only enough to prevent additional fire spread.
- Inside fire line: remove or limb only those fuels that would have potential to spread fire outside the fire line.
- Cut brush or small trees necessary for fire line construction flush to the ground.
- Trees, burned trees, and snags:
    - Minimize cutting of trees, burned trees, and snags.
    - Do not cut live trees unless it is determined they will cause fire spread across the fire line or seriously endanger workers.
    - Cut stumps flush with the ground.
    - Scrape around tree bases near fire line if hot and likely to cause fire spread.
    - Identify hazard trees with flagging, glowsticks, or a lookout.
- When using indirect attack:
    - Do not fall snags on the intended unburned side of the constructed fire line unless they are an obvious safety hazard to crews.
    - Fall only those snags on the intended burn-out side of the line that would reach the fire line should they burn and fall over.

Mop-Up Phase

- Consider using “hot-spot” detection devices along perimeter (aerial or handheld).
- Use extensive cold-trailing to detect hot areas.
- Cold-trail charred logs near fire line: do minimal scraping or tool scarring. Restrict spading to hot areas near fire line.
- Minimize bucking of logs to check for hot spots or extinguish fire, preferably roll the logs and extinguish the fire.
- When ground is cool return logs to original position after checking.
- Refrain from piling: burned/partially burned fuels that were moved should be arranged in natural positions as much as possible.
- Consider allowing larger logs near the fire line to burn out instead of bucking into manageable lengths. Use a lever, etc., to move large logs.
- Use gravity socks in stream sources and/or combination of water blivets and fold-a-tanks to minimize impacts on streams.
- Personnel should avoid using rehabilitated fire lines as travel corridors whenever possible because of potential soil compaction and possible detrimental impacts on rehabilitation work.
- Avoid use of nonnative materials for sediment traps in streams.
- Aerial fuels (brush, small trees, and limbs): remove or limb only those fuels that if ignited have potential to spread fire outside the fire line.
- Burning trees and snags:
    - Be particularly cautious when working near snags. (Ensure adequate safety measures are communicated.)
    - The first consideration is to allow a burning tree/snag to burn itself out or down.
    - Identify hazard trees with flagging, glowsticks, or a lookout.
    - If there is a serious threat of spreading firebrands, extinguish with water or dirt.
    - Consider felling by blasting, if available.

Aviation Management

Minimize the impacts of air operations by incorporating MIST in conjunction with standard aviation risk assessment processes.

- Possible aviation-related impacts include:

  - Damage to soils and vegetation resulting from heavy vehicle traffic, noxious weed transport, and/or extensive modification of landing sites.
  - Impacts on soil, fish, and wildlife habitat and water quality from hazardous material spills.
  - Chemical contamination from use of retardant and foam agents.
  - Biological contamination to water sources; e.g., whirling disease.
  - Safety and noise issues associated with operations in proximity to populated areas, livestock interests, wildland urban interface, and incident camps and staging areas.

- Helispot Planning

  - When planning for helispots, determine the primary function of each helispot; e.g., crew transport or logistical support.
  - Consider using long-line remote hook in lieu of constructing a helispot.
  - Consult Resource Advisors in the selection and construction of helispots during incident planning.
  - Estimate the amount and type of use a helispot will receive and adapt features as needed.
  - Balance aircraft size and efficiency against the impacts of helispot construction.
  - Use natural openings as much as possible. If tree felling is necessary, avoid high visitor-use locations unless the modifications can be rehabilitated. Fall, buck, and limb only what is necessary to achieve a safe and practical operating space.

Retardant, Foam, and Water Bucket Use

- Assess risks to sensitive watersheds from chemical retardants and foam. Communicate specific drop zones to air attack and pilots, including areas to be avoided.

- Fire managers should weigh use of retardant with the probability of success by unsupported ground force. Retardant may be considered for sensitive areas when benefits will exceed the overall impact. This decision must take into account values at risk and consequences of expanded fire response and impact on the land.

- Consider biological and/or chemical contamination impacts when transporting water.

- Limited water sources expended during aerial suppression efforts should be replaced. Consult Resource Advisors prior to extended water use beyond initial attack.

Logistics, Camp Sites, and Personal Conduct

- Consider impacts on present and future visitors.

- Provide portable toilets at areas where crews are staged.

- Good campsites are found, not made. If existing campsites are not available, select campsites not likely to be observed by visitors.

- Select impact-resistant sites such as rocky or sandy soil, or openings within heavy timber. Avoid camping in meadows and along streams or shores.
- When there is a small group, try to disperse use. In the case of larger camps, concentrate, mitigate, and rehabilitate.
- Coordinate the layout of the camp components carefully from the start. Help to define cooking, sleeping, latrine, and water supplies areas.
- Prepare bedding and campfire sites with minimal disturbance to vegetation and ground.
- Personal Sanitation:
    - Designate a common area for personnel to wash up. Provide fresh water and biodegradable soap.
    - Do not introduce soap, shampoo, or other chemicals into waterways.
    - Dispose of wastewater at least 200 feet from water sources.
    - Toilet sites should be located a minimum of 200 feet from water sources. Holes should be dug 6 to 8 inches deep.
    - If more than one crew is camped at a site, strongly consider portable toilets and remove waste.
- Store food so that it is not accessible to wildlife, away from camp and in animal-resistant containers.
- Do not let garbage and food scraps accumulate in camp.
- Monitor travel routes for damage and mitigate by:
    - Dispersing on alternate routes; or
    - Concentrating travel on one route and rehabilitating at end of use.
- If a campfire is built, leave no trace of it and avoid using rock rings. Use dead and down wood for the fire and scatter any unused firewood. Do not burn plastics or metal.
    - Consider using a fire pan or “mound fire” in sensitive areas.
- Use “scrim” (porous ground cloth) to protect high-traffic areas from trampling.

Restoration and Rehabilitation

- Fire lines:
    - After fire spread has stopped and lines are secured, fill in deep and wide fire lines and cup trenches and obliterate any berms. The berm material should be spread back into the fire line or recontoured to the fire line.
    - Be careful not to reignite or spread hot material hidden in berms across the fire line.

- Restore drainages by removing fill or dams, reestablish crossings, and return to natural configuration.
- Use waterbars only when necessary to prevent erosion or use woody material to act as sediment dams. Waterbars should only be used on steep slopes and only when necessary. General guidelines for waterbar spacing are listed in the table below. However, it is important to note that improper construction and inappropriate placement of waterbars can create excessive erosion.
- Ensure stumps are cut flush with ground.
- Camouflage cut stumps by flush-cutting, chopping, covering, or using FLE to create more natural-appearing stumps.
- Any trees or large size brush cut during fire line construction should be scattered to appear natural.
- Discourage the use of newly created fire lines and trails by blocking with brush, limbs, poles, and logs in a natural-appearing arrangement.

Maximum Waterbar Spacing General Guidelines	
Percent Grade	Maximum Spacing (Feet)
< 9	400
10 – 15	200
15 – 25	100
25 +	50

- Camps:
  - Restore campsite to natural conditions.
  - Scatter fireplace rocks and charcoal from fire, cover fire ring with soil, and blend area with natural cover.
- Pack out all garbage and dispose of in an approved facility.
- General:
  - Remove all signs of human activity.
  - Remove all flagging.
  - Restore helicopter landing sites.
  - Fill in and cover latrine sites.
- Walk through adjacent undisturbed areas and take a look at your rehabilitation efforts to determine your success at returning the area to as natural a state as possible.

Appendix H – Response to Comments on the Draft Environmental Impact Statement

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Appendix H – Response to Comments on the Draft Environmental Impact Statement

I. Introduction

In accordance with the National Environmental Policy Act (NEPA) and National Park Service (NPS) policy on compliance with NEPA, the NPS has considered and responded to all substantive comments received during the public comment period for the Golden Gate National Recreation Area (GGNRA) Fire Management Plan Draft Environmental Impact Statement (DEIS). Substantive comments are generally defined by NPS NEPA guidance as those that raise debate or question the accuracy of the information presented, the adequacy of the range of alternatives, or assessment conducted. A total of twelve comment letters were received. Some comments called for the clarification of information presented in the DEIS while other comments required minor text modifications which have been made in the Final Environmental Impact Statement (FEIS). No responses are provided to comments that merely expressed opinions and did not identify a question or needed clarification, correction, or modification.

A notice of availability for the DEIS was published in the Federal Register and the document made available for public review and comment on March 18, 2005. The NPS also provided the notice of availability of the DEIS through a direct mailing and posting on the park's website. The DEIS was made available for review at park headquarters, park visitor centers, local and regional libraries, and on the park's website. The Federal Register noticed a 60-day public comment period ending on May 17, 2005 but this was extended to May 27, 2005 to ensure adequate review time. Notification to the public of the extended deadline was made on the park's website and through announcements at public presentations.

The NPS made two public presentations to provide an informational overview about the DEIS to the public. The first presentation was given at the Pacifica City Council chambers on the evening of April 11, 2005 during the regular City Council meeting. The second presentation was held at the park's regularly scheduled, bi-monthly public meeting on the evening of April 19, 2005 at the San Francisco Bay Model building in Sausalito. At each of the meetings, NPS staff gave an overview of fire management planning and the alternatives studied in the DEIS. The presentations were followed by informal discussion with park staff and the public was encouraged to submit comments on the DEIS via email, fax, or regular mail. The email and mailing addresses for submitting comments on the DEIS were prominently posted at each meeting, printed on workshop handouts and posted on the park's FMP website.

The Notice of Availability and copies of the FEIS will be mailed to the same distribution list as the DEIS. The FEIS will be available on the GGNRA website at: http://parkplanning.nps.gov/goga and upon request.

Appendix H to the FEIS is structured as follows:

I. Introduction

II. Comment Letters and Response to Comments. The GGNRA received a total of twelve comment letters on the DEIS. The letters in Appendix H are organized by government agencies, organizations, and individuals. Each letter has been assigned a number (Letter 1, for example) with each substantive comment per letter assigned a corresponding additional number (Comment 1-1, for example). To help track the responses to comments, each specific comment is presented before the response in the form of a brief paraphrase. Any changes that have been made to the FEIS text in response to a specific comment are noted in the response to that comment with *italicized* text to mark additions and ~~strikeout~~ text to note deletions.

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II. Comment Letters and Response to Comments

Letter 1

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION IX
75 Hawthorne Street
San Francisco, CA 94105-3901

RECEIVED
JUN 16 2005
SUPERINTENDENT'S OFFICE

June 13, 2005

Brian O'Neill
General Superintendent
Golden Gate National Recreation Area
Building 201, Fort Mason
San Francisco, CA 94123
Attention: Fire Management

Subject: Draft Environmental Impact Statement (DEIS) for the Golden Gate National Recreation Area Fire Management Plan, San Mateo, San Francisco, and Marin Counties, California (CEQ #050104)

Dear Mr. O'Neill:

The U.S. Environmental Protection Agency (EPA) has reviewed the above-referenced document pursuant to the National Environmental Policy Act (NEPA), Council on Environmental Quality (CEQ) regulations (40 CFR Parts 1500-1508) and Section 309 of the Clean Air Act. We are aware that comments on the above document were due to the Golden Gate National Recreation Area (GGNRA) on May 27, 2005. Our comments are provided in accordance with the EPA-specific extension to the deadline date from May 27, 2005 to June 13, 2005 granted by Wendy Poinsot, the Project Leader (telephone conversation between Laura Fujii and Wendy Poinsot, May 12, 2005).

EPA recognizes the need for fire management actions on GGNRA lands for fire hazard reduction and resource benefit. The Fire Management Plan will provide the framework for fire management actions for the GGNRA over the next 10-15 years. We commend the commitment to specific mitigation measures as described in Chapter 2 Section 2.7 (pps. 94-110). Of note is the reuse and recycling of mechanically removed wood such as eucalyptus wood into firewood, woody debris in stream restoration projects, and flooring (p. 83).

Based on our review, we have rated the DEIS as Environmental Concerns - Insufficient Information (EC-2). We have concerns regarding smoke management and protection of air quality, water quality, wetlands, and the use of herbicides. Please see the enclosed Detailed Comments for a description of these concerns and our recommendations. A *Summary of EPA Rating Definitions* is enclosed.

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We appreciate the opportunity to review this DEIS. When the Final EIS is released for public review, please send two copies to the address above (mail code: CED-2). If you have questions, please contact me or Laura Fujii, the lead reviewer for this project. Laura can be reached at 415-972-3852 or fujii.laura@epa.gov

Sincerely,

Nova Blazej, Acting Manager
Environmental Review Office
Communities and Ecosystems Division

Enclosures:
Summary of EPA Rating Definitions
EPA's Detailed Comments

cc: Bay Area Air Quality Management District

U.S. Environmental Protection Agency Rating System for
Draft Environmental Impact Statements
Definitions and Follow-Up Action*

Environmental Impact of the Action

LO – Lack of Objections

The U.S. Environmental Protection Agency (EPA) review has not identified any potential environmental impacts requirir substantive changes to the proposal. The review may have disclosed opportunities for application of mitigation measures that could be accomplished with no more than minor changes to the proposal.

EC – Environmental Concerns

EPA review has identified environmental impacts that should be avoided in order to fully protect the environment. Corrective measures may require changes to the preferred alternative or application of mitigation measures that can reduce these impacts.

EO – Environmental Objections

EPA review has identified significant environmental impacts that should be avoided in order to provide adequate protection for the environment. Corrective measures may require substantial changes to the preferred alternative or consideration of some other project alternative (including the no-action alternative or a new alternative). EPA intends to work with the lead agency to reduce these impacts.

EU – Environmentally Unsatisfactory

EPA review has identified adverse environmental impacts that are of sufficient magnitude that they are unsatisfactory from the standpoint of public health or welfare or environmental quality. EPA intends to work with the lead agency to reduce these impacts. If the potential unsatisfactory impacts are not corrected at the final EIS stage, this proposal will be recommended for referral to the Council on Environmental Quality (CEQ).

Adequacy of the Impact Statement

Category 1 – Adequate

EPA believes the draft EIS adequately sets forth the environmental impact(s) of the preferred alternative and those of the alternatives reasonably available to the project or action. No further analysis of data collection is necessary, but the reviewer may suggest the addition of clarifying language or information.

Category 2 – Insufficient Information

The draft EIS does not contain sufficient information for EPA to fully assess environmental impacts that should be avoided in order to fully protect the environment, or the EPA reviewer has identified new reasonably available alternatives that are within the spectrum of alternatives analyzed in the draft EIS, which could reduce the environmental impacts of the action. The identified additional information, data, analyses or discussion should be included in the final EIS.

Category 3 – Inadequate

EPA does not believe that the draft EIS adequately assesses potentially significant environmental impacts of the action, or the EPA reviewer has identified new, reasonably available alternatives that are outside of the spectrum of alternatives analyzed in the draft EIS, which should be analyzed in order to reduce the potentially significant environmental impacts. EPA believes that the identified additional information, data, analyses, or discussions are of such a magnitude that they should have full public review at a draft stage. EPA does not believe that the draft EIS is adequate for the purposes of the National Environmental Policy Act and or Section 309 review, and thus should be formally revised and made available for public comment in a supplemental or revised draft EIS. On the basis of the potential significant impacts involved, this proposal could be a candidate for referral to the CEQ.

* From EPA Manual 1640 Policy and Procedures for the Review of Federal Actions Impacting the Environment. February, 1987.

EPA DETAILED COMMENTS ON THE DRAFT ENVIRONMENTAL IMPACT STATEMENT (DEIS) FOR THE GOLDEN GATE NATIONAL RECREATION AREA FIRE MANAGEMENT PLAN, JUNE 13, 2005

Air Quality

1. Alternative C, the National Park Service (NPS) preferred alternative, would allow, annually, a maximum of 275 acres of mechanical fuel treatment and 320 acres subject to prescribed burning (p. 83). This is the greatest number of acres proposed for treatment, over twice the number of acres treated under Alternative A, No Action - 1993 Fire Management Plan. In addition, Golden Gate National Recreation Area (GGNRA) is adjacent to a highly populated region with approximately 38 miles of wildland urban interface (WUI) at risk from fires and smoke generated by fire management activities. The Fire Management Plan (FMP) and Final EIS (FEIS) should highlight measures to manage smoke and address adverse air quality effects.

Recommendations:

1-1a The Executive Summary should include information on smoke management and protection of air quality. For instance, Table ES-2: Summary of Impacts, Visitor Use and Visitor Experience, should include smoke impacts from prescribed burning such as potential adverse effects to public health, reduced visibility, and smoke irritation.

1-1b FMP Goals (pps. iv-v) should include a goal specific to smoke management and protection of air quality. This goal can emphasize the use of a Smoke Management Plan (SMP) to address smoke and air quality issues.

1-1c Smoke management practices that will be used to protect air quality and public health should be highlighted in the FEIS.

1-1d An option is to include a separate heading in Chapter 4 - Environmental Consequences for smoke management.

2. The DEIS states: "All prescribed burning at Point Reyes National Seashore (PRNS) and GGNRA would continue to be planned and performed under the auspices of the Bay Area Air Quality Management District (BAAQMD) Smoke Management Program, which in turn is incorporated into the State Implementation Plan (SIP)." (Chapter 4, p. 300). EPA does not have a SIP from BAAQMD that contains a Smoke Management Program.

Recommendation:

1-2 The FEIS should describe how the Smoke Management Plan relates to the SIP. State GGNRA compliance with State and local air district regulations.

3. Recommendations for reducing exposure of firefighters to carbon monoxide (CO), aldehydes, and particulates while working prescribed fires are described in the DEIS (p. 424). The increased amount of prescribed burning proposed in the preferred alternative would increase the exposure of NPS firefighters to the above irritants.

1

Recommendation:

1-3 EPA recommends that the FEIS and the Record of Decision (ROD) commit to the recommended measures (p. 424) to reduce smoke exposure of firefighters during prescribed burning.

4. The GGNRA region is nonattainment for ozone and particulate matter and must conform to the federally approved SIP (p. 172). Historically GGNRA has ensured conformity of their fire management plan by ensuring all prescribed burning is planned and implemented in accordance with the BAAQMD Smoke Management Program (p. 175). While the DEIS lists requirements of Section 176 of the Clean Air Act regarding general conformity, it does not state de minimus levels that trigger the need for a conformity determination.

Recommendation:

1-4 The FEIS should state the de minimus levels and whether general conformity is required.

Water Quality

1. Fire roads can be a major cause of water quality problems and adverse impacts to aquatic ecosystems due to their contribution to sediment loads, subsequent in-stream habitat modifications and increased run-off. Other than Figure 2-7 Fire Roads (p.71) and a short description of roadside fuel reduction, the condition of fire roads and their contribution to water quality effects is not described or addressed.

Recommendation:

1-5 The FEIS should address the water quality and aquatic effects of roads by describing the status and management of the GGNRA fire road system. The FEIS should identify avoidance and mitigation measures that are necessary to minimize impacts. For instance, the FEIS should describe the density of roads per watershed; whether fire roads are a major contributor to water quality and aquatic resource impacts; and direction for the maintenance, closure, and designated uses of the fire roads. Because of the environmental impacts of fire roads, we recommend retiring the roads identified on Figure 2-7 (p. 71) as "possibly retire" and identifying the miles of proposed road retirement.

2. The DEIS states that herbicides will be used to control nonnative trees and brush that vigorously resprout (p. 84). Use of herbicides is of concern because of their potential impacts to water quality, fish and wildlife, and human health and safety. We understand that all herbicide use would be administered through the GGNRA integrated pest management coordinator and applied by a state-licensed pesticide applicator (p. 234). However, in the interest of full disclosure, we recommend additional information on proposed herbicide use be included in the FEIS. A project-specific environmental analysis should be considered if extensive use of herbicides is proposed.

Recommendations:

1-6 The FEIS should include additional information regarding herbicide use. Provide a description and environmental evaluation of frequently used herbicides (e.g., EPA Registration Number, key characteristics, environmental effects), frequency of use, the potential for multiple applications, and proposed measures to protect wetlands, sensitive resources, the public, and firefighters.

The FEIS should specify that:

1) The pesticides used must be registered with EPA and the California Department of Pesticide Regulation and used according to the label directions and Federal and State pesticide laws (Executive Order 12088).

2) Since the regulatory status of chemicals can constantly change, a review of the current status of all herbicides considered for use should be conducted prior to each application season.

3. Sensitive watersheds are located within GGNRA with highly erodible Franciscan Complex soils, steep slopes, and unstable geology, which can result in high erosion rates and sensitivity to disturbance (p. 165). In addition, there are specific water bodies such as Rodeo Lagoon which already experience water quality problems (p. 168).

Recommendation:

1-7 The FEIS should commit to project-specific environmental analyses whenever fire management activities are proposed in sensitive watersheds, near water bodies with existing water quality problems, or near key resources, such as Bolinas Lagoon. The analyses should evaluate the potential for erosion and sedimentation, nutrient inputs, and other adverse impacts to resources at risk.

4. Although the DEIS states that water quality monitoring has been conducted, it does not provide a summary of monitoring results or describe the specific water quality of specific water bodies (p. 167). The FEIS should provide a detailed water quality analysis.

Recommendation:

1-8 The FEIS should include water quality data obtained from the cited water quality monitoring projects. Provide a short description of the water quality characteristics of key water bodies and creeks, such as level of fecal coliform, sediment, nutrients, rate of stream flow, pH, biological oxygen demand, total dissolved solids, and temperature. State whether the water quality constituents meet water quality standards.

3

Wetlands

1. The DEIS states that the intensity of impact to wetlands would be considered major if 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 FMP project area (p. 262).

Recommendation:

1-9 The FEIS should provide the rationale, references, and data to support the proposed 20% aerial extent criteria. Describe why other percentages such as 10% or 40% were not used. We recommend the NPS consider "intensity of impact" criteria which includes the quality and functional value of the wetland or resource instead of only an aerial percent loss of the vegetation type.

2. The DEIS states that planning and fire management plans for specific projects should consider other projects in the area and design projects so that the combined impacts of unrelated projects and fire management activities do not exceed the threshold for minor impacts on wetlands (measurable changes but affect less than 5% of the total extent of the wetland type in the project area) (p. 337).

Recommendation:

1-10 The goal of direct, indirect, and cumulative impacts to wetlands should be avoidance. The FEIS should commit to avoid all cumulative impacts to wetlands, whenever possible. Only if impacts are unavoidable should projects be designed to minimize and compensate or mitigate for wetland impacts. In these instances, project-specific analyses should be performed.

Park Operations

1. The DEIS states that very few action items called for in the 1993 FMP have been implemented due in part to funding and staffing availability (p. 82). However, the preferred alternative would require additional funding and staffing (19 FTE versus the 13 FTE under the 1993 FMP, p. xxi, Table ES-2: Summary of Impacts). It is not clear whether, or how, GGNRA would obtain the funds and FTE required to fully implement the preferred alternative.

Recommendations:

1-11 The FEIS should describe the funding and staffing issues encountered under the 1993 FMP. Describe what has not been completed under the 1993 FMP. Evaluate whether the funding and staffing issues will continue under the new FMP and what options are available to overcome these potential implementation barriers.

4

1-11 The FEIS should present management priorities and actions that will be taken if sufficient funding and staffing is not provided for full implementation of the new FMP. Describe the criteria, if any, used to prioritize implementation of FMP actions and to maximize the benefits and use of limited staff and funding resources.

1-12 Given the inability to completely implement the existing FMP, we recommend the NPS consider developing an alternative that can be fully implemented with existing authorized resources.

Existing Conditions

1. While the DEIS describes the use of herbicides to control scrub and invasive species, it does not describe whether GGNRA lands are experiencing habitat conversions which would require future aggressive vegetation management. For example, other sites in California have experienced conversion of forest lands to scrub caused by wildland fires. As a result, the Forest Service has implemented extensive vegetation management projects using manual brush removal, prescribed burns, and multiple herbicide applications to eliminate and control brush.

Recommendation:

1-13 The FEIS should include additional information regarding invasive species and the conversion of forest and grasslands to scrub land , brush fields, or other habitat types that will require future vegetation management. Describe whether the FMP will include actions to control habitat conversions and to actively manage vegetation.

2. The vegetation map, acreages, and overall vegetation distribution are based upon 1994 aerial photography and interpolation (p. 186). It is possible that vegetation distribution and types may have changed in the intervening 11 years given invasive species, wildland fires, and climate change.

Recommendation:

1-14 The FEIS should evaluate the potential for vegetation change since 1994. If significant deviations from 1994 vegetation patterns are possible, the NPS should consider conducting additional vegetation surveys where such changes may have occurred.

General Comments

1. The DEIS state that NPS is in consultation with the U.S. Fish and Wildlife Service (FWS) and National Oceanic and Atmospheric Administration (NOAA)- Fisheries in accordance with Section 7 of the Endangered Species Act (p. 94).

5

Recommend:

1-15 The FEIS should include a short description of the status or outcome of the Section 7 consultation, including FWS and NOAA-Fisheries mandatory and recommended reasonable and prudent measures and terms and conditions for incidental take, if approved. If available, include the Biological Opinions or concurrence/nonconcurrence letters in a FEIS appendix.

2. Appendix C of the DEIS provides a list of projects included in cumulative effects analysis. The criteria used to determine which projects were included is not provided.

Recommendation:

1-16 The FEIS should provide a short description of the criteria and process used to select the projects included in the cumulative effects analysis.

3. The DEIS describes the scheduling and implementation challenges for prescribed burns in GGNRA. For instance, it states there is only a narrow burning window for shrub lands and forested areas and that designated burn days often do not coincide with the weather conditions appropriate for burning in GGNRA (p. 144).

Recommendation:

1-17 The FEIS should describe how the NPS proposes to accomplish the level of prescribed burning proposed in the preferred alternative, which is more than double the amount proposed in the existing 1993 FMP.

6

Responses to Comments in Letter 1

United States Environmental Protection Agency, Region 9, San Francisco, CA.

Comment 1-1(a). The EPA recommends that the FMP FEIS should further highlight smoke management measures and provide more information on the adverse effects on air quality. Table ES-2, Summary of Impacts: Visitor Use and Visitor Experience should include smoke impacts from prescribed burning as potential adverse effects to public health, reduced visibility, and smoke irritation.

Response to Comment 1-1(a) Table ES-2 in the DEIS addresses the potential direct impact from prescribed burning on the public and firefighter staff from exposure to particulates and other toxins in smoke; however, it is addressed under Impacts on Human Health and Safety rather than Impacts on Visitor Use and Visitor Experience. Potential adverse impacts to air basin air quality standards are addressed under Air Quality in Table ES-2 in the DEIS. Impacts from burning on visibility are found to be long-term on the regional air basin air quality under the impact topic of Air Quality and as short-term during prescribed burns under the topic of Public Health and Safety. Text in Table ES-2 has been modified in the FEIS to clarify this as follows:

Table ES-2: Summary of Impacts

Impact Topic	Alternative A – 1993 FMP (No Action)	Alternative B – Hazard Reduction/Restricted Fire Use	Alternative C – Hazard Reduction/ Resource Enhancement
Human Health and Safety and Nuisance Effects	Overall, this alternative would have a long-term, minor benefit to the public and firefighter safety by decreasing the risk of catastrophic fire. *The potential to breathe in particulates and other toxins in the smoke produced by* ~~P~~*p*rescribed burning ~~activities~~ *and fire suppression* would have a ~~render~~ short-term, negligible adverse effect on public and fire staff health and safety.	Similar to Alternative A, except that increased treatments would render long-term, moderate benefits to public and firefighter safety.	Similar to Alternative B, except larger prescription burning component would yield long-term, moderate, beneficial effect.

Comment 1-1 (b). FMP goals should include a goal specific to smoke and air quality issues. This goal can emphasize the use of a Smoke Management Plan to address smoke and air quality.

Response to Comment 1-1(b). The NPS agrees with the EPA recommendation that a separate goal relating to smoke management and protection of air quality should be added to the FMP goals. A major challenge in managing national parks is the protection of human health and air quality while restoring fire-dependent ecosystems to their natural character. The increased use of fire as a management tool must not impede the progress being made in restoring visibility in national park areas as mandated by the Clean Air Act and stipulated in the report "Air Quality in the National Parks, Second Edition (NPS 200b). A new goal for smoke management has been added to the FMP Goals found in the Executive Summary and Section 1.4 of the FEIS. The wording for this smoke management goal is similar to the NPS smoke management statement adopted as part of the NPS

Management Policies 2001 (NPS 200a) and NPS fire management policy found in Resource Handbook 18, Wildland Fire Management (NPS 1999a). The following text has been added to the FEIS as the new smoke management goal found in the FMP Goals and Objectives cited above.

> *Goal 10. Minimize smoke generation during prescribed burning through the use of a smoke management plan (SMP) that details best management practices or non-burning alternatives where these options would meet resource management and fuel reduction objectives and also achieve emissions reduction.*
>
> *Objectives:*
>
> > *Confer regularly with Air Resources staff at the NPS Pacific West Regional Office, other parks, fire agencies, and the Bay Area Air Quality Management District (BAAQMD) to keep current on best management practices and non-burning alternatives.*
> >
> > *Maintain current information on smoke-related health issues affecting firefighters such as exposure limits, exposure monitoring, risk minimization, and respiration technology.*

Comment 1-1 (c). Smoke management practices should be highlighted in the FEIS.

Response to Comment 1-1 (c). Smoke management practices as outlined in "The Smoke Management Guide for Prescribed and Wildland Fires" prepared by the Wild Fire and Fire Use Working Team of the National Wildfire Coordinating Group (NWCG, 2001) were used by NPS staff to develop the smoke management practices listed as mitigation measures on pages 96 and 97 of the DEIS. Alternatives to prescribed fire are described in the document "Non-burning Alternatives to Prescribed Fire on Wildlands in the Western United States," prepared for the Fire Emissions Joint Forum of the Western Regional Air Partnership (Jones and Stokes, 2004).

In response to the EPA's request to further highlight smoke management practices in the FEIS, a new appendix has been added to the FEIS that is a listing of smoke management techniques and non-burning alternatives that GGNRA could incorporate into a smoke management plan and/or that BAAQMD could require as part of the smoke management plan approval process. The referenced appendix is Appendix I – Non-burning Alternatives and Air Emissions Reduction Techniques for Fuel Reduction and Resource Benefiting Prescribed Burns in GGNRA. References to Appendix I have been added to the FEIS text where appropriate and mitigation measures AIR-1 and AIR-2 have been combined into revised mitigation measure AIR-1, reworded as follows:

AIR-1 If recommended by BAAQMD, smoke management plans submitted by the NPS for BAAQMD review can be modified to reduce production of pollutants by reducing the amount of fuels available for burning. Options ~~include~~ *for reducing the amount of fuels available and emissions produced include reducing the area to be burned,* ~~modifying burns to reduce the area burned,~~ reducing fuel loading (e.g., mowing and understory thinning), ~~or~~ managing the rate of fuel consumption, *and redistributing the emissions*. Treatments to reduce overall air emissions from prescribed burns ~~can include~~ *will be based on current smoke management techniques such as those listed in the Western*

Regional Air Partnership publication "Non-burning Alternatives to Prescribed Fire on Wildlands" (Jones and Stokes, 2004) and those listed in Appendix I of this FEIS.

- ~~Mowing grass and reducing density of vegetation in brushlands;~~
- ~~Mechanically treating forested areas by removing standing or downed trees;~~
- ~~Understory thinning, thinning of forests, and creation of shaded firebreaks; and~~
- ~~Scheduling more frequent, less intense burns to prevent unwanted vegetation from becoming established in clearings or in forest understory.~~

~~AIR-2 If requested by BAAQMD, pile or windrow burning, rapid mop-up and shortened fire duration can be used to increase the rate of combustion efficiency and reduce air pollution emissions (except NOX) by shifting the majority of combustion away from the smoldering phase and into the more efficient flaming phase.~~

Comment 1-1(d) An option for the FEIS would be to include a separate heading in Chapter 4, Environmental Consequences, that addresses all smoke management issues.

Response to Comment 1-1(d) The NPS has considered the EPA's recommendation to include a separate section in the Environmental Consequences chapter to address smoke management. However, the structure of NPS NEPA documents is based on an assessment of affects grouped by impact topic rather than project component, such as smoke management or mechanical fuel reduction. Smoke management may be viewed as either a mandatory component of a proposal or a mitigation to reduce effects of prescribed burning or wildland fire.

NPS Director's Order 12 (NPS 2001a), which provides the NPS with guidance in preparing NEPA documents, advises that the "the impact section [of an EIS] can be organized by alternative, with impact topics as subheadings, or by impact topic, with alternatives as subheadings." The impact topics' structure facilitates public and agency review of a proposal's potential effects on the park's important physical and cultural resources. To facilitate the comparison of impacts to park resources, the FMP EIS is organized by these broad resource topics and each is analyzed under each alternative. Smoke management applies to potential impacts under three important resources areas in the EIS: Air Quality, Visitor Use and Visitor Experience and Public Health and Safety.

Comment 1-2. The FEIS should describe how the Smoke Management Plan relates to the State Implementation Plan (SIP). EPA requests GGNRA state compliance requirements with State and local air district regulations.

Response to Comment 1-2. References to GGNRA's compliance with State and local air district regulations can be found in the following places of the DEIS: page 67, Prescribed Burning and Pile Burning; page 444, Research; page 85, Prescribed Burning; pages 96-97, Air Quality mitigation measures; pages 250-251 under Air Quality Policies and Regulation; pages 294-300, Impacts on Air Quality, Analysis, pages 418-433, Impacts on Human Health and Safety; and pages 443-444, Prescribed Burning and Research Burning, respectively.

