ENVIRONMENTAL ASSESSMENT

COASTAL WATERSHED RESTORATION – GEOMORPHIC RESTORATION PROJECT

Point Reyes National Seashore

National Park Service

November 15, 2004

Environmental Assessment

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Table of Contents

List of Appendices

Project Summary

The Coastal Watershed Restoration – Geomorphic Restoration Project Environmental Assessment (EA) examines alternative means to restore natural hydrologic function at these locations and assesses the potential environmental effects of the implementation of each strategy. Following public and agency review and comment, the conclusions of the potential environmental effect in the EA will be used to inform the NPS planning process. This EA addresses topics required under the California Environmental Quality Act (CEQA) and is intended for adoption by California State agencies to meet their CEQA permitting requirements.

This EA is addresses two water impoundments and one road crossing site within the Drakes Estero Watershed. These sites are included as part of the Coastal Watershed Restoration Project, a National Park Service (NPS) Line-Item Construction Program funded project scheduled to be obligated in FY2005. Project areas include the Glenbrook Road Crossing, a non-conforming structure in the Philip Burton Wilderness, Muddy Hollow Dam and Limantour Beach Pond Dam, both constructed across portions of Estero de Limantour.

The proposed project area is located on land adjacent to and within the Philip Burton Wilderness Area of the Seashore. Treatment proposed at these locations is intended to reduce or eliminate the long-term maintenance requirements associated with the existing earthen fill structures. A summary of project needs are identified below.

- The project is intended to restore natural conditions and increase estuarine habitat at Point Reyes. At each of these sites, construction across stream or estuarine habitat impedes natural process and is not consistent with long-term park and NPS management objectives. These sites impede or block access to watersheds that support, or have the potential to support federally threatened coastal California steelhead and coho salmon. Muddy Hollow Dam and Limantour Beach dam restrict tidal action from more than five acres of coastal marsh habitat. The Glenbrook crossing is a non-conforming structure within the Philip Burton Wilderness and is a barrier to fish passage.

- The project is needed to reduce the maintenance demands at Point Reyes. The project addresses facilities within the Drakes Estero watershed that are in need of maintenance, but not considered integral to current park management objectives.

These facilities are in need of major maintenance to stabilize structures, and in the long-term, would require regular maintenance. For example, the Bureau of Reclamation identified the Muddy Hollow Dam to be in "seriously deficient condition and consideration should be given to deactivating the dam and restoring the tidal pool area" (USBR 2001). With numerous high priority maintenance needs, it is likely the facilities would continue to deteriorate. This project is proposed to address long-term maintenance issues at this site, and includes alternatives that would reduce the overall operations and maintenance requirements for these facilities.

- The project is needed to eliminate the risk of catastrophic failure. Maintenance activities are necessary to prevent catastrophic failure at Glenbrook Crossing and Muddy Hollow Pond. The culvert at Glenbrook Crossing (within the Philip Burton Wilderness Area) is eroded and bowed, with water piping around the metal culvert. The outfall of the culvert is 11 feet above the bed of the creek, and is a total barrier to aquatic movement. Catastrophic failure is likely, and could result in large volumes of sediment entering the stream system and result in effects to natural resources. At Muddy Hollow Pond, more than 30 acre-feet of water are stored behind the dam facility. Catastrophic failure would result in loss of pond, estuarine, and upstream wetland habitat.

- The project is needed to increase sustainability, both operationally and ecologically within these small coastal watersheds. These facilities were constructed prior to park establishment and not sustainable, requiring maintenance actions in order that they remain a part of the environment. The project would remove these facilities in a controlled manner thereby improving natural process and sustainability of the park systems.

The current PRNS General Management Plan (NPS 1980) and Statement for Management (NPS 1990) identify objectives for the management of natural and cultural resources. The PRNS Statement for Management sets the primary resource management objectives for PRNS as the identification, protection, perpetuation, and restoration of significant cultural and historic resources and of the diversity of natural ecosystems representative of the California coast (NPS 1993).

The objectives of the Coastal Watershed Restoration - Geomorphic Restoration Project are:

- To reduce or remove the long term operations and maintenance requirements associated with each of these park facilities.

- To increase ecological sustainability through the removal of structures that impede or restrict natural hydrologic, estuarine, and shoreline process within the Drakes Estero/Estero de Limantour watershed.

- To address the non-conforming Glenbrook road crossing structure located within the Philip Burton Wilderness and create a sustainable wilderness trail to maintain visitor access through the site.

- To address deficiencies and impacts to natural hydrologic and estuarine process associated with the Muddy Hollow Dam within Estero de Limantour, and create a sustainable visitor access through the site.

- To replace the Limantour Beach Pond Dam and associated fill with a structure that remains a gateway to Limantour Beach, while allowing for the restoration of natural hydrologic and shoreline process within Estero de Limantour.

Environmental impacts of an additional six road crossing sites, also part of the Coastal Watershed Restoration, are evaluated in a separate compliance document titled the Coastal Watershed Restoration – Drakes Estero Road Crossings Improvement Project Environmental Assessment.

This EA evaluates the potential environmental consequences of 3 alternative strategies for implementing the Coastal Watershed Restoration – Geomorphic Restoration Project. Descriptions of the No Action and the 2 Action Alternatives are discussed in Chapter 2.

The proposed project alternatives include:

Alternative 1 – Full-Build Alternative,

Alternative 2 – Partial Build Alternative, and

Alternative 3 - No Action Alternative

This Environmental Assessment analyzes the potential for direct impact, cumulative impact, and impairment to Visual Resources, Wilderness, Air Quality, Geology, Geohazards, and Soils; Hydrology, Hydraulics, and Water Quality; Vegetation and Wildlife; Wetland Resources; Special Status Species, Critical Habitat, and Essential Fish Habitat; Cultural Resources; Public Health and Safety; Recreational Use, and Transportation and Traffic. Special status species, including California red-legged frog (*Rana aurora draytonii, Federally Threatened*), steelhead (*Oncorhynchus mykiss; Federally Threatened*), Myrtle's silverspot butterfly (*Speyeria zerene myrtleae; Federally Threatened*), California Brown Pelican (*Pelecanus occidentalis californicus; Federally Endangered*), and Western snowy plover (*Charadrius alexandrinus nivosus; Federally Threatened*). As well, impacts to a number of Federal Species of Concern are also evaluated as part of this document.

Table 2-7 summarizes the impacts associated with each of the proposed alternatives. It should be noted that in the impact topics discussion (Section 4), site specific impact descriptions, as well as tables summarizing impacts at each of the sites, under each of the alternatives are included. Cumulative impacts are analyzed in the same manner, by impact topic and Alternative, with a general summary included as part of Section 5.

The NPS has identified a preferred alternative that includes treatments for Muddy Hollow and Limantour Beach Pond described under Alternative 1, and treatment for Glenbrook Crossing described under Alternative 2. These treatments have been selected to best accomplish the objectives of the project. The preferred alternative meets all of the project criteria regarding restoration of natural hydrologic and estuarine process, reduces long-term operations and maintenance requirements, and to increase ecological and operational sustainability associated with these restoration sites.

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1.0 Purpose and Need

1.1 Introduction

The Coastal Watershed Restoration – Geomorphic Restoration Project Environmental Assessment (EA) has been developed in accordance with the 1969 National Environmental Policy Act (NEPA) for use by the National Park Service (NPS), other jurisdictional agencies, and the general public to deliberate the proposed restoration at three sites within the Drakes Estero watershed. The EA examines alternative means to restore natural hydrologic function at these locations and assesses the potential environmental effects of the implementation of each strategy. Following public and agency review and comment, the conclusions of the potential environmental effect in the EA would be used to inform the NPS planning process. This EA addresses topics required under the California Environmental Quality Act (CEQA) and is intended for adoption by California State agencies to meet their CEQA permitting requirements. The EA may identify the need for further environmental review or may lead to a decision that the project's impacts are adequately assessed in conformance with NEPA. The latter outcome is published in a Finding of No Significant Impact (FONSI) which would outline the parameters and mitigation for the implementation of the geomorphic restoration activities within as part of the Coastal Watershed Restoration.

This EA is addresses two water impoundments and one road crossing site within the Drakes Estero Watershed. These sites are included as part of the Coastal Watershed Restoration Project, a National Park Service (NPS) Line-Item Construction Program funded project scheduled to be obligated in FY2005. Project areas include the Glenbrook Road Crossing, a non-conforming structure in the Philip Burton Wilderness, Muddy Hollow Dam and Limantour Beach Pond Dam, both constructed across portions of Estero de Limantour. The site locations are included as Figure 1-1. Environmental impacts of an additional six road crossing sites, also part of the Coastal Watershed Restoration, are evaluated in a separate compliance document, but are considered as part of the cumulative impacts analysis.

1.2 Project Need

In conjunction with NPS management objectives, the project is proposed to enhance or restore natural hydrologic and shoreline process and fish passage through these structures located in the downstream to estuarine portions of Glenbrook, Muddy Hollow, and Laguna Creek (Figure 1-1). Prior to acquisition of the land by the NPS, a network of roads and other infrastructure was constructed to support existing agricultural operations and planned residential development. Many of the existing road and drainage facilities were installed prior to park establishment. Since the Seashore was established, the NPS has continued to manage many of the remaining roads, drainage facilities, and other infrastructure. However, the NPS feels that many of these facilities are not compatible with land use designations (including Wilderness) within the Seashore. To this end, the NPS has been developing a number of projects aimed at removing dams, replacing culverts, and regrading ranch roads to facilitate natural process and conditions. The actions evaluated as part of this EA are a part of the Seashore's Coastal Watershed Restoration Program. The proposed project sites are located within or adjacent to the Philip Burton Wilderness Area of the Seashore. Proposed treatments at these locations is intended to restore natural hydrologic and ecological process while reducing or eliminating the long-term maintenance requirements associated with the existing earthen fill structures. A summary of project needs are identified below.

- The project is needed to restore natural hydrologic conditions and increase estuarine habitat at Point Reyes National Seashore. At each of these sites, construction across stream or estuarine habitat impedes natural process and is not consistent with long-term park and NPS management objectives. These sites impede or block access to watersheds that support, or have the potential to support federally threatened coastal California steelhead and coho salmon. Muddy Hollow Dam and Limantour Beach dam restrict tidal action from more than five acres of coastal marsh habitat. The Glenbrook crossing is a non-conforming structure within the Philip Burton Wilderness and is a barrier to fish passage.

- The project is needed to reduce the maintenance demands at Point Reyes National Seashore. The project addresses facilities within the Drakes Estero watershed that are in need of maintenance, but not considered integral to current park operations. These facilities are in need of major maintenance to stabilize structures, and in the long-term, would require regular maintenance. For example, the Bureau of Reclamation identified the Muddy Hollow Dam to be in "seriously deficient condition and consideration should be given to deactivating the dam and restoring the tidal pool area" (USBR 2001). With numerous high priority maintenance needs, it is likely the facilities would continue to deteriorate. This project is proposed to address long-term maintenance issues at this site, and includes alternatives that would reduce the overall operations and maintenance requirements for these facilities.

- The project is needed to eliminate the risk of catastrophic failure. Maintenance activities are necessary to prevent catastrophic failure at Glenbrook Crossing and Muddy Hollow Pond. The culvert at Glenbrook Crossing (within the Philip Burton Wilderness Area) is eroded and bowed, with water piping around the metal culvert. The outfall of the culvert is 11 feet above the bed of the creek, and is a total barrier to aquatic movement. Catastrophic failure is likely, and could result in large volumes of sediment entering the stream system and result in effects to natural resources. At Muddy Hollow Pond, more than 30 acre-feet of water are stored behind the dam facility. Catastrophic failure would result in loss of pond, estuarine, and upstream wetland habitat.

- The project is needed to increase sustainability, both operationally and ecologically within these small coastal watersheds. These facilities were constructed prior to park establishment and not sustainable, requiring maintenance actions in order that they remain a part of the environment. The project would remove these facilities in a controlled manner thereby improving natural process and sustainability of the park systems.

1.3 Project Purpose

The project addresses facilities constructed prior to establishment of Point Reyes National Seashore. These facilities are not integral to park operations but require repair or replacement in the short term, as well as long-term maintenance for them to remain. The primary goal of the proposed habitat restoration project is to reduce long-term maintenance requirements and increase ecological sustainability through the restoration of natural hydrologic and shoreline process to these sites within the Drakes Bay watershed.

The project approach is consistent with NPS management guidelines that require, "NPS managers will first consider relocating or redesigning facilities, rather than manipulating streams" (Section 4.6.6: NPS 2001). In addition, restoration of water resources and aquatic habitat have been identified as high priority objectives by the NPS in the PRNS General Management Plan (NPS 1980), the PRNS Resource Management Plan (NPS 1999), and the NPS Management Policies (NPS 2001).

Restoration of natural process is intended to result in more sustainable ecological systems based on physical and hydrologic stability. The management policies cited below are indicative of the approach and means by which restoration activities proposed through this program are conducted.

NPS Management Policies, Section 4.1.5, directs actions to restore natural systems in the national parks. The NPS is directed to:

> "re-establish natural functions and processes in human-disturbed components of natural systems in parks unless otherwise directed by Congress…..Impacts to natural systems resulting from human disturbances include the introduction of exotic species; the contamination of air, water, and soil; changes to hydrologic patterns and sediment transport; the acceleration of erosion and sedimentation; and the disruption of natural processes. The Service will seek to return human-disturbed areas to the natural conditions and processes characteristic of the ecological zone in which the damaged resources are situated. (NPS 2000, p. 30)

Section 4.4.2.4 of the NPS Management Policies addresses how parks should approach the management of natural landscapes:

> "…management activities to restore human-altered landscapes may include removing constructed features, restoring natural topographic gradients, …on sites from which previous development is being removed. …Restoring natural processes and conditions to areas disturbed by natural activities.

Section 4.6.4 of the NPS Management Policies addresses protection and management of floodplains, specifically:

> "the NPS will (1) manage for the preservation of floodplain values; (2) minimize potentially hazardous conditions associated with flooding…When it is not practicable to locate or relocate development…to a site outside and not affecting the floodplain the Service will… ensure that structures and facilities are designed to be consistent with the intent of the standards and criteria of the National Flood Insurance Program."

Section 4.6.5 of the NPS Management Policies addresses the restoration of wetlands on NPS lands. Wetlands are present within each of the road crossing improvement locations.

> "When natural wetland characteristics or functions [of wetlands] have been degraded or lost due to previous or on-going human actions, the Service will, to the extent practicable, restore them to predisturbance conditions." (NPS 2000, p. 40)

Section 4.6.6 of the NPS Management Policies supports the project objective to restore natural hydrologic process.

> "The Service will manage watersheds as complete hydrologic systems… The Service will achieve the protection of watershed and stream features … by allowing natural fluvial processes to proceed unimpeded."

As set forth in the 1962 legislation that created PRNS, projection of the unique coastal resources in the park is a primary purpose for its establishment ….

> "…to save and preserve, for the purposes of public recreation, benefit, and inspiration, a portion of the diminishing seashore of the United States that remains undeveloped" (PL 87-657).

An amendment to the legislation passed in 1976 (PL 94-544) provides the NPS with specific management goals for PRNS.

> "…the property … shall be administered …without impairment of its natural values, in a manner which provides for such recreational, educational, historic preservation, interpretation, and scientific research opportunities as are consistent with, based upon, and supportive of the maximum protection, restoration, and preservation of the natural environment within the area."

Section 4.8.1.1 of the NPS Management Policies addresses the management objective to restore natural shoreline process to this section of Drakes Bay.

> "Natural shoreline processes (such as erosion, deposition, dune formation, overwash, inlet formation, and shoreline migration) will be allowed to continue without interference. Where human activities have altered the nature or rate of natural shoreline process, the Service will… investigate alternatives for mitigating the effects of such activities or structures, and for restoring natural conditions."

The current PRNS General Management Plan (NPS 1980) and Statement for Management (NPS 1990) identify objectives for the management of natural and cultural resources. The PRNS Statement for Management sets the primary resource management objectives for PRNS as the identification, protection, perpetuation, and restoration of significant cultural and historic resources and of the diversity of natural ecosystems representative of the California coast (NPS 1993).

The objectives of the Coastal Watershed Restoration Geomorphic Restoration Project are:

- To reduce or remove the long term operations and maintenance requirements associated with each of these park facilities.
- To increase ecological sustainability through the removal of structures that impede or restrict natural hydrologic, estuarine, and shoreline process within the Drakes Estero/Estero de Limantour watershed.
- To address the non-conforming Glenbrook road crossing structure located within the Philip Burton Wilderness and create a sustainable wilderness trail to maintain visitor access through the site.
- To address deficiencies and impacts to natural hydrologic and estuarine process associated with the Muddy Hollow Dam within Estero de Limantour, and create a sustainable visitor access through the site.
- To replace the Limantour Beach Pond Dam and associated fill with a structure that remains a gateway to Limantour Beach, while allowing for the restoration of natural hydrologic and shoreline process within Estero de Limantour.

1.4 Projects considered in Cumulative Impacts Analysis

A cumulative effect is "…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 effects may be the result of multiple, individually minor actions that aggregate to produce an adverse result over a period of time (40 CFR Sec. 1508.27), and a significant impact may exist if an action is related to other actions that have individually insignificant but cumulatively significant impacts (40 CFR Sec. 1508.27[b][7])

NEPA requires lead agencies to analyze the potential of their proposed actions to contribute to any cumulative effects identified in the project region. Because *cumulative effect* refers by definition to a combined effect, there is no cumulative effect on a resource unless more than one action affects that resource, or a single action or activity results in repeated but discrete effects on the resource. Accordingly, the first step in analyzing cumulative effects is to identify the resources that have the potential to be affected by more than one action or activity during the timeframe analyzed. Once the cumulative effects have been identified, a proposed action's potential to contribute to each can be evaluated.

This EA used the "list" approach, in which the additive effects of specific actions proposed for an area are considered as a whole. For most resources, cumulative effects analysis addressed the Drake's Estero/Drake's Bay watershed, with the exception of effects on air quality, which were analyzed for the watershed and adjacent downwind portions of the SFBAAB, and effects on traffic, which were analyzed for the whole of Marin County. The analysis included actions slated for implementation within the next 5 years (through 2009). These actions are listed in Table 1-1.

Table 1-1. Actions Included in Cumulative Effects Analysis

Action	Overview
Coastal Watershed Restoration, Drake's Estero Road Crossing Improvements	This action includes the replacement or enhancement of road crossing facilities to accommodate natural hydrologic process and fish passage at six sites within the Drake's Estero watershed. It is in the planning phases, with EAs slated for public release in fall 2004. Implementation, anticipated for summer 2005, would require state and federal permits similar to those required for the proposed action analyzed in this EA.
Horseshoe Pond Restoration to Coastal Lagoon	This action involves the removal of spillway and dam materials to restore natural hydrologic and shoreline process to a 35-acre area immediately west of the mouth of Drake's Estero. It would also restore or enhance the access road, borrow quarry, and former waste lagoon to more natural conditions. With appropriate compliance complete, the project was implemented in fall 2004.
Glenbrook Dam and Quarry Restoration Project	This action involves the removal of dam remains and restoration of the borrow areas at the mouth of Glenbrook Creek in the Estero de Limantour. Implementation is scheduled to be complete by fall 2005. It would require a number of state and federal permits as well as minimum tool clearance for operations within a designated wilderness area.
Giacomini Wetlands Restoration Project	PRNS and Golden Gate National Recreation Area (GGNRA) are conducting a large-scale wetland restoration project at the southern end of Tomales Bay. This project would restore natural hydrologic and ecological processes and functions to the historic tidal marsh, which was diked in the 1940s for operation of a dairy ranch. The project is currently in the alternatives development phase. A draft EIS/Environmental Impact Report (EIR) is scheduled for 2005, with possible implementation of a portion of the project in late 2006.
Dune Restoration Project	This action involves the removal of nonnative European beach grass from the dune areas within the Seashore. Removal methods and restoration strategies are currently being tested near Abbott's Lagoon and would be employed at a larger scale under a line-item construction project planned for FY 2007.
Fire Management Program	NPS has completed a Fire Management Plan for the Seashore and is conducting environmental analysis of program alternatives. The preferred alternative would result in prescribed fire and mechanical treatment on no more than 3,000 acres per year within identified park fire management units (FMUs). While 27% of the Drake's Bay/Drake's Estero watershed is included in active treatment FMUs under the Plan, NPS does not anticipate treatment on more than 10% of any one watershed within Drake's Bay in any given year. The draft environmental impact statement for the Fire Management Plan is now in public review, with comments expected by June 2004. NPS anticipates implementation beginning in FY2005.

NPS is also in the process of revising the General Management Plan for Point Reyes National Seashore. This is a long-term strategic planning document that would establish management direction in the park for the next 10–20 years. Public scoping has been conducted and NPS expects the planning process to be completed by FY 2006 or 2007. Because management planning is still in the early stages, details are considered outside the scope of "reasonably foreseeable" actions that NEPA requires lead agencies to address in the analysis of cumulative effects. However, it is reasonable to assume that all programs and actions implemented under a revised General Management Plan would be consistent with the mission and vision captured in

this EA, and would include environmental safeguards similar to those incorporated in the actions explicitly analyzed.

1.5 Issues raised during project scoping

Public Scoping

Project scoping was conducted between February 18, 2003 and March 21, 2003. The public scoping document was mailed to the park public outreach mailing list including more than 200 recipients. Four comment letters were received.

Potential impact topics that were identified through the public scoping are described below.

Ecological Restoration

Concern was expressed over restoration at Muddy Hollow Pond, in particular the intent of removing a feature heavily used by birds, for the benefit of other species such as steelhead. The potential impacts associated with restoration of natural process, and associated affects to existing habitat are evaluated as part of the EA.

Recreational Use

Muddy Hollow Pond is a large pond area easily accessible from the Limantour Parking area and is a recreational resource often used by bird watchers and docent led bird watching groups. The pond is one of many within the Seashore providing large areas of open water habitat for diving ducks and other birds to rest and forage during the migration seasons. Recreational use is evaluated as part of the EA.

A trail network runs adjacent to the south side of Muddy Hollow Pond (Muddy Hollow Trail) and across the dam (Estero Trail). Comments noted that similar trail access to/from this area should be maintained. Recreational use and trail access are evaluated as part of the EA.

Wildlife - Birds

Muddy Hollow Pond provides habitat for a wide variety of bird and aquatic species, including, according to a local bird expert, over 20 duck species grebes, coots, American bitterns, Soras, and Virginia rails. Surrounding the edge of the pond are willow and alder that support numerous neotropical migrants along the pond edge. The habitat and use of the Muddy Hollow Pond area is evaluated as part of this EA.

Internal Scoping

The NPS has conducted public scoping (described in Section 1.5.1) as well as conducting internal staff scoping that served as the basis for the scope of the EA. In internal scoping, the NPS examines potential environmental issues relevant to the proposal that are raised by NPS staff. Those issues with potential for effect are addressed in this EA (See Section 1.6 for brief description).

1.6 Impact Topics addressed in the EA

One reason for preparing an EA is when additional analysis and public input is needed to know whether the potential for significant impact exists (DO12 Handbook, p.70). The following impact topics were determined through scoping to have the potential for significant impact on the environment. The following impact topics will be addressed in the EA.

Air Quality. Construction activities would increase short-term production of pollutants from the use of construction equipment for the period of operation. Visible dust would also be generated as earthen dam and road-crossing facilities are removed. Pollutants and dust generated would quickly disperse due to coastal winds. The project effect on air quality would be short-term, negligible and adverse but would not result in an impairment of NPS resources. There is no potential for significant effect. Because this topic is necessary for CEQA compliance, the topic will be included in the EA.

Geology, Geologic Hazards and soils. Project implementation would involve the use of heavy equipment to remove earthen structures from wetland, estuarine, riparian and stream habitat. Restoration activities would include recontouring and revegetation of former road and quarry areas and restoration of natural process through these previously disturbed and altered areas. Project actions could result in increased erosion and changes in the existing topography. The effect of project actions on site soils, geohazard, and topographic features will be addressed in the EA.

Water Resources and Hydrology. The project proposes to restore natural hydrologic and shoreline process at each of the project locations. Impact issues to be evaluated in the EA Water Quality, Quantity, stream flow characteristics, Marine or estuarine resources. Projects that may result in impacts to water quality are required to obtain permits through the Regional Water Quality Control Board under Section 401 of the Clean Water Act. Manipulation of the system may result in impacts to wetlands within the project area. The effect of the project on water quality will be evaluated in the EA.

Floodplains or Wetlands. The US Army Corps of Engineers has determined that the project area occurs within wetlands under jurisdiction granted to the Corps through Section 404 of the Clean Water Act. None of the waters are considered to be within the Corps jurisdiction as defined for the Rivers and Harbors Act - Section 10. The project would result in excavation of and change to existing wetland resources. The NPS will apply to the US Army Corps for a permit to discharge under Nationwide Permit 27. This permit pertains to restoration actions on federal lands or requiring federal permits. Effects to wetlands will be evaluated in the EA.

Rare or Unusual Vegetation. The project sites are located within sensitive riparian and estuarine habitat within the Seashore. As with any restoration project of this type, there would be ground and vegetation disturbance associated with the restoration project. This topic will be included as part of the vegetation section of the EA.

Species of Special Concern. The project area has been documented to support a variety of special status plant and animal species. Based on site surveys and document review, the NPS has determined that the project could result in measurable impacts to the following species identified in Table 1-2 (below).

Table 1-2 Federally-listed Threatened and Endangered species analyzed as part of the Coastal Watershed Restoration – Geomorphic Restoration EA.

Common Name	Scientific Name	Listing Status
Myrtle's silverspot butterfly	*Speyeria zerene myrtleae*	E
California red-legged frog	*Rana aurora draytonii*	T
California red-legged frog Critical Habitat		
California Brown Pelican	*Pelecanus occidentalis californicus*	E
Western snowy plover	*Charadrius alexandrinus nivosus*	T
Central California coast steelhead	*Oncorhynchus mykiss*	T
Magnuson-Stevens Fishery Conservation and Management Act - Essential Fish Habitat		

a/ Listing status: E = Endangered , T= Threatened

Additional data and consultation with the US Fish and Wildlife Service, the agency that enforces the federal Endangered Species Act, is necessary to determine whether the proposed restoration project could have a significant impact on the California red-legged frog, protected by the federal Endangered Species Act. A biological assessment for the project will include analysis of federally endangered or threatened species identified within the project area.

The potential effect to other federally or locally listed species in the Point Reyes area is considered to be negligible or minor. The discussion of effects to species of special concern, including the three species for which more information is needed, will be addressed in the EA.

Unique or Important Fish or Wildlife Habitat. The project watersheds support federally protected species. Evaluation of unique or important habitat would be conducted in conjunction with the Species of special concern section. The riparian corridors throughout Point Reyes National Seashore are documented as an important resource for migratory neotropical bird breeding and habitat. Each of the project planning area locations include riparian habitat and impacts to neotropical migratory birds and their habitat are considered. Habitat is evaluated as part of the Biological Resources topic.

Introduce or Promote Non-Native Species (plant or animal). As with any restoration project, there would be ground disturbance that could promote non-native species to the site. The project area occurs on previously disturbed areas with a mix of native shrubs and trees with non-native grasses. Project impacts on non-native species will be addressed under the impact topic of Biological Resources.

Recreational Resources, including supply, demand, visitation, activities. Visitor use would be affected in the short term by construction activities at the three project locations. The planning process would take into account, and plan for the maintenance and connection existing trail facilities. Recreational Use and Traffic impacts are evaluated as part of this EA.

Visitor experience and aesthetic resources. Visitor use would be affected in the short term by construction activities at the three project locations. The planning process would take into account, and plan for the maintenance and connection existing trail facilities. These topics are analyzed under visual resources and recreational use within the project EA.

Soundscapes. Construction activities would increase short term noise impacts in the area. Wind and water noise generate a high ambient noise level in this area and, in conjunction with barriers posed by topography, would attenuate high noise outside the project vicinity. These construction sounds would last only during the periods of construction. Pending results of geotechnical analysis, there may be the requirement for placement and pounding of pilings which could entail repetitive sounds potentially effecting sensitive noise receptors. The effect on the NPS soundscape will be evaluated as part of this EA.

Cultural Resources, including Cultural Landscapes, Ethnographic Resources. Through internal scoping, it was determined that the project area includes an archaeological resource site near the Limantour Beach Pond. Through the project planning process, the NPS has worked with the Federated Indians of Graton Rancheria and the Anthropological Studies Center of Sonoma State University to document the resources at the site. The project was formulated in consideration of the cultural resources identified in the site surveys. This impact topic will be further addressed in the EA.

Tribal land use, sacred sites. An archeological site was rediscovered during project planning for this project. The location of the archeological site was considered in redesigning the proposed action and limits of site disturbance during implementation. The results of the cultural resources study defined restoration boundaries in consultation with a representative of the Federated Indians of Graton Rancheria. Potential impacts to such sensitive resource area would be addressed in the EA as part of the impact assessment to cultural resources.

Other agency or tribal land use plans or policies. The results of the planning study defined restoration boundaries in consultation with a representative of the Federated Indians of Graton Rancheria. The NPS would remain in contact with representatives of FIGR regarding how to monitor resources during site excavation work at specific locations. Potential impacts to such sensitive resource area would be addressed in the EA as part of the impact assessment to cultural resources.

Unique Ecosystems, biosphere reserves, World Heritage Sites. The project area is along the coastal margin within the Golden Gate Biosphere Reserve. The project is proposed in recognition of this unique ecosystem and would improve natural hydrologic and ecological function to the area. Some of the project sites, particularly Glenbrook Crossing and the trail reroute section of the Muddy Hollow Pond site are located within the Philip Burton Wilderness. Evaluation of these alternatives in the context of Wilderness is conducted as part of this project EA.

1.7 Impact Topics dismissed from further assessment

The following impacts have very low or negligible potential for adverse effect to the environment. The supporting information for these impact topics was assessed through the project environmental screening form and are summarized here.

Socioeconomics, including employment, occupation, income changes, infrastructure, urban quality, Gateway Community. The project would not effect socioeconomic resources within the local area or region. The restoration activities would not change the natural or wilderness area status currently assigned to these areas. This topic will not be addressed in the EA.

Minority and low income populations, ethnography, size, migration patterns, etc. The proposed actions are resource focused and would not result in changes to recreational or agricultural uses in PRNS. The project would not disproportionately affect minority or low income user groups. This topic will not be addressed in the EA.

Energy resources. The action alternatives involve use of heavy equipment for one construction season. The proposed project does not involve the sustained use of energy supplies. The action alternatives would have a short-term, negligible adverse affect on energy resources. This topic will not be further addressed in the EA.

Land use, including occupancy, income, values, ownership, type of use. The project locations are located in the Limantour area of Point Reyes National Seashore. Historically these areas were agricultural, however since establishment of the park the area has been managed as natural area or Wilderness. Land use will remain the same.

Long-term management of resources or land/resource productivity. The project is consistent with long-term general management plans for the Point Reyes National Seashore and the Limantour area. This topic will not be further addressed in the EA.

Prime and Unique Farmlands To ensure compliance with the Farmland Policy Act (FPPA; PL97-98; 7 USC 4201 et. seq.), the Council on Environmental Quality requires consideration of impacts to prime and unique farmland as a result of federal action. Prime and unique farmlands are defined by the US Department of Agriculture and are determined by the Natural Resource Conservation Service. The project area does not occur within any areas defined by the NRCS as prime and unique farmland, and therefore this issue is dismissed from further analysis.

1.8 Environmental Compliance Requirements

Laws, Regulations, and Policies

This section describes key legislation that form the legal context and important NPS policies that direct NPS actions relevant to the Coastal Watershed Restoration – Geomorphic Restoration Project Environmental Assessment. Legislation specific to PRNS and NPS Management Policies relevant to the proposed project were discussed in Chapter 1, Section 1.3, Project Purpose.

National Park Service Legislation and Policy

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

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

manner and by such means as will leave them unimpaired for the enjoyment of future generations."

The National Parks Omnibus Management Act of 1998 (SB 1693) provides for improved management and increased accountability for National Park Service programs. Specifically, Title I, Sec. 101 states, "Recognizing the ever increasing societal pressures being placed upon America's unique natural and cultural resources contained in the National Park System, the Secretary shall continually improve the ability of the National Park Service to provide state-of-the-art management, protection, and interpretation of and research on the resources of the National Park System." In Title II, Sec 201, the stated purposes of the National Park System resource inventory and management programs are to 1) more effectively achieve the mission of the NPS, 2) enhance the management and protection of national park resources by providing clear authority and direction for the conduct of scientific studies and to use the information gathered for management purposes, 3) ensure appropriate documentation of resource conditions in the National Park System, and 4) encourage others to use the National Park System for study to the benefit of park management as well as broader scientific value where consistent with the Organic Act.

Point Reyes Wilderness Area (PL 94-567) established the Point Reyes Wilderness Area in 1976. In 1985 (PL 99-68), Congress designated the Point Reyes wilderness area as the Philip Burton Wilderness in recognition of this congressman's dedication to the protection of the nation's resources and role in the establishment of national parks in the San Francisco Bay Area. Areas that had been designated as potential wilderness (Muddy Hollow, Limantour, and Abbotts Lagoon) were changed to full wilderness status through notice in the Federal Register on November 18, 1999. The Glenbrook Crossing project area and Muddy Hollow Pond Project area trail reroute are within designated wilderness.

National Park Service Management Policies, 2001. This document contains Service-wide policies of the NPS. Adherence to policy is mandatory unless specifically waived or modified by the Secretary, the Assistant Secretary, or the Director of NPS. In addition to sections cited in Chapter 1, Section 3 of this EA, other sections relevant to the proposed actions are Section: 4.4.2.4 - Management of Natural Landscapes; 4.6.4 – Floodplains; 4.6.6 – Watershed and Stream Processes; 4.8.1.1 – Shorelines and Barrier Islands; and 9.5 - Dams and Reservoirs.

Federal Environmental Legislation and Regulations

National Environmental Policy Act (NEPA) of 1970. PL 91-190, 83 Stat. 852, 42 USC §4341 et seq. The NEPA process is intended to help public officials make decisions that are based on understanding of environmental consequences, and take actions that protect, restore, and enhance the environment. Regulations implementing NEPA are set forth by the Council on Environmental Quality. This document has been prepared following NPS Directors Order 12 meeting Department of Interior and National Park Service standards.

Council on Environmental Quality Regulations for Implementing the Procedural Provisions of the National Environmental Policy Act (NEPA) (40 CFR Parts 1500-1508). The Council on Environmental Quality regulations for implementing the National Environmental Policy Act (NEPA) establishes the process by which federal agencies fulfill their obligations under the NEPA process. The Council on Environmental Quality regulations ascertains the requirements for environmental assessments and environmental impact statements that document the NEPA process. The Council on Environmental Quality regulations also define such key terms as "cumulative impact," "mitigation" and "significantly" to ensure consistent application of these terms in environmental documents. This environmental analysis was prepared as directed in the Council on Environmental Quality regulations.

Clean Air Act, as amended, PL Chapter 360, 69 Stat. 322, 42 USC §7401 et seq. Section 118 of the Clean Air Act requires all federal facilities to comply with existing federal, state, and local air pollution control laws and regulations.

Federal Water Pollution Control Act (Clean Water Act) and subsequent amendments of 1977 (33 USC 1251 et seq.). The Clean Water Act provides for the restoration and maintenance of the physical, chemical, and biological integrity of the nation's waters. Section 404 of the act prohibits the discharge of fill material into navigable water of the United States, including wetlands, except as permitted under separate regulations by the U.S. Army Corps of Engineers and U.S. Environmental Protection Agency. The project will be conducted within jurisdictional wetlands as confirmed by the US Army Corps of Engineers August 13, 2002. The project will require 404 permits through the Corps, and 401 certification through the San Francisco Regional Water Quality Control Board. Application for these permits will be submitted subsequent to the Environmental Assessment.

Rivers and Harbors Act (1899) Predating the Clean Water Act, the jurisdiction of the US Army Corps was limited to waters subject to Section 10 of the Rivers and Harbors Act (1899). The Corps continues to oversee Section 10 jurisdictional waters, which are navigable waters that are subject to the ebb & flow of the tide, and/or those that are presently used, have been used in the past, or could be used for interstate transport or foreign commerce. Section 10 jurisdiction extends to mean high water (MHW) and includes tidal areas presently subject to tidal influence, as well as unfilled areas currently behind levees that were historically below MHW. Section 10 jurisdiction also extends upstream to the ordinary high water (OHW) of non-tidal waters designated as navigable waters of the United States. The US Army Corps regulates and permits Section 10 in addition to CWA Section 404. The US Army Corps of Engineers jurisdictional delineation (August 13, 2002) confirmed that the project is outside of waters regulated under Section 10.

Coastal Zone Management Act. This act protects coastal environments. While this act transferred regulatory authority to the States and excluded federal installations from the definition of the "coastal zone," it requires that federal actions be consistent with state coastal management plans. Activities taking place within the coastal zone under the definition established by the California Coastal Management Plan require a federal consistency determination. This project will require federal consistency review by the California Coastal Commission. Consistency determination and request for state concurrence will be conducted in conjunction with review of this Environmental Assessment.

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

Wilderness Act of 1964 (P.L. 88-577). Established a National Wilderness Preservation System, allowing Congress to designate wilderness areas for preservation and protection of their natural condition. "The areas shall be administered… in such a manner as will leave them unimpaired for future use and enjoyment as wilderness." Wilderness is defined in the act as "an area where the earth and community of life are untrammelled by man, where man himself is a visitor who does not remain." The Glenbrook Crossing project area and Muddy Hollow Pond Project area trail reroute are within designated wilderness.

Cultural Resources Legislation

Antiquities Act of 1906, PL 59-209, 34 Stat. 225, 16 USC §432 and 43 CFR 3. This act provides for the protection of historic or prehistoric remains, "or any antiquity," on federal lands. It protects historic monuments and ruins on public lands. It was superseded by the Archeological Resources Protection Act (1979) as an alternative federal tool for prosecution of antiquities violations in the National Park System.

Archeological Resources Protection Act of 1979, PL 96-95, 93 Stat. 712, 16 USC §470aa et seq. and 43 CFR 7, subparts A and B, 36 CFR. This act secures the protection of archeological resources on public or Indian lands and fosters increased cooperation and exchange of information between private, government, and the professional community in order to facilitate the enforcement and education of present and future generations. It regulates excavation and collection on public and Indian lands. It requires notification of Indian tribes who may consider a site of religious or cultural importance prior to issuing a permit. The act was amended in 1988 to require the development of plans for surveying public lands for archeological resources and systems for reporting incidents of suspected violations.

National Historic Preservation Act of 1966, as amended, PL 89-665, 80 Stat. 915, 16 USC §470 et seq. and 36 CFR 18, 60, 61, 63, 68, 79, 800. The National Historic Preservation Act requires agencies to take into account the effects of their actions on properties listed in or eligible for listing in the National Register of Historic Places. The Advisory Council on Historic Preservation has developed implementing regulations (36 CFR 800), which allow agencies to develop agreements for consideration of these historic properties. The NPS, in consultation with the Advisory Council, the California State Historic Preservation Officer (SHPO), American Indian tribes and the public, has developed a Programmatic Agreement for operations and maintenance activities on historic structures. This 1995 Programmatic Agreement (available on the web at http://www.achp.gov/npspa1.html) provides a process for compliance with National Historic Preservation Act, and includes stipulations for identification, evaluation, treatment, and mitigation of adverse effects for actions affecting historic properties.

American Indian Religious Freedom Act, PL 95-341, 92 Stat. 469, 42 USC §1996. This act declares policy to protect and preserve the inherent and constitutional right of the American Indian, Eskimo, Aleut, and Native Hawaiian people to believe, express, and exercise their traditional religions. It provides that religious concerns should be accommodated or addressed under NEPA or other appropriate statutes.

Executive Orders

Executive Orders are issued by the Office of the President and apply to all Federal agencies.

Executive Order 11593: Protection and Enhancement of the Cultural Environment. This Executive Order instructs all federal agencies to support the preservation of cultural properties. It directs them to identify and nominate cultural properties under their jurisdiction to the National Register of Historic Places and to "exercise caution… to assure that any federally owned property that might qualify for nomination is not inadvertently transferred, sold, demolished, or substantially altered."

Executive Order 11988: Floodplain Management. This Executive Order requires federal agencies to avoid, to the extent possible, adverse impacts associated with the occupancy and modification of floodplains, and to avoid development in floodplains whenever there is a practical

alternative. If a proposed action is found to be in the applicable regulatory floodplain, the agency shall prepare a floodplain assessment, known as a Statement of Findings (Directors Order 77-2).

Executive Order 11990: Protection of Wetlands. This Executive Order established the protection of wetlands and riparian systems as the official policy of the federal government. It requires all federal agencies to consider wetland protection as an important part of their policies and take action to minimize the destruction, loss or degradation of wetlands, and to preserve and enhance the natural and beneficial values of wetlands. If a proposed action is found to be in the applicable regulatory wetland, the agency shall prepare a wetland assessment, known as a Statement of Findings (Directors Order 77-1).

Executive Order No. 13112: Invasive Species. This Executive Order prevents the introduction of invasive species and directs federal agencies to not authorize, fund, or carry out actions that it believes are likely to cause or promote the introduction or spread of invasive species. Actions proposed in the project include measures to prevent the introduction and spread of invasive species.

Relationship to Other Plans and Policies

Marin County Local Coastal Program, Unit 1 *(LCP)(1980)* supports and encourages the enhancement of public recreational opportunities. Referring to PRNS and GGNRA, the LCP states "public access to these lands seems to be assured." The LCP assumes that a major portion of the access and visitor services needs within Unit I would and can be successfully integrated into federal park development and management programs. The Seashore has determined that the project is within the Coastal Zone and will require federal consistency review by the California Coastal Commission.

Marin County Community Plan. PRNS and the GGNRA North District are part of the Marin County Coastal Recreation Corridor. The Countywide Plan recommends that PRNS and GGNRA lands are retained in their natural state to the greatest extent possible, and that recreation uses be low intensity. The County Community Plan is currently undergoing a revision.

Resources Management Plan. The Resources Management Plan (RMP) for the park was updated in 1999. The RMP presents an inventory and description of natural and cultural resources; describes and evaluates the current resources management program; and prescribes an action program based on legislative mandates, NPS policies, and provisions of related planning documents. The Coastal Watershed Restoration Project is identified in the RMP.

PRNS General Management Plan Update. The planning process to update the 1980 PRNS General Management Plan (GMP) is in progress; scoping for the GMP update has been conducted. The process is expected to take 4-5 years. The Coastal Watershed Restoration is consistent with the mission and objectives of the NPS and the existing GMP. The NPS continues to implement the goals of the 1980 GMP and the direction and guidance it provides, while updating specific actions, such as the Coastal Watershed Restoration, through the NEPA and planning processes in conformance with NPS policies.

