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Environmental Assessment
Lower Redwood Creek Interim Flood Reduction Measures and Floodplain / Channel Restoration

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1.0 Introduction and Background

Introduction

This Environmental Assessment presents and analyzes actions proposed by the National Park Service (NPS) at two locations in lower Redwood Creek near Muir Beach, in the Golden Gate National Recreation Area (GGNRA). Actions are proposed in two locations:

- Along **Pacific Way**, the access road to Muir Beach and to several residences in the adjacent community, interim measures are proposed in a 2,300-foot long reach of Redwood Creek to reduce flooding that closes the road and to prevent loss of the stream channel for fish passage
- In a 1,800-foot long reach of Redwood Creek adjacent to the former Banducci flower farm, actions are proposed to restore in-stream and floodplain habitat.

Background

Redwood Creek is a coastal stream located in Marin County, California (Figure 1). The Redwood Creek watershed encompasses an 8.9 square mile area beginning on the southwest slopes of Mt. Tamalpais (elev. 2,571 ft.), extending through Muir Woods, and draining into the Pacific Ocean at Muir Beach. The larger tributaries to Redwood Creek include Bootjack, Rattlesnake, Spike Buck, Kent Canyon, Fern Creeks, and Green Gulch Creek, that enters just above the Redwood Creek mouth and accounts for 1.2 square miles of the total watershed area. Average rainfall in the watershed is 37.5 inches[1], with 90 percent occurring from November through April. Monthly average precipitation ranges from 7.8 inches in January to less than 0.2 inches in July and August. Streamflow in the creek is perennial in most reaches, with very low flow in summer and early fall and higher winter base flows. Rapidly rising, short-duration high flows occur during heavy winter rainfall events.

The Redwood Creek watershed is unique among watersheds of similar size along the California coastline because it is largely undeveloped and protected as part of state and federal parkland. Agencies that manage watershed lands include the Marin Municipal Water District, California Department of Parks and Recreation (Mt. Tamalpais State Park), and the NPS (GGNRA and Muir Woods National Monument). Three private communities also reside in the watershed — the community of Muir Beach at the mouth of Redwood Creek, Muir Woods Park, and Greek Gulch Farm. The watershed is home to old growth coast redwoods, native coho salmon and steelhead, spotted owls, and the California red-legged frog, as well as many other special status plants and animals. The creek supports what may be the most southerly run of coastal coho salmon found in California, and provides valuable habitat for other threatened species. More than a million people visit the watershed each year to hike the extensive trail system and enjoy its natural beauty and cultural resources.

The Preferred Alternative will occur at the lower elevations of the 8.9-square mile Redwood Creek watershed. This project encompasses two project areas along Redwood Creek, the **Pacific Way** and the **Banducci** sites, both located within the GGNRA (Figure 2). The **Pacific Way** site encompasses the lower reach of Redwood Creek extending from 500 to 2,800 feet upstream of its mouth. Within this reach, altered hydrologic and geomorphic processes have caused sediment deposition in the creek channel. As a result, the creek floods during moderate rain events and

[1] Based on measurements at Muir Woods National Monument (1941–1985, 1988–2000).

could potentially abandon the current channel through avulsion to the adjacent wetland/floodplain. Such an avulsion would likely impair passage of adult and juvenile coho salmon and steelhead.

The GGNRA is developing a restoration plan for lower Redwood Creek that will encompass the **Pacific Way** site. Once implemented, the restoration will reestablish the ecological function and habitat value of the creek and floodplain and will address long-term flooding at **Pacific Way**. Construction of the restoration project, however, is not anticipated to begin for another three to five years.

The **Banducci** site is a 170-acre parcel of land adjacent to Redwood Creek, referred to as the **Banducci** site for its former owners (Figure 2). It is comprised of lowland areas along the creek, bounded to the north by Mount Tamalpais State Park, to the south and west by Highway 1, and to the east by Muir Woods Road. The project site includes a 28-acre leveled field, formerly a flower farm, and a 5.5-acre area known as the former ballfield. The **Banducci** area is located approximately one half-mile upstream from **Pacific Way** and stretches approximately 3,800 linear feet along Redwood Creek. Coastal hills frame the level field to the west, with multiple drainages flowing into a constructed ditch marking the western boundary of the project area.

Throughout most of the 20th Century, the Banducci family farmed the site, producing primarily flowers and hay. Farmers made several landscape changes to protect their agricultural site; including construction of streamside levees, leveling the site, re-routing drainages into a side ditch, pumping water from the creek for irrigation, clearing woody debris from the creek, and periodically adding revetment to creek banks. NPS purchased the site in 1980. Farming was discontinued in 1995, and today the site is managed by the NPS.

Historic maps show that the **Banducci** site once supported woodland vegetation over an extensive area that would have been a floodplain for Redwood Creek. Today, most of that area is not wooded, nor does it function as an active floodplain due to the presence of berms as well as the effects of channel incision.

Figure 1

Figure 2

2.0 PURPOSE AND NEED

The purpose of the project is to:

1. Improve hydrologic and geomorphic functions at the **Pacific Way** site and thus reduce the magnitude, frequency, and duration of flooding on **Pacific Way** and reduce the risk of channel avulsion at the **Pacific Way** site.
2. Reconnect the creek to its floodplain and expand riparian vegetation at the **Banducci** site, thus improving habitat for coho salmon.
3. Increase in-channel habitat complexity and reestablish geomorphic processes at the **Banducci** site, thus improving habitat for coho salmon and steelhead.

The **Pacific Way** site encompasses the lower reach of Redwood Creek extending from 500 to 2,800 feet upstream of its mouth. Within this reach, the creek and its floodplain have been extensively modified by realignment of the creek; construction of Pacific Way and the Pacific Way bridge, a levee road that borders the creek, and the NPS parking lot and picnic area; and placement of gabions and other artificial fill in the creek channel and on its floodplain (see Figure 2, Appendix B). Combined, these modifications to the creek and its floodplain have altered channel hydraulics and reduced sediment transport capacity, resulting in severe sediment deposition in the creek channel and reduction in channel capacity. Under current conditions, the creek floods during even moderate rain events, inundating **Pacific Way**, stranding residents, and hindering access to the public beach. In the winter, residents along **Pacific Way** often cannot access Highway 1, the sole connecting road, because floodwaters commonly prevent passage by vehicles and pedestrians. This lack of access severely limits emergency services. For example, in winter 2001 the local fire department was called to hand carry a resident through a large wooded area to get to Highway 1 and subsequent transportation to the hospital for treatment.

In addition to the flooding, current conditions in lower Redwood Creek present a risk of channel avulsion, in which the creek could abandon its existing channel and establish a new channel in the floodplain to the east (i.e., through the alder grove adjacent to the Pelican Inn, across **Pacific Way**, and through the wetland/pasture east of the levee road). Avulsion of the channel to the adjacent meadow, which is several feet lower in elevation than the channel bed, could impair passage of adult and juvenile coho salmon and steelhead through the lower creek and could have undetermined consequences to infrastructure.

The **Banducci** site suffers from eroding banks, a lack of channel complexity, and resulting poor habitat quality for aquatic and riparian species. A steep eroded bank retreated approximately 10 feet between 1999 and 2002, depositing an estimated 300 yd^3 of sediment into the creek. The channel was confined and cut off from its adjacent floodplain during the farming period through construction of levees, which affected creek depth, flow velocity, and aquatic habitat. The project area focuses on a channeled reach referred to as the "Bowling Alley," which has very poor in-channel complexity.

3.0 Project Alternatives

Scoping

Through the scoping process, the NPS sought to obtain input from staff, the public, other agencies, and environmental organizations. During scoping, staff noted that three principal areas of potential effects included natural resources, flooding along the creek, and the effects of construction. NPS staff discussed the project and environmental concerns with local citizens and environmental groups (noted below). In addition, the need for permitting and consultation was identified and the pertinent agencies were consulted (see Chapter 4.0 Consultation and Coordination).

Since January 2002, GGNRA staff have presented technical studies and project development for **Pacific Way** at monthly public meetings of the Muir Beach Community Services District. At these meetings, Community Services District board and members of the public expressed the need to immediately address the flooding of **Pacific Way**.

March 1, 2002, NPS staff conducted a field meeting at the **Pacific Way** site, including representatives of Marin County Department of Public Works, the GGNRA Advisory Commission, and NPS hydrology experts.

March 5, 2002, NPS staff walked the **Banducci** site with representatives from the Muir Beach Community Services District (Muir Beach CSD) and Mr. Banducci to explain details of the proposed project. The discussion addressed the eroded banks, installation of log structures in the "Bowling Alley," the grading on creek banks, the removal of corroded irrigation pipes, and the location of fill placement in the upper site. Staff also discussed the beneficial effects for fish and the likely elevations of floodwaters under different events. Muir Beach CSD representatives and Mr. Banducci expressed support for the project.

March 13, 2002, NPS staff discussed the project at the **Banducci** and **Pacific Way** sites with the Redwood Creek "Vision Team," an expert panel, including agency representatives and the public, providing input to the Redwood Creek Watershed Vision Process.

April 9, 2002, NPS staff conducted a **Pacific Way** briefing meeting to review the draft technical report and alternative actions with representatives of Marin County and Muir Beach CSD present.

April 16, 2002, NPS staff presented the **Banducci** site project to the inter-agency Mitigation Bank Review Team, composed of representatives of the U.S. Army Corps of Engineers, U.S. Fish and Wildlife Service, the California Department of Fish and Game, and the state Regional Water Quality Control Board.

May 8, 2002, the **Pacific Way** work was discussed with the Marin Committee of the GGNRA Advisory Commission. NPS staff presented the technical report and proposed actions.

June 12, 2002, the Marin Committee of GGNRA Advisory Commission visited the **Banducci** and **Pacific Way** sites for a brief explanation of the proposed project. The **Banducci** site design plan

was distributed to an interested committee member. The project was again presented to the Marin Committee at the July 10, 2002 meeting.

July 9, 2002, Notice of the preparation of this Draft Environmental Assessment was posted on the GGNRA Advisory Commission agenda and mailed to over 1,300 individuals, agencies, and environmental groups.

July 12, 2002, NPS staff presented issues and proposed actions to the Marin Committee of the GGNRA Advisory Commission in the field. Comments focused on the need to implement Big Lagoon restoration as a long-term solution to flooding in the Pacific Way area.

July 24, 2002, The **Banducci** and **Pacific Way** project will be formally presented to the Muir Beach CSD at their monthly meeting in Muir Beach.

From the scoping process, the following criteria were used to evaluate alternatives for reducing the flooding and preventing channel avulsion along **Pacific Way**.

- Extent the alternative minimizes flooding
- Extent of impacts to listed species and designated critical habitat
- Extent the alternative precludes potential future designs for Lower Redwood Creek Restoration (Big Lagoon)
- Extent the alternative could be implemented in Fall 2002
- Extent the alternative is consistent with NPS Management Policies 2001 and applicable environmental laws
- Cost of alternative

The following criteria were used to evaluate alternatives for restoring the channel and floodplain at the **Banducci** site.

- Extent the alternative enhances natural processes that create rearing and winter habitat for listed fish species
- Extent the alternative expands riparian vegetation cover
- Ability of the alternative to reconnect the creek with its floodplain
- Extent the alternative enhances habitat for nesting songbirds
- Extent the alternative halts erosion

From the analysis a range of alternatives was developed. The two alternatives analyzed include the No Action and the Lower Redwood Creek Interim Flood Reduction Measures and Floodplain and Channel Restoration (the Preferred Alternative). The two project sites were first proposed as separate projects, but were combined because sediment from **Pacific Way** will be stockpiled at the **Banducci** site, the NMFS is considering both project sites as a single project in the Biological Opinion, and the NPS is required to evaluate impacts cumulatively and not separate actions. The projects could operate separately should constraints arise restricting work at one of the project sites. Alternatives considered but not selected are discussed the section entitled Alternatives Considered But Rejected.

Preferred Alternative

The following eight actions are proposed for **Pacific Way** site.

1. Excavate sediment from two high points in the channel extending from approximately 350 feet upstream to approximately 450 feet downstream of the Pacific Way bridge;
2. Remove woody debris and sediment from an additional 300 feet of channel in the reach between the Pacific Way bridge and the NPS parking lot;
3. Remove dead trees at risk of falling into the channel in the reaches described above;
4. Excavate a pilot channel through the willow-alder grove downstream of the NPS parking lot and pedestrian bridge;
5. Install two armored dips in the levee road;
6. Remove the flapgate on the more downstream culvert in the levee road;
7. Install willow mattresses at two floodplain channel inverts upstream of the Pacific Way bridge; and
8. Excavate a small trench at the low point on Pacific Way east of the Pacific Way Bridge.

1. Excavate sediment from two high points in the channel extending from approximately 350 feet upstream to approximately 450 feet downstream of the Pacific Way bridge:

Sediment would be excavated from the creek channel extending from approximately 350 upstream to approximately 450 feet downstream of the Pacific Way bridge (Figure 3). Recent NPS surveys document approximately five feet of sediment deposition in this reach since 1992 (see Figure 3, Appendix B). The excavation would partially remove a high point in the channel profile upstream of the Pacific Way bridge and a high point in the profile downstream of the bridge, thus increasing channel slope and sediment transport capacity in the reach (see Figure 4, Appendix B). Excavation depth would be approximately 2–2.5 feet, resulting in an estimated excavation volume of 1300 yd^3. This sediment excavation is within the realigned and channelized portion of the creek. Excavated sediment would be transported in trucks to an upland location at the **Banducci** site (Figure 4), where it would be either spread onto the site or temporarily stockpiled for future use.

Excavation in the creek channel would be conducted using front-end loaders and excavators. During construction, creek flow would be diverted from the work area. Front-end loaders would access the creek channel at one point upstream of the bridge and one point downstream of the bridge and would push sediment to a location where an excavator could operate from the bank. The excavator would scoop the sediment from the channel and place it in a truck for hauling. Use of heavy equipment requires removal and trimming of native riparian vegetation and non-native Monterey pine trees for access to the channel.

2. Remove woody debris and sediment from an additional 300 feet of channel in the reach between the Pacific Way bridge and the NPS parking lot:

Downstream of the sediment excavation, a series of large woody debris jams (which were partially the cause of the upstream deposition) would be removed from approximately 300 feet of channel (Figure 3). An estimated 300 yd^3 of sediment deposited within and upstream of the debris jams would also be removed. Where feasible and appropriate, large wood pieces would be left in this reach to provide cover and habitat structure for fish. Trees and limbs would be transported and disposed of off-site.

Figure 3

Figure 4

Removal of woody debris from the channel would be conducted using a front-end loader and excavator. During construction, creek flow would be diverted from the work area. The front-end loader would access the channel at one location (in addition to that used for excavation of sediment upstream) and would push woody debris to a location accessible by the excavator. The excavator, which would access the channel bank at two locations (in addition to that used for excavation of sediment upstream), would pick up the woody debris and place it into a truck for hauling. Use of heavy equipment requires removal and trimming of native riparian vegetation and non-native Monterey pine trees for access to the channel.