With regard to the relation of the air district's smoke management plan to the State Implementation Plan (SIP), the text in the FEIS in Chapter 4, Environmental Consequences, Impact Analysis for Air

Quality, Alternative A Cumulative Impacts (found on page 300 of the DEIS) has been modified as follows:

> All prescribed burning at PRNS and GGNRA would continue to be planned and performed under the auspices of *BAAQMD's Regulation 5 governing Open Burning*, ~~Smoke Management Program~~, which *functions as the air district's smoke management plan.* ~~in turn is incorporated into the SIP. The SIP is managed by BAAQMD staff to ensure that all ambient air quality standards and provisions of the Clean Air Act are met and public health is protected.~~ *Since 2001, each air district in California must have an individual smoke management plan that meets state and federal requirements as directed by the Federal Interim Air Quality Policy on Wildland and Prescribed Fires. In conformance with Regulation 5 and p*~~P~~rior to igniting a prescribed fire, NPS fire management staff must submit a smoke management plan to BAAQMD and must obtain meteorological approval to burn from BAAQMD. It is the responsibility of BAAQMD to coordinate the numbers of fires burning in one area in relation to ambient air quality. The oversight of BAAQMD would ensure that annual emissions from fire management actions implemented under the PRNS FMP do not exceed state or federal standards.

Additional text to explain the relationship between the smoke management plan and the SIP has been added to Chapter 4, Environmental Consequences, Regulations and Methodologies for Air Quality, under the heading "Effects on Bay Area Air Basin Air Quality and Conformance with the State Implementation Plan" as follows:

> *When air quality within a region or airshed deteriorates below one or more of the National Ambient Air Quality Standards (NAAQS), a state must develop a State Implementation Plan (SIP) to improve the air quality. The means of achieving the standard is determined largely by the state. The regulators may decide to severely limit prescribed burning, or they may focus on some other pollutant source.*
>
> *Voluntary Smoke Management Program (SMP) developed by states must then be certified by the EPA. Once the SMP is certified and in use, the EPA will allow two exceedances of the NAAQS for PM2.5 attributable to prescribed burning without declaring the region out of attainment. The states will instead be allowed to review their SMP and make adjustments if it is found inadequate. If fires cause or significantly contribute to a third consecutive NAAQS violation, EPA will call for the SMP to be made part of the SIP and be federally-enforceable. If the area was designated nonattainment previously, EPA will also call on the State to review the effectiveness of the SMP and make appropriate improvements.*

Comment 1-3. The EPA recommends that the FEIS and Record of Decision (ROD) commit to the recommended measures (DEIS, p. 424) to reduce smoke exposure to firefighters during prescribed burning.

> ***Response to Comment 1-3*.** The NPS agrees with this comment. The Record of Decision, to be signed by the National Park Service's Pacific West Regional Director, will commit GGNRA to the mitigation measures listed in the FEIS and ROD.

Comment 1-4. The FEIS should state the de minimus levels and whether general conformity is required.

Response to Comment 1-4. The de minimus levels are defined in 40 CFR 93 § 153. The de minimus levels and conformity determination are addressed in the DEIS in Chapter 4, Environmental Consequences, in the discussion of Air Quality Regulations and Methodology, Effects on Bay Area Air Basin Air Quality and Conformance with the SIP. Please refer to pages 257- 258 in the DEIS.

The goal of general conformity with the SIP is to ensure that the State does not exceed the NAAQS, including carbon monoxide (CO). The NPS would be willing to examine the times when the air basin has had exceedences in CO and avoid burning at that time of year. The NPS would also be willing to commit to burning only during the times of year when the NAAQS are not likely to be exceeded and when meteorological conditions are such that burning would have as minimal an impact as possible on air quality, and subsequently visibility and public health.

The GGNRA fire management program maintains a regular working relationship with regional air basin and state air quality regulators and meteorologists. GGNRA staff will submit all smoke management plans to BAAQMD for review and approval. The park relies on the expertise and approval authority of the BAAQMD for conformance with the federal Clean Air Act. The NPS recognizes the importance of protecting human health from smoke emissions. The air quality regulators also acknowledge the importance of the use of fire under managed conditions in contrast to that produced from uncontrolled wildfires. The objectives of both fire and air quality managers can be made more compatible through the use of models with meteorological, emissions, and fire behavior inputs; by gauging the public's tolerance for smoke; and by improved communication among air quality managers, fire managers, and the affected public. The park staff view this communication and coordination as cornerstones of a successful fire program.

In response to this comment, the following text and table have been added to the FEIS under the Effects on Bay Area Air Basin Quality and Conformance with the State Implementation Plan (page 257 in the DEIS):

> *The de minimus levels are the minimum thresholds for which a conformity determination must be performed for the various criteria pollutants in nonattainment or maintenance status in the air basin. Federal agencies need to perform a general conformity analysis if emissions from a proposed action are not accounted for in the air district's State Implementation Plan (SIP) for that emission. The conformity determination shows how the emissions generated by the implementation of a project or plan will conform to the air basin's strategy to control emissions of a criteria pollutant.*

Table 4-3b: *De Minimus* Levels for State Implementation Plan Conformance

Pollutant	Area Type	Tons/Year
Ozone (VOC or NOx)	Serious nonattainment	50
	Severe nonattainment	25
	Extreme nonattainment	10
	Other areas outside an ozone transport region	100

Pollutant	Area Type	Tons/Year
Ozone (NOx)	Marginal and moderate nonattainment inside an ozone transport region	100
	Maintenance	100
Ozone (VOC)	Marginal and moderate nonattainment inside an ozone transport region	50
	Maintenance within an ozone transport region	50
	Maintenance outside an ozone transport region	100
CO, SO_2 & NO_2	All nonattainment & maintenance	100
PM-10	Serious nonattainment	70
	Moderate nonattainment and maintenance	100

Source: BAAQMD, 2005

Notes:
NOx = nitrogen oxides, VOC = volatile organic compounds, CO = carbon monoxide, SO_2 = sulfur dioxide, NO_2 = nitrogen dioxide, PM10 = suspended particulate matter

Though the Bay Area Air Basin is now in attainment with national air quality standards for CO, its maintenance status indicates that exceedences of the CO standard have occurred in the past. The air basin is implementing a plan to maintain a lower level of CO generation. According to the BAAQMD CO maintenance plan, urbanized areas of San Mateo and Marin counties are within the Bay Area Air Basin maintenance area for CO.

In Chapter 4 of the FEIS, the following text has been added to the air quality impact assessment discussion (DEIS page 300):

In the SIP for carbon monoxide, BAAQMD includes an annual level of prescribed burning for vegetation management within the maintenance area as a factor that contributes to annual CO emissions (D. Kolozsvari, BAAQMD, pers.comm.). In developing the SIP, BAAQMD estimated that some 34, 588 tons of woody fuels could be burned annually for non-agricultural, vegetation, and forest management practices in the Bay Area Air Basin. The assumptions of the SIP for CO, provided by BAAQMD, allow 37% of the annual total, or 12,800 tons of woody material, to be allocated to actions in Marin County and 17%, or 5,880 tons, in San Mateo County. This totals 18,680 tons for the two counties (Douglas Kolozsvari, BAAQMD, email 8/24/05).

Using the assumptions provided by BAAQMD, the maximum tonnage of prescribed burning allowed annually under the cumulative scenario, including Alternative A, would represent roughly 80% of the total annual tonnage factored into the SIP for CO for this type of prescribed burning in these two counties. The assumptions include factors for prescribed burning conducted on acreage with heavy fuels, acreage with light fuels, and include maximum allowable acreages on an annual basis from projects by GGNRA, Point Reyes National Seashore (PRNS), local fire agencies, and other land management agencies operating in the two counties.

As a contributor to the cumulative scenario, the park's proposed prescribed burning of the vegetation types at GGNRA under Alternative A would permit the burning of roughly 1,000 tons

of vegetation annually; the SIP's full cumulative scenario accounts for approximately 15,000 tons heavy and light fuels annually. The majority of the tonnage included in the cumulative impact assessment can be attributed to the PRNS FMP, which proposes a cap of 2,000 acres of prescribed burning annually (in contrast to the cap of 110 acres under Alternative A of this EIS). With tonnage for the cumulative scenario calculated at 20% less than assumed for Marin and San Mateo counties under the SIP, and the probability that PRNS would not achieve 2000 acres per year of prescribed burning, the NPS believes that prescribed burning emissions under Alternative A are included in the SIP for CO and that no further conformity analysis is warranted.

The Cumulative Impacts text for Air Quality under Alternative B (page 304, DEIS) has been modified to address the SIP for CO and the need for a conformity determination:

Annual tonnage of vegetation treated under the cumulative scenario in Alternative B is similar to that in Alternative A by both acreage and fuel type (110 tons in Alternative A and 120 tons in Alternative B of this EIS). As in Alternative A, the NPS concludes that the emissions of CO from prescribed burning that would be generated annually under Alternative B are included in the SIP for CO and that no further conformity analysis is warranted.

The Cumulative Impacts text for Air Quality under Alternative C (page 308, DEIS) has been modified to include the following text:

When considering the cumulative impact scenario under Alternative C, the total annual tons of vegetation treated by prescribed burning would be 20% less than the SIP assumption for these two counties. As a contributor to the cumulative scenario, Alternative C would permit burning of roughly 2,000 tons of woody fuels annually. The majority of the tonnage to be treated annually by prescribed burning under the cumulative scenario can be attributed to the PRNS FMP which proposes a cap of 2,000 acres of prescribed burning annually in contrast to a 320-acre annual cap proposed under Alternative C of this EIS. With tonnage for the cumulative scenario calculated at 20% less than assumed for Marin and San Mateo counties under the SIP, and the probability that PRNS would not achieve 2000 acres per year of prescribed burning, the NPS concludes that prescribed burning emissions from Alternative C are included in the SIP for CO and that no further conformity analysis is warranted.

Comment 1-5. The FEIS should address the water quality and aquatic effects of roads by describing the status and management of the GGNRA road system. The FEIS should identify avoidance and mitigation measures that are necessary to minimize impacts.

Response to Comment 1-5. Roads within the park are managed by the GGNRA Maintenance Division for public safety, recreation, and park management purposes. Roads are not exclusively used by or maintained for fire management use. The focus of the FMP is fuel reduction and fire management for resource benefit and public safety. The effect of roads on water quality and aquatic resources is beyond the scope of the FMP since the proposed fire management actions would not change the status or management of park roads.

Language in Section 2.4, Actions Common to All Alternatives, Roadside Fuel Reduction (page 69, DEIS) has been reworded to clearly state that road maintenance and management is not the responsibility of the Fire Management program and is beyond the scope of this EIS. It also states that the condition and management of park roads and trails would not be changed through the course of implementing the FMP. Figures 2-7 and 2-8 of the DEIS, which incorrectly depict roads as "fire roads," have been removed from the FEIS.

Modifications to the DEIS text on page 69, are as follows:

Roadside Fuel Reduction

The park *maintains* ~~routinely clears vegetation and debris from selected paved and unpaved~~ roads that provide routes for ~~emergency evacuation,~~ public safety, *recreation,* and access for *park management uses. Front-country roads that are paved are generally open to public motor vehicle traffic. Unpaved, back-country roads are generally open only to NPS vehicles, but may also be open to foot, horse, and/or bicycle users.* ~~fire suppression activities or conducting prescribed burns, or that~~ *Some roads may* serve as control lines ~~for~~ *during a* prescribed fire *or wildland fire suppression operation.* ~~projects. An assessment of road conditions is typically performed in early spring, and then a work plan is developed and priorities for vegetation clearing are established. Roadsides are inspected for standing snags and/or weakened trees that could fall and block roadways during fires.~~

Upkeep of park roads is the responsibility of the GGNRA Maintenance and Engineering Division. The FMP alternatives do not propose changes to the status or management of park roads and trails. All ~~Designated~~ fire roads would continue to be maintained to allow for safe and efficient access ~~and egress~~ by emergency vehicles, and at a minimum, to allow access by Type III fire engines. Maintenance standards for *emergency vehicles access on back-country roads in Marin County* ~~existing fire roads~~ would *conform to those* ~~be modified from the actions~~ described in *the* ~~a~~ Memorandum of Understanding (MOU) between the Marin Municipal Water District (MMWD) and the NPS ~~for lands in northern Marin~~ (MMWD 2001). *FMP actions* ~~Road maintenance would~~ *may* include grading of ~~all~~ *road* surfaces ~~when necessary~~, placement of *erosion control measures, and vegetation thinning* ~~and removal~~ *by mowing or cutting along the road corridor* to a specified width based on fuel type, slope, and roadway composition. ~~as well as mowing and cutting~~ . ~~For road clearing,~~ *Larger* trees along the sides of the roadways *may be* ~~are~~ limbed *up and smaller trees removed* as needed *to ensure* ~~for~~ emergency vehicle clearance *is met*. ~~Smaller-diameter trees are removed from a corridor on each side of the road (measured from the edge of the roadway). Downed trees in or near the roads are cleared.~~ Grass that grows within the *roadways* ~~is~~ *may be* cut or mowed. ~~Tools used for these tasks include brush cutters, chain saws, pole saws, and a chipper towed onsite.~~ Debris *would* ~~can~~ be cut up and broadcast in the immediate area, piled and burned, or chipped and hauled offsite. ~~Regrading would occur where rills and gullies have formed. Where necessary, regrading should follow standard local practices established by the NPS. This would include outsloping of roads to prevent rill and gully erosion.~~

> *In separate actions, apart from the FMP,* ~~T~~*the* park *may* ~~will~~ evaluate, on an ongoing basis, the condition of ~~fire~~ *park* roads. ~~for direct and safe access conditions. As a result of this evaluation,~~ Unnecessary ~~fire~~ roads may be eliminated *or designated for non-vehicular use*, in coordination with other park planning efforts such as the Trails Forever initiative. ~~and the sites restored to address erosion problems.~~ In some cases, existing roads may be reconfigured or rerouted to address erosion and/or maintenance concerns. ~~but these actions would be subject to further study. The effects of these actions on cultural resources will be taken into account prior to implementation.~~
>
> ~~Figures 2-7 and 2-8 show proposed actions for existing fire roads.~~

Comment 1-6. The FEIS should include additional information regarding herbicide use. Provide a description and environmental evaluation of frequently used herbicides, frequency of use, the potential for multiple applications, and proposed measures to protect wetlands, sensitive resources, the public and firefighters. The FEIS should specify that pesticides must be registered with the EPA and California Department of Pesticide Regulation and used according to the label. A review of the current status of all herbicides should occur annually prior to the application season.

Response to Comment 1-6. Information regarding the proposed use of herbicides and the description of its use is found in the EIS in both Chapter 2 – Alternatives and Chapter 3 – Affected Environment. In response to this comment, text has been modified in both chapters of the FEIS to provide further details and clarification about the park's use of herbicides. In general, it should be noted that the pesticides used on GGNRA lands are registered with EPA and the California Department of Pesticide Regulation and are used according to the label directions and federal and state pesticide laws.

The text in Section 2.5, Alternative A, Mechanical Treatment (DEIS pages 83-84) has been modified in the FEIS as follows in response to this comment:

> The most common method of mechanical fuel reduction is the use of chain saws to thin or remove targeted vegetation, which is then either piled to be chipped, removed, or burned at a later date through the use of pile burns. In some instances, the materials are left in place. Other equipment used during mechanical fuel reduction may include weedwackers, mowers, and masticators. If herbicides are used during any project, they are applied according to strict specifications provided by the park's Integrated Pest Management (IPM) coordinator per the product label and applicable regulations, on nonnative tree and brush species that vigorously resprout. Any application requires the approval of the park's integrated pest manager and the Washington office coordinator for herbicide application. *The pesticides used on GGNRA lands are registered with EPA and the California Department of Pesticide Regulation and are used according to the label directions and federal and state pesticide laws.*
>
> *For all projects that propose an herbicide use, a site specific environmental analysis is conducted by GGNRA staff. This assessment is conducted by, at a minimum, the supervisory vegetation ecologist, the chief of natural resources, and the GGNRA IPM coordinator; the latter also reviews it under his/her capacity as a licensed California Pest Control Adviser. If terrestrial or*

aquatic threatened or endangered wildlife species are in the vicinity of the application site, the park's wildlife biologist and/or aquatic biologist are also consulted. If there is the potential for the listed species to be affected, the park would contact the USFWS for consultation under Section 7 of the Endangered Species Act. Any stipulations provided by the NPS staff and USFWS biologists are included in the written pest control recommendation by the IPM coordinator and issued to the herbicide applicator(s) to provide exact herbicide usage and application requirements. No applications occur in riparian or wetland areas *with the exception of the use of specifically formulated herbicides in or near ephemeral drainages of seasonal wetlands applied during the dry season. Using aquatic formulations of herbicide, these areas would only be treated when targeted non-native invasive plant species cannot feasibly or effectively be controlled by mechanical means and the threat posed by the infestation is considerable. This could be due to the plant's persistent resprouting, its high rate of spread, or the extensive size of the existing infestation*. All use of herbicide must follow federal, state and county regulations.

To protect sensitive species found in the treatment area, a variety of application techniques are used. These techniques may include the use of stump treatment using paint brushes or wick applicators, and/or the use of "shields" to prevent herbicide drift. The use of landscape fabric may also be considered as an alternative to herbicide application in cases where a smaller number of trees are involved, and when other conditions permit.

The text in Chapter 3, Human Health and Safety, Herbicide Use (DEIS page 233) has been modified to further explain the review and approval process for herbicide use in the park as follows:

Fire management and vegetation management projects in GGNRA use herbicides, on a case-by-case approval basis, to control nonnative plant species within specific management areas. *The NPS Integrated Pest Management Manual, Director's Order #77-7 (NPS 1991) requires that all park pesticide use be reviewed each calendar year prior to the application season to ensure that the product and the proposed use for it are still legally registered. NPS requests for herbicide use are written for site- and time-specific applications and do not remain valid beyond one yea. The GGNRA IPM program, consistent with NPS Director's Order #77-7, states that the purchase, storage, and application of any herbicide will follow all federal, NPS, state, and local regulations. If California regulations are more stringent than federal, the former will supersede the applicable federal regulations. The potential for multiple applications of herbicides to any one site is considered very low. Historically, the GGNRA has been able to control the target vegetation with only one application.*

Various brand names of herbicides containing glyphosate are used to prevent resprouting of cut tree stumps within nonnative evergreen forests or shrub lands, especially on blue gum eucalyptus, acacias, cotoneaster, and various brooms. Foliar applications are approved in limited scenarios where nonnative vine or shrub species create a dense and dominant component of the site, and have included Cape-ivy and eupatory. These species can form dense thickets of impenetrable vegetation near developments and other critical resources, posing a fire hazard.

If there are trees within a grove that are to be retained due to cultural resources issues, application of herbicides to the cut stumps is avoided to avoid spread of the systemic treatment through the roots to the trees that were not to be treated with herbicide. In that case, a thick layer of chips could suppress some proportion of the regrowth, or nailing heavy roofing paper to the stump or applying landscape fabric onto the cut stump could serve to depress resprouting.

The most commonly used herbicide for FMP actions in GGNRA is Roundup Pro, a low-toxicity, general use herbicide. The U.S. Environmental Protection Agency (EPA) has rated it as a Class 3, Caution-labeled herbicide; the EPA registration number is 524-475. Roundup Pro has also been approved and registered for use in California by the California Department of Pesticide Regulation. The active ingredient in Roundup Pro is glyphosate. Glyphosate, when applied to foliage, is absorbed by leaves and stems and rapidly moves through the plant. Glyphosate is a translocating herbicide that moves from the area where it was applied down to the roots of the plant via the active tissue – the cambium. It remains in the roots. Glyphosate is applied by painting it on the tree stump immediately after the tree is cut. If the trees are in a riparian area, no foliar spraying may occur, especially if the habitat supports anadromous fish. During the dry season (July 1 to November 15), cut stumps of nonnative trees and shrubs may be treated with herbicide.

Foliar herbicide applications beyond the riparian corridor are not approved where saturated soils are present, at wind speeds over 5 miles per hour, or when weather conditions facilitate herbicide movement toward drainages.

If glyphosate is inadvertently dripped or sprayed onto soil, the product will bind with the soil. When used in accordance with label directions, when the product is bound it is no longer available for plant uptake and will not harm offsite vegetation if roots grow into the treatment area or if the soil is transported offsite. The strong affinity of this product to soil particles prevents the product from leaching out of the soil profile and entering groundwater. The affinity between this product and soil particles remain until this product is degraded, involving primarily a biological degradation process carried out under both aerobic and anaerobic conditions by soil microflora. When sprayed on leaves, the half-life for glyphosate is 1.6 to 26.6 days. In water, the half-life is 3.5 to 70 days, In soil, the half-life is 2.8 to 60 days (Badzik 2004).

The surfactant in Roundup has a soil half-half life of less than one week, thus the potential for leaching of the herbicide is low. According to U.S. Forest Service research (Glyphosate fact sheet), the major products from burning vegetation treated with glyphosate are phosphorus pentoxide, acetonitrile, carbon dioxide and water. Phosphorus pentoxide forms phosphoric acid in the presence of water. None of these compounds are known to be a health threat to firefighters or the public at the levels which would be found in a vegetation fire.

All herbicide use is administered through each park's integrated pest management coordinator. All herbicides must be applied by a state-licensed pesticide applicator. *The pesticides used on GGNRA lands are registered with EPA and the California Department of Pesticide Regulation and used according to the label directions and federal and state pesticide laws.* All use is

reported monthly to the coordinator, the county, and the State of California. A review of the current status of all herbicides considered for use is conducted prior to each application season.

Comment 1-7. The FEIS should commit to project specific environmental analyses whenever fire management activities are proposed in sensitive watersheds, near water bodies with existing water quality problems, or near key resources, such as Bolinas Lagoon. The analyses should evaluate the potential for erosion and sedimentation, nutrient inputs, and other adverse impacts to resources at risk.

Response to Comment 1-7. The NPS agrees with this comment. The NPS is required to conduct these types of analyses in accordance with the NPS Management Policies 2001 (NPS 2000a) and the agency's NEPA guidelines (NPS 2001a). GGNRA staff use the project review process, as described in Mitigation Measure FMP-1(a), to determine the appropriate level of NEPA analysis needed for each project. An analysis of potential project impacts is needed by staff to determine the level of potential effect; it is at this initial planning stage that the analysis recommended in this comment would be conducted. To make that decision, subject matter experts must first identify the sensitive resources that could be directly or indirectly affected by project implementation. One type of resource identified by this process would include water bodies that have water quality issues, provide important habitat values, or have special status. In considering the project, subject matter experts may tailor the project to avoid potential effects or set conditions on project implementation to reduce the degree of potential effect. In addition to the project review process, specific FMP mitigation measures have been developed to address potential effects of erosion and sedimentation to water resources (see mitigation measures SW-1, SW-2, SW-3, SW-4, SW-6, SW-7, SW-9 and SW-11 on pages 97 and 98).

Comment 1-8. The FEIS should include water quality data obtained from the cited water quality monitoring projects. Provide a short description of the water quality characteristics of key water bodies and creeks. State whether the water quality constituents meet water quality standards.

Response to Comment 1-8. As noted on page 160 of the DEIS, GGNRA is presently designing a park-wide monitoring program that will capture past data collection activities and include areas that have not been monitored to date. Until this program is developed, the park has no methodical summary of existing data that would allow for meaningful interpretation.

Edits have been made to the FEIS to describe the types of information and analysis that will be included in the upcoming Water Quality Data Inventory and Analysis Report. Text changes to the DEIS page 167, are as follows:

> Work is in progress to document facilities/roads and trails and other water quality threats more thoroughly. For example, for the Redwood Creek watershed, a sediment budget study and a report of all sediment sources in the watershed were conducted. Trail maps are being updated for the park and erosion surveys continue throughout the Marin Headlands. ~~A dam inventory will be included in upcoming Water Quality Data Inventory and Analysis Report.~~ Culvert mapping has occurred in Rodeo Valley.

A summary of existing data for GGNRA water resources and a description of future monitoring needs is included in a report entitled San Francisco Area Network Preliminary Water Quality Status Report (Cooprider, 2004), which is a review of the nine regional park units,. The following information summarizes the park watersheds that are described in the report.

The following citation has been added to page B-5 of Appendix B - Literature Cited:

Cooprider, Mary. 2004. San Francisco Area Network Preliminary Water Quality Status Report, National Park Service, San Francisco Bay Network.

Comment 1-9. The FEIS should provide the rationale, references and data to support the proposed 20% aerial extent criteria. We recommend the NPS consider "intensity of impact" criteria which includes the quality and functional value of the wetland or resource instead of only an aerial percent loss of the vegetation type.

Response to Comment 1-9. GGNRA is developing methods to evaluate wetland function and value. Until these methods are developed, GGNRA subject matter experts are comfortable using the criteria of aerial extent of impact, as these criteria are consistent with other Service-wide planning documents.

Comment 1-10. The goal of direct, indirect and cumulative impacts should be avoidance. The FEIS should commit to avoid all cumulative impacts to wetlands, whenever possible. Only if impacts are unavoidable should projects be designed to minimize and compensate or mitigate for wetland impacts. In these instances, project-specific analyses should be performed.

Response to Comment 1-10. Text has been added to the FEIS in Chapter 4, Environmental Consequences, Wetlands Assessment Methodology (DEIS page 261):

Executive Order 11990 requires that agencies work to minimize the destruction, loss, or degradation of wetlands. Director's Order 77-1: Wetlands Protection, and Procedural Manual 77 1 (NPS 2002a) provide specific procedures for implementing Executive Order 11990. *Director's Order 77-1 states that NPS adopts a goal of "no net loss of wetlands." In addition, the NPS will strive to achieve a longer-term goal of net gain of wetlands Service-wide. For undertakings that could affect wetlands, the NPS will take the following measures:*

a) avoid adverse wetland impacts to the extent practicable,

b) minimize impacts that cannot be avoided, and

c) *compensate for remaining unavoidable adverse wetland impacts via restoration of degraded wetlands.*

If the preferred alternative in an EA or EIS will result in adverse impacts to wetlands, a "Statement of Findings" documenting compliance with Director's Order 77-1 and Procedural Manual 77-1 will be completed. In addition, all applicable permits sought will be consistent with

Section 10 of the Rivers and Harbors Act and Section 404 of the Clean Water Act, *which* authorize the U.S. Army Corps of Engineers (USACE) to grant permits for construction and disposal of dredged material in waters of the United States, including wetlands.

Comment 1-11. The FEIS should describe the funding and staffing issues encountered under the 1993 FMP. Describe what has not been completed under the 1993 FMP. Evaluate whether the funding and staffing issues will continue under the new FMP and what options are available to overcome these potential implementation barriers. The FEIS should present management priorities and actions that will be taken if sufficient funding and staffing is not provided for full implementation of the new FMP. Describe the criteria, if any, used to prioritize implementation of FMP actions and to maximize the benefits and use of limited staff and funding resources.

Comment 1-12. Given the inability to completely implement the existing FMP, we recommend the NPS consider developing an alternative that can be fully implemented with existing authorized resources.

Response to Comments 1-11 and 1-12. In Chapter 2, Section 2.5 Alternatives, **t**he FEIS describes some of the park's accomplishments in implementing the 1993 FMP. For example, on page 84 of the DEIS under Prescribed Fire, an account of prescribed burns conducted between 1996 through 1998 is given.

The park's implementation of the 1993 FMP has been limited due to a variety of factors, including a shift in the Federal Wildland Fire Management Policy and constraints on funding and staffing, as noted in the comment. Federal policy now requires fire management projects to emphasize the protection of life and property as a primary goal with an emphasis on the reduction of fuels along the federal wildland urban interface. Recently, several large-scale fuel reduction projects have been completed in and adjacent to park lands through the use of National Fire Plan funding granted to GGNRA. National Fire Plan funding is mostly earmarked for mechanical fuel reduction projects. The park's 1993 FMP focused primarily on natural resource management issues and the use of prescribed burning to accomplish natural resource objectives; by contrast, the focus of current fire policy is on fuel reduction within the wildland urban interface areas in the park.

In recent years, GGNRA has had adequate staffing to manage multiple projects. In addition, the park has benefited from access to fire management positions shared among the Bay Area Network of national parks and cooperative working relationships with local fire departments and Fire Safe councils. Overall, the park's fire management operations has steadily improved with an increase in staff, training, project funding, and partnerships with other agencies.

As noted in the EPA comments on Park Operations, funding and staffing issues for the fire management program at GGNRA may continue in the coming years. However, recent experience has demonstrated that undertakings done cooperatively between NPS units, local land management agencies and fire departments can greatly expand the number of projects that can be accomplished each year. The shared use of staff and equipment benefits the goals of all agencies involved. Furthermore, the park's use of local contractors to implement fuel reduction projects not only supports the local economy but leverages the work that can be done by park staff.

As described in the DEIS, NPS policy requires that each park develop five-year implementation plans for fire management projects. Multi-year planning allows parks to prioritize projects based on the size of an area, the difficulty of terrain, and/or the need for ongoing regular treatment to suppress vigorous non-native, highly flammable and invasive vegetation. The five year plans are reviewed, updated, and supplemented annually to reflect the past year's accomplishments and extend the planning horizon one additional year.

With regards to criteria the park uses for setting priorities, GGNRA fire management projects are developed with input from natural and cultural resource staff, park rangers, and local fire departments on an annual basis. Recommendations for fuel reduction projects are also submitted from adjacent homeowners' associations, individuals, and local Fire Safe councils. Fuel reduction projects for areas close to development and that demonstrate public/private or federal/local partnerships are also a federal priority. Projects are sought within the wildland urban interface that can successfully convert vegetation within the WUI from highly flammable non-native plants to more fire-resistant native vegetation.

This FMP FEIS sets forth a framework for the park's fire management at a strategic level. The plan will be used as the basis for future budget requests for implementation activities. The maximum acreages by treatment for each alternative are meant to provide an annual "cap" of work that could be done and to provide a means for meaningful impact assessment between the management alternatives. The NPS believes that each alternative could be implemented with existing funding and staff, but the rate at which each alternative would be implemented would vary due to the amount of work that could be accomplished each year. From year to year, the amount of acreage accomplished will vary based on numerous factors such as allocations from the overall park budget, special project funding from National Fire Plan programs, weather conditions, regional air quality, staffing changes, and requests from individual neighbors, communities, other agencies or jurisdictions.

Comment 1-13. The FEIS should include additional information regarding invasive species and the conversion of forest and grasslands to scrub land, brush fields or other habitat types that will require future vegetation management. Describe whether the FMP will include actions to control habitat conversion and to actively manage vegetation.

Response to Comment 1-13. The Federal Wildland Fire Management Policy and the National Fire Plan require the preparation of fire management plans by all units of the NPS that have burnable vegetation. Federal policy and the National Fire Plan funding for projects and staffing focus the FMPs on programs and projects that promote or support the National Fire Plan priorities of fire suppression, burned area rehabilitation, hazardous fuels reduction, and assistance to nearby communities. Because of this focused mandate, other types of vegetation management not directly related to fuel reduction or prescribed burning, are outside the scope of this FMP.

This FMP provides a framework for fire management activities and is not intended to fully address park-wide vegetation management goals and activities. Park-wide vegetation goals are addressed in the Natural Resources Section of the park's Resource Management Plan (NPS 1999c). If a vegetation

management project is designed strictly to achieve natural resource objectives without a companion objective of fuel reduction, the project is considered outside the scope of the FMP.

The FMP Goals and management objectives, specifically Goals 3 and 5 in Section 1.4 of the DEIS, address natural resource protection and include objectives to control invasive plant species and rehabilitate plant communities and habitat for sensitive species through the use of prescribed fire. As non-native invasive plants are extremely common within the wildland urban interface (WUI) of GGNRA, vegetation type conversion from non-native, pyrophytic invasive plants to more fire resistant native plant communities is an objective of many projects.

The FMP EIS addresses the range of vegetation type conversion issues in Chapter 3, Section 3.4, Plant Communities, under the subheadings of Fire Ecology under each plant community type. As a programmatic document, the FMP broadly describes areas of GGNRA which could benefit from type conversion through prescribed burns and areas where mechanical fuel reduction projects would promote type conversion to less flammable plant communities. The benefits of successful type conversion are discussed in Chapter 4, Environmental Consequences, as part of the impact analysis to vegetation, special status species, cultural resources, human health and safety, and the visitor experience. Examples of beneficial effects include conversion of areas that are solidly non-native Harding or velvet grasses to a mix of native and non-native grasses and forbs; understory burning of forested areas to address the presence of broom; and/or the conversion of a eucalyptus stand sited adjacent to a residential area to a less flammable vegetation species.

Comment 1-14. The FEIS should evaluate the potential for vegetation change since 1994. If significant deviations from 1994 vegetation patterns are possible, the NPS should consider conducting additional vegetation surveys where such changes may have occurred.

Response to Comment 1-14. As stated in Figure 3-9, the park acknowledges that some changes in vegetation communities have occurred since 1994 and are not here represented. Other areas were not included in the 1994 map and more recent photographic imagery was used to generally define vegetative cover. In addition, the stands of nonnative plants in GGNRA and the habitat supporting sensitive species are based on recent records. The park continues to update the vegetation survey data and maps as projects and needs arise, such as during the development of site-specific plans. New data are regularly incorporated into the park maps and planning efforts so that proposed projects and programs reflect current conditions that build from the 1994 base map data.