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2.0 Alternatives

This chapter summarizes the process through which alternative approaches for the proposed action were developed and screened, and describes the alternatives analyzed in this EA. It also provides brief descriptions of the alternatives that were eliminated from EA analysis and briefly discusses the reasons for their elimination.

2.1 Alternatives Development Process

Alternatives for the proposed action were developed and screened through the NPS's value analysis (VA) process, which is a systematic method of weighing the anticipated benefits and risks of various possible solutions to a defined problem. The VA process consists of four phases.

- **Predesign Phase:** Identify project objectives and formulate potential approaches.
- **Creativity Phase:** Conduct free-ranging evaluation of potential outcomes associated with approaches identified in predesign phase.
- **Evaluation Phase:** Systematically evaluate and screen alternatives to narrow the field and, ultimately, identify a preferred alternative for implementation.
- **Implementation Phase:** Modify the preferred alternative to fine-tune it based on results of evaluation phase and environmental review; implement.

During the predesign phase for the proposed action, NPS and their consultant team performed a range of studies aimed at identifying and evaluating the feasibility of a range of approaches to restoration at the three selected sites. Early work included analyses of erosion and sediment delivery at the Muddy Hollow Pond and Glenbrook Crossing sites (Jones & Stokes and NHC 2003a, 2003b). Additional work for each of the sites (summarized in NHC 2004) included analyzing historic and existing hydraulic/hydrologic and habitat conditions; identifying factors with the potential to constrain successful design and implementation of restoration; and estimating the capital cost of alternative restoration approaches.

Once substantial progress had been made in the predesign phase, the VA team for the proposed action convened. The meeting, which took place at Point Reyes National Seashore on June 3–5, 2003, focused on (1) further evaluating various options for construction methods and materials that had been identified in the predesign phase, and (2) selecting an alternative for further refinement during project design. The following sections provide additional detail on the evaluation process used during this meeting, which encompassed the creativity and evaluation phases of the VA process (National Park Service 2003).

Creativity Phase

The creativity phase of the project VA meeting was dedicated to a speculative (free-ranging or brainstorming-style) analysis that first addressed the risks associated with various possible approaches to coastal stream restoration, and then turned to the function and purpose of the system. Based on the results of these first two tasks, the team then reviewed the alternatives developed in the predesign phase and brainstormed to identify other possible approaches.

Evaluation Phase

During the evaluation phase, the VA team conducted a systematic analysis of all alternatives considered and/or developed in the creativity and predesign phases, in order to eliminate those that were not expected to be feasible or were judged unsuitable for other reasons. Principal guidance for the evaluation came from the project objective of repairing or removing facilities that limit or impair the natural hydrologic function in the Drake's Estero watershed, in order to allow reintroduction and enhancement of threatened aquatic populations, including steelhead and coho salmon. Additional guidance was derived from the following priorities or factors for the protection of cultural and natural resources, which are based on the NPS Mission and Strategic Goals.

- **Factor 1:** Prevent loss of cultural resources.
- **Factor 2:** Maintain and improve condition of natural resources.
- **Factor 3:** Provide visitor services, educational opportunities, and recreational opportunities.
- **Factor 4:** Protect the health, safety, and welfare of the public.
- **Factor 5:** Improve operational efficiency, sustainability, and constructability.
- **Factor 6:** Protect employee health, safety, and welfare.
- **Factor 7:** Provide cost-effective, environmentally responsible, and otherwise beneficial development of the NPS.

Table 2-1 summarizes the evaluation criteria used in the VA process. Additional information is provided in the VA report prepared for the project (National Park Service 2003).

Table 2-1. VA Evaluation Criteria for Project Alternatives

Evaluation Focus	Evaluation Criteria
Floodplains	■ Preserve floodplain values. ■ Minimize potentially hazardous conditions associated with flooding. ■ Comply with the NPS Organic Act and all other federal laws and Executive Orders related to the management of activities in flood-prone areas, including Executive Order 11988 (Floodplain Management), NEPA, and applicable provisions of the Clean Water Act and the Rivers and Harbors Appropriation Act of 1899.

Watershed and stream processes	■ Manage watersheds as complete hydrologic systems. ■ Minimize human disturbance to the natural upland processes that deliver water, sediment, and woody debris to streams, including runoff, erosion, and disturbance to vegetation and soil caused by fire, insects, meteorologic events, and mass movement. ■ Manage streams to protect stream processes that create habitat features such as floodplains, riparian systems, woody debris accumulations, terraces, gravel bars, riffles, and pools. ■ Achieve protection of watershed and stream features primarily by avoiding impacts to watershed and riparian vegetation, and by allowing natural fluvial processes to proceed unimpeded. ■ When conflicts between infrastructure (such as bridges and pipeline crossings) and stream processes are unavoidable, consider relocating or redesigning facilities, rather than manipulating streams. ■ Where stream manipulation is unavoidable, use techniques that are visually non-obtrusive and that protect natural processes to the greatest extent practicable.

The geomorphic criteria shown in Table 2-1 were based on NPS Management Policies requiring that structures and facilities be designed consistent with the intent of the National Flood Insurance Program's standards and criteria (44 CFR Part 60). In addition, screening of facilities for the Glenbrook Crossing site and the trail reroute section of the Muddy Hollow site, that are located in a designated wilderness area, was guided by NPS policies pursuant to the federal Wilderness Act of 1964, which include the following.

> … Authorizations of NPS administrative facilities located in wilderness will be limited to the types and minimum number essential to meet the minimum requirements for the administration of the wilderness area. A decision to construct, maintain, or remove an administrative facility will be based primarily on whether or not such a facility is required to preserve wilderness character or values, not on considerations of administrative convenience, economic effect, or convenience to the public or park staff. Maintenance or the removal of historic structures will also comply with cultural resource protection and preservation policies and directives, and with the concept of minimal requirement management techniques for wildernesses.

2.2 Alternatives Analyzed in this EA

The following sections describe the alternatives identified through the predesign and VA process as meriting detailed analysis and consideration. Alternatives analyzed in this EA include two "build" alternatives (Alternative 1 and Alternative 2) and the "no-build" alternative or No Action Alternative. The two build alternatives incorporate the approaches evaluated during the VA process as most likely to be successful at each of the three project sites. To achieve the most complete analysis of potential environmental effects, the build alternatives analyzed in this document represent a spectrum from a "full-build" approach with more extensive earthwork and construction at all sites (Alternative 1) to a less intensive "partial-build" approach (Alternative 2). To provide the greatest flexibility in implementation, the alternatives were designed to be modular, such that each site-specific component could be implemented independently, depending on what is identified as most likely to be both successful and cost-effective for each site.

For all alternatives, site preparation and construction would occur between August 1 and October 31. For work to begin on site prior to August 1, nest surveys would need to be conducted one week prior to implementation to insure nests are no longer present at the site. The construction window is intended to avoid disturbance of migratory bird nesting, and closes early enough to avoid the beginning of the November–April storm season. In addition, to the extent feasible, work in the channel and tidal marsh plain areas at Limantour Beach and Muddy Hollow would be timed during neap tides, when tidal range is at a minimum and the potential for water quality impacts related to tidal remobilization of soils and sediments disturbed by construction is reduced.

The sections below provide additional information on each build alternative and the No Action Alternative, including likely construction scenarios and estimated costs. Descriptions provided in this document represent the progress of the design phase as of June 2004; further modifications based on ongoing geologic and engineering investigations and materials costs are possible, although these would not change the objectives of the restoration, nor the impact footprint or results described in this document.

Alternative 1: Full-Build Approach

Alternative 1 consists of the following components.

- Partial removal of the culverted embankment crossing at Limantour Beach Marsh, and replacement with single bridge span.
- Removal of the existing earthen dam at Muddy Hollow Pond.
- Removal of the existing earthen embankment at Glenbrook Crossing and restoration of stable channel and floodplain geometry.

Construction of Limantour Beach Bridge Span and Restoration of Marsh Channel

Features and Construction Requirements

At Limantour Beach Marsh, Alternative 1 would entail removing a substantial portion of the existing crossing and replacing it with a single bridge span. The lower berm and a substantial portion of the secondary beach access embankment would also be removed (Figure 2-1; Figure 2-2).

Construction, delivery, and haul vehicles would access the site via Limantour Road and the existing visitor parking area. Construction equipment and materials would be staged in the portion of the parking area closest to the crossing, with public access to the staging area restricted by temporary construction fencing and signage.

Dewatering Pond and Channel

The freshwater pond upstream of the culvert is likely to be dry or nearly dry during the construction period. If water is present either in the pond above or the spillway channel downstream of the culvert, it would be necessary to drain the area before removing the existing crossing. A silt fence–type dewatering barrier would be installed below the crossing, and a portable gasoline-powered pump would be placed on the embankment crossing. The barrier would likely consist of heavy-gauge plastic sheeting mounted on untreated wood stakes and secured along the base with sand bags.

Water pumped from the pond and channel would be conveyed via flexible high-density polyethylene (HDPE) pipe with an approximate diameter of 6 inches to a temporary outfall located outboard of the present location of the lower berm (see Figure 2-2). The pump intake would be equipped with appropriate screening to prevent it from drawing in wildlife and fish species. Depending on the amount of water in the pond and channel, and the pumping rates necessary to drain them in a timely manner, it might be necessary to implement flow dissipation measures to prevent erosion and sediment mobilization at the pump outfall. The most likely approach would be to armor the bed and bank temporarily with sand bags or bales of sterile, weed-free straw.

Once the pond is substantially drained, a stream bypass structure consisting of flexible 6-inch HDPE pipe would be installed to convey any remaining flow in the channel around the construction area and discharge it to the temporary outfall site. The bypass structure would be installed before any earthwork or other construction activity begins. Erosion control would remain in place at the outfall to manage potential effects of concentrated flow.

Removal of Lower Berm

Before excavation to remove the lower berm begins, silt fences would be installed across the tidal marsh plain to contain any remobilized sediment. An excavator and/or scraper would be used to remove the berm embankment. It would work from south (seaward side) to north (landward side), operating from the embankment top to avoid the need for heavy equipment on the marsh plain or in the channel. Excavated materials would be handled as described below for removal of the existing crossing.

Removal of Existing Crossing

Approximately 100 linear feet of the northern (landward) end of the existing crossing embankment and much of the secondary beach access spur would be removed to accommodate bridge construction. The rest of the crossing and the easternmost part of the secondary beach access embankment would remain in place (Figure 2-2), although the pavement would be entirely removed. To the extent feasible, shrubs in the area slated for removal would be mowed or grubbed and incorporated into the topsoil.

The existing crossing embankment would be removed using an excavator and/or scraper. As described above, it would operate from the embankment top, and work would begin at the far (east) end of the secondary beach access trail, proceeding west and then from south to north on the crossing embankment. This would enable the excavator to operate entirely from the embankment, avoiding the need for heavy equipment to enter the marsh plain or channel. Removal would be phased as follows, so formwork for the southern bridge abutment (see below) could be placed by equipment operating from the embankment top.

1. Remove pavement and approximately 200 linear feet of road prism from secondary beach access trail.
2. Remove southern (seaward) end of crossing embankment.
3. Excavate for southern bridge abutment.
4. Place formwork for southern bridge abutment, as described in following section.
5. Remove remainder of embankment, working from south to north.
6. Excavate and place formwork for northern bridge abutment, as described in following section.

Material excavated during removal of the existing embankment would be loaded into dump trucks and removed from the immediate vicinity of the channel and transported to the spoils management area adjacent to the Muddy Hollow Trail, approximately 800 feet northwest of the site, where a

conspicuous cut slope likely represents the original borrow area from which materials used to construct the embankment were obtained. Any salvaged topsoil would be stockpiled separately for use in revegetation. Pavement debris and nonnative aggregate would be disposed of as appropriate. If the excavated materials are too wet for immediate placement as fill, a temporary drying basin would be established at the spoils management area, and they would be dried until ready for placement. Some of the clean excavated materials would be reserved for reuse as fill during bridge construction. The remainder would be placed as engineered fill in the spoils management area. The resulting fill slope would be contoured and terraced to restore the area to a more natural appearance. Depending on site conditions at the time of construction, the upper foot below finished grade could be left uncompacted and stabilized with soil stabilizers approved for use adjacent to surface waters until revegetation is completed. An alternative would be to compact the surface and then disc immediately prior to topsoil application and revegetation (see *Revegetation* below).

Once the existing spillway culvert, which consists of an approximately 50-foot long section of 36-inch corrugated metal pipe (CMP), is exposed by excavation, it would be removed and offhauled for recycling or disposal at an appropriate facility. The excavated area would be refilled and compacted within the access corridor to the new bridge span.

Construction of New Bridge Span

The new bridge would be approximately 8 feet wide and would consist of a single 100 to 120 foot–long span. The frame would be constructed of Cone 10 or equivalent weathering steel. The deck would consist of 3 x 12 timbers selected to maximize strength and longevity, and would be constructed with a finished elevation of approximately 8 feet above mean sea level, allowing 2 feet of freeboard above the highest recorded tide elevation in Drake's Bay.

The bridge foundation is expected to consist of cast concrete spread footings, each supported by driven steel pipe piles. The piles would be seated using an excavator with a crane attachment and would be driven with a hydraulic pile driver. The footings would be cast in place. Formwork components and rebar would be placed by an excavator with a crane attachment, operating from the embankment top and/or existing roadway. As described above, embankment removal would be phased to allow formwork for the southern bridge abutment (see below) to be placed from the embankment top. Concrete would be pumped into the formwork from a concrete truck on the existing roadway.

Materials required for bridge construction would be delivered via flatbed trucks and would be staged along with construction equipment in the temporary laydown area established in the existing Limantour Beach parking area.

Red Legged Frog Habitat Enhancement

Proposed restoration actions would result in direct impacts to documented California red-legged frog breeding habitat. While the proposed actions are intended to restore natural hydrologic process, which would mainly be tidal, there will be freshwater resources that remain adjacent to the site. In order to mitigate impacts to frog breeding habitat, excavation of appropriate sites would be conducted as part of the project to hold freshwater that could act as breeding habitat. East of, and adjacent to the current marsh, staff would excavate pits that would be potential breeding habitat for the frogs. In addition, areas east of the current channel leading to the Limantour Beach Pond would be excavated to hold water. These areas would be isolated from the tidal areas and would not affect connectivity of the system. Instead, these areas would be located in low-energy areas and not expected to fill up with large amounts of sediment. Digging closer to the groundwater table would allow these systems to remain wet. Freshwater would be available making this breeding habitat viable.

The NPS is currently in the process of assessing frog pond conditions within the wilderness areas adjacent to the project area. This assessment would also inform the implementation process.

Revegetation and Erosion Control

After bridge construction is complete, the marsh channel would be allowed to revegetate by natural recruitment.

Following fill placement and slope recontouring, the spoils management area adjacent to the Muddy Hollow Trail would be topsoiled as feasible, using the topsoil collected during removal of the embankment crossing. If a need is identified, the surface would also be seeded with a locally native mix and mulched. As shown in Table 2-2, appropriate species include coastal bush lupine (*Lupinus arboreus*), California sagebrush (*Artemisia californica)*, coyote brush (*Baccharis pilularis*) and bush monkeyflower (*Diplaudicus aurantiacus*). Poison-oak (*Toxicodendron diversilobum*) would likely recruit to the site naturally.

Table 2-2. Seed Specifications for Use in Revegetation, by Habitat

Habitat	Appropriate Seed Mix
Marsh channel	Natural recruitment
Marsh plain	Natural recruitment
Stream channel and adjacent floodplain	Natural recruitment
Riparian and terrace slopes	Sterile, fast-growing erosion control mix (Regreen or equivalent)
Upland slope	Locally native seed mix[a] including ■ bush monkeyflower (*Diplaudicus aurantiacus*) ■ blue blossom (*Ceanothus thrysiflorus*) ■ Coyote brush (*Baccharis pilularis*) ■ coastal bush lupine (*Lupinus arboreus*)

[a] All seed should be collected from the Drake's Estero watershed.

Mulch would consist of sterile, weed-free straw. Revegetation would not take place at the spoils management area until excavated materials from both the Limantour Beach Marsh site and the Muddy Hollow site have been accommodated. Coir logs and other erosion control measures would be installed as needed on the slope and at the toe of the slope to prevent excessive sediment runoff until vegetation reestablishes. If necessary, the area could also be seeded with a sterile, fast-growing erosion control mix that would germinate quickly to provide added stabilization, but would not reproduce and thus would not impede establishment of the desired native species.

Topsoiled and/or seeded areas would be monitored following standard NPS protocols to ensure that vegetation establishes successfully. Topsoiling would provide a natural seedbank and if used is expected to foster rapid establishment of vegetation.

Construction Closures

For the Limantour Beach Marsh site, Alternative 1 would require closure of approximately half of the north Limantour Beach parking lot for the duration of the construction window (3–4 weeks), to

provide the necessary area for staging of construction equipment and materials. The other half of the parking area, and the restroom facilities, would remain open for use by the public. Temporary construction fencing and signage would be used to restrict public access to the staging area and the active construction area beyond. The north Limantour Beach access trail and the lower Muddy Hollow Trail would probably also be closed throughout the construction window; signage would also redirect visitors to the south Limantour Beach access 0.5 mile to the south. It may be necessary to close Limantour Road briefly during delivery of some bridge components; in this event, the construction contractor would be required to coordinate delivery(ies) with county, state, and NPS law enforcement staff as appropriate.

During construction, the south Limantour Beach access would remain open, providing recreational access to the beach outboard of the active construction area. If necessary, grassy areas at the south access point would be mowed to provide additional parking.

Removal of Muddy Hollow Dam

Features and Construction Requirements

At Muddy Hollow, Alternative 1 would entail draining the reservoir (Muddy Hollow Pond) and removing the existing earthen dam to restore full hydraulic connectivity between the upper portion of the watershed and the Estero proper (Figure 2-3). Dam removal would take place within a single construction season. Channel geometry and function are expected to evolve and readjust by natural processes following the restoration of drainage connectivity. A check structure or structures would be installed on the former reservoir floor to trap coarse sediment and assist the development of floodplain areas for revegetation. The Estero Trail, which now crosses Muddy Hollow via the dam embankment, would be rerouted.

Construction, delivery, and haul vehicles would access the site via the Lower Muddy Hollow Trail, so the lower portion of the trail would be closed during construction. Construction materials and equipment would be staged at the north end of the existing Limantour Beach parking lot, with public access to the staging area restricted by temporary construction fencing and signage.

Construction of Alternative 1 would be followed by an adaptive management phase as the restored system readjusts and moves to a new equilibrium. It should be noted that only the Estero Trail reroute portion of the project would be conducted within the Wilderness Boundary. All proposed work upstream of the dam including adaptive management monitoring and implementation would be conducted in the Environmental Protection—Natural Environment.

Reservoir Dewatering and Streamflow Bypass

Before removing the existing dam, it would be necessary to drain the reservoir and isolate the tidal channel reaches immediately below the dam. Multiple siphon tubes would be set up at this site to initiate the pond dewatering process. A likely method for draining the reservoir (approximately 20 acre-feet of water) would be initially to use portable gasoline-powered pumps placed on the dam top to lower the water below the spillway. Water pumped from the reservoir would be conveyed via 6-inch flexible HDPE pipes to a temporary outfall located on the largest existing tidal channel, downstream of the reach slated for recontouring. Dewatering barriers similar to those described above for the Limantour Beach Marsh site would be positioned downstream of the channel reaches to be recontoured, and an additional pump would be used to dewater any channels containing water, discharging to the same temporary outfall. Pump intakes would be equipped with screening to prevent them from drawing in wildlife. In addition, flow dissipation measures would be implemented to prevent erosion and sediment mobilization at the pump outfall. The most likely approach would be to armor the bed and bank temporarily with sand bags or bales of sterile, weed-free straw.

Once the reservoir is substantially drained, a stream bypass structure consisting of flexible 18- to 24-inch HDPE pipe would be installed to convey remaining low flow in the stream channel around the construction area and discharge it into the upper Estero below the dam site. Park biologists would survey the habitat to recover and move fish and aquatic species to existing suitable habitat. Silt fences would be installed on the tidal marsh plain below the dam site to prevent sediment and soil disturbed during dam removal or other construction activities from entering the Estero system. The bypass structure and silt fences would be installed before any earthwork or other construction activity begins.

Removal of Existing Dam

Before excavation begins, trees would be removed from the dam embankment and stockpiled for reuse in the construction of check structures (see following section). To the extent feasible, shrubs would be mowed or grubbed and incorporated into the topsoil. Any salvageable topsoil would then be removed and stockpiled separately at the spoils management site (adjacent to the Muddy Hollow Trail, approximately 1,000 feet south of the site) for use during revegetation.

Dam removal would begin with excavation of sufficient material from the top of the dam to backfill the existing spillway. The dam would then be removed by an excavator and/or scraper operating from the dam top, working from the west abutment back toward the east abutment. Filling the existing spillway would enable complete removal of the dam without the need for heavy equipment to enter the channel or marsh plain area.

Excavated materials would be moved to the spoils management area, where they would be placed as engineered fill. The total volume of material removed from the dam embankment and placed as fill in the spoils management area is expected to be approximately 9,700 cubic yards.

If excavated materials are too wet for immediate placement as fill, a temporary drying basin would be established at the spoils management area, and they would be dried until ready for placement. As described above, the new fill slope would be contoured and terraced, restoring the original borrow area to a more natural appearance. Depending on site conditions at the time of construction, the upper foot below finished grade could be left uncompacted and stabilized with soil stabilizers approved for use adjacent to surface waters until revegetation is completed. An alternative would be to compact the surface and then disc immediately prior to topsoil application and revegetation (see *Revegetation* below).

Construction of Check Structure(s)

Following dam removal, a check structure or series of check structures would be constructed across the former reservoir floor, approximately transverse to flow, as shown in Figure 2-4. The check structure(s) would foster the development of channel meanders and would also serve to trap coarse sediment except at high flood stages, contributing to the development of a functional fluvial drainage and buffering sediment loading to tidal environments downstream.

The check structures are envisioned as roughened, low-relief features with some degree of permeability. They could be constructed as brush check dams anchored by keying into the substrate, or could consist of tied and anchored trees, cruciforms, or driven posts or piles and rails. Construction would rely primarily on hand techniques, and most if not all of the materials would be obtained from the immediate project site. This “low-tech” approach to constructing the check structures is intended to result in structures that would gradually degrade following channel readjustment, releasing sediment in limited amounts over an extended period of time.

A check structure would be constructed across the former pond bottom near the end of the Muddy Hollow Delta (see Figure 2-4). Installation of additional check structures may be required in the future based on site performance and monitoring as described in the adaptive management section below.

Estero Trail Reroute

Because the Estero Trail alignment now crosses the Muddy Hollow drainage via the dam embankment, it would be necessary to reroute a portion of the trail to keep it in service following dam removal. The proposed new alignment is shown as a 200 foot–wide planning corridor in Figure 2-5. The new alignment is located primarily within the Philip Burton Wilderness, and the trail would be designed and constructed to be a sustainable facility that requires a minimum of maintenance by hand crews only, compatible with NPS policies for wilderness uses.

The new trail is proposed to cross Muddy Hollow Creek in the developed area at the Muddy Hollow pump station. A wet crossing (similar to Muddy Hollow Trail crossing) or bridge would be installed at this site to ensure that fish passage is maintained on the restored system. In the case of a bridge, footings would be installed on the terrace benches above the ordinary high water mark, avoiding the need to place fill in jurisdictional wetlands or waters. In the case of a wet crossing, an alignment across the creek that minimizes delivery of upland sediment to the creek would be implemented.

Trail design would be consistent with NPS and State park guidelines for hiker/equestrian trail uses, which recommend a 3-4 foot–wide trail tread. Based on the geology and soils in the area, it is recommended that a full bench-cut be used on steep slopes and a one-half to three-quarters bench cut on gentler slopes. Because the trail is expected to accommodate heavy use by hikers and equestrians, a compacted gravel surface with geotextile fabric or an equivalent may be needed to protect against excessive wear and erosion in certain areas.

Construction methods are evaluated in light of the minimum tool requirement for work in wilderness areas (Appendix B). Proposed construction techniques include vegetation clearing by mower and by hand, followed by the combination of specialized trail construction equipment such as a Sweco dozer and hand crew work, to establish the new trail tread. Proposed construction requirements are informed by localized experience related to vegetation density, soil types, and slope stability. These methods are consistent with recommendations within the Seashore and the Trail Inventory and Condition Assessment Report (NPS 2003).

Revegetation and Erosion Control

Areas disturbed by earthwork or any other construction activity would be topsoiled as feasible, using the topsoil salvaged during dam removal. If necessary, an area may also be seeded with a locally native mix and mulched. Appropriate seed species are shown in Table 2-2. Mulch would consist of sterile, weed-free straw.

Following fill placement and slope recontouring, the spoils management area adjacent to the Muddy Hollow Trail would be topsoiled and/or seeded with a locally native mix and mulched, as described above. Revegetation would not take place at the spoils management area until excavated materials from both the Limantour Beach Marsh site and the Muddy Hollow site have been accommodated. Coir logs and other erosion control measures would be installed as needed on the slope and at the toe of the slope to prevent excessive sediment runoff until vegetation reestablishes. If necessary, the area could also be seeded with a sterile, fast-growing erosion control mix that would germinate quickly to provide added stabilization, but would not reproduce and thus would not impede establishment of the desired native species.

Following revegetation, topsoiled and/or seeded areas would be monitored following standard NPS protocols to ensure that vegetation establishes successfully. Topsoiling would provide a natural seedbank and if used is expected to foster rapid establishment of vegetation.

Construction Closures

Facilities closures for removal of the Muddy Hollow Dam would be the same as those described above for work at the Limantour Beach Marsh site, since both sites are accessed via the same parking lot and trails. Under Alternative 1, construction at Muddy Hollow would require 2–3 weeks.

Adaptive Management

The purpose of the adaptive management program at Muddy Hollow is to monitor channel adjustments and allow NPS to take action when necessary to slow rates of channel incision and erosion through the delta and reduce annual sediment delivery to Muddy Hollow Creek and the tidal marsh downstream.

NPS expects the stream system to be highly dynamic in the first years following restoration, particularly before vegetation is fully reestablished, so an active program of adaptive management treatments would likely be needed. Potential treatments would be based on observed needs and would employ locally harvested materials such as willow (*Salix* spp.) and alder (*Alnus* sp.) wood and debris. Treatments could be implemented either by NPS staff, or by a contractor. If a contractor is used, the preference would be to retain the same contractor who is responsible for restoration construction to support monitoring and adaptive management, in order to provide continuity of vision and capitalize on the contractor's experience with the sites.

Monitoring and adaptive management are expected to proceed in three phases: initial development, incision management, and channel widening management. Each phase would be initiated based on the restored system's geomorphic development, so different reaches of the system are expected to undergo the various monitoring phases at different times, as they develop progressively. Table 2-3 presents the nature and duration of each monitoring phase, identifies action triggers, and summarizes the corrective actions expected to be appropriate.

Table 2-3. Monitoring and Adaptive Management Program for Muddy Hollow Site

Monitoring Phase	Anticipated Duration	Factor(s) Evaluated	Action Triggers and Corrective Measures
Initial development	Post-construction, until the channel is deep enough that any needed works can be constructed inchannel without forcing flow out of the channel (4–5 feet near dam site, 2–3 feet upstream).	Development of a single channel through the aggraded sediment prism, starting at downstream end.	No substantial works are anticipated, although some clearing of woody brush or debris may be needed if the channel avulses excessively.

Monitoring Phase	Anticipated Duration	Factor(s) Evaluated	Action Triggers and Corrective Measures
Incision management	Following initial development, until channel bed has stabilized	Location of knickpoint in channel monitored for initial development; effectiveness of previously constructed measures in slowing channel incision and trapping sediment; potential for previously constructed measures to act as fish passage barriers.	If the knickpoint migrates too rapidly upstream (i.e., channel incision is too rapid), grade control structures should be constructed at the knickpoint; recommended structures include branch layers or branch packing structures, anchored by poles keyed into the banks. Sediment trapping structures may also be needed downstream of the knickpoint; recommended structures would be similar to pole palisades or live palisades. More substantial structures constructed of poles backfilled with native bed material may be used if palisades prove to be ineffective. Previously constructed measures identified as ineffective should be replaced or modified. If barriers to fish passage are identified, structures should be replaced or modified.
Channel widening management * *this is the most intensive measure and would only be used in extreme cases.	1–2 years following completion of incision management phase	Channel bank stability; channel width	If bank erosion occurs as a result of lateral scour around structures installed to manage incision, the original structure(s) should be modified. If bank erosion results from scour around logjams, the logjam should be removed or modified and the woody material laid along the eroding bank with rootwads in the channel at the bank toe and opposite ends anchored to stable trees in place along the bank. If sediment delivered to downstream areas by bank erosion appears to be important to channel development, bank erosion should be allowed to continue, and ■ existing riparian trees should be cut and used to stabilize the bank, as described above; or ■ existing trees should be anchored while still in place such that they would protect the bank when they fall.

Each adaptive management phase would entail the following steps.

- **Conduct Monitoring—**Inspect the channel following significant storms to determine whether management intervention is required, and if so, what actions are appropriate and where they should be applied.
- **Implement Adaptive Measures—**Construct management measures with materials harvested in the Muddy Hollow watershed, primarily using hand labor and hand tools. As with the check structures included in the initial phase of project construction, this "low-tech" approach to constructing the check structures is intended to result in structures that would degrade over time following channel readjustment, gradually releasing impounded sediment back into transport.
- **Continue Monitoring—**Inspect the constructed measures and the progress of incision and erosion along the new channel; determine whether additional

maintenance or measures are required, and if so, what actions are appropriate and where they should be applied.

- **Implement Additional Measures, as Needed—**Based on the results of monitoring, modify existing measures (check structures, etc.), replace with alternative designs, and/or construct additional measures in other locations, if needed. Any additional structures should be constructed using materials harvested in the Muddy Hollow corridor, and hand techniques.

Creation of Stable Channel and Floodplain Geometry at Glenbrook Crossing Site

The Glenbrook Crossing site is a non-conforming structure located entirely within the Philip Burton Wilderness Area. Alternative 1 would entail removing the existing culverted Glenbrook crossing, and recontouring the channel and floodplain via excavation and fill placement to approximate a geomorphically stable condition (Figure 2-6, Figure 2-7). The Muddy Hollow trail would be rerouted where it crosses Glenbrook Creek. Construction, delivery, and haul vehicles would access the site from Limantour Road via the existing Muddy Hollow trail (Figure 2-8). A temporary construction access crossing would be required to cross Muddy Hollow Creek adjacent to the Muddy Hollow Parking area, to avoid disturbance of channel and streambank habitat. If necessary, sections of the road would be graded to accommodate construction vehicles; level of effort would not exceed standard fire road maintenance procedures for Point Reyes National Seashore.

Construction materials and equipment would be staged approximately 1,000 feet east of the crossing site, on the south side of the road. Public access to the staging area would be restricted by temporary construction fencing and signage.

Specific measures would be implemented at the Glenbrook Crossing site to mitigate for impacts to wilderness associated with this proposed restoration action. Workers would stage at the Lower Muddy Hollow Parking Lot and take a shuttle into the work area. Trips along the Muddy Hollow Trail corridor would be minimized to the greatest extent possible. Within the construction area, activities and equipment should be appropriate to accomplish the objectives of the project in the best manner and shortest time possible. Analysis of Wilderness Minimum Requirements and Minimum Tool is included as Appendix B of this Environmental Assessment.

Features and Construction Requirements

Streamflow Bypass and Water Quality Protection

Before construction begins, a bypass consisting of flexible 24-inch HDPE pipe would be installed to convey streamflow around the construction area, beginning approximately 700 feet upstream of the crossing site and discharging at a temporary outfall approximately 850 feet downstream of the crossing, below the construction area. Depending on the amount of flow in the channel, it might be necessary to implement flow dissipation measures to prevent erosion and sediment mobilization at the outfall. As described for the Limantour Beach Marsh and Muddy Hollow sites, the most likely approach would be to armor the bed and bank temporarily with sand bags or bales of sterile, weed-free straw.

Following installation of the bypass, the channel reaches up- and downstream of the crossing would be coffer-dammed and dewatered, using equipment similar to that described above for Muddy Hollow and Limantour Beach dewatering. Park biologists would survey the stream reaches during dewatering, to recover and move fish and aquatic species to existing suitable habitat. Water pumped from the channel would be discharged to the creek at the temporary outfall described above.

Subsurface flows of shallow groundwater are considered likely after diversion of surface flow, especially during the early part of the construction season. Consequently, it may be necessary to supplement the surface bypass by installing additional dewatering facilities to control subsurface flows in the vicinity of the construction area and enable heavy equipment to operate in lowland areas. Information on subsurface conditions and likely dewatering needs is being collected as part of the engineering geologic and geotechnical studies in progress for the project.

Removal of Existing Road Embankment and Culvert

The existing road embankment, except for the easternmost portion, would be removed using an excavator and/or scraper operating from the embankment top. Removal would begin on the west abutment and proceed toward the east, enabling equipment to work entirely from the embankment top and adjacent roadway, without entering the channel area. The east end of the embankment would be recontoured to create an access ramp for equipment entering the area upstream from the crossing (see *Channel and Floodplain Recontouring* below).

Existing concrete riprap and any other imported material removed during excavation would be offhauled for appropriate recycling or disposal. A small volume of the clean excavated material would be placed as engineered fill to backfill the side gully downstream of the crossing. The remainder would be transported to the designated spoils management area, approximately 1,000 feet east of the site on the south side of Muddy Hollow Road. There, it would be placed as engineered fill along the toe of the existing cut slope, adjacent to the trail. This area is believed to have been the original borrow site for material used to construct the embankment and nearby dams; fill would be contoured to restore the slope to a more natural-appearing topography, and the slope would be topsoiled and/or revegetated with a locally native seed mix (see *Revegetation* below). Coir logs and other erosion control measures would be installed as needed on the slope and at the toe of the slope to prevent excessive sediment runoff until vegetation reestablishes. If it is necessary to stockpile excavated materials temporarily to allow them to dry before they are placed and compacted, a temporary drying basin would be established in the spoils management area.

Once the culvert is exposed by excavation, it would be removed and offhauled for recycling or disposal at an appropriate facility.

Channel and Floodplain Recontouring

Following removal of the existing embankment and culvert, the drainage up- and downstream of the crossing would be recontoured to create a channel and floodplain geometry appropriate to the gradient, size, and discharge of the overall system, allowing natural hydraulic function to resume. This would include the following activities.

1. Excavating accumulated sediment upstream of the crossing to create an inset floodplain with a total width of approximately 45 feet, consistent with NHCs (2004) modeling results and the characteristics of other similar drainages in the area.
2. Within the inset floodplain, excavating to create a low-flow channel approximately 10 feet wide, with a thalweg depth of 2 feet and a gradient of approximately 2%, designed to contain flows up to and including the 2-year flood.
3. Creating a 2:1 (horizontal:vertical) slope connecting the excavated floodplain to the existing upper portion of the floodplain or terrace along Glenbrook Creek. (The old terrace and floodplain are typically 5–8 feet above the excavated floodplain, and would rarely be flooded.)

Downstream of the crossing site, onsite fill would be placed in approximately 850 linear feet of the channel to raise the bed and reduce the invert gradient to a slope of approximately 2%. As a

result of fill placement, the invert elevation immediately below the crossing site would be increased by 8 feet.

Several mature red alders (*Alnus rubra*) would be removed to permit channel and floodplain recontouring. Some of the resulting woody material would be left in place on the newly contoured floodplain for natural recruitment into the stream system. Additional large pieces of woody material, or a combination of woody debris and boulders (Flosi et.al. 1998), would be used to construct eight grade control structures designed to resemble buried debris jams below the crossing site, and another nine upstream. The grade control structures would be installed at intervals of approximately 100 feet along the channel, with drops of less than 2 feet between the crests of adjacent structures. Following channel reconstruction, erosion control measures such as coir fiber logs would be installed in the newly created channel to reduce sediment entrainment and erosion.

Glenbrook Crossing Trail Reroute

Restoration at the Glenbrook Crossing site would require realigning a portion of the Muddy Hollow Trail, which now crosses Glenbrook Creek via the embankment slated for removal. The proposed alignment is shown as a 200 foot–wide planning corridor on Figure 2-8. It would leave the existing alignment near the intersection with the Bucklin trail, immediately east of the spoils management area, and would follow contours, descending gradually towards the floodplain area and cross Glenbrook Creek near the original crossing area. The new alignment would be located entirely within the Philip Burton Wilderness, and the trail would be designed and constructed to be a sustainable facility that requires a minimum of maintenance by hand crews only, compatible with NPS policies for wilderness uses.

The trail would cross Glenbrook Creek using either a bridge or wet crossing upstream of the former site. The bridge crossing is proposed to ensure fish passage on this perennial creek and to minimize the effects of heavy trail usage on creek and riparian habitats. In the case of a bridge, footings would be installed on the terrace benches above the ordinary high water mark, avoiding the need to place fill in jurisdictional wetlands or waters. In the case of a wet crossing, an alignment across the creek that minimizes delivery of upland sediment to the creek would be implemented.

Trail design would be consistent with NPS and State park guidelines for hiker/equestrian trail uses, which recommend a 3-4 foot–wide trail tread. Based on the geology and soils in the area, it is recommended that a full bench-cut be used on steep slopes and a one-half to three-quarters bench cut on gentler slopes. Because the trail is expected to accommodate heavy use by hikers and equestrians, a compacted gravel surface with geotextile fabric or an equivalent may be needed to protect against excessive wear and erosion in certain areas.

Construction methods are evaluated in light of the minimum tool requirement for work in wilderness areas (Appendix B). Proposed construction techniques include vegetation clearing by mower and by hand, followed by the combination of specialized trail construction equipment such as a Sweco dozer and hand crew work, to establish the new trail tread. Proposed construction requirements are informed by localized experience related to vegetation density, soil types, and slope stability. These methods are consistent with recommendations within the Seashore and the Trail Inventory and Condition Assessment Report (NPS 2003).

Revegetation and Erosion Control

After channel and floodplain recontouring is complete, the channel and adjacent floodplain area would be allowed to revegetate by natural recruitment. A sterile, fast-growing erosion control mix would be applied to the terrace slopes if judged necessary.

Following fill placement and slope recontouring, the spoils management area adjacent to Muddy Hollow Road would be seeded with a locally native mix and mulched. If feasible, topsoiling could also be implemented at Glenbrook Crossing, as described above for the other two sites. Appropriate seed species are shown in Table 2-2. Mulch would consist of sterile, weed-free straw. Erosion control would be installed as needed, and could include coir logs, fabrics, or use of a sterile, fast-growing erosion control seed mix. Any additional areas disturbed by staging, earthwork, or other construction activities would be similarly treated.

Following revegetation, seeded and/or topsoiled areas would be monitored following standard NPS protocols to ensure that vegetation establishes successfully.

Construction Closures

Work at Glenbrook Crossing would require closure of the Muddy Hollow Trail and reduction of available parking at the Muddy Hollow Trailhead for the duration of construction, expected to be a total of 3–4 weeks. As discussed above, the site is located in a designated wilderness area, so wilderness treatment procedures would apply during trail closures.

Adaptive Management

The measurable result of adaptive management at the Glenbrook Crossing site is to slow rates of channel incision and erosion, matching the sediment volumes resulting from incision and widening as closely as possible to sediment transport capacity, and controlling sediment loading to lower Glenbrook Creek. As at Muddy Hollow, adaptive management at the Glenbrook Crossing site would proceed in three phases: initial development, incision management, and channel widening management, summarized in Table 2-4. NPS expects the system to be highly dynamic in the first years following restoration, particularly before vegetation is fully reestablished, so an active program of adaptive management measures would likely be implemented. Treatments would be based on observed needs and would employ locally harvested materials such as willow and alder wood and debris.

Table 2-4. Monitoring and Adaptive Management Program for Glenbrook Crossing

Monitoring Phase	Anticipated Duration	Factor(s) Evaluated	Action Triggers and Corrective Measures
Initial development	Post-construction, until the channel is deep enough that any needed works can be constructed within the channel without forcing flow out of the channel (4–5 feet near crossing site, 2–3 feet upstream).	Development of channel through the aggraded sediment prism, starting at downstream end.	No substantial works are anticipated, although it may be necessary to clear brush or remove woody debris if the channel avulses.
Incision management	Following initial development, until channel bed has stabilized	Location of channel knickpoint; effectiveness of previously constructed measures in slowing channel incision and trapping sediment; potential for previously constructed measures to act as fish passage barriers.	If the knickpoint migrates too rapidly upstream (i.e., channel incision is too rapid), grade control structures should be constructed at the knickpoint; recommended structures include branch layers or branch packing structures, anchored by poles keyed into the banks. Sediment trapping structures may also be needed downstream of the knickpoint; recommended structures would be similar to pole palisades or live palisades. More substantial structures constructed of poles backfilled with native bed material may be

Monitoring Phase	Anticipated Duration	Factor(s) Evaluated	Action Triggers and Corrective Measures
			used if palisades prove to be ineffective. Previously constructed measures identified as ineffective should be replaced or modified. If barriers to fish passage are identified, structures should be replaced or modified.
Channel widening management	1–2 years following completion of incision management phase	Channel bank stability; channel width	If excessive bank erosion or lateral channel migration occurs, measures should be installed to control scour. Recommended measures include woody debris structures constructed of individual trees placed in an overlapping configuration along the bank, with their rootwads at the bank toe. Riparian trees can also be anchored so that as the bank retreats, they fall over to protect the bank from further erosion.

Each adaptive management phase at Glenbrook Crossing would entail the following steps.

- **Conduct Monitoring—**Inspect the channel following significant storms to determine whether management intervention is required, and if so, what actions are appropriate and where they should be applied.
- **Implement Adaptive Measures—**Construct management measures with locally harvested materials, using hand labor and hand tools. This "low-tech" approach to constructing management works is intended to result in structures that would degrade over time following channel readjustment, gradually releasing any impounded sediment back into transport.
- **Continue Monitoring—**Inspect the constructed measures and the progress of incision and erosion along the restored channel; determine whether additional maintenance or measures are required, and if so, what actions are appropriate and where they should be applied.
- **Implement Additional Measures, as Needed—**Based on the results of monitoring, modify existing measures (check structures, etc.), replace with alternative designs, and/or construct additional measures in other locations, if needed. Any additional structures should be constructed using locally harvested materials and hand techniques.

Alternative 2: Partial Build Approach

Alternative 2 consists of the following components.