3. Remove dead trees at risk of falling into the channel from approximately 350 feet upstream to approximately 750 feet downstream of the Pacific Way bridge:

Standing dead trees with an immediate risk of falling into the channel would be removed to prevent the near-term formation of debris jams in the creek (Figure 3). Upstream of Pacific Way, seven standing dead alders would be removed. Downstream of Pacific Way, an additional 17 standing dead alders would be removed or limbed, and one Monterey pine would be limbed. Removed trees and limbs would be transported and disposed of off-site.

4. Excavate a pilot channel through the willow-alder grove downstream of the NPS parking lot and pedestrian bridge:

A 300-foot-long pilot channel would be excavated through the willow-alder grove downstream of the NPS pedestrian bridge (Figure 3). Establishment of the channel would remove or partially remove artificial base level controls and is intended to initiate scour of a channel capable of transporting sediment (see Figure 4, Appendix B). Excavation of the channel would include removal of artificial fill near the downstream end of the grove and excavation of a pilot channel through the willow-alder grove. Artificial fill consists of approximately 25 yd^3 of cobbles and small boulders in the creek channel and approximately 20 yd^3 of compacted sand and gravel on the floodplain. Excavation of the pilot channel would require clearing a 12-foot-wide swath through the willow-alder grove. Clearing would completely remove willow and alder shrubs in the downstream 50 feet of the swath. In the remainder of the swath, clearing would require removing limbs from large willow and alder trees, allowing canopy closure over the channel to be preserved. The excavated channel would be approximately 6 feet in width and 2 feet in depth, requiring the excavation of approximately 150 yd^3 of silt, sand, and gravel. Excavated material would be side-cast and graded into the banks of the excavated channel.

Excavation of the artificial fill would be accomplished using an excavator and haul truck. Artificial fill would be disposed of at NPS maintenance facilities or a landfill off-site. Excavation of the pilot channel would be accomplished using a mini-excavator, which can operate in the narrow openings between tree trunks in the grove. Sediment excavated from the pilot channel will be graded onto the banks. Removing the sediment from the site would require clearing of vegetation to provide access for front-end loaders and/or haul trucks. Disposal of the native sediment on-site minimizes impacts to riparian vegetation.

5. Install two armored dips in the levee road:

Armored dips would be constructed at two locations on the levee road. Under current conditions, flood flows spill from the creek channel, into an adjacent backwater, and over the levee road, causing scour of the levee and presenting a risk of levee failure and channel avulsion. Two trapezoidal dips would be constructed across the levee road at the locations of current scour channels. Dips would have a 20-foot bottom width and 10:1 side slopes and would be lined with 1-6-inch diameter mixed grade, compacted rock. The dips would allow flood water to spill into

the adjacent pasture, thus maximizing the use of the wetland pasture for flood routing, while reducing the risk of levee failure and channel avulsion

6. Remove the flapgate on the more downstream culvert in the levee road:

Under current conditions, flood flows from Redwood Creek that are stored in the wetland/floodplain and inflows from the Green Gulch tributary can enter the Redwood Creek channel through two culverts in the levee road. The downstream culvert, which was put in place around 1970, is fitted with a flapgate that is stuck partially shut and hinders flows reentering the creek. The removal of the flapgate would improve flood routing from the wetland/floodplain back to Redwood Creek and would also provide an improved route for juvenile fish that enter the wetland during high flows to return to the creek. In order to maintain water levels in the wetland for the protection of the California red-legged frog, risers would be installed on the culvert during the late spring and summer months to maintain inundation of the wetland.

7. Install willow mattresses at two floodplain channel inverts upstream of the Pacific Way bridge:

Willow mattresses would be installed at the inlets of two floodplain channels upstream of the Pacific Way bridge. These floodplain channels are steeper than the current creek channel and could potentially capture the creek. The willow mattresses are intended to prevent or slow the development of these channels and reduce the risk of channel avulsion. They are not intended to prevent or reduce inundation of the floodplain or increase conveyance capacity of the Redwood Creek channel.

8. Excavate a small trench at the low point on **Pacific Way** east of the Pacific Way bridge:

A small trench would be excavated from the low point of **Pacific Way** into the adjacent pasture. This ditch would drain off ponded water between flooding events.

The following three actions are proposed for **Banducci** site.

1. Remove the four-foot high levee adjacent to Redwood Creek and grade portions of the manually built-up creek bank at seven locations along 1,800 linear feet of channel.
2. Install approximately 18 individual Engineered Log Jams (ELJ's) at seven locations in 1,300 linear feet of the creek channel for habitat enhancement and erosion protection.
3. Revegetate newly graded areas.

1 The first action is proposed to reconnect Redwood Creek to its historic floodplain. The riparian corridor will be expanded by grading channel banks on the west side (right bank) of the creek at seven locations. Recontouring from bankfull elevation will occur at a gradual slope to meet the existing elevations. Approximately 3,827 cubic yards of material will be excavated. Following grading and in-stream installation, erosion control materials will be installed on newly graded banks, with the heaviest material, such as coconut fiber, used within or just above bankfull elevations and other materials such as rice straw at higher elevations.

2. The installation of ELJs will improve habitat for listed fish species and limit further erosion. Log structures to be installed include deflection jams, weirs, and toe revetments, composed of large-diameter logs, most with rootwads. About 63 logs will be used in the log structures. Specific designs for log structures are included in Appendix C. To install each log structure,

an excavator will enter the creek over the newly graded bank and operate from a single location to minimize impacts to the creekbed. Due to the weight of the logs (as much as 4 tons), it is not possible for an excavator to properly install the logs from the creekbank. The excavator will fit through remaining alder trees at the bank edge, requiring the removal of selected branches in order to gain access to the creek. A separate excavator will deliver log elements to the bank edge in order to reduce the number of times the excavator moves in and out of the creekbed.

At the eroded bank, a complex log jam will be constructed to reduce the impact of flows on the bank. In addition, log structures will be placed upstream to route water away from the eroded bank. To prevent an existing gravel bar from functioning as an obstacle to newly deflected flows, young willows will be cleared from the gravel bar and the bar will be graded down about one foot. A pilot channel will be excavated about two-foot deep and four-foot wide. Gravel excavated from the existing gravel bar will be placed between the eroded bank and the newly placed log structures. The unstable bank will be graded and replanted with willows to prevent additional erosion.

3. Native riparian plants, grown from locally collected seeds and cuttings will be planted in graded areas, during the first growing season immediately following the completion of in-stream construction activities. Approximately seven acres of floodplain will be restored through periodic inundation, sustaining new riparian growth in an area currently occupied by non-native grasses. Over a longer period of time, the channel and floodplain process will naturally sustain in-channel complexity and the riparian vegetation.

No Action

Under this alternative, no actions would be taken to restore the creek, alleviate flooding, or prevent channel avulsion in the lower Redwood Creek area. Sediment would continue to deposit in the creek channel, which could eventually lead to channel avulsion during a flood event. Channel avulsion could occur if the creek abandons its existing channel and establishes a new channel in the floodplain to the east, perhaps through the alder grove adjacent to the Pelican Inn, across **Pacific Way**, and through the wetland/field east of the levee road. In the interim, flooding of **Pacific Way** would continue. The high velocity flows and channel scour at the **Banducci** site would also continue and salmon habitat would continue to degrade.

Table 1: Comparison of Alternatives

Topic Area	Pacific Way Site	Banducci Site
Preferred Alternative	• Excavate sediment from two high points in the channel extending from approximately 350 feet upstream to approximately 450 feet downstream of the Pacific Way bridge; • Remove woody debris and sediment from an additional 300 feet of channel in the reach between the Pacific Way bridge and the NPS parking lot; • Remove dead trees at risk of falling into the channel in the reaches described above; • Excavate a pilot channel through the willow-alder grove downstream of the NPS parking lot and pedestrian bridge; • Install two armored dips in the levee road; • Remove the flapgate on the more downstream culvert in the levee road; • Install willow mattresses at two floodplain channel inverts upstream of the Pacific Way bridge; and • Excavate a small trench at the low point on Pacific Way east of the Pacific Way Bridge.	• Remove the four-foot high levee adjacent to Redwood Creek and grade portions of the manually built-up creek bank at seven locations along 1,800 linear feet of channel. • Install approximately 18 individual Engineered Log Jams (ELJ's) at seven locations in 1,300 linear feet of the creek channel for habitat enhancement and erosion protection. • Revegetate newly graded areas.
Impacts of Preferred Alternative	Short-term adverse effects to biological resources, water quality, air quality, noise, and resident and visitor use due to construction. Short and Long-term beneficial impacts to hydrology, biological resources, and resident and visitor use.	Short-term adverse effects to biological resources, water quality, air quality, noise, and resident and visitor use due to construction. Short and Long-term beneficial impacts to hydrology, biological resources, and resident and visitor use.
No Action Alternative	No Action	No Action
Impacts of Preferred Alternative	Short and long term adverse impacts to hydrology, biological resources, and resident and visitor use. Avoid short-term construction impacts.	Short and long term adverse impacts to hydrology, biological resources, and resident and visitor use. Avoid short-term construction impacts.

Alternatives Considered but Eliminated

Three alternatives were considered at the **Pacific Way** site.

1) Installation of a temporary bridge at the low point of **Pacific Way**, east of Redwood Creek.
2) Channel Excavation:
   - More extensive excavation of the channel from the parking lot up to the Pacific Way bridge, or
   - More extensive excavation of the channel from the parking lot to well upstream of the Pacific Way bridge
3) Construction of a controlled bypass channel to convey floods from upstream of the Pacific Way bridge, through the wetland/field, and back to Redwood Creek.

An analysis of these alternatives indicates they are not feasible as interim actions. Because **Pacific Way** is a county road, Alternative 1 would require Marin County to install and maintain a

temporary bridge, which would provide one-way access and which would incur substantial cost for purchase, installation, and maintenance of the bridge. In addition, while this action could potentially reduce or eliminate inundation of the road, it would not meet the project objective of preventing or reducing the risk of channel avulsion.

More extensive excavation than proposed under the preferred alternative would result in increased impacts to the creek and to listed aquatic species in the creek and would generate larger quantities of excavated material that would require transport and disposal. Due to the lack of disposal sites for excavated sediment and potential impacts to species within the creek this alternative was rejected.

The construction of a controlled bypass involves complex analysis, including modeling and technical analyses that could not be determined or implemented within the required timeframe.

At the **Banducci** site, alternative locations for enhancing salmonid habitat and restoring the creek connection to its floodplain were evaluated. Redwood Creek could potentially be reconnected with its floodplain at two locations at the **Banducci** site, based on analyses conducted by consulting hydrologists Philip Williams and Associates (PWA, 2000). One reconnection could occur through removal of the levee at the lower end of the Bowling Alley. A technical evaluation was conducted for an alternative location for floodplain reconnection that included the removal of the berm that prevents waters from flooding the ballfield. That action was rejected pending NPS evaluation/planning for other potential uses of that site. Upstream reaches of the creek, such as the Upper Alley, were shown by PWA to be highly disconnected from the floodplain (PWA, 2000). Restoration in these areas will be considered in a future phase of work. The Preferred Alternative was selected because erosion can be halted immediately and hydrological reconnection with the floodplain can be made easily and with little flooding risk. In addition, the Bowling Alley has poor fish habitat that can be feasibly enhanced.

Environmentally Preferred Alternative

The environmentally Preferred Alternative is the alternative that will promote the national environmental policy expressed in NEPA (sec.101 (b)). This includes alternatives that:

1. Fulfill the responsibilities of each generation as trustee of the environment for succeeding generations;
2. Assure for all generations safe, healthful, productive, and aesthetically and culturally pleasing surroundings;
3. Attain the widest range of beneficial uses of the environment without degradation, risk of health or safety, or other undesirable or unintended consequences;
4. Preserve important historic, cultural, and natural aspects of our national heritage and maintain, wherever possible, an environment that supports diversity and variety of individual choices;
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.

An evaluation of alternatives suggests that the Preferred Alternative is the environmentally Preferred Alternative because it preserves important natural resources while achieving balance

between population and resources. The GGNRA is proposing a reasonable alternative to protect resources and allow visitors and residents "safe, healthful, productive, and aesthetically and culturally pleasing surroundings." In addition, the NPS would be meeting its responsibilities as trustee of the area by taking action to reduce a hazardous situation and enhance Redwood Creek in-stream and floodplain habitat for current and future generations.

The No Action Alternative would avoid construction effects, yet does not attain the widest range of beneficial uses identified by NEPA and allows the risk of loss of resources. Additionally, the very imminent risk of channel avulsion could result in infrastructure loss, habitat loss, adverse impacts to listed species, and impacts on visitor use.

The NPS has endeavored to identify interim actions that are reasonable and restoration efforts that are effective. The project was selected because it achieves the purpose and need through the least amount of disturbance. Based on the principals of Section 101 of the National Environmental Policy Act (NEPA), the Preferred Alternative is identified as the environmentally Preferred Alternative.

3.0 Environmental Analysis

Introduction and Methodology

NEPA requires that environmental documents disclose the environmental impacts of the proposed federal action, reasonable alternatives to that action, and any adverse environmental effects that cannot be avoided should the Preferred Alternative be implemented. NEPA requires consideration of context, intensity, and duration of impacts, indirect impacts, cumulative impacts, and measures to mitigate impacts. Consistent with Section 1500.4 of the Council of Environmental Quality's regulations implementing NEPA, issues that are not significant are addressed briefly in this EA. Section 1500.4 also encourages the use of the scoping process to "...not only identify significant environmental issues deserving study, but also to de-emphasize insignificant issues, narrowing the scope of the environmental impact statement process accordingly."

Usually, Environmental Assessments are divided with the Affected Environment and Impact sections separated into two different chapters. This EA discusses the affected environment and identifies impacts of the alternatives in the same chapter. It is assembled in this fashion so the reader will not need to flip between chapters, effectively describing the resources, impacts, and mitigations in a straightforward and readable manner. Cumulative impacts and impairment is discussed at the end of each resource section.

The impact analysis and conclusions were based on information available in the literature, data from park studies and records, and information provided by experts with the NPS and other agencies. Unless otherwise stated, impacts were assumed to be direct and occur during the construction period. In addition, the impact analyses assume that mitigating measures would be applied at the time the alternative is implemented in order to minimize or avoid impacts. Mitigating measures are described in each section and included as Appendix A.

General Definitions

The following definitions were used to evaluate the context, intensity, duration, and cumulative nature of impacts associated with project alternatives:

Context is the setting within which an impact is analyzed, such as the affected region, society as a whole, the affected interests, and/or a locality. In this environmental assessment, the intensity of impacts are evaluated within a local (i.e., project area) context, while the intensity of the contribution of effects to cumulative impacts are evaluated in a regional (i.e., park-wide) context or in the case of special-status species, within the context of a species range.