Comment 1-15. US EPA recommends that the FEIS includes a short description of the status or outcome of the Section 7 consultation, including FWS and NOAA Fisheries mandatory and recommended reasonable and prudent measures and terms and conditions for incidental take, if approved. If available, include the Biological Opinions or concurrence/nonconcurrence letters in a FEIS appendix.

Response to Comment 1-15. Text has been added to Chapter 5, Section 5.2 to summarize the findings of the USFWS consultation and gives the status of the consultation with NOAA Fisheries. The terms and conditions of the USFWS Incidental Take Permits have been added as new mitigation

measures SS-5 and SS-6 in the FEIS in Chapter 2, Section 2.7 under Special Status Species. The final USFWS Biological Opinion is included in the FEIS as Appendix K.

Comment 1-16. The FEIS should provide a short description of the criteria and process used to select the projects included in the cumulative effects analysis in Appendix C of the DEIS.

Response to Comment 1-16. The following text has been added to the introduction of Appendix C – Cumulative Actions.

The cumulative project list was developed by an interdisclipinary team of GGNRA staff assigned to prepare the FMP. The team looked for past, present, and reasonably foreseeable future projects that could affect the same resources as the FMP. NPS NEPA guidance states that cumulative actions considered should be those that would have additive impacts on a particular environmental resource to allow for reasonable decision-making about the management of that resource. The list should be limited to projects that would clearly have potential effects and are far enough along in the planning process make some level of analysis feasible. As a general rule, the farther removed an action is from the project area or the project start date, the less need there is for detailed and exact analysis of the action's cumulative impacts.

Implementation of the FMP would have the greatest impact on resources within the federal parklands and on visitors to those parks. In addition, the FMP's implementation would affect air basin air quality and shared watersheds. Most projects in the cumulative actions list share the same affected area as the FMP or would impact similar receptors, whether they are park visitors or park neighbors. Some similar, non-park actions are also included in the cumulative list, such as vegetation management projects or prescribed burns conducted by other land management agencies, the Marin County Fire Department, and the California Department of Forestry and Fire Protection.

No known large scale development projects are currently proposed for western Marin, Woodside or Pacifica; all three areas are largely built out and have restrictive zoning requirements on remaining vacant parcels due to steep, unstable slopes, seismic hazard, viewshed impacts, or to protect the agricultural base of western Marin.

Comment 1-17. Given the local weather and regulatory restrictions, the FEIS should describe how the NPS proposes to accomplish the level of prescribed burning proposed in the preferred alternative, which is more than double the amount in the existing 1993 FMP.

Response to Comment 1-17. The proposed acreage under Alternative C, the preferred alternative, given local air quality regulations and weather variables, is very achievable. Smoke emissions during the burn can be controlled using a variety of firing techniques, time of ignitions, and acceptable weather conditions. Point Reyes National Seashore has been successful in burning up to 500 acres a year in similar fuel types. Strict allowable weather parameters are determined and followed for every burn. The targeted acreage for prescribed fire, as proposed in the FEIS, will be accomplished by

utilizing park staff, local cooperators, and out-of-area resources. The amount of acres treated is not bound by existing park staffing levels. Each prescribed fire has an approved plan that includes a burn- specific worksheet that determines the number and types of resources (.i.e., engines and hand crews) needed to accomplish the project safely. These resource numbers are based on fuel types, weather parameters that fall within pre-determined prescription parameters, and calculated fire behavior. These required resources will be on site prior to any prescribed fire initiation.

Letter 2

STATE OF CALIFORNIA

Governor's Office of Planning and Research

State Clearinghouse and Planning Unit

Arnold Schwarzenegger
Governor

Sean Walsh
Director

May 31, 2005

Brian O'Neill
National Park Service
Building 201 Fort Mason
San Francisco, CA 94123

Subject: Golden Gate National Recreation Area Fire Management Plan
SCH#: 2005032135

Dear Brian O'Neill:

The State Clearinghouse submitted the above named Draft EIS to selected state agencies for review. The review period closed on May 27, 2005, 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

1400 TENTH STREET P.O. BOX 3044 SACRAMENTO, CALIFORNIA 95812-3044
TEL (916) 445-0613 FAX (916) 323-3018 www.opr.ca.gov

Document Details Report
State Clearinghouse Data Base

SCH#	**2005032135**
Project Title	Golden Gate National Recreation Area Fire Management Plan
Lead Agency	National Park Service

Type	**EIS** Draft EIS
Description	The DEIS for the Golden Gate NRA Fire Management Plan describes and analyzes three alternative strategies for implementing fire management actions on GGNRA lands in San Mateo, San Francisco, and Marin Counties. In conformance with federal wildland fire management policy, fire management actions address the range of mechanical treatments (from handtools to heavy equipment) and prescribed burning applied with the objectives of reducing fire hazard in the wildland urban interface zone.

Lead Agency Contact

Name	Brian O'Neill		
Agency	National Park Service		
Phone	(415) 218-6551 (Wendy	***Fax***	
email	Poinsot)		
Address			
City	Building 201 Fort Mason San Francisco	***State*** CA	***Zip*** 94123

Project Location

County	San Mateo, San Francisco, Marin			
City				
Region				
Cross Streets				
Parcel No.	Numerous			
Township		***Range***	***Section***	***Base***

Proximity to:

Highways	1, 101
Airports	
Railways	
Waterways	San Francisco Bay, Pacific Ocean, Bolinas Lagoon, Rodeo Lagoon
Schools	
Land Use	Federal National Parklands

Project Issues	Aesthetic/Visual; Air Quality; Archaeologic-Historic; Coastal Zone; Cumulative Effects; Drainage/Absorption; Economics/Jobs; Forest Land/Fire Hazard; Landuse; Noise; Recreation/Parks; Soil Erosion/Compaction/Grading; Vegetation; Wetland/Riparian; Wildlife
Reviewing Agencies	Resources Agency; Regional Water Quality Control Board, Region 2; Department of Parks and Recreation; Native American Heritage Commission; Department of Health Services; Office of Historic Preservation; Department of Forestry and Fire Protection; Department of Fish and Game, Region 3; Department of Water Resources; California Coastal Commission; California Highway Patrol; Caltrans, District 4; San Francisco Bay Conservation and Development Commission; State Lands Commission

Date Received 03/29/2005 ***Start of Review*** 03/29/2005 ***End of Review*** 05/27/2005

Note: Blanks in data fields result from insufficient information provided by lead agency.

Response to Comment Letter 2

State of California, Governor's Office of Planning and Research, State Clearinghouse and Planning Unit.

The State Clearinghouse letter lists the State agencies that were sent a copy of the GGNRA FMP DEIS to review and notes that no comments were received back from these reviewing agencies by the close of comments date. The letter also acknowledges that GGNRA has complied with State Clearinghouse review requirements for draft environmental documents. No response required.

Letter 3

STATE OF CALIFORNIA—THE RESOURCES AGENCY ARNOLD SCHWARZENEGGER, *Governor*

DEPARTMENT OF FORESTRY AND FIRE PROTECTION
P.O. Box 944246
SACRAMENTO, CA 94244-2460
Website: www.fire.ca.gov
(916) 653-9424

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MAY 27 2005
SUPERINTENDENT'S OFFICE

Superintendent
Golden Gate National Recreation Area
Building 201, Fort Mason
San Francisco, CA 94123

May 26, 2005

Attention: Fire Management

We have reviewed the Fire Management Plan (FMP) Draft Environmental Impact Statement for the National Park Service (NPS) Golden Gate National Recreation Area (GGNRA), giving special attention to the areas within San Mateo County. Overall, we feel this document provides an excellent basis for current and future project planning. This document represents a synthesis from many sources of information regarding fire history, fire weather, and the impacts of vegetation management. Indeed, it will be a helpful addition for the California Department of Forestry and Fire Protection – San Mateo Santa Cruz Unit's (CDF-CZU) Vegetation Management and Community Wildfire Protection Programs.

The stated goals of the FMP are consistent with the California Fire Plan and CDF's Vegetation Management Program. We support the chosen alternative C, as this alternative will permit the broadest use of fire management strategies to reduce fuel loads within the wildland urban interface. The addition of properties within San Mateo to the GGNRA presents opportunities for CDF to coordinate efforts across ownership boundaries and to maximize the benefits of fuel management projects. There is already a proven track record in Marin County of successful implementation of fuel management projects across ownership boundaries in GGNRA and State Responsibility Area lands. In fact, we look forward to working cooperatively with the NPS to achieve our common goals.

Specific comments regarding the FMP are listed below:

3-1 • Page 24, third paragraph, incorrectly refers to CDF as the "State Division of Forestry".

3-2 • Maps throughout the plan showing Phleger Estates incorrectly identifies Skyline Road (Highway 35) as Canada Road.

3-3 • It is unclear whether Phleger Estates contains non-native eucalyptus forest, as the maps on pages 50 and 190 are inconsistent. The map on page 50 shows the vegetation type as eucalyptus forest while the map on page 190 shows the same area as coastal scrub. The map on page 190 shows no Douglas-fire/redwood forest in Phleger Estates.

3-4 • It will be helpful for future project planning to map and identify adjoining larger ownerships to GGNRA lands such as the Mid-Peninsula Open Space District, San

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3-4 Francisco Watershed property, Department of Fish and Game holdings and other large ownerships.

3-5 • Page 168 of the FMP discusses erosion and landslides in Phleger Estates associated with trails. It will be of critical importance to assess the condition of the roads and trails and correct problems, not only for water quality concerns but also for emergency access. It is expected that that project plans for Phleger Estates identify sources of sediment and stability problems and incorporate mitigations as appropriate.

We once again thank you for our opportunity to review the GGNRA FMP. We also look forward to working with your agency on future wildland fuel mitigation projects. It is the common goal of our two agencies to protect communities and the environment from large devastating wildfires. If you should have any questions, or if you require further information, please contact Assistant Chief John Sims at (650) 573-8844.

Sincerely;
John E. Ferreira, Chief
San Mateo & Santa Cruz Unit

By:

John T. Sims
Assistant Chief, Operations
CDF/San Mateo County Fire Dept.

Cc: John Ferreira, Chief
Ken Massucco, Chief
Allen S. Robertson, Deputy Chief
file

Response to Comments in Letter 3

State of California – The Resources Agency, Department of Forestry and Fire Protection, San Mateo & Santa Cruz Unit

Comment 3-1. Page 24, 3rd paragraph incorrectly refers to CDF as the State Division of Forestry.

Response to Comment 3-1. The referenced text has been corrected in the FEIS as follows:

> The 1994 Marin Countywide Plan directs the MCFD and other local fire protection agencies to work in concert with the Marin County Open Space District, the State *Department* ~~Division~~ of Forestry *and Fire Protection*, and the NPS to encourage and promote the maintenance of existing fuel breaks and emergency access routes for effective fire suppression.

Comment 3-2. Maps throughout the plan showing Phleger Estates incorrectly identify Skyline Road as Canada Road.

Response to Comment 3-2. The text on Figures 2-2, 2-4, 2-6, 3-6, 3-10 has been corrected in the FEIS to change Canada Road to Skyline Road.

Comment 3-3. Maps on pages 50 and 190 are inconsistent. Clarify whether Phleger Estates has eucalyptus forest and/or Douglas fir forest.

Response to Comment 3-3. Figure 2-2 has been corrected to show Douglas fir forest and no eucalyptus forest at the Phleger Estate.

Comment 3-4. It will be helpful for future planning projects to map and identify the larger adjoining public ownership areas such as Midpeninsula Open Space District Preserves, San Francisco Watershed property, Department of Fish and Game holdings and other large ownerships.

Response to Comment 3-4. The maps have been corrected to show larger public agency land management areas.

Comment 3-5. Page 168 of the DEIS discusses erosion and landslides in Phleger Estates associated with trails. It will be of critical importance to assess the condition of the roads and trails and correct problems, not only for water quality concerns but also for emergency access. It is expected that project-specific plans for Phleger Estates identify sources of sediment and stability problems and incorporate mitigations as appropriate.

Response to Comment 3-5. The commenter is correct. In conformance with mitigation measure FMP-1(a), site-specific fire management actions proposed for the Phleger Estate would require additional NEPA review by NPS staff to assure that proposed projects conform with the findings of the FMP EIS. Site-specific mitigation measures would be developed at that point to address any potential impacts not sufficiently addressed in this programmatic EIS. As described in the Response to Comment 1-5, the assessment and rehabilitation of roads and trails on national park lands is the

responsibility of the GGNRA Maintenance and Engineering Division. That Division would assist the Fire Management Office in roadbed or trail rehabilitation, relocation, or repair.

Letter 4

MARIN COUNTY
COMMUNITY DEVELOPMENT AGENCY
ALEX HINDS, DIRECTOR

May 27, 2005

Superintendent
Golden Gate National Recreation Area
Building 201, Fort Mason
San Francisco, CA 94123
Attention: Fire Management

Subject: Golden Gate National Recreational Area Fire Management Plan Draft Environmental Impact Statement.

Dear Superintendent,

Thank you for providing us the opportunity to comment on the scope of the DEIR for the Golden Gate National Recreation Area Fire Management Plan (FMP). Please take the following into consideration when selecting the alternative for the FMP:

4-1 1. Regarding the information provided on page 24 on the Marin Countywide Plan, both a new Wildland Urban Interface and a Fire Risk map have been included in the update. The Fire Risk map illustrates which areas of the County have the greatest potential for large, damaging fires based on vegetation and slope. As depicted on this map, some of the most hazardous locations are in Marin Municipal Water District and federal lands, which interface with a variety of communities. This map should be consulted in the preparation of the final EIR.

4-2 2. Several areas adjacent to the GGNRA each have their own individual Community Plans, consistent with the policies in the Countywide Plan. Communities with Community Plans include Stinson Beach, Muir Beach, and Tamalpais Valley. These documents should also be consulted in the EIR.

4-3 3. The DEIR did not include a reference to the Marin County Local Coastal Program (LCP), Units I and II, which was certified by the California Coastal Commission on April 1, 1980 and April 1, 1981, respectively. Under the 1976 Coastal Act, the purpose of the LCP is to protect and conserve the coastal resources and maximize public use and enjoyment of them. The DEIR should include a reference to the LCP.

4-4 4. The DEIS addresses water quality and wetlands, but does not address water supply. Water supply is an important issue that should be addressed. For example, depending on which Alternative is selected, will adequate water be available for fire suppression and to avoid unacceptable risks, when and if the controlled burns occur, particularly during the summer months when peak demand is at its highest? Will additional water be needed, above and beyond what is currently being used, in the implementation of these alternatives?

4-5 5. Chapter 2, Section 2.5: Alternatives, describes specific research projects regarding the impacts under each alternative. With regards to the monarch butterfly, research should be taken to document the long-term impacts that the alternatives may have on them. A local biologist and

3501 CIVIC CENTER DRIVE, ROOM 308 – SAN RAFAEL, CA 94903-4157 – 415-499-6269 – FAX 415-499-7880

4-5 expert on the monarch butterfly should be consulted to provide recommendations and possible mitigation measures.

4-6 6. The DEIR gives brief mention to monarch butterflies in SS-37 on page 105. This statement should be expanded to include all habitat areas, not just clustering sites. In March 2004 the Community Development Agency conducted a study of the monarch butterfly, mapping the current climax, transitional, and historic overwintering sites from Bolinas south to Fort Baker. This study included mapping the known area of monarch use for sunning, nectaring, watering, and shifting for protection during storm events. These areas should be included in addition to the cluster sites.

4-7 7. Herbicide use is discussed in Chapter 3 under Human Health and Safety on page 233. The Countywide Plan Update includes policies to restrict the use of herbicides, insecticides, or any toxic chemical substances in sensitive habitats, except when an emergency has been declared; the habitat itself is threatened; a substantial risk to public health and safety exists; or when such use is authorized pursuant to a permit issued by the Agricultural Commissioner. The DEIR should consider limiting the use of herbicides.

If you have any questions, please do not hesitate to contact me at (415) 499-6290.

Sincerely,

Kristin Drumm, Planner

Cc: Michele Rodriguez, Principal Planner

Response to Comments in Letter 4

Marin County Community Development Agency

Comment 4-1. The County's Wildland Urban Interface map and Fire Risk map have recently been updated and should be consulted in the preparation of the Final EIS.

Response to Comment 4-1. GGNRA staff consulted with Marin County Fire Department (MCFD) staff early in the FMP planning process. MCFD staff made a presentation to NPS staff on the factors and outcomes of the updated WUI and Fire Risk models; this presentation was followed by an extensive question and answer session. Information NPS staff gained from the MCFD presentation was used to develop the model described and maps shown in Appendix E, Fire Hazard Model.

Comment 4-2. The Community Plans of Stinson Beach, Muir Beach and Tamalpais Valley should be consulted in the EIS.

Response to Comment 4-2. The text on page 25 of the DEIS, in the section on Applicable County, Special District, and State Plans, has been modified to address conformance with the local community plans as follows:

Marin County Community Plans

The principal unincorporated residential areas of Marin County have Community Plans that were developed through a CEQA process led by the County with the participation of local residents. The Community Plans guide land use and development for each residential area by setting goals, policies and objectives. Relevant to this FMP FEIS are the Marin City Community Plan (1992), Stinson Beach Community Plan (1985), the Muir Beach Community Plan (1972), the Bolinas Community Plan (1975), and the Tamalpais Area Community Plan (1992). The Tamalpais Area Community Plan includes the neighborhoods of Tam Valley, Homestead Valley, Almonte and Muir Woods Park. The section of the Tamalpais Area Plan addressing Homestead Valley includes an objective to reduce wildfire hazard by working with residents and landowners to catalog and remove stands of eucalyptus trees which pose a risk to persons and property (LU30.1a, page III-69). The Plan encourages homeowners in the urban/wildland interface areas to remove flammable vegetation and to plant fire-resistant landscaping around the perimeter of their properties (page V-4).

Citations for the five community plans have been added to Appendix B – Literature Cited.

Marin County. 1992. Marin City Community Plan. Department of Community Development.

_____. 1992b. Tamalpais Valley Community Plan. Department of Community Development.

_____. 1985. Stinson Beach Community Plan. Department of Community Development.

_____. 1975. Bolinas Community Plan. Department of Community Development.

_____. 1972. Muir Beach Community Plan. Department of Community Development.

Comment 4-3. The EIS should include a reference to the County's Local Coastal Plan.

Response to Comment 4-3. In response to this comment, a new paragraph has been added to the Marin Countywide Plan (page 25, DEIS) section after the listing of county implementation programs.

The Marin County Local Coastal Plan, Units 1 and 2 (1980 and 1981), guides development in the coastal region of Marin County but does not address wildland fire hazard, fuel reduction, wildland urban interface, nor vegetation management.

Comment 4-4. The DEIS addresses water quality and wetlands but does not address water supply. Under each alternative, will there be adequate water supply for fire suppression or for prescribed burns conducted during periods of high water demand? Will additional water be needed, above the current levels of use, if each alternative is implemented?

Response to Comment 4-4. All necessary water will be on-site prior to ignition of any prescribed fire. Water is stored in fire engines and water tenders. Portable water sources, such as 2,500 or 5,000 gallon folda-tanks, can also be pre-positioned at the site. For projects in Marin County, GGNRA could request from Point Reyes National Seashore or Stinson Volunteer Fire Department of Southern Marin Fire the use of a water tender truck for the duration of the prescribed burn. Water is typically filled from hydrants at the point of origin. For prescribed burns near communities with limited water supply, water can be shuttled to the site and transferred to the tanks using fire engines. Water shuttled from local fire district would be refilled during off-peak hours to avoid excessive drawdown of local supplies. Unplanned wildland fires are unpredictable in their location, intensities, duration, size, and timing. Therefore, it is difficult to predict the water usage requirements for wildland fire events.

Comment 4-5. Chapter 2, Section 2.5, Alternatives, describes specific research projects regarding the impacts under each alternative. With regard to the monarch butterfly, research should be taken to document the long-term impacts that the alternatives may have on them. A local biologist and expert on the monarch butterfly should be consulted to provide recommendations and possible mitigation measures.

AND

Comment 4-6. The DEIR gave brief mention to monarch butterflies in SS-37 on page 105. This statement should be expanded to include all habitat areas, not just clustering sites. The areas identified through the March 2004 monarch butterfly study conducted by the County Community Development Agency should be included in SS-37. That study mapped areas used by the monarch for sunning, nectaring, watering and shifting for protection during storm events.

Responses to Comments 4-5 and 4-6. Site-specific plans and actions will address these concerns on a case by case basis. Projects that have the potential to impact monarch butterfly use areas are evaluated by park staff, and if necessary, by a qualified monarch butterfly biologist. Through the park's environmental review process, the impacts on this species will be carefully weighed in conjunction with impacts (both positive and negative) on other listed and species of concern, as well as overall habitat conditions. As needed for the assessment process, qualified monarch butterfly biologists will be used for surveying and assessment.

Comment 4-7. Pesticide use is discussed in Chapter 3 under Human Health and Safety on page 233. The Countywide Plan Update includes policies to restrict the use of pesticides or any toxic chemical substance in sensitive habitats, except when an emergency has been declared; the habitat itself is threatened; a substantial risk to public health and safety exists; or when such use is authorized pursuant to a permit issued by the Agricultural Commissioner. The Final EIS should consider limiting the use of herbicides.

Response to Comment 4-7. Herbicide use within the park is carefully managed through the park's Integrated Pest Management coordinator within the division of Natural Resources and Science. Text describing the review procedure for projects proposing herbicides use, the type of herbicide applied, and the conditions for herbicide application has been added to the FEIS in Chapters 2 and 3. See the Response to Comment 1-6. Sensitive habitats and resources are considered as key components in the environmental review and evaluation process for approval of projects that include herbicide use. Typically, herbicide use is approved for restricted application to cut stumps of non-native invasive plant species that vigorously resprout, such as eucalyptus and broom.

Letter 5

5/24 SUSPENSED CORRESPONDENC
ACTION PERSON: N. Hornor
REPLY DUE
SUPT'S OFC: June 10, 2005
PWR/OTHER:
COPIES PROVIDED O'Neill
OR FORWARDED Bartling
VIA E-MAIL File
P.05-117 A. Naar

May 23, 2005

Brian O' Neill, Superintendent
Golden Gate National Recreation Area
Building 201, Fort Mason
San Francisco, CA 94123

ENVIRONMENTAL SERVICES AGENCY

Agricultural Commissioner/ Sealer of Weights & Measures

Animal Control

Cooperative Extension

RE: Golden Gate National Recreation Area (GGNRA) Fire Management Plan Draft Environmental Impact Statement

Dear Superintendent:

The San Mateo County Parks staff has reviewed the GGNRA Fire Management Plan Draft Environmental Impact Statement. As it pertains to the Phleger Estate we believe an agreement should be reached to share the costs to maintain a mile long stretch of Richards Road, which is the only access to the Phleger Estate through Huddart County Park. In addition, where there are overlaps between GGNRA and four other County Park facilities we need to clarify our relationship through an agreement, so that we are both working from the same set of assumptions regarding park planning, operations and maintenance and areas of collaboration in the future.

Over the past year, the San Mateo County Environmental Services Agency Parks and Recreation Division has been preparing a new Huddart/Wunderlich Master Plan. Richards Road, in Huddart Park, is the only main access into and out of the Phleger Estate, which is owned and managed by GGNRA. During the course of planning for the Huddart/Wunderlich Master Plan, staff had a meeting on February 22, 2005 with Nancy Horner, Planning Manager for GGNRA, regarding opportunities for collaboration and cooperation between our two park districts for the two adjacent parks. A variety of issues were discussed, among them the need to share joint management in the future improvements and maintenance of Richards Road, which is the only current access to the Phleger Estate through Huddart Park.

County Parks currently solely manages the one-mile stretch of Richards Road to the Phleger Estate. This is an old logging road that has served as a service road/trail since the County acquired Huddart County Park in 1948. The road is located very close to West Union Creek, which provides spawning habitat for Steelhead trout. The San Francisquito Creek watershed has been designated by the Regional Water Quality Control Board to be sediment

DEPARTMENT OF THE INTERIOR
SPECIAL
DI 17
(August 1985)

PARKS AND RECREATION DIVISION
455 County Center, 4th Floor • Redwood City CA 94063 • Phone (650) 363-4020 • Fax (650) 599-1721

impaired in part due to the presence of the Steelhead trout. This section of road requires regular maintenance to ensure it drains properly and does not erode away. Since Richards Road is such an important road to both Huddart County Park and the Phleger Estate, it would make sense if there were some type of an agreement to jointly manage this section of road.

Recently, the San Francisquito Creek Watershed Council identified Steelhead trout migration barriers throughout the watershed under a California Department of Fish and Game SB 271 grant. One of the barriers that was identified was a 50-year-old rusted and perched culvert, which is part of Richards Road and drains McGarvey Gulch directly into West Union Creek. The San Francisquito Creek Watershed Council and County Parks Foundation worked with County Parks to apply for and secure a Bay Bridge Salmonid Mitigation Grant to replace this culvert with an arched culvert and a gravel bottom. Due to the road dipping at the culvert location and the tight turning radius, we will likely also be required to improve the road gradient and turning radius for vehicles of the California Department of Forestry and Fire Protection and Woodside Fire Department. In the process of applying for this grant, we talked to Nancy Horner about the possibility of GGNRA assisting in the matching cost share for this project because improvement of this road to enhance fire and service vehicle access serves both of our parks. Since we do not have any agreement in place to share in the cost to improve or maintain this section of road no matching costs from GGNRA could be secured.
5-1 County Parks would like to request that some agreement be developed at this time with GGNRA memorializing a financial contribution from GGNRA on future improvements and the ongoing maintenance of this one-mile section of Richards Road. In addition to maintenance of Richards Road, which benefits GGNRA, County Parks also currently provides mutual aid for GGNRA at the Phleger Estate for emergency tree removals, and medical and emergency response.

5-2 In addition to the Phleger Estate and Huddart Park, there are a number of other County Park facilities in which there is a relationship with GGNRA. At Sawyer Camp Trail and Edgewood County Park and Natural Preserve, GGNRA has a Scenic and Recreation Easement. GGNRA's jurisdiction overlaps both San Pedro Valley and Fitzgerald Marine Reserve County Parks. While we understand that staff has yet to be assigned to serve GGNRA's parklands in San Mateo County, we look forward to formalizing and growing our relationship between our agencies to promote communication, and collaboration on issues of mutual concern. If you have any further questions, please contact Senior Park Planner Sam Herzberg at 650/363-1823.

Sincerely,

MRaines

Marcia Raines, Director
Environmental Services Agency

C: Nancy Horner, Planning Manager, GGNRA
Sam Herzberg, Senior Planner
Dave Moore, Superintendent

Responses to Comments in Letter 5

County of San Mateo, Environmental Services Agency

Comment 5-1. San Mateo County Parks staff believes an agreement should be reached to share the costs to maintain the mile long stretch of Richards Road, the only access to the Phleger Estate through Huddart County Park. A recent improvement by the County improved a section of Richards Road that had a tight, steep turn making it easier to negotiate by California Department of Forestry and Woodside Fire Department engines responding to an emergency. County Parks is requesting an agreement be developed with GGNRA memorializing a financial contribution from GGNRA on future improvements and ongoing maintenance of Richards Road, the sole access for emergency vehicles into the Phleger Estate.

Response to Comment 5-1. The primary focus of the FMP is firefighter and public safety, pre-fire planning and vegetation management to achieve fuel reduction and resource benefits. These actions are within the purview of the GGNRA Fire Management Office. Capital improvements to park roads and other infrastructure are the responsibility of the GGNRA Maintenance and Engineering Division. It is recommended that representatives of San Mateo County Parks contact the GGNRA Fire Management Office to arrange a meeting between GGNRA staff from the Maintenance Division, the Fire Management Office, and other relevant GGNRA divisions, to pursue agreements necessary to carry out the FMP and to assess Richards Road access deficiencies.

Comment 5-2. In addition to Phleger Estate and Huddart Parks, Sawyer Camp Trail and Edgewood County Park and Nature Preserve are within the GGNRA Scenic and Recreation Easement. GGNRA's jurisdiction overlaps both San Pedro Valley County Park and the Fitzgerald Marine Reserve. County Parks looks forward to formalizing the relationship between our two agencies to collaborate on issues of mutual concern.

Response to Comment 5-2. These County park areas have been added to Figure 1-2 in the FEIS. Sawyer Camp Trail and the westernmost strip of Edgewood County Park, which parallel Interstate 280, are within the GGNRA Scenic and Recreation Easement. GGNRA staff will contact the County Parks staff when projects, such as mechanical fuel reduction, are being planned for areas near County parklands and where the collaboration could benefit both agencies.

Text on page 38 of the DEIS has been revised in the FEIS to reflect the County's land management within the GGNRA jurisdictional boundary as follows:

State, *County* and City Managed Lands

The FMP will not address fire management planning on lands within the legislated GGNRA boundary that are under the direct administration of other land management entities. The FMP will address conformance with fire management plans of adjacent public open space areas such as the northern lands administered by Point Reyes National Seashore, *San Pedro Valley County Park* and the City of San Francisco watershed lands.

In addition, text on page 65 of the DEIS has been amended as follows:

The Sweeney Ridge/Cattle Hill project area is defined by the boundaries that constitute *these* two GGNRA parcels. The project area lies just east of Pacifica and *is bordered to the south* ~~extends southeast toward lands managed by the Midpeninsula Regional Open Space District.and The~~ east~~ern boundary is largely~~ *by* San Francisco watershed lands managed by the San Francisco Public Utilities Commission (SFPUC).

Letter 6

SAN FRANCISCO PUBLIC UTILITIES COMMISSION

Water Supply and Treatment Division
Land and Resources Management Section
1657 Rollins Road, Burlingame, Ca 94010 ♦ Tel: (650) 652-3209 ♦ Fax: (650) 652-3219

WATER
HETCH HETCHY WATER & POWER
CLEAN WATER

GAVIN NEWSOM
MAYOR

RICHARD SKLAR
PRESIDENT

ANN MOLLER CAEN
VICE PRESIDENT

E. DENNIS NORMANDY
ADAM WERBACH
RYAN L. BROOKS

SUSAN LEAL
GENERAL MANAGER

May 26, 2005

Brian O'Neill
Superintendent
Golden Gate National Recreation Area
Building 201, Fort Mason
San Francisco, CA 94123
Attention: Fire Management

Dear Mr. O'Neill:

The City and County of San Francisco, Public Utilities Commission (SFPUC), has reviewed the Draft Environmental Impact Statement (Draft EIS) for Golden Gate National Recreation Area's (GGNRA) Fire Management Plan.

The proposed plan involves the implementation of various fire management actions on GGNRA lands in San Mateo, San Francisco, and Marin Counties. As you are aware, the SFPUC manages the Peninsula Watershed Lands located in San Mateo County, protecting the water supply and maintaining the highest possible source water quality.

6-1 The SFPUC encourages the GGNRA to carry out its fire management operations in areas adjacent to the Watershed lands in a manner that is as consistent as possible with the Peninsula Watershed Management Plan, which the DEIS references.

6-2 The SFPUC fully supports the DEIS and will continue to cooperate with GGNRA on future fire management issues. The SFPUC is, however, particularly interested in the future plans for the Phleger Estate and would like to review and comment on all such plans.

Sincerely,

Joseph P. Naras
Watershed Resources Manager

Responses to Comments in Letter 6

Water Supply and Treatment Division, Land and Resources Management Section, San Francisco Public Utilities Commission

Comment 6-1. The SFPUC encourages the GGNRA to carry out its fire management operations in areas adjacent to the Watershed lands in a manner that is as consistent as possible with the Peninsula Watershed Management Plan, which the DEIS references.

Comment 6-2. The SFPUC is particularly interested in the future plans for the Phleger Estate and would like to review and comment on all such plans [future fire management issues].

Responses to Comments 6-1 and 6-2. Comment noted. The text on page 27 of the DEIS has been revised by adding the following paragraph to the end of the top paragraph that addresses the SFPUC Watershed Management Plan.

In implementing the GGNRA FMP, the NPS will coordinate with the SFPUC Land and Resources Management Section to ensure that NPS actions conform to the watershed's Watershed Management Plan and Fire Management Plan to the extent possible to meet NPS objectives. GGNRA staff meets annually with the SFPUC Land and Resources Management Section to discuss issues of joint interest and will inform SFPUC staff of proposed fire management actions at the Phleger Estate, particularly those that could affect management of the adjacent watershed lands.

Letter 7

ron maykel
<themaykelfamily@sbcglobal.net>
05/27/2005 04:29 PM
MST

To: goga_fire@nps.gov, crabtreem@ci.pacifica.ca.us
cc:
Subject: Public input on fire management

Hello Park Staff,

7-1 A source for fires on GGNRA property in Pacifica are the mature pine trees, many of them affected by pitch pine canker. I have noticed them on Mori Point, Milagra Ridge, and near the Shelldance Nursery. Removal of these trees would be in the best interest of GGNRA and the public, not only in fire prevention, but also in preventing the spread of these non-native species.

Thank you,
Ron Maykel
Pacifica City Council GGNRA Committee Liaison

Response to Comment in Letter 7

Pacifica City Council GGNRA Committee Liaison, Ron Maykel

Comment 7-1. A source of fire on GGNRA property in Pacifica is the mature pine trees, many of them affected by pitch pine canker. I have noticed these on Mori Point, Milagra Ridge and near the Shelldance Nursery. Removal of these trees would be in the best interest of GGNRA and the public, not only in fire prevention, but also in preventing the spread of these non-native invasive species.