- Replacement of the culverted crossing at Limantour Beach Marsh with a boardwalk.
- Phased removal of the Muddy Hollow Dam, with stream and tidal channel function restored over time as a result of natural processes.
- Removal of the existing earthen embankment at the Glenbrook Crossing, followed by balanced excavation and fill to restore the creek channel.

Construction of Boardwalk at Limantour Beach Marsh

Features and Construction Requirements

At Limantour Beach Marsh, Alternative 2 would entail draining the freshwater pond, spillway, and channel immediately downstream of the spillway, if water is present; removing the lower berm; removing the existing embankment crossing and culvert; and constructing a new boardwalk to provide pedestrian access to the beach. As described for Alternative 1, equipment and materials would be staged from the portion of the parking lot closest to the crossing; public access to the staging area would be restricted by temporary construction fencing and signage.

Dewatering Pond and Channel

Pond and channel dewatering at Limantour Beach Marsh would be the same under Alternative 2 as those described above for Alternative 1.

Removal of Lower Berm

Removal of the lower berm at Limantour Beach Marsh would be the same under Alternative 2 as those described above for Alternative 1.

Removal of Existing Crossing

The existing crossing embankment would be removed to accommodate boardwalk construction (Figure 2-1). Most of the secondary beach access trail embankment would also be removed.

Before earthwork to remove the crossing begins, shrubs would be mowed or grubbed and incorporated into the site topsoil as feasible. As much topsoil as possible would be salvaged for use during revegetation.

An excavator would be used to remove the crossing and trail embankments. As described for Alternative 1, it would operate from the embankment top, beginning at the far end of the secondary beach access trail and working first west (toward the crossing embankment) and then north (from the seaward end of the crossing toward the landward end). This would enable the excavator to operate entirely from the embankments, avoiding the need for heavy equipment to enter the marsh plain or channel. Removal would be phased as follows, so formwork for the southern bridge abutment (see below) could be placed by equipment operating from the embankment top.

1. Remove pavement and approximately 200 linear feet of road prism from easterly spur.
2. Remove existing crossing and culvert, working from south to north.

Material excavated during removal of the existing embankment would be handled as described above for Alternative 1. Culvert removal would also proceed as described for Alternative 1.

Boardwalk Construction

The new boardwalk would be 270 feet long and 8 feet wide, and would be equipped with a 3-foot-high safety railing consistent with ADA standards on each side. It would be constructed of sustainable materials and supported on driven steel pipe, wood or recycled plastic piles. Boardwalk piles would be driven with a hydraulic pile driver. Boardwalk construction would proceed at the level of the deck, and would avoid placement of equipment within the wetland areas.

Over the active tidal channel, the finished elevation of the boardwalk deck would be approximately 8 feet above MSL, about 2 feet above the level of the highest tide recorded in

Drake's Bay; the deck would curve gently upward to the south to follow the contour of the dune surface. Although public access would be restricted to pedestrian and equestrian use, the boardwalk would be designed to support limited vehicle traffic (all-terrain vehicles or small pick-up trucks) to allow NPS staff access for maintenance and management activities.

Red Legged Frog Habitat Enhancement

Red-legged frog habitat enhancement would be the same under Alternative 2 as those described above for Alternative 1.

Revegetation and Erosion Control

Revegetation and Erosion Control at Limantour Beach Marsh would be the same under Alternative 2 as those described above for Alternative 1.

Construction Closures

Construction closures for work at Limantour Beach Marsh would be the same under Alternative 2 as those described above for Alternative 1.

Phased Removal of Muddy Hollow Dam

At the Muddy Hollow site, Alternative 2 would entail phased removal of the existing dam, rather than removal in a single construction year as described under Alternative 1. During the first year (Phase 1) of the project, a low-level outlet would be installed to permit the reservoir to drain except during flood periods. Following an adjustment period, during which the reservoir bottom would be allowed to revegetate and the channel system would adjust to restored tidal exchange, the dam would be completely removed (Phase 2). As described under Alternative 1, the lower Muddy Hollow Trail would be rerouted.

Phase 1: Installation of Low-Level Outlet and Reservoir Dewatering

Water Quality Protection and Culvert Installation

The low-level outlet would consist of a culvert equipped with a slide gate. It would be sited to discharge into the largest tidal channel downstream of the existing dam.

Before culvert installation begins, it would be necessary to dewater the portion of the reservoir adjacent to the work area, as well as the adjacent downstream tidal channel reach. Coffer dams or silt fences would be installed around the work area in the reservoir and across the tidal channel downstream of the reservoir. The coffer-dammed portion of the reservoir would be drained using portable gasoline-powered pumps located on the dam top. Water pumped from the reservoir would be conveyed via 6-inch flexible HDPE pipes to a temporary outfall located on the largest existing tidal channel, downstream of the work area. The same system would then be used to dewater the channel reach. As described for Alternative 1, pump intakes would be equipped with NPS-approved screening to prevent them from drawing in wildlife. In addition, flow dissipation measures would be implemented to prevent erosion and sediment mobilization at the pump outfall. The most likely approach would be to armor the bed and bank temporarily with sand bags or bales of sterile, weed-free straw.

Silt fences would be installed on the tidal marsh plain below the dam site to prevent sediment and soil disturbed during construction activities from entering the Estero tidal system. The silt fences would be installed before any earthwork or other construction activity begins.

Following dewatering, the portion of the existing embankment in the work area would be excavated, using an excavator operating from the embankment top. The culvert for the temporary low-level outlet would then be placed, using an excavator with a crane attachment or a crane. The culvert would consist of CMP and would be sized to carry flows up to and including those expected from the 1-year storm event, and to cause backwater in the reservoir area during larger storms. Based on modeling by NHC (2002), this would require a working diameter of 48 inches. The culvert would be installed with approximately 1 foot of the culvert barrel buried below finished grade; consequently, the actual diameter of the culvert pipe would likely be on the order of 60 inches. The finished invert elevation would be consistent with that of the immediately adjacent downstream tidal channel reach.

Following culvert placement, the excavation would be backfilled with onsite materials temporarily stockpiled in the spoils management area for reuse. Fill would be compacted with walk-behind pneumatic compactors and/or rollers. The surface of the dam would be seeded with an appropriate locally native seed mix and mulched with sterile, weed-free straw.

Reservoir Dewatering

The reservoir would be dewatered via the low-level culvert outlet, using the slide gate to regulate flow and prevent excessive erosion or channel migration. To ensure that dewatering is proceeding as expected, and that no adverse changes in downstream channel function or sediment mobility have occurred, NPS intends to monitor the site on a monthly basis and following large storm events.

Construction of Check Structure(s)

Like Alternative 1, Alternative 2 would entail construction of a check structure or series of check structures across the former reservoir floor after dam removal, to develop channel meanders and trap coarse sediment, buffering effects on the downstream system. Construction of check structures would likely begin in the upstream portion of the former reservoir area in Year 1, following partial dewatering, and continue as the system evolves in subsequent years. Check structures would be similar under Alternative 2 to those described above for Alternative 1, and would be designed to degrade over time following channel readjustment, releasing sediment in small amounts over an extended duration.

Estero Trail Reroute

Under Alternative 2, the trail reroute (Figure 2-5), trail design, and trail construction methods, would be the same as those described above for Alternative 1. The trail reroute would be constructed during Phase 1, to avoid potential hazards associated with recreational use around the temporary dewatering outlet, and to minimize interruption and possible degradation of the recreational experience.

Phase 2: Removal of Dam

Phase 2 would be implemented following a one-year adjustment period, during which the reservoir bottom would be allowed to revegetate and the channel system would adjust to restored tidal exchange. Under Phase 2, the dam would be completely removed.

Channel Dewatering and Streamflow Bypass

Before dam removal begins, a stream bypass structure consisting of 18- to 24-inch flexible HDPE pipe would be installed to convey remaining low flow in the stream channel around the construction area and discharge it into the upper Estero below the dam site. Dewatering barriers similar to those described above for Limantour Beach Marsh would be installed up- and downstream of the construction area, and the channel reaches adjacent to the dam would be

dewatered; discharge would be conveyed via 6-inch HDPE pipe to a temporary outfall located downstream of the construction area. Pumps would be placed on the top of the dam. Pump intakes would be equipped with NPS-approved screening to prevent them from drawing in wildlife. In addition, flow dissipation measures would be implemented to prevent erosion and sediment mobilization at the pump outfall. The most likely approach would be to armor channel bed and banks temporarily with sand bags or bales of sterile, weed-free straw.

Silt fences would be installed on the tidal marsh plain below the dam site to prevent sediment and soil disturbed during dam removal or other construction activities from entering the Estero tidal system. As described above for Year 1, the bypass structure and silt fences would be installed before any earthwork or other construction activity begins.

Removal of Existing Dam

As described for Alternative 1, dam removal would begin with excavation of a sufficient amount of material from the top of the dam to fill the existing spillway. The dam would then be removed by an excavator and/or scraper working from the top of the dam, moving from the west abutment back toward the east abutment. Filling the existing spillway would enable complete removal of the dam without the need for heavy equipment to enter the channel or tidal marsh plain areas.

As with Alternative 1, excavated materials would be transported to the spoils management area adjacent to the Muddy Hollow Trail, approximately 1,000 feet south of the site, where they would be placed as engineered fill. If materials require drying before they can be placed as fill, a drying basin would be established at the spoils management area. As described above, the new fill slope would be contoured and terraced, restoring the original borrow area to a more natural appearance. Depending on site conditions at the time of construction, the upper foot below finished grade could be left uncompacted and stabilized with soil stabilizers approved for use adjacent to surface waters until revegetation is completed. An alternative would be to compact the surface and then disc immediately prior to topsoil application and revegetation.

Construction of Check Structure(s)

As described above, construction of check structures would continue under Phase 2, following complete dewatering of the reservoir. Check structures would be similar under Alternative 2 to those described above for Alternative 1.

Revegetation and Erosion Control

Revegetation and erosion control would be the same under Alternative 2 as described above for Alternative 1.

Construction Closures

During Phase 1, the Lower Muddy Hollow Trail and Estero Trail would be closed during construction to install the low-level outlet (approximately 2 weeks). Closures during Phase 2 dam removal activities would be the same as those described above for Alternative 1 at Muddy Hollow.

Adaptive Management

The purpose of the adaptive management program at Muddy Hollow is to monitor channel adjustments and allow NPS to take action when necessary to slow rates of channel incision and erosion through the delta and reduce annual sediment delivery to Muddy Hollow Creek and the tidal marsh downstream. As described for Alternative 1, the system is expected to be highly dynamic in the first years following implementation of Alternative 2. Although the need for adaptive intervention could be greater under Alternative 2, the adaptive management component

for Alternative 2 would be operate in the same way as that described above for Alternative 1. As with Alternative 1, adaptive management would proceed in three phases under Alternative 2: initial development, incision management, and channel widening management. Each phase would be initiated based on the restored system's geomorphic development, so different reaches of the system are expected to undergo the various monitoring phases at different times, as they develop progressively. Treatments would be based on observed needs and would employ locally harvested materials such as willow and alder wood and debris.

Limited Channel Restoration at Glenbrook Crossing Site

At the Glenbrook Crossing site, Alternative 2 provides for removal of the existing culverted embankment crossing and limited channel grading to enable readjustment of the channel via natural processes of erosion and transport. The proposed treatment reduces the areal extent of treatment activities from those described under alternative 1, focusing on removal of the features that impede natural process, and balancing cut and fill actions in the channel to reconnect the system through the project area. The extent of treatment under Alternative 2 is 600 feet downstream and 200 feet upstream (Figure 2-9). Log and boulder structures would be installed within the zone as described in Alternative 1, to moderate the grade and provide habitat in the restored channel.

The Muddy Hollow Trail would be rerouted in the same manner as described under Alternative 1. Construction access, staging, and wilderness mitigations would be the same under Alternative 2 as under Alternative 1.

Features and Construction Requirements

Streamflow Bypass and Water Quality Protection

Before construction begins, a bypass consisting of 24-inch flexible HDPE pipe would be installed to convey streamflow around the construction area, beginning approximately 400 feet upstream of the crossing site and discharging approximately 850 feet downstream of the crossing. The channel reaches up- and downstream of the cross would then be isolated and dewatered, as described above for Alternative 1. Water pumped from the channel would be discharged to the creek downstream of the construction area. As with Alternative 1, the channel bed and bank would be protected from excessive erosion through placement of sand bags or bales of sterile, weed-free straw.

As described above, it might be necessary to install additional dewatering facilities to control subsurface flow of shallow groundwater in the vicinity of the Glenbrook crossing construction area and enable heavy equipment to operate in lowland areas. Dewatering facilities would be designed based on the results of engineering geologic and geotechnical investigations now in progress.

Removal of Existing Road Embankment and Culvert

As described for Alternative 1, the existing road embankment, except for the easternmost portion, would be removed using an excavator and/or scraper operating from the embankment top. Removal would begin on the west abutment and proceed toward the east, enabling equipment to work entirely from the embankment top and adjacent roadway, without entering the channel area. The east end of the embankment would be recontoured to create an access ramp for equipment entering the area upstream from the crossing (see *Channel and Floodplain Recontouring* below).

As with Alternative 1, existing concrete riprap and any other imported material removed during excavation would be offhauled for appropriate recycling or disposal. A small portion of the clean excavated material would be placed as engineered fill to fill the side gully downstream of the

crossing. The remainder would be transported to the spoils management area, east of the site on the south side of Muddy Hollow Road, where it would be placed as engineered fill along the toe of the existing cut slope, restoring the original borrow site to a more natural-appearing topography. The slope would then be revegetated with a locally native seed mix (see below). It may be necessary to stockpile excavated materials temporarily to allow them to dry before they are placed and compacted; if so, a temporary drying basin would be established in the spoils management area.

Once the culvert is exposed by excavation, it would be removed and offhauled for recycling or disposal at an appropriate facility.

Channel and Floodplain Recontouring

Following removal of the existing embankment and culvert, sediment stored above the crossing would be removed and placed downstream in the reconstructed channel section. This balanced cut and fill approach would minimize excavation upstream approximately 100-200 linear feet. Upstream, the channel would be recontoured, with the invert elevation at the crossing site adjusted by as much as 8 feet.

Material recovered from the aggraded upstream area would be used for channel recontouring below the crossing site, where onsite fill would be placed in approximately 600 linear feet of the channel, reducing the invert gradient to a slope of approximately 2% and increasing the invert elevation immediately below the crossing site by about 8 feet. While the intent of the site treatment is to balance cut and fill, any excess spoils would be managed as described above for embankment removal.

To stabilize the recontoured portion of the channel, grade control structures designed to resemble buried debris jams would be installed at intervals of approximately 100 feet, with drops of 2 feet or less between the crest of adjacent structures. Grade control structures would be installed over the entire length of the recontoured reach downstream of the crossing site. The design would integrate two additional structures to be placed in the short recontoured reach upstream of the crossing site. To the extent feasible, they would be constructed using woody materials from the site. It is likely that boulders would need to be imported from approved quarries for use in this area.

Several mature alders would likely be removed to accommodate channel earthwork. The resulting large woody material would be left in place for natural recruitment into the stream system.

This approach to restoration of a more natural channel gradient would more closely balance excavation upstream of the crossing site with fill placement downstream than Alternative 1, and would result in a smaller volume of excess spoils requiring placement in the spoils management area. Because it would reduce upstream excavation, it would also minimize intrusion into the mature, established riparian forest upstream of the crossing, allowing this living community to continue to provide channel stability as natural hydrologic and hydraulic process is reintroduced to the system.

Glenbrook Crossing Trail Reroute

Under Alternative 2, the trail reroute (Figure 2-8), trail design, and trail construction methods, would be the same as those described above for Alternative 1.

Revegetation

Once channel recontouring has been completed, revegetation would proceed as described above for Alternative 1. The channel area would be allowed to revegetate by natural recruitment; other areas disturbed by construction would be topsoiled and/or seeded with an appropriate mix and mulched. The volume of spoils placed in the spoils management area would be less than for Alternative 1, but the area would be contoured and topsoiled an/or seeded and mulched, and erosion control would be installed, as described above.

Construction Closures

Construction closures for Alternative 2 at the Glenbrook Creek crossing site would be the same as those described above for Alternative 1.

Adaptive Management

As described above for Alternative 1, the purpose of adaptive management at the Glenbrook Crossing site is to slow rates of channel incision and erosion, matching the sediment volumes resulting from incision and widening as closely as possible to sediment transport capacity, and controlling sediment loading to lower Glenbrook Creek. As at Muddy Hollow, adaptive management at the Glenbrook Crossing site would proceed in three phases: initial development, incision management, and channel widening management, summarized in Table 2-4, presented above. Although the mature riparian vegetation left in place under Alternative 2 would provide an additional degree of channel stability by comparison with Alternative 1, NPS nonetheless expects the system to be dynamic in the first years following restoration, such that vigilant monitoring and an active program of adaptive management treatments would likely be needed. Treatments would be based on observed needs and would employ locally harvested materials such as willow and alder wood and debris.

Alternative 3: No Action Alternative

Under the No Action Alternative, no construction or earthwork would take place at any of the three sites. Existing management and use would continue unchanged, with management limited to activities required to preserve public health and safety. The potential for catastrophic or unplanned failure at any of these sites would remain a possibility. The following sections provide details for each site.

No Action at Limantour Beach Marsh

At Limantour Beach Marsh, the No Action Alternative would leave the existing culverted embankment crossing, secondary beach access spur, and lower berm in place. Remnants of paving would continue in place on the beach access trail and secondary beach access spur. The lower berm would continue to impede natural tidal hydraulics and marsh plain/channel dynamics below the culverted crossing. The culvert would continue to exclude tidal exchange in the freshwater pond except during high storm tides, when natural current and sediment transport processes would nonetheless be severely restricted. No slope restoration would take place in the spoils management area.

Under the No Action Alternative, management activities at Limantour Beach Marsh would include removal of debris from the culvert, and maintenance and repair of the beach access trail, as needed.

No Action at Muddy Hollow

At Muddy Hollow, the No Action Alternative would leave the existing dam embankment in place. The existing freshwater impoundment would remain unchanged, and the Estero Trail would continue to cross the Muddy Hollow drainage via its current alignment along the embankment top. The dam would continue to truncate natural hydrologic/hydraulic connectivity between the Muddy Hollow stream drainage and the tidal and estuarine habitats below the dam. Historic steelhead and coho passage up Muddy Hollow would remain impeded. No slope restoration would take place in the spoils management area.

Under the No Action Alternative, the NPS would remain responsible for ongoing monitoring and maintenance of the dam facility which is identified by the Bureau of Reclamation in 2001 as in "seriously deficient condition." Management activities at Muddy Hollow would include spillway cleaning to remove trash and debris; maintenance and repair of the Muddy Hollow and Estero Trails; and removal of shrubs and trees from the dam embankment. However, no large-scale repair or upgrade of the dam would be implemented.

No Action at Glenbrook Crossing

At Glenbrook Crossing, the No Action Alternative would leave the existing culverted embankment crossing and Muddy Hollow trail alignment in place. There would be no alteration of existing vegetation, including the mature riparian forest upstream of the crossing. Natural sediment transport and channel and floodplain processes would continue to be interrupted by the presence of the embankment and culvert, which would also continue to prevent fish passage into the headwaters of Glenbrook Creek. No slope restoration would take place in the spoils management area.

Under the No Action Alternative, management activities at Glenbrook Crossing would include maintenance and repair of existing roads and trails, and removal of debris from the culvert. Because the culvert is failed, it is likely that no action would eventually require in-kind replacement of the structure. This would be problematic considering the culvert and embankment crossing would continue to represent nonconforming structures in the Philip Burton Wilderness Area. No other major alterations or repairs are planned,.

2.3 Environmental Commitments

Environmental commitments refers to measures and practices adopted by a project proponent to reduce or avoid adverse effects that could result from construction or operation of the proposed features.

NPS is committed to ensuring that actions implemented at Point Reyes National Seashore proceed in the most environmentally sensitive manner possible. Consequently, a number of Best Management practices have been adopted for the proposed action, and would be incorporated into construction documents (plans and specifications), providing a contractual requirement that any contractor retained for any phase of the action would abide by the conditions and procedures identified.

The following sections describe the environmental commitments that would be implemented for the proposed action. They apply to all build alternatives selected for implementation.

Engineering Geologic/Geotechnical Measures

NPS would retain qualified geologic and geotechnical personnel to perform engineering geologic and geotechnical studies at each site during the design and construction phases of the proposed action, in order to ensure appropriate design for existing substrate conditions. Design recommendations would be presented to NPS in the form of written soils engineering and engineering geologic reports. The geologic and geotechnical personnel would also be responsible for monitoring earthwork and construction to ensure compliance with applicable codes and standards and with the recommendations of the soils and engineering geologic reports.

Design and Construction Commitments

NPS will ensure that design and construction of project features, including earthwork and infrastructure, proceeds in accordance with the appropriate codes and standards. Applicable codes are as follows.

- Restoration and spoils disposal earthwork: *Caltrans Standard Specifications* (California Department of Transportation 1999).
- Structural features for water conveyance, such as Alternative 2 low-level outlet at Muddy Hollow: relevant guidance of the American Waterworks Association.
- Other structural features, such as bridge or boardwalk: *Uniform Building Code* (International Conference of Building Officials).

Measures to Protect Water Quality

Seashore staff and NPS contractors will implement the preferred alternative to abide by the following stipulations in order to protect Water Quality at and downstream of the Project Sites:

- Conduct construction activities during the dry season.
- Conduct construction work in accordance with site-specific construction plans that minimize the potential for increased delivery of sediment to surface waters.
- Ensure that concentrated runoff and concentrated discharge are diverted away from channel banks.
- Minimize removal of and damage to native vegetation.
- Install temporary construction fencing to identify areas that require clearing, grading, revegetation, or recontouring, and minimize the extent of areas to be cleared, graded, recontoured, or otherwise disturbed.
- Grade and stabilize spoils sites to minimize erosion and sediment input to surface waters and generation of fugitive dust (see discussions under *Measures to Protect Air Quality* below).
- As appropriate, implement erosion control measures to prevent sediment from entering surface waters, including the use of silt fencing or fiber rolls to trap sediments and erosion control blankets on slopes and channel banks.

- Avoid operating equipment in flowing water by using temporary cofferdams and/or other suitable structures to divert flow around the channel and bank construction area.

Measures to Protect Wildlife

Measures for Migratory Birds

To prevent disturbance of migratory birds—protected under the federal Migratory Bird Treaty Act, the California Fish and Game Code, and CEQA—no project-related activities will take place during the migratory bird nesting season (February 15–August 1). To provide additional assurance, the NPS will conduct preconstruction surveys for migratory birds and their nests at the project site no more than 1 week prior to the initiation site preparation, staging, or construction activity planned before August 1. If preconstruction surveys identify active nests belonging to common migratory bird species, a 100-foot exclusion zone will be established around each nest to minimize disturbance-related impacts on nesting birds. If active nests belonging to special-status migratory birds are identified, a no-activity buffer zone will be established around each nest. The radius of the no-activity zone and the duration of exclusion will be determined in consultation with the U.S. Fish and Wildlife Service.

Measures for Aquatic Species

Before de-watering activities begin at the project site, NPS will ensure that native aquatic vertebrates and larger invertebrates are relocated to a flowing channel segment by a qualified fisheries biologist. NPS will work with NOAA Fisheries to identify or develop the most appropriate relocation protocol. Construction activities will be prohibited from unnecessarily disturbing aquatic habitat.

To ensure against adverse impacts on California red-legged frog (*Rana aurora draytonii*), NPS will conduct preconstruction clearance surveys for this species. The construction will occur during a period of time when frog use of these areas would be low. A biologist will survey the construction area on a daily basis to insure that frogs or other species have not moved in during the night. Frogs that have moved into the area would be captured and relocated to habitat outside of the construction area.

For large scale habitat projects, water levels would be lowered to manageable levels using methods outlined in the specific site description, prior to aquatic species recovery activities.

Measures to Protect Vegetation and Prevent the Introduction and Spread of Invasive Plant Species

BMPs to protect riparian vegetation during construction will be incorporated into construction documents (plans and specifications) for the proposed action. They will include, but may not be limited to, the following:

- Requiring the use of temporary construction fencing to delimit work areas. Requiring that fencing be installed before site preparation work or earthwork begins.

- Excluding foot and vehicle traffic from particularly sensitive areas by delimiting exclusion areas with temporary construction fencing and flagging tape in a conspicuous color.

- Washing off the tires or tracks of trucks and equipment entering and leaving project sites to prevent seed transport.

Spill Prevention and Response Plan

The NPS and its contractors will prepare a spill prevention and response plan that regulates the use of hazardous and toxic materials, such as fuels and lubricants for construction equipment. NPS or designated representatives would oversee implementation of the spill prevention and response plan. Elements of the plan will ensure that:

- workers are trained to avoid and manage spills;
- construction and maintenance materials are prevented from entering surface waters and groundwater;
- spills are cleaned up immediately and appropriate agencies are notified of spills and of the cleanup procedures employed;
- staging and storage areas for equipment, materials, fuels, lubricants, solvents, and other possible contaminants are located at least 100 feet away from surface waters;
- no vehicles are fueled, lubricated, or otherwise serviced within the normal high-water area of any surface water body;
- vehicles are immediately removed from work areas if they are leaking; and
- no equipment is operated in flowing water (suitable temporary structures are installed to divert water around in-channel work areas).

Measures to Protect Natural Quiet and Soundscapes

Seashore staff and NPS contractors will implement the following measures to reduce construction noise and lessen the impacts of noise that cannot be avoided.

Construction equipment will be required to have sound-control devices at least as effective as those originally provided by the manufacturer, and no equipment will be operated with an unmuffled exhaust. In general, construction will take place between 7:00 a.m. and 7:00 p.m., Monday through Saturday.

In addition, NPS will post signs at each restoration site and on the park website providing the name and contact information for an NPS staff member the public can contact with noise concerns. This person will be responsible for recording and monitoring complaints related to construction noise, and for ensuring that logged complaints are mitigated to the maximum extent possible. Construction times and contact information for noise concerns will also be publicized in the park newsletter.

Measures to Protect Air Quality

The NPS and its contractors will implement the following measures to control the generation of fugitive dust during site preparation and construction activities. These measures are contained in

the Bay Area Air Quality Management District's (BAAQMD's) Feasible Control Measures for PM10 Emissions[1] from Soil Removal Activities (BAAQMD 1996).

- Limit the area subject to excavation, grading and other construction activity at any one time.
- Water unpaved access roads, parking areas, and staging areas as necessary, or stabilize them with nontoxic soil stabilizers approved for use adjacent to surface waters.
- Apply (nontoxic) soil stabilizers to inactive earthwork areas (previously graded areas inactive for 10 days or more).
- Enclose, cover, water, or apply nontoxic soil stabilizers to exposed stockpiles as necessary.
- Maintain properly tuned equipment and limit idling time to 5 minutes.
- Cover trucks hauling soil, sand, or other loose materials, or require them to maintain at least 2 feet of freeboard.
- Replant vegetation or topsoil disturbed areas as quickly as possible.
- Limit traffic speeds on unpaved roads to 10 mph.

Measures to Address Effects on Traffic

NPS will require the construction contractor to prepare and implement a traffic safety plan. The traffic safety plan would address appropriate vehicle size and speed, travel routes, closure plans, detour plans (if any), flagperson requirements (if any), locations of turnouts to be constructed (if any), coordination with law enforcement and fire control agencies, measures ensuring emergency access, and any additional need for traffic or speed-limit signs. Delivery and haulage access, including contractor mobilization and demobilization, will be scheduled to minimize impacts on traffic on area roadways, including US-101. Construction worker parking and access would be managed to avoid impeding access for park visitors and emergency vehicles.

Measures to Protect Recreational Use

NPS will take feasible measures to minimize the effects of project construction on recreational use. Information on upcoming closures, including closure dates and arrangements for alternate parking, restroom facilities, and trail access points will be posted on the park website, distributed at the Bear Valley Visitor Center, and posted at each construction site. Information on alternate recreational opportunities will be publicized on the park website, in the park newsletter, and in signage at the construction sites where closures are necessary.

The project includes trail reroutes providing access to all existing trails along improved routes.

NPS is committed to working with the birding community to develop informational signage that explains the reasons for the change and identifies other nearby birding opportunities.

[1] *PM10* refers to particulate matter with a diameter of 10 microns or less. Material of this size is small enough to be drawn deep into the lungs when inhaled and thus poses a human health hazard.

Measures to Protect Wetland Resources

BMPs to protect wetland resources during construction will be incorporated into construction documents (plans and specifications) for the proposed action. They would include, but may not be limited to, the following.

- Where possible, construction access and staging shall occur in uplands and non-riparian habitat.
- If construction access or staging must occur in wetlands and riparian habitat, access within these areas shall be kept to the minimum road width and acreage possible. Contractors will work with NPS personnel to minimize impacts to wetlands and riparian habitat.
- Construction access routes will be flagged to ensure that construction equipment does not detour from authorized entry points and access routes.
- Where possible, construction equipment will work from upland locations to minimize impacts to wetlands and riparian habitats.
- Any temporary "fill" or staging material placed in wetlands will be removed to upland locations at the earliest possible date.
- Construction equipment will be cleaned prior to construction start to ensure that no seeds or vegetative fragments of invasive, non-native species are introduced into the Project Areas.

Measures to Protect Wilderness Values

Minimum Requirements and Minimum Tool

Work in designated wilderness areas must comply with the minimum tool requirements as designated in the Wilderness Act. Appendix B of this document presents findings of Minimum Requirements and Minimum Tool determination for the aspects of the project that occur within the Philip Burton Wilderness boundary.

Access and Construction

In addition, to ensure that wilderness values are protected, park staff would brief construction crews on procedures for operations in wilderness areas and concerns related to the wilderness, and would monitor to ensure that operations minimize impacts on wilderness values and resources. The briefing and monitoring are intended to provide an increased level of vigilance during wilderness construction.

At the work site, the crew will establish a construction center where refueling and overnight storage will occur. This site will be within the construction zone, but at a minimum distance of 100 feet from surface water and wetland resource areas. At the construction center, a temporary containment zone would be lined with impermeable material. This material would be removed at the closeout of the construction activities at this site.

Measures to Protect Cultural Resources

The NPS will coordinate with the Federated Indians of Graton Rancheria (FIGR) to insure that either an NPS or FIGR representative is on-call or on-site during the construction activities. While the project has been designed exclude work in documented resource areas, the NPS employee will be on site to insure that this is indeed the case. In the case that resources are discovered during the course of construction, the NPS will act immediately and appropriately as documented in 36 CFR 800.13 "Post-review discoveries" (http://www.achp.gov/regs.html#800.13).

2.4 Alternatives Eliminated from Further Consideration

This section presents the alternatives that were considered in the VA process but were dismissed from detailed analysis because they did not effectively meet the principal project goals. Table 2-5 briefly describes each alternative eliminated and summarizes the reasons it was not carried forward.

Table 2-5. Summary of Approaches Eliminated from Further Consideration

Site	Approach	Advantages	Reasons Eliminated from Further Consideration
Limantour Beach Marsh	Replacing existing culvert with larger box culvert.	Would improve tidal exchange/flushing in freshwater marsh area.	Would not meet objectives of removing existing infrastructure and restoring natural stream processes. Channel would still be confined and would not evolve naturally.
	Replace existing culvert with several parallel box culverts.	Would have the potential to substantially improve tidal exchange/flushing in the freshwater marsh area.	Would not meet objectives of removing existing infrastructure and restoring natural stream processes. Channel would remain confined, and flow would be divided and disrupted by passage through culverts. Sediment would likely accumulate in culvert inverts, and downstream erosion would probably continue, maintaining or worsening the existing scour pool below the crossing.
	Remove existing crossing and terminate pedestrian and equestrian access to Limantour Beach from this point.	Could meet all project objectives.	Would violate NPS mission and mission of Point Reyes National Seashore to provide recreational access to Seashore lands.
Muddy Hollow	Remove existing dam	Would restore connectivity	Outcome very uncertain;

Site	Approach	Advantages	Reasons Eliminated from Further Consideration
	without additional treatment.	between upper and lower reaches of system. Depending on how the channel evolved, would probably restore fish passage.	substantial adverse effects on water quality and tidal channel habitat likely during first 10 years following dam removal.
	Leave dam in place and increase maintenance activities to minimize vegetation on dam embankment. Install fish ladder.	Would meet objective of restoring fish passage. Would likely be cost-effective; initial cost would be comparatively low, and continuing costs would be distributed over a period of years.	Would not meet objectives of removing existing infrastructure and restoring natural hydrologic processes; the dam would continue to impede stream and shoreline processes. Because of dam's unsafe condition, could also pose safety hazards to the public, and risks to water quality and tidal habitat; risk of failure would remain.
	Remove a portion of the existing dam and replace with a culvert; leave remainder of dam in place.	Costs would be low. Depending on culvert design, could partially achieve objective of restoring connectivity between upper and lower reaches of Muddy Hollow.	Would not meet objectives of removing existing infrastructure and restoring natural stream processes.
Glenbrook Crossing	Remove existing crossing embankment without additional treatment.	Costs would be low. Would restore connectivity between upper and lower creek reaches.	Would not meet objective of restoring natural stream processes. Because substantial erosion and sediment transport would be required to eliminate the "drop" at the crossing site, would be slow to meet objective of restoring fish passage, and final success would be uncertain. Substantial adverse effects on water quality and inchannel habitat likely for first 10 years following restoration.

Site	Approach	Advantages	Reasons Eliminated from Further Consideration
	Divert flow to a new, created channel, routing Glenbrook Creek around the existing crossing site at a more natural gradient.	Would meet objectives of restoring connectivity and restoring fish passage.	Would not meet objective of restoring natural processes. Depending on design for treating existing creek channel, could have adverse effects on visual quality in wilderness area. Inconsistent with NPS commitment to minimally invasive solutions in wilderness areas.

2.5 Comparison of Alternatives and Identification of Preferred Alternative

This Environmental Assessment covers three specific sites, and project alternatives have been grouped and analyzed according to "full-build" and "partial build." The NPS has identified a combination of treatments from Alternatives 1 and 2 as the *preferred alternative.* The NPS preferred alternative for each site is one that best achieves the stated purpose and need of the project, in a manner that is compatible with the spatial and ecological context of the project site.

Table 2-6 presents an overview of the three alternatives evaluated in this EA and compares their anticipated success in meeting the objectives identified for the proposed action. Based on the environmental analysis in this EA (summarized in Table 2-6), NPS has elected a combination of Alternative 1 and Alternative 2 as its preferred alternative. The components of the preferred alternative are summarized below and highlighted in Table 2-6. They include the following.

- **Full build at Limantour Beach Marsh.** This approach would entail replacing the existing culvert with a bridge crossing as described for Alternative 1. It would meet the project's hydrologic and ecological objectives, including restoration of full tidal exchange at Limantour Beach Marsh, while maintaining and enhancing the area as a visual gateway to Limantour Beach.
- **Full build at Muddy Hollow.** This approach would entail complete removal of the existing dam and spillway during a single construction season, as described for Alternative 1. It would meet all of the project's hydrologic and ecological objectives, while removing a structure identified as unsound and "deficient" from a heavily used and ecologically important area of the Seashore. Completing dam removal during a single phase would reduce the environmental impacts associated with demolition and construction and would minimize the duration of impacts on visitor use and access.
- **Limited channel earthwork at Glenbrook Crossing.** This approach would entail excavation of the crossing facility and balanced channel excavation and fill placement to restore connectivity and channel gradient, as described for Alternative 2. It would meet all of the project's hydrologic and ecological objectives, while minimizing construction activities in a wilderness area, and maximizing the preservation of existing established native vegetation in the riparian area upstream of the crossing.

Generally, the preferred alternative treatments at each site reflect the location and land use management in the area. The full-build treatments at Muddy Hollow Pond and Limantour Beach Pond involve equal levels of work and result in similar function as the partial build treatments. However, under Alternative 1, they are timed for a single treatment (Muddy Hollow Pond) or would involve a different type access to the beach (Limantour Beach Marsh). In the case of Glenbrook Crossing, the limited treatment was selected over the full-build (fully engineered) solution because of its location within the Philip Burton Wilderness. The limited treatment is intended to remove the anthropogenic impediments to natural function and set the stage for natural process ultimately to shape the final outcome and function of the project area.

2.6 Environmentally Preferred Alternative

The *environmentally preferred alternative* is the alternative that would best promote the national environmental policy expressed in NEPA (Sec. 101[b]). It represents the alternative that would cause the least damage to the biological and physical environment while best protecting, preserving, and enhancing historic, cultural, and natural resources.

Table 2-6 presents an overview of the three alternatives evaluated in this EA and compares their anticipated success in meeting the objectives identified for the proposed action. Based on the environmental analysis in this EA (summarized in Table 2-6), NPS has elected a combination of Alternative 1 and Alternative 2 as its preferred alternative. The components of the preferred alternative are highlighted in Table 2-6 and summarized below. They include the following.

- **Full build at Limantour Beach Marsh.** This approach would entail replacing the existing culvert with a bridge crossing as described for Alternative 1. It would meet the project's hydrologic and ecological objectives, including restoration of full tidal exchange at Limantour Beach Marsh, while maintaining and enhancing the area as a visual gateway to Limantour Beach.
- **Full build at Muddy Hollow.** This approach would entail complete removal of the existing dam and spillway during a single construction season, as described for Alternative 1. It would meet all of the project's hydrologic and ecological objectives, while removing a structure identified as unsound and "deficient" from a heavily used and ecologically important area of the Seashore. Completing dam removal during a single phase would reduce the environmental impacts associated with demolition and construction and would minimize the duration of impacts on visitor use and access.
- **Limited channel earthwork at Glenbrook Crossing.** This approach would entail balanced channel excavation and fill placement to restore connectivity and channel gradient, as described for Alternative 2. It would meet all of the project's hydrologic and ecological objectives, while minimizing construction activities in a wilderness area, and maximizing the preservation of existing established native vegetation in the riparian area upstream of the crossing.

Table 2-7 summarizes the impacts associated with each of the proposed alternatives. It should be noted that in the impact topics discussion (Section 4), site specific impact descriptions, as well as tables summarizing impacts at each of the sites, under each of the alternatives are included.

Table 2-6. Anticipated Success in Meeting Project Goals and Objectives, by Alternative* * Shaded cells represent components of the preferred alternative.

	Alternative 1			Alternative 2			No Action		
	Limantour	**Muddy Hollow**	**Glenbrook**	**Limantour**	**Muddy Hollow**	**Glenbrook**	**Limantour**	**Muddy Hollow**	**Glenbrook**
	Replace most of existing culverted crossing with bridge span; remove pavement from remainder. Remove secondary beach access trail embankment.	Remove dam and recontour channels to establish more natural hydraulic function. All project earthwork complete in one construction season.	Remove existing crossing and culvert; recontour channel extensively to create "stable" geometry.	Replace culverted crossing with boardwalk. Remove most of secondary beach access trail embankment.	Phase dam removal over a period of several years, relying on natural processes to adjust channel geometry.	Remove existing crossing and culvert; perform limited channel grading and fill, relying on natural erosion to fully adjust channel once flow is restored.	No earthwork or construction. Continue existing maintenance and management unchanged.	No earthwork or construction. Clean spillway and remove vegetation from dam face and top; otherwise, continue existing maintenance and management.	No earthwork or construction. Continue existing maintenance and management unchanged.
Objective									
Reduce or remove long-term operations and maintenance requirements; create sustainable visitor access, including a visual gateway to Limantour Beach	High	High	Moderate to high	High	High, although complete removal of dam would take longer than under Alt 1	Moderate to high	No improvement	No improvement Risk of catastrophic failure with damage or loss to existing resources	No improvement Risk of catastrophic failure with damage or loss to existing resources
Improve hydrologic function; restore natural hydrologic processes, including surface water connectivity	High	High	High Initial channel gradient likely more stable than Alt 2, but riparian vegetation would be removed from channel and floodplain in restored area; denuded areas would require management until revegetation establishes	High	High, although complete restoration of natural processes would take longer than under Alt 1	Moderate to high Adjustment would be more protracted than under Alt 1, but established riparian growth would remain in place upstream of crossing site, and would likely provide additional channel stability in this area	No improvement	No improvement Risk of catastrophic failure with damage or loss to existing resources	No improvement Risk of catastrophic failure with damage or loss to existing resources
Improve ecological function in general; increase ecological sustainability	High	High	High Earthwork impacts would be substantially greater than Alt 2	Moderate Boardwalk would be less protective of habitat than bridge	Moderate to high Outcome more uncertain than under Alt 1	Moderate to high Depending on stabilization offered by riparian growth left in place, adjustment could result in more prolonged water quality effects than under Alt 1	No improvement	No improvement Risk of catastrophic failure with damage or loss to existing resources	No improvement Risk of catastrophic failure with damage or loss to existing resources

Table 2.7- Summary of Impacts of Alternatives

	Alternative 1: Full-Build	Alternative 2: Partial -Build	Alternative 3: No Action
Visual Resources	Under Alternative 1, short-term adverse minor impacts to visual resources would occur as a result of construction activities. The installation of signs describing the restoration activities and intent, as well as distribution of flyers and education at the Visitors Centers would mitigate some of these impacts. With these outreach activities in place, the long-term impacts would be beneficial as visitors are educated about restoration and natural process. Interpretation of the restoration activities and the ecological recovery is a unique education opportunity for visitors.	Actions under Alternative 2 would be extended over a period of two years. This alternative would result in short-term adverse minor impacts to visual resources would occur as a result of construction activities in both construction years. The installation of signs describing the restoration activities and intent, as well as distribution of flyers and education at the Visitors Centers would mitigate some of these impacts. With these outreach activities in place, the long-term impacts would still be beneficial as visitors are educated about restoration and natural process. Interpretation of the restoration activities and the ecological recovery is a unique education opportunity for visitors.	Under Alternative 3, no effects to visual resources would occur as a result of direct park actions. In the long-term, ongoing maintenance activities would result in negligible adverse effects to visual resources. No additional outreach and education opportunities would be available to park visitors.
Wilderness	Under Alternative 1, localized short-term adverse impacts to wilderness resources are considered adverse moderate. In the long-term, the proposed actions would result in benefits to the wilderness by restoring natural process to a confined system. This would also provide for visitor recognition that structures are not consistent with wilderness. Interpretation of the restoration activities and the ecological recovery is a unique education opportunity for visitors.	Under Alternative 2, localized short-term adverse impacts to wilderness resources are considered adverse minor. In the long-term, the proposed actions would result in benefits to the wilderness by restoring natural process to a confined system. This would also provide for visitor recognition that structures are not consistent with wilderness. Interpretation of the restoration activities and the ecological recovery is a unique education opportunity for visitors.	Under Alternative 3, no direct effects to wilderness resources would occur as a result of direct park actions. However, the presence of non-conforming structures (at Glenbrook) and the maintenance requirements of the trails are considered minor adverse short-term impacts. In the long-term, catastrophic failure or maintenance activities to replace a culvert would result in localized moderate adverse effects at the Glenbrook site. No additional outreach and education opportunities would be available to park visitors.