Intensity is a measure of the severity of an impact. The intensity of an impact may be:

- ***Negligible***, when the impact is localized and not measurable or at the lowest level of detection;
- ***Minor***, when the impact is localized and slight but detectable;
- ***Moderate***, when the impact is readily apparent and appreciable; or
- ***Major***, when the impact is severely adverse or exceptionally beneficial and highly noticeable.

Duration is a measure of the time period over which the effects of an impact persist. The duration of impacts evaluated in this EA may be:

- ***Short-term***, when impacts occur only during construction or last less than three years; or
- ***Long-term***, when impacts last three years or longer.

Special Status Species Analyses. In accordance with language used to determine effects on threatened and endangered species under the federal Endangered Species Act (USFWS 1998), potential effects on special status species were categorized as follows:

- ***No Effect***, when the Preferred Alternatives would not affect special status species or critical habitat;
- ***Not likely to adversely affect***, when effects on special status species are discountable (i.e., extremely unlikely to occur and not able to be meaningfully measured, detected, or evaluated) or completely beneficial; or
- ***Likely to adversely affect***, when any adverse effect to listed species may occur as a direct or indirect result of Preferred Alternatives and the effect is not discountable or completely beneficial.

To evaluate effects of alternatives on listed species NPS staff used essential habitat features including: substrate, water quality, quantity, temperature, and velocity, cover/shelter, food, riparian vegetation, space, and safe passage (NOAA 1997). Remaining considerations concerning special status species, including conclusions and evaluation of cumulative impacts, are presented in accordance with the general definitions described above.

Cultural Resources Analyses. The assessment of impacts on cultural resources and historic properties was made in accordance with regulations of the Advisory Council on Historic Preservation (36 CFR 800) implementing Section 106 of the National Historic Preservation Act (NHPA). Following a determination of the area of potential effect, cultural resources were identified within these areas that are either listed in, or eligible for listing in, the National Register of Historic Places.

An assessment was made of the nature and extent of effects on cultural resources anticipated from implementing proposed undertakings. Cultural resources can be affected by actions that alter in any way the attributes that qualify the resources for inclusion in the National Register. Adverse effects can result when the integrity of a resource's significant characteristics is diminished. Consideration was given both to the effects anticipated at the same time and place of the undertaking, and to those potentially occurring indirectly at a later time and distance.

To provide consistency with requirements of the NEPA, the effects on cultural resources are also described in terminology intended to convey the duration, intensity, and beneficial or adverse nature of potential impacts. Impacts could be of short term, long term, or permanent duration. Analysis of the duration of impacts is required under the NEPA; however, duration is not required and is not usually considered in assessing effects in terms of the NHPA. The intensity of impacts is defined as follows:

Negligible, when the impact is barely perceptible and not measurable. The undertaking does not appreciably diminish significant character-defining attributes of historic properties (including the informational potential of archaeological resources).

Minor, when the impact is perceptible and measurable. The effects remain localized and confined to a single element contributing to the significance of a larger National Register property/district, or archaeological site(s) with low to moderate data potential;

Moderate, when the impact is sufficient to alter the character-defining features of historic properties, generally involving a single or small group of contributing elements, or archaeological site(s) with moderate to high data potential; or

Major, when the impact results in a substantial and highly noticeable change in character-defining features of historic properties, generally involving a large group of contributing elements and/or individually significant property, or archaeological site(s) with high to exceptional data potential.

Cumulative Context

The Council on Environmental Quality (CEQ) regulations implementing NEPA 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" (CEQ Section 1508.7). The primary projects and actions that could contribute to the cumulative effects of the Preferred Alternative are summarized below.

The NPS is developing a restoration plan for Big Lagoon, which will improve its ecological function and habitat value and address long-term flooding at **Pacific Way**. Planning is beginning for the project and construction of the restoration project is anticipated to begin in three to five years. It is expected that the impacts of the Big Lagoon project will be beneficial upon the environment, improving habitat and reducing flooding.

PG&E is proposing to remove trees in the **Pacific Way** area to protect overhead power lines. PG&E has proposed to trim or remove approximately 11 trees about one-half mile from the **Pacific Way** site on Highway 1. This project could add a few trucks on Highway 1 and reduce in nesting habitat in the general project area.

To address flooding in the past, the NPS and Marin County Department of Public Works have installed culverts, constructed a berm along **Pacific Way** west of the bridge, and provided pumps to remove ponded water. These actions have done little to resolve flooding and the effects of these past actions are not expected increase or decrease the impacts identified for the Preferred Alternative.

Currently, the NPS and Marin County Public Works may implement a project to address a bank failure that is threatening Muir Woods Road along Redwood Creek; and the California Department of Parks and Marin Municipal Water District have requested California Department of Fish and Game funds to reduce road-related sediment delivery to Redwood Creek and its tributaries. This project will have beneficial impacts to the environment by reducing potential sediment in the creek.

Marin County Public Works may repair potholes along **Pacific Way**. The work would occur after this project and is not expected to add cumulative effects.

Hydrologic, Geomorphic, Water Quality, and Geologic Resources

Existing Conditions

Hydrologic Resources

Climate in the Redwood Creek watershed is characterized by mild, wet winters and cool, foggy summers. Since 1941, annual rainfall in the watershed has averaged 37.5 inches, with 90% of rainfall occurring from November through April.

Seasonal flow patterns in Redwood Creek are typified by low flows in the summer and fall, low-to-moderate winter baseflows, and sharp, short-duration winter storm peaks. During summer, baseflows in lower Redwood Creek range from 0 cfs to 2 cfs. During winter, estimated annual flood peaks[2] (from 1962 through 1999) ranged from 59 cfs in 1972 to 2,605 cfs in 1982, and the mean annual flood was 1,027 cfs. The 2-year, 5-year, and 10-year floods[2] are estimated to be 805 cfs, 1,600 cfs, and 2,270, respectively (PWA 2000).

Channel Morphology

Redwood Creek is the main channel draining the Redwood Creek watershed. Major tributaries to Redwood Creek include Bootjack, Rattlesnake, Spike Buck, Fern, and Kent Canyon creeks and Green Gulch Creek, which drains into Big Lagoon. In the upper portions of the watershed, tributary channels (Bootjack, Rattlesnake, Spike Buck, and Fern creeks) flow through deep canyons incised into Franciscan Complex mélange. Channel slope in these canyon reaches is approximately 0.04 and steeper. In the vicinity of Muir Woods National Monument, channel slope decreases to 0.01. In this reach, channel morphology has been radically altered by a Civilian Conservation Corps channelization project conducted in the 1930s, which excavated a wide, flat channel and placed rock revetment along most of the channel length. In this reach, where large woody debris occurs, it plays an important role in forming bars and pools. Large wood in this reach, however, is sparse due to previous NPS management of the creek, which until the early 1980s included routine removal of wood from the creek. As a result, the reach is primarily plane-bed and pools are sparse.

Downstream of Muir Woods, Redwood Creek enters the alluvial Frank Valley. Within Frank Valley (and also in Green Gulch), the valley floor consists of Quaternary alluvial fill, the depth of which is estimate to be at least 37 feet (Martin 2000). Channel slope in Frank Valley ranges from 0.009 at the upstream end to 0.004 near the Highway One bridge. Throughout most of Frank Valley, the creek channel is incised and is thus isolated from its floodplain. No assessment of the causal mechanisms or magnitude of this stream incision has been conducted. As in Muir Woods, large woody debris is lacking in this reach and pools are infrequent.

The **Banducci** site includes the lower 3,800-ft of Frank Valley upstream of the Highway One bridge to the boundary of California State Parks. This reach of Redwood Creek can be divided into three distinct subreaches; the upper third, referred to as the "Upper Alley;" the middle portion, referred to as the "Bowling Alley," and the lower reach. The Lower Reach is the only area that is highly sinuous, with well formed gravel point bars. Both the Upper Alley and the Bowling Alley have straight channel alignments and poor in-channel complexity.

[2] At the Highway One bridge, which does not include inflows from the Green Gulch tributary.

As the channel approaches the **Pacific Way** bridge, downstream of the Highway 1 bridge, channel slope decreases to 0.001 and transitions to a sand-bedded regime morphology. The channel and floodplain in this reach have been extensively modified over the last several decades. Major modifications include:

- Construction of floodwalls and placement of bank revetment between the Highway 1 and **Pacific Way** bridges
- Construction of a levee across the floodplain, conversion of a portion of the floodplain to field, and isolating most of the floodplain from the creek
- Realignment of Redwood and Green Gulch creeks
- Construction of a dirt/gravel fill parking lot in the lagoon;
- Construction of the **Pacific Way** bridge and concrete box culvert across Redwood Creek at the upstream end of Big Lagoon
- Periodic dredging of the creek channel to maintain conveyance capacity (dredging was discontinued and has not occurred for at least the past 20 years).

These modifications have reduced floodplain area and have altered channel hydraulics and sediment transport capacity. Combined with the delivery of sediment derived from large storms in 1997, these modifications have resulted in the rapid and continued aggradation of the channel bed. Channel surveys conducted by the NPS document approximately five feet of channel aggradation since 1993 (see Figure 3, Appendix B). Given this magnitude of aggradation, the channel alignment has become highly unstable and there is a risk of avulsion to the adjacent wetland/floodplain, the elevation of which is several feet lower than the creek bed. This deposition has also resulted in substantial loss of channel conveyance capacity, causing overbank flooding to increase in frequency, magnitude, and duration. Floods now occur during much smaller storms than prior to aggradation, and overbank areas remain inundated for much longer periods.

Hillslope Processes

Hillslope erosion processes in the Redwood Creek watershed include landslides, gullying, soil creep, and sheet erosion. Slopes in the watershed are highly susceptible to landsliding and debris flows. Almost half (46%) of the hillsides in the watershed consist of landslide deposits (Wentworth et al. 1997). In recent years, extensive landsliding has been observed in the watershed. Following the El Niño storms of January 1982, which triggered numerous debris flows throughout the Bay Area, the U.S. Geological Survey identified twenty debris flows in the Redwood Creek watershed triggered by that single, large storm event (Ellen et al. 1988). The majority of these debris flows were located in the Green Gulch watershed, a tributary canyon upstream of the **Banducci** property, and Conlon Canyon. In January 1997, heavy rainfall triggered another large landslide in Conlon Canyon, which blocked the Camino del Canyon Road.

In addition to hillslope processes, streambank erosion and channel incision also contribute to sediment supply. Shanz et al. (1995) used a combination of regional approaches and evaluation of historical data in the Redwood Creek watershed to estimate annual sediment yield from the watershed. The estimates from their analyses ranged from 90 to 2,400 tons/year.

Water Quality

Lower Redwood Creek, including the **Banducci** and **Pacific Way** sites, has been identified as a critical location for water quality and quantity. Three years of intensive water quality data (1998,

1999, 2001) by NPS have identified the channel downstream of the Muir Beach CSD's pedestrian bridge as having poor water quality under low flow conditions. NPS staff conducted a literature review to identify critical water quality parameters that would adversely affect fish. NPS adopted a sublethal minimum dissolved oxygen threshold of 5 mg/l and maximum water temperature of 68 degrees F as significance thresholds.

When surface flows diminished to a point where only isolated pools were present, measured dissolved oxygen levels dipped below 1 mg/l for many pools (Fong, unpublished data, 2001). Concurrent temperature measurements did not exceed the 20° C threshold. The water temperature and dissolved oxygen levels are critical to providing adequate habitat for fish. Impacts of poor water quality to listed species are discussed under "Biological Resources" below.

Water Use

The Community of Muir Beach receives their drinking water from a well located approximately 1,500 feet upstream of the **Banducci** site.

Geologic/ Paleontological Resources

The Redwood Creek watershed is located in the Coast Ranges, which were formed by the subduction of the Farallones tectonic plate under the western edge of the North American tectonic plate. The watershed is underlain primarily by the Franciscan Complex, which consists of highly deformed beds of sedimentary, metamorphic, and igneous rocks of late Jurassic and Cretaceous age and is dominated by shales and sandstones, often interbedded with limestone and chert (Blake et al. 2000). Igneous rocks, including basalt flows, pillow basalts, agglomerates, tuffs, and diabase dikes, occur as minor components in the complex. Serpentenites, which are formed by metamorphosis of some igneous rocks, also occur. Because these serpentine rocks are composed of a variety of minerals, their weathering contributes to the great diversity of soil types observed in the Coast Ranges.

The San Andreas Fault is located just offshore of the mouth of Redwood Creek. The San Andreas Fault is a transform fault at the boundary of the Pacific and North American tectonic plates. Since the early 1800s, four large earthquakes have been recorded along San Andreas Fault zone, including the "Great San Francisco Quake" of 1906 and the Loma Prieta earthquake of 1989. There are no known unique geologic or known Paleontological resources in the project areas.

Impacts of Preferred Alternative

The preferred alternative would have moderate short-term and long-term beneficial effects on the hydrology and geomorphic processes in Redwood Creek, including:

1. Improved sediment transport continuity, reduced sediment accumulation, and reduced risk of channel avulsion at the **Pacific Way** site, and
2. Increased frequency, depth, and duration of floodplain inundation, reduced in-channel flow velocity, and reinitiation of channel dynamics driven by the presence of large woody debris in the channel at the **Banducci** site.

As described in Chapter 3, the preferred alternative would improve geomorphic processes at the **Pacific Way** site by removing obstructions to flow and thus improving sediment transport continuity and reduce the rate of sediment aggradation in the channel. By increasing channel

capacity, increasing sediment transport capacity, initiating channel scour, stabilizing the inverts of major floodplain channels, and armoring scour channels on the levee road, the project will also reduce the risk of channel avulsion.

At the **Banducci** site, the preferred alternative would encourage development of a meandering creek in a channelized portion of the creek and allow overbank flow into an adjacent floodplain. Following removal of floodplain berms and installation of the ELJs, the floodplain in the project reach is expected to be inundated at flows exceeding the 2-year flood stage (PWA 2002). The resulting change in the flood dynamics at the site will be most evident during lower magnitude, higher frequency flood events, such as the 2-year event. During these events, large areas of the field adjacent to the creek not currently inundated will be inundated to depths of approximately 0.5 feet for short periods (PWA 2002). The total area of flood inundation is approximately seven acres (PWA 2002). During less frequent, higher magnitude events, such as the 50-year flow event, the water depth will be approximately 3.5 feet in the lowest portion of the field, which is 0.5 ft deeper than water would be under a similar flow without the project implementation (PWA, 2002). The reconnection of the creek with its floodplain at the **Banducci** site would have a minor beneficial impact on flooding at the **Pacific Way** site.

The preferred alternative would also reinitiate in-channel geomorphic processes. The ELJs would act to reduce flow velocity in the channel and initiate localized deposition and scour, thus increasing in-channel habitat complexity by creating riffles and pools in a reach that is currently predominantly plane-bed. This localized deposition and fill will also reinitiate channel migration in the project reach, an important fluvial process that will further increase habitat complexity.