> ***Response to Comment 7-1.*** Pines infected with pitch pine canker and overly mature and dense stands of non-native, invasive pines can be highly flammable with large amounts of dry duff and dead branches that can quickly move a ground fire into the forest canopy. Trees or groups of trees that are identified as being a fire hazard and pose a threat to public safety may be removed during FMP project implementation. Fuel reduction projects will be proposed annually as part of the 5 year implementation plan and will be prioritized based on funding, cost, hazard potential, resource benefit, site accessibility, and environmental effect.

Letter 8

Paul Jones
<paulginger@sbcglobal.net>
05/10/2005 07:11 PM MST

To: Michael Crabtree <crabtreem@ci.pacifica.ca.us>, Chris Powell <chris_powell@nps.gov>, Noel Blincoe <noelblincoe@msn.com>, Hal Bohner <hbohner@earthlink.net>, Carl Cahill <chcahill@juno.com>, Don Eagleston <don@pacificachamber.com>, Julie Hartsell <jjhcoastside@aol.com>, paul jones <jones.paul@epa.gov>, Joe Murphy <murphyj@usfca.edu>, Sean Smith <ssmith@bluewaternetwork.org>, Mike Vasey <mvasey@sfsu.edu>
cc: Julie Lancelle <ccjulie@knosys.com>
Subject: Fwd: Fire Plan Thoughts

Hello: here are Sean's comments in the forwarded email. I really don't have others to contribute
8-1 with the exception of the following. I am admittedly a bit concerned about the fire potential at Pedro Point, as there is much fuel in the eucalyptus and pine forests adjacent to Hwy 1 and the PP community. If strong offshore winds blow in dry conditions, such as during the Oakland fire, and there is a fire started in Linda Mar or along the highway, that area could be seriously jeopardized. I didn't see specific plans to address this in the Fire Mgt Plan, but I also didn't go over it with a fine comb, so to speak.

If others have comments, perhaps you can plas them directly on to Chris Powell. By the way, I won't be at the next meeting...but will be somewhere out in the Pacific Ocean on an ocean sailing trip by that time.

Thanks,
Paul

Response to Comment in Letter 8

Email from Paul Jones

Comment 8-1. I am admittedly a bit concerned about the fire potential at Pedro Point, as there is much fuel in the eucalyptus and pine forests adjacent to Hwy 1 and the PP community. If strong offshore winds blow in dry conditions, such as during the Oakland fire, and there is a fire started in Linda Mar or along the highway, that area could be seriously jeopardized. I didn't see specific plans to address this in the Fire Management Plan but I also didn't go over it with a fine comb.

> ***Response to Comment 8-1.*** The DEIS on pages 64-65 describe the Pedro Point lands as entirely within the Wildland Urban Interface FMU. The vegetation is described as "mostly coastal scrub, with nonnative evergreen forest encroaching from the northern boundary. The western portion of the area is nonvegetated coastal bluffs. The fire management issue here is the buildup of hazardous fuels adjacent to the Highway 1 corridor and other built-up areas." The NPS shares the commenter's concern regarding high fire hazard in this area. On page 89 of the DEIS, removal of the non-native evergreen trees at Pedro Point is listed as one of 5 goals to be accomplished in the WUI fire management unit park-wide. Table 3-10 (Draft EIS page 191) lists the Pedro Point parcel as 229 acres total of which 33 acres are vegetated with highly flammable non-native evergreen hardwood. There are no specific plans for the Pedro Point area in the FMP as this area is still under State of California and City of Pacifica ownership. The FMP goal of removal of non-native hardwood trees on Pedro Point lands will be further developed in future land management planning efforts. Pedro Point will likely become part of GGNRA in 2006.

Letter 9

"Sean Smith"
<ssmith@bluewaternetwork.org>
05/02/2005 04:09 PM
MST

To: <Alanna_Donahoe@nps.gov>
cc:
Subject: RE: Golden Gate NRA Fire Management Plan

Hey Alanna:

Here are my initial thoughts on the Fire GMP. Any insight you can give on the following would be appreciated.

Sean

Here are my quick thoughts on the GGNRA draft fire plan. Please let me know if you want more detail.

9-1 First, the plan is heavily Marin centered. While a majority of the GGNRA lands lie within Marin County, the most recent fire affecting GGNRA lands and resources actually took place in San Mateo County. In this light, the NPS is considering consolidating the Park's fire cache, thus all its equipment in Marin county. This will dramatically increase response times to San Mateo and San Francisco fires. At a minimum, a fire cache should be established in San Mateo County.

9-2 Next, the NPS needs to provide more detail on how it will rehabilitate burned areas to prevent landslides and exotic species spread.

9-3 Third, the NPS has stated that its position is that any unplanned fire will be extinguished. I am wondering if the NPS would consider loosening this policy for inland acres on the Marin headland. There appears to be ample acreage there to allow some natural fires that are in the right spot, occur under correct weather conditions, and at appropriate times of the year.

9-4 Finally, the final plan needs more discussion on how the NPS will partner and educate state and local fire departments to insure that fire fighting on park land will be done to minimize damage to park resources and wildlife habitat.

Sean Smith, M.S.
Public Lands Director
Bluewater Network
311 California Street, Suite 510
San Francisco, CA 94104
P. 415/544-0790 x 19
F. 415/544-0796
ssmith@bluewaternetwork.org
www.bluewaternetwork.org

Responses to Comments in Letter 9

Sean Smith, Bluewater Network

Comment 9-1. The FMP is heavily Marin centered. While a majority of the GGNRA lands lie within Marin County, the most recent fire affecting GGNRA lands and resources actually took place in San Mateo County. In this light, the NPS is considering consolidating the Park's fire cache, thus all its equipment in Marin County. This will dramatically increase response times to San Mateo and San Francisco fires. At a minimum, a fire cache should be established in San Mateo County.

> ***Response to Comment 9-1***. The DEIS, on page 80, explains that the new fire cache facility proposed for the Marin Headlands would combine fire equipment and vehicles currently stored in two separate locations at the southern end of the Marin Headlands (Fort Baker and Fort Cronkhite) to one central location at Fort Cronkhite. The GGNRA Fire Management Office is considered siting a fire cache in San Mateo County near the Pacifica parklands and has submitted a funding request for a structure and supplies (A. Naar, pers. comm. 6/29/05).

Comment 9-2. The FMP needs to provide more detail on how it will rehabilitate burned areas to prevent landslides and exotic species spread.

> ***Response to Comment 9-2.*** Planning for burned area rehabilitation is determined by the type of fire incident. In the case of wildland fires, an emergency stabilization request is submitted through the Pacific West Regional Office primarily to address the potential for erosion and slope failure as a result of the burn. The NPS Burned Area Emergency Rehabilitation Handbook (BAER) is the primary source of guidance on rehabilitation policies and procedures following a fire. NPS Director's Order 18, Wildland Fire Management (2003a) calls for the use of the least environmentally intrusive yet effective BAER techniques to mitigate actual or potential damage from a fire. Potential problems that could arise from wildland fire include erosion on slopes and in stream channels, sediment and debris jams in streams, weed infestations, loss of vegetation and forest cover, hazards from fire-killed trees falling, and potential damage from post-fire activities like salvage logging. Runoff may increase after fire due to water-repellency in soils and lack of vegetation to absorb and use rainfall. The range of corrective treatments includes revegetation, erosion control blankets, straw mulching, temporary check structures in ephemeral drainages such as straw bale check dams and silt fences, directional log felling and contour scarification. BAER requests are also submitted to address the need for funding of short-term and long-term exotic plant species removal and control actions.

Comment 9-3. The NPS has stated that its position is that any unplanned fire will be extinguished. Would the NPS consider loosening this policy for inland acres on the Marin Headlands? There appears to be ample acreage there to allow some natural fires that are in the right spot, occur under correct weather conditions, and at appropriate times of the year.

> ***Response to Comment 9-3***. The NPS is committed to implementing a flexible suppression strategy based on minimum impact suppression techniques (MIST), as described in Appendix G – MIST Guidelines Implementation. As explained on page 70 of the DEIS and in Appendix G, this gives the

firefighter the opportunity to choose a strategy that may have minimal environmental impacts. However, GGNRA cannot endorse a policy advocating "wildland fire use fires" wherein firefighters monitor a naturally ignited wildland fire, such as a lightning fire, as long as conditions stay within what is considered a safe prescription. Through the use of MIST tactics, the NPS can choose among a range of strategies to determine an approach that protects resources while suppressing the fire. Unlike a prescribed burn, wildland fires do not have a perimeter defined or cleared and are likely to occur under the least favorable conditions when there are not adequate resources to contain and control it. The DEIS on page 228 outlines some of the potentially hazardous conditions in the Marin Headlands – the area of the park that contains some of GGNRA's more remote lands – that preclude the consideration of a "wildland fire use" strategy.

Comment 9-4. The final plan needs more discussion on how the NPS will partner and educate state and local fire departments to insure that fire fighting on park land will be done to minimize damage to park resources and wildlife habitat.

Response to Comment 9-4. GGNRA Fire Management Office staff will continue to meet on a regular basis with cooperating fire fighting agencies to discuss suppression strategies and concerns on NPS lands in conformance with Mitigation Measure FMP-2. These meetings will include discussion and study of maps of sensitive resources within the federal parklands, areas preferred for use for staging equipment or for helipads, and indication of which water resources within federal lands should and should not be used to fight fire. The NPS will also review with local agencies the conditions developed in the Programmatic Agreement between the NPS and the State Historic Preservation Officer to protect areas with known or high potential for finding cultural resources. See Appendix J in the FEIS. These areas should be avoided to the degree possible during fire suppression actions. Similarly, responsibilities under the Endangered Species Act will be discussed with neighboring fire agencies with reference to wildland fire response. Cooperative Agreements signed by the NPS and local fire departments will include the guidelines for implementation of Minimum Impact Suppression Tactic for wildland fires in the park. Annual update meetings will review sensitive area maps with local firefighters and inform them of changes that have been made to maps during the past year.

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Letter 10

"Drumm, Kristin" <KDrumm@co.marin.ca.us> To: <mia_monroe@nps.gov>
cc:
05/04/2005 04:04 PM MST Subject: GGNRA Fire Management Plan DEIS

Hi Mia,

10-1 I did come across SS-37 on pg. 105. While I'm glad they mention the butterfly here, I don't think this is adequate. While I haven't read the entire document yet, I am concerned that the monarchs are being overlooked because they are not a federally listed species. Does it matter if the butterflies are listed in the CNDDB? I think they should clearly identify what their mitigation measures are going to be for the butterfly. They provide more specific measaures for the other species, so I don't see why they can't provide the same for the monarchs. Anyway, those are some of my thoughts.

Response to Comment in Letter 10

Kristin Drumm

Comment 10-1. Page 105, mitigation measure SS-37 mentions the monarch butterfly. I don't think this is adequate. I am concerned that the monarchs are being overlooked because they are not a federally listed species. Does it matter if the butterflies are listed in the CNDDB? I think they should clearly identify what their mitigation measures are going to be for the butterfly. More specific measures are provided for the other species, so I don't see why it can't be the same for the monarchs.

> ***Response to Comment 10-1.*** Please see responses to Comments 4-5 and 4-6.Projects that have the potential to impact monarch butterfly use areas are evaluated by park staff, and if necessary, by a qualified monarch butterfly biologist according to conditions of approval developed during the interdisciplinary review process described in FMP-1(a) and required for NEPA conformance. The impacts on this species are carefully weighed in conjunction with impacts (both positive and negative) on other listed and species of concern, as well as overall habitat conditions, through the park's project review process. This approach is taken for any species (or habitat) that is a species of concern.

Letter 11

82 Karen Court
San Francisco, CA 94134
Telephone 415-657-0253

RECEIVED
MAY 16 2005
GGNRA - FMO

Golden Gate National Regional Area;

Atten: Fire Management Team;

Thank you for the opportunity to introduce you to my idea, for putting out grass and other fires more easily and faster!

PM Fire Fighting Method is about fighting Fires from every angle, as we know the Wonderful fire fighters, fight fires from the beginning or in front, however that is Chasing the fires, Most time the fires keep burning and burning destroying everything in it's pass.

11-1 PM Fire Fighting Method Suggest that Fireman be placed at the beginning of the fire, behind or at the ending of that fire and at the ending and everywhere that fire has spread!

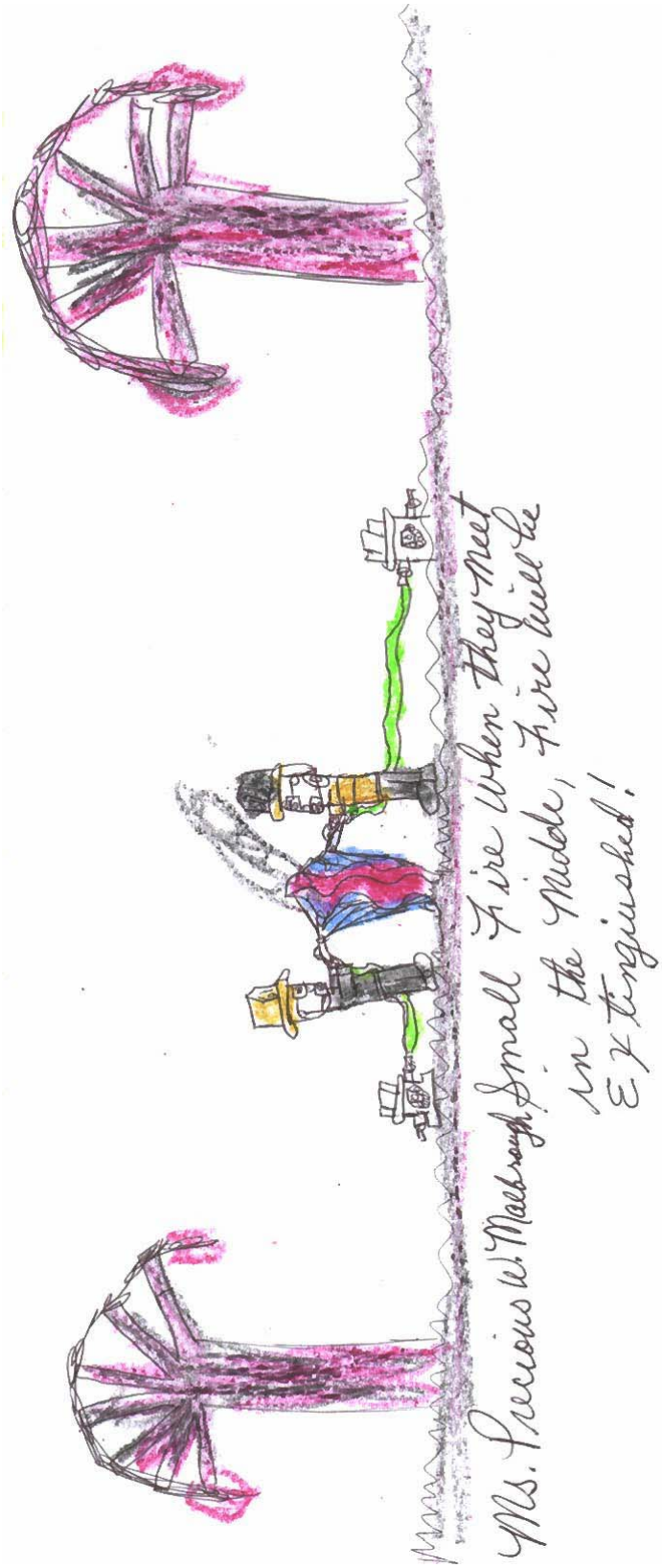
11-1 Thus, When all Fire-Fighters
Met Near the Middle that
Fire will be Extinguished!

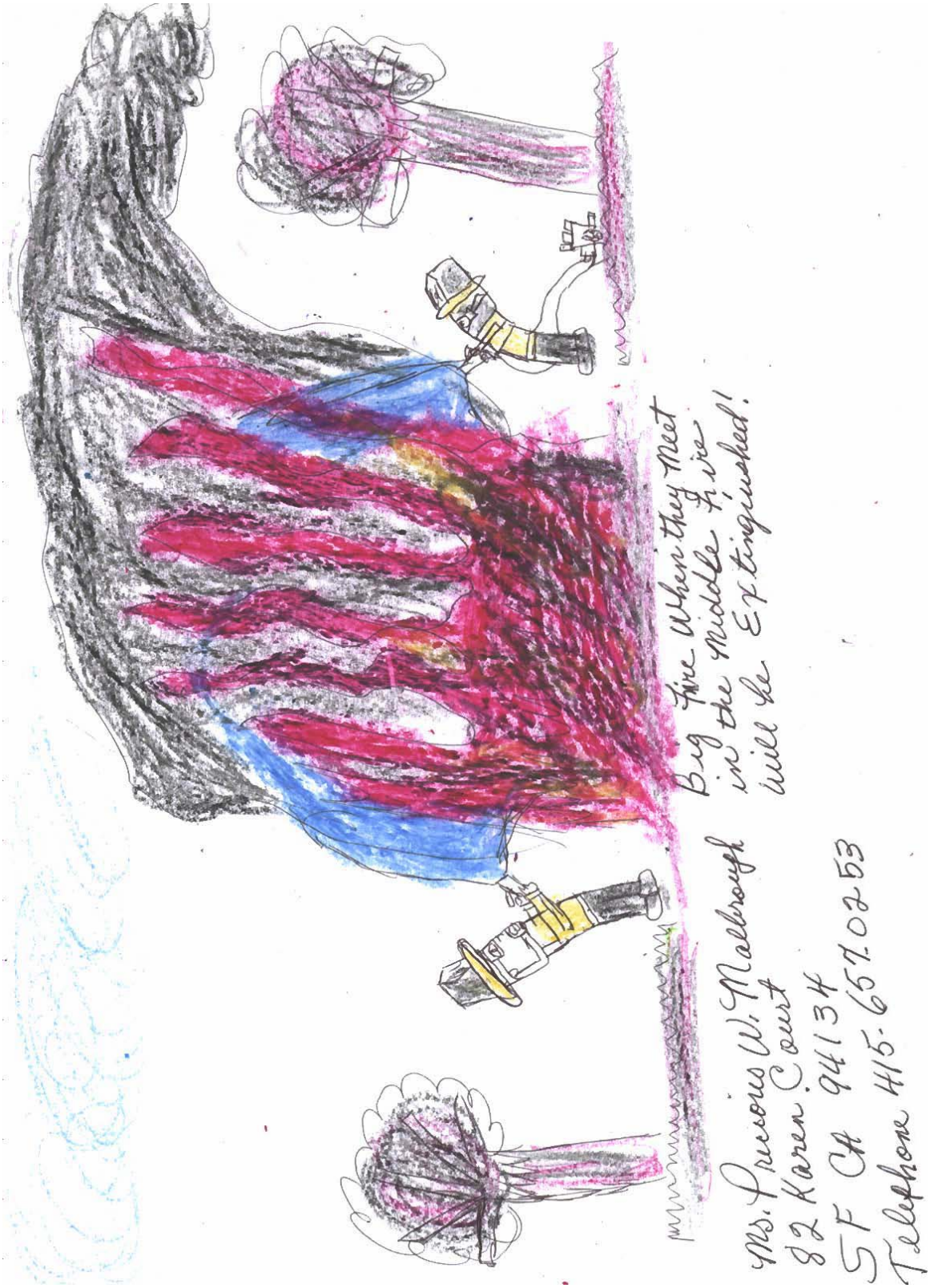
I hope you will Consider this
Idea, because I really believe
this Method will enable Fires
Men to put Fires out faster,
thus helping to save Human
lives, Wild-lives, Properties,
Trees, Plants and etc Including
Millions of Dollars!

Thank you for Replying!

Yours Truly,
Ms. Precious W. Mackrough

P.S. Sketch ENCLOSED!


Ms. Precious W. Marbrough Small Fire When They Meet
in the Middle, Fire Line be
Extinguished!


Big Fire When they Meet
in the middle Fire
will be Extinguished!
Ms. Precious W. Malbrough
82 Karen Court
SF CA 94134
Telephone 415-657 0253

Response to Comment in Letter 11

Letter from Ms. Precious Malbrough

Comment 11-1. Thank you for your letter. Proposes the idea of PM Fire Fighting Method to fight fires from every angle rather than from the beginning or in front which is chasing the fire which burns ahead. PM Fire Fighting Method suggests that firemen be placed at the beginning of the fire, behind or at the ending of that fire and everywhere that fire has spread. Thus when all the firefighters meet near the middle that fire will be extinguished.

> ***Response to Comment 11-1*.** Current firefighting strategies include using appropriate suppression efforts which can include the methods described above. All wildland fires are different and flexible suppression efforts must be used to provide for firefighter and public safety.

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Letter 12

bk1492@aol.com
03/24/2005 06:36 PM
EST

To: goga_fire@nps.gov
cc: rodney.frelinghuysen@mail.house.gov
Subject: public comment on federal register of 3/21/05 vol 70 no 53 pg 13538

us doi nps - eis -alleged fire Mgt plan (but really a plan to log and make money for timber barons)

golden gate NATIONAL recreation area -

12-1 i note prescribed burning being planned . prescribed burning pollutes the air that people breathe. it lets particulates fall into people's lungs so that they get lung cancer. if they dont get lung cancer they can have a heart attack or a stroke as a result. children get asthma from the release of these air particulates. why in california would anyone want to get the air any dirtier with this prescribed burning?

12-2 i oppose thinning of the forest so that lumber barons and friends of washington politicians can make big money out of the forests that american taxpayers have been spending their hard earned tax dollars for eons to protect. such burning and thinning destroys wildlife and bird habitats and give them no home -it makes them homeless and they die = a truly destructive anti environmental action by greedy humans. it is a scam to say its ffor fire managment when its really for forest profits.

i would like to receive a copy of the fmp deis. i oppose and object to this proposal.

b sachau
15 elm st
florham park nj 07932

To: goga_fire@nps.gov, rodney.frelinghuysen@mail.house.gov
From: Bk1492@aol.com
Date: 05/01/2005 02:39PM
Subject: public comment on golden gate fire "management" plan which will pollute air

i have some comments on the national park service deis for golden gate nra fire alleged "management" plan.

12-3 firstly, since the document is long, i think the comment period should be a minimum of three months.

i also think this plan stinks and is misguided.

12-4 Where does the spotted owl live when you burn down its tree? it doesnt live. It dies.

The long term will be nothing alive if you kill them short term. This plan does that.

12-5 i think the goal of preserving this area is too far down your list of goals and find that outrageous.

this plan hurts wildlife, vegetation, humans by burning pollution and birds.

There is no need for this - if there is a fire fight it then.

12-6 i think budget money should be spent on effective fire fighting equipment when needed so when fire breaks out it can be quickly put out. i do not think current policy is to do that - put all resources into fighting fires.

stop developers from building so close to the parks. buy up the land so that development is not the problem it is. it is the development that is the problem, not the park.

this plan was made by park staff with far too little public input although its the public's tax dollars that sustain this park.

b. sachau
15 elm st
florham park nj 07932

Response to Comments in Letter 12

B. Sachau

Comment 12-1. Prescribed burning pollutes the air that people breathe by creating particulates that fall into people's lungs and cause lung cancer, heart attack, stroke or asthma in children. Why in California would anyone want to get the air dirtier?

Response to Comment 12-1. The Purpose and Need for the GGNRA FMP is presented on pages 9 through 15 of the DEIS. One of the primary needs for preparing the FMP is to address the existing hazard presented to neighboring residential communities by high fuel loading along the park's wildland urban interface. The primary purpose is to provide a framework for all fire management activities in GGNRA in a manner that is responsive to natural and cultural resource objectives, reduces risks to developed facilities and adjacent communities, and provides for public and staff safety. The assessment of potential impacts on public health from prescribed burning is addressed in the DEIS on pages 411 through 433. Appendix I - Non-burning Alternatives and Air Emissions Reduction Techniques for Fuel Reduction and Resource Benefiting Prescribed Burns in GGNRA in the FEIS details the range of mitigation measures available to the Air District and GGNRA fire management staff to reduce the amount of particulates generated by prescribed burning. The primary recipients of particulates from prescribed burns are the firefighters monitoring and controlling the burns, especially when pile burning is involved. Public notification prior to prescribed burning near interface lands would alert those residents especially sensitive to smoke to stay indoors during the duration of the burn. All prescribed burns must have a smoke management plan approved by the Bay Area Air Quality Management District (BAAQMD) and receive day-of-burn authorization to proceed based on current air quality conditions and forecasts that allow the BAAQMD to limit the amount of pollution generated by burning throughout the nine counties of the Bay Area Air Basin and minimize public health effects.

Comment 12-2. I oppose thinning of the forest so that lumber barons and friends of Washington politicians can make big money out of the forests that American taxpayers have been spending their hard earned tax dollars for eons to protect. Such burning and thinning destroys wildlife and bird habitats and gives them no home and they die – a truly destructive anti environmental action by greedy humans. It is a scam to say it's for fire management when it's really for forest profits.

Response to Comment 12-2. GGNRA does not sell lumber taken from the park as part of fuel reduction projects nor are there leases for commercial logging operations in the park. The vast majority of trees removed are non-native evergreen hardwoods that have little or no commercial value other than biomass fuel[1] or firewood. Other uses can include the use of the stumps for habitat improvement in local stream channels. Very few native trees would be removed under the FMP. Exceptions may be permitted where targeted tree removal would improve access on fire roads for emergency vehicles or where weakened trees or snags could fall across fire roads during a wildland

[1] Biomass fuels are carbonaceous waste of various human and natural activities derived from numerous sources, including the by-products from the timber industry, agricultural crops, raw material from the forest, major parts of household waste and wood.

fire. Smaller native trees could be removed in areas where shaded fuel breaks are constructed to achieve necessary fuel reduction and where understory vegetation is scant and saplings are densely packed.

Comment 12-3. The document is too long. The comment period should be a minimum of three months.

Response to Comment 12-3. The length of the document is dictated by the number of environmental issues that require assessment for affect for fire management implementation. The NPS follows agency-wide guidance in the preparation of NEPA documents and the FMP DEIS meets the requirements for an EIS. The NPS guidance document for NEPA is Director's Order 12 and the accompanying handbook (2001a). Director's Order 12 calls for a minimum 60 day public review period for an EIS prepared by the NPS. The GGNRA FMP DEIS was available for public review for 68 days.

Comment 12-4. Where does the spotted owl live when you burn down its tree. It doesn't live. It dies.

Response to Comment 12-4. Prescribed fires conducted in forested areas in GGNRA are not intended to remove mature trees but rather are planned to reduce the volume of understory vegetation in a forest. Reducing understory vegetation lowers the potential for a high intensity wildland fire to strike the forest which would result in widespread mortality. Prescribed burns are kept to the understory by pre-treating forest stands prior to the burn. During pre-treatment, firefighters cut branches, dead limbs and hanging bark and vines that run from the understory towards the tree canopy creating a ladder of fuels that flames can climb. Compared to a typical wildland fire in a forest, a prescribed burn would be timed for a day of cool weather with low winds and would be sited in an area pre-treated to reduce the potential for fire to spread to the canopy. Therefore, prescribed burns implemented under the FMP would not normally result in long-term damage to the larger diameter trees (greater than 8 inches diameter at breast height) used by the northern spotted owl as is suggested by the comment.

However, as explained on page 369 of the DEIS, there are fire management activities that do have potential to affect spotted owls. These impacts may include habitat alteration from wildfire, short-term reduction of understory vegetation after prescribed burning or from mechanical treatment; noise associated with suppression activities and mechanical treatment; and the potential for widespread habitat destruction from catastrophic wildfire. For this reason, the NPS initiated formal consultation with the US Fish and Wildlife Service (USFWS) to develop procedures for conducting fire management actions within the habitat of the northern spotted owl. The USFWS concluded that the NPS would not adversely affect the northern spotted owls or cause the "take" of any individuals of the species, provided that the avoidance measures in the FMP EIS in addition to those recommended by the USFWS are implemented for FMP projects (C. Nagano, pers. comm. 9/16/05). See Appendix K – USFWS Biological Opinion of the DEIS.

Comment 12-5. I think the goal of preserving this area is too far down your list of goals.

Response to Comment 12-5. With the exception of protecting life and property, which is the primary goal of Federal Wildland Fire Policy, the remaining goals are not listed in order of importance and have equal status.

Comment 12-6. I think budget money should be spent on effective fire fighting equipment when needed so when fire breaks out it can be quickly put out.

Response to Comment 12-6. The NPS, in conformance with Federal Wildland Fire Policy (1995), is implementing fuel reduction projects to reduce the overall intensity of wildland fires; to provide areas with reduced fuels from which firefighters can more safely stage suppression efforts; and to reduce the potential for wildfires to move from the parklands to adjacent residential developments along the park perimeter [also known as the wildland urban interface]. NPS funding of fuel reduction projects comes directly from the National Fire Plan budget which provides only limited funding to local fire agencies for equipment and vehicles. The principal focus of the National Fire Plan is vegetation management to reduce risk and protect life and property. Funding for the purchase of heavy equipment, vehicles and engines is provided by separate funding initiatives. Catastrophic wildfires in the 1990s convinced the federal government to redirect firefighting efforts to slowing the rate of spread of fires by strategically reducing fuels rather than focusing on increasing equipment and staffing. In developing the Federal policy, it was recognized that reducing fuels around and within rural residential neighborhoods provides the greatest protection from wildland fire and that there are logistical limits to what firefighters and equipment can do once fires grow in intensity in difficult terrain. Vegetation management provides safer access routes for firefighters and the evacuating public while contributing to an overall reduction in the intensity of the wildland fire and slowing the rate of spread. Strategically reducing fuel loading within parklands may reduce the potential for resource damage to occur from heavy equipment use during fire suppression.

Appendix I – Non-burning Alternatives and Air Emissions Reduction Techniques for Fuel Reduction and Resource Benefiting Prescribed Burns in GGNRA

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Appendix I – Non-burning Alternatives and Air Emissions Reduction Techniques for Fuel Reduction and Resource Benefiting Prescribed Burns in GGNRA

Smoke management practices referenced in mitigation measure AIR-1 of the FMP FEIS are outlined in this Appendix. The sources of this information are the Smoke Management Guide for Prescribed and Wildland Fire (NWCG 2001) and Non-burning Alternatives to Prescribed Fire on Wildlands in the Western United States (Jones and Stokes 2004), prepared for the Fire Emissions Joint Forum of the Western Regional Air Partnership.

Techniques for emissions reduction can be grouped in four main categories:

- reducing the area burned;
- reducing fuel loading (e.g., mowing and understory thinning);
- managing the rate of fuel consumption; and
- redistributing the emissions from prescribed burning.

Techniques for Reducing the Area Burned:

- Burn Concentrations. Burn only areas of the site with highest fuel concentrations and avoid intervening areas of low fuel loading.
- Isolate Fuels. Avoid areas of highest fuel concentrations that will smolder the longest by building a protective fire line, applying foam or using natural barriers. Fuel concentrations can also be reduced by scattering the fuels before firing or avoiding direct ignition to the specific areas.
- Mosaic Burning. Burn during periods of higher natural fuel moisture levels to mimic natural wildfire patterns by allowing burning to proceed in patches to form a mosaic landscape around more resistant features such as wetlands, hardwoods and wetter live fuels.

Techniques for Reducing Fuel Loading (used in conjunction with prescribed burning or alone as an alternative to burning):

- Site Conversion. Scheduling more frequent, less intense burns to prevent unwanted vegetation from becoming established in clearings or in forest understory.
- Mechanical Removal. Mowing grass and reducing density of vegetation in brushlands. Understory thinning, thinning of forests, and creation of shaded firebreaks.
- Firewood Sales. Mechanically removing fuels from a site to be burned elsewhere as firewood,
- Biomass utilization. Chipping vegetation for off-site use in landscaping, weed suppression, composting material or for reuse as lumber or in the production of paper, methanol, wood pellets, etc.
- Biomass for Electrical Generation. Chipping or shredding of vegetation for biomass fuel for cogeneration power plants.

- Ungulates. Use grazing to reduce fuels prior to burning.
- Chemical treatment. Reduce or remove live vegetation through herbicide application.
- Burn when large diameter woody fuels are wet can result in lower fuel consumption and less smoldering. This can be used to limit large fuels and organic layer consumption and significantly reduce emissions.
- Burn when the organic duff layer is wet focusing burning on surface fuels. Most effective in non-fire adapted forest and brush types to reduce fuels. Conditions occur directly following a soaking rain.
- Burn before a precipitation event to limit the consumption of large woody material and reduce the smoldering period.
- Burn within 3 or 4 months after mechanical reduction before large fuels cure.
- Burn before litter fall so there is less fuel consumed and less smoke generated.
- Burn before green-up and growth of grasses or herbaceous shrubs.

Techniques for Managing the Rate of Fuel Consumption:

- Burn piles or windrows to generate greater heat and burn more efficiently.
- Burn using a backing fire to achieve more flaming and less smoldering.
- Burn under dry conditions in areas where most fuel would be consumed whether burned under wet or under dry conditions.
- Employ rapid mop-up techniques to reduce smoldering of large woody fuels, stumps, snags and duff.
- Burn through mass ignition to cause rapid consumption of dry, surface fuels.
- Burn with an air curtain incinerator.

Techniques for Redistributing the Emissions from Prescribed Burning:

- Burn when dispersion is good.
- Share the airshed through cooperation and BAAQMD approvals.
- Burn during favorable wind direction that direct smoke away from sensitive receptors.
- Burn smaller units over multiple days.
- Burn more frequently to prevent fuels from building up.