Air Quality	Under both action alternatives, production of emissions and associated dust would be similar. NPS would require contractors to adhere to the BAAQMD's Feasible Control Measures for PM10 and to ensure that earthwork equipment is properly tuned and meets applicable emissions standards. The analysis concludes that Alternative 1 and Alternative 2 would result in short-term minor adverse impacts to air quality. The project would not result in long-term effects to air resources.	Same as Alternative 1	Under Alternative 3, no construction emissions or dust generation would take place as a result of direct actions. Alternative 3 would result in no effect to park air resources.
Geology, Geologic Hazards, and Soils	Under alternative 1, structures are removed from Muddy Hollow and Glenbrook Crossing sites, reducing the potential of failure under evaluated risks factors. The resulting conditions, including the constructed bridge facility at the Limantour Marsh area would be designed with potential risk under consideration. Restoration of natural hydrologic and shoreline process would change existing slope and local soil conditions, resulting in potential short-term negligible adverse effects. In the long-term, however, removal of existing unengineered earthen facilities would reduce site susceptibility to failure in association with geologic hazards. The long-term effect of actions proposed under Alternative 1 are considered beneficial.	Under Alternative 2, structures are removed from Muddy Hollow and Glenbrook Crossing sites, reducing the potential of failure under evaluated risks factors. The resulting conditions, including the constructed boardwalk at the Limantour Marsh area would be designed with potential risk under consideration. Restoration of natural hydrologic and shoreline process would change existing slope and local soil conditions, resulting in potential short-term negligible adverse effects. In the long-term, removal of existing unengineered earthen facilities would reduce site susceptibility to failure in association with geologic hazards. The long-term effect of actions proposed under alternative 2 are beneficial.	Under Alternative 3, existing unengineered structures would remain, pooling excessive water or sediment behind these aged facilities. Alternative 3 would not result in short term effects to existing slope and local soil conditions. In the long-term, however, the existing unengineered earthen facilities would remain susceptible to failure in association with geologic hazards. In the long-term, the risk of failure associated with no action would result in localized moderate adverse effects.

Hydrology, Hydraulics, and Water Quality	Evaluation of potential impacts to hydrology, hydraulics and water quality under Alternative 1 shows the likelihood of short-term minor to moderate localized adverse impacts as hydrologic configurations and conditions adjust as a result of the restoration activities. Shifts in water regime, channel and estuarine configuration would occur, but be muted in scale through proposed adaptive management measures including installation of passive grade control, adaptive monitoring and management actions. In the long-term, the actions identified under Alternative 1 would be considered beneficial as natural hydrologic and estuarine process are restored to a new, functional dynamic equilibrium at these sites. The restoration actions would facilitate sustainable, naturally functioning hydrologic systems that would not require continued maintenance.	Evaluation of potential impacts to hydrology, hydraulics and water quality under Alternative 2 shows the likelihood of short-term minor adverse impacts as hydrologic configurations and conditions adjust as a result of the restoration activities. Shifts in water regime, channel and estuarine configuration would occur, but be muted in scale through proposed adaptive management measures including installation of passive grade control, adaptive monitoring and management actions. The longer construction window proposed under Alternative 2 for Muddy Hollow would extend potential effects, and delay natural recovery and revegetation at the site. In the long-term, the actions identified under Alternative 2 would result in minor to moderate benefits as natural hydrologic and estuarine process are restored to a new, functional dynamic equilibrium at these sites. The restoration actions would facilitate sustainable, naturally functioning hydrologic systems that would not require continued maintenance.	Evaluation of potential impacts to hydrology, hydraulics and water quality under Alternative 3 would not lead to short-term effects as a result of direct construction activities. In the long-term, the actions identified under Alternative 3 could potentially result in minor to moderate adverse impacts to water resources. At Muddy Hollow and Glenbrook, inaction could facilitate catastrophic failures leading to moderate adverse impacts to the adjacent water resources and associated habitats. Such events would lead to large-scale complete changes in habitat, and require longer periods of time to recover. Such events, occurring in association with unnatural features, result in impacts to the stream channel or ecosystem that are not within the range of natural variability, thereby increasing the time required to recover dynamic equilibrium.
Vegetation and Wildlife	Alternatives 1 and 2 would result in similar impacts to vegetation, wildlife, and habitat as a result of the direct construction activities, short-term and long-term habitat changes. Overall the changes to vegetation and wildlife habitat are considered adverse minor in the short term, with recovery, however, the long-term effects are considered beneficial.	Same as Alternative 1	Under Alternative 3, there would be no effect to existing vegetation and wildlife within the project area during the short term. In the long-term, potential failure of these earthen facilities under either flood flow or geologic hazard scenarios would result in minor adverse effects to vegetation and wildlife resources. Recovery time of these resources as a result of potential uncontrolled (catastrophic) failure would be more protracted and could prevent these areas from reaching stable physical or ecological equilibrium.

Wetland Resources	Overall, Alternative 1 would result in minor short-term adverse impacts associated with conversion or direct impacts as a result of construction. In the long-term, the recovery or conversion to more ecologically sustainable wetlands and habitat is considered a benefit to wetlands and wetland functionality at all the Project Sites.	Alternative 2 would result in minor short-term adverse impacts associated with conversion or direct impacts as a result of construction. The extended duration associated with Muddy Hollow and the smaller impact area at Glenbrook do not change the overall impacts to wetlands between Alternative 1 and 2. In the long-term, the recovery or conversion to more ecologically sustainable wetlands are considered beneficial to wetlands and wetland functionality at all the Project Sites.	Overall, the No Action Alternative would have adverse, negligible impacts in the short-term and localized minor to moderate, adverse impacts on wetlands and wetland functionality in the long-term. The severity of impact for each Project Site depends to a large degree on the potential for and consequences of catastrophic failure of the existing infrastructure. Limantour Beach Marsh has the lowest potential for catastrophic failure of the culverted berm, and failure would have the least impact on Project Site and downstream and upstream wetlands. Conversely, the potential for catastrophic failure, and associated impacts are much higher at Glenbrook Creek and Muddy Hollow, and should these structures fail, these and adjoining areas would be likely to incise and thereby cause more extensive losses of wetlands and wetland functions.
Special Status Plant Species	The project would not result in impacts to federally threatened or endangered plant species. The project would, to the greatest extent possible, avoid direct impacts to special status plants, but deconstruction activities could result in short-term minor adverse effects associated with changes to circulation and depositional patterns. The project build alternatives would result in smoothing of physical and ecological gradients, and in the long-term would result in expansion of habitat beneficial to special status plants in the area.	Same as Alternative 1	Alternative 3 would not result in impacts to special status plant species in the short-term or in the long-term.

Special Status Fish Species	Restoration actions under the build alternatives would result in increased sediment loading following deconstruction, but would restore habitat and access to habitat available to the fish in the long-term. Based on this analysis, the project build alternatives would result in short-term minor effects to special status fish (namely steelhead) and EFH within the project watersheds. The proposed actions, intended to restore hydrologic connectivity and access to the Muddy Hollow and Glenbrook watersheds would result in long-term beneficial effects to steelhead, potential coho salmon habitat, and EFH.	Same as Alternative 1	Under the no action alternative, there would be no effect on special status fish species and EFH in the short term. In the long-term, the potential for catastrophic failure would result in minor to moderate adverse impacts to steelhead and EFH in the project area.
Special Status Amphibians	The effects of changing habitat associated with the proposed restoration activities would result in localized short-term moderate adverse effects on the California red-legged frogs and the critical habitat at Limantour Beach Pond and Muddy Hollow Pond. In the long-term, enhancement actions adjacent to Limantour Beach Pond are expected to offset long-term impacts, resulting in minor adverse effects to the individuals. At the Glenbrook Crossing, non-breeding habitat would be effected, and only temporarily. The actions at Glenbrook Crossing would result in localized minor adverse effects in the short-term, with long-term beneficial effects as the system moves towards natural equilibrium. The proposed action alternatives would not result in impairment of park special-status amphibian species. The build alternatives would not jeopardize the persistence of California red-legged frogs in the project area or within the park.	Same as Alternative 1	Under the no action alternative, there would be no effect on special status amphibians in the short term. In the long-term, the potential for catastrophic failure would result habitat loss similar to that described for the build alternatives, and therefore minor to moderate localized adverse impacts at these sites.

Special Status Reptiles	The build alternatives would result in indirect impacts on the northwestern pond turtle through changes in habitat at Muddy Hollow and Limantour Beach Pond. These changes represent a localized moderate adverse impact in the short-term and minor adverse impacts in the long-term within the project area. The project actions at Glenbrook Crossing would not effect the northwestern pond turtle.	Same as Alternative 1	In the short-term the no action alternative would not result in direct or indirect impacts on the northwestern pond turtle within the project area. In the long-term, potential catastrophic failure could result in minor long-term impacts to the special status reptile species. The project actions at Glenbrook Crossing would not effect the northwestern pond turtle.
Special Status Avian Species	Analysis of Alternatives 1 and 2 indicates that there would not be impacts to bird reproduction and nesting, associated with project construction window. For resident birds, construction noises would persist for a period of 2-3 weeks at each site, but construction would avoid direct impacts. Standard mitigations to avoid impacts to the western snowy plover would include morning surveys adjacent to the work area. If snowy plovers are encountered, equipment would not be started until after the plovers fly away from the area. The project would result in negligible short-term effects on special status birds, and as a result of restoration of marsh habitat at Limantour Beach Pond and Muddy Hollow, potential black rail, salt marsh common yellowthroat, and sora habitat would expand in the local area. The long-term effects therefore would be beneficial to the special status bird species and their habitat. Because of the timing of the project, the actions at Glenbrook crossing would not result in impacts to special status bird species in the short or long-term.	Same as Alternative 1	Analysis of Alternatives 3 indicates that there would not be impacts to bird reproduction and nesting as the result of construction activities. In the long-term, the potential for catastrophic failure would result in minor impacts to the habitat of special status bird species.
Special Status Mammal Species	The build alternatives would result in the potential for indirect impacts, and would be negligible in the short term, but in the long-term no effect on Point Reyes mountain beaver is likely. Alternative 1 or Alternative 2 would not result in impairment of park special-status mammal species.	Same as Alternative 1	The no action alternative would not result in the potential for direct or indirect impacts, and would be no effect to special status mammal species in the short or long-term. Alternative 3 would not result in impairment of park special-status mammal species.

Special Status Invertebrate Species	The build alternatives would result in the potential for indirect impacts, and would be minor in the short term, but in the long-term no effect on special status invertebrates is likely. For this reason, it is concluded that the proposed build actions would result in minor short-term impacts to special status invertebrate species. In the long-term, restoration of more natural conditions and processes would result in beneficial effects to special status invertebrate species, specifically the globose dune beetle.	Same as Alternative 1	Under no action, there would be no short or long-term effects on special status invertebrate species as a result of direct action
Cultural Resources	Under Alternatives 1 and 2, the proposed restoration designs would avoid impacts to documented cultural resource areas. The analysis concludes that the project would result in no short-term or long-term effects on cultural resources. If operations reveal previously undocumented resources, the NPS would implement management measures described above to ensure that resources are preserved and protected in an appropriate manner. Alternative 1 or Alternative 2 would not result in impairment of park cultural resources.	Same as Alternative 1	Under Alternative 3, no action would take place within the project area therefore, no effect on cultural resources would occur as a result of this project. Alternative 3 would not result in impairment of park cultural resources.
Soundscape	Under either Alternative 1 or Alternative 2, and in combination with the proposed environmental commitments, short-term adverse minor effects would occur on the natural soundscape. Following construction, no additional operations at the site would affect the soundscape, therefore there is no effect in the long-term. The action alternatives would not result in impairment of the park soundscape resource.	Same as Alternative 1	Under Alternative 3 no construction would occur, therefore there would be no effect to the soundscape in both the short-term and long-term. Alternative 3 would not result in impairment of the park soundscape resource.

Public Health and Safety	Both Alternative 1 or Alternative 2 would result in the removal of facilities that pond water. Based on the analysis above, the action alternatives would result in short term minor impacts to public health and safety as a result of construction activities and closures, and beneficial long-term effects with the removal of these structures. Alternative 1 or Alternative 2 would not result in impairment of park public health and safety.	Same as Alternative 1	Alternative 3 would result in no effect in the short-term, and the potential for minor adverse effects to public health and safety in the long term. Alternative 3 would not result in impairment of park public health and safety.
Recreational Use	Either Alternative 1 or Alternative 2 would change existing habitat features requiring new trail access corridors and shifts to current recreational uses. In the short-term, minor adverse impacts to recreation would occur as a result of temporary construction closures. In the long-term, changes to the trail network and habitat would result in new and different recreational opportunities and are considered beneficial.	Same as Alternative 1	Alternative 3 would not result in temporary closures and therefore there would be no effect to recreational resources in the short term. In the long-term, potential failure of facilities without plans to repair or replace them would result in minor to moderate adverse impacts to recreational uses, including trail access as well as wildlife viewing.
Transportation and Traffic	Alternative 1 would result in short-term minor adverse effects to traffic during the period of construction. However, once construction is completed, the resulting restoration is not expected to change the traffic loading patterns to or within the park, therefore no long-term effects would occur to traffic.	Alternative 2 would result in short-term minor adverse effects to traffic during the period of construction, but would include 2 construction years rather than one (Muddy Hollow phasing). However, once construction is completed, the resulting restoration is not expected to change the traffic loading patterns to or within the park, therefore no long-term effects would occur to traffic.	Alternative 3 would result in short-term or long-term effects to traffic. Alternative 3 would not result in impairment to park resources as a result of traffic.

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3.0 Affected Environment

3.1 Introduction

Overview of Land Uses in the Project Area

Historically, the project area was part of a larger dairy district that provided much of the butter and cream used in San Francisco during the Gold Rush of the mid-1800s. From the 1850s through the 1950s, land uses in the area included row crop cultivation and dairy production. In addition, during World War II, embattlements were installed upslope of the Limantour Beach site.

The facilities proposed for removal were constructed during the postwar development boom of the 1950s and early 1960s, when the Limantour area was in private ownership. At this time, lands in the project area became part of the proposed Drake's Estates residential development, which was intended to comprise more than 1,000 houses, including a number of homes on Limantour spit itself. Ultimately, although fewer than 20 houses were completed as part of Drake's Estates, the major road and water system components for the development were installed.

The embankment crossing at Limantour Beach was constructed as the main access road to a group of about 10 houses located on Limantour Spit, while Muddy Hollow Road, the main transportation artery through the development, was widened and straightened. The dam at Muddy Hollow Pond was built across the former tidal estuary to enhance recreational opportunities within the development. The Glenbrook Crossing was constructed as part of the Muddy Hollow Road redevelopment; air photos show that the crossing was completed in the fall of 1963, after the park was established but before the land was acquired by NPS.

When it acquired the Limantour property, NPS relocated or removed the houses on and upslope from Limantour Spit, except for three, which remain and are used as park housing. Currently, the project sites are open-space areas that support a number of recreational uses. The road and dam infrastructure from this era of development also remain in place, and while NPS management goals for the area have evolved since the original 1963 Master Plan, the Limantour Area continues to serve as a primary beach access point.

Land Use Planning at Point Reyes National Seashore

Point Reyes National Seashore is managed according to guidelines established in the Point Reyes General Management Plan (National Park Service 1980), which defines management practices and identifies the land uses that are permitted throughout the park. The land use designations used in the General Management Plan were developed to support management of Point Reyes National Seashore lands and development of their future based on the value of the Seashore's resources,

identified management objectives, and the expectations of the public. Those relevant to the project sites and immediate vicinity are defined below.

- **Environmental Protection—Reserves:** There are 1,300 acres of reserves designated within the Seashore, consisting of the Point Reyes Headlands Reserve and the Estero de Limantour Reserve. These lands and waters have been preserved in a natural condition to protect their terrestrial and aquatic wildlife for public observation and scientific study. Management of the headlands reserve allows no human intrusion except that associated with approved research projects, and the Estero Reserve additionally protects all lifeforms from removal or disturbance without state and federal collecting permits.
- **Environmental Protection—Wilderness:** There are 32,730 acres of wilderness designated within the Seashore. These lands are managed in accordance with the mandates of the federal Wilderness Act of 1964.
- **Natural Environment:** There are 1,838 acres of natural environment designated within the Seashore. An additional 3,413 acres of wetlands designated as potential wilderness are managed as natural environment. Natural environment lands are managed to maintain their natural appearance while allowing compatible visitor use and providing a transition between human intrusions, such as roads and other developments, and the designated wilderness.
- **Development:** There are 85 acres of development within the Seashore. Development areas are managed to provide essential visitor service and administrative facilities.

The Seashore also includes a designated pastoral zone, which supports agricultural land uses, including dairy farming and beef cattle ranching.

Current Uses and Management at the Project Sites

The project sites currently support recreational uses under Reserve or Wilderness designations. None is within the designated pastoral zone, and there are no agricultural land uses at or adjacent to the project sites.

The Limantour Beach site is a designated recreation area that provides trailhead parking, restrooms, and telephones for visitors. This site supports hiking, and is used heavily by recreators enjoying the adjacent beach. Limantour Road, a paved main roadway, provides access to the site. Most of the Limantour Beach site is designated Natural Environment, Environmental Protection—Reserves, and Development. The tidal portions of the Limantour Beach site are within the Estero de Limantour Environmental Protection—Reserves management sub-zone.

The Muddy Hollow Pond site is connected to the existing trail network by the Lower Muddy Hollow Trail and by the Estero Trail. Lower Muddy Hollow Trail travels the length of the pond and lower valley, accommodating biking, hiking and equestrian use. Estero trail crosses the Muddy Hollow Pond dam, providing access to the coastal bluffs along Estero de Limantour. The Muddy Hollow Pond is within the Environmental Protection—Natural Environment. The tidal areas below the Muddy Hollow dam are within the Estero de Limantour Environmental Protection—Reserves management sub-zone. The Estero trail reroutes associated with this project site would be included in the Environmental Protection—Wilderness and Natural Environment sub-zones.

At the Glenbrook Crossing site, the Muddy Hollow Trail supports hiking through the project site and provides a nexus to other trails in the area. The Glenbrook Crossing site and trail reroute

section of the Muddy Hollow Pond site are within the Philip Burton Wilderness and are managed as Environmental Protection—Wilderness.

3.2 Physical Environment at Point Reyes

Visual Resources

Point Reyes National Seashore presents a wide variety of views, ranging from forested ridges to open grasslands to crashing waves along a dramatic shoreline. The three project sites are located in the central portion of the Seashore. Limantour Beach represents a back-beach coastal setting, Muddy Hollow is located in a modified estuarine setting, and Glenbrook Crossing is a riparian site surrounded by scrub and grassland uplands.

Limantour Beach is accessed via Limantour Road, a principal route into the central portion of the Seashore. Limantour Beach itself provides two beach access points approximately 0.5 mile apart, with a large parking lot at the north access and a smaller parking area at the south access. Limantour also offers restrooms, picnic tables, and telephones for visitor use, and overall is the most developed of the three sites. Thus, views in the Limantour Beach area, although dominated by the natural character of the beach, estuary, and upland landscapes, offer a combination of natural and built visual elements. In its current state, the proposed restoration site itself consists of a paved road crossing Limantour Beach Marsh on a culverted embankment. Visually, the existing embankment, paved road, and culvert represent an intrusion into the surrounding natural landscape. Because of its easily accessible location and the amenities it provides, the Limantour Beach area is used by as many as 180,000 visitors and is thus viewed by a wide range of recreators. Consequently, it represents an important aspect of the Seashore's "public face."

Views at Muddy Hollow also offer a combination of natural and built elements. Approaching the site from the south (Limantour Beach) side along the Muddy Hollow Trail, views are dominated by tidal marsh flatlands in the upper Estero de Limantour, cradled by rolling hills that support grassland and scrub habitat. At the site itself, the constructed dam embankment, although vegetated, is a discordant element that disrupts the unity of the largely natural views. Muddy Hollow Pond offers views of open water ringed by emergent marsh and riparian vegetation, but is nonetheless a clearly artificial feature. Like Limantour Beach, Muddy Hollow is easily accessible, and is thus viewed by a comparatively large number of recreators.

The Glenbrook Crossing site is located in the Philip Burton Wilderness, where the Muddy Hollow Trail crosses perennial Glenbrook Creek. Views in the area are primarily natural and are dominated by hilly topography and vistas of grassland, scrub, and riparian vegetation. However, topography and vegetation at the proposed spoils disposal site are obviously disturbed and as such present an obtrusive reminder of human activities in the wilderness setting. At the site itself, the embankment crossing and culvert are similarly disruptive. The Glenbrook Crossing site is accessible only by trail and is not visible from public roads. Consequently, it is viewed by fewer people than the other two sites, but viewers are likely to include a high percentage of people who particularly value its wilderness character.

Wilderness

Wilderness is managed and protected as a resource. Wilderness characteristics and values, including primeval character, preservation of natural conditions implies that the Wilderness is to be preserved and used in unimpaired condition. Prior to establishment of the Seashore, the entire

designated Wilderness was part of intensive agriculture and in many areas logging was common. Roads and ponds persist within the Wilderness. In order to manage or restore such areas in the Wilderness, it is common that motorized equipment is necessary to accomplish the work. Evaluation of physical conditions and process in the wilderness indicate that in many areas, particularly associated with roads and stream crossings, the pre-Wilderness land uses continue to influence and impede natural process, and thus the wilderness character and quality. Considering restoration within Wilderness includes weighing the impacts of implementation with those of leaving the site alone. Particularly with facilities, such as road crossings, culverts, and dams, the implications of these man-made facilities being a part of wilderness reduces the strength of the overall Wilderness objective of 'untrammeled by man'.

The Glenbrook Crossing site is located approximately one mile inside of the Wilderness boundary. It is accessible on the Muddy Hollow Trail (former road). The 20-25 foot high road embankment, 5 foot diameter culvert and 11 foot outfall are considered non-conforming wilderness features. These facilities, the materials that allow them to remain, and the equipment used to construct them are considered non-conforming with the wilderness character.

In addition to the facility deconstruction, actions at Muddy Hollow and Glenbrook Crossing would require trail reroutes through the Wilderness. Current trails are primarily converted roads leading to large scale drainage and maintenance issues. The proposed reroutes would be constructed to a scale more appropriate for wilderness, and more sustainable/compatible with the Wilderness designation.

Section 4(c) of the Wilderness Act of 1964 prohibits certain activities in wilderness by the public, and, at the same time allows the agencies to engage in those prohibited activities in some situations. Section 4(c) states:

> "… except as necessary to meet minimum requirements for the administration of the area for the purpose of this Act (including measures required in emergencies involving the health and safety of persons within the area), there shall be no temporary road, no use of motor vehicles, motorized equipment or motorboats, no landing of aircraft, no other form of mechanical transport, and no structure or installation within any such area."

Through this Wilderness Act language, Congress acknowledged that there are times when exceptions are allowed to meet the minimum required administration of the area as wilderness. The minimum tool requirements analysis required determine the least impactive way of administering the wilderness. The wilderness manager may authorize any of the generally prohibited activities or uses listed in Sec. 4(c) of the Wilderness Act if they are determined to be the minimum necessary to do the job and meet wilderness management objectives.

The impacts of the proposed alternatives on wilderness character are evaluated in Chapter 4. In addition, the Wilderness Minimum Requirements Decision Guide to determine minimum tool is included as Appendix B to this EA.

Air Quality

The primary factors controlling air quality include the locations of air pollutant sources and the amount and nature of the pollutants emitted from those sources. Meteorologic processes and topography are also important factors: atmospheric conditions, such as wind speed, wind direction, and air temperature gradients interact with the physical features of the landscape to determine the movement and dispersal of air pollutants.

Point Reyes National Seashore is located within the San Francisco Bay Area Air Basin (SFBAAB). Temperatures on the coast of Marin County are typically in the high 50s or low 60s (F) year-round. Daily and seasonal oscillations of temperature are small because of the moderating effects of the nearby Pacific Ocean. Winds in coastal Marin County are typically out of the northwest, and annual average wind speeds are approximately 8–10 miles per hour (Bay Area Air Quality Management District 1999).

The air pollutants of greatest concern in the SFBAAB are ozone, carbon monoxide, and inhalable particulate matter (particulate matter <10 microns in diameter, or PM10), and the proposed action is not expected to generate a substantial amount of any other pollutant. Consistent with the guidance of the BAAQMD (Bay Area Air Quality Management District 1999) and standard industry practice, this EA focuses on the pollutants of greatest concern in the area. Their characteristics are summarized in Table 3-1.

Table 3-1. Overview of Pollutants of Greatest Concern in the SFBAAB

Pollutant	Sources	Health and Other Concerns
Ozone	Formed by a photochemical reaction in the atmosphere; ozone precursors, including reactive organic gases and oxides of nitrogen (NO_x), react in the atmosphere in the presence of sunlight to form ozone. Ozone precursors are emitted by mobile sources such as vehicles, and by stationary combustion equipment.	■ A severe eye, nose, and throat irritant; increases susceptibility to respiratory infections. ■ An oxidant; can cause substantial damage to synthetic rubber, textiles, and other materials. ■ Produces leaf discoloration and cell damage in plants.
PM10	Results from many kinds of dust- and fume-producing activities, such as demolition, construction, and vehicular traffic; entrained road dust from motor vehicles accounts for approximately two-thirds of the regional PM10 inventory in the project area.	■ Health concerns focus on particles small enough to be drawn into the lungs when inhaled (PM10). ■ Can increase the risk of chronic respiratory disease with extended exposure.
CO	Motor vehicles are the primary source of CO emissions in most areas. In the urbanized portions of the San Francisco Bay Area, high CO levels primarily develop during the winter near congested intersections, when periods of light winds combine with the formation of ground-level temperature inversions from evening through early morning. In addition, motor vehicles exhibit increased CO emission rates at low air temperatures.	■ Combines readily with hemoglobin and thus reduces the amount of oxygen transported in the bloodstream. ■ Effects on humans range from slight headaches to nausea to death.

Sensitive receptor refers to land uses that are considered particularly sensitive to decreases in air quality. The designation typically refers to uses such as residences, schools, libraries, hospitals, and other similar facilities where there are large concentrations of children and young people; the elderly; and/or the chronically ill. Because all of the project sites are within Point Reyes National Seashore, few sensitive receptors of these types are located near the sites. However, the area is widely used for recreation, wildlife viewing, and scientific research, and all of these uses are potentially vulnerable to air quality degradation.

Geology, Geologic Hazards, and Soils

Geologic Setting

The Point Reyes peninsula is bounded on the east by the San Andreas fault zone, which defines the elongate, linear Olema Valley extending from Bolinas Bay on the southeast through Tomales Bay on the northwest. East of the San Andreas trend, basement rocks comprise graywacke, serpentinite, pillow basalt, chert, and blueschist in mélange of the Jurassic–Cretaceous Franciscan Complex. West of the San Andreas trend, on the peninsula proper, the basement consists of plutonic rocks of Cretaceous age, primarily granodiorite, tonalite, and granodiorite. Metasedimentary rocks (mica schist, quartzite, calc-hornfels, and marble) are locally present as inclusions and roof pendants within plutonic rocks (Galloway 1977, Clark et al. 1984, Wagner et al. 1991, Clark and Brabb 1997). The plutonic rocks of the Point Reyes peninsula are likely correlative with similar units exposed in the Monterey area, reflecting some 94 miles (150 kilometers) of displacement along the active San Gregorio fault (Clark and Brabb 1997).

The plutonic basement of the Point Reyes peninsula is overlain by deep-marine clastic rocks of the Paleocene or Eocene Point Reyes Conglomerate, which is exposed at the surface only in the vicinity of the Point Reyes lighthouse (e.g., Galloway 1977; see also Clark and Brabb 1997). Both the Point Reyes conglomerate and the older plutonic units are in turn overlain by two sequences of Neogene strata. A mid- to upper Miocene sequence comprises a basal transgressive shallow-marine sandstone (the Laird Sandstone of Galloway 1977) overlain by deep-marine porcellanite of the Monterey Formation. The mid- to upper Miocene sequence is unconformably overlain by marine sedimentary units of late Miocene and Pliocene age, including a basal glauconitic sandstone (Santa Margarita Sandstone); siliceous mudstones assigned to the Santa Cruz Mudstone; and siltstone, mudstone, and sandstone of the Purisima Formation (Clark and Brabb 1997).

Finally, all of the peninsula's older units are overlain by Quaternary deposits that record surficial processes in fluvial and coastal/estuarine environments on essentially modern topography. These include well-developed Pleistocene marine terraces, Holocene alluvium in the larger active drainages, and Holocene tidal sediments in the larger embayments, such as Drake's Estero and the Estero de Limantour. Active dune fields and stabilized dunes are present along segments of the coastline and are especially well-developed at Kehoe Beach, along Point Reyes Beach, and along Limantour Spit (Galloway 1977, Clark and Brabb 1997).

Geologic Hazards

Seismicity and Seismic Hazards

No faults recognized by the State of California as active traverse any of the restoration sites (Hart and Bryant 1997). Consequently, the risk of surface rupture associated with active faulting is probably quite low at these sites.

However, as described above, the Point Reyes peninsula is bounded to the east by the active San Andreas fault zone. In addition, the restoration sites are located in close proximity to the offshore Point Reyes fault, which is identified as a Type B seismic source[2] by the current Uniform Building Code (UBC) (International Conference of Building Officials 1997), although it is not zoned by the State of California. The Rodgers Creek fault, the likely northward continuation of the Hayward

[2] The UBC evaluates the risk associated with active faults based on their potential to generate large earthquakes (measured as the moment magnitude for the largest earthquake anticipated on the fault) and their degree of seismic activity (measured as average annual slip rate). Under this system, a *Type A seismic source* is a fault that is capable of producing large-magnitude events (≥ M 7.0) and is highly active (has a high average annual slip rate). A *Type B seismic source* is associated with smaller maximum event and/or is less active, but still constitutes a substantial seismic threat (International Conference of Building Officials 1997).

fault trend, is located about 25 miles northeast of the project area. It is zoned by the State, and is identified as a Type A seismic source by the UBC (Hart and Bryant 1997, International Conference of Building Officials 1997). Because of their proximity to several major active faults, the restoration sites are likely to experience strong groundshaking during the life of the project. Table 3-2 summarizes current estimates of the maximum earthquake anticipated on the principal active faults in the vicinity of the restoration sites.

Table 3-2. Maximum Earthquake Anticipated on Major Faults in Vicinity of Point Reyes National Seashore

Fault	Estimates of Maximum Earthquake	Estimated Mean Recurrence Interval[b]
San Andreas (northern segment)	7.9[a]	223 years
	7.45[b]	
Rodgers Creek	7[a]	205 years
	6.98[b]	
Point Reyes	6.8[a]	Unkown

Sources: [a]International Conference of Building Officials 1997, [b]U.S. Geological Survey Working Group on California Earthquake Probabilities.

Seismic hazard maps have not been issued for the any of the quadrangles in the vicinity of the proposed action (see California Geological Survey 2003). Generalized liquefaction potential mapping available from the Association of Bay Area Governments (2003) and the County of Marin (1994) suggests that unconsolidated sediments in low-lying portions of the project area may be subject to liquefaction. This would be of particular concern at the Limantour Beach Marsh site, where well-sorted dune sands may be saturated by shallow groundwater. Similar concerns may exist at the Muddy Hollow site. Liquefaction is likely less of a concern at the Glenbrook Crossing site, because the volume of sediments is probably smaller, and the deposits of high-gradient alluvial and fluvial systems are typically poorly sorted and less likely to liquefy. Geotechnical surveys have been conducted at the project sites and would be used to refine construction specifications necessary to meet potential hazard.

Landslide Hazards

As described above, seismic hazards mapping for the vicinity of the proposed action has not been published, and no quantitative analysis of slope stability has been performed for any of the restoration sites to date. Both the Muddy Hollow and Glenbrook Crossing sites are adjacent to steep slopes in rugged, hilly topography, and mapping by the U.S. Geological Survey (Wentworth et al. 1997) shows substantial landsliding in highlands in the project vicinity. Both Muddy Hollow and Glenbrook Crossing were affected by the flood/debris flow events that struck west Marin County in January 1982. In particular, aggradation above the Glenbrook Crossing site is likely due in large part to debris flows that occurred in January 1982, with the gully west of the road crossing formed as the culvert was plugged and floodflows overtopped the roadbed (see related discussion in *Hydrology, Hydraulics, and Water Quality* below). More recently, during the El Niño flood year 1998, oversaturation of colluvium following some 25 inches of rainfall in a single month triggered shallow landslides on slopes within the Muddy Hollow and Glenbrook watersheds. Thus, based on their general geologic characteristics, and evidence of recurrent past instability, some risk of slope failure is likely still present at Glenbrook Crossing and Muddy

Hollow. The existing hazard of landsliding in particular is substantially less at Limantour Beach Marsh, where the slopes adjacent to the site are more gentle.

Soils

Soils at Limantour Beach Marsh Site

The Limantour Beach Marsh site is located on humaquepts, seeped and dune land. The proposed spoils management area (shared with the Muddy Hollow site, as described in Chapter 2) is located on Tomales fine sandy loam, 30–50% slopes.

The existing embankment crossing, its immediate downstream vicinity, and the small upstream valley occupied by freshwater marsh are all underlain by **humaquepts, seeped**. This unit typically consists of 3–6 inches of sod (locally containing ≥50% peat), overlying very dark gray or black loam, clay loam, or clay. Aerially deposited sand may also be present, contributing to local development of loamy sand and loam. Humaquepts, seeped occurs in areas that are consistently saturated by shallow groundwater during the winter and spring, with the water table at or immediately below the ground surface; during the dry season, the water table is typically 2–5 feet below the surface (U.S. Soil Conservation Service 1985).

Dune land consists of loose sand moved by wind transport from adjacent beach areas. It includes both active and stabilized dune systems; at Limantour Beach, active dunes immediately behind the beach face give way to stabilized dunes on the south flank of the marsh drainage. Dune lands typically exhibit no soil profile development. Permeability is very rapid (U.S. Soil Conservation Service 1985).

Tomales fine sandy loam, 30–50% slopes is a deep, moderately well drained upland soil formed in material derived from sandstone bedrock. It consists of ~12 inches of brown fine sandy loam overlying ~12 inches of brown and grayish brown loam, which in turns overlies a subsoil consisting of brownish gray and yellow clays. Depth to bedrock is typically 40–60 inches, but is locally more. Permeability is very slow, runoff is rapid, and water erosion hazard is high. Shrink-swell potential ranges from low to high, and is higher in the clay-rich subsoils than in the overlying loamy material. Corrosion risk is high for uncoated steel and moderate for concrete (U.S. Soil Conservation Service 1985).

Soils at Muddy Hollow Site

The Muddy Hollow site is located on hydraquents, saline. The spoils management site (shared with the Limantour Beach Marsh site, as described in Chapter 2) is located on Tomales fine sandy loam, 30–50% slopes.

Hydraquents, saline typically consists of stratified silt and clay with thin peat interlayers. Soils in this unit are typically mottled. Hydraquents, saline is typical of areas inundated by tides at least during unusually high tide conditions, and is typically waterlogged. This unit is very poorly drained; surface runoff is very slow to ponded, and erosion hazard is slight.

Tomales fine sandy loam, 30–50% slopes is described in *Soils at Limantour Beach Marsh Site* above.

Soils at Glenbrook Crossing Site

The Glenbrook crossing site is located on Tomales fine sandy loam, 9–15% slopes; Tomales fine sandy loam, 15–30% slopes; and Tomales fine sandy loam, 30–50% slopes. The crossing and its immediate vicinity underlain by **Tomales fine sandy loam, 30–50% slopes**, described in *Soils at*

Limantour Beach Marsh Site above. The proposed spoils management area is underlain by **Tomales fine sandy loam, 9–15% slopes** and **Tomales fine sandy loam, 15–30% slopes**. These units are very similar to occurrences of Tomales fine sandy loam on steeper slopes, as described above.

Hydrology, Hydraulics, and Water Quality

Climate and Precipitation in the Point Reyes Area

Like the rest of California's north-central coast, the Point Reyes peninsula is characterized by a Mediterranean climate. As discussed in air quality above, temperatures on the peninsula are moderated by proximity to the ocean: summers are cool and dry, with temperatures even in inland areas rarely in excess of 100° F, while winters are chilly and rainy but rarely fall below freezing. Average annual precipitation at the Bear Valley headquarters is near 40 inches, most of which is received during the winter storm season, and almost exclusively in the form of rain. Within the project watersheds, average precipitation ranges from 30-40 inches. West of Inverness Ridge, fog is common during the summer months (Galloway 1977, Kashiwagi 1985, Jones & Stokes 2001, NHC 2002).

Surface Water Hydrology

Surface Water Drainage

Overview

Surface water drainage on the Point Reyes peninsula exhibits a generally dendritic pattern. The principal topographic features governing regional drainage are both fault-controlled: Inverness Ridge, uplifted along the active San Andreas fault to form the peninsula's steep, northwest-trending topographic backbone; and the Tomales Bay–Olema Valley–Bolinas Lagoon trough, an elongate low that marks the position of the so-called San Andreas fault zone. Most small streams on the east flank of Inverness ridge flow approximately perpendicular to the ridgecrest, discharging northward toward Tomales Bay or southward into Bolinas Lagoon. On the west side of the ridge, drainage is dominated by the generally westward gradient to the Pacific Ocean, although several larger streams flow almost due south toward the ocean from the south half of Inverness Ridge, possibly reflecting the persistence of antecedent drainage patterns (Galloway 1977).

Surface drainages of the Point Reyes peninsula include both perennial and intermittent streams. As in the rest of the Bay Area and coastal California in general, streamflow varies markedly between the wet and dry seasons. Even the upper watersheds are at comparatively low elevations, and, as described above, climate is moderated by the marine influence, so there is no significant snowmelt contribution to runoff. In addition, infiltration rates are typically slow and runoff rates are high except in sandy sediments along the immediate coastline, so runoff typically peaks during and shortly after rainfall events. Consequently, as in much of the Coast Range region, base flow is for the most part poorly sustained except where it is fed by shallow groundwater (e.g., Jones & Stokes 2001). At Point Reyes, there is also some evidence that streams in wooded drainages are fed in part by localized groundwater recharge from fog drip (Galloway 1977, Matthews 2003).

Surface Water at Limantour Beach Marsh Site

Limantour Beach Marsh occupies an elongate, east-west trending topographic low separated from the open ocean by active and stabilized dunes that compose Limantour Spit (Figure 2-1).

Freshwater flows enter the marsh both via overland runoff from immediately adjacent hillslopes and through an open-ditch channel (another remnant of 1950s-era construction) that connects with

the upstream Laguna Creek Lagoon under most conditions. Some 15–20 feet wide and 2–3 feet deep, the channel delivers most of the marsh's freshwater input; the adjacent hillslope watershed has an area of approximately 0.1 square mile, and probably contributes a comparatively minor volume of flow to the marsh. Although it is equipped with a screw gate, the channel is not maintained, and it is breached such that overbank flow now diverts directly to the ocean at flood stage (nhc 2002).

The west end of the marsh is open to tidal exchange, and historically the entire marsh area was probably subject to varying degrees of tidal influence. At present, however, the east portion of the marsh, upstream of the constructed embankment crossing that provides access to Limantour Beach, is a freshwater marsh that supports as much as 1–3 feet of standing water during the wet season. Although a 36-inch RCP culvert beneath the crossing permits some flow, the culvert was placed with an adverse slope; invert elevations up- and downstream of the crossing are 3.7 and 4.3 feet above mean sea level (MSL), respectively. Consequently, tidal flow is expected to enter the area upstream of the crossing only during extreme conditions (nhc 2002).

A plunge pool eroded 2–3 feet into soft sedimentary bedrock immediately below the culvert outfall attests to substantial freshwater discharge during the flood season. Some water may remain in the channel throughout the dry season, but typical base flow is minimal (nhc 2002).

Immediately below the embankment crossing is an intermediate tidal marsh with an extent of approximately 4.8 acres. Both natural and constructed channels are present in this area. Channel form is constrained and deflected to some extent by the presence of a second constructed embankment or berm, which originally separated the intermediate tidal marsh from open tidal marsh, with flow conveyed via a culvert. The culvert is now abandoned, and tidal exchange occurs through a breach on the south end of the berm (nhc 2002).

Tides at Limantour Beach follow a typical Pacific Coast mixed semi-diurnal pattern, with two high and two low tides of differing elevations occurring each day. Table 3-3 summarizes tidal elevations at Limantour Beach Marsh, based on data for the period 1975–1995 collected at the Point Reyes/Drake's Bay tide gaging station (NOS/NOAA Station #941 5020) (nhc 2002).

Table 3-3. Tide Elevations, Limantour Beach Marsh, Point Reyes National Seashore

Tide Level	Tide Elevation (feet NGVD29)
Mean Higher High Water (MHHW)	2.92
Mean Tide Level (MTL)	0.30
Mean High Water (MHW)	2.26
Mean Low Water (MLW)	-1.67
Mean Lower Low Water (MLLW)	-2.85

Source: nhc 2002

Surface Water at Muddy Hollow Site

The Muddy Hollow reservoir (Muddy Hollow Pond) occupies an area of slightly more than 11 acres on the lower reach of Muddy Hollow Creek (Figure 2-2). The reservoir was created by constructing an earthen dam across the stream valley at approximately the natural transition from freshwater drainage to tidal marsh. Muddy Hollow now discharges into the upstream end of the reservoir, where an alluvial delta has formed, extending downstream to within 700 feet of the dam. Bottom elevations in the reservoir range from 3 feet above MSL at the dam to 8 feet above MSL at

the delta. An overflow channel near the west dam abutment discharges into the downstream tidal marsh to maintain the surface water elevation in the reservoir at approximately 9 feet above MSL. The overflow channel is 300 feet long and has a trapezoidal cross section, with a top width of 12 feet and a depth of 3 feet (nhc 2002).

Upstream of the reservoir, Muddy Hollow Creek can be divided into several geomorphically distinct reaches. In its upper reaches, some 1.5 miles upstream of the dam, the creek is primarily considered a source reach, with a single channel with an estimated gradient of 1.7%. The central portion of the watershed remains incised but acts primarily as a transport reach, delivering most sand and gravel through the system to the depositional area below the Muddy Hollow Pump station. In this area, the channel, once confined by levees on the north side of the valley, has avulsed and has actively flooded across the valley bottom since the 1995 Vision Fire (Collins and Ketcham 2001). While likely initiated as a response to base level change triggered by dam construction, the upstream migration of this avulsion is likely now disconnected from the dam presence, and is based on local hydraulics, vegetation, and sediment supply.