The preferred alternative would have minor short-term adverse impacts to water quality. At the **Pacific Way** site, creek flow would be diverted from the work site to prevent downstream increases in water turbidity. Within the worksite, however, standing water will be turbid. Also, disturbance of the bed and subsequent adjustment of the bed to excavation may result in increased suspended sediment loads and increased turbidity during the first storms following construction. At the **Banducci** site, the log structure installation and regrading of the gravel bar would occur during the late summer and early fall (August 15 to October 1) and upland work could continue until November 15th. During the construction period, flow is expected to range from 0.01 to 0.1 cfs (based on previous records combined with current precipitation). Depending upon flow conditions, portions of Redwood Creek may be dry during construction. However, if **in-stream** flow is present, construction activities will result in localized turbidity. In addition, any exposed bank materials after construction may have increased susceptibility to surface erosion in the short-term. At the **Pacific Way** site, tree removal, bank or in-channel excavation of woody debris could result in turbidity and increased channel velocity.

Construction is not expected to adversely affect dissolved oxygen or temperature conditions. Localized removal of adjacent vegetation is expected to have a neutral effect on water quality. Slight increase in water temperature would be expected, but based on past data, water temperatures would not be expected to exceed 20^{0}C. In addition, localized increases in sunlight penetration would result in increased dissolved oxygen levels during daylight hours and slight decreases at night.

Sediment from the **Pacific Way** site will be stockpiled at the **Banducci** site. The gravel will be separated from the fine sediment and used for road or trail maintenance. The fine sediment will be spread on the **Banducci** site. The following mitigation measures will ensure that neither

stockpiled nor spread material reaches the creek. The following mitigation measures will be implemented during and after construction to reduce short-term impacts to water quality to a minor to negligible level.

Mitigation Measure WQ-1: Flow Diversion: If flowing water is present, flow will be diverted around the work areas. Standing water, however, may remain in the work areas due to the high water table at the sites.

Mitigation Measure WQ-2: Erosion and Sediment Control: In-water work will cease on or before October 1.

Mitigation Measure WQ-3: Erosion and Sediment Control: The number of equipment access points to the channel will be minimized to reduce the effects of equipment access of channel banks.

Mitigation Measure WQ-4: Erosion and Sediment Control: Erosion control materials, such as mulch, jute netting, and/or native plant materials, will be placed on creek banks disturbed by construction. Erosion control will be in place by October 1.

Mitigation Measure WQ-5: Erosion and Sediment Control: Stockpiles of excavated sediment (from **Pacific Way**) that will remain after completion of the project will be at least 100 feet from the creek and will be contained using silt fences, straw bails, and/or other appropriate sediment catchment devices.

Mitigation Measure WQ-6: Erosion and Sediment Control: To prevent construction debris from entering the creek, appropriate best management practices set forth in the California Storm Water Best Management Practice Handbooks will be employed.

Mitigation Measure WQ-7: Erosion and Sediment Control: In upland work areas, barriers will be placed between the construction area and the creek to prevent construction debris or surface runoff from entering the creek.

Mitigation Measure WQ-8: Erosion, Sediment, and Pollution Control: Potential contaminants and erodable materials stockpiled within 100feet of the creek will be covered with tarps during construction, and potential pollutants (e.g., fuels, etc.) will be stored with proper containment and outside of areas where contact with stormwater runoff or creek waters could occur.

Mitigation Measure WQ-9: Erosion and Sediment Control: During excavation of berms at the **Banducci** site, any sediment piles left overnight on the site will be covered completely with tarps to prevent airborne migration and watering will occur as needed to prevent windborne dust.

Implementation of the Preferred Alternative-will not impact the Muir Beach CSD's well or its available water supply. The local community of Muir Beach will continue to utilize waters within the Redwood Creek drainage for municipal purposes and a reduction in the well capacity will not occur because it sits upgradient from the project site, approximately 1,500 feet. However, the Preferred Alternative may affect the substrate of the creek, forming deeper disconnected pools. The NPS will monitor the creek channel at the project site and extending upstream to the well site to identify and quantify changes to the creek bed, including pool deepening and bed aggradation. Consideration for rationing will include this analysis in the future.

If geologic or paleontological resources exist and are encountered during construction, the preferred alternative could have adverse impacts through construction. With mitigation disturbance would be minimized and impacts would be negligible.

Mitigation Measure PAL-1: If paleontological resources are encountered during construction, work in the immediate vicinity of the find will be stopped and a GGNRA archaeologist will be called to inspect the finds. The recommendations of the archaeologist with regard to on-site preservation, recovery and/or documentation of the resources will be implemented before construction re-commences.

Cumulative Impacts of the Preferred Alternative

The work included in the preferred alternative should add cumulative benefit to the Big Lagoon restoration by reducing flooding and adding riparian habitat in the Redwood Creek watershed. County and State projects to reduce sediment deposition in the creek should also be beneficial and reduce flooding at the **Pacific Way** site.

Conclusion

The Preferred Alternative would not result in impairment to park resources and values related to Geologic, Hydrologic, Geomorphic, and Water Quality Resources. The actions would improve the long-term health of a resource that is "key to the natural or cultural integrity of the park or to opportunities for enjoyment of the park NPS Management Policies 2001, Section 1.4.5)."

Impacts of the No Action Alternative

At the **Pacific Way** site, the No Action alternative will result in ongoing streambed aggradation and an ongoing risk of channel avulsion. Flows will continue to slow as sedimentation and creek obstructions increase and **Pacific Way** would continue to flood.

At the **Banducci** site, the No Action alternative would result in continuation of the current lack of complexity in the creek and lack of floodplain connectivity. At both locations, dissolved oxygen levels would remain low during the summer and water temperatures would not be impacted. The No Action alternative will result in moderate long-term adverse effects to the hydrology of Redwood Creek.

Cumulative Impacts of the No Action Alternative

The No Action Alternative would result in on-going impacts to Geologic, Hydrologic, Geomorphic, and Water Quality Resources that could be increased by other projects in the watershed.

Conclusion

The no action alternative would result in the status quo relating to on-going impacts to Geologic, Hydrologic, Geomorphic, and Water Quality Resources. However, an argument could be made that channel avulsion could permanently adversely impact the creek and could result in impairment because of the loss of a key natural feature of the park.

Biological Resources

Existing Conditions

Lower Redwood Creek supports important wetland and riparian habitat as well as special status fish, birds, and amphibians.

Coho Salmon(*Oncorhynchus. kisutch*) /Steelhead Trout (*O. mykiss*).

Redwood Creek supports critical habitat for two special status fish species, listed by the National Marine Fisheries Service (NMFS), the Central California Coast Evolutionary Significant Unit (ESU) steelhead trout (*Oncorhynchus mykiss*) and Central California Coast ESU coho salmon (*O. kisutch*). NMFS classifies and lists salmon by Evolutionarily Significant Units (ESU). To be considered an ESU, a population or group of populations must be substantially reproductively isolated from other populations, and contribute substantially to the ecological or genetic diversity of the biological species. According to the NMFS, essential habitat features for the various life stages of steelhead and coho salmon include the following:

- juvenile rearing areas
- juvenile migration corridors
- areas for growth and development to adulthood
- adult migration corridors
- spawning areas

Juvenile Salmonid Rearing and Areas For Growth And Development. One of the primary limiting factors to salmonid production in the Redwood Creek watershed is a lack of juvenile rearing habitat. A basin-wide habitat inventory was conducted by NPS in 1995 to describe in-stream and riparian habitat conditions from the mouth of Redwood Creek into Muir Woods. When water is present, Redwood Creek supports juvenile coho and steelhead of various ages throughout the year. A 1998 survey found that the density of juveniles near the **Banducci** site declined where significant pool filling had occurred during the high flows of the El Nino events. Lack of secondary channels and backwater areas, woody debris, exposed tree roots, or other features that can provide refugia from high velocity flows limits summer and winter salmonid rearing habitat at the **Banducci** site.

The **Pacific Way** site provides generally poor salmonid rearing habitat. Throughout the project reach, the channel exhibits a plane-bed morphology, lacking pools and complex cover. Within the debris jam area, however, several deep pools provide spring and early summer rearing habitat for salmonids. The forested floodplain also provides winter rearing habitat for coho salmon.

Migration Corridors and Spawning Areas. Current conditions are likely adequate for movement of juvenile fish both upstream and downstream under most flow conditions. Previous trapping data indicate that most outmigration activity of juvenile salmonids occurs in the spring and early summer. Adult coho and steelhead typically migrate upstream during the late winter through spring, with run-back steelhead seen as late as late-April and May. Since upstream movements are associated with storm events, no barriers are likely to occur within the project area that could impede upstream adult fish passage. In coho spawner surveys conducted from the winter season of 1997-98 through 2001-02, no redds have been reported by within the project sites. Most redds are observed upstream of the **Banducci** site.

California red-legged frog (*Rana aurora draytonii*). The California red-legged frog is known to occur in the wetland/floodplain at Muir Beach, adjacent to the **Pacific Way** site. In annual surveys conducted by NPS in 1998 through 2002, California red-legged frogs have been periodically identified by the presence of egg masses and calls in the wetland area. Water is present year-round at various sites in this wetland/floodplain.

Based on field reviews, NPS aquatic and natural resource specialists report marginal breeding habitat for red-legged frogs in a drainage ditch on the west side of the former agricultural field at the **Banducci** site. The ditch is about 300 feet from Redwood Creek at its furthest and joins the creek at the downstream end of the **Banducci** site. Ponded water persists at spot locations in the ditch into the late spring, but it is generally dry in the summer and less than 1.5 feet deep except in the highest flows of the winter. A small, open reservoir is also present near the former agricultural field. NPS staff conducted a survey for red-legged frogs along the drainage ditch (January 18, 1999 and July 9, 2002) and did not encounter California red-legged frogs. No life stages of the California red-legged frog were present in the reservoir during sampling in July 2002. Construction will occur in the creekbed, that does not provide still or ponded water suitable for California red-legged frog breeding.

Based on field reviews, NPS aquatic and natural resource specialists have identified marginal breeding habitat in a drainage ditch on the west-side of the former agricultural field at the **Banducci** site. The ditch is about 300 feet from Redwood Creek at its furthest and joins the creek at the downstream end of the **Banducci** site. Ponded water persists at spot locations in the ditch into the late spring and early summer, but is less than 1.5 feet deep except in the highest flows of the winter. A small, open reservoir is also present near the former agricultural field. NPS staff conducted a survey for red-legged frogs along the drainage ditch (January 18, 1999 and July 9, 2002) and did not encounter any California red-legged frogs. No life stages of the California red-legged frog were present in the reservoir during sampling in July 2002. Where construction activities will occur, no areas provide still, ponded water suitable for California red-legged frog breeding.

Northern Spotted Owl (*Strix occidentalis caurina*). The Northern Spotted Owl is listed as threatened under the federal Endangered Species Act. Based on annual surveys conducted by NPS, Northern Spotted Owls are known to breed approximately two miles from the **Banducci** site, in a canyon where Douglas fir and redwood trees occur. Other spotted owls nest at locations further upstream in Muir Woods National Monument. Spotted owls are not known to nest near the **Pacific Way** site. Spotted owls are known to nest and roost only in coniferous and mixed evergreen forests in Marin County. Riparian habitat supports high densities of dusky-footed woodrats, a favored prey species, and is expected to be regularly used as foraging habitat by spotted owls from dusk to dawn throughout the year.

Riparian and Cavity-nesting Songbirds. Five species of resident and migrant songbirds have been identified in the Redwood Creek watershed for monitoring the long-term health of riparian habitat . Riparian restoration efforts are also targeting this suite of species; Warbling Vireo (*Vireo gilvus*), Swainson's Thrush (*Catharus ustulatus*), Wilson's Warbler (*Wilsonia pusilla*), Black-headed Grosbeak (*Pheucticus melanocephalus*) and Song Sparrow (*Melospiza melodia*). The Warbling Vireo is a California Species of Concern, while the Swainson's Thrush and Wilson's Warbler are declining in California. These five species are among a suite of 14 riparian songbird species native to northern California that are recognized by The Riparian Habitat Joint Venture as focal species for monitoring the overall health of riparian systems. Mist-netting of songbirds at the **Banducci** site indicates that willow riparian vegetation is particularly important as feeding habitat for juvenile songbirds due the abundant insect life associated with willows.

At least 10 species of native birds are likely to nest in cavities of dead or partially dead trees in the riparian zone in the Redwood Creek watershed, like that found along **Pacific Way**, including: American kestrel (*Falco sparverius*), downy woodpecker (*Picoides pubescens*), hairy

woodpecker (*Picoides villosus*), northern flicker (*Colaptes auratus*), Pacific-slope flycatcher (*Empidonax difficilis*) tree swallow (*Tachycineta bicolor*), violet-green swallow (*Tachycineta thalassina*), chestnut-backed chickadee (*Poecile rufescens*), pygmy nuthatch (*Sitta pygmaea*), western bluebird (*Sialia mexicana*), as well as the non-native European starling (*Sturnus vulgaris*) which often displaces native cavity nesters.

Riparian Vegetation. Healthy riparian vegetation is a key component of a healthy stream ecosystem. The loss of riparian vegetation can result in increased water temperature fluctuations, reduced inputs of terrestrial plant and invertebrate foods into the creek, decreased water storage capacity, reduced filtration capacity, and increased erosion potential. The **Banducci** site features a riparian corridor that is presently dominated by red alders (*Alnus rubra*), with some arroyo willows *(Salix lasiolepis*). The riparian corridor on the right bank (west side) of Redwood Creek is unnaturally narrow compared to that shown on historic maps, with the width of the riparian corridor typically no wider than the canopy of a single alder tree. Some portions of the **Banducci** site have no riparian tree cover. At the **Pacific Way** site, riparian vegetation consists of red alder, arryo willow, and non-native Monterey pine. Throughout the **Pacific Way** site, most mature red alders are dead or dying, which is thought to be a result of the increased water table elevation caused by sedimentation in the creek channel.

Monarch Butterfly *(Danaus plexippus).* Monarch Butterflys overwinter in certain locations of the GGNRA from October through February. Monarch butterflies are sensitive to changes in their microclimate and dust. At the **Pacific Way** site, there is an overwintering site approximately 100 feet uphill from the construction area.

Impacts of Preferred Alternative

Coho Salmon(*O. kisutch*) /Steelhead Trout (*Oncorhynchus mykiss*) The Preferred Alternative involves work in the creek bed, requiring diversion of flow in areas of the creek. During dewatering operations, it will be necessary to move the fish away from project area by a variety of methods including: herding them away from the site and the use of nets and/or electrofishing to capture fish. Nets or cofferdams will be used to prevent entry of fish into the project area during construction activities. Fish capture activities will be consistent with the Conservation Recommendations and Terms and Conditions contained in the NMFS Biological Opinion and Incidental Take Authorization for the project.