Appendix J – Programmatic Agreement for Fire Management Activities

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PROGRAMMATIC AGREEMENT
AMONG THE ADVISORY COUNCIL ON HISTORIC PRESERVATION,
THE CALIFORNIA OFFICE OF HISTORIC PRESERVATION, AND
THE NATIONAL PARK SERVICE,
GOLDEN GATE NATIONAL RECREATION AREA
REGARDING THE TREATMENT OF HISTORIC PROPERTIES THAT MAY BE AFFECTED BY FEDERAL FIRE MANAGEMENT ACTIVITIES

WHEREAS, the Golden Gate National Recreation Area (Park) is a unit of the National Park Service (NPS), a Federal land managing agency; and

WHEREAS, the Secretary of the Interior has directed his/her agency heads to assume responsibility for implementing the principles, policies, and recommendations of the 1995 Federal Wildland Fire Management Policy (Federal Fire Policy) on a joint, interagency basis whenever possible; and

WHEREAS, implementation of the Federal Fire Policy on Federal lands by the NPS may affect properties either listed in or eligible for listing in the National Register of Historic Places (historic properties); and

WHEREAS, a coordinated program among the parties to this agreement would: facilitate compliance with Section 106 of the National Historic Preservation Act, as amended (NHPA), and the National Environmental Policy Act (NEPA); provide for effective and timely coordination among local fire fighting agencies, Indian tribes, the State Historic Preservation Officer (SHPO), Advisory Council on Historic Preservation (ACHP), and interested public; and improve efficiency, consistency, and accountability in the development and application of appropriate measures to inventory, evaluate, protect, and manage historic properties that may be affected by implementation of the Federal Fire Policy; and

WHEREAS, the Park has consulted with the SHPO (and invited the participation of the ACHP, which declined to participate) and has, through the Fire Management Plan Environmental Impact Statement (EIS), provided for consultation with affected Indian tribes regarding the process by which historic properties shall be considered by the Agencies in conducting fire management activities in accordance with the intent of Section 106 and Section 110(a) of the NHPA (16 U.S.C. 470f and 470h-2), and the ACHP's implementing regulations entitled "Protection of Historic and Cultural Properties" (36 CFR § 800);

NOW, THEREFORE, the Park and the SHPO, mutually agree that the Park shall carry out their Section 106 responsibilities in accordance with the stipulations of this Agreement in order to take into account the effects of fire management activities on historic properties.

PREFACE

The past federal policy of total fire suppression on federal lands has resulted in massive increases in flammable vegetation (i.e., fuel loads) that threaten life and property, including National Register of Historic Places listed and eligible properties (historic properties). The federal government spends billions of dollars each year on wildfire suppression, damage, and fire recovery, and those annual costs are rising due to accumulated vegetation that fuels increasing numbers of large and devastating wildfires. In response to this problem, the Federal Wildland Fire Management Policy of 1995 (Federal Fire Policy), including the Federal Wildland Fire Policy for Wildland/Urban Interface Protection, was developed and adopted by the Secretaries of Agriculture and Interior as the policy of their member agencies, including: the United States Forest Service the NPS; the Bureau of Indian Affairs ; the Bureau of Land Management ; and the United States Fish and Wildlife Service (Agencies).

Wildfires are unscheduled events for which planned responses can result in logical levels of resource protection. The Federal Fire Policy emphasizes long-term and pre-incident planning in the form of Fire Management Plans for each administrative unit of federal lands with burnable vegetation. Thoughtful fire management planning will benefit historic properties by reducing the potential for catastrophic fires while affording such properties appropriate levels of consideration.

The Agency heads have been directed by the Secretaries of Agriculture and Interior to develop an integrated strategy that will implement the principles, policies and recommendations of the Federal Fire Policy on a joint, interagency basis whenever possible. The Agencies must also meet legal mandates including the requirements of Section 106 of the National Historic Preservation Act. However, the standard Section 106 process described at 36 CFR § 800 is not well suited to the circumstances of fire management. This Programmatic Agreement (Agreement) is designed to contribute to the success of the three major program areas of federal fire management (fuel reduction, wildfire suppression, and fire recovery) by decreasing regulatory delays, assisting agencies in meeting their historic preservation responsibilities, and developing effective strategies to implement the Federal Fire Policy at the Golden Gate National Recreation Area.

This Agreement affords the Park the ability to develop or pursue cultural resource management processes that are most effective in satisfying its Section 106 responsibilities for fire management undertakings according to its particular operations. The Agreement incorporates recommended Cultural Resource Components from the Guideline for the Management of Cultural Resources Related to Fuels Management Projects, and provides incentives for their further development and incorporation into the Park's Fire Management Plan. This agreement integrates cultural resource management procedures with the Park's fire program, and is consistent with, and based upon, NPS historic property preservation policy as set forth in NPS *Management Policies* and *NPS-28, Cultural Resource Management Guidelines*.

STIPULATIONS

I. DEFINITIONS

Unless otherwise defined within this Agreement, the definitions contained in 36 CFR 800.16 shall apply to this Agreement.

II. STAFFING AND QUALIFICATIONS

The Park shall ensure that historic preservation activities conducted under the terms of this Agreement are carried out by, or under the supervision of, historic preservation specialists (Cultural Resource Specialists) in appropriate disciplines that meet the *Secretary of Interior's Guidelines for Historic Preservation Projects, Professional Qualifications Standards (Federal Register 1983, Vol. 48, No. 190. 44738-39)* and Office of Personnel Management's *X118 Standards*. "Supervise" means active oversight or review, as appropriate, of all aspects of the work to ensure that it meets professional standards.

III. PLANNING

The Secretary of the Interior has directed the Agencies under their jurisdiction to implement the Federal Fire Policy. Accordingly, every federally managed area with burnable vegetation must have an approved Fire Management Plan (FMP) that guides decision making. FMPs describe the application of various fire management practices to those specific land units, taking into consideration an array of environmental concerns, including the consideration of historic properties. Fire management decisions and actions applicable to this Agreement are made within the context of the *Fire Management Plan Environmental Impact Statement for Golden Gate National Recreation Area*.

IV. PARTICIPATION BY INDIAN TRIBES AND PUBLIC

A. General Policy

The views of Indian tribes and the public are essential to informed Federal decision-making regarding the effects of fire management activities on historic properties. Consultation with Indian tribes will be on a government-to-government basis. The Park shall make reasonable efforts to seek and consider such views.

Consistent with the Federal Fire Policy , firefighter and public safety is the first priority in every fire management activity. No provisions of this Agreement shall restrict the Park from taking any actions necessary to protect firefighter and public safety.

B. PROCEDURES FOR INVOLVING THE PUBLIC

The Park may be able to plan all specific fire management activities within a single annual planning document, or a five-year fire management activity plan, while activities may require multiple levels of planning with the planning for specific undertakings deferred for years. In light of this variability, no single standard for consultation with Indian tribes and public participation will be suitable to all the Park undertakings.

1. Every five years, beginning with the adoption of the Fire Management Plan, the Park shall provide the public and appropriate Indian tribes with the opportunity to comment on the five-year fire management activity plan. The results of this public comment will be communicated to the SHPO and ACHP, who shall have thirty days to comment.

2. The Park shall review its projected fire management activities annually, under the stipulations of section VI.C. of this Agreement.

V. IDENTIFICATION OF HISTORIC PROPERTIES

A. ONGOING IDENTIFICATION EFFORTS

1. Since its establishment in 1972 the Park has made efforts to carry out the identification of historic properties, and continues to do so on an ongoing basis, supplemented by NPS-wide efforts. Numerous historic resource studies, cultural landscape inventories, archeological surveys and other reports—supplemented by NPS databases such as the List of Classified Structures, the Cultural Landscape Inventory and the Archeological Servicewide Management Information System—have resulted in the identification of the known historic properties that are listed in Appendix 1 to this Agreement.

2. Despite substantial identification efforts, only a small portion of Park lands have been surveyed for archeological resources, and there remain structures, landscapes and districts within the Park that have not yet been assessed for National Register eligibility. Thus, in accordance with 36 CFR 800.4(b) (2), the Park proposes to carry out ongoing identification efforts in consultation with the SHPO.

B. IDENTIFICATION OF HISTORIC PROPERTIES IN ASSOCIATION WITH UNDERTAKINGS

1. In addition to on-going efforts to identify historic resources the Park will carry out identification work on an as-needed basis in relation to individual undertakings, annual fire management activity plans, and five-year fire management plans.

2. This additional effort to identify historic resources in relation to undertakings is elaborated upon in Section VI.C. of this Agreement, describing the process for review of individual undertakings and fire management plans.

VI. REVIEW OF UNDERTAKINGS

A. USE OF EXISTING PROCESSES

Either the Golden Gate National Recreation Area Programmatic Agreement, the NPS Programmatic Agreement, or the procedures described at 36 CFR 800 may be followed if either of these alternatives is suited to the nature of a fire management undertaking.

B. RESOLUTION OF PROCEDURAL QUESTIONS

1. The SHPO and/or the ACHP may choose to monitor the manner in which the Park is following the procedures described in the EIS, FMP and this Agreement, by reviewing the manner in which those procedures are implemented for individual fire management undertakings.

2. SHPO and/or ACHP (reviewing parties) may request the Park to provide documentation for review of individual undertakings. Such documentation will be carried out using the "Assessment of Effects Form" (Appendix 4).

3. Reviewing parties shall review documented historic preservation activities according to the procedures, standards, and guidelines provided in the FMP and EIS.

4. Reviewing parties shall be afforded 30 calendar days from receipt to review documentation for individual fire management undertakings, if reviewing parties' requests for review are made prior to, or at the time of, Park and public review of documentation (e.g., NEPA review).

5. If a reviewing parties' request for review occurs during the public review period, then the reviewing parties must provide review and comments in accordance with the ongoing or remaining public review period, but in no case will the reviewing party have less than 30 calendar days for review.

6. If Park planning for an undertaking has begun under the terms of this Agreement prior to reviewing parties' request for review under 36 CFR 800, subsequent review of the undertaking under 36 CFR 800 shall apply only to those historic preservation activities that have not been conducted by the date of the SHPO/ACHP request.

7. If the Park does not adopt or incorporate the recommendations of the SHPO/ACHP into the plans for implementing the fire management activity, the Park must consult with the SHPO pursuant to 36 CFR 800 for the specific undertaking, instead of the provisions of this Agreement.

C. Review of Undertakings Under This Agreement by Park Cultural Resource Staff

1. Types of Activities

   a) Wildland fire suppression, including the use of water, chemical fire retardant, aircraft and heavy earth-moving equipment necessary to put out an active fire.

   b) Prescribed fires, ignited by trained personnel, for specific resource and fire management goals under predefined fuel and weather conditions, in order to manage vegetation, reduce hazardous fuel loads, manage cultural landscapes and restore natural systems, and for research purposed.

   c) Mechanical treatments, involving the use of hand tools and power tools and equipment for treatments such as, clearing corridors of vegetation and reducing the density of vegetation through mowing, cutting and selective trimming, using animals to reduce fuels, and revegetation of treated areas.

2. Scope of Activities

   a) As per a Five-year plan that has been reviewed and commented upon by the public, tribes, the SHPO and ACHP as per Section IV.B.1. of this Agreement.

   b) As listed in an annual fire management activity plan that will be reviewed in the Park per Section IV.B.2. of this Agreement.

   c) Unanticipated individual fire management activities that come to park review individually as per Section VI.C.3. of this Agreement.

   d) Federal Wildland-Urban Interface projects to reduce fire hazard on private properties adjacent to the Park will be reviewed under this Agreement, according to the same procedures as stipulated in subsections 3 and 4 of this section.

3. Level of Effect

   a) When the level of effect on an undertaking is determined to be No Effect or No Adverse Effect, the undertaking may be reviewed through procedures stipulated in this Agreement in Section VI.C.4, below.

   b) The mitigations listed in the Park's FMP EIS shall be considered and applied whenever applicable to reducing the level of effect of an undertaking. These mitigations are contained in Appendix 2 to this Agreement.

   c) When the level of effect of an undertaking is determined to be Adverse Effect, the undertaking shall be reviewed under procedures of 36 CFR 800 .4-.6.

4. Procedure for Review at Park Level

a) Project Submission: The project proponent shall submit the proposed undertaking through the Park Fire Management Officer, using the "Assessment of Effects Form" (Appendix 3) with all necessary documentation to the Golden Gate Section 106 Coordinator and shall consult with the Section 106 Coordinator regarding the APE for the undertaking.

b) Consolidation of Fire Management Activity: Every attempt shall be made to consolidate all fire management undertakings into a yearly program that can be understood in context and reviewed in its entirety. However unanticipated fire management undertakings are to be expected, and will be reviewed individually as necessary.

c) Adequacy of Submission: The Golden Gate Section 106 Coordinator shall review the undertaking to ensure that consideration of historic properties has been given, and that adequate documentation has been compiled to identify and evaluate the effects of the proposed undertaking(s) on historic properties.

d) Identification of Historic Properties: As stipulated in Section V.B.1 of this Agreement, the Park will identify historic properties for individual undertakings by:
   (1) performing a records search for properties in existing databases,
   (2) surveying areas that have not previously been subject to survey, or consulting with the SHPO to determine whether survey efforts over ten years old meet current professional standards for archaeological and built environment surveys. Areas where the Park and the SHPO agree that prior surveys do meet such standards will not be subject to resurvey. Areas where the Park and the SHPO agree that prior surveys do *not* meet such standards may, however, require resurvey. If the Park and the SHPO disagree on the adequacy of prior survey efforts, then the procedures outlined in Section VIII will be followed to resolve the conflict,
   (3) performing intensive surveys in areas that the archaeological sensitivity models for the Park predict as being sensitive, and performing reconnaissance level surveys for areas that the models predict as being not sensitive, and
   (4) ensuring that the level of survey effort for any given undertaking is commensurate with the potential effects of that undertaking's implementation on historic properties.

e) Review Coordination: The Golden Gate Section 106 Coordinator will provide the Assessment of Effects Form for the proposed undertaking(s) to the Golden Gate cultural resources preservation staff for review, comment, and/or recommendations as outlined in the Golden Gate Standard Operating Procedure for Section 106 Compliance (SOP 606, Appendix 4). In reviewing these proposed undertakings, emphasis will be given to a multi-disciplinary approach, in acknowledgement of the wide range of resources with potential to be affected by fire and fire management activities.

f) Adherence to Governing Principles: Golden Gate cultural resource preservation staff shall ensure that proposed undertakings comply with laws, regulations, standards, guidelines and NPS policy.

g) Certification of Undertaking(s): When the Golden Gate Section 106 Coordinator and the Golden Gate Cultural Resources staff find that either no historic properties will be affected by the undertaking or that historic properties are affected but the level of effect is not

B. Failure to Resolve Objections

1. If the Park determines that the objection cannot be resolved it shall forward all documentation relevant to the dispute to the ACHP and notify the SHPO. Within 30 calendar days after receipt of all pertinent documentation, the ACHP will either:

   a) Provide the Park with recommendations, which the responsible Agency Official shall take into account in reaching a final decision regarding the dispute; or

   b) Notify Notify the Park that it will comment pursuant to 36 CFR 800.7(c), and proceed to comment. Any ACHP comment provided in response to such a request shall be taken into account by the Park in accordance with 36 CFR Part 800.7(c) (4) with reference to the subject of the dispute.

2. Any recommendation or comment provided by the ACHP will be understood to pertain only to the subject of the dispute. The Park's responsibility to carry out all actions under this Agreement that are not the subject of the dispute will remain unchanged.

3. In order to document the resolution of objections, the "Assessment of Effects Form" (Appendix 3) will be used to keep a permanent record of how objections among the parties were resolved.

IX. DISCOVERIES AND UNANTICIPATED EFFECTS

A. Historic Properties

1. If historic properties are discovered or unanticipated effects on historic properties are discovered during or after implementation of an undertaking, or during or after an emergency, the agency official shall make reasonable efforts to avoid, minimize or mitigate adverse effects to such properties and:

2. Implement the procedures for discoveries and unanticipated effects to historic properties described in the FMP and EIS; or

3. Follow the procedures described at 36 CFR 800.13(b-d).

B. Other Authorities

1. The terms of this Agreement do not relieve or substitute the Agencies of responsibilities under the Native American Graves Protection and Repatriation Act (NAGPRA) (104 Stat. 3048-3058; 25 U.S.C. 3001-3013) or the National Environmental Policy Act (NEPA) (42 USC 4321-4347).

X. AMENDMENT

Any signatory to this Agreement may request it be amended, whereupon, the signatory shall consult to consider such amendments. Amendments of this Agreement shall be executed in the same manner as the original Agreement

XI. AGENCY FAILURE TO COMPLY WITH THIS AGREEMENT

The ACHP, SHPO or the Park may determine that the Park has failed to, or is unable to, carry out the terms of this Agreement. Inability to carry out the terms of this Agreement shall be determined through periodic review of the Agreement or the review of individual undertakings pursuant to Stipulations VI. and VII. Failure to comply with the terms of this Agreement shall require the Park to comply with the requirements of 36 CFR 800 for individual undertakings of the federal wildland fire management program.

XII. TERMINATION OF THE AGREEMENT

The SHPO or the Park may notify the other party to this Agreement that it is terminated by providing 30 calendar days notice to the other party.

A. The parties to this Agreement shall make a good faith effort to resolve the issue(s) prompting termination. If consultation fails to resolve these issue(s), one or more party to this Agreement may issue a termination notice to the other parties.

B. The Agreement shall be terminated in 30 days from the date the termination notification was received. The time frame for termination may be alternatively specified upon agreement of all parties to the Agreement.

C. In the event of termination, the Park shall submit all individual fire management undertakings for review pursuant to 36 CFR 800 or the terms of another executed Programmatic Agreement.

XIII. COORDINATION WITH OTHER AGREEMENTS

Should a conflict occur between the terms of this Agreement and the terms of another agreement document executed in accordance with 36 CFR 800, the signatories to this Agreement shall consult with the parties to the conflicting agreement to determine which terms should be followed.

A. The Park shall document the consultation and resulting agreement, invoking Section VIII.B.3. of this Agreement.

B. If the consulting parties fail to reach agreement, the provisions of Stipulation VIII.B. will be followed to resolve the objection.

adverse and that the documentation provided is adequate to determine those effects, the undertaking(s) will be Certified by signature of the Golden Gate cultural resources preservation staff and by the Golden Gate General Superintendent. If the level of effect is determined to be adverse, then the Park will follow the procedures at 36 CFR 800 .4-.6 to complete the Section 106 consultation process.

VII. PERIODIC MONITORING OF THIS AGREEMENT

A. USE OF 36 CFR 800 .4-.6

SHPO and/or (reviewing parties) may, at their discretion, request that the Park follow the procedures at 36 CFR 800 .4-.6 to complete the Section 106 consultation process for an individual undertaking under the following circumstances:

A substantial public concern exists such that the expedited review procedures in this Agreement cannot ensure that those concerns are adequately considered; or

The Park has a poor or suspect record of compliance with the terms of this Agreement.

B. ANNUAL REPORT

The Park shall submit an annual report to the SHPO and ACHP at the end of each fiscal year on September 30th**,** listing all undertakings reviewed during the course of that fiscal year, in order to provide SHPO/ACHP with an opportunity to monitor the record of the Park in implementing this Agreement.

C. MONITORING OF THIS AGREEMENT

The SHPO/ACHP or the Park (reviewing parties) may periodically monitor the effectiveness of this Agreement. Based on such monitoring, the reviewing party(s) may propose to amend the Agreement pursuant to Stipulation X, or terminate the Agreement pursuant to Stipulation XII.

VIII. OBJECTIONS

Should the ACHP, the SHPO, or member of the public, make a timely objection to any actions proposed under this Agreement, the Park shall consult with the objecting party to resolve the objection. Timely objections are those that are raised within the public notification and review procedures specified under NEPA (42 U.S.C. 4321-4347), consistent with the Council on Environmental Quality (CEQ) regulations (40 CFR 1508), or within the review periods specified in this Agreement.

A. Objections during Emergencies

If the objection is raised during implementation of emergency activities that are necessary to protect life or property, the objection will be noted and addressed during the emergency as time and circumstances allow, but shall be resolved after the emergency has ended.

C. Annual reports or other types of reports specified in other agreements may be coordinated with the reporting requirements of this Agreement, as long as the intent and report information requirements specified in this Agreement are met.

D. Other NPS or Golden Gate National Recreation Area programmatic agreements may be developed as alternatives to this Agreement, consistent with 36 CFR 800.14(b).

XIV. SCOPE AND LIMITATIONS

This Agreement is limited in scope to Federal fire management activities and is entered into solely for that purpose and does not affect in any way the positions taken by the NPS, Golden Gate National Recreation Area, or ACHP, regarding the proper implementation of the Park's responsibilities for other undertakings under Section 106 or related historic preservation or other environmental review statutes or regulations.

XV. TIME LIMITS

A. Unless otherwise specified in this Agreement, or agreed to between the concurring party appropriate to the undertaking and review procedure, the SHPO and ACHP shall be afforded 30 calendar days from receipt of appropriate documents to respond to any Park communications. Should the SHPO or ACHP not respond within 30 days, the Park may assume SHPO or ACHP concurrence with the Agency's determination or proposed course of action, and will document non-response by the SHPO and/or ACHP in the project file.

B. Unless otherwise terminated as provided for elsewhere in this Agreement, this Agreement shall remain in effect for fifteen years from the date of execution of this agreement.

XVI. Execution

Execution of this Agreement and implementation of its terms evidences that the Park has afforded the SHPO and the ACHP a reasonable opportunity to examine and share their views on how the Park manages historic properties related to fire management activities. Execution of this Agreement and implementation of its terms also evidences that the Park has satisfied its Section 106 responsibilities for fire management activities covered by this Agreement.

XVII. SIGNATORIES

Golden Gate National Recreation Area

_____

General Superintendent
Date:

Signed copy on file at the Park

State Historic Preservation Office

_____

State Historic Preservation Officer
Date:

Appendix K – U.S. Fish and Wildlife Service Biological Opinion

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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:
1-1-05-F-0104

October 7, 2005

Memorandum

To: Superintendent, Golden Gate National Recreation Area, National Park Service, San Francisco, California

From: For ~~Acting~~ Field Supervisor, Sacramento Fish and Wildlife Office, Sacramento, California Chf Nogami

Subject: Formal Consultation on the Fire Management Plan for Muir Woods National Monument, Golden Gate National Recreation Area, and Fort Point National Historic Site in Marin, San Francisco, and San Mateo Counties, California

This is in response to your March 4, 2005, request for formal consultation with the U.S. Fish and Wildlife Service (Service) on the Fire Management Plan at the Golden Gate National Recreation Area, Muir Woods National Monument, and Fort Point National Historic Site in Marin, San Francisco, and San Mateo counties, California. Your letter was received by this Field Office on March 16, 2005. The National Park Service requested our concurrence that the proposed project is not likely to adversely affect the endangered salt marsh harvest mouse (*Reithrodontomys raviventris*), tidewater goby (*Eucyclogobius newberryi*), California brown pelican (*Pelecanus occidenatalis californicus*), San Francisco garter snake (*Thamnophis sirtalis tetrataenia*), Raven's manzanita (*Arctostaphylos hookeri* ssp. *raveni*), San Bruno elfin butterfly (*Incisalia mossii bayensis*), mission blue butterfly (*Icaricia icarioides missonensis*), and the threatened marbled murrelet (*Brachyramphus marmoratus marmoratus*), San Francisco lessingia (*Lessingia germanorum*), Marin dwarf flax (*Hesperolinon congestum*), California red-legged frog (*Rana aurora draytonii*), Pacific Coast Population of the western snowy plover (*Chardrius alexandrinus nivosus*), and the northern spotted owl (*Strix occidentalis caurina*), and proposed critical habitat for the California red-legged frog. We also have included the endangered Presidio clarkia (*Clarkia francisciana*) in this document. This biological opinion analyzes the effects to listed species that would result from the implementation of Alternative C, as described in the *Golden Gate National Recreation Area Fire Management Plan Draft Environmental Impact Statement* (DEIS) dated March 2005. This biological opinion is issued pursuant to the Endangered Species Act of 1973, as amended (Act) and in accordance with the regulations governing interagency consultations (50 CFR § 402).

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.

The National Park Service should contact NOAA- Fisheries regarding the potential effects of the proposed project on the threatened Central California steelhead (*Oncorhynchus mykiss*), threatened California coast coho salmon (*Oncorhynchus kisutch*), and the endangered white abalone (*Haliotis sorenseni*).

This biological opinion is based on: 1) your March 4, 2005, letter, to the Service; 2) *Golden Gate National Recreation Area Fire Management Plan Draft Environmental Impact Statement* (DEIS) dated March 2005, that was prepared by the U. S. National Park Service; 3) *Point Reyes National Seashore Threatened and Endangered Species Locations as of 2001*, undated, that was prepared by the National Park Service; 4) *Biological and Essential Fish Habitat Assessment for Federally-listed and Candidate Species Potentially affected by the Golden Gate National Recreation Area's Fire Management Plan* (Biological Assessment) dated January 2005 that was prepared by the National Park Service; 5) an electronic mail message from the National Park Service to the Service dated October 6, 2005, that contained comments on the draft biological opinion; and 6) other information available to the Service.

The Service concurs with the determination that the proposed project is not likely to adversely affect the salt marsh harvest mouse, tidewater goby, California brown pelican, and the Pacific Coast Population of the western snowy plover because of the avoidance measures included in the proposed project, the proposed project is either outside of the range of the listed species, or the action area does not contain suitable habitat for the taxa.

The October 6, 2005, electronic mail message from the National Park Service to the Service stated that they had determined the proposed project is likely to adversely affect the San Bruno elfin butterfly. However, the Service does not concur and we have concluded this listed animal is not likely to adversely affected due to the avoidance measures that are contained in the proposed project.

The Service concurs with the determination that the proposed project is not likely to adversely affect the northern spotted owl because of the measures that will be implemented by the National Park Service. According to the BA, the measures include the following:

1. Treatment activities described in the BA and DEIS or any noise generation above ambient noise levels will not occur within 0.25 mile of a known occupied or previously used northern spotted owl nest site, or within potential spotted owl habitat between February 1 and July 31 (breeding season), or until such date as surveys conforming to accepted protocol have determined that the site is unoccupied or non-nesting or nest failure is confirmed.

2. Mechanical fuel reduction activities in suitable spotted owl habitat, known or potential, will not substantially alter the percent cover of canopy over-story and will preserve multilayered structure. When shaded fuel break features in suitable northern spotted owl habitat are constructed, the resulting multilayered canopy will only be reduced to a height of 6 to 8 feet, or along roadways as needed for emergency vehicle clearance.

3. Prior to fire management activities, project areas will be surveyed for the presence of dusky footed woodrat (*Neotoma fuscipes*) nests. If feasible, woodrat nests will be protected.

4. Within northern spotted owl habitat, the cutting of native trees greater than 10 inches diameter at breast height (dbh) will be avoided unless a determination is made that the native tree presents a clear hazard in the event of a fire or is the only option to reduce high fuel loading.

5. The fire management officer will arrange for qualified biologists to conduct post-project monitoring to determine short- and long-term effects of fire management actions on spotted owl activity centers if resources are available.

The Service concurs with the determination that the proposed project is not likely to adversely affect the marbled murrelet because of the measures that will be implemented by the National Park Service. According to the BA, the measures include the following:

1. Where marbled murrelet habitat overlaps northern spotted owl habitat, the restrictions on noise generation in spotted owl habitat above the level of ambient noise is extended to August 5. Further, from August 6th through September 30th, noise generation should be limited to ambient noise levels from two hours before sunset to two hours after sunrise to protect any nesting marbled murrelets that have not been noted during surveys.

2. In marbled murrelet habitat, avoid felling very large Douglas fir or coast redwood trees and establish the fire perimeter at a distance that will preclude the need to fell large trees.

The Service does not concur that the proposed project is not likely to result in adverse effects to the threatened California red-legged frog, proposed critical habitat for the California red-legged frog, San Francisco garter snake, mission blue butterfly. San Francisco lessingia, Raven's manazanita, Marin dwarf flax, and the Presidio clarkia.

Consultation History

March 16, 2005: The Service received the request for the initiation of formal consultation from the Park Service that was dated March 4, 2005.

April 2005: The Service received a copy of the DEIS from the National Park Service.

September 12, 2005: The Service requested additional information from the National Park Service on the proposed project.

September 12, 2005: The National Park Service provided the Service with the requested information via electronic mail and telephone.

September 16, 2005: The Service sent the National Park Service a draft of the biological opinion for their review and comment.

October 6, 2005: The National Park Service sent the Service comments 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 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.

The Golden Gate National Recreation Area consists of 74,816 acres in San Mateo, San Francisco and Marin counties in California. Within the Golden Gate National Recreation Area legislative boundary are lands directly managed by the National Park Service, including Muir Woods National Monument and Fort Point National Historic Site. The majority of the Park is in Marin County and includes former military lands in the Marin Headlands and Fort Baker, and the 554-acre Muir Woods National Monument. The proposed Golden Gate National Recreation Area Fire Management Plan addresses 15,152 acres that are directly managed by the National Park Service and contain burnable vegetation. The San Francisco park lands include nearly all of the City's Pacific Ocean shoreline and lands formerly held by the military at Fort Mason, the coastal portion of the Presidio, and Alcatraz Island. The larger park units in San Mateo County are Milagra Ridge and Sweeney Ridge, both former military sites between the cities of Pacifica and San Bruno. The 1,200-acre Phleger Estate is the southernmost area in the Golden Gate National Recreation Area.

The National Park Service is directly involved with actions involving federally-listed species in both Areas A and B of the Presidio in San Francisco. The National Park Service has full responsibility for actions in Area A (the coastal and bayside perimeter of he Presidio) and conducts projects under the Presidio Vegetation Management Plan (VMP). As provided in the VMP, the National Park Service subject matter experts provide resource management expertise and work collaboratively with Presidio Trust staff on projects involving wetlands or native plant communities in Area B. The National Park Service also coordinates the volunteer stewardship program whose volunteers maybe working in both Areas A and B under the guidance of National Park Service staff in areas with listed plants. This biological opinion for the Golden Gate National Recreation Area Fire Management Plan will apply to all National Park Service fire

management actions with Area A and those fire management actions in Area B that involve pacticipation by National Park Service staff or National Park Service funding.

Under Alternative C, the preferred alternative in the DEIS, mechanical treatment (e.g., mowing, grazing, selective thinning) and prescribed burning, including broadcast burns, would be used as a means to reduce fuel loading near developed areas and achieve resource enhancement goals. Mechanical treatments, complemented by prescribed fire, would be employed to assist with restoration and maintenance of the Park's natural and cultural resources throughout the Park. All wildfires would be suppressed. Research projects would examine the role of fire to enhance resources and the effects of fire on key natural resources to determine the effectiveness of various fuel treatments. They could also be used to adaptively guide the fire management program and help to maximize the benefits to Park resources.

There are three Fire Management Units (FMU) identified within the DEIS:

1. Unit 1, Wildland Urban Interface (WUI): This FMU includes lands that border developed or "interface" zones. The basic WUI zone was defined as any land within 1,200 feet of an urban/developed area. Where it made practical management sense, the WUI FMU boundary was extended to fire roads, trails, and jurisdictional boundaries. Lands within this FMU are characterized by a close proximity to values at risk (i.e., houses, infrastructure, etc.), typically high hazard fuel loads or slopes (sometimes with dry, easterly wind exposure), and high visitation (increased chance of ignitions).

2. Unit 2, Park Interior: This FMU is the largest and is characterized by a lower probability of fire threatening structures and a greater potential for using prescribed fires to achieve some resource management goals. The park interior lands include larger expanses of natural areas and cultural landscapes, inclusive of ranching and farming lands, and contain relatively intact native plant communities and contiguous areas and corridors of wildlife habitat.

3. Unit 3, Muir Woods National Monument: The designation of Muir Woods National Monument as an FMU is based on the area's unique at-risk values (first-growth redwoods), the area's high visitation (ignition potential), and an ongoing fire management program for this area.

Table 1 presents the number of acres of Park lands that are within each FMU and within each County for the preferred GGNRA Fire Management Plan alternative.

Table 1: Total acreage in each FMU and County for the preferred alternative.

FMU	Marin	San Francisco	San Mateo	Total Acres
WUI	2,524	922	1,479	4,925
Park Interior	7,910	N/A	1,765	9,675

FMU	Marin	San Francisco	San Mateo	Total Acres
Muir Woods	552	N/A	NA	552
Total Acres	10,986	922	3,244	15,152

Table 2: Annual Acres to be treated within each Fire Management Unit and County per Treatment Type

Treatment Type	County	Maximum to be treated per County (acres/year)	Acres to be treated per FMU Unit (per year)			
			WUI	Park Interior	Muir Woods	Total
Mechanical Treatment[1] (acres/year)	Marin	225	130	90	5	225
	San Francisco	10	10	0	0	10
	San Mateo	40	30	10	0	40
	TOTAL	275	170	100	5	275
Prescribed Burning (acres/year)	Marin	285	50	185	50	285
	San Francisco	<1	<1	NA	NA	<1
	San Mateo	35	5	30	0	35
	TOTAL	320	55	210	50	315

The fire management actions, treatments and methods proposed under the FMP in the DEIS and the BA are as follows:

Suppression

Suppression includes all actions taken to put out an active fire, and is defined as the restriction of the spread of a wildland fire and the elimination of all threats from that fire. All unplanned ignitions would be suppressed using minimum impact suppression tactics. Fire suppression methods will attempt to minimize the disturbance of all threatened and endangered species and their habitats to the greatest extent feasible (e.g. when these activities do not preclude life, safety or private property considerations).