Beginning below the pump station, the channel gradient decreases to about 1.3% and the channel begins to braid. Further downstream, the channel gradient decreases further, to about 1.0%. In this area, the creek typically consists of two main channels with average widths of 6–12 feet and thalweg depths 1–2 feet below the floodplain. As much as 3 feet of aggradation has been observed in places along this reach (nhc 2002).

The elevation of the tidal marsh plain downstream of the dam ranges from 2 to 3.5 feet above MSL. This area is drained by a single, strongly meandering channel approximately 25–30 feet wide and 3 feet deep (nhc 2002).

Table 3-4 shows estimated flood discharges for the Muddy Hollow basin.

Table 3-4. Estimated Flood Discharge, Muddy Hollow Basin, Point Reyes National Seashore

Flood Recurrence Interval	Peak Discharge
2 years	271 cfs
10 years	542 cfs
100 years	922 cfs

Source: nhc 2002.

Tidal elevations at the Muddy Hollow site are the same as those for the Limantour Beach Marsh site, given above in Table 3-3. Some reduction in tidal amplitude (*tidal muting*) may occur between the open ocean and inland waters, but is not expected to be substantial over the small distance separating the Muddy Hollow site from open water (nhc 2002).

Glenbrook Site

Glenbrook Creek is a perennial stream that drains a watershed of about 1.4 square miles in the uplands northeast of the Estero de Limantour (Figure 2-6). It is fed by a number of small tributaries as well as shallow groundwater, and drains into a southeasterly tidal arm of the Estero de Limantour system via a series of two constructed ponds (nhc 2002).

The Glenbrook Crossing site is located where the Muddy Hollow Trail crosses the creek channel on an earthen embankment to connect with the trace of the Old Glenbrook Road. Flow is culverted beneath the roadway embankment via a 60-foot length of 60-inch CMP. The steeply sloped, eroded, and bowed culvert delivers water downstream via an 11-foot vertical drop to the streambed below.

The existing crossing represents a substantial discontinuity in stream channel and floodplain profile and hydrologic connectivity within the watershed. Marked aggradation has occurred as much as 700 feet upstream of the crossing, the approximate upstream extent of backwater when the water surface elevation reaches the culvert crest. Although smaller events may also have contributed, it is assumed that at least some of this aggradation is the result of debris flows that occurred in January 1982, with the beheaded gully west of the crossing likely formed as the culvert became obstructed and flows overtopped the road. Following the 1982 floods, the culvert was replaced at the new upstream bed level, approximately 12 feet above the downstream bed elevation. The very flat floodplain in this reach is likely the result of settling following installation of the new culvert. While the road embankment likely captured most of the sediment and debris during the 1982 event, most of the floodwaters likely continued on over the embankment scouring new material from the channel downstream. Since 1982, although some bedload is carried through the culvert, starved flows below the crossing have continued to erode the scour pool below the drop, and the channel is impassable to fish (nhc 2002, Jones & Stokes and nhc 2003a).

Upstream of the crossing, Glenbrook Creek is confined in a single main channel. In its upper reaches, 1400–1700 feet upstream of the crossing, bedrock is visible in the channel bed, and likely controls the stream gradient. Downstream, a terraced geometry with an upper and lower floodplain develops. The width between the upper floodplains in this portion of the channel is 70–100 feet. Closer to the crossing, only one floodplain terrace is evident; in this area, the low-flow channel is 4–8 feet wide, with bankfull widths of 7–20 feet. In general, both the channel and the floodplain maintain a gradient of approximately 2.0% upstream of the crossing. In the aggraded reach immediately upstream of the crossing, the channel gradient decreases to approximately 1.1% (nhc 2002).

About 50 feet upstream of the crossing, a small tributary flows across a gently sloping alluvial cone to join Glenbrook Creek from the east. The tributary channel is poorly defined at the confluence, which represents the distal portion of the cone (nhc 2002).

Immediately below the culvert outfall, the channel bed has been rip-rapped with broken concrete and rock to control channel incision. Downstream of the crossing, the creek continues to be confined within a single main channel incised some 10–16 feet into the floodplain. The low-flow channel is approximately 6 feet wide, with bankfull widths of 35–70 feet. At the outfall, the channel gradient is approximately 1%, increasing downstream to approximately 1.3%, or roughly equivalent to the floodplain gradient. Abundant large woody debris is present in the reaches downstream of the crossing (nhc 2002).

An incised gully, located about 100 feet west of the main channel centerline, parallels the main channel downstream of the embankment. It is believed to have formed during a 1982 storm event, when the roadway embankment was overtopped (nhc 2002).

The channel continues downstream through the remnants of two breached ponds approximately a mile to the Glenbrook arm of the Estero de Limantour. Table 3-5 shows estimated flood discharges for Glenbrook Creek at the Glenbrook Crossing site.

Table 3-5. Estimated Flood Discharge, Glenbrook Creek Basin, Point Reyes National Seashore

Flood Recurrence Interval	Peak Discharge
2 years	128 cfs
10 years	261 cfs
100 years	447 cfs

Source: nhc 2002.

Surface Water Quality

The quality of surface waters on the Point Reyes peninsula is generally good, but reflects the influence of current land uses. For instance, NPS water quality monitoring has shown that pathogen, sediment, and nutrient levels are elevated in areas with active livestock or dairy operations. NPS conducts water quality monitoring in the Laguna and Muddy Hollow watersheds, and uses water quality results from these watersheds as control indicators for the park's other pastoral watersheds. Results of monitoring pathogens, sediment, nitrogen and orthophosphorus show that water quality conditions are generally in good condition in these watersheds (NPS 2001).

To the east of the project area, Tomales Bay and its tributaries have been identified as water quality–limited for the same constituents that affect pastoral drainages at Point Reyes (State Water Resources Control Board 2003). Total maximum daily load (TMDL) limits for nutrients, sediment, and pathogens are now being identified through an ongoing management effort for the Tomales Bay watershed. The project area is not within a TMDL planning area.

Groundwater Hydrology

Little site-specific information is available on groundwater in the immediate vicinity of the restoration sites. The following sections provide a regional overview.

Water-Bearing Units and Groundwater Flow

Regionally in the North Bay the principal aquifers consist of unconsolidated and poorly consolidated marine and terrestrial sediments. Permeability varies widely. Groundwater is typically unconfined in shallow alluvial deposits and confined in deeper alluvial/fluvial strata and nonalluvial units. Principal sources of recharge include infiltration of precipitation through permeable valley-margin and valley-floor sediments, and infiltration in influent streams. Discharge occurs via seepage in effluent stream reaches, spring outflow, evapotranspiration, and well withdrawal. Prior to development, groundwater flow largely followed surface-water drainage paths. For the most part, this is still the case, although withdrawal has locally altered groundwater flow patterns. In particularly, historic overdraft in the lower Sonoma and Petaluma basins has led to substantial saltwater intrusion along the Bay margin (Planert and Williams 1995). This is probably less true along the Point Reyes coast, where historic groundwater usage has been less intensive.

At the project sites, shallow groundwater is contained in unconfined aquifers that receive recharge directly via in-channel infiltration. The Muddy Hollow corridor is developed for groundwater production supplying the Clem Miller Ed Center, American Youth Hostel, and a handfull of park residences. The well and pump station were redeveloped following the 1995 Vision Fire. The well is 156 feet deep, and screened from 55-150 feet below ground surface (BGS). Production from this well originally was to supply a 1500 unit development. A new well was installed at this site in 1997. The well completion report (Weeks Drilling 1997) showed that the estimated the water yield from the well at 48 gallons per minute (gpm) and that during a 33 hour pump test, the

well drawdown was 46 feet. Current water supply needs are far less than the well production. No new development is planned for the area, so water demand is not expected to increase.

Groundwater Quality

One groundwater well is used for domestic water production within the Muddy Hollow watershed. The well water quality is tested monthly as required for public water supply, and well production samples show that the raw water is high in some heavy metals including iron and manganese. While saltwater intrusion would be a concern over high production, the limited use of the well does not threaten the aquifer.

3.3 Biological Environment

Vegetation

As with other areas of western Marin County, the Seashore supports a high number of vegetation communities that are diverse in nature. More than 64 vegetation communities or "alliances" have been mapped within the boundaries of the Seashore and the north district of GGNRA. This diversity can be attributed in large part to this area's varied geologic history and structure, hydrology, and climate. Bordered by the San Andreas Fault, movement of the Pacific plate relative to the North American Plate has led to the Point Reyes Peninsula having a community and flora composition that is sometimes distinct from that of the Marin County "mainland." Tectonic uplifting of granitic rock such as quartz-diorite and granodiorite along the fault has created an incredibly steep, varied, and unstable topography punctuated by ravines along the backbone of the Point Reyes Peninsula that borders Tomales Bay. Topography on the west side of the Inverness Ridge is more gradual as it descends to Drakes Estero and the Pacific Ocean, with many of the higher elevation upland areas characterized by soft, rolling hills that have been formed within the marine-influenced Purisma Formation.

The geologic instability of this area has produced a diverse array of hydrologic sources for vegetation communities, including isolated lakes, ponds created within "sags" along the fault, and an abundance of groundwater seeps that often serve as sources or "headwaters" for perennially and seasonally flowing streams. These freshwater influences mix with tidal waters from the Pacific Ocean to create estuarine habitats within sheltered embayments and coastlines along the Peninsula's perimeter. Over geologic time, the Pacific Ocean has alternately encroached upon and retreated from the Marin coastline because of a number of factors, including sea level rise caused by melting of the once extensive glaciers present in North America and land uplift. Not only does this geologic action control the extent of tidal influence in this area, but it has created elevated marine depositional terraces in areas such as the town of Point Reyes Station that are extremely permeable to groundwater seepage. This seepage has created unusual wetland communities that have established on the steep sides of these mesa bluffs.

Superimposed on this geologic matrix are coastal climatic influences that create an extremely mesic environment for vegetation. Unlike more inland areas, the summer season in this Mediterranean climate area often remains very cool due to extended periods of fog or marine layers. Because of this mesic influence, even so-called upland vegetation communities such as coastal prairie often support plant species that would normally only be found in wetlands within more inland areas. Moisture is often concentrated within some of the steep ravines or valleys along the Inverness Ridge, leading to development of highly mesic communities such as coast redwood (*Sequoia sempervirens*) and Douglas Fir (*Pseudotsuga menziesii*) forests on north-facing slopes with more arid shrublands on the opposing south-facing slopes. Arid vegetation communities such as chamise (*Adenostoma fasiculatum*)-dominated chaparral are often isolated in areas that receive much less fog and rain.

There are a number of vegetation communities within the Project Area. Most of these communities within the Project Sites are wetland- and riparian-associated communities or ones that are ecotonal or adjacent to wetlands and riparian areas. In addition to special status plants, the California Natural Diversity Database (NDDB) also tracks occurrences of rare and significant vegetation communities that have been imperiled by commercial and residential development, invasion by non-native species, etc. (CDFG 2003). A search of the NDDB identified several special habitats or Natural Communities with potential to occur within the Seashore, although none occurred within the Project Area or immediate vicinity. Special habitats included Coastal and Valley Freshwater Marsh, Northern Coastal Salt Marsh, Central Dune Scrub, Coastal Terrace Prairie, and Northern Maritime Chaparral. Descriptions of the primary communities observed within the Project Area are listed below.

Coastal Freshwater Marsh (NDDB Natural Community) Coastal Freshwater Marsh communities are flooded perennially or at least through the large portion of the growing season, establishing in slow-moving, low gradient, or stagnant water areas fed by groundwater, seeps, and streams consists of a mixture of herbaceous hydrophytic species.[3] Marshes are often defined by either supporting tall emergents such as bulrush (*Scirpus californicus*), cattails (*Typha* spp.), or bur-reed (*Sparganium* spp.) or by low-growing emergents such as water parsley (*Oenanthe sarmentosa*), hydrocotyle (*Hydrocotyle ranunculoides*), knotweed (*Polygonum* spp.), and water plantain (*Alisma* spp.). The nearest documented NDDB occurrence of this special habitat is a 34-acre marsh west of Drakes Beach (NDDB).

Northern Coastal Salt Marsh (NDDB Natural Community) Northern Coastal Salt Marsh is a transitional habitat between freshwater and marine environments that develops within sheltered embayments, stream mouths, and along the fringes of larger water bodies such as estuaries and bays. It is dominated by species that have developed a tolerance to salt water. Most of this community supports a low-growing emergent community on large flood or marshplains, with slightly taller emergents occurring in the "low marsh" directly adjacent to intertidal and subtidal tidal channels. The most common species at the project sites are pickleweed (*Salicornia virginica*). Other common associates include saltgrass (*Distichlis spicata*) and fleshy jaumea (*Jaumea carnosa*). Sea lavender (*Limonium californicum*), arrow-grass (*Triglochin concinna*), alkali heath (*Frankenia salina*) and Point Reyes bird's-beak (*Cordylanthus maritimus* ssp. *palustris*) are often associates as well. The nearest documented NDDB occurrences of this special habitat are at Tom's Point and the Lagunitas Creek delta within Tomales Bay (NDDB).

Coastal Brackish Marsh The boundary between Coastal Freshwater Marsh and Coastal Salt Marsh often constitutes a highly dynamic zone in terms of variable salinity throughout the year. Plant species that thrive in this interface zone must be capable of tolerating salinities that drop during the winter to 0-2 parts per thousand (ppt) and climb as high as 18-20 ppt or even higher during the summer (Ocean salinity is approximately 34 ppt). Coastal Brackish Marsh is also variable in terms of vegetation height. Low-growing plant species occur on marshplains with medium- to tall emergents occurring alongside or within channels or in open water areas. Because brackish marsh does not typically have a unique group of species -- most of these plant species can occur either in Coastal Freshwater Marsh or Coastal Salt Marsh – these areas are often characterized more by the mixture of species and a knowledge of salinity regimes present. Some common species in Coastal Brackish Marsh include bulrush (*Scirpus californicus*), alkali bulrush (*Scirpus maritimus*), fat hen (*Atriplex triangularis*), brass-buttons (*Cotula coronopifolia*), and annual beard grass (*Polypogon monspeliensis*).

Riparian Forest/Scrub within the Project Area is typical of low gradient streams and systems within western Marin County, being dominated by fast-growing, pioneering species such as arroyo

[3] *Hydrophytic species* or *hydrophytes* are plants that grow in water or on a substrate that is at least periodically deficient in oxygen as a result of high water content.

willow and red alder that often grow in almost impenetrable thickets. Forests at Project Sites typically have an overstory of red alder (*Alnus rubra*), with arroyo willow (*Salix lasiolepis*) and/or yellow willow (*S.lucida* ssp. *lasiandra*) in the subcanopy. Understory is usually moderate to dense. Berry species salmonberry (*Rubus spectabilis)*, thimbleberry (*R. parviflorus*), California blackberry (*R. ursinus*) and red elderberry (*Sambucus racemosa*) are the common shrubs. Hedgenettle (*Stachys ajugoides*), sedges (*Carex spp*.), rushes (*Juncus spp*.), small-fruited bulrush (*Scirpus microcarpus*), and ferns such as sword fern (*Polystichum munitum*) and lady fern (*Athyrium felix-femina*) dominate the herbaceous layer. Scrub is a shorter vegetation community occurring along streams that is characterized either by young willow or alder that fall within the subcanopy or shrub layer or by hydrophytic shrubs such as blackberry, elderberry, etc.

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

Coastal Grassland (Coastal Terrace Prairie – NDDB Natural Community) Although pristine coastal prairie is dominated by native perennial bunchgrasses, roughly 80% of the grasslands in the Seashore are dominated by non-native grasses, as are most of the grasslands within California. The most common non-native is the hydrophytic, invasive perennial purple velvet grass (*Holcus lanatus*), although the hydrophytic, annual Italian wild rye (*Lolium multiflorum*), farmer's foxtail (*Hordeum murinum*), and rattail fescue spp. (*Vulpia* spp.) also cover large acreage. Pacific reedgrass (*Calamagrostis nutkaensis*), along with tufted hairgrass (*Deschampsia cespitosa*), California oatgrass (*Danthonia californica*), meadow barley (*Hordeum brachyantherum*), and California brome (*Bromus carinatus*) are constituents of the native coastal grassland. Native grasses are often found in association with annual non-native grasses, coyote brush, California blackberry, and a variety of native and weedy herbs. The nearest documented NDDB occurrence of Coastal Terrace Prairie – a coastal grassland dominated by native grass species – occurs at Tom's Point in Tomales Bay.

Coastal Dune (**Central Dune Scrub – NDDB Natural Community**) Coastal Dune communities are extensive along the Seashore's land edge, but they, as with many other habitats, have been negatively affected by non-native invasive species such as European dunegrass (*Ammophila arenaria*) and iceplant (*Carpobrotus edulis*). The invasion of these dense, fast-spreading species into dunes has altered natural dune dynamics such as the ability of dune systems to shift and move and has reduced habitat for special status plant species that are specifically adapted to the dune environment. European dunegrass often excludes almost all other species, accounting for 99 percent of the vegetative cover (Seashore, unpub. data). Conversely, within dunes dominated by native species (native dunes), vegetative cover consists of a mixture of species such as coastal sagewort (*Artemisia pycnocephala*), beach-bur (*Ambrosia chamissonis*), gumplant (*Grindelia stricta*), wild pea (*Lathyrus littoralis*), and others. Total vegetative cover is also higher within European dunegrass systems, with open sand only accounting for 38 percent of the dunes versus 66 percent in dunes dominated by native species (Seashore, unpub. data). The nearest documented NDDB occurrences of Central Dune Scrub stretch from the Point Reyes Lighthouse to Abbotts Lagoon.

One of the more interesting features of dune communities are **Dune Swale Ponds** or **Seasonal Wetlands** that form between dunes and that support hydrophytic plant species despite the sandy substrate. These features typically are dominated by a low-growing community of perennial and

annual herbaceous plant species. The ponds support mostly species associated with freshwater communities such as Seasonal Wetlands despite their proximity to the ocean. The primary hydrologic source appears to be seasonal groundwater discharge and, to a lesser degree, precipitation and fog (Amy Parravano, pers comm.). Pond species include fat hen (*Atriplex triangularis*), water star-wort (*Callitriche heterophylla*), slough sedge (*Carex obnupta*), brass-buttons *(Cotula coronopifolia*), umbrella sedge (*Cyperus eragrostis*) spikerush (*Eleocharis macrostachya*), western mannagrass (*Glyceria occidentalis*), hydrocotyle (*Hydrocotyle ranunculoides*), rush (*Juncus bufonius* and *phaeocephalus*), loosestrife (*Lythrum hyssopifolium*), pennyroyal (*Mentha pulegium*), water parsley (*Oenanthe sarmentosa*), and annual beard grass (*Polypogon monspeliensis*).

With the exception of Glenbrook Creek, vegetation communities within the Project Area reflect a transition from the freshwater environment of the Inverness Ridge to the saltwater environment of the Pacific Ocean. Both the Muddy Hollow and Limantour Beach Marsh Project Sites have changed greatly since the 1800s in terms of vegetation communities due to construction of dams and berms. Coast Survey maps from the 1860s, combined with aerial photographs starting in the 1940s, document a considerable amount of change in these coastal Project Sites. Prior to the 1960s when the Muddy Hollow dam was constructed, the area functioned as an estuarine Coastal Salt Marsh, bisected by a meandering tidal creek. This creek eventually transitioned into a freshwater system probably dominated by a Riparian Forest as the valley slope increased.

The present-day Limantour Marsh Coastal Salt Marsh was much smaller, with most of it being open water subtidal areas and intertidal mudflats. Construction of the dam caused a rapid conversion of the estuarine marsh into a freshwater open water pond fringed by Coastal Freshwater Marsh, Riparian Forest, and Riparian Scrub. The Pond has shrunk in size over the years since its construction, but it remains ponded throughout the year. Downstream of the dam, changes in hydraulic and sediment delivery patterns encouraged rapid development of marshplains and Coastal Salt Marsh. Coastal Brackish Marsh established at the base of the dam, fed by the mixing of tidal flows, freshwater from the pond spillway, and seepage at the base of the dam itself. As previously described, the upland areas adjacent to the project site are dominated by Coastal Scrub and Coastal Grassland that has suffered to some degree from the introduction on non-native species, particularly non-native annual and perennial grasses.

Based on Coast Survey maps from 1860 and subsequent aerial photographs, the Limantour Beach Marsh Project Site actually appeared to be a Coastal Dune complex that supported some Dune Swale Ponds. This area was hydrologically isolated from Laguna Creek unlike today, but it probably was still heavily influenced by freshwater from drainages on its northern edge, as well as overwash of the dunes by tides on its southern edge. Berming on the western end of this area, as well as redirection of Laguna Creek, has created a less saline mix of habitats, although some salinity still exists probably due to historic deposition of salts in sediment, overwash into the pond during storm-related extreme tidal events, aerial deposition of salts, and possibly even some limited groundwater connection with the ocean through the porous dunes. The center of Limantour Beach Pond is open water, but the proportion of open water relative to Muddy Hollow Pond is much smaller, and it often dries up in the late summer and fall. A significant portion of the Pond and upstream areas support Coastal Freshwater Marsh, Coastal Brackish Marsh, and some pockets of Coastal Salt Marsh and Seasonal Wetlands. The dunes along its southern perimeter have lost some of their mobility due to construction of a path for visitors and establishment of Coastal Scrub and extensive patches of the non-native European dune grass, *Ammophila arenaria*. North of Limantour Beach Marsh are areas of Coastal Scrub that are dominated by coyote brush and non-native grasses and a large drainage swale dominated by Coastal Freshwater Marsh.

The Glenbrook Creek Project Site occurs at a higher elevation within the Glenbrook Creek watershed and is dominated by freshwater vegetation communities. Aerial photographs dating from the 1940s show a much larger expanse of Riparian Forest relative to today, even though a

road had already been constructed in this area at that time. However, in subsequent years, the road was redirected south of the historic road alignment to run directly through the project site, and it appeared that other land-clearing activities may have occurred that substantially reduced the amount of Riparian Forest. Based on aerial photographs, it actually appears that the Riparian Forest has expanded from conditions in 1963-1974, with a much larger riparian zone both upstream and downstream of the road crossing. However, at least downstream of the crossing, continued downcutting of the channel bottom could be slowing or even reversing this trend and increasing the distance between the channel bottom and the floodplain. Eventually, this channel deepening could cut off the groundwater supply to riparian species and cause these areas to convert to more upland communities such as Coastal Scrub or Coastal Grassland.

Wetlands

Wetlands and riparian habitats are integral components of many watershed functions, such as reduction of flood flow velocity, water quality improvement, food support for aquatic organisms, and wildlife habitat. The value and importance of these functions for both people and wildlife may represent one of the primary reasons that impacts to wetlands and their watersheds have become more closely regulated in recent decades. The U.S. Army Corps of Engineers (Corps) oversees Section 404 of the Clean Water Act and Section 10 of the Rivers and Harbors Act, both of which serve to ensure that impacts to navigable waters and special aquatic sites such as wetlands are minimized. In addition, wetlands are also regulated under other federal statutes, including Section 401 of the Clean Water Act and the federal Coastal Act, both of which are administered by state agencies – RWQCB and California Coastal Commission (CCC), respectively.

The NPS also scrutinizes projects with the potential to impact wetlands in order to comply with an executive order that decreed that federal agencies should "...avoid to the extent possible the long and short term adverse impacts associated with the destruction or modification of wetlands and to avoid direct and indirect support of new construction in wetlands wherever there is a practicable alternative..." In compliance with this Executive Order, the Park Service adopted a policy of "no net loss of wetlands," with a longer term goal of net gain Service-wide. Implementation of this policy meant that, for new development or new activities, the Park Service pledged to avoid adverse wetland impacts to the extent practicable; minimize impacts that could not be avoided, and compensate for remaining unavoidable adverse impacts through restoration of degraded wetlands at a 1:1 ratio. Unlike Section 404 of the Clean Water Act, adverse impacts under Executive Order 11990 are not interpreted strictly as discharge of dredged or fill material, but encompasses a much broader range of actions, including groundwater withdrawals, water diversions, nutrient enrichment, livestock grazing, pumping, flooding, and impounding.

These regulations have seemingly increased the amount of confusion regarding how wetlands are defined. The confusion stems from the fact that jurisdiction or the amount and type of wetlands regulated under these statutes can vary between administrative agencies. While the RWQCB relies largely upon the Corps and its 1987 methodology to determine Section 401 jurisdiction, the CCC has taken a broader, more expansive interpretation of wetlands, and so has the NPS. The net result is that there could be substantially more CCC- and NPS- regulated wetlands than Corps-regulated wetlands within the same Project Area. Riparian zones often fall into one of these regulatory "gray" zones. Riparian zones can be defined as "wetlands" by the Corps if they remain wet enough to support hydrophytic or "water-loving" plant species and have soils that show indications of prolonged ponding or saturation. Typically, juvenile or young riparian stands often qualify as Corps' "wetlands" and then transition to non-jurisdictional wetlands as the elevation becomes higher through sediment deposition and the older plants become more capable of surviving through tapping into groundwater tables rather than relying on surface inundation or saturation. The CCC, however, might continue to classify them as wetlands based exclusively on the predominance of hydrophytic or water-loving plant species. Ultimately, these disparities in

regulatory interpretation really reflect differences in the jurisdiction of these various state and federal agencies, not differences in the definition of wetlands.

Wetlands and waters within the Project Areas principally occur in creek channels; active floodplains or floodplain terraces along creeks; artificially created ponds; vegetated swales, drainages, or gullies flowing into the creeks and ponds; and depressional features adjacent to creeks and ponds. In addition to creek surface flow and precipitation, hydrologic sources for these creeks and ponds included small, sometimes eroded vegetated and unvegetated drainages that conveyed surface run-off from adjacent roads, hillsides, and seeps. Based on the Cowardin wetlands classification system (Cowardin et al. 1979) developed by the U.S. Fish and Wildlife Service (USFWS), most of the wetlands ranged from palustrine forested areas to unconsolidated bottom estuarine areas (Parsons 2003, Parsons and Allen 2003, Allen and Parsons 2003).

For the purposes of complying with federal regulations, three separate wetland delineations were performed to determine whether areas subject to the jurisdiction or oversight of the Corps, CCC, and NPS existed.

Corps Jurisdiction. The Corps regulates several types of activities in waters of the United States, which includes navigable waters, tributaries to navigable waters, special aquatic sites (e.g., wetlands), and areas that are "adjacent" to navigable waters. These waters are regulated under Section 404 of the Clean Water Act (40 CFR Section 328.3) or Section 10 of the Rivers and Harbors Act (33 U.S.C. 403). Wetland delineations were performed. The Corps has verified two of the three delineations to date: Muddy Hollow and Glenbrook Creek Project Sites. Jurisdictional or potential jurisdictional tidal waters or tidal wetlands occurred in the Muddy Hollow and Limantour Beach Marsh Project Sites. Section 10 waters were only in the Muddy Hollow Project Site and included navigable waters both currently and historically below Mean High Water: historic Section 10 waters occurred in the Pond itself where tidal creeks once occurred before the area was dammed. Jurisdictional non-tidal waters and wetlands were mapped within all three Project Sites and typically included portions of the Project Site creeks and drainages or "tributaries" to these creeks, as well as the artificially created ponds and pond fringes. Jurisdictional adjacent wetlands and waters consisted of vegetated or unvegetated drainages or "tributaries" and swales "adjacent" to creeks and ponds that were not directly connected to creeks and ponds, but that showed some evidence of connectivity, typically hydrologic. Adjacent features also included depressional features that may have some hydrologic or ecological connection with nearby creeks and ponds.

Table 3-6 Acreages of jurisdictional and potential jurisdictional Section 404 wetlands and waters and Section 10 waters.

	Section 404 Waters			***Section 404 Wetlands***			***Section 10***
	Tidal	*Non-Tidal*	*Adjacent*	*Tidal*	*Non-Tidal*	*Adjacent*	Waters
Muddy Hollow	0.24	9.10	0.00	1.28	10.86	0.31	1.07
Limantour Beach*	0.98	1.92	0.00	2.33	5.40	7.76	0.00
Glenbrook Creek	0.00	0.35	0.03	0.00	0.13	0.67	0.00

* These are potential jurisdictional acreages. Delineation has not yet been verified.

CCC Jurisdiction. Within California, the CCC administers the state program (California Coastal Act) for implementation of the federal Coastal Zone Management Act (CZMA). Any action by a federal agency such as the NPS requires a federal consistency determination by the CCC as required by CZMA. The CCC reviews all proposed wetland development projects within the California coastal zone. In the coastal zone, the CCC, with assistance from CDFG, is responsible

for determining the presence and size of wetlands subject to regulation under the California Coastal Act (1976). The CCC has adopted the CDFG wetland definition and classification system. Within the Project Area, all three Project Sites appear to fall within the Coastal Zone.

Table 3-7 presents a list of Project Sites and acreages of wetlands delineated within these areas that would appear to be potentially subject to regulatory oversight by the CCC. Because the CCC takes a broader interpretation of wetlands relative to its regulatory oversight, acreages of wetlands potentially subject to CCC jurisdiction are greater than that subject to Corps' jurisdiction. The Project Sites with the largest amount of wetlands potentially subject to CCC oversight would appear to be Limantour Beach and Muddy Hollow, with 37.9 and 22.2 acres, respectively. However, it should be noted that, because of the way that the CCC delineates wetlands, these totals include coastal prairies and grasslands that appear to be dominated by hydrophytic plant species because of the mesic coastal climate, not necessarily because wetland hydrology is present. Systems delineated within the Project Area include Lacustrine Limnetic (L1), Lacustrine Littoral (L2), Palustrine (P), and Estuarine Subtidal (E1) and Estuarine Intertidal (E2). Classes were Unconsolidated Bottom (UB), Streambed (SB), Rock bottom (RB), Emergent (EM), Scrub-Shrub (SS), Forested (FO), and combinations of these classes.

Table 3-7. Acreage of areas potentially subject to CCC oversight under the California Coastal Act.

	Cowardin Classification Codes																
Site	L1UB	L2EM	PUB	PRB	PEM/UB	PEM	PEM/SS	PSS	PFO	PFO/SS	E1UB	E2UB	E2SB	E2EM	E2EM/SS	E2SS	TOTAL
Muddy Hollow	9.03	1.79	0.01	0.07	0.06	0.31		0.45	9.2	0.12	0.21			0.90			22.2
Limantour Beach							7.47	10.9			0.06	1.90	0.42	13.9	0.70	2.57	37.9
Glenbrook Crossing						1.54		2.95	1.90								6.39

NPS Oversight. Director's Order #77-1 established Park Service policies, requirements, and standards for implementing Executive Order 11990, which directs federal agencies to avoid long- and short-term impacts to wetlands. The Park Service uses the Cowardin classification system (Cowardin et al. 1979) as the basis for creating a NPS standard for defining, classifying, and inventorying wetlands that might be subject to adverse impacts and NPS oversight. Table 3-7 presents a list of the Project Sites and acreages of wetlands delineated within these areas that would appear to be subject to Executive Order 11990, as well as the CCC.

Wetland Functionality. A key component of wetland functionality is hydrologic connectivity. For wetland and riparian areas to perform functions such as water quality improvement, floodwater retention, and carbon export, these areas have to be hydrologically connected to both upstream lands and upstream and downstream water bodies. Construction of the dam at Muddy Hollow substantially reduced the connection between Muddy Hollow Creek and Muddy Hollow Pond and their downstream water body, Limantour Estero. Some connection still exists via a spillway channel, but, to a large degree, most of the carbon from Muddy Hollow Creek and the Pond resides in the Pond and is probably not exported to Limantour Marsh and Estero for use by marine and estuarine organisms. Muddy Hollow Pond does act as a sediment trap and floodwater detention basin for Muddy Hollow Creek. However, conversion of the historic estuarine marsh into an open water pond with little vegetation decreases the potential for this area to transform -- if not retain -- nutrients from Muddy Hollow Creek for uptake into the estuarine food web.

Limantour Beach Marsh suffers from many of the same problems with regards to wetlands functionality. Construction of the beach access berm has largely disconnected the marsh from its downstream water body, Limantour Estero, with a small spillway providing the only connection between the two. Potential functions performed by the Project Site have shifted dramatically from historic conditions, with the historic Dune Swale complex being converted to an impounded freshwater marsh through construction of the berm and diversion of Laguna Creek to the south. Limantour Pond probably plays a much less important role relative to Muddy Hollow Creek and Pond with regards to trapping sediments and detaining floodwaters. However, the higher percentage of vegetation present in the Pond probably increases its potential to transform nutrients for later uptake into the food web. In addition, Limantour Pond may produce more carbon that would be available for export, but the relatively small amount of flow occurring through the spillway limits its export capability.

While the road crossing at Glenbrook Creek is not intended to be a dam, it has, to some degree, acted as a dam and created some hydrologic disconnection between the upstream and downstream sections of creek. Backwater flooding at the culvert has probably encouraged discontinuities in flood dynamics and sediment transport, unnaturally increasing the amount of floodwaters and sediment deposited just upstream of the road crossing. These factors increase the potential for deposition and transformation of nutrients, reduction in flood flow velocities, and export of both large woody debris and detritus available for transport downstream. However, downstream of the road crossing, incision or deepening of the stream channel is disconnecting the stream from its floodplains, thereby reducing functionality of this section of the creek. Only larger storm events can overwash onto the elevated floodplains, thereby reducing the potential for floodwater retention, dissipation of flood flows, and water quality improvement. In addition, incision downstream of the culvert is actually causing water quality problems by increasing suspended sediment in creek waters.

Wildlife

One of the most important functions associated with wetlands and riparian areas is the habitat that they provide for wildlife species. Some wildlife species use creeks, wetlands, and riparian habitat for a portion of their life cycles such as breeding or spawning, foraging, refugia, or as a migration corridor. Others are resident species that spend their entire lives within these systems. Adjacent uplands not only support wildlife typically considered upland species, but are also important to wetland- and riparian-associated species for refugia during high tides or high freshwater storm flows, foraging, movement between sites, etc. Most of the Project Area supports wetland and riparian vegetation communities that provide important habitat for common and special status wildlife species. The value of these areas is enhanced by the fact that there is a mosaic of habitat types present that allows wildlife to move between them for nesting, foraging, roosting, etc. Some of the most important habitats are described below:

Open Water habitat typically consists of ponds or lakes that are created naturally or unnaturally from damming, excavation, for use as reservoirs, stockponds, etc. These ponds or lakes are fed either by inflowing streams or seeps, or they are hydrologically isolated and reliant primarily on being a catchbasin for rainwater. Some ponds and lakes are perennially flooded, while others only have water during the winter, spring, and/or early summer. Vegetation cover is very low within the open water area itself, but these areas often have a fringe of marsh vegetation along the edges. Most of these ponds have a large insect, algae, and invertebrate community that provide food for other organisms. The density of benthic invertebrates is typically low, because of the anoxic or low oxygen conditions in the pond substrate. Because most of these are freshwater ponds or lakes, they support native fish species such as rainbow trout (*Oncorhynchus mykiss*), as well as non-native, introduced game fish such as bass (*Micropterus ssp.*). Fish species within some of the more shallowly ponded areas often have to be tolerant of high temperatures and large swings in

oxygen within waters due to the lack of shading cover and high productivity of algal species and aquatic organisms.

The ready supply of food and water attract species such as waterfowl, including mallard (*Anus platyrhynchos*), canvasback (*Aythya valisineria*), American coot (*Fulica americana*), ruddy duck (*Oxyura jamaicensis*), and American wigeon (*Anus americana*) that use these areas for foraging, as well as breeding. Other types of bird species such as common yellowthroat (*Geothlypis trichas sinuosa*), marsh wren (*Cistothorus palustris*), blackbirds (*Agelais ssp.*), rails, herons and egrets may use the tall emergent Coastal Freshwater Marsh that fringes many of these features. At some point, Open Water ponds or lakes that dry down seasonally may attract shorebirds that prey on invertebrates within the sediment. These ponds and lakes are also important habitat for reptiles and amphibians such as the California red-legged frog (*Rana aurora draytonii*; federally threatened) and the Northwestern pond turtle (*Clemmys marmorata marmorata*) federal Species of Concern). Red-legged frogs use Open Water ponds for egg laying and tadpole rearing during the winter and spring months, and pond turtles are typically found along the edges of Open Water areas, using submerged logs and other features for basking. These and other special status wildlife species would be discussed in more detail in the Special Status Species section. While most of these species are resident or at least long-term users of Open Water, a number of common wildlife species are at least transient visitors that water or forage in the ponds. These species include black-tailed deer (*Odocoileus hemionus columbianus*), tule elk (*Cervus elaphus nannodes*), racoons (*Procyon lotor*), mountain lion (*Felis concolor californicus*), bobcats (*Lynx rufus californicus*), etc.

Freshwater Streams While streams also incorporate "open water," they are typically much more narrow and have flowing, as opposed to, standing water. In addition, because streams are narrow, they are often covered by riparian forest that provides significant shade and a source of detritus for the creek. For these reasons, Freshwater Streams are consistently more well oxygenated with lower temperatures than ponds, but are generally less productive in terms of the algal and zooplankton community. However, aquatic insects are abundant and provide an important food source for larger stream organisms such as fish and macroinvertebrates such as crayfish (P*rocambaru ssp.*). As with ponds, Freshwater Streams support a number of resident and transient fish species in west Marin, including federally threatened coho salmon (*Oncorhynchus kisutch*) and steelhead trout (*Oncorhynchus mykiss*). These anadromous species that move between ocean and freshwater environments use freshwater streams within the Seashore for spawning and rearing of young. Streams that are disconnected from the ocean through construction of dams or culverts that prohibit upstream fish passage often lose their populations of anadromous species. Red-legged frogs are also found in Freshwater Streams, representing critical non-breeding habitat. Frogs within the Seashore appear to move into Freshwater Streams with riparian habitat in the summer after breeding (Fellers and Guscio 2002). These species are discussed in more detail under Special Status Species.

Tidal Channels While also largely open water, Tidal Channels support a very different suite of species typically than Open Water ponds and Freshwater Streams. As with Open Water ponds, a fringe of vegetation is often present on the perimeter of the channel and is dominated by so-called "low marsh" plant species such as Pacific cordgrass (*Spartina foliosa*) and alkali bulrush (*Scirpus maritimus*). Organisms must be able to tolerate higher water salinities and temperatures due to the lack of shading vegetation. Tidal Channels are, again, less productive generally than Open Water Ponds in terms of the algal, zooplankton, and aquatic insect community because tidal action and freshwater inflows from streams keeps waters moving in and out of the system. However, exposure of the channel bottom twice daily during low tides also promotes oxygenation of the sediment, which dramatically increases the number of benthic invertebrates in these channels relative to Open Water ponds and Freshwater Streams. These benthic invertebrates, as well as other aquatic organisms, provide an important food source for resident estuarine fish species such as threespine stickleback (*Gasterosteus aculeatus*), staghorn sculpin (*Leptocottus armatus*), goby, etc. Non-resident estuarine and marine fish species also use these tidal channels for foraging or as

nurseries for young. In addition, during low tides, shorebirds such as semipalmated plovers (*Charadrius semipalmatus*), willet (*Catoptrophorus semipalmatus*), long-billed curlew (*Numenius americanus*), western sandpiper (*Calidris mauri*), and dunlin (*Calidris alpina*) may forage on invertebrates within the exposed intertidal mudflat. Rail species such as the federally listed endangered California clapper rail (*Rallus longirostris obsoletus*) and the stated-listed threatened California black rail (*Laterallus jamaicensis coturniculus*), as well as Virginia rail (*Rallus limicola*), yellow rail (*Coturnicops noveboracensis*), and sora (*Porzana carolina*) also forage in tidal channels and use fringing vegetation for refugia from predators.

Tall emergent Coastal Freshwater Marsh and Coastal Brackish Marsh As noted earlier, a number of bird species use tall emergents within Coastal Freshwater Marsh and Coastal Brackish Marsh. These marshes are typically dominated by species such as cattails (*Typha* spp.), bulrush (*Scirpus californicus*), tules (*Scirpus acutus*), and even bur-reed (*Sparganium* spp.). These tall emergents often attract songbirds and other bird species such as marsh wrens, common yellowthroats, blackbirds, rails, and herons and egrets. Freshwater marsh may also provide high-tide refugia for California black rail (*Laterallus jamaicensis coturniculus*) and other coastal marsh species; seasonal foraging and resting habitat for migratory shorebirds and waterfowl; and foraging habitat for raptors, herons, egrets, blackbirds (*Agelaius* spp.). Most of these species are residents that may nest and forage within marshes, while others are migrants.

Coastal Salt Marsh adjoins Tidal Channels and provides foraging and roosting habitat for landbirds such as osprey (*Pandion haliaetus*) and northern harrier (*Circus cyaneus*), herons and egrets, and Canada geese (*Branta canadensis*). These species forage on small voles (*Microtus californicus eximus*) or mammals within the marsh or invertebrates such as snails and crabs that utilize "mid-marsh" areas dominated by pickleweed (*Salicornia virginica*). In addition, rail species such as the California clapper rail and California black rail use marshplains or associated low marsh habitat for nesting. Physically contiguous "high marsh" areas and uplands directly adjacent to the marsh provide refugia during extreme high tides or storm tides for these poor-flying birds. Recent studies suggest that Coastal Salt Marsh supports a lower diversity of avian species than does Open Water ponds or Coastal Freshwater Marsh (Warnock et. al. 2002). However, Coastal Salt Marshes within the Seashore are also utilized by some species not typically associated with marshes such as deer and tule elk that graze extensively on the marshplains. Fishes that use coastal salt marsh habitat at Point Reyes include longfin smelt (*Spirinchus thaleichthys*), Pacific herring (*Clupea pallasii*), Pacific lamprey (*Lampetra tridentata*), green sturgeon (*Acipenser medirostris*), and California roach (*Hesperoleucus symmetricus*).

Riparian Forest/Riparian Scrub Riparian habitat adjacent to Freshwater Streams and Open Water ponds plays an extremely important role for wildlife species. Not only does it provide woody debris and detritus that is used for refugia and food sources for aquatic invertebrates, it supports a tremendous number and diversity of breeding and non-breeding species. Both non-migrant and migrant birds use riparian habitat for breeding during the spring, and migrant birds such as neotropical migrants from south and central America are protected under the Migratory Bird Treaty Act of 1918. Breeding birds utilizing riparian habitat include warblers (*Dendroica ssp.*), raptors, swallows (*Tachycineta ssp.*), hummingbirds , common and salt marsh yellowthroat, and yellow-breasted chat (*Icteria virens*). The density of trees and shrubs, as well as the variety in vegetation layers, often plays a key role in these areas' attractiveness to breeding bird species and is typically associated with healthier, non-disturbed riparian areas. Riparian habitat, particularly unfragmented or continuous habitat, also provides an important corridor for migration of terrestrial and aquatic species such as bobcat and racoons. While much attention has been focused on special status species such as steelhead, coho salmon, California red-legged frog, and breeding birds, these areas also play an important role for common wildlife species such as the Pacific giant salamander (*Dicamptodon tenebrus*), California newt (*Taricha torosa*), rough-skinned newt (*Taricha granulosa*), and wood rat (*Neotoma fuscipes*).