Because the Preferred Alternative involves handling of listed fish species, it is considered likely to adversely affect, but not likely to jeopardize the continued existence of these fish species or adversely modify designated critical habitat. The determination of likely to adversely affect is based on the Endangered Species Act that defines take as "to harass, harm, pursue, shoot, wound, kill, trap, capture, or collect or attempt to engage in any such conduct." The Preferred Alternative will result in take by (1) harassment of fish through behavioral changes caused by construction activities adjacent to areas with listed fish or through (2) capturing and transferring coho and steelhead, (3) removal of large wood from the creek and standing dead wood from the riparian corridor, and (4) removal of riparian living vegetation. The numbers of fish likely to be captured will depend on in-stream flow conditions at the time of construction and the reproductive success of steelhead and coho adults for the year.

Using average juvenile densities from prior studies, it is possible that 509 juvenile steelhead and 182 juvenile coho will be captured, transported, and released within the **Banducci** project reach.

For the **Pacific Way** reach, it is likely that 128 juvenile steelhead and 43 juvenile coho will be captured, transported, and released. However, there may be more fish because winter 2001 was a productive year for adult coho entering Redwood Creek to spawn.

Mitigation provided in the Hydrology and Water Quality section provides adequate protection for turbidity and erosion. The reduction of riparian and in-stream cover may also increase predation by birds (e.g., kingfisher and egrets) over natural levels. Mitigation to reduce the loss of cover will reduce the impacts from a moderate to a minor level

> Mitigation Measure BIO-1: Heavy Equipment: Heavy equipment used in the streambed will be placed on protective material, such as mats, to the greatest extent possible to reduce loss of riparian cover and reduce compaction and disturbance of surface gravel.

Construction would occur during a critical portion of the summer and fall when dissolved oxygen levels and area of rearing habitat is at an annual low. Due to extreme low flow conditions in Redwood Creek, fish would have limited ability to leave areas of in-water construction. Therefore, it is possible that unintended injury or mortality could occur to fish in the construction area.

The NMFS finding for the Biological Opinion (BO) will consider the baseline for the action area, effects of the Preferred Alternative, and the cumulative effects weighed against the status of the species or designated critical habitat. The BO will contain specific "terms and conditions" that set out specific methods by which salvage and other work is to be accomplished. NMFS Terms and Conditions will be included in the project as mitigation measures, in addition to mitigation measures identified below. It is expected that implementation of the mitigation measures along with the terms and conditions from NMFS will reduce the impacts to listed fish species from moderate to minor.

> Mitigation Measure BIO-2: Temporary Fish Relocation: In areas where creek flow occurs, prior to construction, juvenile coho and steelhead will be removed from the project area and released in an adjacent portion of the creek that has been blocked by a net.. Handling of these species will be overseen by a qualified biologist with appropriate handling permits, and will comply with the Conservation Measures and Terms and Conditions set forth in the NMFS Biological Opinion.
>
> Mitigation Measure BIO-3: Spawning Season: In-channel construction activities will occur during the low-flow period between August 15 and October 1 to avoid spawning, adult in-migration, and juvenile outmigration.
>
> Mitigation Measure BIO-4: Construction Period Dewatering: Temporary fills-and coffer dams will be established to divert flow around areas where construction activities will occur. Materials used for cofferdams will be completely removed after construction. If needed to complete work, a sump pump will be temporarily placed in the creek bed to dewater the area near Grade Area 1 and 2 at the **Banducci** Site and at **Pacific Way**.
>
> Mitigation Measure BIO-5 : **Pacific Way** Site Debris Jam Removal: Where appropriate, some wood will be left in the channel to provide structure and cover for juvenile fish. The area where wood will be left will be limited to the current debris jam area.
>
> Mitigation Measure BIO-6: Silt Fences: If flowing water is present, nets and silt fences will be placed at the upstream and downstream limits of the project area to prevent entry of fish into the project area and to prevent dispersal of sediments downstream.

The long-term effect of the Preferred Alternative on listed fish species will be moderate and beneficial. Losses of in-stream habitat complexity through removal of woody materials at the **Pacific Way** site will be offset by habitat gains upstream. At the **Banducci** site, log structures will be installed at seven locations extending over 1,300 linear feet of stream, offsetting the removal of standing dead wood from 750 feet of the creek and woody debris from 300 feet of the creek. Stability analyses have been conducted by engineers and indicate that the logs will remain stable in high flows (PWA, 2002). Log structures will provide aquatic cover, create scour pools to add habitat for juvenile fish species, and improve spawning habitat by creating a pool-riffle structure in a channeled reach of Redwood Creek.

At the **Banducci** site, the Preferred Alternative will have a long-term beneficial effect on habitat quantity and quality during summer and winter. At least 10 additional pools ranging from 1.5 to 2 feet deep will be created in a reach where few pools currently occur. In the long-term, the added connection of the stream with its floodplain will provide woody debris input to help maintain the channel complexity and available habitat and will provide winter refugial habitat important to coho salmon. The Preferred Alternative will allow usage of the floodplain by aquatic organisms.

California red-legged frog (*Rana aurora draytonii*).

The Preferred Alternative is not likely to adversely affect the California red-legged frog. Removal of the flapgate from the levee road culvert could reduce the duration and depth of inundation of the wetland/floodplain, resulting in long-term moderate adverse impacts to amphibian habitat. The following mitigation measure will be incorporated to reduce impacts to California red-legged frogs to a negligible level.

> Mitigation Measure BIO-7: Seasonal Flapgate Risers: Risers will be installed on the upstream side of the flapgate culvert during the late spring and summer months to maintain wetland/floodplain inundation depths adequate to support the California red-legged frog.

Heavy equipment and construction activities in riparian or creek areas near breeding localities could result in "take" of juvenile or adult California red-legged frogs. Frog use of riparian and creek areas away from breeding localities during the non-breeding season (late spring through fall) is common. The following mitigation measure will reduce any direct, indirect, and cumulative effects on the California red-legged frog to an insignificant or discountable level (U.S. Fish and Wildlife Service, Memorandum to Park Superintendent 1-1-02-I-2345, June 18, 2002). The mitigation measure will also reduce to an insignificant level any impacts to other amphibians (e.g., California giant salamanders and newts) that routinely use riparian areas.

> Mitigation Measure BIO-8. A biological monitor familiar with the identification of the red-legged frog will search work localities for their presence and as well as for slow-moving animals. The search area will encompass a 50-foot radius around the sites. Should any listed frogs be observed, any work activities within 50-feet away would be halted for a day. The Endangered Species Division of the U.S. Fish and Wildlife Service (Sacramento Office) will be immediately notified if any frogs are observed. Any slow moving animals (e.g., newts) will be collected and relocated to similar habitats just outside the project.

Northern Spotted Owl (*Strix occidentalis caurina*).

The preferred alternative is not likely to adversely affect the Northern Spotted Owl. The project sites are greater than a mile from any known Spotted Owl activity centers. The project sites do support potential foraging habitat for Spotted Owls. Impacts to Spotted Owls are expected to be negligible as a result of removal of approximately three woodrat nests at the **Banducci** site (not all woodrat nests are active). Abundant woodrat habitat exists upstream of, and in the uplands adjacent to the **Banducci** project site Only woody debris within the stream channel and dead alder snags adjacent to the stream channel will be removed at **Pacific Way**. Construction will occur during the day and not during the nocturnal foraging period of spotted owls. Therefore, the following mitigation will be incorporated:

> Mitigation Measure BIO-9: Northern Spotted Owl Disturbance and Prey Impacts: Project activities will be conducted outside of the spotted owl breeding season and between dawn and dusk, outside the daily foraging activity period. Removal of woodrat nests will be the minimum necessary to complete the project.

Riparian and Cavity-nesting Songbirds

The Preferred Alternative will result in minor short-term adverse impacts and long-term moderate beneficial impacts to riparian songbird habitat. In the short-term, trees used by songbirds for nesting and foraging will be removed, including 0.68 acres of willows at the **Banducci** site and approximately 24 dead alders at the **Pacific Way** site. In the long-term, riparian habitat will be enhanced at the **Banducci** site, having a moderate beneficial impact on riparian songbirds.

At the **Pacific Way** site, nesting habitat for cavity nesting species will be reduced by the removal or partial removal of standing dead trees along the creek. Cutting will occur outside of nesting season. Numerous dead trees have already fallen at **Pacific Way**, and those being removed would largely be expected to fall within the next few years. A large stand of red alders in various states of decay (live, dead and dying) will remain adjacent to the Pelican Inn, and is expected to continue to provide habitat for cavity nesters in the future, although there will be an overall reduction in dead and dying snags available for nesting.

> Mitigation Measure BIO-10: Riparian and Cavity-nesting Songbirds:
> Tree removal will occur outside of the songbird nesting season, which ends in early August. Willow riparian habitat removed at the **Banducci** site will be replanted with native vegetation. Only dead trees and snags with a high potential to fall directly into the Redwood Creek channel at **Pacific Way** will be removed. Where possible, portions of tree stumps would be left in place to provide some habitat for cavity nesters. PRBO Conservation Science has conducted an assessment and will provide recommendations to minimize impacts of the project. NPS will consider implementing recommendations that are feasible and compatible with the objective to reduce flooding along **Pacific Way**.

Riparian Habitat

At the **Banducci** site, some trees that are rooted above bankfull elevation and are on the berm will be removed for grading (Grade Areas 4 and 5, totaling 0.68 acres). These include a grove of arroyo willows (*Salix lasiolepis*), a bay laurel, one Eucalyptus, and some riparian shrubs, primarily elderberry (*Sambucus racemosa*). Limbs will be removed from two other arroyo willows, one at the downstream end of Grade Area 1 and one at the upstream end of Grade Area 3, however the base of the trunks will remain and the trees will resprout. An arroyo willow at

Grade Area 7 will be limbed to allow access for bank grading, but the base of the trunk will remain and will resprout.

The mature alders adjacent to the edge of the creek at the **Banducci** site will remain. Grading will be conducted in a manner that allows slightly higher elevations where necessary to protect trees at or near the bankfull elevation. Existing tree cover closest to the stream will remain and impacts to riparian trees will be negligible.

Approximately seven acres of riparian habitat will be restored at the **Banducci** site. Graded areas will accommodate future riparian plant growth better than current elevations. Graded areas will be planted with native riparian trees and understory species from stock obtained in the watershed. Substantial cover is expected to be established within five years. There will be a net gain of about seven acres in riparian songbird habitat both from grading the channel banks and from the overbank flow onto the adjacent floodplain at the **Banducci** site.

At the **Pacific Way** site, establishment of a pilot channel through the willow/alder grove downstream of the pedestrian bridge will displace approximately 600 ft^2 of willow and alder shrub and require trimming of approximately 20 mature willow and alder trees. This grove has become established on a sediment deposit that formed in response to flow constraints caused by the NPS parking lot and the levee road.

Monarch Butterfly

The **Pacific Way** project is expected to have a negligible short-term impact on monarch butterflies. Tree removal is of sufficient distance to have negligible effects on the microclimate within the roosting trees. In addition, dust generated by construction activities and heavy equipment traffic will be minimal because **Pacific Way** is a paved road and much of the sediment and debris moved will be wet. The following mitigation measure is incorporated to reduce the impacts to a negligible level:

> Mitigation Measure BIO-11: Monarch Butterflies: Tree removal on the **Pacific Way** site will occur from August 15th to October 1, outside the overwintering period. If excessive dust is generated by construction activities on **Pacific Way** after mid-September, a survey will be conducted to determine if monarchs are present and their proximity to the project site. If deemed necessary, the project work site will be watered to minimize dust generation.

Cumulative Impacts of the Preferred Alternative

PG&E has proposed to trim or remove approximately 11 dead or dying trees approximately one-half mile north of **Pacific Way** on Highway 1. This project will add cumulative effects to the removal of trees along **Pacific Way** and the subsequent reduction in nesting habitat.

Conclusion

The Preferred Alternative would have minor to moderate, short-term adverse effects on Biological Resources. Short-term effects would include impacts to threatened fish and amphibian species, riparian and cavity-nesting songbirds, and riparian vegetation. The Mitigation Measures presented are designed to reduce the potential for adverse effects to listed species, birds, and riparian habitat. Following completion, the project will provide long-term moderate beneficial impacts to threatened species resulting from enhanced in-channel and floodplain habitat and

reduced risk of channel avulsion. In addition, riparian habitat would be moderately enhanced by the project, resulting in increased habitat for riparian songbirds. The Preferred Alternative will not result in impairment of park resources or values related to Biological Resources.

Impacts of the No Action Alternative

The no action alternative would avoid construction impacts to Biological Resources. Because channel excavation nor bank grading would occur, no impact to coho and steelhead populations would result.

However, no action could result in channel avulsion of Redwood Creek resulting in long-term moderate adverse impacts to riparian habitat and species and federally threatened fish species. At the **Pacific Way** site, channel avulsion could result in a change in the creek outlet to the ocean potentially impacting the ability of fish to enter and exit the stream. In addition, the current wetland habitat adjacent to Redwood Creek could be impacted due to a change in hydrologic conditions. Similarly, the sedimentation and flooding occurring at the **Pacific Way** site would continue under the no action alternative and the water quality would diminish, degrading habitat for listed fish species.

At the **Banducci** site, listed fish species would endure moderate long-term adverse impacts from decreasing juvenile salmonid habitat. An increasing lack of in-channel complexity resulting from increased flow velocity would continue to result in poor quality habitat. The unstable bank at the site would continue to deposit sediment into the stream impacting water quality degrading downstream habitat.

Cumulative Impacts of the No Action Alternative

Should other projects to reduce sedimentation in the watershed fail to be implemented, the No Action Alternative could have cumulative impacts to Geologic, Hydrologic, Geomorphic, and Water Quality Resources. The creek would continue to be filled with sediment.

Conclusion

Although, the no action alternative would avoid the potential for incidental take of listed fish species possible under the Preferred Alternative, the no action alternative would result in long term moderate adverse effects to biological resources. Threatened fish species would be impacted by an increasing lack of habitat and from the potential for channel avulsion. Channel avulsion could block fish passage resulting in loss of a key natural resource of the GGNRA. No Action could lead to impairment should the listed fish species be lost.

Cultural/Historic Resources

History

The Redwood Creek watershed was originally with in the territory of native peoples referred to as the Coast Miwok. The indigenous archeological site CA-MRN-333 on the edge of Big Lagoon is listed on the National Register of Historic Places as the Muir Beach Archeological Site and confirms that the Coast Miwok lived in this area. The Coast Miwok may have set periodic fires within the wooded watershed to promote prairie grasslands. At the time Europeans arrived in the Bay area, fifteen independent Coast Miwok Tribes lived in Marin and southern Sonoma Counties. At that time the Redwood Creek watershed was within the territory of the Coast Miwok Tribe referred to as the Huimen.