Suppression includes all actions taken to put out an active fire. Fire suppression methods typically include fire line construction and laying hose. A fire handline (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 size, the National Park Service 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. Aircraft dropping retardant foam and water may occur during suppression of unplanned ignitions. Since retardant (e.g., Phoschek®) contains phosphorus, retardants will avoid streams or wetlands to the greatest extent feasible. Helicopters may also be used to deliver water, foam, and/or retardant.

Mechanical Treatment

Mechanical treatment is the application of various tools and equipment to reduce fuels and achieve fire and resource management goals. The Park uses mechanical treatments, including mowing, grazing, and selective thinning, to remove hazardous fuels around buildings, along travel corridors, and in a number of places within the Park where wildland fuels grow directly against the urban interface (i.e., along the boundaries where there are houses and other built developments). Priorities would be set annually, and the projects performed throughout the year within allowable seasons based upon the incorporation of conservation measures. The most common method of mechanical fuel reduction is through the use of chainsaws to thin or remove targeted vegetation, which is then piled to be burned at a later date, or chipped using a chipper. In other instances, such as for fire road maintenance, large mowers and brush-cutting attachments are used for controlling vegetation. Mechanical treatment may include: fuel breaks – clearing corridors of vegetation; shaded fuel breaks – reducing density of underbrush, removing tree limbs; mosaics of cleared areas, areas with reduced vegetation density, and uncleared areas; Use of animals (such as goats) to reduce fuels; removal of non-native trees and treatment of cut stumps with herbicide; defensible space/vegetation clearing around buildings – reducing hazardous fuels from 30-50 feet around structures; and roadside fuel reduction from designated paved and unpaved roads that provide emergency evacuation, public safety and access for fire suppression activities – actions would include grading surfaces when necessary, vegetation removal, tree limbing, etc. In many cases, mechanical treatments would be used to compliment prescribed burning, with the two being implemented hand-in-hand to address specific fire, cultural, and natural resource management objectives.

Prescribed Fire

Prescribed fire is the use of management-ignited fire to meet specific resource and fire management goals and objectives under pre-defined fuel and weather conditions. The focus for prescribed burns would be on areas where the National Park Service determines that ecosystem health would be enhanced by burning and on areas where fuel accumulations create fire hazards. To the extent possible, prescribed burns would be conducted to achieve burn objectives and enhance natural resource conditions.

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. All prescribed burns would be conducted under specific burn plans in accordance with national fire policy requirements.

Once the prescribed burn project area is determined, fire and resource management staff would define its boundaries, which would include incorporating survey information regarding sensitive species and their habitat. This information, plus an analysis of affected physical or natural resources, fuel loading, access routes, staging areas, approved equipment, and burn techniques and strategies, would be included in a burn plan that would be submitted for recommendation to the Park superintendent. After the burn plan is approved by the superintendent, and other regulatory approvals are received (e.g. Bay Area Air Quality Management District) the project site would be prepared for the burn.

Pile Burning

Pile burning is the controlled burning of piles created during mechanical fuel reduction activities or general park maintenance operations. Pile burning would be used when chipping vegetation material is not feasible. Pile burning is also done in conjunction with prescribed burning (in the first phase) to reduce fuel loads to a level allowing for burning over the landscape. Pile locations are sited to minimize effects from intensive soil heating (pile sizes are limited to 4 cubic yards). Piles are also sited to minimize any effects to sensitive species and their habitats. Piles are covered, allowed to dry, and then typically burned during wet conditions when the probability of fire extending beyond the piles is low. As pile burning contributes emissions to the Bay Area Air Basin, an application would be made to Bay Area Air Quality Management District and approval received prior to burning.

Monitoring, Research and Education

An integral component of the proposed project is a monitoring and research program that allows the park to document basic information, to detect trends, and to ensure that parks meet their fire and resource management objectives. A fire research program would also continue as a component of the proposed project. New research would be initiated as needed to direct the prescribed burning program, including habitat enhancement actions for special status species. A comprehensive public information and education program would be included as part of all of the alternatives.

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. National Park Service staff will conduct a training session for all contractor crews at the beginning of new fuel reduction projects to familiarize the crews with sensitive resources at the project site and review project conditions. Training sessions may include identification of National Park Service resource contacts, special status plants, wildlife or other sensitive resources in the work area, identification and specific removal techniques to protect cultural resources from disturbance or prevent resprouting of nonnative plants, markings for the limit line of disturbance, thresholds that trigger a change in implementation techniques or require a halt in project implementation, proper disposal of food waste and garbage to discourage feeding by vectors and corvid birds, daily close-up of the project site to assure public safety and information for public contacts during project implementation.

2. An education program for field personnel involved with implementation of FMP projects will be conducted prior to the initiation of field activities. The program may include a brief presentation on any listed species at the work area including a description of the species and its ecology, habitat needs, legal status and protection afforded to the species.

3. Fires would be allowed to back into, around or through wetlands and meadows to avoid suppression damage. Wetlands will be avoided to the greatest extent possible during constructing fire lines and breaks during wildfire suppression. Where wetlands are used as a natural boundary to help contain a fire, the control line will be sited outside the wetland area. Trample lines (rather than dug lines) may be used if it is necessary to site the control line in the wetland.

4. Foams, saltwater or other fire retardants will not be used on or near wetlands to the greatest extent possible.

5. 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.

6. Soil disturbance during mechanical treatments, prescribed burns, and suppression fires will be minimized to the greatest extent possible to reduce potential for introduction or spread of invasive non-native plant species, to protect topsoil resources and to reduce available habitat for new non-native plant species.

7. Areas subject to fire management treatments would be monitored periodically for the presence of invasive non-native plant species; if such species become established or spread as a result of such activities, the non-native, non-historic plants will be removed.

8. All vegetation management actions under the FMP will conform to Federal and State regulations governing interstate and intrastate restrictions (respectively) adopted to prevent the artificial spread of Sudden Oak Death (*Phytophthora ramorum*) beyond the currently affected area. It will be the responsibility of the natural resources division chief to ensure that current guidelines and regulations are circulated to National Park Service staff involved in fire management actions. Current regulations do not permit the movement of specific plant

species and associated material outside of the regulated quarantine area that includes Marin, San Francisco, and San Mateo counties.

9. All FMP projects will incorporate techniques that control existing populations of weed species at the project site and incorporate practices to reduce the potential spread of weed species to non-infested areas of the Park.

10. Practices to reduce the spread of weed species include: a) restrictions on the movement or deposition of fill, rock, or other materials containing weed seed or viable plant cuttings to areas relatively free of weeds; b) where feasible based on the density of the weed population present, the fire management project manager will survey the road shoulders of the routes that provide project access for non-native plant species and coordinate removal of those plants that could be disturbed by passing vehicles; and c) when project vehicles are required to move from off-road use in weed-infested areas to relatively weed-free areas, and water lines and water tenders are available for use, the tires and body of heavy equipment and vehicles will be hosed down before each transit to the relatively weed-free area.

11. No herbicide use will be administered through the park's integrated pest management (IPM) coordinator and only licensed personnel may apply pesticides. All herbicide use for fire management actions will be reported monthly to the IPM coordinator.

12 No herbicide foliar spraying or direct stump applications will be allowed in riparian or wetland habitats supporting special status species except in the dry season..

13. When emergency actions must be taken to prevent imminent loss of human life or property and these actions would result in a taking of listed species or adverse modification of critical habitat not covered under existing FMP biological opinion, the National Park Service will respond to the situation in an expedient manner to protect human health and safety. After the incident is under control, the National Park Service will initiate emergency consultation procedures with the appropriate agency(ies).

14. The fire management project manager will ensure that contractor crews working in areas designated as habitat of listed species are monitored by a qualified biological monitor to ensure that project actions conform to restrictions developed for species protection.

15. All fire management actions will operate under a policy of No Net Loss of Endangered Species Habitat which applies to all species federally-listed as threatened or endangered or proposed for listing. The project review process will be used to document the no net loss finding through the conformance assessment conducted for each FMP action proposed for listed species habitat.

16. To avoid the spread of highly non-native animal species (e.g. bullfrogs = *Rana catesbeiana*) and protect the habitat of federally-listed threatened or endangered species, Golden Gate National Recreation Area resource advisors and fire management staff will advise local fire agencies responding to wildland fires in the Park and vicinity of the following guidance:

Drawing water from freshwater bodies in Golden Gate National Recreation Area and Rodeo Lagoon should be avoided unless there are no alternative sources available. If freshwater is drawn or scooped from water bodies in the park it should be used on wildfires within the same watershed, whenever possible.

17. Ocean and bay waters are preferred water sources for fighting wildfires in the Park and vicinity. Habitats of sensitive aquatic species and mission blue butterflies should be avoided when saltwater is used.

18. Prescribed burns, mechanical treatments, and mowing of shrubs and grasses taller than 8 inches will not be conducted during the bird-nesting season, from March 1 through July 31st, unless a qualified biologist conducts a pre-project survey for nesting birds and determines that birds are not nesting within the project area. To the greatest extent possible, these activities will be planned and conducted outside bird-nesting season. In intensively managed landscapes where mowing is justified for fuel reduction, vegetation shall be maintained at a height of less than 8 inches throughout the nesting season (March 1st through July 31st) to discourage the nesting of ground-dwelling bird species.

19. In order to protect nesting raptors, trees shall not be removed between January 1st and March 1st unless qualified personnel conduct a pre-project survey for nesting birds and determine that birds are not nesting within the project area. If nesting raptors are detected, a qualified biologist will delineate a suitable buffer.

20. Since older burn piles could provide wildlife habitat, the piles should be spread out (to move out animals) as much as possible before burning. If moving the piles is not feasible, the fire management project manager will ensure that piles are lit from one side only (with firefighters on the ignition side), so any wildlife in the pile can run out.

21. For prescribed fire projects proposed in the Muir Woods National Monument FMU, the fire management project manager will arrange for bat surveys of the tree hollows within the burn unit to be conducted by a qualified biologist to identify potential maternity colonies. Measures will be implemented to protect active maternity roosts.

Species-Specific Conservation Measures for Listed Species

Raven's Manzanita, San Francisco Lessingia, and Marin Dwarf Flax

1. Potential effects associated with tree removal in the vicinity of the Raven's manzanita, San Francisco Lessingia and Marin dwarf flax will be evaluated in consultation with the Service.

2. To address fire actions occurring within special status plant species populations, site and/or species specific rehabilitation plans will be developed to minimize or avoid impacts to the greatest extent possible.

3. When FMP actions disturb the habitat of special status plant species, revegetation and weeding plans will be developed in conjunction with project planning.

4. The potential for research burning and/or mechanical fuel treatments to enhance federally listed threatened or endangered plant habitat will be investigated. Burning in these habitats will be limited to carefully prescribed research burns, designed in conjunction with the Service and in accordance with established recovery plan objectives. Experimental treatments will be scientifically designed with replicate controls and a commitment to post-treatment monitoring.

San Francisco Garter Snake

1. No heavy equipment will be used off of existing fire roads or developed features in areas of known San Francisco garter snake habitat. If use of heavy equipment and trucks is required during emergency situations or for work that would improve habitat for this listed species, compensation measures to avoid mortality will be incorporated into the project schedule. Measures to avoid mortality include hand clearing areas prior to fire management activities, hand excavating all burrows, trapping snakes out of the excavation area, using monitors to prevent equipment from injuring listed species, and training workers on identification and avoidance of listed species. Work will be conducted by biologists with a valid section 10(a)(1)(A) permit and any collected individuals will be relocated outside affected areas.

Mission Blue Butterfly

1. Fire management activities will not occur within or immediately adjacent to existing or potential mission blue butterfly habitat during the flight period of the butterfly from February 15th through July 4th.

2. Pile burning is only permitted on barren, disturbed soils in mission blue butterfly habitat.

3. During the information meeting with local fire agencies, the location of mission blue butterfly habitat will be identified. During this meeting and when providing information at an active wildland fire as a resource advisor, natural resources staff will advise the local fire agency of the following guidelines: a) avoid staging fire suppression actions in or directly adjacent to mission blue butterfly habitat; b) construct fire lines outside of mission blue habitat to the greatest extent possible; c) use wet lines wherever feasible, or narrow, hand-constructed fire lines where water is not available to help contain the spread of the fire, and d) avoid using saltwater or retardant on habitat of the mission blue butterfly.

4. The potential for research burning and/or mechanical fuel treatments to enhance butterfly habitat will be investigated. Burning in mission blue habitat will be limited to carefully prescribed research burns. Experimental treatments will be scientifically designed with replicate controls and a commitment to post-treatment monitoring. No more than five

percent of existing mission blue butterfly habitat in each county will be treated experimentally annually.

5. Where possible, maintain a 100-foot-wide buffer between fire management activities and mission blue habitat except when fires are being conducted for research purposes. For habitat enhancement projects, additional measures will include establishment of buffer areas, flagging *Lupinus albifrons* in the vicinity of activities, installation of temporary fencing, dust control, and worker education.

6. The fire management project manager will arrange for the removal of non-native plants from in and adjacent to mission blue habitat following fire management actions, including fire suppression.

California Red-legged Frog

1. All suitable habitat within areas proposed for fire management activities will be surveyed and flagged by a qualified biologist to determine if the site supports suitable breeding or non-breeding areas for the California red-legged frog.

2. To protect direct injury to California red-legged frogs, removal of vegetation within suitable frog habitat will be accomplished by a progressive cutting of vegetation from the overstory level to ground level to allow frogs to move out of the treatment area.

3. If likely habitat is identified at the project site, a qualified and permitted biologist will follow accepted protocol and collect and relocate any individual red-legged frogs to nearby suitable habitat, in accordance with the biological opinion from the Service.

Status of the Species

California red-legged frog

The California red-legged frog was listed as a threatened species on May 23, 1996, (U.S. Fish and Wildlife Service 1996). Please refer to the final rule and the *Recovery Plan for the California Red-Legged Frog (Rana aurora draytonii)* (U.S. Fish and Wildlife Service 2002) for additional information on this species.

This species is the largest native frog in the western United States (Wright and Wright 1949), ranging from 1.5 to 5.1 inches in length (Stebbins 2003). 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 2003), and dorsolateral folds are prominent on the back. Larvae (tadpoles) range from 0.6 to 3.1 inches in length, and the background color of the body is dark brown and yellow with darker spots (Storer 1925).

The California red-legged frog has 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). This animal breeds 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.

The historic range of the California red-legged frog extended coastally from the vicinity of Elk Creek in Mendocino County, California, and inland from the vicinity of Redding, Shasta County, California, southward to northwestern Baja California, Mexico (Fellers 2005; Jennings and Hayes 1985; Hayes and Krempels 1986). This amphibian 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 (U.S. Fish and Wildlife Service 2002). The California red-legged frog is 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 2004).

Adult California red-legged frogs prefer dense, shrubby or emergent riparian vegetation closely associated with deep (>2.3 feet), 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). Individuals disperse upstream and downstream of their breeding habitat to forage and seek sheltering habitat.

During other parts of the year habitat includes nearly any area within 1-2 miles of a breeding site that stays moist and cool through the summer (Fellers 2005). According to Fellers (2005), this includes coyote bush (*Baccharis pilularis*) California blackberry thickets (*Rubus ursinus*), and root masses associated with willow (*Salix* species) and California bay trees (*Umbellularis californica*). Sometimes the non-breeding habitat used by the California red-legged frog is extremely limited in size, for example, a 6-foot wide Coyote bush thicket growing along a tiny intermittent creek surrounded by heavily grazed grassland (Fellers 2005). Sheltering habitat for 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 and depths greater than than 18 inches also may provide important summer sheltering habitat. Accessibility to sheltering habitat is essential for the survival of red-legged frogs within a watershed, and can be a factor limiting frog population numbers and survival.

The California red-legged frog does not have a distinct breeding migration (Fellers 2005). Adult frogs are often associated with permanent bodies of water. Some frogs remain at breeding sites all year while others disperse. Dispersal distances are typically less than 0.5 mile, with a few individuals moving up to 1-2 miles (Fellers 2005). Movements are typically along riparian

corridors, but some individuals, especially on rainy nights, move directly from one site to another through normally inhospitable habitats, such as heavily grazed pastures or oak-grassland savannas (Fellers 2005). Dispersing frogs in northern Santa Cruz County traveled distances from 0.25 mile to more than 2 miles without apparent regard to topography, vegetation type, or riparian corridors (Bulger *et al.* 2003).

Egg masses contain about 2,000 to 5,000 moderate sized (0.08 to 0.11 inches 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). 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 results 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 the California red-legged frog fluctuates from year to year. When conditions are favorable this species 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, red-legged frogs may temporarily disappear from an area when conditions are stressful (*e.g.*, drought).

The diet of the California red-legged frog is highly variable. Hayes and Tennant (1985) found invertebrates to be the most common food items. Vertebrates, such as Pacific tree frogs (*Pseudacris 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). The diet of red-legged frogs apparently has not been studied, but their diet probably is similar to other ranid frogs that feed on algae, diatoms, and detritus by grazing on the surface of rocks and vegetation (Fellers 2005; Kupferberg 1996a, 1996b).

Several researchers in central California have noted the decline and eventual local disappearance of California and northern red-legged frogs (*Rana aurora aurora*) 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 red-legged frog throughout its range.

Several researchers in central California have noted the decline and eventual disappearance of the populations of the California red-legged frog 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 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 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 may be 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 the species. These declines are attributed to channelization of riparian areas, enclosure of the channels by urban development that blocks red-legged frog dispersal, and the introduction of predatory fishes and bullfrogs.

Mao *et al.* (1999 cited in Fellers 2005) reported northern red-legged frog infected with an iridovirus, which also was presented in sympatric three-spined sticklebacks (*Gasterosteus aculeatus*) in northwestern California. Ingles (1932a, 1932b, and 1933 cited in Fellers 2005) reported four species of trematodes from red-legged frogs, but he later synonomized two of them.

The recovery plan for the California red-legged frog identifies eight recovery units (U.S. Fish and Wildlife Service 2002). 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 survival and recovery. The status of the 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 the California red-legged frog.

The action area falls within Core Area # 13 - the Point Reyes Peninsula 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 in the Golden Gate National recreation Area in Marin County and San Mateo County (California Department of Fish and Game 2004; BA, 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

The final rule determining critical habitat for the California red-legged frogs was published in March 2001(U.S. Fish and Wildlife Service 2001). 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 (U.S. Fish and Wildlife Service 2004). This proposed rule basically re-proposes the same areas designated critical habitat in the 2001 final rule.

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 non-native predators), may be necessary in the area designated. The proposed critical habitat for the

California red-legged frog provides for breeding and non-breeding 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 the California red-legged frog. 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 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 20 inches, 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 the California red-legged frog, 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 1.25 miles 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 non-breeding water source located within 1.25 miles of each breeding site. California red-legged frogs have been documented to travel 2.25 miles in a virtual straight line migration from non-breeding to breeding habitats (U. S. Fish and Wildlife Service 2001). 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 300 feet, or no further than the watershed boundary, of the edge of the ordinary high-water mark of essential aquatic habitat (U. S. Fish and Wildlife Service 2001).

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 300 feet 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 1.25 miles 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 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 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.

Mission Blue Butterfly

The mission blue butterfly was listed as endangered in 1976 (U.S. Fish and Wildlife Service 1976). Critical habitat was proposed in 1977 (U.S. Fish and Wildlife Service 1977) but was later withdrawn (U.S. Fish and Wildlife Service 1978).

The mission blue butterfly was described by Hovanitz in 1937 based on specimens collected at Twin Peaks in San Francisco. The animal has not been observed at that location in a number of years. The butterfly inhabits grasslands and coastal shrub in southern Marin, San Francisco, and San Mateo counties in California that contain one or all three of its larvae foodplants (*Lupinus albifrons*, *L. formosus*, and *L. variicolor*).

The wingspan of the adult mission blue butterfly is about an inch. The uppersides of the wings of the males are bright blue with white margins; the undersides are pale grey with two rows of irregular white-ringed black spots. The upperside of the wings of the female are brown, usually with a flush of blue scales at the base of the forewing.

The mission blue butterfly is univoltine and has a flight period that extends from late March to mid-June. On San Bruno Mountain, discrete populations of the animal near the mountain's peak and on the western and southern-facing slopes generally are the first to emerge each year (U.S. Fish and Wildlife Service 1984). These are followed by populations on the Northeast Ridge and the main ridge. Mission blue butterflies in Owl and Buckeye canyons are the last to emerge, perhaps due to their northern exposure and intermittent creeks which keep these areas cooler and more moist than other areas of San Bruno Mountain.

After they have mated, the females lay their eggs throughout their flight period. Single eggs are deposited on the leaves, stems, flowers, and seed pods of the *Lupinus* foodplants. The eggs are green overlaid by white papillae of the chorion (Comstock and Dammers 1935). The majority of eggs are laid on new growth, primarily the upper surfaces of the leaflets (U.S. Fish and Wildlife Service 1984) and they hatch in about 4-10 days (Downey 1957; Guppy and Shepard 2001; U.S. Fish and Wildlife Service 1984). The mature larvae are reddish purple or green with three purple or inconspicuous diagonal white lines on each body segment and the body is covered with short white hairs (Layberry *et al.* 1998; Guppy and Shepard 2001). The first and second instar larvae feed on the mesophyll of the *Lupinus* foodplant. About three weeks after eclosion, the second instar larvae begin an obligate diapause; most diapause in the leaf litter at the base of the foodplants. The following spring, the larvae break diapause and resume feeding. Cessation of diapause varies widely, even among sibling larvae. Under laboratory conditions, this period may be as great as one month. This protracted cessation of diapause and the variation in microclimate is why newly emerged adults can be observed throughout the 8-10 week flight period. The last instar larvae pupate on or near the base of the *Lupinus* foodplant rather than in the ground or in ant nests as suggested by Downey (1957). The pupal stage lasts approximately three weeks (Guppy and Shepard 2001). The pupa is green, and the abdomen is green or reddish-brown with green blotches (Scott 1986; Guppy and Shepard 2001).

The mission blue butterfly is a facultative myrmecophile; presumably specific ant species protect the larvae from parasites, parasitoids, and predators in return for honeydew secreted from special glands on the caterpillars' bodies. Downey (1962a) recorded 11 species of ants that tended Boisduval's blue butterfly (*Icaricia icarioides*), of which the mission blue butterfly is a subspecies. Third and fourth instar larvae are tended by ants, primarily *Prenolepis imparis* (U.S. Fish and Wildlife Service 1984). Downey (1957) found that the ant *Formica lasioides* tended the mission blue butterfly on Twin Peaks. Howe (1975) stated that larvae of the mission blue butterfly may sometimes be found on leaves or in the lupine blossoms by looking for the more conspicuous ants in attendance. Ants may construct chambers at the base of the foodplants just beneath the surface of the soil for access to the resting larvae, as diurnal resting places for the larvae, or both (Howe 1975).

In one study, 35 percent of field collected eggs of the mission blue butterfly were parasitized by an unidentified species of encyrtid wasp (U.S. Fish and Wildlife Service 1984; Downey (1962b) recorded parasitic wasps of the genus *Trichogramma* as an egg parasite from 50% of the 53 populations that he examined of Boisduval's blue butterfly. Third and fourth instar larvae were parasitized by a tachnid fly or braconid wasp. According to Howe (1975), there is a high incidence of parasitism in mature larvae of Boisduval's blue butterfly located on the foodplants during the daytime; he stated that healthy larvae tend to be nocturnal feeders. Rodents also may prey on the early stages (U.S. Fish and Wildlife Service 1984).

The grassland and to a lesser degree the coastal scrub habitat are disclimax communities. That is, maintenance and regeneration of the plants characteristic of these ecosystems are dependent upon irregular perturbation process that preclude normal succession. The *Lupinus* foodplants are dependent upon natural disturbance processes, such as rockslides, mudslides and fires to establish their seedlings. Thus, the survival and recovery of the mission blue butterfly requires

not only sufficient tracts of natural habitat, but also maintenance of the natural disturbance factors.

One of the most significant threats to the listed butterfly is loss of habitat due to succession and invasive exotic plant species. Ecosystems are dynamic, fluctuating through time in structure, composition and areal extent. Dynamics are initiated by environmental fluctuation, natural disturbance, species senescence or other intra-community characteristics. The *Lupinus* foodplants of the mission blue butterfly are dependent upon natural perturbations to establish seedlings. Under natural conditions, adults of the mission blue butterfly are widely distributed at relatively low densities. *Lupinus albifrons*, *L. formosus*, and *L. variicolor* also are widely distributed at low densities. These three plants are "pioneer" species (i.e., they grow best in areas of recent localized disturbance or in early stages of grassland succession). Patchily distributed dense colonies of these *Lupinus* are found at sites of natural disturbance, such as rodent burrows, mudslides, rock slides, fire, etc throughout the grassland. These colonies eventually senesce as other successional plants and weeds invade these sites, unless an irregular disturbance regime occurs that allows the *Lupinus* to propagate.

Non-native grasses and forbs that have invaded California grasslands are a serious threat to the mission blue butterfly due to their ability to become more abundant at the expense of the animal's larval foodplants and adult nectar sources. European annual grasses and forbs have displaced native forbs in native California grasslands, and in turn, have contributed to the decline of the mission blue butterfly (Biswell 1956; Murphy and Ehrlich 1989). This invasion was facilitated by widespread and intensive grazing (Fleischner 1994). Some of the exotic grasses that have invaded grasslands of the San Francisco Bay area are Italian ryegrass (*Lolium multiflorum*), slener oats (*Avena barbata*), ripgut (*Bromus diandrus*), red brome (*B. madritensis rubens*), and softchess (*B. hordaceus*). Some of the exotic forbs that have invaded these grasslands are Italian thistle (*Carduus pycnocephalus*), star thistle (*Centaurea solstitialis*), bull thistle (*Cirsium vulgare*), ehrharta (*Ehrharta erecta*), filaree (*Erodium* spp.), cat's ears (*Hypochaeris radicata*), burclover (*Medicago polymorpha*), yellow oxalis (*Oxalis pes-capra*es), plantain (*Plantago lanceolata*), sheep sorel (*Rumex acetosella*), blessed milk thistle (*Silybum marianum*), and mustards (*Brassica* and *Sisymbrium* spp.) (Amme 2002). Although many exotic forbs are used by the mission blue butterfly as nectar sources, they outcompete and replace native nectar plants, and replace their larval foodplants. A number of shrub species have also invaded grassland habitats in the Bay Area over the past 40 years. These include gorse (*Ulex europaeus*), various brooms (*Genista monspessulana* and *Cytisus scoparius*), and even native shrubs. For example, gorse increased in acreage 140 percent from 1972 to 1986 on San Bruno Mountain (Thomas Reid Associates 1987). Shrubs shade out native grassland forbs and grasses, including the lupine foodplants of the mission blue butterfly. Some California grasslands are subject to reversion to shrubland habitats in the absence of a mechanism to prevent it. Fire and grazing may reverse shrub invasion. While exotic grasses, forbs, and shrubs have displaced the three *Lupinus* species, and various nectar sources from grasslands, some exotic trees have created forests that have replaced the grassland ecosystem inhabited by the mission blue butterfly. For instance, forests of gum trees = eucalyptus (*Eucalyptus* spp.) at San Bruno Mountain have displaced grassland habitat that likely were used by this species

There are recent records of the mission blue butterfly within the portions of the proposed project located in Marin and San Mateo counties (California Department of Fish and Game 2004). Suitable habitat containing the larval foodplants and adult nectar sources are found in and adjacent to the action area. Therefore, the Service believes that the mission blue butterfly 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.

San Francisco Garter Snake

The San Francisco garter snake was listed as endangered in 1967 under the Endangered Species Conservation Act (U.S. Bureau of Sport Fisheries and Wildlife 1967), prior to the passage of the Endangered Species Act, and it was included when that Act was signed into law in 1973. The San Francisco garter snake was listed as endangered by the State of California in 1971.

The San Francisco garter snake has distinctive alternating longitudinal red, black, green, and blue stripes. The diagnostic character is the longitudinal lateral red stripe that separates two black stripes and, except anteriorly in some individuals, lacks ventral extensions (Barry 1994, 2005). The top of the head is red and the underside of the body is a rich turquoise blue. The adult females are larger than the males, up to 36 inches, as opposed to a length of 28 inches for the adult males.

The *San Francisco garter snake recovery plan* identified threats to the species as loss of habitat from agricultural, commercial and urban development, and collection by reptile collectors (U.S.. Fish and Wildlife Service 1985). Other threats include: (1) The California red-legged frog, the primary prey for the San Francisco garter snake, is in decline, and this amphibian faces several threats; (2) introduction of bullfrogs which may feed on both the San Francisco garter snake and California red-legged frog; (3) possible hybridization and outcrossing; and (4) seral succession of the remaining breeding habitat to the level that much of it has become unsuitable for the species.

The San Francisco garter snake is found only in San Mateo County on the San Francisco peninsula (Barry 1994, undated; U.S. Fish and Wildlife Service 1985). Fox (1951) and Barry (1994) stated the distribution of species is the western portion of the San Francisco peninsula from about the San Francisco County line south along the crest of the peninsula hills to at least Crystal Lake and along the coast west of this region to Point Año Nuevo. The *San Francisco Garter Snake Recovery Plan* identified six significant populations of this animal. These are located at the West-of-Bayshore adjacent to the San Francisco International Airport, the San Francisco State Fish and Game Refuge and associated San Francisco Water Department lands, Laguna Salada in the City of Pacifica, Pescadero Marsh Natural Preserve, Año Nuevo State Reserve, and a north of the Town of Half Moon Bay.

Barry (1994) reported that the San Franciso garter snake apparently was abundant in the sag ponds that existed where the current Skyline Boulevard was constructed in northern San Mateo County. Sag ponds are waterbodies that resulted where fault activity had impounded springflow

or runoff in an enclosed depression. Barry (1994) reported that in 1966, "dozens" of San Francisco garter snakes were captured and transplanted from these soon to be destroyed sag ponds to Point Reyes National Seashore in Marin County, and various other unrecorded locations in San Mateo County. It is believed that the animals did not survive at Point Reyes National Seashore, however, the status of the other translocations remains unknown (S. Barry pers. comm. to C. D. Nagano).

There are two significant components to San Francisco garter snake habitat: 1) ponds that support the California red-legged frog, bullfrogs, and the Pacific treefrog and 2) the surrounding upland that supports the Botta's pocket gopher (*Thomomys bottae*) and the California meadow vole (*Microtus californicus*). Ranid frogs are an obligate component of the San Francisco garter snake's diet (Barry undated, 1994, 2005, pers. comm. to C.D. Nagano). Barry (1994) noted that scattered, as opposed to dense brush was preferred basking habitat for San Francisco garter snakes.

This species is extremely shy, difficult to locate and capture, and quick to flee to water or cover when disturbed. Adult garter snakes may seek cover in rodent burrows during summer months when ponds become dry. Along the coast, snakes hibernate during the winter, but further inland, if the weather is suitable, garter snakes may be active year-round (U.S. Fish and Wildlife Service 1985; Wharton *et al.* 1989; Barry 1994). Information on seasonal movements of the species is scant (U.S. Fish and Wildlife Service 1985; Barry 1994, undated). However, it is known that some adults may spend considerable time near the hibernacula site after emergence from it. For example, they have been recorded breeding at entrances to these burrows shortly after emergence from hibernation (Keel, pers. comm.), and may spend the majority of each day during the active season in or near the same burrows. Breeding occurs in the spring or late fall and the snake bears live young from May through October; average litter size is about 12-18 (McGinnis 1988; Barry 1994; Stebbins 1985). Although primarily a diurnal species, captive snakes housed in an outside enclosure have been observed foraging at night on warm evenings.

Wharton (undated) and Wharton *et al.* (1989) reported that at the West of Bayshore property, the San Francisco garter snake emerged from hibernation during early March and their activity reached a peak in May. In June, their activity substantially dropped and then remained relatively stable through the summer months. In September, the activity of the San Francisco garter snake again dropped and remained low throughout the fall. They found almost no activity during the winter, except for brief periods on sunny days.

A seasonal shift in the distribution of the San Francisco garter snake between South Lomita Canal and Cupid Row Canal and the ephemeral marshes was observed at the West of Bayshore property (Wharton undated; Wharton *et al.* 1989). Throughout the winter, the listed reptile only occurred along the canals, apparently hibernating in rodent burrows on the high ground surrounding the canals. The exact location and nature of the overwintering sites remains undetermined. One local resident reported finding a dozen San Francisco garter snakes and "other snakes" in a rodent burrow at the top of the levee above South Lomita Canal during January or February of 1985 (Wharton undated; Wharton *et al.* 1989). It is possible that the San

Francisco garter snake, like other subspecies of *Thamnophis sirtalis* overwinters in communal dens (Fitch 1965; Alesiuk and Gregory 1974).

According to Wharton (undated) and Wharton *et al.* (1989), San Francisco garter snakes remained along the canals until early March when they began to utilize the ephemeral marshes; the females arrived at the marshes before the males. Although the reasons for his in unclear, the study by Gregory (1974) suggests an explanation. In Manitoba, Canada, male red-sided garter snakes (*Thamnophis parietalis*) emerge in the spring before the females and remain near the dens. When a females emerges, she is courted by the males and breeding occurs at that time. The females then move away from the den to the summer feeding range. Males stay near the dens until all the females have emerged and dispersed, at that time, the males move to a summer feeding range. Wharton (undated) and Wharton *et al.* (1989) hypothesized that a similar pattern of behavior may occur in the San Francisco garter snake. The males emerge first, remain near the canals, and then court and mate with the females as they emerge from their hibernation sites. After mating, the females then move to the ephemeral marshes; male dispersal probably occurs after the females have left the canals.