Coastal Dunes Coastal Dunes have attracted a lot of attention in recent decades, because some species associated with dunes have declined dramatically. Numbers of snowy plovers (*Charadrius alexandrinus nivosus*) , which establish nests within open, sandy areas of dunes, have dropped so low that this species is in danger of extinction. In addition to trampling by beach users and even cattle, dune habitat has been threatened by the invasion of non-native European dune grass (*Ammophila arenaria*) that decreases habitat value for plovers. Other species associated with dunes and adjoining beaches include roosting and foraging gulls (*Larus ssp.*) and shorebirds, as well as occasionally sea lions (*Zalophus californianus*) and elephant seals (*Mirounga angustirostris*).

The Muddy Hollow Project Site appeared to once consist of a Tidal Channel-Coastal Salt Marsh habitat that linked to a Freshwater Stream/Riparian Forest at its upstream end, as the valley gradient began to increase. Construction of the Muddy Hollow dam converted the Project Site into Open Water pond fringed by tall emergent Coastal Freshwater Marsh. The Freshwater Stream/Riparian Forest habitat remained, but may have moved upstream slightly due to water impoundment. It also probably changed in nature from a defined Freshwater Stream channel adjacent to Riparian Forest-dominated floodplain terraces to a more diffuse, delatic riparian system with no well defined, primary stream channel. The Coastal Salt Marsh and Tidal Channel habitats once present shifted downstream, forming on the outboard portion of the dam and into Limantour Estero.

Muddy Hollow Pond is currently a perennial Open Water area that has shrunk somewhat since its construction. Documented fish species known to occur within the Pond include native rainbow trout/steelhead (*Oncorhynchus mykiss*), threespine stickleback, and sculpin, but some non-native, game fish species such as bass are also believed to be present, as well. While the *Oncorhynchus mykiss* observed are likely resident, they are considered part of the federally threatened population. The Pond also supports a considerable number and diversity of waterfowl species, including canvasback, American coot, ruddy duck, American wigeon, and mallards, as well as some less common species (bufflehead, scaup, ring-necked duck, gadwall, northern shoveler, cinammon teal, green-winged teal). The Pond attracts a moderate number of Seashore visitors interested in bird-watching. Tall emergent marsh fringes may be used by songbirds, although none were documented during area search bird inventories (White 1999). A small population of red-legged frog occurs at the Pond, but does not appear to be a breeding one based on the absence of egg masses and tadpoles (Fellers and Guscio 2002). The potential presence of non-native game fishes within the Pond may preclude successful breeding as these species, as well as native bird species such as black-crowned night herons, can predate upon tadpoles (Fellers and Guscio 2002). At least one northwestern pond turtle was also observed within the Pond (Fellers and Guscio 2002). Upstream of the Pond, the dense Riparian Forest along Muddy Hollow Creek likely provides good habitat for breeding birds such as Allen's hummingbird (*Selasphorus sasin*), Bewick's wren (*Thryomanes bewickii*), common yellowthroat (*Geothlypis trichas sinuosa*), song sparrow (*Melospiza melodia*), Swainson's thrush (*Catharus ustulatus oedicus*), and Wilson's warbler (*Wilsonia pusilla*), all of which have been documented within riparian corridors of this and adjacent Coast Trail watersheds (Toniolo and Gardali 2002). The value of Muddy Hollow Creek as Freshwater Stream habitat has been decreased significantly for at least anadromous species by construction of the dam as mentioned earlier and the diffuse nature of the channel system within this section of the creek. Downstream Tidal Channel and Coastal Salt Marsh habitats support characteristic marine and estuarine invertebrate and fish species, as well as probably herons, egrets, shorebirds, raptors, and even deer and tule elk.

The Limantour Marsh Beach Project Site has also changed greatly in terms of wildlife habitat since the 1800s. Historically, it appeared to be a Coastal Dune complex with several Dune Swale Ponds. However, construction of the berm, as well as redirection of Laguna Creek, has created a seasonal Open Water pond that is much smaller in size and less deep than Muddy Hollow Pond. In addition, a significant portion of the Pond supports extensive patches of tall emergent Coastal Freshwater Marsh and Coastal Brackish Marsh characterized by bulrush (*Scirpus californicus*) and

cattails (*Typha* spp.). Further upstream along the diverted Laguna Creek are patches of Coastal Salt Marsh, Seasonal Wetland, and short- to medium-sized emergent Coastal Freshwater Marsh. The Open Water Pond probably is used during flooded periods by waterfowl, with bird use shifting perhaps to shorebirds during drawdown or when water levels become low enough to expose the pond bottom. Tall emergent marsh could provide habitat for songbirds such as common yellowthroat, red-winged blackbirds (*Agelaius phoeniceus*), marsh wren, etc., although none of these species were sighted during area search bird inventories (White 1999).

The Pond does support a moderately sized population of red-legged frog that appear to breeding based on the observation of egg masses and tadpoles (Fellers and Guscio 2002). It is possible that the lower water levels, combined with increased vegetation cover along the edges, provides better breeding habitat for the frogs, because they like to attach their eggs to emergent vegetation. Also, the seasonal nature of the pond precludes establishment of fish species that might predate upon the egg masses or tadpoles. No fish or northwestern pond turtles were observed during surveys (Seahsore, unpub. data; Fellers and Guscio 2002). A more detailed discussion of special status wildlife species occurs under the Special Status Species section. While Coastal Dunes are still present on the northern side of the Pond, they are dominated by European dune grass (*Ammophila arenaria*) and provide poor nesting habitat for plovers, which have never been documented by the Seashore in this area. The dunes and associated Coastal Scrub are heavily used, however, by deer and perhaps tule elk for foraging and "deer beds."

Wildlife habitats within the Glenbrook Creek Project Site have not changed as dramatically as those within other Project Sites. However, impacts from the road construction, installation of culverts, and other land-clearing activities did reduce the amount of riparian habitat at one point relative to historic conditions. The Riparian Forest and Riparian Scrub along this portion of Glenbrook Creek probably provides moderate to good habitat for breeding birds such as Allen's hummingbird, Bewick's wren, common yellowthroat, song sparrow, Swainson's thrush, and Wilson's warbler, all of which have been documented within riparian corridors of this and adjacent Coast Trail watersheds (Toniolo and Gardali 2002). Habitat for breeding birds and other riparian-associated wildlife has been negatively affected downstream of the road crossing by the deterioration of the riparian corridor. Not only is total riparian cover decreased relative to upstream conditions, but the density of vegetation is lower, as well. Riparian habitat in this section appears to have declined in areal extent and quality because of a number of reasons, including past land disturbance and possibly disconnection of the floodplain terrace from the groundwater/surface water supply due to channel downcutting. Federally threatened steelhead have been observed within the Glenbrook Creek watershed (B. Ketcham, *pers. comm*.), both upstream and downstream of Glenbrook Crossing. No red-legged frogs or northwestern pond turtles were observed in this Project Site (Fellers and Guscio 2002).

Special-Status Species

Special-status species refers to species that fall into any of the following categories.

- Plant and wildlife species **listed as endangered pursuant to the federal Endangered Species Act** (species in danger of extinction throughout all or a significant portion of their national range).
- Plant and wildlife species **listed as threatened pursuant to the federal Endangered Species Act** (species identified as likely to become endangered species within the foreseeable future throughout all or a significant portion of their national range).

- Plant and wildlife species **listed as endangered pursuant to the California Endangered Species Act** (species in danger of extinction throughout all or a significant portion of their range in the state).
- Plant and wildlife species **listed as threatened pursuant to the California Endangered Species Act** (species likely to become endangered within the foreseeable future throughout all or a significant portion of their state range).
- **California species of special concern** (plant and wildlife species that may become vulnerable to extinction on a state level from declining population trends, limited range, and/or continuing threats; i.e., species at risk of threatened or endangered status).
- **Native plants identified as rare by the California Native Plant Society** (CNPS) (plants that, although not currently threatened with extinction, are present in small numbers throughout their range, and are considered at risk of endangered status).

A total of 81 special-status species (31 plants species, 3 fish species, and 47 avian and terrestrial wildlife species) were considered for this EA analysis. They are listed in Tables 3-8 and 3-9. The following sections provide brief descriptions of the special-status species that have the potential to be found at the project sites, and thus could be affected by the proposed restoration activities.

Special Status Plant Species

Marin Knotweed, FSC

Marin knotweed (*Polygonum marinense*) is found in coastal salt marsh and brackish marsh habitats in Marin, Napa, Sonoma, and Solano Counties. It is considered a "List 3" species by the CNPS, meaning that existing information is inadequate to resolve the species' status and prognosis. Several recorded locations of this species are known from the vicinity of the Limantour Beach Marsh and Muddy Hollow Pond sites. However, a botanical survey performed in conjunction with the project wetland delineations did not observe Marin knotweed (Parsons and Allen 2003).

Point Reyes Bird's-Beak, FSC

Point Reyes bird's-beak (*Cordylanthus maritimus* ssp. *palustris*) is found in coastal salt marshes in Humboldt, Marin, and Sonoma Counties, and in Oregon. It is considered a "List 1B" species by CNPS, meaning that it is rare, threatened, or endangered in California and elsewhere. Several recorded locations of this species are known from the vicinity of the Limantour Beach Marsh and Muddy Hollow Pond sites, and it has been informally reported from the area in recent years, but it was not observed during the project site botanical surveys (Parsons and Allen 2003).

Marin Checker Lily, FSC

Marin checker lily (*Fritillaria affinis* spp. *tristulis*) (=*Fritillaria lanceolata* var. *tristulis*) has been identified in some 10 occurrences in coastal bluff scrub, coastal prairie, and coastal scrub habitats in Marin County. It is considered a List 1B species by CNPS. Several recorded locations of this species are known from the vicinity of the Limantour Beach Marsh and Muddy Hollow Pond sites, but it was not observed during the project site botanical surveys (Parsons and Allen 2003).

Fragrant Fritillary, FSC

Fragrant fritillary (*Fritillaria liliacea*) is known from Alameda, Contra Costa, Monterey, Marin, San Benito, Santa Clara, San Francisco, San Mateo, Solano, and Sonoma Counties. It is found in cismontane woodland, coastal prairie, coastal scrub, and valley and foothill grassland habitats, commonly on serpentine soils. It is considered a List 1B species by CNPS. Several recorded locations of this species are known from the vicinity of the Limantour Beach Marsh and Muddy Hollow Pond sites, but it was not observed during the project site botanical surveys (Parsons and Allen 2003).

Special Status Fish Species

Three listed fish species; tidewater goby (*Eucyclogobius newberryi* FE), coho salmon (*Oncorhynchus kisutch* FT), or steelhead trout (*Oncorhynchus mykiss* FT) have the potential to occur in the Drakes Bay and Inverness Quadrangles.

Steelhead (FT)

The only special-status fish known to occur at the project sites is the steelhead. Steelhead in the project area belong to the Central California Coast Evolutionarily Significant Unit (ESU), which is federally listed as threatened. The Central California Coast ESU includes all naturally spawned populations of steelhead in California streams from the Russian River south to Aptos Creek, and those in the drainages tributary to San Francisco and San Pablo Bays eastward to and including the Napa River, except for the Sacramento–San Joaquin River Basin.

Steelhead begin migrating up coastal and inland streams from November through early May to spawn in freshwater streams. Juvenile steelhead spend up to 3 years rearing in freshwater, and then migrate to the ocean, where they feed and mature for another 3 years before returning to their natal streams to breed. NPS has documented the presence of steelhead at the Glenbrook Crossing site and in the Muddy Hollow drainage below the existing dam (Self and Ranlett 1984;Cappellini and Everly 1997). They may also be present at Limantour Beach, although this drainage offers even more limited connectivity to inland waters.

The project area also lies within the ESU and includes designated critical habitat for Central California Coast Coho salmon, but Coho have not been found in streams within the project area (Jones 2001; Ketcham pers. comm. 2004).

Essential Fish Habitat

The Magnuson-Stevens Fishery Conservation and Management Act requires all federal agencies to consult with NOAA Fisheries on all cumulative and synergistic actions or proposed actions that may adversely affect Essential Fish Habitat (EFH). The assessment of cumulative effects on EFH is consolidated with the assessment of cumulative effects under ESA.

EFH is the aquatic habitat (water and substrate) necessary for fish to spawn, breed, feed, or grow to maturity (National Marine Fisheries Service 1998) that would allow a level of production needed to support a long-term, sustainable commercial fishery and contribute to a healthy ecosystem.

The species covered under EFH include coho salmon (*Oncorhynchus kisutch*), chinook salmon (*Oncorhynchus tshawytscha*), and pink salmon (*Oncorhynchus gorbuscha*). Neither pink nor chinook salmon have been documented in the project area historically or presently, but coho were historically present in the watersheds of PRNS. Coho are currently unknown in the project area and are believed to be extirpated from the action area.

Tidewater Goby (FE)

The Recovery Planning Team for the tidewater goby is drafting a recovery plan for the species which includes documentation of potential habitat for reintroduction to establish satellite populations to protect of unique genetic stocks. Tidewater goby have been documented within Tomasini Creek at the head of Tomales Bay (Fong 2002). While not documented in the Estero de Limantour action area, it does provide suitable habitat and introduction of the species into the area has been proposed (Jacobs pers comm 2004). Goby introduction would not occur prior to the proposed restoration activities in 2005 or 2006. Given the long-term improvements to habitat that the project would facilitate, it is likely that introductions should not be considered until after restoration and enhancement activities are complete and vegetation and habitat within the actions areas have reestablished.

Special Status Amphibian Species

California red-legged frog (FT)

The only special-status amphibian known to use the project sites is the California red-legged frog (*Rana aurora draytonii*) (CRLF). The CRLF was once an abundant frog throughout much of California, but is now completely extirpated in the floor of the Central Valley (Fisher and Shaffer, 1996) and nearly extirpated in both the Sierra Nevada foothills and in the southern 1/4 of its range. The listing under the Endangered Species Act in 1996 was necessary because the frog is absent from more than 70% of its original range and is threatened within its remaining range by a wide variety of human impacts, including urban encroachment, construction of reservoirs and water diversion, contaminants, agriculture, and livestock grazing (USFWS 2000). In a few parts of the central coast range, there are still large, vigorous populations, some of which probably rival what was present 200 years ago (Fellers, *in press*). CRLF requires permanent or semi-permanent ponded water habitat with emergent and submergent vegetation, and may use stock ponds and pools within streams. The species is most often found near ponds, creeks, marshes, and other vegetated wetlands, but may disperse several miles from water to aestivate in rodent burrows or cracks in the soil during summer and fall dry periods. California red-legged frogs are most common in intermittent waters that lack bullfrogs and introduced fish species.

The largest known populations of CRLFs are at PRNS where there are more than 120 breeding sites with a total adult population of several thousand frogs. Peak egg laying by CRLFs at Point Reyes is in January and occurs in slow moving or static water systems. Most of the breeding sites at PRNS are artificial stock ponds constructed on lands that have been grazed by cattle for 150 years. There is much less information on habitat requirements away from the breeding sites. Data from radio-tagged CRLFs suggest that riparian areas provide critically important habitat for frogs during most of the year (Fellers, *in press*). This type of habitat is likely essential to the continued survival of CRLFs, particularly in dry years when water in breeding ponds is not likely to persist.

The Project Area falls within a region of California that was proposed as Critical Habitat for the red-legged frog in 2001. PRNS is within the Point Reyes Critical Habitat Unit (Unit 12), which consists of "watersheds within and adjacent to Bolinas Lagoon, Point Reyes, and Tomales Bay in Marin and Sonoma counties" and "contains one of the largest known populations of California red-legged frogs" (USFWS 2001). However, a federal court ruling in fall 2002 required the US Fish & Wildlife Service (USFWS) to review the economic analysis performed for the red-legged frog Critical Habitat designation, so the designation remains a proposal. For the purposes of this EA, Critical Habitat for red-legged frog is treated as a proposed designation.

Though not as concentrated, there are good populations of CRLFs elsewhere in the San Francisco Bay area (especially Alameda and Contra Costa Counties) and in the coastal drainages from San Mateo County (just south of San Francisco) south to Santa Barbara County. One of the largest single populations consists of an estimated 350 adult frogs at Pescadero Marsh (San Mateo County) (Fellers, *in press*).

The Draft Recovery Plan for the CRLF reports that eggs exposed to salinity levels greater than 4.5 ppt experience 100 percent mortality and that larvae die when exposed to salinities greater than 7.0 ppt (USFWS 2000). Although Fellers and Guscio (2002) recorded a maximum salinity of 1.1 ppt, PRNS has observed salinity ranges from 0.1 ppt to 13.1 ppt at the Horseshoe Pond site, known to support the California red-legged frog. Based on the data in the Recovery Plan, it can be assumed that breeding success is lower during breeding seasons where salinity in these brackish water bodies is high. Even under high winter salinity conditions, tadpoles were observed in areas with salinities up to 8.6 ppt. (B. Ketcham, pers. com.).

PRNS contracted with Dr. Gary Fellers of the USGS-BRD to perform focused surveys for CRLFs within the project areas. Extensive surveys of the project sites were conducted in 2002, and CRLF is known to be present at the Limantour Beach Marsh site (Fellers and Guscio 2002). It may also

use the Muddy Hollow drainage and ponded portions of Glenbrook Creek. The final report of CRLF observations within the Coastal Watershed Restoration Project area were completed in May 2002 (Fellers and Guscio 2002).

Critical Habitat

PRNS, and adjoining areas of Marin County comprise one of the 57 core areas for focused recovery of red-legged frogs established in the Draft Recovery Plan for the species. The central peninsula has roughly 75 stock ponds in an area extending from the Kehoe Ranch near Pierce Point south to Point Reyes itself and east to Tomales Bay, Mt. Vision, and the Laguna Ranch (now the Clem Miler Environmental Education Center). Approximately 50 of these ponds are located on land currently used for ranching, with most of the remaining 25 on former ranch lands on Inverness Ridge and above Limantour Estero. Most of these ponds retain water at least 20" deep well into the summer, and a number are perennial in typical rainfall years. Evidence of breeding red-legged frogs has been observed in many of these ponds. Pond habitat and several perennial creeks are densely clustered on the Point. Distances of under 1.25 miles separate one or more adjacent aquatic habitats, and the ground between them is suitable for red-legged frog overland movement.

Special Status Reptile Species

Northwestern pond turtle (FSC)

The only special-status reptile at issue for the proposed action is the northwestern pond turtle (*Clemmys marmorata marmorata*), which is a state species of special concern. Northwestern pond turtles are typically observed in quiet waters of ponds, reservoirs, and slow-moving streams. They may leave the water to bask on rocks or logs and to deposit eggs along the streambank or in nearby uplands. They are also capable of overwintering in upland sites, which may allow them to use habitat in intermittent waterways (Stebbins 1985). Northwestern pond turtles have been recorded in major drainages in the project vicinity, and may use Muddy Hollow Pond.

Special Status Bird Species

The short-tailed albatross, and California least tern are migratory marine birds, with albatross preferring nesting at offshore islands near California and in the northern latitudes of the Pacific. Albatross are only very rare visitors to PRNS. Viable California least tern breeding habitat does exist at PRNS, but the species has not been recorded within the action areas of the proposed projects and is relatively rare in the vicinity Point Reyes. Marbled murrelets and bald eagles are also uncommon visitors to PRNS, but are preferential to mature forest canopies at outside of the action area and are uncommon on Point Reyes. Marbled murrelets occur in Drakes Bay nearshore in the non-breeding season but not in the proposed action area. For these reasons, it is highly unlikely that the proposed projects would impact these species. The northern Spotted owl occurs in the park in very high densities. The project would occur outside of the nesting season, and none of the project areas are within ¼ mile of known nesting sites.

Western snowy plover (FT)

Western snowy plovers use the Point Reyes peninsula as both wintering and nesting habitat. Wintering birds occur around Drakes Estero and Abbott's Lagoon, and along Limantour Spit and the Great Beach. During the 1980' s nesting took place along the entire Great Beach Drake s Beach, and at Limantour Spit. In recent years, erosion along the southern portion of the Great Beach has diminished the upper beach area such that the entire beach can be washed by waves. Nesting is occurring on the northern portion of this beach, between the North Beach parking area and Kehoe Beach, which is backed by extensive dunes. Snowy plovers also nest along the western edge of Abbott's Lagoon. Erosion has also affected Limantour Spit, and it has not been used by snowy plovers for nesting since 2000 when Limantour had three nests on it. Limantour beach and spit continue to be used as wintering habitat by plovers.

Monitoring of nesting snowy plovers in 1986-1989 and 1995-2003 indicates a decline in the number of nesting birds through 1996, followed by a gradual rebound in recent years. PRBO Conservation Science (PRBO) monitored individual nests at all nesting areas during the period 1986 - 2003. On the Great Beach, where most nesting took place, the number of chicks fledged per egg laid during 1986-89 and 1995 ranged from 1%-7%.

In 1996, a program to increase snowy plover nesting success was initiated, and this program continues to the present. The program consists of signs and habitat fencing to minimize disturbances and nest enclosures to prevent nests and egg predation by both terrestrial and avian predators. Visitors are advised to avoid walking on upper beach areas used by plovers, and dogs are prohibited from nesting areas. Since the program began, the rate of chicks fledged per egg has increased to 20%-58% (Ruhlen and Abbott 2000), and between one and three chicks per female have fledged. Several nesting areas, including Limantour Spit and sections of the Great Beach accessed by the Abbott' s Lagoon and Kehoe Beach trails, experience regular visitor use. During a study in 1999 and 2000, biologists found a higher rate of snowy plover chick loss in these areas on weekends, when disturbance by human visitors and dogs is more likely. In response, PRNS began a weekend Plover Docent Patrol Program to place volunteer docents on plover nesting beaches and beach trailheads to educate visitors about beach restrictions. In 2000-2003, although egg laying remained high, fledging rate declined. Causes for the decline could include predation by ravens, owls, falcons, and disturbance by visitors or cattle.

California Brown Pelican (FE)

The California brown pelican (*Pelecanus occidentalis californicus*) is one of six recognized subspecies of brown pelican. Brown pelicans are distinguished by their large size and brown color. Adults weigh approximately 9 pounds, and have a wingspan of over 6 feet. They have long, dark bills with big pouches for catching and holding fish. The brown pelican is easily distinguished from the American white pelican, the only other pelican in its range, which is white with black primary and secondary flight feathers.

Pelicans breed in nesting colonies on islands without mammal predators. They typically build a nest of sticks on the ground. All courtship occurs at the nest site. The male brings nesting materials to the female and she builds the nest. Normal clutch size is three eggs, which are laid in March or April. Both take turns incubating the eggs and rearing the chicks.

The brown pelican is found in estuarine, marine subtidal, and marine pelagic waters along the California coast. Brown pelicans breed on Channel Islands: Anacapa, Santa Barbara, and Santa Cruz (Garrett and Dunn 1981) from March to early August; most numerous then within 20 km (12 mi) of those islands (Briggs et al. 1981). In northern California, the species is common June to November, rare to uncommon December to February and May, and very rare and irregular March and April (Anderson and Anderson 1976, Cogswell 1977, McCaskie et al. 1979).

Tricolored Blackbird (FSC)

Tricolored blackbird (*Agelaius tricolor*), a state species of special concern, is a permanent resident in California's Central Valley from Butte County south to Kern County, and is also found at scattered coastal locations from Marin County south to San Diego County. The species breeds at scattered locations in Lake, Sonoma, and Solano Counties and rarely in Siskiyou, Modoc, and Lassen Counties as well. Tricolored Blackbirds forage in open areas that offer abundant insect prey, such as marshes, pastures, agricultural wetlands, dairies, and feedlots. They are colonial nesters and prefer nest sites in emergent marsh vegetation such as cattails, or upland nest sites that offer blackberries or grain crops and a nearby source of water. Suitable habitat is present around Muddy Hollow Pond, and possibly also at Limantour Beach Marsh.

Little Willow Flycatcher (FSC)

The little willow flycatcher (*Empidonax traillii brewsteri*) is a state species of special concern. This species nests in wet meadows with abundant willows, and may use willow thickets in the Muddy Hollow area.

Salt Marsh Common Yellowthroat (FSC)

The salt marsh common yellowthroat (*Geothlypis trichas sinuosa*) is a state species of special concern. Yellowthroats inhabit areas between freshwater and tidal marsh and are also found in upland grasslands. They typically use salt marshes during winter and prefer brackish or freshwater marshes during the breeding season. Nests are found on the ground in low herbaceous vegetation or emergent vegetation, to a height of approximately 5 feet above the ground. Suitable nesting habitat for this species is present in the vicinity of the Limantour Beach Marsh and Muddy Hollow Pond sites.

California Black Rail (FSC)

The California black rail is listed as threatened under the California Endangered Species Act. The species' range is currently confined to the northern San Francisco Bay Estuary, with small, isolated populations along the outer coast in Tomales Bay, Bolinas Lagoon, Morro Bay, and Bodega Bay (Manolis 1978, Evens et al. 1991); in the Sacramento Valley and foothills (Aigner et al. 1995); and in the Colorado River basin (Evens et al. 1991). Black rails primarily use tidal salt marsh habitat, but they are also observed in freshwater marsh (Evens et al. 1991, Evens and Page 1986, Grinnell and Miller 1944, Manolis 1978, Aigner et al. 1995). Suitable habitat may be present at Limantour Beach and Muddy Hollow, but habitat in these areas is likely too exposed to support sustained use by rails.

Special Status Mammal Species

Point Reyes mountain beaver (FSC)

The only special-status mammal at issue for the proposed action is the Point Reyes mountain beaver (*Aplodontia rufa phaea*), which is not listed but is considered a species of concern by the U.S. Fish and Wildlife Service. This subspecies of the common mountain beaver is only known to occur in Marin County, and its range is almost entirely within Point Reyes National Seashore. The Point Reyes mountain beaver inhabits moderately dense coastal scrub habitat in colluvial hollows, and may use scrub habitat in the vicinity of all three project sites.

Point Reyes jumping mouse (FSC)

The Point Reyes jumping mouse (*Zapus trinotatus orarius*) occurs in riparian and grassland habitat within the Seashore. The mouse has been documented near Abbotts Lagoon and Limantour beach and could occur within the Muddy Hollow Pond Project area. The mouse has not been documented during any surveys at the project site.

Special Status Invertebrate Species

Myrtles Silverspot Butterfly (FT)

Myrtle's silverspot butterflies inhabit coastal dune, coastal prairie, and coastal scrub habitats at elevations ranging from sea level to 300 meters, and as far as 5 kilometers inland (Launer et al. 1992). The species historic distribution is believed to have extended from near Fort Ross south to Punta Ano Nuevo. By the 1970's populations south of the Golden Gate were believed to be extinct and extant populations of the butterfly were believed to exist only within PRNS. Reasons for this decline include urban and agricultural development, invasive non-native plants, livestock grazing, over-collecting, and other human impacts.

Following discovery of a population near the Estero de San Antonio in the early 1990's, field surveys were conducted by the Center for Conservation Biology at Stanford University. Two additional apparently separate populations in PRNS were located and fieldwork was done to

estimate population sizes. One population, centered on North Beach, extended from Abbott's Lagoon to South Beach and east to Drakes Estero and Drakes Beach. The highest numbers were found along the dune-scrub interface in the back dune area of the central peninsula on F and G ranches and the AT&T property, and on the bluffs on either side of the Drakes Beach visitor center. The population was estimated to number in the low thousands in 1993. More recent survey work in 1997 put the population estimate at 50-200 individuals, with no silverspots being found in portions of the 1993 range. The other population was found on the Tule Elk Reserve, with small numbers on the adjacent J Ranch. In 1993, the number of individuals in this population was estimated to be in the mid-hundreds. The 1997 survey of this northern Point Reyes population gave a population estimate of 250-500 (Launer et al. 1998).

Silverspot numbers in the area outside of park lands around the Estero de San Antonio were estimated at 2,000-5,000 individuals in 1991. Other nearby areas with potentially suitable habitat was not surveyed. Together with those found at Point Reyes, estimated numbers for the three known populations of the species total less than 10,000 individuals (USFWS 1998).

Known Myrtle's silverspot nectar plants include bull thistle (*Cirsium vulgare*), gum plant (*Grindelia* spp.), western pennyroyal (*Monardella undulata*) yellow sand verbena (*Abronia latifolia*), seaside daisy (*Erigeron glaucus*), and mule ears (*Wyethia* spp.). Brownie thistle (*Cirsium quercetorum*) and groundsel (*Senecio* spp.) are also fed upon. Many of these species are commonly found at Point Reyes. Oregon silverspot (*Speyeria zerene hippolyta*) feeds on other common plant species that may also be used by Myrtle's silverspot.

Myrtles silverspot larvae are known to use only one species as a host plant, western dog violet (*Viola adunca*). It is possible that, like other subspecies of *Speyeria zerene* and other species of silverspots, Myrtle's silverspot uses other violet species as larval hosts, although this has not been observed. The perennial, rhizomatous western dog violet is found on open grassy slopes sandy flats behind dunes, and on the edge of brush under pines (Howell 1970). While it is described as "rather common near the coast", including the Point Reyes dunes, distribution of the species is patchy. Abundance of western dog violet alone is not a good predictor of silverspot presence. Myrtle's silverspot presence also is associated with protection from high coastal winds that are common during the summer flight season (Launer et al. 1992). The complex habitat needs of breeding Myrtle's silverspots may be the species' limiting factor.

Due to the lack of historic data previous to the 1990's, it is not known if the silverspot has declined at Point Reyes. While surveys of the two populations during the period 1993-1997 found that the Tule Elk Reserve population remained stable and the central Point Reyes population declined sharply, such variation is well within that normally found in *Speyeria* species (USFWS 1998).

In 2002 and 2003, Point Reyes National Seashore biologists conducted vegetation surveys for the larval host plant and nectar sources and butterfly surveys for Myrtle's silverspot butterflies. In 2002, the first Myrtle's silverspot butterfly sighting was made on June 26th and the last sighting was on September 10th, with the peak population size the last week of July. Over 30 butterfly transects (203 km) were performed in the 2002, spanning a period of 13 weeks and included areas in Tomales Point, North Beach, South Beach, and Drakes Estero. Overall, biologists observed a total number of 598 butterflies in all areas. Similar efforts and results were obtained in 2003 Adams, 2004) Very few observations of the butterfly were made within the project area. Biologists' notes additional nectar species used by Myrtle's silverspot butterflies during survey transects, including goldenrod (*Solidago* sp., 2 visits), Yarrow (2 visits), *Cammisonia* (1 visit), *Jaumea carnosa* (1 visit), *Ericomeria ericoides* (1 visit), the coast fiddleneck (*Amsinkia spectabilis*, 1 visit) (Adams 2004).

Globose dune beetle (FSC)

The globose dune beetle (*Coelus globosus*) is a subterranean dweller of the California coastal dunes. The distribution and abundance of the species is unknown but it could occur near the Limantour Beach Pond project area.

3.4 Social Environment

Cultural Resources

The following overview of cultural resources research in the Point Reyes area is summarized from a technical report prepared for the project (Newland 2004).

Prehistoric and Historic Context

Prehistoric Period

The Point Reyes area can be included in the analytic framework for the interpretation of North Coast and central California prehistory constructed by Fredrickson (1974), who divided human history in California into three broad periods: the Paleoindian period, the Archaic period, and the Emergent period. This scheme used sociopolitical complexity, trade networks, population, and the introduction and variations of artifact types to differentiate between cultural units. With minor revisions, it remains the dominant framework for prehistoric archaeological research in the project region.

The Paleoindian period (10,000–6,000 BC) was characterized by small, highly mobile groups occupying broad geographic areas. During the Archaic period, consisting of the Lower Archaic period (6,000–3,000 BC), Middle Archaic period (3,000–500 BC), and Upper Archaic period (500 BC–AD 1000), geographic mobility may have continued, although groups began to establish longer-term base camps in localities from which a more diverse range of resources could be exploited. The addition of milling tools and obsidian and chert concave-base points, and the occurrence of sites in a wider range of environments, suggest that the economic base was more diverse. By the Upper Archaic period, mobility was being replaced by a more sedentary adaptation in the development of numerous small villages and the beginnings of a more complex society and economy began to emerge.

During the Emergent period (AD 1000–1800), social complexity developed toward an ethnographic pattern of large, central villages where political leaders resided, with associated hamlets and specialized activity sites. Artifacts associated with this period are the bow and arrow; small serrated corner-notched points; mortars and pestles; and a diversity of beads and ornaments that became especially abundant (Gerike et al. 1996).

Most sites within Point Reyes National Seashore that have been dated appear to fall into the Emergent period (e.g., Origer 1982, 1987; King and Upson 1970; Von der Porten 1963), although at least two substantial sites may belong to the Upper Archaic period, the McClure site and the Cauley Site (CA-Mrn-242) (Beardsley 1954). Other sites dating to the Upper Archaic or earlier may be present in the Point Reyes National Seashore under alluvial or colluvial sediments.

Ethnographic Period

The Point Reyes Area is within the traditional territory of the Coast Miwok. The Coast Miwok language, a member of the Miwokan subfamily of the Utian family, is divided into two dialect groups: Western (Bodega) and Southern (Kelly 1978, Shipley 1978). Based on common linguistic associations, the territory of the Coast Miwok extended from Duncan's Point on the

Sonoma County coast south to the Marin headlands (Kroeber 1925), and east to a point approximately halfway between the Sonoma and Napa Rivers (Kelly 1978).

The fundamental unit of Coast Miwok political organization was tribelet, which encompassed the village community (Kroeber 1925); Coast Miwok sociopolitical organization did not extend beyond the village. Larger villages had a chief, whose position was nonhereditary. The chief's responsibilities included advising and caring for the villagers and overseeing activities in the dance house. Incipient chiefs were tutored by the current chief and four elderly women (Kelly 1978). Other important leaders included the woman chief and the *máien*. The woman chief appears to have been primarily a ceremonial leader, who was involved in the Bird Cult and coordinated the Acorn Dance and the Sünwele Dance. The *máien* was the head of the female ceremonial house, and was responsible for directing the construction of new dance houses, having wood hauled for festivals, supervising the preparation of foods for special events, sending invitations to dances, and sometimes also for selecting dance performers (Kelly 1978).

Historic Period

The Point Reyes–Drakes Bay–Tomales Bay region was one of the first areas described by European explorers who traveled the California coast. Contact between the Coast Miwok and Europeans first occurred on the Marin County coast as early as 1579, when Sir Francis Drake spent 5 weeks on the coast to repair his damaged ship (Kroeber 1953). Some 16 years after Drake's landing, the *San Agustín*, a Manila galleon piloted by Sebastián Rodríguez Cermeño, entered Drakes Bay. The ship, loaded with trade goods from Asia and bound for Acapulco, was wrecked by a violent storm 3 weeks after its arrival in November of 1595; Asian ceramic fragments from the wreck have been found on the beaches throughout Drake's Bay. Before returning to the sea in a launch, the crew explored several miles inland from the coast, making contact with several Coast Miwok villages and obtaining acorns from them (Hoover et al. 1990, Moratto 1974).

Juan Sebastián Vizcaíno's 1603 expedition was the one to bestow the name *Punta de los Reyes* on the point, after the day of *los reyes magos*, the "three holy kings" (Gudde 1998). The Vizcaíno expedition also entered Tomales Bay that same year, though they assumed that the narrow bay was a river (Gudde 1998).[4]

After the visits of these explorers, it was almost 200 years before Europeans returned to the area, but by 1776, Mission San Francisco de Asís had been founded, and before long numerous other missions and their associated pueblos were in place across the bay area. The mission *padres* began forced conversions of Native Americans to Christianity and brought Coast Miwok to mission lands, causing a partial abandonment of native settlements. Many of the Coast Miwok were taken to San Francisco's Mission Dolores (established in 1776), to Mission San José de Guadalupe (established in 1797), and to Mission San Rafael Arcangel (established in 1817), to be converted. Large groups (40–150 people) were taken at one time (Milliken 1995). Their numbers decreased rapidly, as did those of Native American populations throughout the Bay Area and California. Subsequent ranching and settlement by Mexicans and, later, by Americans further displaced Coast Miwok from their homes and subjected the group to intense depredation as a result of homicide and epidemic diseases (Cook 1976).

With the secularization of mission properties in the early 1800s, large ranchos began to be established through the Mexican government's land grant program. The project area is in the Rancho Punta de Los Reyes Sobrante land grant. The nearby Rancho Punta de Los Reyes (a

[4] The bay may derive its name from the Tamal Indians, a group of Coast Miwok who appear in the baptismal records of Mission Dolores between 1802 and 1810 (Milliken 1995), or from the Coast Miwok word for "bay," *tomales* (Gudde 1998, Hoover et al. 1990).

separate grant from the Sobrante property), consisted of 35,000 acres granted in 1836 to James Richard Berry, an Irishman, who shortly thereafter sold a portion of the rancho to Joseph Snook, who in turn sold his portion to Antonio María Osio in 1843. Osio obtained the rest of the original Los Reyes grant and was also granted the remaining 48,000 acres of land on Point Reyes, which was given the name Rancho Punta de los Reyes Sobrante, *sobrante* meaning "surplus" or "leftover land." This settlement eventually lead to the founding of numerous ranches and dairies in the Point Reyes region (Newland 2004).

The acquisition of Alta California by the United States as a result of the Mexican-American War of 1846–1848 had little effect on the established ranching and dairying economy. The area became an increasingly important center for dairy production, providing much of the butter and cream used in the San Francisco area during the Gold Rush of the mid-1800s. Row crop cultivation also became important, and from the 1850s through the 1950s, dairy production and row crop cultivation were the area's economic mainstay.

In the early 1920s, the Bureau of Indian Affairs purchased land near the city of Graton and placed it in government trust as a ranchería for the remaining 75 Coast Miwok and Southern Pomo that shared their territory (Campbell et al. 2002). Today, the Coast Miwok population has increased to 366 individuals and is represented by the federally recognized Federated Indians of the Graton Ranchería located in Graton, with offices in Santa Rosa and Novato (Newland 2004).

Archeological Sites in the Project Area

An archaeological survey conducted for the proposed action by staff of Sonoma State University's Anthropological Studies Center (ASC) in November and December of 2001 identified one cultural resource site within the general project area. CA-Mrn-236/H is a prehistoric and historic archaeological site located adjacent to the Limantour Beach Marsh site (Newland 2004).

CA-Mrn-236/H is a prehistoric campsite with a historic artifact scatter component. The site was initially discovered and excavated in 1941 by Beardsley and was re-excavated in 1967 by Edwards. Treganza then conducted several excavations at the site in 1965 and 1968. These multiple excavations recovered Ming porcelain fragments, several iron spikes, miscellaneous ceramic fragments, and a light shell scatter (Newland 2004). CA-Mrn-236/H was revisited by ASC staff in 1999; at that time, a light concentration of shell was still visible on the surface (Jablonowski et al. 1999), although when ASC staff archaeologist Michael Newland and Frank Ross of the Federated Indians of the Graton Ranchería conducted the archaeological survey for this project in December 2001, no archaeological remains were visible (Newland 2004). However, NPS archaeologists who visited the site in 2003 were again able to observe the remains of the site, although approximately 50% of the area was vegetated at the time of their visit. The NPS survey included surface scraping and random troweling to a depth of approximately 5 inches. No midden deposits or fire-affected rock were observed in this survey, although several shell fragments of possible archaeological origin (fragments of *Clinocardium* and *Protothaca*) observed at various locations on the surface indicated at least a possibility of buried archaeological deposits (Rudo and Maxey pers. comm.).

While the five most recent investigations of CA-Mrn-236/H (Rudo and Maxey pers. comm., Newland 2004, Jablonowski et al. 1999, Moratto 1974, Edwards 1967) did not definitively locate substantive remains of this site, it is still possible that the site, possibly including human remains, may be partially intact beneath the sand and paved roadway (Rudo and Maxey pers. comm.); a number of archaeological sites along the ocean coast and Tomales Bay that have been identified as destroyed have been rediscovered. Though the remains of this archaeological site may not be eligible for listing in the National Register of Historic Places (NRHP), the possibility that there are human remains increases the potential significance of CA-Mrn-236/H, particularly in regard to compliance with the Native American Graves Protection and Repatriation Act (Rudo and Maxey pers. comm.) (see additional discussion under *Cultural Resources* in Chapter 4).

Noise

Ambient noise levels within and adjacent to the project areas are generally low. The primary sources of noise are traffic on nearby Limantour Road, and general noise from recreators utilizing hiking trails and service areas.

There are no permanent sensitive receptors within or adjacent to the project area. However, the project sites are used extensively for recreation throughout the year, and therefore a large number of sensitive receptors are present year round within and adjacent to the project area. In addition, this area supports a wide range of wildlife species that are sensitive to noise and area present at all of the sites throughout the year.

Public Health and Safety

Two issues related to public health and safety are specifically relevant to the proposed action:

- current and continuing safety of the existing dam and embankment structures, and
- potential effects of altered hydraulics and circulation on mosquito population levels.

Dam and Embankment Safety

No embankment safety concerns have been identified at Limantour Beach Marsh.

The Muddy Hollow Pond dam is on the NPS dam inventory (CA10262 – "Lower Muddy Hollow Dam") and requires regular inspection for condition and safety purposes. The U.S. Bureau of Reclamation (USBR) has assessed the condition of the Muddy Hollow dam as "seriously deficient" and has suggested that "consideration should be given to deactivation" (USBR 2001). Erosion on the downstream face of the dam indicated that it had been overtopped in the past (USBR 2001). While the downstream Hazard Classification (based on potential loss of life and property if the dam were to fail) is low, public safety is nonetheless a concern because the dam supports a heavily used trail corridor.

The condition of the Glenbrook Crossing embankment is uncertain. Details of construction are unknown, but it is assumed to consist of unengineered fill. Because of its age and uncertainty about the quality of its construction, it is assumed to be at risk of failure over the long term. The current condition of the culvert (eroded and bowed with water piping around it) makes the site a high risk of catastrophic failure under high flow conditions. Although public safety risks associated with failure are minimal because of the remote location, the remaining structure and trail access could pose risk to visitors following a potential failure.