European modifications to Redwood Creek began in 1817 when Spanish settlers introduced grazing and agriculture to Marin County. In 1838, the Mexican governor granted William Richardson Rancho Sausalito. The Rancho boundaries extended from the southern tip of Marin County to Mt. Tamalpais, and included both the **Banducci** site and **Pacific Way** site. The area was heavily grazed and farmed by the Spanish, and later by Portuguese dairy farmers. In 1870, the road that is now Highway 1 was built, and tourism followed with construction of a railroad, inns and a sporting club. The compounded effect of road building, timber harvesting, loss of natural vegetation cover due to grazing, and construction altered natural state of the creek.

In the early 1900's, a small house and structures were constructed adjacent to Redwood Creek, and levees were constructed to reduce flooding. By the 1920's, an inn and series of small cottages were operating at Muir Beach, and a 150-foot pedestrian bridge crossed the tidal lagoon to the beach. During this time, grazing continued, recreational use increased and home building began to occur in the community of Muir Beach. It was also at this time that Amadeo Banducci Sr. rented land along the creek for a flower farm. Banducci purchased the land in 1948 and leveled the fields, filled in tributary channels, and constructed soil dikes on the field edges along the creek to protect the fields. The Banducci's sold their property to NPS in 1980, but continued leasing and farming at the site until 1995.

In 1945, George Wheelwright purchased the Green Gulch Farm including Muir Beach where he created pasture out of marsh by constructing drainage channels, levees, and a dam and excavating a large channel along Redwood Creek. In 1967, Wheelwright donated the Muir Beach area to the State Park System, which built a parking lot in the current location at the beach. In 1981, the NPS elevated the existing parking lot. Today, most of the Redwood Creek watershed is under the jurisdiction of the GGNRA, the California Department of Parks and Recreation, and the Marin Municipal Water District.

Existing Conditions

GGNRA Cultural Resource staff, in compliance with Section 110 of the Historic Preservation Act of 1966 have conducted List of Classified Structures surveys for historic properties in the project areas. The Lower Redwood Creek area (**Banducci** and **Pacific Way** sites) has not been surveyed to inventory and evaluate archaeological resources.

No evidence of historic resources has been reported at **Pacific Way**. Except for nearby CA-MRN-333, the **Pacific Way** site does not appear to contain any soils, landscapes, objects, buildings, structures, sites, areas, places, records or other significant historic resources. The site is not known to contain any resources that meet the criteria for listing on the California or National Register of Historic Places or on a local or applicable regional historic register.

Cultural Resource staff found the upper hillsides of the Banducci Flower Farm (where heather was historically grown) to have cultural and historic value. Furthermore, Amadeo Banducci has reported that his brother found obsidian artifacts along the lower hillside near the fields. However, the area of proposed restoration - the leveled fields along the creek and its banks - are not currently known to contain soils, landscapes, objects, buildings, structures, sites, areas, places, records or other significant historic resources.

A 1994 report by Historian Dewey Livingston, entitled *A Short History of Ranch S (Rancho Sausalito), Banducci Wholesale Florists, Muir Beach, California* states "the Banducci flower farm may have local historic significance in the categories of agriculture and commerce. As a resource, the property is interesting as a cultural landscape; no buildings have historical significance in themselves and none will be listed in the park List of Classified Structures."

A 1998 report by environmental scientist John Culp, entitled *Banducci Flower Farm... Inventory of Cultural Landscape Elements*, concludes that, "as the only historic commercial flower farm in the coastal Marin area, one which has been operated the same Italian immigrant family for two generations, it is recommended that further study of the Banducci property in the form of a Cultural Landscape Report be completed. Also, documentation should be submitted to the State Historic Preservation Office for either a formal nomination, or a Determination of Eligibility for the National Register of Historic Places as a rural historic landscape."

Thus the existing conditions reflect the Coast Miwok, Banducci, and Wheelright associations with the land. However, it must be emphasized that, for the purposes of this Environmental Assessment, the area of proposed restoration—the leveled fields along the creek and its banks—are not currently known to contain soils, landscapes, objects, buildings, structures, sites or other resources that are known to be historically significant or that would contribute to any such proposed historic landscape district.

Archaeological Resources

There are no known archaeological resources at the **Pacific Way** site. An indigenous archaeological site, the National Register Property (CA-MRN-333) is on the edge of Big Lagoon, but is not in the proximity of either project site and therefore it will not be disturbed. The soils proposed for excavation at **Pacific Way** were determined to be recent sediment deposits and therefore are not likely to contain any archaeological resources.

Although there are no recorded archaeological resources at the **Banducci** site, there is the anecdotal reporting of one site on the west edge of the fields and of a site in the creek south of the **Banducci** site. Also, there is the possibility that this area may contain older soils. A geo-technical assessment of the project began on July 1, 2002 with monitoring from the Coast Miwok (Federated Indians of Graton Rancheria). One buried soil sample is currently being clarified in consultation with a geo-archaeologist at Sonoma State University. A surface archaeological survey monitored by the Coast Miwok (Federated Indians of Graton Rancheria) is complete and resulted in no indigenous sites.

Impacts of Preferred Alternative

The park has assessed the potential effects of the Preferred Alternative on **Pacific Way** and the **Banducci** site under the park's Programmatic Agreement with the California State Office of Historic Preservation. Under this alternative, there would be no impacts to historic resources at **Pacific Way** or the **Banducci** sites since there is no evidence of significant historic resources.

The area of proposed restoration at the **Banducci** site, the creek and its banks, are not currently known to contain soils, landscapes, objects, buildings, structures, sites or other significant historic resources. However, the hillside of the Banducci Flower Farm does have value as a cultural landscape. Construction crews will be strictly confined to the defined project area along the creek

and its banks, and restricted from access to the cultural hillside so that any impacts would negligible and short-term.

GGNRA Cultural Resources staff, under PA with SHPO and ACHP certified that the proposed actions would have no effect on archaeological properties at **Pacific Way** or the **Banducci** site. Intermittent monitoring of the excavation by park archaeologists will ensure no resources are impacted.

Thus far, there are no recorded archaeological resources on the **Banducci** site. The potential does exist however, that some may be discovered during the restoration actions. Monitoring of the **Banducci** site will occur during construction by park archaeologists in consultation with a geo-archaeologist at Sonoma State University in order to complete the dating of buried soils for the geo-archaeological survey. At the start of project implementation, the contractor will dig four trenches for the geo-archaeologist from Sonoma State University to document floodplain stratigraphy. Work in this area will be completed with a monitor from the Federated Indians of Graton Rancheria present.

If buried archaeological resources are discovered during construction, the disturbance would constitute an adverse impact. Therefore, the following mitigation measure is included to address the possibility of discovering archaeological resources during construction. With mitigation the Preferred Alternative is expected to have negligible impacts on archaeological resources.

> Mitigation measure CUL-1 Archaeological Resources: If buried archaeological resources are discovered during construction, work at the discovery site will be stopped. A GGNRA archaeologist and a Coast Miwok representative will visit the site to record the discovery. The project will also be redesigned to avoid impacts.

Cumulative Impacts of Preferred Alternative

The Preferred Alternative will not cumulatively impact historic or archaeological resources within the Redwood Creek watershed.

Conclusion

The preferred alternative would have negligible impacts to historic and archaeological resources. Components of the proposed project(s) have been reviewed and certified for compliance with the NHPA through the GGNRA PA. A copy of the GGNRA Preservation Assessment Forms (5X), signed by the Assistant Park Superintendent for Operations can be found in the Consultation and Coordination Section. After applying the criteria of adverse effects of the Advisory Council on Historic Preservation (36 CFR 800.5, *Assessment of Adverse Effects*), the NPS concludes that implementation of the Preferred Alternative would not impair park resources or values related to historic or archaeological resources.

Impacts of the No Action Alternative

Under the no action alternative, no construction activities would take place along Redwood Creek or reduce flooding at **Pacific Way**. With implementation of this alternative, there would be no impacts to historic or archaeological resources.

Cumulative Impacts of the No Action Alternative

The No Action Alternative will not cumulatively impacts historic or archaeological resources within the Redwood Creek watershed.

Conclusion

After applying the criteria of adverse effects of the Advisory Council on Historic Preservation (36 CFR 800.5, *Assessment of Adverse Effects*), the NPS concludes that implementation of the no action alternative would have no adverse effect on historic resources. The no action alternative would not impair park resources or values related to cultural resources.

Air Quality

Existing Conditions

The impacts of air pollution on health and other aspects of the quality of life are considered harmful by regulatory agencies such as the U.S. Environmental Protection Agency (U.S. EPA). A number of federal, state, and local regulations and programs exist to protect and improve air quality in the Bay Area.

The Bay Area has been designated as being in attainment (meeting standards) or unclassified (i.e., available data do not support a designation of non-attainment or attainment) with respect to the federal standards for all air pollutants, except ozone. In June 1998, the U.S. EPA re-designated the Bay Area as a non-attainment area for ozone, because the area had 11 violations in 1995 and six violations in 1996. The Bay Area Air Quality Management District, the local agency with responsibility for controlling air pollution and attaining the ambient air quality standards in the Bay Area, developed an Ozone Attainment Plan, which was adopted in June 1999 (BAAQMD et al. 1999). The U.S. EPA has indicated that the 1999 Ozone Attainment Plan is inadequate. As a result, the Metropolitan Transportation Commission (MTC), the Association of Bay Area Governments, and the Air District have prepared a revised Ozone Attainment Plan, which was completed in September 2001 (BAAQMD et al., 2001). The revised 2001 Plan addresses the deficiencies noted by U.S. EPA in the 1999 Plan, and includes a new emissions inventory and commitments to adopt and implement additional control measures to attain the ozone standard by 2006. The Revised Plan has been submitted to the California Air Resources Board for approval and subsequent transmittal to U.S. EPA. Upon receiving U.S. EPA approval, it will be incorporated into California's State Implementation Plan.

The San Francisco Bay Area has been classified by the California Air Resources Board as a state non-attainment area for ozone. The Bay Area also does not meet state PM_{10} ambient air quality standards, but attainment programs for PM_{10} are not yet required. Appendix E includes a more detailed description of existing conditions for Air Quality.

Impacts of Preferred Alternative

The Preferred Alternative would generate some emissions of air pollutants during the construction from construction vehicles and equipment. The Bay Area Air Quality Management District is the agency with jurisdiction over air quality matters in the San Francisco Bay Area. The *BAAQMD CEQA Guidelines* (BAAQMD, 1996) state that particulate matter (PM_{10}) is the pollutant of primary concern for construction emissions. The *Guidelines* state further that the BAAQMD evaluates the significance/insignificance of air pollutant emissions from construction

projects according to the mitigation measures that would be employed to reduce PM_{10} emissions, rather than on the basis of specific emission threshold quantities.

Most of the control measures listed in the *Guidelines* are designed to control dust due to grading and earthmoving activities. The remaining measures that would be applicable to the Preferred Alternative include covering haul tracks, water-sweeping the site, and proper equipment maintenance throughout the construction period. A qualitative examination was undertaken of construction activities that would generate air pollutant emissions. For each project activity, the specific emission sources and types of pollutants emissions were identified, and corresponding mitigation measures to minimize the associated air quality impacts were discussed.

Construction-related emissions are generally temporary, transient and intermittent, but may cause short-term adverse air quality impacts in some cases. General construction emissions are included in the emissions inventory for the BAAQMD that is the basis for regional air quality plans. Therefore, such emissions are not expected to impede progress toward attainment or maintenance of the ozone and CO standards, respectively. PM_{10} emissions due to the Preferred Alternative would result from removal and transport of debris and from operation of diesel and gasoline-fired equipment and vehicles.

Table 2 lists the specific activities of the Preferred Alternative that would result in air emissions and provides general information on the nature of these emissions.

Table 2
Expected Air Pollutant Emissions from the Preferred Alternative

Activity	Specific Operations	Specific Emission Sources and Pollutants
***Banducci** Site*		
Removal of levee and accumulated creek bank	A 4-foot high levee will be removed and portions of the manually built-up creek bank at seven locations along 1,800 linear feet of the channel, removing a total of 3,827 cubic yards of material. Material will be placed and graded within the **Banducci** project site.	Excavators and haul trucks. Pollutants from operation of diesel equipment would include NO_X, SO_2, CO, ROG, PM_{10}.
Installation of log jams	18 individual Engineered Log Jams will be installed using an excavator at seven general locations in 1,300 linear feet of the creek channel.	Pollutants from excavator operation of diesel equipment would include NO_X, SO_2, CO, ROG, PM_{10}.
Grading of channel banks	Grading channel banks with an excavator on the west side of the creek at five locations, extending from bankfull elevation at a gradual slope to meet the existing elevations will expand the riparian corridor.	Excavator. Pollutants from operation of diesel equipment would include NO_X, SO_2, CO, ROG, PM_{10}.
***Pacific Way** Site*		
Removal of dead trees	23 trees will be cut down with a chainsaw. The trees will be cut up using a chainsaw and hauled off site.	Chainsaw. Pollutants from operation of gasoline equipment would include NO_X, SO_2, CO, ROG, PM_{10}.
Installation of armored dips in the levee road	Two armored dips will be installed using an excavator and a dump truck.	Excavator and dump truck. Pollutants from operation of diesel equipment would include NO_X, SO_2, CO, ROG, PM_{10}.

Excavation	Excavation of two high points upstream of the **Pacific Way** bridge and in the reach between the **Pacific Way** bridge and the NPS parking lot. Excavation of a channel through a willow/alder grove downstream of the NPS parking lot and pedestrian bridge. Excavated material will be hauled to the **Banducci** project site and will be stockpiled or regraded on site.	Excavator, front-end loader, and haul truck. Pollutants from operation of diesel equipment would include NO_X, SO_2, CO, ROG, PM_{10}.
Installation of trench or culvert	A 50-foot long, 1-foot wide trench will be excavated using hand tools and mobile equipment.	Gasoline powered "Ditch Witch" would include NO_X, SO_2, CO, ROG, PM_{10}.
Removal of woody debris	Woody debris will be removed from the channel between **Pacific Way** and the NPS parking lot using chainsaws and an excavator.	Chainsaw and front-end loader and excavator. Pollutants from operation of diesel equipment would include NO_X, SO_2, CO, ROG, PM_{10}.

Source: NPS Project Description provided list of specific operations

Notes:

NO_X = oxides of nitrogen
SO_2 = sulfur dioxide
CO = carbon monoxide
ROG = reactive organic gases
PM_{10} = particulate matter with diameter less than or equal to 10 microns

Conformity with State Implementation Plans

The Clean Air Act Amendments of 1990 require federal agencies to ensure that actions are consistent with the Clean Air Act and with federally enforceable air quality management plans, including State Implementation Plans. The conformity assessment is intended to ensure that federal agency actions occurring within nonattainment or maintenance areas: (1) will not cause or contribute to new violations of the National Ambient Air Quality Standards; (2) will not increase the frequency or severity of any existing violations of ambient air quality standards; and (3) will not delay the timely attainment of ambient air quality standards.