The San Francisco garter snake population at the West of Bayshore property was concentrated at the marshes until June at which time these wetlands dried out (Wharton undated; Wharton *et al.* 1989). As the sightings decreased in the marshes, there was a corresponding increase at the canals. The females returned to the canals before the males. The earlier return of the females may be due to the timing of parturition. Parturition probably occurs in late spring or early summer at the canals based on the presence of gravid females. Throughout the summer and fall, the animals were concentrated along the canals, however, in October, an occasional San Francisco garter snake was observed 50-100 feet from a canal, apparently searching for an overwintering site.

Adult San Francisco garter snakes primarily feed on California red-legged frogs, bullfrogs and Pacific treefrogs (Barry 1994, 2005, undated), although at the West of Bayshore property, a small number of the reptiles were observed to have fed on three-spined sticklebacks (*Gasterosteus aculeatus*), mosquito fish (*Gambusia affinis*), dead rodents (*Microtus* species), earthworms, leeches, pond snails, and a western toad (*Bufo boreas*)(Wharton undated; Wharton *et al.* 1989) . The food eaten by the San Francisco garter snake at the West of Bayshore property changed seasonally and appeared to be based on the availability of the prey. In early spring, when the listed reptiles emerged from hibernation along the canals and began to disperse to the marshes, Pacific tree frogs and California red-legged frogs constituted the primary food sources. During the spring season, when the reptiles occurred throughout the marshes, Pacific tree frog tadpoles were taken in great numbers. The tadpoles were available as a food source in late spring, when they were trapped in small pools as the marshes dried out. During the summer, after the San Francisco garter snakes returned to the canals, California red-legged frogs and their tadpoles provided the main food items. California red-legged frog tadpoles were highly vulnerable to predation during the spring when they were metamorphosing. The San Francisco garter snakes would hide or lie on floating vegetation in the canals and when the tadpoles swam to the surface of the water, they were captured, taken to the bank of the canal, and then consumed.

In the marshes of the West of Bayshore property, sticklebacks were taken by adult San Francisco garter snakes during the spring, and by newborn snakes in the southwestern portion of Cupid Row Canal during the fall (Wharton undated; Wharton *et al.* 1989). However, Wharton (undated) captured three San Francisco garter snakes with sticklebacks wedged in their mouths, and the spines of the fishes were impaled in the snakes' jaws. Although 64 sticklebacks or 7% of the snakes examined had eaten these fish, he hypothesized that *Gasterosteus aculeatus* were eaten incidentally while the reptiles were foraging in shallow water for tadpoles, or when no other preferred food sources were available.

With respect to the feeding habitats of the San Francisco garter snake at the West of Bayshore property, the ephemeral marshes were considered by Wharton (undated) and Wharton *et al.* (1989). Although the listed reptiles only spend two to three months each year in these areas, relatively more feeding occurred during these times than any other time of the year. Gravid female San Francisco garter snakes were captured in the greatest number in the areas around these wetlands. The ephemeral marshes also are the primary breeding site for the Pacific tree frog and the tadpoles of this amphibian comprised over 75% of the snakes' diet.

Barry (2005, pers. comm. to C. Nagano) stated that one method of determining the potential presence of the San Francisco garter snake at a site is to complete surveys for ranid frogs, e.g., the California red-legged frog and the bullfrog. Both of these frog species are used as food source by the listed reptile (Barry 2005).

Female San Francisco garter snakes exhibit a high level of site fidelity (McGinnis 1989; McGinnis *et al.* 1987), particularly to the burrow they use for aestivation and hibernation. Females can be found daily at the entrance to their burrow, and travel to the wetland one to two times per day (Paul Keel, pers. comm.) The aestivation burrow also is where females hibernate. The mean distance of female hibernacula to the Visitor Center Pond at Año Nuevo State Reserve was 459 feet, with a maximum distance of 637 feet. Distances of greater than 637 feet have been reported, including an unconfirmed distance of approximately 1000 feet. Though there are periods of time that a female will not be found at the burrow, such as during treefrog metamorphosis and dispersal, the majority of females have been observed in the vicinity of burrows in consecutive survey years (McGinnis *et al.* 1989).

McGinnis reported low survivorship of juvenile San Francisco garter snakes. In areas where other species of garter snake are present, and where Western yellow-bellied racers (*Coluber constrictor mormon*) are present, recruitment of San Francisco garter snakes is almost non-existent. Having up to three species of garter snake to forage on, each with different life histories and birthing periods, may enhance the yellow-bellied racer population. This, in conjunction with overlap of yellow-bellied racer foraging and the San Francisco garter snake juvenile dispersal period, may subject juvenile San Francisco garter snakes to higher predation pressure than other garter snakes. Therefore, low survivorship of juvenile San Francisco garter snakes could be from increased predation from yellow-bellied racers, increased competition from other garter snakes, or a combination of increased predation and competition.

The species has been extirpated from most of its historical distribution in the Skyline Boulevard area of San Mateo County. Fox (1951) reported typical populations of the snake on the coast around Sharp Park Golf Course at the Laguna Salada, and along Skyline Boulevard. Since then, the sag ponds along Skyline Boulevard have been drained and filled for urban development and the Sharp Park area has been severely impacted by residential and golf course development. In 1987, the seawall at Sharp Park failed, allowing the intrusion of salt water into Laguna Salada. However, in 2004, a trapping survey conducted at Sharp Park Golf Course and Mori Point (owned by the National Park Service) documented seven San Francisco garter snakes, and an individual was killed by a lawn mover in 2005. The seven snakes were trapped near Horse Stable Pond on the golf course, near Laguna Salada on golf course property, and near a wetland on Mori Point.

In 1989, abandoned quarry ponds adjacent to Calera Creek, over the ridge from Sharp Park, were found to support a small population of snakes. These snakes may have migrated from Laguna Salada after the failure of the sea wall. In August 1989, the quarry ponds were illegally drained and filled. The current population status at the quarry ponds is unknown. In 1985, the population at Año Nuevo State Reserve was thought to be stable at fewer than 50 snakes, but in 1995 the population appeared to be declining (Paul Keel, pers. comm.). This decline may be caused by inadequate management for the San Francisco garter snake and the recent introduction of bullfrogs.

There are recent records of the San Francisco garter snake within the portions of the proposed project located in San Mateo County (California Department of Fish and Game 2004). Suitable habitat for foraging, mating, sunning, and aestivation is found in and adjacent to the action area. Barry (pers. comm.) noted that extremely low density populations of this endangered snake may persist in extremely small areas. Therefore, the Service believes that the San Francisco garter snake 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.

Raven's Manzanita

Raven's manzanita was listed as endangered in 1979 (U.S. Fish and Wildlife Service 1979). A detailed account of the taxonomy, ecology, and biology of this species is presented in the *Raven's manzanita Recovery Plan* (U.S. Fish and Wildlife Service 1984) and the *Draft Recovery Plan for Coastal Plants of the Northern San Francisco Peninsula* (U.S. Fish and Wildlife Service 2002).

Raven's manzanita is a prostrate to ascending evergreen shrub in the heath family (Ericaceae). It was reported to grow less than 2 feet tall in historic inland localities (U.S. Fish and Wildlife Service 1984), but the single wild plant today grows nearly prostrate on an exposed coastal site. Raven's manzanita lacks burls (lignotubers), specialized flattened trunk-like structures which are adapted to rapid vegetative regeneration following fires. Its leathery, evergreen, round to round-elliptic leaves are 0.3 to 0.7 inch long, and are isofacial (have the same type of surface on both sides). Flowers are urn-shaped to round, with five-lobed white to pinkish corollas about 0.25 inch long, with ovaries (floral precursors of fruits containing undeveloped seeds) lacking

pubescence (Wells 1993). Flowers appear from midwinter (in mild winters) to mid-spring (U.S. Fish and Wildlife Service 1984). Fruits are tan or brownish, round and berry-like with thick pulp, containing 2 to 10 stony seeds. The flower stalks are densely covered with fine woolly hairs. Prostrate stems in prolonged contact with the ground are reported to develop roots (U.S. Fish and Wildlife Service 1984). Key distinguishing characteristics of this taxon, based on the single surviving individual plant, are the combination of prostrate juvenile growth habit, the round to round-elliptic isofacial leaves, and the small flowers and fruits (Wells 1993).In the current taxonomic treatment of California manzanitas (Wells 1993),

Only a single natural clonal colony of Raven's manzanita remains on an ocean-facing serpentine bedrock outcrop within a larger serpentine soil area near Baker Beach in the Presidio. All other populations in San Francisco have been extirpated. The clonal colony, rediscovered around 1950, is probably well over a century old (Raven 1952). This population of one plant has been augmented by planting artificially propagated genetically identical daughter clones of the mother plant in its vicinity. Additional genetically identical populations have been established by transplanting clonally propagated (rooted cuttings) plants in the general vicinity of this site at three nearby locations. A clone has also been planted at another serpentine outcrop in the Presidio, off Arguello Boulevard. This same clone has also been maintained in cultivated populations in San Francisco and Berkeley. Unlike Franciscan manzanita, no plants of Raven's manzanita were salvaged from former interior San Francisco localities before they were destroyed by urban development. Raven's manzanitas at interior sites may not have attracted conservation attention because they were once considered to be atypical forms of Franciscan manzanita (Roof 1976).

Historic San Francisco manzanita localities that supported both Franciscan manzanita and Raven's manzanita included: (1) the former Laurel Hill Cemetery; (2) the former Masonic Cemetery (near Lone Mountain; the "base of Lone Mountain" locality of "*Arctostaphylos pumila* Nutt." reported by Greene (1894) may have been the Masonic Cemetery locality or a nearby population); (3) Mount Davidson, in the south-central part of the City; and (4) the Presidio locality still surviving. In addition, there is a record of "*Arctostaphylos pumila*" (Behr 1892; a misnomer for either Franciscan or Raven's manzanita, or perhaps both) at the former Protestant Orphan Asylum (Laguna at Haight Street, long urbanized in the late 1800's). Nearly all historic localities of creeping manzanitas in San Francisco were outcrops of serpentine (all sites except Mount Davidson, which comprises greenstone and mixed Franciscan rocks), which suggests limited historic and prehistoric distribution and only local abundance. Evidence for historic mixed populations consists of inadvertent inclusions of Raven's manzanita material within herbarium collections of Franciscan manzanita and direct observations of co-occurrence (Roof 1976, U.S. Fish and Wildlife Service 1984). Otherwise, definitive historic records and surveys of Raven's manzanita are lacking because it was not recognized as distinct from Franciscan manzanita until long after all but one of its populations were extirpated.

It is possible that the limited historic records under-sampled and under- represented the early historic abundance and distribution of Raven's manzanita. Many collectors of Franciscan manzanita may have consciously or unconsciously selected material most similar to the type of this taxon (Roof 1976), which could have biased the sampling of specimens. Behr (1892)

described "*Arctostaphylos pumila*" (not the species endemic to sandy soils near Monterey, but the "creeping manzanita" of Brandegee's San Francisco flora of 1894) as "once abundant" in his botanical memoirs of San Francisco in the 1850's, and predicted its extirpation there nearly a century ago. It is unknown how many populations of San Franciscan manzanitas (mixed Raven's and Franciscan manzanita) occurred during and prior to the 1850's. Herbarium collections of manzanitas in San Francisco were made in the 20th century, after urbanization was well advanced in much of the City.

Generally, available data suggest that Raven's manzanita is a slow-growing, stress-tolerant evergreen shrub which is able to grow on serpentine soils with sparse competing vegetation, but like many manzanitas (Gottlieb 1968; Kruckeberg 1977), is relatively intolerant of competition (especially shading from shrub or tree canopies). It appears to have been locally abundant (Behr 1892) in relatively isolated, localized open serpentinite outcrop colonies, determined by structural geology of the local landscape.

Raven's manzanita has been successfully cultivated for many years under non-serpentine, irrigated garden soil conditions without growth abnormalities or indications of nutrient deficiencies at Tilden Park in Berkeley, California and the Berkeley Botanical Gardens at the University of California, and the Strybing Arboretum in San Francisco, California (McCarten 1986). The successful growth of Raven's manzanita and related taxa on non-serpentine substrates at multiple locations indicates that they have no specific physiological (nutritional) requirement for serpentine soil chemistry per se.

Climate and environment affect growth and form of Raven's manzanita. High rainfall appears to promote incidence of twig blight, but also appears to support luxuriant growth later in the growing season (P. Baye unpublished data 1997 to 1998). Some plants from extirpated populations in sheltered conditions apparently developed a more ascending to erect, but low, growth habit compared with wind-flagged plants on exposed bluffs (U.S. Fish and Wildlife Service 1984). Mature clones of the Presidio Raven's manzanita growing at Tilden Botanical Gardens in warmer, sheltered inland conditions remain strongly prostrate, indicating a strong genetic component to the growth habit of the lone individual from the exposed coastal site (P. Baye, pers. observ. 1998). Prostrate habit may also sometimes be partly a juvenile trait.

There are no scientific data on the breeding system of Raven's manzanita, and available evidence is unclear. Raven's manzanita has been reported to be an obligate outcrosser (M. Parker, pers. comm. cited in McCarten 1986), a cross-fertilizing species unable to produce significant amounts of viable seed from self-pollination. Obligate outcrossing plants require more than one genetically compatible individual to reproduce sexually. The remaining isolated Raven's manzanita in the Presidio, however, has been observed to set seed spontaneously, which suggests either some degree of self-pollination or very long-distance hybrid cross-pollination. Cultivated and wild manzanitas alike readily hybridize among species (McMinn 1939; Wells 1968, 1991; Roof 1976; Ellstrand *et al.* 1987). The wild Raven's manzanita plant, however, is reported to produce few mature fruits and seed (U.S. Fish and Wildlife Service 1984). No fruits were produced on the Presidio remnant clone, or its daughter clones, in 1998 or 1999, despite abundant flowering and presence of bees during flowering (P. Baye, pers. observ. 1998-1999). In

contrast, both self-pollinated and open-pollinated Raven's manzanita in cultivation at the University of California, Berkeley, have been reported to produce abundant seed, with about 20 percent viability in both lots (40 percent of the fruits with at least one viable seed) in 1995 (H. Forbes, pers. comm. 1999).

There have been no reports of natural seedling establishment around the remnant wild Raven's manzanita or elsewhere since it was rediscovered in 1952. This may be due to a lack of viable seed, seed predation, or lack of sufficient seedling microsites in the undisturbed vegetation around the single natural plant, or possibly other factors. No data are available on the natural germination ecology of Raven's manzanita. Propagation of other California species of manzanita often requires moist-chilling, scarification (mechanical attrition) of seed coats, or treatments which mimic burns (Lenz 1956; U.S. Fish and Wildlife Service 1984). It is possible that seed germination of Raven's manzanita could be stimulated by burns (Keeley 1987), as in other manzanita taxa further south on the San Francisco Peninsula (McClintock *et al.* 1990). Tamalpais manzanita has been observed to regenerate from seed following fire (herbarium sheet annotation, *Eastwood 12980,* CAS 128697). Generally, seed germination of manzanitas is slow and erratic (Lenz 1956), traits consistent with persistent seed banks from which seedlings are recruited following disturbances (Thompson 1992). Naturally occurring dormant seed banks occur in other Californian manzanita species, both in fire-adapted species (post-burn resprouting manzanitas with woody burls rich in regeneration buds) or fire-sensitive species (regenerating only from seed after burns; Kelly and Parker 1990). However, most studies indicate that most seeds produced do not accumulate in soil seed banks, and many seeds are lost to predation (Kelly and Parker 1990).

The major cause of historic decline in Raven's manzanita populations was the irreversible elimination of its habitat by San Francisco's urban growth. The lack of seedling colonization of new habitat (possibly due to observed low reproductive output and poor dispersal to isolated patches of suitable seedling habitat) appears to have prevented it from overcoming the adverse effects of habitat loss and fragmentation. Current threats to its survival are partly due to inherent risks associated with the extreme reduction in population size to a single clone (genetic individual), and partly due to external threats. The external threats to the single Presidio individual that were described in the original recovery plan continue to some extent today, with the exception of shading by trees, which were removed about 1984. The small population of replicate clones on the Presidio is also vulnerable to fire, landslides, accidental injury by road maintenance or vegetation management activities, and vandalism (U.S. Fish and Wildlife Service 1984).

The principal contemporary threat to the persistence of the long-lived original clone of Raven's manzanita is competition (interception of light) by vegetation that overtops the prostrate plant (U.S. Fish and Wildlife Service 1984). The most significant potential competitors are trees that are not native to the San Francisco Peninsula which can overtop and shade the remnant wild manzanita clone: Monterey cypress (*Cupressus macrocarpa*), Monterey pine (*Pinus radiata*), and blue gum trees (*Eucalyptus globulus*). These trees have been removed from the immediate vicinity of the remnant clone (U.S. Fish and Wildlife Service 1984), but reinvasion from abundant local seed sources remains a threat. Other invasive non-native plants in the vicinity of

the Raven's manzanita site which represents potential competitive threats include iceplant (*Carpobrotus edulis* and its hybrids), myoporum (*Myoporum laetum*), plume acacia (*Albizia lophantha*), juvenile wattle (*Acacia* spp.), jubata grass or "pampas grass" (*Cortaderia jubata*), and non-native annual grasses. Of these, jubata grass is now among the most invasive species on serpentine bluffs, scarps, and landslides below the manzanita preserve site. It has proven to be highly invasive to disturbed sites, and produces abundant plumed seed capable of long-distance wind-dispersal. Although jubata grass abundance has recently been reduced on the bluffs, it recolonizes readily and can grow very rapidly even on serpentine soil (P. Baye, pers. observ. 1993 to 1999). One native shrub species, a prostrate form of blue-blossom (California-lilac, *Ceanothus thyrsiflorus)*, also competes with Raven's manzanita to some extent (U.S. Fish and Wildlife Service 1984), but has apparently coexisted with it for decades without causing progressive decline in the clone.

Ongoing rigorous vegetation management is needed to suppress reinvasion of non-native vegetation in the immediate vicinity of the preserved clone at the Presidio, and in the surrounding area which is a source of non-native plant seed. Reinvasion would remain a potential threat to the site even if contemporary invasion levels are low. Reducing the effort to suppress these invasive species, even temporarily, would probably enable them to recolonize the preservation site, and resume their threat to the manzanita clone.

In years of frequent and late rains, Raven's manzanita develops relatively extensive infections by a twig blight (called "black smut" in the original recovery plan; U.S. Fish and Wildlife Service 1984) which causes leaf necrosis (tissue death) and dieback of whole sectors of stems in winter and early spring (S. Farrell, pers. comm. 1998, as cited in Coastal Plan). Up to 40 percent of individual clones may suffer dieback in a mosaic pattern during winter months. Affected clones typically quickly recover from blight-induced dieback during the subsequent growing season. Recovery occurs mainly by overgrowth of dead sectors by vegetative shoots from adjacent portions of the clone in spring and early summer (P. Baye unpublished data 1997 to 1999, as cited in Coastal Plan). Twig blight is likely due to fungal pathogens such as *Phomopsis* spp., which affect other species of manzanita as well (Lenz 1956). Cultivated specimens of other native manzanitas at the Strybing Arboretum vary in susceptibility to twig blight in rainy years. At Strybing, the Raven's manzanita clone is relatively susceptible to blight, even compared with Franciscan manzanita. Cultivated clonal replicates of Raven's manzanita in the drier, warmer inland hills of Berkeley (Alameda County) exhibited no blight symptoms after several wet years (P. Baye, pers. observ. 1997 to 1998).

The long-term threat of fungal pathogens to the wild Raven's manzanita clone is uncertain, but the old age of the wild clone suggests that it is a short-term, cyclic effect, not a progressively degenerative problem. Fungal infection appears to be a greater potential threat to the survival of the smaller daughter clones, which have proportionally more necrotic area when infected. The former variability in pathogen resistance within the entire original population of Raven's manzanita is unknown. Natural genetic variability in pathogen resistance within populations is widespread among plant species (Burdon 1987), and some variation may have been lost with former extirpated populations of Raven's manzanita. Lack of adequate levels of genetic variability in pathogen resistance traits may make plant populations more susceptible to disease

outbreaks and increased mortality (Burdon 1987; Huenneke 1991). If more virulent strains of twig blight or other pathogens infest the population, dieback could imperil the single wild manzanita clone. Cumulative effects of infection or cumulative increases in inoculum potential (accumulation of diseased leaf litter, a source of spores for reinfection) could also threaten the single clone. Fungicidal treatment of infected plants, which are obligate mycorrhizal species, may be impractical.

Since the issuance of the 1984 recovery plan, the Golden Gate National Recreation Area and its volunteers significantly reduced competition by non-native vegetation around the natural Raven's manzanita clone, removing Monterey cypress, iceplant, and non-native grasses, and minimizing recolonization by these species. Symbolic fencing, interpretive signs, and improved coordination with road maintenance and other staff of the Golden Gate National Recreation Area have reduced threats of trampling and accidental damage. These actions have resulted in expansion of the clone in a generally healthy condition most years.

In January 1987, the Presidio, then managed by the U.S. Army, and the Golden Gate National Recreation Area cooperatively propagated 168 cuttings of the wild clone, from which 50 propagated plants survived to be planted in the Golden Gate National Recreation Area. This is a step toward, but far short of, the 1984 recovery plan's prescription for 5 populations of at least 20 plants each. Tilden Park and the University of California, Berkeley, have maintained their collections of both endemic San Francisco manzanita taxa. Strybing Arboretum has maintained a single replicate clone of Raven's manzanita, but it has declined precariously in recent years due to blight and high rainfall. University of California, Berkeley, obtained open-pollinated and self-pollinated seed from approximately 4,500 fruits harvested from cultivated clones in 1995 (H. Forbes, pers. comm. 1999, as cited in Coastal Plan), from which 12 seedlings from the open-pollinated source were obtained under experimental germination conditions.

The parent plants and the 12 surviving clones are on lands managed by the Presidio Trust in Area B of the Presidio. Six additional clones exist in Area A managed by the National Park Service.

San Francisco Lessingia

The San Francisco lessingia was listed as endangered in 1997 (U.S. Fish and Wildlife Service 1997). A detailed account of the taxonomy, ecology, and biology of this listed plant is presented in the *Draft Recovery Plan for Coastal Plants of the Northern San Francisco Peninsula* (Service 2002).

The San Francisco lessingia is an annual herb in the aster family (Asteraceae). Seedlings and young vegetative plants develop from unbranched rosettes of oblanceolate (spear-shaped but tapered at base, wide and rounded at tip) leaves. As the plant matures, some lateral shoots elongate markedly, and then branch profusely, developing a decumbent (growing mostly through lateral branches) growth habit. Mature plant heights can range from less than 2 inches in stunted plants to 1.2 feet tall. Mature stems are reddish brown and are tomentose (with loose grayish woolly hairs). Leaves on mature stems are small (0.2 to 1.2 inches), most less than 0.3 inch, pinnately lobed (branching from a single central vein), toothed or entire (lacking teeth and lobes),

oblanceolate or long-tapered obovate (egg-shaped, but widest at the far end), and grayish-green due to dense woolly hairs. Flowerheads appear in late summer through fall, and occur singly or in loose clusters at the ends of stems. Depending on plant size, individuals may bear a few to hundreds of flowerheads. The bell-shaped involucre (a mantle of tiny leaf-like appendages called phyllaries which enclose the immature flower head) is 0.15 to 0.3 inch wide. Phyllaries are lance-shaped, with abruptly pointed tips. All florets within the flowerhead are disk florets (composite flowers within the flowerhead); ray florets (small individual flowers with strap-shaped corollas resembling single petals at the margin of the flower head) are lacking. Each head contains from 20 to 40 disk florets. Each floret has a yellow corolla (series of petals which are united into a tubular to funnel-shaped deeply lobed structure), with brownish bands in the throat. The fruit is an achene (a seed-like dry fruit) 0.04 to 0.12 inch with tan or whitish pappus (hairy bristles that increase the dispersability of achenes in air currents). No other annual *Lessingia* species occur within the range of *Lessingia germanorum* on the San Francisco Peninsula, making it easy to distinguish (Howell 1929; Spence 1964; Lane 1993, as cited in Hickman 1993).

Seedlings emerge from late fall to spring, soon after periods of rainfall and increased near-surface sand moisture (Pogge 1998; J. Cannon, pers. comm. 1996, as cited in the *Draft Recovery Plan for Coastal Plants of the Northern San Francisco Peninsula*). There are two marked growth phases in development (Howell 1929). During the rainy season, seedlings develop into juveniles which develop as unbranched vegetative short plants, typically basal rosettes (relatively broad leaves on short erect stems with the growing tip near the ground). Around the end of the rainy season (mid- to late spring) the erect central shoot of the juvenile plants elongates, then branches profusely, producing smaller leaves. The plant develops a low, spreading, bushy growth habit in open conditions before it enters reproductive phase (Howell 1929; Pogge 1998). Branching continues repeatedly after flowering and seed set. Lateral shoots develop below individual flowerheads and seedheads, terminating in new clusters of flowerheads, which in turn develop more lateral shoots below them.

Flowerheads begin to form as early as May; unopened flowerheads are common in early summer. Flowers usually open beginning mid- to late summer, with abundant flowering in August-September, continuing through November (Howell 1929; Pogge 1998). Large plants in sparsely vegetated areas may produce many hundreds of flowerheads, each bearing up to 40 florets (potential seeds; Lane 1993, as cited in Hickman 1993), but actual average number of seeds per flower head is about 26 (Pogge 1998), implying that the largest individuals may produce up to 36,400 seeds. Individuals competing with dense non-native annual grasses may be very short and sparsely branched, with few or tens of flowerheads.

Pollination may be achieved by insects, or possibly by wind as well (Spence 1964). Pollen of *Lessingia* species is light and dry (Spence 1964) rather than heavy and sticky, as would be expected for flowers exclusively adapted to insect pollination (Faegri and van der Pijl 1979; Proctor *et al.* 1996). Some wind-pollinated grassland species are also pollinated by insects (Faegri and van der Pijl 1979). Spence (1964) failed to detect any indication of pollen transfer by insects in any wild populations of *Lessingia* species, even though potential pollinators (syrphid flies, which lacked detectable pollen traces on their bodies) were present. Other potential insect pollinators observed visiting *Lessingia germanorum* flowers include numerous moths and

butterflies, such as pyralid moths, skippers, ringlet butterflies, cabbage white butterflies (*Pieris rapae*), blue and hairstreak butterflies, and American lady butterflies (*Vanessa virginiensis*); flies; bees and wasps, including sphecid wasps, halictid bees, andrenid bees, bumblebees (*Bombus vosnesenskii*); mirid bugs; and weevils (A. Whelchel unpublished data 1998).

Ripe achenes (plumed "seeds") begin to disperse in September, and continue through late fall. Earliest achenes have been observed in late June (Pogge 1998). Achenes are primarily wind-dispersed, as indicated by their light weight, small size, and well-developed pappus (Spence 1964). Seed set of populations at the Presidio appears to be consistently high (P. Baye, pers. observ. 1996 to 1998, as cited in Coastal Plan). Seed dispersal distance has not been studied, but seedling distribution tends to be contagious around parent plants. Landscape barriers to dispersal, such as tree plantations, may be more significant barriers to dispersal than inherent dispersal ability of achenes. Seeds may also possibly be passively dispersed by humans, by adherence of seed to footwear or clothing (J. Cannon, pers. comm. 1997, as cited in Coastal Plan). While dispersal ability of the San Francisco lessingia may be low because of landscape and habitat constraints, its colonizing ability in suitable open or disturbed sandy vegetation gaps (*e.g.*, Hillside Park, Lobos Dunes, Wherry Dunes) appears to be quite strong.

In the 19th century, San Francisco lessingia was reported or collected from numerous unspecified localities and two specific areas in San Francisco: one in the northwest, from the Presidio (near Lobos Creek) to Lone Mountain, and one in the southwest, near Lake Merced (Brandegee 1892). Herbarium sheets with specific collection localities from the 19th and 20th centuries clearly indicate that the historic distribution of San Francisco lessingia on the San Francisco Peninsula was considerably wider than today. The modern distribution of this listed species is probably due to habitat loss, habitat alteration, and extirpation of populations (Spence 1964).

The San Francisco lessingia is currently known from one population at Hillside Park in Daly City and six sites at the Presidio. At the Presidio, each population is located from a few hundred to few thousand feet from the nearest neighboring population.

The Lobos (Creek) Dunes site is an area of early-succession stable dune scrub which was recently (1995 to 1997) restored by removal of non-native trees and replanting locally propagated native vegetation (J. Cannon, pers. comm. 1996, as cited in the *Draft Recovery Plan for Coastal Plants of the Northern San Francisco Peninsula*). This expanded the small (less than 0.5 acre) remnant Lobos Creek population which occurred on a formerly graded, disturbed, weedy, open space on mixed dune sand and fill substrates above Lobos Creek. The site is bordered by non-native Monterey cypress groves and Lobos Creek's riparian zone. The restored dune area supporting San Francisco lessingia now occupies approximately 13 acres. The rapid expansion of the San Francisco lessingia at this site reflects the early successional development of the restored vegetation there.

The Battery Caulfield Road site is a small dune scrub patch (1 acre) which was subjected to early (1988) restoration efforts by the Golden Gate Recreation Area. A planted Monterey cypress grove partially shades the site to the west and isolates it from Lobos Dunes. The site is heavily invaded by non-native grasses. It supports a moderate sized colony of San Francisco lessingia,

consisting mostly of small plants (P. Baye, pers. observ. 1996 to 1999, as cited in the *Draft Recovery Plan for Coastal Plants of the Northern San Francisco Peninsula*). This population is reintroduced, the product of seeding conducted in 1988 at the approximate location of a historic remnant colony (Golden Gate National Recreation Area unpublished data as cited in the *Draft Recovery Plan for Coastal Plants of the Northern San Francisco Peninsula*). The original colony was probably a subpopulation or daughter colony of the population at the adjacent Lobos Creek site, from which it was severed by the Monterey cypress grove that today covers many acres of a high, west-facing intact dune slope.

The Marine Hospital site is northeast of the former Marine Hospital is a disturbed remnant stable dune with coast live oak (*Quercus agrifolia*), native and non-native grassland, and dune scrub vegetation consisting mostly mock-heather (*Ericameria ericoides*), and coyote-brush. Part of this site had been disturbed by earthmoving activities (a borrow pit for sand and haul road) and trampling, which may have provided or expanded open sandy habitat for the San Francisco lessingia here in the past. The site is bordered by a strip of Monterey pine to the south and a strip of blue gum trees to the east. These tree plantings function as wind-breaks and visual barriers for the adjacent Presidio golf course. San Francisco lessingia is most often associated here with partially bare erosional slopes, remnants of vehicle and pedestrian tracks, annual-dominated sandy flats, and edges of active pedestrian paths along fences — all microsites where vegetation is either low, open, or sparse. The site, now fenced and relatively undisturbed, shows indications of succession towards closed perennial and woody native dune scrub vegetation, as well as colonization by some oak seedlings (P. Baye unpublished data 1998). An undisturbed grove of native oak woodland and dune scrub borders the west end of the San Francisco lessingia population. A formerly excavated/graded/filled dune area supporting mixed wet meadow and dune slack vegetation such as salt rush (*Juncus lesueurii)* and Pacific blackberry, dune scrub consisting mostly coyote-brush, and iceplant occurs to the north and northwest.

The Presidio Golf Course roadside site is a narrow, steep road cut in old dunes on the west side of the maintenance road adjacent to the Presidio Golf Course, across the golf course from the Marine Hospital San Francisco lessingia site. This area, which covers less than 1 acre, is a gap in the narrow stand of blue gum trees which otherwise line the top of the cut and borders the golf course. The steep slope undergoes small-scale chronic erosion, and supports a moderate to small population of the San Francisco lessingia in the vegetation gaps. Dominant vegetation comprises typical native dune scrub dominants, non-native grasses, primarily *Briza* sp., and bracken fern (*Pteridium aquilinum*) (P. Baye unpublished data 1998). The site is bounded by the maintenance road, the Golf Course, and blue gum stands, and is parallel to Highway 1. The population here is located near Mountain Lake, a historic extirpated locality of San Francisco lessingia.

The Rob Hill site is a patch of disturbed, weedy old dune scrub and grassland at the edge of a eucalyptus grove, and adjacent to Battery McKinnon-Stotsenberg. It supports a population of San Francisco lessingia ranging in the thousands of plants. The portion of the site supporting locally abundant dune annuals and San Francisco lessingia covers about 1 acre. The site is bounded by a dense grove of blue gum, an evergreen understory of Canary Island ivy (*Hedera canariensis*), and historic military buildings.

The Wherry Dunes restoration site is a 10-acre restoration site above the north end of Baker Beach near Battery Chamberlain, located upslope of Lincoln Boulevard at the north end of Pershing Drive. This site of demolished buildings has been planted with native dune scrub vegetation, and a small, volatile founder population of San Francisco lessingia has recently established spontaneously. Above the Wherry Housing area is an undeveloped site ("Feral dunes") with vegetation composed of remnant dune scrub, primarily coyote brush, and grassland. This dune scrub site also supported a transient colony of three pioneer plants of San Francisco lessingia in 1997 (Golden Gate National Recreation Area unpublished data 1998 as cited in the *Draft Recovery Plan for Coastal Plants of the Northern San Francisco Peninsula*). The Lobos (Creek) Dunes site is within Area A managed by the National Park Service. The remaining five sites are in Area B of the Presidio managed by the Presidio Trust.