Mosquito Populations

Public health and safety concerns related to mosquito populations focus on the potential for mosquitoes to spread disease. The greatest concern in coastal northern California, where malaria and other common mosquito-borne diseases are not endemic, is West Nile virus, which has been identified in several counties in the state (e.g., California Department of Health Services 2004) and is expected to become an increasing concern in the Bay Area in the near future.

All species of mosquitoes require standing water to complete their growth cycle, and any body of standing water represents a potential breeding site. However, the productivity of mosquito breeding is related to water quality: as water quality increases, mosquito productivity typically

decreases. In addition, permanent bodies of open water that have good water quality typically have a stable nutrient content and support a rich diversity of floral and faunal species, including mosquito predators. Other specific factors that influence mosquito breeding success include salinity and degree of stagnancy. Mosquito productivity is inversely related to water salinity, with increased salinity tending to lower mosquito productivity. Current action also tends to lower mosquito productivity, in part because currents foster mixing that improves water quality. In addition, currents (particularly river currents and wave action across larger bodies of water) physically retard mosquito production by inhibiting egg laying and reducing the survival rate of larvae (Collins and Resh 1989).

The most productive mosquito breeding environments thus occur in stagnant waters and water bodies with stable or slowly changing water levels. Rapid fluctuations in water level (e.g., wave disturbance of the water surface) typically reduce mosquito breeding success. This is because mosquito larvae live at or immediately below the water surface and breathe oxygen; if the water surface is disturbed, they may drown (Malamud-Roam pers. comm.).

At present, both the Limantour Beach Marsh and Muddy Hollow sites support ponded water, and water in Glenbrook Creek is also intermittently ponded near the crossing site. Thus there is some potential for mosquito breeding at all three site, although none of the sites has been identified as a particular concern for mosquito breeding; in particular, Muddy Hollow Pond is large enough to experience wind-driven wave currents that likely impede breeding, while Glenbrook Creek flows throughout most years. Of the three sites, Limantour Beach Marsh is most likely to support mosquito breeding under existing conditions.

Recreational Use

Point Reyes National Seashore welcomes more than 2.5 million visitors annually, many of them drawn by the area's outstanding recreational opportunities, which include hiking; horseback riding; backcountry camping; beachwalking; wildlife viewing and birdwatching; and mountain biking (National Park Service 1999).

The project sites support a number of recreational uses. Limantour Beach is a designated recreational area, and can be accessed easily via Limantour Road, one of the Seashore's major roadways. Serving some 180,000 visitors per year, Limantour Beach offers various amenities, including a developed parking lot, restrooms, telephones, and picnic tables. The crossing at the Limantour Beach Marsh site is the primary access point for Limantour Beach, and the parking area provides access to a number of local trails. The Muddy Hollow and Glenbrook sites are both located adjacent to the Muddy Hollow Trail, an important wilderness trail that connects with the networked trail system serving the central part of the Seashore and is used by hikers and equestrians. At Muddy Hollow, the ponded open water habitat and riparian vegetation provide outstanding opportunities for birdwatching. The dam is also used and maintained as part of the Estero Trail.

Transportation and Traffic

Overview

Point Reyes National Seashore is located in unincorporated Marin County. The major roads through the park, including Sir Francis Drake Boulevard to the Chimney Rock Road intersection, and Pierce Point Road to the Pierce Point Ranch, and Bear Valley Road are county roads, and maintained by their Department of Public Works. State Route 1 is maintained by Caltrans. Other roads in the park, including Limantour Road are maintained by the NPS.

Because the County maintains roads leading to, and within the park, the transportation element of the Marin Countywide Plan (County of Marin 1994) provides guidance for traffic planning at the Seashore. The transportation element's purpose is to (1) describe existing and projected transportation conditions in Marin County, and (2) articulate County transportation policy. It describes and evaluates the existing (1991) condition and function of the County's transportation system and projects anticipated function if growth and land use evolve as predicted in the Countywide Plan's community development element. With certain exceptions, it also defines level of service[3] (LOS) D as the minimum goal for all streets in unincorporated areas, and for area highways, and identifies infrastructure improvements that would be required to continue to achieve that LOS under the anticipated growth and land use patterns (County of Marin 1994, 2003). In response to state requirements following passage of Propositions 111 and 116 in 1990, the County of Marin and eleven Marin city jurisdictions designated the Countywide Planning Agency as the congestion management agency responsible for developing and adopting a countywide plan to reduce traffic congestion (County of Marin 1994).

Transportation access to Point Reyes National Seashore is limited, in keeping with the area's open space/wilderness character. The Seashore is not directly served by air, rail, or mass transit. Road access from the south occurs from Highway 1 northbound via Bear Valley Road. From the east, visitors access the Seashore via Sir Francis Drake Boulevard from U.S. Highway 101. Visitors can also approach from the north, entering the town of Point Reyes Station from Highway 1 southbound and following the continuation of Sir Francis Drake Boulevard across Olema Valley into the Seashore area. All primary access roads are two-lane corridors in the vicinity of the Seashore. Most intersections are controlled by stop signs only or are uncontrolled.

Within the Seashore, Sir Francis Drake Boulevard continues as a two-lane rural road to serve the Point Reyes Lighthouse and Lighthouse Visitor Center at Point Reyes proper, with spurs providing visitor access to the Estero trailhead and to the Kenneth C. Patrick Visitor Center at Drake's Beach. Pierce Point Road, a smaller two-lane rural road, diverges from Sir Francis Drake Road about 2 miles northwest of Inverness to serve the northern beaches (Kehoe and McClure's) as well as historic Pierce Point Ranch and the Tomales Point trailhead. A narrow, winding spur descends to Heart's Desire Beach on Tomales Bay.

Limantour Beach Marsh and Muddy Hollow Pond are accessed via Limantour Road from Bear Valley Road. Limantour Road is a winding two-lane rural road with limited shoulder width. The intersection at Bear Valley Road is controlled by a stop sign, and sight distance is limited by vegetation along the roadside. Limantour Road provides access to a network of hiking trails in the central portion of the Seashore.

The Glenbrook Crossing site is accessed from the Muddy Hollow Parking area, just north of Limantour Road. The site is approximately one mile from the parking area, on the Muddy Hollow Trail, within the Philip Burton Wilderness.

Access for Emergency Services

Emergency services access the project sites and surrounds from Bear Valley Road and Limantour Road. NPS maintains a wildland and engine fire crew based at the Hagmaier complex 5 miles

[3] *Level of service* (LOS) is a measurement used to describe how well a roadway is operating. LOS is evaluated either on the basis of delays experienced by motorists, or the ratio between the roadway's design capacity and the number of vehicles it actually conveys. To describe LOS, roadways are assigned a letter designation (A–F). The letters A through F represent progressively worse conditions: LOS A indicates free-flow operation with excellent maneuverability, stable speeds, and little or no delay, and LOS F indicates a breakdown of flow, substantial delay, and unstable and erratic speeds. LOS D describes traffic that is approaching an unstable condition; at LOS D, queues develop rapidly but motorists do not experience excessive delays (Transportation Research Board 2000).

south of Olema. The NPS law enforcement staff provide resource enforcement and initial response to most medical and traffic related emergencies on federal lands. Depending on need and location, federal, state, county, and local fire agencies can and do respond to calls within the Seashore. The County of Marin maintains primary fire and EMT services based in Point Reyes Station, and the area is also served by local emergency and fire response through the Inverness Public Utilities District.

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4.0 Environmental Consequences and Mitigation Approaches

This chapter analyzes the potential effects of Alternative 1 (Full-Build), Alternative 2 (Partial-build), and Alternative 3(No Action) on the environmental resources described in Chapter 3. Where appropriate, it also identifies mitigation strategies that could be implemented to avoid or reduce adverse effects. Analysis is generally presented separately for each alternative and each restoration site, except where there would be no material difference between the effects under the different alternatives, or the effects at each site.

4.1 Overview of Analysis Approach

Analysis of Incremental Effects

Incremental effects refers to the effects specific to a particular proposed action or activity, independent of other activities taking place at the Seashore. Consistent with NEPA requirements, the analysis in this chapter considered the context, intensity, and duration of potential incremental effects.

Context describes the setting within which effects are analyzed. Incremental effects were evaluated in the local context of the immediate project area, except for impacts on traffic, which were analyzed in the context of the whole of Marin County.

Intensity is a measure of an effect's severity. In this analysis, impacts were identified as *beneficial* or *adverse*; beneficial impacts would improve resource conditions and adverse impacts would negatively alter or deplete resources. Adverse effects were further qualified as **negligible**, **minor**, **moderate**, or **major**. These terms are defined for each resource area in the *Assessment Methods* section of each analysis below.

Duration refers to the timeframe over which an effect persists. This analysis identified effects as **short-term** or **long-term**. The duration of time describing short and long-term are defined for each impact topic individually. Information specific to particular resource areas is provided in the *Assessment Methods* sections below.

Analysis of Potential to Impair Park Resources

Current NPS management policies (National Park Service 2000) and NPS Director's Order 12 (*Conservation Planning, Environmental Impact Analysis, and Decision Making)* require decision makers to determine whether a proposed action could lead to an impairment of park resources or

values before approving the action. *Impairment* is defined as "an impact that … would harm the integrity of park resources or values, including the opportunities that would otherwise be present for the enjoyment of those resources or values." In general, an impact is more likely to constitute an impairment if it affects a resource or value whose conservation is necessary to specific purposes identified in the legislation or proclamation that created the park; is essential to the park's natural or cultural integrity, or to the public's opportunities to enjoy the park; or is specifically identified as a goal in the park's General Management Plan or other relevant NPS planning documents (National Park Service 2000).

At Point Reyes National Seashore, the park resources and values that are subject to the no-impairment standard include the physical, biological, and ecological processes that created the park and continue to act upon it, as well as the cultural resources that reflect the area's legacy of Native American use. With these values in mind, analysis of incremental effects factored in consideration of the proposed action's potential to result in impairment of natural and cultural resources at the Seashore.

Analysis of Cumulative Effects

A complete summary of cumulative effects analysis is described in Section 1.4. For the purpose of document review, the actions considered part of the cumulative impacts section are presented again in Table 4-1.

Table 4-1. Actions Included in Cumulative Effects Analysis

Action	Overview
Coastal Watershed Restoration, Drake's Estero Road Crossing Improvements	This action includes the replacement or enhancement of road crossing facilities to accommodate natural hydrologic process and fish passage at six sites within the Drake's Estero watershed. It is in the planning phases, with EAs slated for public release in fall 2004. Implementation, anticipated for summer 2005, would require state and federal permits similar to those required for the proposed action analyzed in this EA.
Horseshoe Pond Restoration to Coastal Lagoon	This action involves the removal of spillway and dam materials to restore natural hydrologic and shoreline process to a 35-acre area immediately west of the mouth of Drake's Estero. It would also restore or enhance the access road, borrow quarry, and former waste lagoon to more natural conditions. With appropriate compliance complete, the project was implemented in fall 2004.
Glenbrook Dam and Quarry Restoration Project	This action involves the removal of dam remains and restoration of the borrow areas at the mouth of Glenbrook Creek in the Estero de Limantour. Implementation is scheduled to be complete by fall 2005. It would require a number of state and federal permits as well as minimum tool clearance for operations within a designated wilderness area.
Giacomini Wetlands Restoration Project	PRNS and Golden Gate National Recreation Area (GGNRA) are conducting a large-scale wetland restoration project at the southern end of Tomales Bay. This project would restore natural hydrologic and ecological processes and functions to the historic tidal marsh, which was diked in the 1940s for operation of a dairy ranch. The project is currently in the alternatives development phase. A draft EIS/Environmental Impact Report (EIR) is scheduled for 2005, with possible implementation of a portion of the project in late 2006.
Dune Restoration Project	This action involves the removal of nonnative European beach grass from the dune areas within the Seashore. Removal methods and restoration strategies are currently being tested near Abbott's Lagoon and would be employed at a larger scale under a line-item construction project planned for FY 2007.
Fire Management Program	NPS has completed a Fire Management Plan for the Seashore and is conducting environmental analysis of program alternatives. The preferred alternative would result in prescribed fire and mechanical treatment on no more than 3,000 acres per year within identified park fire management units (FMUs). While 27% of the Drake's Bay/Drake's Estero watershed is included in active treatment FMUs under the Plan, NPS does not anticipate treatment on more than 10% of any one watershed within Drake's Bay in any given year. The draft environmental impact statement for the Fire Management Plan is now in public review, with comments expected by June 2004. NPS anticipates implementation beginning in FY2005.

NPS is also in the process of revising the General Management Plan for Point Reyes National Seashore. This is a long-term strategic planning document that would establish management direction in the park for the next 10–20 years. Public scoping has been conducted and NPS expects the planning process to be completed by FY 2006 or 2007. Because management planning is still in the early stages, details are considered outside the scope of "reasonably foreseeable" actions that NEPA requires lead agencies to address in the analysis of cumulative effects. However, it is reasonable to assume that all programs and actions implemented under a revised General Management Plan would be consistent with the mission and vision captured in this EA, and would include environmental safeguards similar to those incorporated in the actions explicitly analyzed.

4.2 Effects on the Physical Environment

Effects on Visual Resources

Policies and Regulations

Visual intrusions in coastal areas are considered in association with the federal consistency review by the California Coastal Commission (CCC). The CCC's protection of coastal viewsheds relates specifically to constructed facilities as observed within the coastal zone and from the water. In support of this protection, the CCC conducts consistency review of projects on federal lands to determine concurrence and identify whether permitting is necessary.

NPS management policies (National Park Service 2000) make numerous references to aspects of aesthetics as central issues in the considerations that go into resource management. It specifically includes "aesthetic values, such as scenic vistas … and clear night skies" among the resources that NPS must protect.

Assessment Methodology

The proposed action's likely effects on visual resources were evaluated qualitatively, based on anticipated short- and long-term change in the visual character of the sites as a result of restoration activities, as experienced by the public. Topics addressed included

- the project's potential to alter existing natural viewsheds, and
- the project's potential to introduce new sources of light or glare into the vicinity of the sites.

The following specific questions were factored into the analysis, as required by NPS Director's Order #77.

- Could the action or activity be seen from the park? From a developed overlook, road, or trail?
- Would the action or activity be continuously or intermittently seen? Are there any alternative sites that would be less visible from the park, or would not be visible from the park?
- Could the action impact a scenic vista along a road or a scenic view? How long would the proposed activity affect an area?

Table 4-2 summarizes the descriptors used to evaluate effects on visual resources.

Table 4-2. Descriptors for Visual Resources Effects

Type of Effect	Beneficial—Project activities would improve the integrity of visual resources at and surrounding the project site(s), would result in a more natural viewscape, and/or would introduce visual elements that support park purposes, as identified in relevant planning documents.

	Adverse—Project activities would degrade visual resources at and surrounding the project site(s) and/or would introduce discordant built elements into a natural or largely natural viewscape.
Duration of Effect	Short-term—Effects would be limited to the construction period and days/weeks immediately preceding and following.
	Long-term—Effects would persist for months or years following the completion of construction.
Intensity of Effect	Negligible—Effects would be very slight and the area affected would be very small. Effects would be unlikely to alter the quality of visitors' experience of the project site(s) and surrounds.
	Minor—Effects would be slight and/or the area affected would be small. The proposed action would have a limited adverse effect on the quality of visitors' experience of the project site(s) or surrounds.
	Moderate—Effects would be more noticeable and a greater proportion of the project site(s) and surrounding area would be affected. Visitors' experience of the site and surrounds would be noticeably degraded.
	Major—Effects would be extremely conspicuous and a large proportion of the project area would be affected. Visitors' experience of the area would be substantially degraded.

Evaluation of Impacts

Alternative 1: Full-Build Approach (preferred alternative at Limantour Beach Marsh and Muddy Hollow)

Aesthetic Effects

Limantour Beach Marsh

As described in Chapter 3, views of the Limantour Beach Marsh site are largely natural in character, but the site currently includes an earthen embankment that supports a paved walkway, with a culvert functioning as the spillway between the pond and the tidal marsh. An additional paved embankment spur extends south from the main crossing. A second fill area extends into the tidal marsh from the Lower Muddy Hollow trail approximately 300 feet west of the pond embankment. All of these built features currently represent visual intrusions into a largely natural viewshed.

Alternatives 1 would entail replacing the existing embankment crossing with a bridge constructed of weathered steel and timber, and removal of the second fill area to the west. During construction, the presence of heavy equipment and the disruption associated with dewatering, earthwork, and bridge construction would degrade the visual character of the immediate site vicinity. However, this effect would be temporary (limited to the construction window). In addition, the number of visitors to the area would probably decrease substantially during construction because of limited access, so a reduced number of visitors would experience the degraded views during construction. Consequently, visual disruption would be temporary, resulting in short term minor effects.

Following the completion of bridge construction, restoration of hydrologic connectivity would allow the marsh system to readjust to a more natural, fully functional configuration so that over the long term channel and marsh plain conditions would more closely resemble the area's historic geomorphology. Over time, natural recruitment would revegetate the marsh plain with an appropriate balance of vegetation. In addition, the spoils management area adjacent to the Muddy Hollow Trail would be contoured to a natural appearance and revegetated. This would result in an improved appearance by comparison with the present disturbed hillside, where the scar from past borrow activities is currently evident.

The bridge structure itself would represent an unnatural feature and would be slightly higher than the existing embankment, but the increase in height would be minimal. Because the bridge

framework would have less visual massing than the solid embankment, and its coloration should fit in with surrounding colors, is not expected to have an adverse effect on the viewshed. Most people would find the bridge a more attractive approach to the beach than the existing embankment, providing a more substantial gateway to Limantour Beach and a visual reminder of the restoration of tidal process occurring directly beneath the structure. In the long-term, this would represent a beneficial effect on visual resources.

Muddy Hollow

As at Limantour Beach Marsh, views of the Muddy Hollow site are dominated by natural features, with the exception of the dam embankment and the Muddy Hollow and Estero Trail alignments. The dam embankment is heavily vegetated and blends with the surrounding landscape but is still an evident nonnatural feature. In addition, although Muddy Hollow Pond is attractive and has a quasi-natural appearance, it is not a natural feature of the landscape and appears out of place in what is topographically/geomorphically the upper portion of an estuary system. Alternative 1 would result in the removal of the existing Muddy Hollow dam, eliminating the impoundment upstream of the dam site and reestablishing throughgoing streamflow and tidal exchange.

As discussed above for Limantour Beach Marsh, the presence of heavy equipment during construction, and the disruption associated with dam removal, would degrade the visual character of the immediate site vicinity. However, as at Limantour Beach, this effect would be temporary (limited to the construction window), and the number of visitors to the area would decrease during construction because of limited access, so a reduced number of visitors would experience the degraded views during construction. Consequently, this effect is considered minor adverse in the short-term, but no mitigation is required.

Immediately following dam removal, the drained pond area would likely be less attractive than the existing impoundment because of the blanket of sediment expected to cover what is now the pond bottom, and the absence of terrestrial vegetation in the area now below the waterline. However, this effect would begin to repair itself as vegetation establishes in the first wet season after the dam is removed. The former pond site would become increasingly attractive and natural in appearance in subsequent years, as channelform evolves toward a more functional configuration and vegetation (and wildlife use) become increasingly established. In the first few months or years after dam removal, some visitors may experience the site's altered visual character as a minor effect on their enjoyment of the Muddy Hollow and Estero Trails.

Over the long term, key visual effects of Alternative 1 would include the removal of an intrusive built element (the dam) from the Muddy Hollow viewshed and restoration of stream/tidal marsh geomorphology and vegetation patterns more closely resembling the area's historic condition. This is considered a beneficial effect.

Glenbrook Crossing

Like Limantour Beach Marsh and Muddy Hollow, the Glenbrook Crossing viewshed is largely natural but is disrupted by the presence of an intrusive built feature (the embankment crossing) and by geomorphic and habitat alteration that has occurred as a result of interrupted stream process (the conspicuously aggraded reach and excessive riparian vegetation immediately upstream of the crossing). Alternative 1 would remove the existing crossing embankment and recontour the stream channel toward a more stable condition.

As at Limantour Beach Marsh and Muddy Hollow, the presence of heavy equipment during construction, and the disruption associated with dam removal, would degrade the visual character of the immediate site vicinity. However, as at the other sites, this effect would be temporary (limited to the construction window). Moreover, the number of visitors to the Glenbrook Crossing site is much smaller than at the other two sites because the site is more remote, and visitor usage would be minimized or eliminated by trail closure; consequently, the number of visitors affected

by construction-related changes in the site's appearance would be very small. This effect is considered minor, and no mitigation is required.

Immediately following construction, the spoils management area would be contoured to a natural appearance and revegetated. This would result in a greatly improved appearance by comparison with the present disturbed hillside. The improvement would likely be apparent within the first wet season following construction, and is considered a beneficial effect.

As at Muddy Hollow, the Glenbrook Crossing site would continue to appear somewhat disturbed during the months following removal of the crossing and recontouring of the channel. However, this effect would begin to repair itself with remobilization/redistribution of sediment in the channel during the first wet season after construction (see related discussion in *Hydrology, Hydraulics, and Water Quality* below). The site's appearance would continue to improve in subsequent seasons, with continued evolution of the channel toward full natural function, and progressive reestablishment of riparian vegetation. During the first few months or years after restoration, some visitors may experience the site's altered appearance as an adverse effect, but the number of people affected would be small and the duration would be temporary, so this effect is considered minor.

Over the long term, key visual effects of Alternative 1 would include the removal of an intrusive built element (the crossing embankment) from the Glenbrook Crossing viewshed and restoration of stream geomorphology and riparian vegetation patterns more closely resembling the area's historic condition. This is considered a beneficial effect.

Effects Related to Light and Glare

The following discussion focuses on glare effects, because the proposed activities would introduce no short- or long-term sources of additional light at any of the project sites.

Limantour Beach Marsh

During construction at Limantour Beach Marsh, the presence of heavy construction equipment would introduce a small amount of additional glare generated by reflective metal and glass surfaces into the vicinity of the site. However, because the increase in glare would be comparatively small and would be of short duration (limited to the active construction window), this effect is considered negligible and no mitigation is required.

Following construction, the new bridge structure may slightly increase glare in the project vicinity. However, because the bridge would be constructed of weathered steel and treated timber, it would be minimally reflective, and no adverse effect on visitors' experience of the site is expected. No mitigation is required.

Muddy Hollow

As at Limantour Beach Marsh, the presence of construction equipment and materials at Muddy Hollow would introduce a small amount of additional glare into the vicinity of the site. However, because the increase in glare would be comparatively small and would be of short duration (limited to the active construction window), this effect is considered negligible and no mitigation is required.

Over the long term, glare at Muddy Hollow is likely to decrease, because the impounded water upstream of the dam site would no longer be present. This is considered a beneficial effect. No mitigation is required.

Glenbrook Crossing

As described for the other two sites, the presence of construction equipment and materials at Glenbrook Crossing would introduce a small amount of additional glare into the vicinity of the site. However, the increase in glare would be comparatively small and would be of short duration

(limited to the active construction window). In addition, because of trail closures, the number of people affected would be minimal. This effect is considered negligible and no mitigation is required.

No long-term effect on glare is anticipated at Glenbrook Crossing.

Alternative 1 Contribution to Cumulative Effects on Visual Resources

To the extent that construction periods overlap, the actions listed in Table 4-1 could result in a cumulative effect on visual resources in the Drake's Bay/Drake's Estero watershed. The actions most likely to be constructed during overlapping periods are the Drake's Estero Road Crossing Improvements and potentially the Glenbrook Dam and Quarry Restoration Project, together with the proposed action. These actions would require earthwork, and the associated disruption would represent a net adverse effect on visual resources. However, the construction windows would be fairly short, and visitor access to all sites would be restricted during construction, so the detriment would be limited in duration and would be observed by a greatly reduced number of visitors. Consequently, cumulative short-term effects on visual resources are considered minor. The contribution of Alternative 1 to this net effect, while adverse, would be minor because the construction window would be short and visitors would be largely unable to access the sites during active construction.

Over the long term, the actions listed in Table 4-1 would contribute to visual improvements in the Drake's Bay/Drake's Estero watershed, by removing intrusive built elements from the viewscape and restoring natural habitats and processes. Long-term cumulative effects on visual resources are expected to be highly beneficial, and under Alternative 1, the proposed action would be an important contributor to this net benefit.

Alternative 1 Conclusion on project Visual Resource effects

Under Alternative 1, short-term adverse minor impacts to visual resources would occur as a result of construction activities. The installation of signs describing the restoration activities and intent, as well as distribution of flyers and education at the Visitors Centers would mitigate some of these impacts. With these outreach activities in place, the long-term impacts would be beneficial as visitors are educated about restoration and natural process. Interpretation of the restoration activities and the ecological recovery is a unique education opportunity for visitors.

Alternative 1 would not result in impairment to park visual resources.

Table 4.3 Alternative 1: Overall Effects on Visual Resources

Sites	Resources	Type and intensity of short term effect	Type and intensity of long-term effect
Limantour Beach Pond	Aesthetic effects	Minor adverse *	Beneficial
	Light and Glare	Negligible adverse	No effect
Muddy Hollow Pond	Aesthetic effects	Minor adverse *	Beneficial
	Light and Glare	Negligible adverse	No effect
Glenbrook Crossing	Aesthetic effects	Minor adverse *	Beneficial
	Light and Glare	Negligible adverse	No effect
All Sites	Cumulative	Minor adverse	Beneficial

*mitigation through interpretive description of restoration

Alternative 2: Partial-Build Approach (Preferred Alternative at Glenbrook Crossing)

Aesthetic Effects

Limantour Beach Marsh

Short- and long-term effects of Alternative 2 on visual resources at Limantour Beach Marsh are expected to be very similar to those described above for Alternative 1. As with Alternative 1, construction effects would be temporary and minor. Long-term effects are expected to be beneficial because Alternative 2 would result in restoration of natural hydrology/geomorphology and vegetation, and would replace the unattractive embankment crossing with a more attractive boardwalk structure.

Muddy Hollow

Effects of Alternative 2 on visual resources at Muddy Hollow would be similar to those described above for Alternative 1. Under Alternative 2, however, construction-related effects would be greater because construction would occur in phases over a period of years. Correspondingly, the transition to the final naturalized condition would be more protracted, with built elements (the dam and temporary low-level outlet) remaining in place for a longer period; but, as with Alternative 1, any adverse effect on visitors' visual experience of the area could likely be offset by providing information signage to explain the restoration project and the changes taking place. Long-term visual effects would be beneficial under Alternative 2, as under Alternative 1.

Glenbrook Crossing

Short- and long-term effects of Alternative 2 on visual resources at Glenbrook Crossing would be similar to those described above for Alternative 1. As with Alternative 1, construction effects would be temporary and minimal. The transition to the final visually improved condition could be more protracted under Alternative 2 than Alternative 1, because less channel regrading would be accomplished during construction. However, long-term effects are expected to be beneficial because Alternative 2 would remove the intrusive embankment structure and facilitate readjustment of the unnaturally aggraded area upstream of the crossing site. In addition, existing mature riparian vegetation would remain in place upstream of the crossing site under Alternative 2.

Effects Related to Light and Glare

Alternative 2 would not introduce any short- or long-term sources of additional light at any of the project sites. Effects related to glare would be very similar at all three sites to those described above for Alternative 1, except that the duration of temporary, construction-related effects would differ slightly because of the slight difference in construction windows; this effect would be most marked at Muddy Hollow, where construction under Alternative 2 would be phased over 2 (non-consecutive) years. No long-term adverse effect related to increased glare is expected.

Alternative 2 Contribution to Cumulative Effects on Visual Resources

Under Alternative 2, the proposed action's contributions to short- and long-term cumulative impacts in the Drake's Bay/Drake's Estero watershed would essentially the same as those identified for Alternative 1. The only short-term difference would be that the construction window would last for more than one season at Muddy Hollow, resulting in a more protracted contribution to visual disruption. However, effects would still be minor because of the limited area affected. The principal long-term difference would be the presence of a boardwalk rather that a bridge following construction at Limantour Beach Marsh. This would not materially alter the proposed action's contribution to net long-term benefits.

Alternative 2 Conclusion on project Visual Resource effects

Actions under Alternative 2 would be extended over a period of two years. This alternative would result in short-term adverse minor impacts to visual resources would occur as a result of construction activities in both construction years. The installation of signs describing the

restoration activities and intent, as well as distribution of flyers and education at the Visitors Centers would mitigate some of these impacts. With these outreach activities in place, the long-term impacts would still be beneficial as visitors are educated about restoration and natural process. Interpretation of the restoration activities and the ecological recovery is a unique education opportunity for visitors.

Alternative 2 would not result in impairment to park visual resources.

Table 4.4 Alternative 2: Overall Effects on Visual Resources

Sites	Resources	Type and intensity of short term effect	Type and intensity of long-term effect
Limantour Beach Pond	Aesthetic effects	Minor adverse *	Beneficial
	Light and Glare	Negligible adverse	No effect
Muddy Hollow Pond	Aesthetic effects	Minor adverse *	Beneficial
	Light and Glare	Negligible adverse	No effect
Glenbrook Crossing	Aesthetic effects	Minor adverse *	Beneficial
	Light and Glare	Negligible adverse	No effect
All Sites	Cumulative	Minor adverse	Beneficial

*mitigation through interpretive description of restoration

Alternative 3: No Action

Under the No Action Alternative, no restoration would take place and existing management practices would continue. The sites would continue in their current condition, with intrusive built elements and degraded or altered habitats remaining in place, and **no effect** on visual character or light and glare is anticipated.

In the long-term, potential catastrophic failure, and resulting scar could result in minor impacts to visual resources.

Cumulative Effects on Visual Resources

Because it would not alter the existing visual character of the Drake's Bay/Drake's Estero watershed, the No Action Alternative would not contribute to cumulative effects on visual resources.

In the long-term, potential catastrophic failure, and resulting scar could result in minor impacts to visual resources.

Conclusion on project Visual Resource effects

Under Alternative 3, no effects to visual resources would occur as a result of direct park actions. In the long-term, ongoing maintenance activities would result in negligible adverse effects to visual resources. No additional outreach and education opportunities would be available to park visitors.

Alternative 3 would not result in impairment to park visual resources.

Table 4.5 Alternative 3: Overall Effects on Visual Resources

Sites	Resources	Type and intensity of short term effect	Type and intensity of long-term effect
All sites	Visual Resources	No effect	Minor adverse
	Cumulative	No effect	Minor adverse

Effects on Wilderness

Policies and Regulations

The Wilderness Act of 1964 (P.L. 88-577 established a National Wilderness Preservation System, allowing Congress to designate wilderness areas for preservation and protection of their natural condition. "The areas shall be administered… in such a manner as will leave them unimpaired for future use and enjoyment as wilderness." Wilderness is defined in the act as "an area where the earth and community of life are untrammelled by man, where man himself is a visitor who does not remain." The Glenbrook Crossing project area, and the trail reroute associated with the Muddy Hollow Pond site are within the Philip Burton Wilderness.

NPS management policies (National Park Service 2000) include a chapter on Wilderness Preservation and Management and outlines a process for conducting compliance and evaluation of impacts associated with activities and equipment within the Wilderness.

Enabling legislation of the Seashore includes language that acknowledges the alterations to the landscape and the need to include "… maximum protection, restoration, and preservation of the natural environment… (PL 94-544 1976)."

Assessment Methodology

The proposed action's likely effects on Wilderness resources were evaluated qualitatively, based on anticipated short- and long-term change in the character of the sites as a result of restoration activities and their potential to alter existing wilderness values.

The following specific questions were factored into the analysis, as required by the minimum requirement decision guide (See Appendix B).

Table 4-6 summarizes the descriptors used to evaluate effects on Wilderness resources.

Table 4-6. Descriptors for Wilderness Effects

Type of Effect	Beneficial—Actions would maintain, support or protect wilderness character. This may include promotion of natural process or naturalness to enhance ecological sustainability in the Wilderness area.
	Adverse—Actions would degrade wilderness resource values, through reduction of wildness in the designated wilderness areas.
Duration of Effect	Short-term—Effects of the actions would result in visible Wilderness effects for less than two years.
	Long-term—Effects would persist beyond two years following the completion of construction.
Intensity of Effect	Negligible—Effects would be localized and limited to a confined area.
	Minor—Effects would be slight and/or the area affected would be small. The proposed action would have a limited effect on the wilderness character, naturalness, and natural function of the area.
	Moderate—Effects would be more noticeable and a greater proportion of the project site(s) and surrounding area would be affected. Wilderness character would be noticeably degraded, with a loss of wildness and naturalness.
	Major—Effects would be extremely conspicuous and a large proportion of the project area would be affected. Wilderness values and character would be permanently and substantially degraded.

Evaluation of Impacts

Alternative 1: Full-Build Approach (preferred alternative at Limantour Beach Marsh and Muddy Hollow)

Limantour Beach Marsh

Limantour Beach Marsh project area is not within the Philip Burton Wilderness

Muddy Hollow

The Muddy Hollow Pond is within the Environmental Protection—Natural Environment. The tidal areas below the Muddy Hollow dam are within the Estero de Limantour Environmental Protection—Reserves management sub-zone. The Estero trail reroutes associated with this project site would be included in the Environmental Protection—Wilderness and Natural Environment sub-zones. Only the trail reroute portion of the Muddy Hollow project is within the Philip Burton Wilderness.

The trail reroute would take advantage of existing slopes to construct a trail that would be sustainable in the long-term. Many trails in the park are adapted from old roadbeds and are problematic to maintain. Where new routes are installed, the construction techniques and scale are designed to allow for better trail maintenance in the long-term.

The proposed method of installing the trail reroute is through the use of a specialized trail building machinery. The use of this machinery would create a trail that would, in the long-term, be sustainable and could be maintained through the employment of hand crews. In this area of highly erodible soils, heavy trail use, and aggressive vegetation growth, creation of a sustainable trail tread at appropriate grades is desireable, and best achived using specially designed equipment.

Currently, trails within these areas are former roads. The scale and condition requires use of mechanized equipment to maintain water bars and drainage devices along the most problematic sections. The use of mechanized equipment to create a sustainable trail would result in minor short-term adverse effects on wilderness, but in the long-term, the sustainable trail would reduce the need for mechanized equipment to actually maintain the facility. The long-term effect of this trail reroute on wilderness resources and values is considered beneficial.

Glenbrook Crossing

Glenbrook Crossing and the associated trail reroute are located approximately one mile into the Wilderness area from the proposed access at Upper Muddy Hollow parking area. The intent of actions at this location are to remove a non-conforming structure from the Wilderness and restore natural hydrologic process to Glenbrook Creek.

The construction activities are estimated to take three weeks, requiring daily access to the site and work at the site. The contractor would be required to stage at the parking area and run a shuttle between the access and the site to minimize trips between the sites.

The deconstruction activities themselves would require large-scale operations for the duration of the construction period. During this time, the Wilderness values would be effected and short-term impacts are considered moderate in this localized area. In the long-term, the removal of a non-conforming structure and restoration of natural hydrologic process in a planned manner, would be beneficial to Wilderness values and resources.

At the Glenbrook site, there is a 15-foot vertical elevation difference in the bed of the creek at the road crossing location. Restoration planning has identified a 2% grade as providing stability in the channel. Under Alternative 1, the restoration would include excavation of a 30-foot wide corridor at a 2% grade upstream approximately 600 feet until it intersects with the existing channel and floodplain. Fill would be placed downstream, approximately 850 feet, with constructed woody

debris/boulder structures installed at or below grade to reduce potential downcutting and to provide structure in the newly created channel bed.

Alternative 1 would result in the removal of the well-established riparian corridor upstream of the crossing and would depend on engineered grades to provide stability in the channel. This alternative has been identified to minimize sediment erosion and transport from the site as a result of the proposed construction activities. The level of construction effort and manipulation is extensive and would result in localized short-term moderate adverse impacts to the wilderness values in this area.

Currently, a visitor on the trail does not necessarily realize the scale or effect of the former road facility on the creek or natural process. These actions, though extensive, would create opportunities to educate the public about wilderness, non-conforming structures, restoration, and protection. The construction activities would be a visible action that would prompt visitor interest and allow for dissemination of this information.

The trail reroute would be located upstream of the existing crossing, and would take advantage of existing slopes to construct a trail that would be sustainable in the long-term. Many trails in the park are adapted from old roadbeds and are problematic to maintain. Where new routes are installed, the construction techniques and scale are designed to allow for better trail maintenance in the long-term.

The use of this machinery would create a trail that would, in the long-term, be sustainable and could be maintained through the employment of hand crews. In this area of highly erodible soils, heavy trail use, and aggressive vegetation growth, creation of a sustainable trail tread at appropriate grades is desireable, and best achived using specially designed equipment.

Currently, trails within these areas are former roads. The scale and condition requires use of mechanized equipment to maintain water bars and drainage devices along the most problematic sections. The use of mechanized equipment to create a sustainable trail would result in minor short-term adverse effects on wilderness, but in the long-term, the sustainable trail would reduce the need for mechanized equipment to actually maintain the facility. The long-term effect of this trail reroute on wilderness resources and values is considered beneficial.

Alternative 1 Contribution to Cumulative Effects on Wilderness Resources

Of the projects identified in Table 4-1, the Glenbrook Dam and Quarry Restoration Project and Fire Management Plan may also result in impacts to Wilderness. These effects would also be considered localized, and would be the result of restoration actions intended to remove non-conforming structures and restore natural process to the wilderness portions of the park.

While localized effects at particular sites would be more intense, the cumulative impacts on wilderness resources evaluated through this process are considered moderate in the short-term. In the long-term removal of non-conforming wilderness structures, creation of more sustainable trail corridors, and reintroduction or restoration of natural process is considered a long-term benefit to wilderness resources.

Alternative 1 Conclusion on project Wilderness effects

Under Alternative 1, localized short-term adverse impacts to wilderness resources are considered adverse moderate. In the long-term, the proposed actions would result in benefits to the wilderness by restoring natural process to a confined system. This would also provide for visitor recognition that structures are not consistent with wilderness. Interpretation of the restoration activities and the ecological recovery is a unique education opportunity for visitors.

Alternative 1 would not result in impairment to park wilderness resources.

Table 4.7 Alternative 1: Overall Effects on Wilderness Resources

Sites	Resources	Type and intensity of short term effect	Type and intensity of long-term effect
Limantour Beach Pond	Wilderness	Not applicable	Not applicable
Muddy Hollow Pond*	Wilderness	Minor adverse*	Beneficial
Glenbrook Crossing	Wilderness	Moderate adverse	Beneficial
All Sites	Cumulative	Moderate adverse	Beneficial

*Trail reroute only –pond area is not in the Wilderness

Alternative 2: Partial-Build Approach (Preferred Alternative at Glenbrook Crossing)

Limantour Beach Marsh

Limantour Beach Marsh project area is not within the Philip Burton Wilderness

Muddy Hollow

At this project site, potential impacts under Alternative 2 are the same as those evaluated on the trail reroute described under Alternative 1 above. This includes minor adverse impacts in the short-term associated with trail construction techniques, but beneficial long-term impacts related to a more sustainable and properly built trail.

Glenbrook Crossing

Glenbrook Crossing and the associated trail reroute are located approximately one mile into the Wilderness area from the proposed access at Upper Muddy Hollow parking area. The intent of actions at this location are to remove a non-conforming structure from the Wilderness and restore natural hydrologic process to Glenbrook Creek.

The construction activities are estimated to take three weeks, requiring daily access to the site and work at the site. The contractor would be required to stage at the parking area and run a shuttle between the access and the site to minimize trips between the sites.

At the Glenbrook site, there is a 15-foot vertical elevation difference in the bed of the creek at the road crossing location. Under Alternative 2, the downstream reach would be treated in a similar manner as described in Alternative 1, though the extent of treatment may only extend 600 feet below the crossing, rather than 850 described in Alternative 1. The channel would be filled creating a 2-3% grade with constructed boulder/woody debris structures installed at or below grade to reduce potential downcutting and to provide structure in the newly created channel bed. Upstream, the restoration actions would include limited excavation upstream up to approximately 200 feet, as well as installation of two boulder/woody debris structures. The volumes excavated upstream would be balanced with the fill requirements necessary downstream.

This limited upstream excavation would reduce potential direct effects on existing riparian habitat and depend on this heavily vegetated area to provide some level of stability in the bed profile. Compared with Alternative 1, the work is less intrusive and depends on natural process to develop a level of stability. The tradeoff, however, is that the sediment transport levels would also be higher, as the system adjusts over time. The level of construction effort and manipulation is extensive, but is far less extensive than the approach described under Alternative 1. While the same equipment would be required, the duration of construction and extent of intrusion associated with construction activities are reduced from Alternative 1. In addition, Alternative 2 leaves much of the upstream riparian complex and allows for the channel to more completely evolve through natural dynamic processes. When considering these treatments and minimization of impacts where possible, the short-term impacts are considered minor at this site. In the long-term, the removal of non-conforming structure and restoration of natural process is considered beneficial.

Currently, a visitor on the trail does not necessarily realize the scale or effect of the former road facility on the creek or natural process. These actions, though extensive, would create opportunities to educate the public about wilderness, non-conforming structures, restoration, and protection. The construction activities would be a visible action that would prompt visitor interest and allow for dissemination of this information.

The trail reroute actions would be the same as those described under Alternative 1, above.

Alternative 2 Contribution to Cumulative Effects on Wilderness Resources

Cumulative effects on Wilderness resources are considered to be the same as those described in Alternative 1. While localized effects at particular sites would be intense, the cumulative impacts on wilderness resources evaluated through this process are considered minor in the short-term. In the long-term removal of non-conforming wilderness structures, and creation of more sustainable trail corridors is considered beneficial to wilderness resources.

Alternative 2 Conclusion on project Wilderness effects

Under Alternative 2, localized short-term adverse impacts to wilderness resources are considered adverse minor. In the long-term, the proposed actions would result in benefits to the wilderness by restoring natural process to a confined system. This would also provide for visitor recognition that structures are not consistent with wilderness. Interpretation of the restoration activities and the ecological recovery is a unique education opportunity for visitors.

Alternative 2 would not result in impairment to park wilderness resources.

Table 4.8 Alternative 2: Overall Effects on Wilderness Resources

Sites	Resources	Type and intensity of short term effect	Type and intensity of long-term effect
Limantour Beach Pond	Wilderness	Not applicable	Not applicable
Muddy Hollow Pond *	Wilderness	Minor adverse*	Beneficial
Glenbrook Crossing	Wilderness	Minor adverse	Beneficial
All Sites	Cumulative	Minor adverse	Beneficial

* Trail reroute only –pond area is not in the Wilderness

Alternative 3: No Action

Under the No Action Alternative, no restoration would take place and these facilities would remain. There would not be effects to wilderness at the Limantour site. Existing trails associated with the Muddy Hollow and Glenbrook project sites require extensive maintenance sometimes requiring mechanized equipment. Under no action, the existing status would continue resulting in minor adverse effects to wilderness associated with ongoing trail maintenance requirements.