Pursuant to 40 CFR 51.853 and 40 CFR 93.153, no conformity determination is required for projects with emissions that do not exceed the following levels: 50 tons per year (tpy) for ROG, 100 tpy for NO_X and 100 tpy for CO. The Preferred Alternative would not be expected to exceed these levels, and would therefore not trigger the requirement for a conformity determination. The Preferred Alternative, which would produce only temporary construction emissions, would not result in new violations, contribute substantially to future violations, nor interfere with the future maintenance of the ambient air quality standards.

Cumulative Impacts of Preferred Alternative

The Preferred Alternative would generate small quantities of construction-related emissions over a limited time period. The NPS would implement the BAAQMD's feasible control measures for PM_{10} and dust emissions. As a result, the Preferred Alternative would contribute to a minor, short-term adverse cumulative effect on air quality. Also per the *BAAQMD CEQA Guidelines* (BAAQMD, 1996), a cumulative air quality impact could also occur if a project would contribute to impacts at nearby sensitive receptors due to odorous, toxic, or hazardous emissions. The Preferred Alternative will result in negligible sources of such emissions, and would therefore not contribute to long-term, adverse cumulative effects to sensitive receptors.

Conclusion

The Preferred Alternative would have minor, short-term adverse effects on air quality from construction equipment and truck emissions, and would contribute to minor, short-term adverse cumulative effects on air quality. Mitigation would reduce the severity of these impacts, and there would be no impairment of park resources or values related to air quality. The Preferred Alternative would not impair park resources or values related to air quality.

> Mitigation Measure AIR-1: Air Quality: Cover trucks hauling soil, sand and other loose materials, *or* require haul trucks to maintain at least two feet of freeboard.
>
> Mitigation Measure AIR-2: Air Quality: Sweep paved surfaces at the project construction site daily with water sweepers; this mitigation would be required during dust-creating operations and in locations/routes where dust would be generated as a result of project construction. Surface debris shall not be swept into the creek.
>
> Mitigation Measure AIR-3: Air Quality: Trucks hauling or moving soil shall not idle for more than five minutes.

Impacts of the No Action Alternative

Under the no-action alternative, none of the proposed construction and repair activities would be conducted, and current air quality would not change.

Cumulative Impacts on the No Action Alternative

The no-action alternative would have a negligible, cumulative long-term, beneficial effect on air quality.

Conclusion

The no-action alternative would have a negligible, long-term, beneficial effect on air quality. This alternative would not result in impairment to park resources or values.

Noise

Existing Conditions

Noise-sensitive land uses in the vicinity of the project site include residences along **Pacific Way** and access Lagoon Drive. In addition, the Pelican Inn, a bed and breakfast that provides a quiet setting for vacationers, is located at the corner of **Pacific Way** and Highway One. Three residences occur within 50 feet of the work area. Residences occur along the Highway One haul route. Ambient noise levels in the residential neighborhoods near Redwood Creek are generally low. Primary noise sources in the project area include traffic from the roadways. Appendix E includes a more detailed description of existing conditions for Noise.

Impacts of the Preferred Alternative

Under the Preferred Alternative, the following construction activities will take place at the **Banducci** Site: installation of 18 engineered log jams at seven general locations, the grading of channel banks, and the removal of a levee and accumulated creek bank. The following activities will take place at the **Pacific Way** Site: removal of 24 trees, installation of two armored dips in the levee road, excavation of two high points and a channel, installation of a trench, and removal of woody debris. Excavated dirt will be hauled to the **Banducci** site from the **Pacific Way** site.

Woody debris from the **Pacific Way** site will be hauled and taken to a landfill or used in another park project.

Sounds from construction activities typically consist of noise emanating from equipment such as excavators and trucks. According to U.S. EPA studies of equipment types and activities, construction noise would range from approximately 70 dBA to 95 dBA at 50 feet from its source (U.S. EPA, 1971). Typical construction noise decreases 6 decibels with each doubling of distance from the noise source to the receptor. Typical construction equipment noise generation levels are shown in Appendix E.

The majority of construction will occur from August 15th to October 1. At the **Banducci** site, some upland work may occur until November 15th. Construction-related noise would occur sporadically during the construction period when general construction would raise ambient noise levels for several hours at a time, and periods when there would be relatively no construction noise emanating from the site. The high range of sound levels due to construction noise would substantially exceed the EPA's recommended guideline of 55 dBA outdoors. Therefore, construction noise would have a minor to moderate short-term adverse impact to one business, nearly residences, and wildlife.

Cumulative Impacts of the Preferred Alternative

PG&E tree trimming could add noise to the construction activities occurring at the **Pacific Way** site. The impacts would be short-term and minor because of the distance from the project site (approximately one-half mile north) and the short term nature of tree trimming and removal work.

Conclusion

The Preferred Alternative would have a minor to moderate short-term adverse effect on noise levels. With implementation of mitigation measures, the severity of these adverse effects would be reduced and there would be no impairment of park resources or values related to noise.

> Mitigation Measure NOI-1: Noise: Select equipment capable of performing the necessary tasks with the lowest sound level and the lowest acoustic height possible.
>
> Mitigation Measure NOI-2: Noise: Operate and maintain construction equipment to minimize noise generation. Equipment and vehicles will be kept in good repair and fitted with "manufacturer-recommended" mufflers.
>
> Mitigation Measure NOI-3: Noise: Construction activities will be limited to 7:00am to 7:00pm.

Impacts of No Action Alternative

Under this alternative, no construction would take place at the site and no changes in the local noise environment would occur.

Cumulative Impacts of the No Action Alternative

The no-action alternative would not contribute a cumulative effect on the existing noise environment in the Redwood Creek watershed.

Conclusion

The no-action alternative would have no direct, indirect, or cumulative impacts related to increased noise levels and not result in impairment to park resources.

Resident and Visitor Use

Existing Conditions

More than a million people visit the Redwood Creek watershed each year to hike the extensive trail system and enjoy its natural beauty and cultural resources. Muir Beach is a popular location, attracting approximately 440,000 people per year. High bluffs border the beach to the north and south and wetlands and a lagoon can be found behind the beach. The area offers hiking/walking trails, bicycle trails, beachcombing, horseback riding, and picnicking. Users of Muir Beach include local residents and visitors from the Bay Area, United States, and the world. Overall peak recreational use of the Muir Beach area is during the summer and fall months, although the area is utilized year-round, and warm, sunny winter and spring days can bring out visitors at levels comparable to summer.

Vehicle access to Muir Beach is via Pacific Way and under current conditions, the roadway is flooded in even moderate rain events. High water on the road prevents passage to and from the beach for visitors and residents who live on Pacific Way.

The entrance to the Banducci's home is via a gravel driveway to the north of Highway 1. The access road travels north along the base of the hillside, and provides access for the Banducci family and Alcala family.

Access

Under current conditions, the creek floods in even moderate rain events. The high magnitude of water on the road prevents passage to and from the beach. Some residents of Muir Beach rely on Pacific Way for access to their homes.

Beach/Water-Related Recreation

Most visitors come to Muir Beach to enjoy the ocean views and relax and socialize on the beach. Swimming and wading is not permitted in the lagoon in order to protect wildlife habitat. The lagoon and beach are excellent locations to observe nature and enjoy peaceful solitude. Picnicking is another popular activity at Muir Beach, and there is a developed picnic area at the south end of the parking lot.

Pedestrian Uses

Many visitors are involved in pedestrian-oriented activities. Hiking is a popular activity around Muir Beach and its surrounding areas. There are more than 50 miles of hiking trails in the watershed, some of which have been used by hikers for more than 100 years. Visitors can access Muir Beach on many trails from Mount Tamalpais State Park and other locations in the GGNRA such as Muir Woods NM, the Marin Headlands and Tennessee Valley.

Bicycling and Horseback Riding

There are no classified bike routes on roads in the watershed, however, there are several trails in the project area that permit both bicycles and horseback riding. The Redwood Creek Trail, which

passes the **Banducci** site and terminates at **Pacific Way**, allows for both of these activities. The Miwok trail and Redwood Creek Trail provide equestrian users an important route to areas north and south of the watershed.

Special Events

Occasionally, the NPS permits special events at Muir Beach, such as Solstice celebrations, Earth Day activities, and beach clean-ups.

Impacts of the Preferred Alternative

The proposed action will result in short-term minor adverse impacts to resident and visitor use and long-term moderate beneficial impacts from the reduction of flooding on **Pacific Way**. The preferred alternative would include construction activities along Pacific Way, Lagoon Drive, and the levee road, as well as hauling on Highway One. Project implementation will require construction vehicles to work along **Pacific Way**, the levee road, and the trail to the beach. Two to four dump trucks, one to two excavators, and one to two front-end loaders may be on **Pacific Way** at any time during construction.

During the project, **Pacific Way** will remain open to the greatest extent possible, but residents and visitors may experience traffic delays on the road from 7:00 AM to 7:00 PM. Work at the **Pacific Way** site is expected to take three to six weeks to complete, beginning mid August. The proposed actions will increase traffic on **Pacific Way** as a result of a possible cue of cars waiting to pass construction equipment. The project may affect traffic on Highway 1 if backup from **Pacific Way** is experienced. Traffic delays will affect resident access, beach/water-related recreation, pedestrian uses, bicycling and horseback riding, special events and other uses on the beach that may occur during the project. With mitigation, these delays will result in short-term minor impacts on access to private homes and the public beach.

During construction, access on the seasonal trail from the Muir Beach parking lot to the beach will be prohibited. Access will be provided via the year-round trail over the pedestrian bridge.

The NPS will work in close coordination with Marin County Public Works to ensure traffic on **Pacific Way** flows as efficiently as possible. With the implementation of the below mitigations, the temporary inconveniences caused by construction are reduced to minor impacts.

> Mitigation Measure REC-1: When it is necessary to have construction crews or equipment on Pacific Way, there will be a flagperson directing traffic, and the delay will be minimized as much as possible.
>
> Mitigation Measure REC-2: Appropriate advanced signage along Pacific Way will be provided in both directions informing the public of possible delay.
>
> Mitigation Measure REC-3: Construction crews will terminate work each day by 7:00 PM thereby allowing unrestricted access along Pacific Way during evening hours.

For stockpiling of excavated sediment from the **Pacific Way** site, trucks will travel to the **Banducci** site via the dirt and gravel access road at the Highway One bridge access road. To avoid passing residences, trucks will turn off the access road approximately 500 feet from the entrance, at the first location where the lower field can be reached from the road. A path through upland areas of the field will be mowed in advance to define the truck route and trucks will drive into the open field to a staging area where sediment will be stored. An estimated 150 to 200 truck

trips will be needed to haul the excavated sediment. The NPS will work in close coordination with the contractor to ensure traffic on the access road and onto Highway One flows as efficiently as possible. With the implementation of the below mitigation measures, impacts from access to the **Banducci** site are expected to be short-term and minor.

> Mitigation Measure REC-4: At the **Banducci** site, a Caltrans escort will assist the contractor with the transportation of large equipment safely down Highway 1.
> Mitigation Measure REC-5: A flagperson will be provided to assist residents with ingress/egress from Highway 1 to the access road.

Cumulative Impacts of the Preferred Alternative

PG&E tree trimming and removal activities will add one to two trucks. However, field crews using hand equipment, not requiring large vehicles will complete their work.

Conclusion

The preferred alternative will have short-term minor adverse impacts on visitor and resident access to Muir Beach by contributing to traffic congestion. With the implementation of the mitigation measures, the intensity of these adverse effects will be reduced to a minor level. In addition, the overall effect of the project is beneficial and will improve resident/visitor access and recreation opportunities. Implementation of the Preferred Alternative would not impair park visitors or residents.

Impacts of the No Action Alternative

Under the no action alternative, no construction activities would take place restore Redwood Creek or reduce flooding at **Pacific Way**. Flooding would continue to impact access for residents and visitors. However, residents and visitors would not be subject to the adverse short term construction impacts.

Cumulative Impacts of the No Action Alternative

The no-action alternative would not contribute a cumulative effect on the resident and visitor access in the Redwood Creek watershed.

Conclusion

The no action alternative would have minor to moderate adverse impacts to resident and visitor use. The lack of access caused by the frequent flooding would continue to be a minor to moderate adverse impact. An argument could be made that no action could result in impairment to park visitors or residents should emergency vehicle access be prevented by flooding of Pacific Way during an emergency situation.

4.0 Consultation and Coordination

Federal Laws, Regulations and Policies

Federal Endangered Species Act

Pursuant to the federal Endangered Species Act (ESA), USFWS and NMFS have authority over projects that may affect the continued existence of a federally listed species. If a federal action may result in the "take" of a federally listed species, a federal consultation under Section 7 of ESA is required. Under ESA, the definition of take includes kill, harm, or harass. USFWS has interpreted the definition of harm to include significant habitat modification.

Take of a federally listed species may be approved through a Section 7 consultation between USFWS and another federal agency, if the proposed project is sponsored by or under another federal agency's jurisdiction. Because this is a federal project with a federal lead agency, the NPS, Section 7 consultation would be applicable. If the proposed project would result in take of a federally listed species, the NPS would be required to initiate consultation with USFWS (and/or NMFS) and to provide them available information regarding the potential affect of the proposed project on a listed species. This procedure requires the NPS prepare a biological assessment of the affect of the permit action on the listed species or critical habitat. The biological assessment, if required, for listed species or those with critical habitat within the project area will be attached to the Finding Of No Significant Impact (FONSI) as an appended item.

NPS, as the lead federal agency, will determine if the project would result in "no effect" to listed threatened or endangered species or critical habitat, "not likely to adversely affect", or if the project "may affect" these species. The NMFS and/or USFWS would either concur or disagree with the lead federal agency's determination. Initiation of formal or informal consultation or cessation of discussion on the issues would depend upon the lead agency's determination and concurrence/disagreement by NMFS or USFWS. If formal consultation is required, USFWS (and/or NMFS) will issue a biological opinion stating whether the permit action is likely to jeopardize the continued existence of the listed species. If the federal lead agency does not concur with the findings in the Biological Opinion, it may request further discussion to resolve the issues. If this project would impact a federally listed species, consultation under Section 7 of the ESA would be required.

Consultation with the National Marine Fisheries Service (NMFS)

The NPS, as the lead federal agency, has determined the project may affect listed fish species and has initiated formal consultation with the NMFS. The formal Section 7 evaluation addresses: steelhead (*Oncorhynchus mykiss*), coho Salmon (*O. kisutch*) and their designated critical habitat. For the **Banducci** site, NPS requested formal consultation on April 30, 2002, and submitted two reports prepared by Philip Williams and Associates (PWA): The Feasibility of Restoring Floodplain and Riparian Ecosystem Processes on the **Banducci** Site (October 2000); and the Preliminary Design Report, Lower Redwood Creek Restoration (April 2002). A Biological Assessment was submitted for the **Banducci** site on June 5, 2002. Appendix D contains consultation letters.