Habitat loss and adverse alteration of ecological processes are the principal historic causes of decline of San Francisco lessingia. The resulting small numbers and localized distribution of the species have in themselves become a primary threat to survival because of the amplified risk of extinction through random catastrophic events or progressive vegetation change.

The essential ecological processes which have been lost in San Francisco dune vegetation are unimpeded transport of sand from beaches and mobile dune complexes, and natural disturbances at both large and small scales that controlled vegetation gap dynamics. Other essential ecological and geomorphic properties of the San Francisco dune system which have been lost or diminished significantly include variation in dune topography that controls windflow patterns and intensity (Olson 1958); burial and rejuvenation of stabilized dunes and dune slacks (wet depressions) by mobile dunes; wind erosion and sand transport in dune blowouts; and sand slope adjustment in eroding dune scarps (Jungerius *et al.* 1981; Carter 1988; Gares and Nordstrom 1990; Fraser *et al.* 1998).

The secondary cause of decline, and the most important short-term threat to survival of San Francisco lessingia, is habitat change caused mainly by the spread of invasive non-native vegetation, but also by excessive density and cover of native woody shrub species, especially in sheltered conditions such as planted groves of evergreen trees. The principal non-native invasive plants in older, stabilized San Francisco dunes are iceplant, and annual Mediterranean grasses (in particular ripgut brome). Other species which are locally aggressive and colonial invaders of stable dunes and sandy urban soils include an annual iceplant (*Conicosia pugioniformis*); Bermuda-sorrel (*Oxalis pes-capreae*); and a relatively recently established South African grass (*Ehrharta erecta*). Species like iceplant and ripgut brome tend to produce continuous, dense stands which lack vegetation gaps, and accumulate surface plant litter and soil organic matter. These conditions apparently discourage regeneration of San Francisco lessingia.

Introduced trees from plantings in former dunes such as Monterey cypress; Monterey pine; and blue gum also spread spontaneously into dune scrub over time, and may convert dune scrub remnants to non-native forests.

Small population size, small habitat patch size, and fragmentation (isolation) of habitat patches in the urban landscape are indirect effects of habitat loss and degradation, but they are now also probably independent threats to the survival of San Francisco lessingia.

The Golden Gate National Recreation Area, following the closure of the Presidio as a military facility, has led the conservation of San Francisco lessingia. The Golden Gate National Recreation Area has established site stewardship programs aimed at coordinating volunteer labor to control non-native vegetation at Presidio population sites. In cooperation with the non-profit Golden Gate National Parks Association, it has significantly expanded dune scrub habitat and population size of San Francisco lessingia at the Lobos Dune restoration area from less than 0.5 acre with a small colony to approximately 13 acres supporting an extensive, vigorous population. This restoration anticipated recovery actions in this plan, and would contribute substantially to the recovery of the species, assuming appropriate vegetation management is sustained. The Golden Gate National Recreation Area has also monitored population sizes of San Francisco lessingia over time, and fenced off remnant populations on the Presidio to protect them from excessive trampling. Joint, cooperative stewardship weeding programs run by the Golden Gate National Recreation Area and the Golden Gate National Parks Association have improved habitat quality of San Francisco lessingia sites. The Golden Gate National Recreation Area has also facilitated and permitted graduate student research on San Francisco lessingia populations, providing important basic biological information on pollination ecology and plant interactions.

Presidio Clarkia

The Presidio clarkia was federally listed as endangered in 1995 (U. S. Fish and Wildlife Service 1995). A detailed account of the taxonomy, ecology, and biology of this listed plant is presented in the *Recovery Plan for Serpentine Soil Species of the San Francisco Bay Area* (U. S. Fish and Wildlife Service 1998) and the *Draft Recovery Plan for Coastal Plants of the Northern San Francisco Peninsula* (U.S. Fish and Wildlife Service 2002).

The Presidio clarkia is a slender, erect, herbaceous annual of the evening-primrose family (Onagraceae), 16 inches tall with few, very small, and narrow leaves. The lavender-pink petals have a lighter basal portion and a reddish-purple basal spot. The slender capsule is 1 to 2 inches long. *Clarkia franciscana* can be distinguished from ruby chalice clarkia (*Clarkia rubicunda*), a related species that may occur in the same area, by its petals that have irregular teeth on the apical margin (the edge near the tip). *Clarkia rubicunda* has petals that are rounded at the apex (Lewis and Raven 1958*a*) and usually twice the length of *Clarkia franciscana* (Lewis and Raven 1958*a*; Lewis 1977).

The Presidio clarkia flowers from May to July (Munz and Keck 1959). At the Presidio, clarkia is visited by small halictid bees which may be pollinators of the species. However, plants can self-pollinate by shedding pollen directly on the stigma (female reproductive part) (Lewis and Raven 1958*a*). This listed species is thought to be predominantly self-pollinated in natural populations. Based on electrophoretic evidence, there is little genetic variability within populations of clarkia. However, the Presidio and Oakland Hills populations, which have been examined, are genetically different from one another (Gottlieb and Edwards 1992).

The Presidio clarkia is restricted to serpentine soils in grassland communities and coastal scrub in San Francisco and Alameda Counties (Skinner and Pavlik 1994). It is the only species of *Clarkia* restricted to serpentine soils (Lewis and Raven 1958*a*).

The species is known from only two natural populations: one in San Francisco at Inspiration Point in the Presidio (Area B), and a series of subpopulations in the Oakland Hills (Gottlieb and Edwards 1992). An artificially seeded population in the Presidio occurs near the parent plant of the Raven's manzanita (Area B) occurring on a coastal serpentine outcrop above the north end of Baker Beach. It was established there by translocation of seed in 1972 (Roof 1972), and has persisted since then. The main population on the Presidio is currently protected against development, but it remains strongly threatened by introduced conifers and eucalyptus trees, weedy herbaceous non-native plant species, trampling, and unfavorable mowing times (prior to seed maturation and dispersal).

The Presidio populations are threatened by habitat degradation, including mowing, trampling, roadside maintenance and presence of non-native species (California Department of Fish and Game 1996). The Presidio represents a significant natural and cultural resource within San Francisco city limits and was expected to be widely promoted and heavily used by visitors after transfer to the National Park Service (T. Thomas, pers. comm., 1992, as cited in the Serpentine Plan). Increasingly heavy use by visitors could increase negative effects on the clarkia (U.S. Fish and Wildlife Service, in litt., 1995*a*). Road maintenance and mowing of grasslands before the clarkia has set seed also threatens the Presidio populations (California Department of Fish and Game 1992) as does the encroachment of non-native plant species, including German ivy,, iceplant, and blackberries (California Native Plant Society 1988; Service, in litt., 1995*a*), non-native grasses (S. Farrell, in litt., 1996), and natives planted outside their natural range, such as Monterey pine (California Native Plant Society 1988). Two years of sampling indicate that serpentine grasslands at the Presidio support nearly 50 percent cover of non-native grasses, particularly soft brome and Italian ryegrass (S. Farrell, in litt., 1996). Removal of Monterey pines in 1995 also allowed the clarkia to move into previously unoccupied habitat (S. Farrell, in litt., 1996).

The Presidio populations of the species have been monitored annually since 1994; permanent vegetation transects were established in 1995. The largest population at the Presidio was fenced in 1995, and invasive Monterey pines occupying serpentine soil were removed in 1995 and 1996. Following tree removal in 1995, the Presidio clarkia moved into the newly open habitat (S. Farrell, in litt., 1996). Efforts to improve habitat by removing non-natives and removing accumulated acidic soils are ongoing at the Presidio.

Marin Dwarf Flax

Dwarf flax was federally listed as threatened in 1995 (U.S. Fish and Wildlife Service 1995). A detailed account of the taxonomy, ecology, and biology of the dwarf flax is presented in the *Recovery Plan for Serpentine Soil Species of the San Francisco Bay Area* (U.S. Fish and Wildlife Service 1998).

Dwarf flax is an herbaceous annual of the flax family (Linaceae) with slender, thread-like stems, 4 to 16 inches tall. The leaves are linear. The flowers are borne in congested (crowded together) clusters; the pedicels are 0.04 to 3.2 inches long. The sepals are hairy, and the five petals are rose to whitish (Niehaus 1977). The anthers are deep pink to purple; this character helps distinguish the Marin dwarf flax from California dwarf flax (*Hesperolinon californicum*), found in the same geographic area, which has white to rose anthers as well as hairless sepals. Two other species that are found in the same region are smallflower flax (*Hesperolinon micranthum*) and slender dwarf flax (*Hesperolinon spergulinum*). They differ from Marin dwarf flax in having hairless sepals and a long, open inflorescence, with pedicels 0.08 to 1 inch long (Hickman 1993).

Flowering occurs from May to June or July (Munz and Keck 1959; Skinner and Pavlik 1994). The species is pollinated by native insects including bee flies and pollen beetles (Robison and Morey 1992). Populations range in size from one plant to thousands of plants (California Department of Fish and Game 1996). Population sizes can fluctuate greatly from year to year (D. Smith, in litt., 1998). No further data on the reproductive biology or demography of the species are available.

The species is found on serpentine soils from Marin County south to San Mateo County (Munz and Keck 1959), a range of 50 miles (U.S. Fish and Wildlife Service 1995). Marin County locations include the Tiburon Peninsula , Carson Ridge, and the Mount Burdell Open Space (California Department of Fish and Game 1996), Big Rock and Golden Gate National Recreation Area (Norris 1995). Two extant occurrences are known from the Presidio in San Francisco County. Both populations are in Area B managed by the Presidio Trust. San Mateo County contains four specific locations near Crystal Springs Reservoir, two in Edgewood County Park and one near Woodside Glens. Previously identified occurrences now extirpated include two from San Mateo County and two from San Francisco County. One additional occurrence on the Tiburon Peninsula in Marin County is possibly extirpated (California Department of Fish and Game 1996).

A variety of activities have contributed to the decline of dwarf flax. These include, but are not limited to development, recreation, trampling, and competition with native and non-native species such as barbed goatgrass (*Aegilops triuncialis*). Little is known of the species' tolerance to grazing or soil disturbance. However, it is likely that dwarf flax may benefit from some levels of grazing and soil disturbance, considering the coexistence of the dwarf flax with other species, such as harvest brodiaea (*Brodiaea elegans*) and Mariposa lily (*Calochortus spp.*), which are known to benefit from disturbance.

At the Presidio one population was fenced off in 1995, and several Monterey cypress trees adjacent to the habitat were removed in 1995 and 1996. Few natives have established in the area; cypress duff and fill material from an adjacent road may prevent *the* species from moving into the restored area. Over 20,000 individuals were identified at Inspiration Point in the Presidio.

Effects of the Proposed Action

The proposed Fire Management Plan likely will result in adverse effects to the mission blue butterfly, San Francisco garter snake, California red-legged frog, Raven's manzanita, San Francisco lessingia, Presidio clarkia, and the Marin dwarf flax. There is a likelihood the animals and plants may be affected by a number of activities including being incinerated, asphyxiated, crushed, entombed in their burrows, hit and injured or killed by vehicle strikes, poisoned by chemical agents, harassed by noise, smoke and vibration, and smoke particles coating their leaves. Temporary effects are project activities that temporarily remove one or more essential components of the habitat of a listed species, but can be restored to pre-project conditions of equal or greater habitat value. In order for the effects to be considered temporary, the affected habitat of the listed species should be totally restored within two seasons. Failure to adequate revegetate the disturbed areas with appropriate locally collected native vegetation likely would facilitate the invasion and establishment by plant and animal species that are not native to the area.

Mission Blue butterfly

Implementation of the proposed project within the habitat of the mission blue butterfly may result in the death, injury, harassment, or harm to this listed animal due to clearing of vegetation and other activities associated with suppression and mechanical treatment; 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. However, the Fire Management Plan likely will assist in the elimination of invasive exotic plants that compete with native plants utilized by all life history stages of the mission blue butterfly and thus result in significant long-term benefits to the survival and recovery of this listed animal in the wild.

Activities associated with suppression and mechanical treatment likely will adversely affect the mission blue butterfly. Habitat of varying quality for this listed animal is located within the action area. Adults and early stages could be injure or killed as a result of these activities, including those from temporary and permanent disturbances of habitat. Increased levels of smoke caused by prescribed fire could clog the spiracles and asphyxiate the mission blue butterfly.

Another potential effect of the proposed project on the listed butterfly is the elimination of their habitat due to non-native vegetation invading areas where restoration has not been implemented or is inadequate. Soil disturbance, such as that associated with project associated activities, facilitates the invasion of areas by non-native species. Increased human activity in areas introduces new non-native species. Although many of these plants do not survive or thrive in the areas to which they are introduced, some do. These plants could eventually displace or otherwise out-compete the plants which are depended upon by the mission blue butterfly.

Historically, fire played a major role in maintaining California grasslands occupied by the mission blue butterfly. It seems likely that this animal has behavioral and biological adaptations to cope with fire, and that their populations can be maintained in a landscape with occasional grassland fires. However, if hot burning slow fire moves through a grassland when eggs, larvae, or pupae are present, it likely kills them. If fire occurs during the spring flight period of the mission blue butterfly, we expect that most, if not all, adults present will avoid death by flying away from the fire. After the fire is out, and the grassland has cooled down, adults are likely to return to the burned areas in search of host plants and nectar plants. This behavior was observed in the regal silverspot butterfly (*Speyeria regalis*)(Huebschman and Bragg 2000). However, at one site in the midwestern United States, the abundance of the regal silverspot butterfly was reduced for a period of 3 to 5 years following the application of fire due to the impacts on larvae food plants and adult nectar sources (Swengel 1996). Grassland fires in the San Francisco Bay area within the range of the mission blue butterfly may leave patches of unburned habitat; it is possible that this species will use host plants and nectar plants in these unburned areas. On a longer time scale, a mosaic of fire in a large habitat area could be beneficial if it retards shrub invasion or otherwise promotes host plant growth.

In moderation, grazing may be helpful to maintain habitat (e.g., Weiss 1999) for the mission blue butterfly. Appropriately timed, low-intensity grazing may reduce the invasion of exotic species. Such benefits must be weighed against the possible trampling of the early stages of the mission blue butterfly and its host and nectar plants, and disruption of cryptogamic soil crusts allowing for invasive, non-native species to gain access to good habitat and displace food sources and host plants. Grazing by Pleistocene herbivorous mammals and then domestic livestock occurred in areas inhabited by the mission blue butterfly.

San Francisco Garter Snake

Considering the Golden Gate National Recreation Area supports a number of the known populations of the San Francisco garter snake, and fire is an important component of natural ecosystems in this region of California, the mechanical treatment and prescribed fire portions of the Fire Management Plan likely will result in long-term beneficial effects to the listed reptile. In fact, fire likely is very important for maintaining the habitats of the San Francisco garter snake. However, in the short term, heat and smoke from the fires may kill or injure individuals. Individuals of the San Francisco garter snake may be adversely affected by increased levels of sedimentation into aquatic habitats caused by runoff from burned areas. If heavy sedimentation occurs in ponds or other water bodies where the prey of the San Francisco garter snake, the California red-legged frog breeds, it is possible that California red-legged frog egg masses will suffocate from being buried under sediments, and thus reduce or eliminate the listed reptile at the site. 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. Excess sedimentation or excess numbers of fire-associated personnel and their vehicles and equipment could damage or destroy the mammal burrows used by the aestivating or hibernating snakes.

The maintenance of fire roads and trails, and mechanical treatments may result in killing or injuring San Francisco garter snakes which may be present during grading, vegetation removal or clearing, mowing, and other related activities. Clearing of vegetation (i.e., mowing) may result in harm, harassment, or killing of individuals of this listed reptile. In addition, vehicular use of fire roads and other roads may result in mortality or injury of San Francisco garter snakes which may disperse across such roads.

Migrating males, from adjacent populations, and naïve juveniles may be exposed due to their wandering habits. San Francisco garter snakes have male:female sex ratios ranging from 1:1 in populations with low numbers to 3:1 in populations with high numbers. San Francisco garter snakes dependence on gopher and possibly ground squirrel (*Spermophilus* species) burrows for retreat habitat places them in the safest possible location during a fire, especially a cool-slow fire. Juvenile San Francisco garter snakes are know to have a mortality of greater than 90%, most likely due to naiveté and predation. Gophers, which have a higher metabolism and oxygen demand than snakes, are able to persist underground during fires.

There is no scientific information on members of the genus *Thamnophis* response to smoke exposure; however, gophers and ground squirrel have higher metabolisms than snakes and easily persist through light fires in grasslands and removal of shrub canopy.

Ground squirrel and gopher burrow densities may increase significantly as a result of the mechanical treatment and prescribed fire portions of the proposed project. Gopher burrows vacated as a result of predation by raptors are typically occupied by voles. Ground squirrel and gopher burrows will provide retreats for voles and will create the sub-surface structure sufficient for San Francisco garter snakes retreat sites and occupancy of burrows. Gopher burrows are a known escape refugia for San Francisco garter snakes and are often used as hibernacula. San Francisco garter snake populations are dependent on sufficient hibernacula, situated adjacent to foraging habitat.

California Red-legged Frog

The Golden Gate National Recreation Area supports the California red-legged frog and fire is an important component of natural ecosystems in this region of California, therefore, the mechanical treatment and prescribed fire portions of the Fire Management Plan likely 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 and tadpoles 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) 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

This conference opinion on the proposed critical habitat for the California red-legged frog does not rely on the regulatory definition of "destruction or adverse modification" of critical habitat at 50 CFR § 402.02. Instead, we have relied upon the statute and the August 6, 2004, Ninth Circuit Court of Appeals decision in *Gifford Pinchot Task Force v. U.S. Fish and Wildlife Service* (No. 03-35279) to complete the following analysis with respect to the proposed critical habitat.

There will be disturbance to the proposed critical habitat 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, discountable, or insignificant 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.

Raven's Manzanita, San Francisco Lessingia, Presidio Clarkia, and the Marin Dwarf Flax

The potential effects of the proposed Fire Management Plan to the Raven's manzanita, San Francisco lessingia, Marin dwarf flax, and the Presidio clarkia include direct mortality from burning, mowing, and clearing, or being crushed by vehicles, project-related personnel, or associated equipment. Potential harmful or injurious effects include impairment of respiratory and photosynthesis processes due to smoke resulting from project activities. Removal of structures or trees may degrade microhabitats and other site specific conditions upon which listed plants depend. Alteration of microhabitats may include the destruction of cryptogamic crusts that help to exclude invasive non-native plants and improve water infiltration. Below ground effects include loss or degradation of soil structure, fertility, porosity, and water holding capacity. These effects typically result from the soil compaction associated with the activities included as part of the proposed Fire Management Plan. Below ground effects also include potential loss of seed banks which are vital to re-establishing broadly distributed populations. Species which are broadly distributed are less likely to suffer catastrophic population declines over their entire range and less likely to become extinct.

Fire is an important component of natural ecosystems in this region of California, and the Fire Management Plan likely will result in long-term beneficial effects to the San Francisco lessingia, Marin dwarf flax, and the Presidio clarkia, especially due to the reduction or elimination of invasive exotic plant species. However, the single known individual of Raven's manzanita makes this species highly vulnerable to the potential adverse effects of the proposed project.

Deposits of high amounts of smoke particles on the listed plants can abrade leaves, and adversely affect photosynthesis (Thompson *et al.* 1984). Particle cover on leaves can also induce an increase in leaf temperature from greater absorption of incident radiation resulting in reduced net photosynthesis and productivity (Eller 1977; Hirano *et al.* 1995). Dust abatement measures that include the wetting or dampening of exposed ground surfaces may result in adverse effects. Unseasonal moisture may trigger untimely germination of seeds when growing conditions are unfavorable. Seeds may potentially germinate followed by dessication and the eventual death of seedlings, a process that has been used as an eradication method for the invasive yellow star thistle (DeTimoso, Univ. of California at Davis, pers. comm., 2000).

As previously described in this biological opinion, the activities comprising this proposed project, suppression, mechanical treatment, and prescribed burning can facilitate the encroachment of non-native plants into native plant communities, especially if restoration of native habitat is not implemented by the National Park Service. The proposed project may contribute to this encroachment as a result of soil disturbance which may provide non-native invasive or weedy plants with a competitive advantage over the listed plants.

Project-related activities within occupied habitat fragments populations and may restrict gene flow, thereby reducing the species' ability to survive and may undermine efforts to recover these species in the wild. Fragmentation of plant habitat isolates plant populations such that cross-pollination between populations becomes prohibitive or limited. Fragmentation also limits seed dispersal resulting in a reduced chance of repopulation from extirpated species. Isolation due to fragmentation can result in distinct genetic populations and the ultimate decline of some species because of the lack of genetic variability and reduced adaptability within populations.

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.

From 1995 to 2020, the human population is projected to increase by 18 percent for the San Francisco Bay hydrologic region, while at the same time agricultural crop land use in the region is projected to remain around 65,000 acres (California Department of Water Resources 1998). According the California Department of Forestry, from 2000 to 2020, the human population within counties in the Bay Area region is expected to grow by 29 percent (5.3 million people to 6.8 million people), and by 60 percent from 2000 to 2040 (5.3 million people to 8.4 million people) (California Department of Forestry 1998). There will likely be many other development projects that occur during this timeframe due to increases in human population growth that will continue to imperil the San Francisco garter snake, California red-legged frog, mission blue butterfly, San Francisco lessingia, Presidio clarkia, Raven's manzanita, and the Marin dwarf flax..

Non-Federal activities continue to eliminate habitat for the California red-legged frog, San Francisco garter snake, and the mission blue butterfly in the action area. Loss and degradation of habitat affecting both animals and plants with or without Service authorization continues as a result of: urbanization; and road and utility right-of-way management that may not be funded, permitted, or constructed by a Federal agency. The listed butterfly and San Francisco garter snake also likely may be subject to unauthorized collecting for commercial and personal uses. The continued spread and increasing density of exotic plant species which eliminate habitat for the six listed animals and plants is an ongoing and significant threat. Existing habitat for the San Francisco garter snake, California red-legged frog, mission blue butterfly, San Francisco lessingia, Presidio clarkia, Raven's manzanita, and the Marin dwarf flax is fragmented and extirpation of certain remaining populations is of significant concern, due to chance fluctuation of small populations, unusual climatic events, the loss of genetic fitness commonly associated with very small populations, and other factors discussed previously. The cumulative effects of these threats pose a significant impediment to the survival and recovery of these species

The application of pesticides, herbicides, or fertilizers could degrade surface water quality in wetlands, including creeks and streams utilized by the San Francisco garter snake and the California red-legged frog. Water quality may become impaired when pesticides/fertilizers or sediment enters the waterbody from the surrounding area.

Deposition of nitrogen from air pollution presents a significant threat to California grasslands (Weiss 1999). Invasive species are often better competitors for soil nutrients than native plants (Allen *et al.* 2000a). The result of high nitrogen deposition for the mission blue butterfly is a possible accelerated invasion of weedy grass and herb species that displace native host plants and nectar sources. Weeds may either out-compete the three *Lupinus* species, or grow so densely that host plants are not easily found by adult female mission blue butterflies.

Ongoing climate change threatens the phenological relationship between the mission blue butterfly, its early life history stages, and the resources necessary for their survival. Since climate change threatens to disrupt annual weather patterns, it may result in a timing mismatch between the butterflies, their nectar sources, and larval food plants. Many butterfly species have already experienced shifts in distribution and phenology in response to global warming (Hill *et al.* 1999; Parmesan *et al.* 1999; Roy *et al.* 2001). Where populations are isolated, a changing climate may result in local extinction, with range shifts precluded by lack of habitat.

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 San Francisco garter snake and the California red-legged frog. People exploring creeks and other water bodies inhabited by these two species can harass, collect, and kill the animals, especially the snake. 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 and San Francisco garter snakes.

Non-native species that prey upon, or compete with, San Francisco garter snake and 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, warm water game fish species, crayfish, and African clawed frogs (*Xenopus laevis*) are all expected to continue to persist in the wild and degrade the quality of habitat for these two species. The introduced animals may also act as disease vectors and impact threatened and endangered species.

The endangered San Francisco garter snake is a species highly valued in the international reptile trade (Special Agent K. McCloud pers. comm. to C.D. Nagano). For example, the Laguna Salada area and the marsh near the San Francisco International Airport are both well-known collecting sites for this imperiled animal. Low numbers, and scrutiny by residents, make poaching less lucrative at the Laguna Salada area than it has been in the past. Poaching from small or isolated populations of this listed species may result in their extirpation.

A threat to the mission blue butterfly is the illegal collection for commercial and personal purposes. Adult specimens of this species are highly valued by private collectors, and an international market exists for illegally collected specimens of them, as well as other listed and rare butterflies (Ehrlich 1984; Collins and Morris 1985; U.S. Attorney's Office 1994; Williams 1996). A convicted collector had large numbers of the mission blue butterfly in his collection (C.D. Nagano, pers. obs.; U.S. Attorney's Office 1994). Butterflies in small populations are vulnerable to harm from collection of adult butterflies (Gall 1984a, 1984b). A population may be reduced to below sustainable numbers (Allee effect) by removal of females, reducing the probability that new colonies will be founded. Collectors pose a threat because they may be unable to recognize when they are depleting butterfly colonies below the thresholds of survival or recovery (Collins and Morris 1985). The extirpation of the large copper butterfly (*Lycaena dispar*) in Great Britain was preceded by heavy bouts of collecting (Duffey 1968, 1977).

Conclusion

After reviewing the current status of the mission blue butterfly, San Francisco garter snake, California red-legged frog, Raven's manzanita, San Francisco lessingia, Presidio clarkia, and the Marin dwarf flax, 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 Alternative C of the Fire Management Plan at the Muir Woods National Monument, Golden Gate National Recreation Area, and Fort Point National Historic Site in Marin, San Francisco, and San Mateo counties, California, as proposed, is not likely to jeopardize the continued existence of these seven 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 mission blue butterfly, San Francisco garter snake, Raven's manzanita, San Francisco lessingia, Presidio clarkia, and the Marin dwarf flax, 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.

Sections 7(b)(4) and 7(o)(2) of the Act, which refer to terms and conditions and exemptions on taking listed fish and wildlife species, do not apply to listed plant species. However, section 9(a)(2) of the Act prohibits removal, reduction to possession, and malicious damage or destruction of listed plant species on Federal lands and the removal, cutting, digging up, or damaging or destroying such species in knowing violation of any State law or regulation, including State criminal trespass law. Actions funded, authorized or implemented by a Federal agency that could incidentally result in the damage or destruction of such species on Federal lands are not a violation of the Act, provided the Service determines in a biological opinion that the actions are not likely to jeopardize the continued existence of the species.

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.

NOTE: The San Francisco garter snake is a fully protected species under California law (California Fish and Game Code § 5050), and no injury or killing of this reptile is authorized by California law.

Amount or Extent of Take

The Service anticipates incidental take of mission blue butterfly, California red-legged frog, and the San Francisco garter snake 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 three 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 BA and DEIS 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.

The Service expects that incidental take of the San Francisco garter snake will be difficult to detect or quantify because when this listed reptile is not foraging, sunning, mating, or conducting other surface activity, it often inhabits burrows, the animal may range over a relatively large territory, it is an extremely shy animal, and the finding of an injured or dead individual is unlikely because of their relatively small body size. Losses of this species also may be difficult to quantify due to seasonal fluctuations in their numbers. Therefore, the Service is estimating that all of the San Francisco garter snakes inhabiting 108 acres, as described in the BA and DEIS will be subject to incidental take. Upon implementation of the Reasonable and Prudent Measure, incidental take associated with the fire management plan in the form of harm and harassment of the San Francisco garter snake caused by habitat loss and project activities will become exempt from the prohibitions described under section 9 of the Act.

The Service anticipates that incidental take of the California red-legged frog will be difficult to detect because when this amphibian is not in their breeding ponds, it inhabits the burrows of ground squirrels or other rodents, or may be difficult to locate due to their cryptic appearance and behavior; the sub-adult and adult animals may be located a distance from the breeding ponds; the migrations occur on a limited period during rainy nights in the fall, winter, or spring; and the finding of an injured or dead individual is unlikely because of their relatively small body size. Losses of this species also may be difficult to quantify due to seasonal fluctuations in their numbers, random environmental events, changes in water regime at their breeding ponds, or additional environmental disturbances. Therefore, based on the BA and DEIS, the Service is estimating that all California red-legged frogs inhabiting 1,732 acres will be subject to incidental take in the form of harassment and harm; and 18 California red-legged frogs will be subject to incidental take in the form of death or injury. Upon implementation of the Reasonable and Prudent Measure, incidental take associated with the proposed project in the form of harm, harassment, capture, injury, and death of the California red-legged frog caused by habitat loss and project activities will become exempt from the prohibitions described under section 9 of the Act.

The Service anticipates that incidental take of the mission blue butterfly will be difficult to detect because when this animal is in its early life history stages it is difficult to locate due to the cryptic appearance of the eggs, larvae, and pupae, and their small size. Adults may be difficult to observe due to environmental conditions or the field experience of the observers. Losses of this species also may be difficult to quantify due to seasonal fluctuations in their numbers, random environmental events, changes in the amounts of larvae foodplants or adult nectar sources, or additional environmental disturbances. Therefore, based on the BA and DEIS, the Service is estimating that all mission blue butterflies inhabiting 5,428 acres will be subject to incidental take in the form of harassment, capture, harm, injury or death. Upon implementation of the Reasonable and Prudent Measure, incidental take associated with the proposed project in the form of harm, harassment, capture, injury, and death of the mission blue butterfly caused by habitat loss and project activities will become exempt from the prohibitions described under section 9 of the Act

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, mission blue butterfly, and the San Francisco garter snake or result in destruction or adverse modification of proposed critical habitat for the California red-legged frog. Critical habitat for the mission blue butterfly and the San Francisco garter snake has not been designated or proposed, therefore none will be affected.

Reasonable and Prudent Measure

The Service believes the following reasonable and prudent measure is necessary and appropriate to minimize the effect of take on the California red-legged frog, mission blue butterfly, and the San Francisco garter snake:

> Minimize the potential for harm, harassment, injury, or mortality of the mission blue butterfly, San Francisco garter snake, 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 National Park Service shall implement the conservation measures as described in the DEIS, BA, and the *Terms and Conditions* 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 California red-legged frog, San Francisco garter snake, mission blue butterfly, 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 field setting).

3. If a California red-legged frog(s), San Francisco garter snake(s), or early stages of the mission blue butterfly are observed in the work/burn areas, a qualified biologist or an individual trained in the biology and ecology of these listed animals and designated by the National Park Service shall capture and move the animal(s) to an appropriate aquatic or upland location outside of the work area.

Reporting Requirements

The Service must be notified within 24 hours of the finding of any injured or dead mission blue butterflies, California red-legged frog, San Francisco garter snakes, or any unanticipated damage to their habitats associated with the proposed project. Injured San Francisco garter snakes or California red-legged frogs shall be cared by a licensed veterinarian or other qualified person, such as a National Park Service ranger. Notification must include the date, time, and precise location of the specimen/incident, and any other pertinent information. The Service contact persons are Chris Nagano, Deputy Assistant Field Supervisor (Endangered Species Program) at the Sacramento Fish and Wildlife Office at 916/414-6600 and Resident Agent-in-Charge Scott Heard of the Service's Law Enforcement Division at telephone 916/414-6660. Any dead or injured specimens should be deposited with the Resident Agent-in-Charge at 2800 Cottage Way, Room W-2928, Sacramento, California 95825.

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 National Park Service should minimize the potential for adverse effects to the Raven's manzanita, San Francisco lessingia, Presidio clarkia, and the Marin dwarf flax from the project related activities by implementation of the conservation measures as described in the BA, DEIS, and the *Terms and Conditions* of this biological opinion.

2. The National Park Service should implement the appropriate actions described in the *Recovery Plan for the California red-legged frog (Rana aurora draytonii)*.

3. The National Park Service should continue to encourage or require the use of appropriate species of locally collected California native plants in the restoration or enhancement of native species diversity and ecosystem functions at the Golden Gate National Recreation Area.

4. The National Park Service should conduct surveys to determine if the xerces blue butterfly (*Glaucopsyche xerces*) is extant within the Presidio or the Golden Gate National Recreation Area. The Service is interested in providing guidance on the appropriate survey methods and techniques for this animal.

5. The law enforcement rangers of the National Park Service should continue their vigilance for individuals who collect the endangered mission blue butterfly, endangered Myrtle's silverspot butterfly (*Speyeria zerene myrtleae*), other listed and rare butterflies, such as the blue copper butterfly (*Lycaena heteronea*) 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 the conference opinion for effects of Alternative C of the proposed Fire Management Plan at the Golden Gate National Recreation Area, Muir Woods National Monument, and Fort Point National Historic Site in Marin, San Francisco, and San Mateo counties, California, on the proposed critical habitat of the California red-legged frog. You may ask the Service to confirm the conference opinion as a biological opinion issued through formal consultation if this critical habitat is designated. The request must be in writing. If the Service reviews the proposed action and finds that there have been no significant changes in the action as planned or in the information used during the conference, the Service will confirm the conference opinion as the biological opinion on the project and no further section 7 consultation will be necessary.

This concludes formal consultation on Alternative C of the proposed Fire Management Plan at the at the Golden Gate National Recreation Area, Muir Woods National Monument, and Fort Point National Historic Site in Marin, San Francisco, and San Mateo counties, 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 Alternative C of the proposed Fire Management Plan, please contact Chris Nagano, Deputy Assistant Field Supervisor (Endangered Species Program) at the letterhead address or telephone 916/414-6600.

cc:
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