For the **Pacific Way** site, NPS requested formal consultation on May 23, 2002 (letter to Mr. Dick Butler) and included a Biological Assessment with the letter. NMFS staff visited both the **Banducci** site and **Pacific Way** site on June 14, 2002. NMFS staff have indicated that the

Biological Opinion (BO) will address both the **Pacific Way** and **Banducci** sites and that restoration at **Banducci** is a mitigating element for the work at **Pacific Way**. The NPS expects to receive the BO in late July or early August. Appendix D contains coordination letters with the NMFS, and the BO will be attached to the Finding of No Significant Impact (FONSI).

Consultation with the U.S. Fish and Wildlife Service (USFWS)

On January 24, 2002, NPS staff met with Mr. Chris Nagano from the USFWS to discuss habitat near **Pacific Way**. On February 7, 2002, the NPS received concurrence from the USFWS that proposed activities to protect the creek and reduce flooding would not likely adversely affect the California red-legged frog or adversely modify or destroy critical habitat (Memorandum 1-1-02-1-0814 from U.S. Fish and Wildlife Service, Sacramento Office to Park Superintendent, GGNRA). Informal consultation was reinitiated because of changes in the proposed project. On June 14, 2002, the NPS sent a memorandum to Chris Nagano, Endangered Species Division, U.S. Fish and Wildlife Service to request concurrence on *not likely to adversely affect determination* for the threatened California red-legged frog resulting from flood control activities proposed in this EA. The USFWS concurred with this determination (USFWS, Memorandum to Park Superintendent 1-1-02-I-2345, June 18, 2002). Appendix D contains coordination letters with the USFWS.

Migratory Bird Treaty Act

The Migratory Bird Treaty Act (MBTA), first enacted in 1918, implements domestically a series of treaties between the United States and Great Britain (on behalf of Canada), Mexico, Japan, and the former U.S.S.R., which provide for international migratory bird protection and authorize the Secretary of the Interior to regulate the taking of migratory birds. MBTA provides that it shall be unlawful, except as permitted by regulations, "at any time, by any means, or in any manner, to pursue, take, or kill any migratory bird, or any part, nest or egg of any such bird, included in the terms of conventions" with certain other countries (16 U.S.C. 703). This includes direct and indirect acts, although harassment and habitat modification are not included unless they result in direct loss of birds, nests, or eggs. The current list of species protected by MBTA can be found in Title 50, Code of Federal Regulations §10.13. This statute does not cover loss of non-native species, such as house sparrows, European starlings, and rock doves,, whereas impacts to most other native non-game bird species are covered. This federal code offers no statutory or regulatory mechanism for obtaining an incidental take permit for the loss of non-game, migratory birds.

Point Reyes Bird Observatory (PRBO)

On July 12, 2002 the NPS met with Jill Harley, Terrestrial Biologist of Point Reyes Bird Observatory (PRBO) to assess the potential impacts of the project to cavity nesting birds along Redwood Creek. The proposed project is expected to result in the loss of approximately 29 cavities. Known breeding cavity nesters in the proposed project area, based on three years of nest monitoring by PRBO, include the Downy woodpecker, Hairy Woodpecker, Chestnut-backed Chickadee, Red-shafted flicker, Ash-throated Flycatcher, Pygmy Nuthatch, and the European Starling. PRBO indicated that the loss of cavities reduces the number of cavity nesting sites and may possibly create a negative impact on the cavity nesting birds. However, three of the above species are primary cavity nesters, which excavate new cavities for nests and could utilize remaining trees. During the site visit, PRBO indicated that the area upstream of the Pacific Way bridge contained other standing trees in which cavity nesters could nest. PRBO also indicated that the area of proposed tree removal downstream of the bridge did not appear to be optimal habitat for cavity nesters.

The PRBO is preparing a report for the NPS to document the loss of habitat for cavity nesting birds and to assess the number and abundance of species that may be impacted. Information for the report will be taken from bird territory maps and point count data from previous surveys along Redwood Creek. Appendix D contains correspondence from PRBO. It is expected that migratory birds and cavity nesters will not be adversely impacted by the construction and will benefit from increased riparian area at the **Banducci** site.

Coastal Zone Management Act

On the California Coast, except for the San Francisco Bay, the California Coastal Commission is the State Agency responsible for implementing the Coastal Zone Management Act (CZMA). Federal and federally authorized activities are assessed by the Commission to determine their consistency with the approved state coastal management program. The rules for implementing the CZMA are established in federal regulations at 15 CFR Part 930. The California Coastal Management Program (CCMP) was developed by the Commission pursuant to the requirements of the CZMA. The California Coastal Act of 1976, as amended, is the key policy component of the CCMP. The CCMP was approved by the National Oceanic and Atmospheric Administration (NOAA) in November of 1977. The Commission began conducting consistency reviews in November 1978. A federal agency may decide that a consistency determination is not required if it determines that there would be no effects upon coastal uses or resources.

California Coastal Commission

The NPS is submitting with this EA a request for concurrence that this project is consistent with the Coastal Zone Management Act. Discussions with Coastal Commission staff indicate that the project is consistent with the California Coastal Management Plan. A Consistency Determination will be attached to the FONSI.

Clean Water Act

Section 404 of the Clean Water Act (CWA) establishes a requirement to obtain authorization or a permit prior to any activity that involves any discharge of dredged or fill material into "Waters of the United States," including wetlands. Waters of the United States include navigable waters of the United States, interstate waters, all other waters where the use or degradation or destruction of the waters could affect interstate or foreign commerce, tributaries to any of these waters, and wetlands that meet any of these criteria or that are adjacent to any of these waters or their tributaries. Pursuant to Section 404 of the CWA, the United States Army Corps of Engineers (USACE) regulates and issues authorization or permits for such activities. Nearly all surface waters and wetlands in California meet the criteria for waters of the United States, including tidal waters and non-tidal waters. Activities that require authorization or a permit under Section 404 include placing fill or riprap, grading, mechanized land clearing, dredging, excavation and leveling. Any activity that results in the deposit of dredge or fill material within the "Ordinary High Water Mark" of waters of the United States usually requires a permit, even if the area is dry at the time the activity takes place.

Rivers and Harbors Act

Under Section 10 of the Rivers and Harbors Act of 1899, the construction of structures in, over, or under, excavation of material from, or deposition of material into "navigable waters" are regulated by USACE. Navigable waters of the United States are defined as those waters subject to the ebb and flow of the tide shoreward to the mean high water mark or those that are currently used, have been used on the past, or may be susceptible to use to transport interstate or foreign

commerce. A Letter of Permission or permit is required from USACE prior to any work being completed within a navigable water.

United States Army Corps of Engineers

NPS policies require protection of water quality consistent with the Clean Water Act, Section 404 of this act authorizes the US Army Corps of Engineers to prohibit or regulate, through a permit process, discharge of dredged or fill material into U.S. waters, including wetlands. Temporary structures, work and discharges, including cofferdams, necessary for construction activities or access fills or dewatering of construction sites require a Nationwide Permit No. 33. Appropriate measures must be taken to maintain near normal downstream flows and to minimize flooding. Fill must be of materials, and placed in a manner, that will not be eroded by expected high flows. The use of dredged material may be allowed if it is determined by the District Engineer that it will not cause more than minimal adverse effects on aquatic resources.

On July 10, 2002, the NPS sent a letter to the USACE requesting the issuance of Section 404 Nationwide Permits 27 and 33 for the activities at the **Banducci** Site (Appendix D). A Section 404 permit is required since project area includes jurisdictional waters of the U.S. in Redwood Creek. The Preferred alternative is expected to qualify for Nationwide permits 27 and 33 pursuant to Section 404 of the Clean Water Act (33 U.S.C. 1344) and Section 10 of the U.S. Rivers and Harbors Act (33 U.S.C. 406) and the District of the Engineer of the U.S. Army Corps of Engineers. The required permits will be obtained prior to construction.

The Preferred Alternative would qualify for a Nationwide Permit 27: Stream and Wetland Restoration Activities Permit because the project:

- Restores riffle and pool stream structure
- Will place structures in-stream for habitat benefit
- Involves stream bank modification to expand riparian habitat
- Involves berm removal
- Includes planting of native riparian species

This project complies with San Francisco District regional conditions for Nationwide Permit 27, for Stream and Wetland Restoration Activities, through submittal of this Preconstruction Notification and documentation of existing conditions.

The Preferred Alternative would qualify for a Nationwide Permit 33: Temporary Construction, Access and Dewatering Permit because the project includes:

- Placement of temporary cofferdams, necessary for dewatering
- Temporary dewatering in localized areas where log structures will be placed.
- Actions are part of an **in-stream** and riparian restoration plan.

The total volume of fill to be placed in an USACE jurisdictional area at the **Banducci** site consists of 233 cubic yards, from the log structures to be installed. Approximately 63 individual logs will be used, averaging 25 feet long and ranging from 3 ft. diameter at breast height (dbh) to 2 ft dbh, occupying a total area of 4,725 sq. ft. The structures will be placed at seven locations within 1,300 linear feet of the creek. The total area to be graded within a jurisdictional area is 1,800 sq. ft. in Grade Area 2, where the gravel bar will be graded. Other grading occurs above the Ordinary High Water Mark (OHWM) on the channel banks and does not occur within an USACE jurisdictional area.

Regional Water Quality Control Board (RWQCB)

The NPS will submit an application for Water Quality Certification and/or Waiver of Waste Discharge Requirements to the Water Quality Certification to the San Francisco Bay Region, Regional Water Quality Control Board. NPS staff met with the Regional Board and staff regarding the scope of the project and applicable regulatory compliance and these conversations were followed by a series of email exchanges. The NPS is currently coordinating with the RWQCB to receive the required certifications for the project. It is anticipated that the Regional Board will grant the waiver and it will be completed prior to construction.

Natural Resource Management Guidelines

NPS has developed specific guidelines for the management of natural resources (NPS-77). These guidelines provide for management of native and non-native plant and animal species. They are designed to assist parks in developing resource management plans and action plans for specific park programs in park management zones: natural, cultural, park development, and special use zones as described in the NPS Management Policies and articulated in each park general management plan.

The NPS Management Policies (2001) direct the NPS to preserve natural resources, processes, systems, and values of units of the national park system in an unimpaired condition, to perpetuate their inherent integrity and to provide present and future generations with the opportunity to enjoy them. Natural resources will be managed to preserve fundamental physical and biological processes, as well as individual species, features, and plant and animal communities. The NPS will strive to understand, maintain, restore, and protect the inherent integrity of the natural resources, processes, systems, and values of the parks. The natural resources, processes, systems, and values that the NPS preserves are described generally in the 1916 NPS Organic Act and in the enabling legislation or presidential proclamation establishing each park.

Director's Order #77-1: Wetland Protection

The NPS, through Director's Order (DO) #77, has established policies, requirements and standards for implementing Executive Order (E.O.) 11990: "Protection of Wetlands" (42 Fed. Reg. 26961). E.O.11990 was written "to avoid to the extent possible the long and short term adverse impacts associated with the destruction or modification of wetlands and to avoid direct or indirect support of new construction in wetlands wherever there is a practicable alternative...." E.O. 11990 gives the NPS several directives, such as providing leadership and taking action to minimize the destruction, loss or degradation of wetlands.

DO #77 also dictates that a *Statement of Findings* must be prepared for activities that have the potential for direct or indirect adverse impacts on wetlands. *A Statement of Findings* documents the rationale of a preferred alternative with potential adverse impacts on wetlands, explains why no alternatives with less wetland impacts were practicable, and documents compliance with the policies and requirements/procedures of Director's Order #77. DO #77 also identifies certain activities that comply with E.O. 11990 but are excepted from SOF requirements. Excepted actions must satisfy a list of conditions issued in DO-#77.

NPS staff, consulting with a NPS staff hydrologist in Denver, examined this project for compliance with DO-#77 and determined it to be an excepted action. The proposed project meets an exception for water dependent actions or other actions with minimal impacts, under Section

4.2, A. 1 (e) of the Procedural Manual #77-1. This exception is designed for "Actions designed specifically for the purpose of restoring degraded (or completely lost) natural wetland, stream, riparian, or other aquatic habitats or ecological processes."

The proposed project will "avoid wetlands and minimize unavoidable wetland impacts, to the extent practicable" and plans to re-establish natural ecological functions of the Redwood Creek. The project clearly meets the definition in DO-#77 of a restoration project and will include the Best Management Practices (BMP)/Conditions for Exception listed in DO-#77.

The first BMP/condition states that actions "must have only negligible effects on site hydrology." The preferred alternative would have short and long-term beneficial effects on the hydrology and geomorphic processes in Redwood Creek. For example, the proposed actions will improve sediment transport, reduce sediment accumulation, and reduce the risk of channel avulsion at **Pacific Way**; and increase frequency, depth, and duration of floodplain inundation and reduced channel flow velocity at the **Banducci** site.

BMP/Condition 14 states that the "actions must not jeopardize the continued existence of a threatened or endangered species...." The proposed project will facilitate the continued existence of threatened species in the watershed such as coho salmon and steelhead trout by adding cover and improving rearing habitat.

With the implementation of the above conditions, and others listed in DO-#77 that are appropriate to the proposed actions, the project will not degrade any of the natural and beneficial ecological, social/cultural, and other functions and values of wetlands at **Pacific Way** or the **Banducci** site. A list of BMPs/Conditions are listed in Appendix A.

National Historic Preservation Act

Under Section 106 of the NHPA, federal agencies are required to identify historic or archaeological properties near proposed project site, including properties on the National Register of Historic Properties (NRHP) or properties that the agency and the State Historic Preservation Officer (SHPO) agree are eligible for listing on the NRHP, the federal agency must consult with SHPO and the Advisory Council on Historic Preservation (ACHP) to develop alternatives or mitigation measures that will allow the proposed action to proceed. 16 USC 470.

State Historic Preservation Officer

In June 1992, the NPS, SHPO, and the Advisory Council on Historic Preservation (ACHP) entered into a programmatic agreement (PA) regarding the operation and maintenance activities within the GGNRA. The proposed work in this project falls under this existing PA. On May 16, 2002, the project work at the **Banducci** Site received certification for compliance with the NHPA through the Preservation Assessment (5X) Form (Certification No: GOGA-02-073) with the following stipulations:

1. Archeological survey and geo-archeological assessment of project are required, coordinate with Park Historical Archeologist (Leo Barker, 561-4836).
2. Consultation with the Federated Indians of Graton Rancheria is required, coordinate with Historian (Paul Scolari, 561-4813)

On June 14, 2002, the project work at **Pacific Way** received certification for compliance with the NHPA through the Preservation Assessment (5X) Form (Certification No: GOGA-02-075).

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