At Glenbrook, there is a high potential that the culvert and fill would fail catastrophically. Currently, water pipes around the culvert, and the last 20 feet of the culvert are eroded through, resulting in headcutting of the road embankment. This would result in immediate and extensive changes to the channel and corridor, with no accommodation for access around the site. While this could be perceived as "wildness", the catastrophic failure of a man-made structure within wilderness would be considered a moderate impact. With failure, there would no longer be an opportunity to effectively remove the facility while minimizing potential impacts to habitat and stream condition.

The other potential action that could occur at Glenbrook is the replacement of the existing culvert, thereby maintaining this non-conforming facility in the wilderness, which would also be considered an adverse impact.

It is likely the culvert and facility would remain at Glenbrook for the next two years, without maintenance. The short-term presence of a non-conforming structure is considered a minor adverse impact to Wilderness. In the long-term, however, there is a high likelihood that the culvert would fail catastrophically. This would result in localized moderate impacts in the long-term.

Cumulative Effects on Wilderness Resources

Because it would not alter the existing structures or condition of non-conforming structures within wilderness, within the Drake's Bay/Drake's Estero watershed, the No Action Alternative would maintain minor adverse cumulative effects on wilderness resources in the short-term. In the long-term, the potential catastrophic failure of the Glenbrook Crossing would result in localized effects at the site, but cumulatively would be considered minor adverse effects on Wilderness Resources.

Conclusion on project Wilderness Resource effects

Under Alternative 3, no direct effects to wilderness resources would occur as a result of direct park actions. However, the presence of non-conforming structures (at Glenbrook) and the maintenance requirements of the trails are considered minor adverse short-term impacts. In the long-term, catastrophic failure or maintenance activities to replace a culvert would result in localized moderate adverse effects at the Glenbrook site. No additional outreach and education opportunities would be available to park visitors.

Alternative 3 would not result in impairment to park wilderness resources.

Table 4.9 Alternative 3: Overall Effects on Wilderness Resources

Sites	Resources	Type and intensity of short term effect	Type and intensity of long-term effect
Limantour Beach Pond	Wilderness	Not applicable	Not applicable
Muddy Hollow Pond	Wilderness	No effect	No effect
Glenbrook Crossing	Wilderness	Minor adverse	Moderate adverse
All Sites	Cumulative	Minor adverse	Minor adverse

Effects on Air Quality

Policies and Regulations

Federal and State Guidance. Air quality is regulated under the federal and California Clean Air Acts and amendments. Pursuant to these regulations, the state and federal governments have established ambient air quality standards for 6 "criteria" pollutants: carbon monoxide, ozone, particulate matter of less than 10 microns in diameter, oxides of nitrogen, sulfur dioxide, and lead. Within the San Francisco Bay Area Air Basin, the BAAQMD ensures that these standards are not exceeded. The BAAQMD also issues permits for various activities that may affect air quality.

Air Quality Management at Point Reyes National Seashore. Scenic resources are extremely sensitive to air pollution. For example, even a very small amount of fine particulate matter can affect a viewer's ability to perceive colors, contrast, texture, and form of features, landmarks, and panoramas. Consequently, visual air quality is very important to park visitors.

PRNS is classified as a mandatory Class I area under the Federal Clean Air Act and its amendments. This classification requires the NPS to prevent significant deterioration of air quality as a result of park activities. The NPS is responsible for protecting the Seashore from impacts to ambient air quality and air quality related values, such as visibility and the protection of natural and cultural resources from the effects of contaminants.

Assessment Methods

Analysis of effects on air quality focused on construction, because "operation" of the restored sites (including monitoring, maintenance, and inspection visits by NPS staff) is not expected to result in substantial pollutant emissions or in a substantial change in emissions by comparison with current operations and maintenance practice.

This analysis was performed in accordance with guidelines published by the Bay Area Air Quality Management District (BAAQMD) (1999). Although construction vehicle exhaust represents a source of pollutants, its contribution to construction-related emissions is comparatively minor; the primary concern with regard to construction-related emissions is generation of fugitive dust, with a specific concern for inhalable particulate matter (PM10), which is associated with a variety of health effects; the BAAQMD does not require quantification of construction emissions if project proponents agree to implement specific, stipulated dust control measures. Accordingly, this analysis took a qualitative approach and prioritized the potential for PM10 generation.

Table 4-10 below summarizes the descriptors used to evaluate effects on air quality.

Table 4-10. Descriptors for Air Quality Effects

Type of Effect	Beneficial—The proposed action would improve or maintain air quality while lowering the potential for substantial pollutant releases.
	Adverse—The proposed action would result in degradation of current air quality or increase the potential for substantial pollutant releases.
Duration of Effect	Short-term—Effects on air quality last would persist no more than 3 days beyond the completion of construction.
	Long-term— Effects on air quality would persist more than 3 days beyond the completion of construction.
Intensity of Effect	Negligible—Dust and emissions would be barely perceptible or detectable, and would affect an undeveloped area with no recreational facilities or trails, no habitable structures, etc.
	Minor—Dust and emissions would be detectable but would be localized within an area of low-density development, would be of short duration (several hours or less), and would have no lasting effects.
	Moderate—Dust and emissions would be readily perceptible but would be localized in an area of low-density development, would limit use of the area for no more than 1 day, and would result in no damage to property or other lasting effect.
	Major—Dust and emissions would be readily noticeable, would occur in a developed area resulting in a potential hazard to human health and/or potential for property damage or other lasting effect.

Evaluation of Impacts

Build Alternatives, All Sites

Restoration activities, including earthwork at all three sites, construction of a new bridge or boardwalk at Limantour Beach Marsh, and channel recontouring at Glenbrook crossing, have the potential to temporarily increase pollutant emissions under both Alternative 1 and Alternative 2. As discussed in the *Methodology* section above, the key concern in this regard is the potential for increased generation of fugitive dust (PM10). To address the potential for increased PM10 generation, NPS has committed to requiring the construction contractor(s) selected for project implementation to implement dust control measures consistent with the current guidelines of the

BAAQMD. These measures are described under *Environmental Commitments* in Chapter 2. As the federal land manager, NPS would be responsible for inspections and visual monitoring to ensure effective implementation of these measures. With these commitments in place, and monitoring and corrective action provided by the NPS, effects on air quality as a result of construction activities are expected to be minor short-term and adverse, and no mitigation is required. No long-term effects are anticipated as a result of this project.

Cumulative Effects—Build Alternatives

To the extent that construction periods overlap, the actions listed in Table 4-1 could result in a cumulative effect on air quality in the Drake's Bay/Drake's Estero watershed and downwind portions of the SFBAAB. The actions most likely to overlap are the Drake's Estero Road Crossing Improvements, and the Glenbrook Dam and Quarry Restoration Project, together with the proposed action. These actions would require earthwork, and would have the potential to increase emissions of fugitive dust as well as adding tailpipe emissions from earthwork equipment. Fire planning is tied directly to the air quality issues, and would be subject to existing conditions at the time an actual burn was approved and implemented. PM10 and ozone precursors (ROG, NO_x) are the greatest concern, because of the SFBAAB's nonattainment status for these criteria pollutants.

The duration of construction actions identified as potentially overlapping would be comparatively short, and the number of pieces of equipment and volume of earthwork required would be small. Thus, the cumulative volume of pollutants generated during overlapping construction windows would be small, and is expected to disperse rapidly as it is transported downwind; the likelihood of measurable contributions to exceedance is considered very small. Moreover, NPS would require contractors to adhere to the BAAQMD's Feasible Control Measures for PM10 and to ensure that earthwork equipment is properly tuned and meets applicable emissions standards. Because of the limited area affected, the BMPs in place to control PM10 and tailpipe emissions, and the relatively short construction window, which further limits the proposed action's potential to generate pollutants, the proposed action's contribution to any cumulative effect is expected to be adverse short-term minor effects under either build alternative.

No cumulative long-term effect on air quality in the Drake's Bay/Drake's Estero watershed and adjacent downwind portions of the SFBAAB has been identified. The listed actions are not expected to substantially change patterns of vehicle use in the area.

Conclusion for action effect on Air Resources

Under both action alternatives, production of emissions and associated dust would be similar. NPS would require contractors to adhere to the BAAQMD's Feasible Control Measures for PM10 and to ensure that earthwork equipment is properly tuned and meets applicable emissions standards. The analysis concludes that Alternative 1 and Alternative 2 would result in short-term minor adverse impacts to air quality. The project would not result in long-term effects to air resources.

Alternative 1 or Alternative 2 would not result in impairment to park air resources.

Table 4.11 Alternatives 1 and 2: Overall Effects on Air Quality under Build Alternatives

Sites	Resources	Type and intensity of short term effect	Type and intensity of long-term effect
All sites	Air Quality	Adverse minor	No effect
	Cumulative	Adverse minor	No effect

Alternative 3: No Action

Under the No Action Alternative, no restoration would take place and existing management practices would continue. No change in conditions or practices relevant to air quality is expected under the No Action Alternative. There would be no effect.

Contribution to Cumulative Effects

Because it would not alter conditions or practices relevant to air quality, the No Action Alternative would not contribute to cumulative air quality effects.

Conclusion for Air Resources

Under Alternative 3, no construction emissions or dust generation would take place as a result of direct actions. Alternative 3 would result in no effect to park air resources.

Alternative 3 would not result in impairment to park air resources.

Table 4.12 Alternative 3: Overall Effects on Air Quality

Sites	Resources	Type and intensity of short term effect	Type and intensity of long-term effect
All sites	Air Quality	No effect	No effect
	Cumulative	No effect	No effect

Effects Related to Geology, Geologic Hazards, and Soils

Policies and Regulations

Federal Guidance. As directed by NPS Management Policies, soil resources are subject to the "no impairment" clause that guides NPS decision-making to protect of the integrity of the important resources and values within the parks (NPS 2000, §1.4.6). The NPS is directed to protect geologic features from the adverse effects of human activity, while allowing natural processes to continue (NPS 2000, §4.1.5 and §4.8.2). Management action taken by the parks would prevent to the greatest extent possible the unnatural erosion, physical removal, contamination, and other potentially irreversible impacts to soil (NPS 2000, §4.8.2.4).

Hydric soils, associated with wetland features such as bogs, marshes, and some wetlands, are afforded special protection by Executive Order 11990, Protection of Wetlands and the Clean Water Act § 404 as regulated by the U.S. Army Corps of Engineers, and the State Regional Water Quality Control Board. Specific procedural guidance to NPS staff on the protection of wetlands and areas of hydric soils is outlined in Director's Order #77-1, Wetland Protection. Assessment of potential impacts to hydric soils is addressed as a wetland impact in this document.

Within many areas of the park, the soil resources have been heavily manipulated through previous land uses including gravel extraction, road construction, grading, plowing, grazing, logging, etc. The soil resources in impacted areas have been previously disturbed. Activities conducted within these previously disturbed areas cannot restore natural soil horizon patterns, but can restore natural grades and improve the potential redevelopment of organic surface soils through actions such as topsoiling or revegetation.

As the project areas fall within the California Coastal Zone, defined as lands within one mile of the California Coast, PRNS will be seeking a consistency review and possibly a county coastal permit pursuant to the California Coastal Act.

Assessment Methods

Effects related to geology, geologic hazards, and soils were evaluated qualitatively, based on professional judgment in light of available information on the geology of the restoration sites and the surrounding area. No geologic mapping, engineering geologic studies, or engineering analyses were conducted for this EA; they would be completed as part of the final design process.

The principal concerns in analyzing effects related to geology, geologic hazards, and soils center on the potential for a proposed action to create or increase the risk to life and property as a result of existing geologic conditions, including seismic hazards. Because the proposed action would not result in the construction of any structures intended for human occupancy, this analysis focused on the potential for damage to restoration facilities, and the potential for restoration activities, including earthwork, to exacerbate existing risks, such as slope failure hazard and liquefaction hazard.

Table 4-13 summarizes the descriptors used to evaluate effects related to geology, geologic hazards, and soils.

Table 4-13. Descriptors for Geology, Geologic Hazards, and Soils Effects

Type of Effect	Beneficial—The proposed action would improve or maintain existing conditions with regard to geologic hazards to life and property.
	Adverse—The proposed action would increase risks to life or property related to geologic hazards such as seismicity and slope instability.
Duration of Effect	Short-term—Effects would be confined to the construction period.
	Long-term—Effects would persist beyond the construction period.
Intensity of Effect	Negligible—Risk to safety and property would not be measurably increased.
	Minor—Risks to safety and property would increase slightly, but the number of persons potentially affected would be very small, and the financial risk would be small and easily recoupable.
	Moderate—Risks to safety and property would be markedly increased. A larger number of persons would potentially be affected, and/or the financial risk would be greater.
	Major—Risks to safety and property would be substantially increased. A large number of persons would potentially be affected, and/or there would be substantial financial risk, with losses difficult to recoup without adverse economic effects.

Evaluation of Impacts

Alternative 1: Full-Build Approach (preferred alternative at Limantour Beach Marsh and Muddy Hollow)

All sites

Geology

At each of the sites, the materials are mapped as Quarternary alluvium. There is no bedrock at the surface, and actions proposed under Alternative 1 would result in minor impacts. The construction of dams has altered the natural sediment transport and depositional processes affecting the overall geologic conditions within these project areas.

The replacement of fill back to quarried areas would restore topographic characteristics of the area, though the layering would remain permanently disturbed. At all sites, the proposed actions

would result in minor adverse effects to geology in the short-term, but in the long-term restoration of more natural processes is considered a beneficial effect on geology and geologic process.

Surface Fault Rupture and Groundshaking

No faults recognized as active by the State of California traverse any of the restoration sites. Consequently, neither the new bridge proposed for Limantour Beach Marsh nor the restored geomorphology at Muddy Hollow and Glenbrook Crossing is expected to be subject to surface fault rupture. However, the restoration sites are located in a seismically active area, in proximity to several important active faults, and are thus likely to experience strong groundshaking during the lifetime of the proposed action.

Under Alternative 1, the only structure to be constructed is the proposed bridge at Limantour Beach Marsh. Geotechnical analyses of the site indicate bedrock at approximately 20 feet below ground surface, so footings would not likely be effected by liquifaction, and remain stable. This risk cannot be entirely avoided, but would be reduced by ensuring that design and construction of the new bridge meet or exceed the requirements of all applicable codes. The risk of damage and corollary financial loss would be further reduced by retaining a qualified engineering consultant to ensure that design and construction are appropriate for the ground accelerations anticipated with the maximum credible earthquake on nearby active faults. At other sites, deconstruction is indented to remove the facility, thereby reducing risk of failure under such a scenario. The environmental commitments incorporated into the project (see Chapter 2) are thus expected to minimize risks related to groundshaking to the extent feasible. Potential effects are expected to be minor, and no mitigation is required.

Seismically Induced Liquefaction

Because few site-specific data are available at this time, it is difficult to assess the risk of seismically induced liquefaction and other types of seismic ground failure at the restoration sites. However, based on general understanding of site conditions, liquefaction is a possibility at both the Limantour Beach Marsh and Muddy Hollow sites, where well-sorted unconsolidated sands are likely present in the subsurface and the water table is shallow. Initial results of geotechnical analysis indicate bedrock at a shallow level below Limantour Beach Pond making risk at this site low.

As with groundshaking, the principal concern with liquefaction and other types of seismic ground failure is the potential for damage to the proposed bridge at Limantour Beach Marsh; no permanent facilities would be constructed at the other sites under Alternative 1. To reduce the risk of damage and financial loss as a result of liquefaction, the design phase of Alternative 1 would include site-specific geotechnical investigations, with the goal of characterizing subsurface site conditions and supporting engineering design appropriate to minimize risks associated with seismically induced ground failure to the extent feasible (see description under *Environmental Commitments* in Chapter 2). This pertains to the bridge at Limantour Beach Marsh and to proposed earthworks at all sites.

Actions under alternative 1 would reduce the potential of seismically induced liquifaction through the removal of embankments effecting water storage capacity and elevation. The environmental commitments incorporated into the project (see Chapter 2) are thus expected to reduce risks related to groundshaking on the bridge structure to the extent feasible resulting in negligible long-term adverse effects.

Under Alternative 1 there is some potential at all three sites that liquefaction or other seismically induced ground failure could mobilize sediment, resulting in water quality degradation. The proposed action, including controlled deconstruction of existing unengineered earthen fill facilities retaining large volumes or sediment or water, would reduce the existing potential of catastrophic failure. A return to natural conditions is considered beneficial in the long-term.

Landslide Hazards

The risk of slope failure, including seismically induced landsliding, has not been assessed in detail for the restoration area. However, landsliding is a possibility at Muddy Hollow and Glenbrook Crossing, where steep slopes are located close to the restoration site. In addition, restoration at Glenbrook Crossing would entail the creation of quasi-natural floodplain terrace geomorphology, with flat benches separated by steeper risers. If improperly designed or constructed, the reconstructed terraces could be subject to localized failure. To ensure that project earthwork does not increase landslide hazard, the design phase of Alternative 1 would include site-specific geotechnical investigations that support appropriate design, and restoration earthwork would meet or exceed the applicable codes and standards (see *Environmental Commitments* in Chapter 2). In addition, to ensure that excavation, grading, and fill placement during construction do not create or contribute to slope failure hazard, NPS and the restoration contractor would ensure that work proceeds in accordance with accepted industry standards for good earthwork practices. Consequently, Alternative 1 is not expected to exacerbate existing landslide hazard. No mitigation is required.

As discussed in *Hydrology, Hydraulics, and Water Quality* below, the area's high-gradient drainages, such as Glenbrook Creek, are commonly subject to debris flows. The concern with regard to debris flows is that when they follow stream channels—as they did in Glenbrook Creek during the floods of January 1982—they can lead to rapid channel bed aggradation, potentially choking the channel and damaging structures, or contributing to channel migration, overtopping, and/or erosion, with corollary effects on slope process and water quality. Of the three restoration sites, Glenbrook Crossing is the most likely to be affected by debris flows. Alternative 1 would improve the conveyance capacity of the Glenbrook Creek channel and is thus expected to improve its ability to convey debris flows as well as dilute (water-dominated) floodflows. Moreover, debris flows are part of the natural landscape evolution process in the project area, as in much of coastal California. Restoring debris flow conveyance capacity and removing the culvert crossing that both impedes debris flow passage and is at risk of debris flow damage would represent a beneficial effect. No mitigation is required.

Soils

The soils at each of the sites would not preclude actions proposed under Alternative 1. Investigation of soil saturation and compaction requirements may result in the need to dry excavated soils prior to placement. Areas for drying would be included in the fill disposal sites and determinations would be made in the field at the time of construction as to the need to implement such actions. For the purpose of this planning process, such drying areas are described in the project description, and evaluated as part of this document. Soils at each site would not effect the potential for restoration at any of the sites. The restoration actions themselves, would result in short-term minor impacts to soils during and following construction. In the long-term, the recountouring and stabilization of sites is considered beneficial to park soil resources.

Alternative 1 Contribution to Cumulative Effects Related to Geology, Geologic Hazards and Soils

Negligible cumulative short-term adverse effects related to geology, geologic hazards, or soils in the Drake's Bay/Drake's Estero watershed would result in combination with other proposed projects identified in Table 4-1. In the long-term, removal of structures from Muddy Hollow and Glenbrook would reduce the potential of failure under evaluated risk factors. This is considered a long-term benefit related to geology, geologic hazard and soils.

Alternative 1 Conclusion on Effects Related to Geology, Geologic Hazards and Soils

Under alternative 1, structures are removed from Muddy Hollow and Glenbrook Crossing sites, reducing the potential of failure under evaluated risks factors. The resulting conditions, including the constructed bridge facility at the Limantour Marsh area would be designed with potential risk under consideration. Restoration of natural hydrologic and shoreline process would change

existing slope and local soil conditions, resulting in potential short-term negligible adverse effects. In the long-term, however, removal of existing unengineered earthen facilities would reduce site susceptibility to failure in association with geologic hazards. The long-term effect of actions proposed under Alternative 1 are considered beneficial.

Alternative 1 would not result in impairment of park geology, geologic hazards or soil resources.

Table 4.14 Alternative 1: Overall Effects on Geology, Geohazards, and Soils

Sites	Resources	Type and intensity of short term effect	Type and intensity of long-term effect
All sites	Geology	Minor adverse	Beneficial
	Geohazard	Minor adverse	Beneficial
	Soils	Minor adverse	No effect
	Cumulative	No effect	No effect

Alternative 2: Partial-Build Approach (Preferred Alternative at Glenbrook Crossing)

All Sites

Geology

Under Alternative 2, the effects to geology are considered the same as those evaluated under Alternative 1.

Surface Fault Rupture and Groundshaking

As with Alternative 1, the risk of damage to restoration facilities as a result of surface fault rupture is considered low under Alternative 2, because no faults recognized as active by the State of California traverse any of the restoration sites. However, because of the nature of boardwalk construction and pier depths, strong groundshaking is a concern, and could result in substantial damage to the proposed boardwalk at Limantour Beach Marsh. In addition, if an earthquake were to occur during the first year or two after Alternative 2 begins, while the Muddy Hollow reservoir is undergoing progressive dewatering, groundshaking could damage the low-level outlet and impede the implementation of the phased dewatering plan; if the outlet were severely damaged, or the new earthwork failed, the reservoir could drain rapidly, resulting in increased erosion and adverse water quality impacts in the tidal system.

As with Alternative 1, risks related to strong seismic groundshaking cannot be entirely avoided. However, they would be reduced by ensuring that design and construction of the new boardwalk, the temporary low-level outlet, and associated earthworks meet or exceed the requirements of applicable codes. As discussed for Alternative 1, the risk of seismic damage and corollary financial loss would be further reduced by retaining a qualified engineering consultant to ensure that design and construction are appropriate for the ground accelerations anticipated with the maximum credible earthquake on nearby active faults. Actions under alternative 1 would reduce the potential of seismically induced liquifaction through the removal of embankments effecting water storage capacity and elevation. As with Alternative 1, the environmental commitments incorporated into the project (see Chapter 2) are thus expected to reduce risks related to groundshaking to the extent feasible resulting in negligible long-term adverse effects.

Seismically Induced Liquefaction

As described above for Alternative 1, general understanding of site conditions suggests that while liquefaction may not be a strong possibility at both the Limantour Beach Marsh and Muddy Hollow sites, the installation of shallower piers associated with the boardwalk could become unstable under a large earthshaking scenario. Liquefaction is probably less likely at Glenbrook

Crossing, where shallow subsurface sediments are expected to be poorly sorted, but it may still be a concern.

As with groundshaking, the principal concern with liquefaction and other types of seismic ground failure is the potential for damage to the proposed boardwalk at Limantour Beach Marsh and the temporary low-level outlet at Muddy Hollow. As with Alternative 1, the design phase of Alternative 2 would include site-specific geotechnical investigations, with the goal of characterizing subsurface site conditions and supporting appropriate engineering design to reduce risks associated with seismically induced ground failure to the extent feasible (see *Environmental Commitments* section in Chapter 2). This pertains to the boardwalk at Limantour Beach Marsh, to the temporary low-level outlet at Muddy Hollow, and to proposed earthworks at all sites. Effects would be minor, and no mitigation is required.

As with Alternative 1, there is some potential at all three sites that liquefaction or other seismically induced ground failure could mobilize sediment, resulting in water quality degradation under Alternative 2. The proposed action, including controlled deconstruction of existing unengineered earthen fill facilities retaining large volumes or sediment or water, would reduce the existing potential of catastrophic failure. A return to natural conditions is considered a beneficial long-term effect.

Landslide Hazards

The potential landslide hazards affecting Alternative 2 are the same as those described under Alternative 1, above.

Soils

The potential effects of and to soils associated with Alternative 2 are the same as those described under Alternative 1, above.

Alternative 2 Contribution to Cumulative Effects Related to Geology, Geologic Hazards and Soils

Alternative 2 would result in negligible cumulative short-term adverse effects related to geology, geologic hazards, or soils in the Drake's Bay/Drake's Estero watershed would result in combination with other proposed projects identified in Table 4-1. In the long-term, removal of structures from Muddy Hollow and Glenbrook would reduce the potential of failure under evaluated risk factors. This is considered a long-term benefit related to geology, geologic hazard and soils.

Alternative 2 Conclusion on Effects Related to Geology, Geologic Hazards and Soils

Under Alternative 2, structures are removed from Muddy Hollow and Glenbrook Crossing sites, reducing the potential of failure under evaluated risks factors. The resulting conditions, including the constructed boardwalk at the Limantour Marsh area would be designed with potential risk under consideration. Restoration of natural hydrologic and shoreline process would change existing slope and local soil conditions, resulting in potential short-term negligible adverse effects. In the long-term, removal of existing unengineered earthen facilities would reduce site susceptibility to failure in association with geologic hazards. The long-term effect of actions proposed under alternative 2 are beneficial.

Alternative 2 would not result in impairment of park geology, geologic hazards or soil resources.

Table 4.15 Alternative 2: Overall Effects on Geology, Geohazards, and Soils

Sites	Resources	Type and intensity of short term effect	Type and intensity of long-term effect
All sites	Geology	Minor adverse	Beneficial

Geohazard	Minor adverse	Beneficial
Soils	Minor adverse	No effect
Cumulative	No effect	No effect

Alternative 3: No Action

All Sites

Under Alternative 3, no restoration would take place and existing management practices, including trail maintenance and removal of debris and trash from the culverts at Limantour Beach Marsh and Glenbrook Crossing would continue. Vegetation removal would also continue to be necessary to maintain the Muddy Hollow dam.

Because no construction or other new earthwork activities would take place under the No Action Alternative, it would not result in any impact related to soil conditions. Existing site hazards related to geology and seismicity would remain unchanged, including the following.

- Potential for earthquake damage to existing dam at Muddy Hollow, and corollary risk of increased erosion downstream of the dam if impounded water were released suddenly. Water quality could also be adversely affected, if sediment now trapped behind the dam were remobilized either during sudden dewatering or during subsequent storm events. The Muddy Hollow dam does not meet current applicable construction standards, and, as described in the *Public Health and Safety* section of Chapter 3, the U.S. Bureau of Reclamation has identified its condition as "seriously deficient."
- Potential for landslide and/or seismically induced landslide at Muddy Hollow and Glenbrook Crossing; corollary risk of adverse impacts on water quality as slide material is dissected and remobilized.
- The risk of catastrophic failure at the Glenbrook Crossing could result in debris flow impacts to the habitat downstream of the proposed project area.
- The existing Glenbrook crossing facility is subject to failure as a result of geologic hazard and could become the source of a debris flow as a result of structural failure under flood flow conditions.

Contribution to Cumulative Effects Related to Geology, Geologic Hazards, and Soils

As discussed above, no cumulative short-term effect related to geology, geologic hazards, or soils in the Drake's Bay/Drake's Estero watershed has been identified. The risk of failure as a result of any potential risk factor would remain higher under Alternative 3 than either of the action alternatives, and would result in minor adverse long-term effects related to geology, geologic hazard and soils and is considered minor in the long-term.

Alternative 3 Conclusion on Effects Related to Geology, Geologic Hazards and Soils

Under Alternative 3, existing unengineered structures would remain, pooling excessive water or sediment behind these aged facilities. Alternative 3 would not result in short term effects to existing slope and local soil conditions. In the long-term, however, the existing unengineered earthen facilities would remain susceptible to failure in association with geologic hazards. In the long-term, the risk of failure associated with no action would result in localized moderate adverse effects.

Alternative 3 would not result in impairment of park geology, geologic hazards or soil resources.

Table 4.16 Alternative 3: Overall Effects on Geology, Geohazards, and Soils

Sites	Resources	Type and intensity of short term effect	Type and intensity of long-term effect
All sites	Geology	No effect	Minor adverse
	Geohazard	No effect	Moderate adverse
	Soils	No effect	Moderate adverse
	Cumulative	No effect	Minor adverse

Effects on Hydrology, Hydraulics, and Water Quality

Policies and Regulations

Federal Guidance. The Clean Water Act is the primary federal law that protects the quality of the nation's surface waters. It operates on the principle that discharges into the nation's waters are unlawful unless specifically authorized by permit.

CWA § 404 regulates the discharge and fill of discharge and dredged materials into "waters of the United States" which include oceans, bays, rivers, streams, lakes, ponds, and some wetlands. Section 404 permits are granted only for the least environmentally damaging practicable alternative.

CWA § 402 regulates construction-related stormwater discharges to surface waters through the National Pollutant Discharge Elimination System NPDES program administered by the Environmental Protection Agency (EPA). The EPA delegates administration of the NPDES program to Regional Water Quality Control Boards (RWQCBs); PRNS is in the jurisdiction of the San Francisco Bay RWQCB. Most construction projects which will disturb more than one acre of land are required to apply to their RWQCB for a NPDES General Permit for Construction Activities. Applicants must file a public notice of intent to discharge stormwater, and prepare and implement a stormwater pollution prevention plan. This plan describes proposed activities and Best Management Practices to minimize pollutant discharge and soil erosion. Permitees are required to conduct annual monitoring and reporting to assure that Best Management Practices are correctly implemented and effective in controlling the discharge of stormwater-related pollutants.

CWA § 401 requires agencies, which obtain a federal permit to conduct discharge-producing activities, to also obtain a state certification for the activity. Section 401 certification for projects at PRNS fall under the jurisdiction of the San Francisco Bay Area RWQCB.

Under CWA § 303(d), the state of California has established water quality standards to protect the beneficial uses of state waters. This statute requires states to identify water bodies whose water quality is "impaired" or "limited" by the presence of pollutants or contaminants. The statute also requires the state to establish limits for discharge into water bodies which correspond with the maximum quantity of a particular contaminant that the water body can assimilate without experiencing water quality declines.

State Guidance. The California Porter-Cologne Water Quality Control Act created the State Water Resources Control Board and 9 RWQCBs to protect the state's surface water through implementation of the Federal CWA. In addition to assuring implementation of the CWA, the Porter-Cologne Act requires the development and periodic review of water quality control plans (Basin Plans) that describe the beneficial uses of California's major rivers and groundwater basins and establish water quality objectives for those waters.

Point Reyes National Seashore Activities. The NPS is currently sponsoring several research and monitoring efforts aimed at improving water quality at PRNS. Work now in progress includes:

- Expansion of the PRNS water quality monitoring program to include sites throughout the Seashore
- Assessment of the water quality impacts of rangeland use
- Identification of artificial water impoundments in designated wilderness areas that offer habitat for the California red-legged frog (*Rana aurora draytonii*) in order to develop a management plan that will ensure the maintenance of the most critical breeding habitat impoundments
- Development of a Geographic Information Systems (GIS) water resources atlas for PRNS
- Establishment of stream gauges in high-priority locations throughout the Seashore.

In addition, the NPS is currently developing a Water Resources Management Plan for PRNS. This plan is intended to be a comprehensive yet flexible management tool to document existing water resources and systems, identify inventory and monitoring needs, and establish guidance for water resource management for the Seashore over the next 10-15 years.

Analysis of effects related to hydrology, hydraulics, and water quality included both qualitative and quantitative studies. The following reports prepared for the Point Reyes National Seashore Coastal Watershed Restoration Project were key sources of quantitative information.

- *Feasibility Study for Restoration at Muddy Hollow Pond, Limantour Beach Marsh, and Glenbrook Crossing—Final Report* (nhc 2004).
- *Muddy Hollow Pond Erosion and Sediment Delivery Analysis* (Jones & Stokes and nhc 2003b).
- *Glenbrook Crossing Erosion and Sediment Delivery Analysis* (Jones & Stokes and nhc 2003a).

Additional nonquantitative analyses were performed as part of this EA.

Table 4-17 summarizes the descriptors used to evaluate effects on hydrology, hydraulics, and water quality.

Table 4-17. Descriptors for Hydrology, Hydraulics, and Water Quality Effects

Type of Effect	Beneficial—The proposed action would restore natural hydrologic and shoreline conditions by removing impediments to floodflows, stabilizing riverbanks, etc.; improve water quality; or improve or maintain aquatic habitat. The proposed action would improve or maintain groundwater hydrologic function and quality.

	Adverse—The proposed action has the potential to alter natural surface water drainage, impede groundwater recharge, or alter groundwater flow by excess withdrawals. The proposed action could alter or prevent progress towards natural hydrologic and shoreline process. The proposed action has the potential to degrade surface- or groundwater quality, impede progress toward improved water quality, or degrade aquatic habitat.
Duration of Effect	Short-term—Effects would last less than two (2) years.
	Long-term—Effects would persist beyond two (2) years.
Intensity of Effect	Negligible—Adverse effects would be barely detectable, and would be limited to the immediate project vicinity for a period of several days or less. There is no potential for impairment of designated beneficial uses.
	Minor—Adverse effects would be detectable, but would be limited in areal extent. There is no potential for impairment of beneficial uses.
	Moderate—Adverse effects would be apparent at the local scale and affect an area beyond the immediate project vicinity. Beneficial uses may be affected for short periods (storm based) of time. Health and/or ecosystem concerns could arise.
	Major—Adverse effects would be substantial, highly noticeable, and regional. Beneficial uses would be affected for extended periods (seasonal), and health and/or ecosystem effects are likely.

Evaluation of Impacts

Alternative 1: Full-Build Approach (preferred alternative at Limantour Beach Marsh and Muddy Hollow)

Effects on Surface Water Hydrology, Hydraulics, and Water Quality

Surface Water Effects at Limantour Beach Marsh Site. Construction of a bridge at the Limantour Beach Marsh site would remove approximately 100 linear feet of the existing earthen embankment including the culverted pond spillway, and restore natural flow conditions to this area. Restoring the hydraulic connection would convert the pond habitat to intertidal habitat and conditions throughout the Estero, and over time would allow a more natural tidal channel/tidal marsh plain geometry to develop in the area now occupied by freshwater marsh and pond.

Following bridge construction, hydrologic flow patterns would begin to dissect the aggraded pond floor. Ultimately, an integrated tidally influenced habitat would likely develop. Overland flow would continue as a source of local freshwater input to the system. The rate of drainage development and integration would depend largely on rainfall patterns, tidal inundation patterns, and natural revegetation in the first few years after restoration. Substantial adjustment could likely be accomplished in one or two storm events of sufficient magnitude, but adjustment would be slower if the years following restoration are comparatively dry.

Initially, assuming that flow through the Laguna Creek channel from Laguna Pond to Limantour Beach Pond continues to be unregulated, channel development is expected to be most rapid at the change in vertical profile between the existing pond bottom and the tidal plain. Input from overland flow on the slopes and small tributary drainages adjacent to the pond area would probably contribute to the development of dendritic drainage, modified by restored tidal ebb and flow. The tributary drainages may incise or channelize slightly in response to the decrease in mean base level. Monitoring would be conducted to ensure that the system approaches a functional geomorphology. The anticipated long-term evolution of drainage geomorphology toward a functional tidal condition is considered a benefit.

Drainage readjustment would restore a mobile saltwater-freshwater interface. Water chemistry in the former pond—now tidal channel/tidal marsh—area would reflect the tidal influence, and would be expected to be brackish, freshening inland. Ramifications of this change, and potential biological impacts are discussed in the *Biological Resources* section of this chapter. However, because the changes in vegetation and habitat use that are likely to result would represent a return to a more natural condition reflecting improved hydrologic and hydraulic function, this is considered a benefit.

Erosion during the adjustment period could affect water quality in the Estero system, because sediment eroded from the restoration area would be carried downgradient into the Estero. Sediment in areas disturbed by earthwork, bridge construction, and removal of the downstream berm are expected to be mobile in the first year following restoration. Erosion would be at a maximum during storm events, when tides are higher and tidal currents are likely to be stronger, tending to keep sediment in motion, and in particular, to keep fine-grained sediment suspended. However, water quality impacts associated with the project would be short-term adverse minor effects. Because tidal systems are naturally dynamic no mitigation is required.

While the contributing drainage area to the pond exceeds 2 square miles, the major contributing drainage, Laguna Creek, flows through the Laguna Pond prior to discharging to the Limantour Beach Pond. In this way, sediment contribution to the area from the watershed is very low in comparison with most downstream pond areas. For this reason, excess erosion during the adjustment period following restoration is not likely a problem associated with the Limantour Marsh restoration.

Following reequilibration of the system, sediment would continue to be more mobile than it is under existing conditions, because it would be affected both by restored surface water drainage and by restored tidal processes. The restoration of natural tidal process at this site would result in the ongoing redistribution of fine-grained sediment within the estuarine area, with sediment mobility (and water turbidity) expected to peak during storm events. However, this is a natural condition in tidal settings, and restoration of this process to Limantour Beach Marsh is considered a benefit.

The creation of habitat to offset changes associated with the removal of the pond would not affect surface water dynamics as they would be isolated from the main freshwater or tidal source and flow areas.

Surface Water Effects at Muddy Hollow Site. Removing the existing dam at the Muddy Hollow site would eliminate the barrier that maintains the reservoir's artificial lake environment, restoring the surface hydrologic connection between the upper reaches of Muddy Hollow Creek and the creek's natural outflow to the southernmost arm of the Estero de Limantour system. Base level for the restored system would be consistent with tidal range throughout the Estero, likely triggering channel incision into the aggraded former reservoir floor as the stream channel readjusts. Incision is expected to be most marked in the delta area, where the most post-dam aggradation has occurred. Following the incision phase, the channelform would continue to develop through processes of bank erosion/channel widening and bar formation (see additional discussion in Jones & Stokes and nhc 2003b).

Over time, a natural downstream transition from creek/floodplain to tidal channel/tidal marsh plain would reestablish in Muddy Hollow, resembling historic patterns shown on aerial photographs (e.g., nhc 2004). The rate of channel development would depend largely on rainfall patterns in the first few years after restoration; substantial channel adjustment could likely be accomplished in one or two storm events of sufficient magnitude. Thus, if restoration is carried out during the summer of a wet year, the channel incision phase could be completed during the following winter; in any case, the majority of channel incision would likely be complete the following year (2 years'

total duration). An additional period of about 3 years would likely see complete readjustment to a healthy, dynamic channel geometry and function (NHC 2004).

Channel erosion during the post-restoration adjustment phase would increase the mobility of sediment in the Muddy Hollow/Estero system. Delivery of sediment to the Estero would be controlled to some extent by the check structures proposed for construction on the former reservoir floor. The check structures are planned to operate as part of a program of monitoring and adaptive management, as described in Chapter 2—excessive sediment delivery would serve as a signal to initiate additional adaptive action. Thus, periodic pulses of increased sedimentation to the Estero would likely be unavoidable. This would include all grain size fractions, including fine sediment, which is the greatest concern from a water quality standpoint.

Increased sediment delivery to the Estero would peak during storm events, when erosion is at a maximum. These are also times when tides are higher and tidal currents are likely to be stronger, tending to keep sediment in motion, and in particular, to keep fine-grained sediment suspended. Water quality would thus undergo periodic degradation as a result of increased turbidity for several years following restoration. Effects would be minimized to the extent feasible by NPS's proposed monitoring and adaptive management program; with this program in place, sustained effects are not expected to exceed a minor level.

Increased sediment delivery following restoration could also have adverse effects on channel geomorphology below the restored area. Delivery of sediment pulses in excess of the system's capacity could cause tidal channels to bifurcate or braid excessively, with potential changes to channel width:depth ratios, the long-term geometry of the saltwater-freshwater interface, and the system's habitat potential. Erosion of the deltaic sediment prism during large storms in the first few seasons after restoration is a particular concern; such erosion could deliver large volumes of sediment to the downstream tidal system, with potentially dramatic effects on downstream channelform. The installation of the grade control structures (described in Chapter 2) and adaptive management and monitoring would result in a short-term minor adverse impact in association with increased sediment delivery.

Turbidity is expected to return to prerestoration (existing) levels as the channel adjustment phases wanes. After channel readjustment is complete, more bedload sediment would be delivered to the Estero via a restored Muddy Hollow Creek than under existing conditions, because, as shown by Jones & Stokes and nhc (2003b), the dam and reservoir presently interrupt the transport of all but the suspended fraction of Muddy Creek's sediment load. Delivery of bedload sediment is expected to increase gradually as the check structures degrade over time. The long-term increase in sediment delivery is regarded as a benefit because it represents a return to natural surface drainage function.

Activities to construct the trail reroute would not affect surface water resources. In addition, construction of a sustainable trail would reduce potential for erosion and gullying that would result in sediment mobilization and delivery to stream resources.

Surface Water Effects at Glenbrook Crossing Site. The principal outcome of Alternative 1 at the Glenbrook Crossing site would be the removal of a non-conforming structure from the Philip Burton Wilderness Area and the restoration of surface hydrologic connectivity between the channel reaches interrupted by the existing culverted crossing and 11-foot drop in profile. Alternative 1 would include earthwork to (1) lower the aggraded reach and reconstruct a more natural channel and floodplain geometry upstream of the crossing site, and (2) raise the scoured bed below the crossing. Earthwork is intended to approach a stable channel and floodplain geomorphology. However, some channel adjustment is still expected to take place after restoration is completed, probably comprising the following three stages described by Jones & Stokes and nhc 2003b).

- Rapid channel incision up- and downstream of the former crossing site.
- Deposition of coarse sediment transported from the upper watershed along the channel; recruitment of woody debris into channel sediment and growth of vegetation along channel banks, increasing channel stability.
- Long-term bed adjustments as woody debris deteriorates.

The restored creek channel would be contoured to contain most of the 2-year flood. The expectation is that bedload would be mobile in each year's larger flood events, and that disturbed materials in the restoration area are likely to be especially vulnerable to erosion. The upstream extent of channel incision is difficult to predict, but headcutting would be constrained by the bedrock channel reach upstream of the crossing site. The channel is not expected to widen substantially (Jones & Stokes and nhc 2003a).

Most of the channel incision is expected to take place during the first year or two after restoration, and could be accomplished in a single storm of sufficient magnitude.[5] A subsequent period of intensive channel adjustment would probably continue for about 5 years. During this phase, the area would remain a source of increased sediment supply. This would likely include a substantially greater proportion of coarse bedload, which is currently blocked by the crossing, comprising both material remobilized from the aggraded and restored reaches, and "background" load delivered by ongoing flow from the upper watershed. The coarse bedload fraction typically moves episodically in streams like Glenbrook Creek where discharge is variable, and the coarsest fraction may only move at flood stage.

Erosion during the adjustment period would episodically effect downstream water quality and habitat in Glenbrook Creek. This work would not likely result in observable changes within the Estero. Bedload is expected to drop out of transport before it reaches the Estero, although suspended load may be delivered this far. This effect would be addressed to the extent feasible by NPS's proposed monitoring and adaptive management program.

Concerns about the effects of increased erosion and sediment mobility on water quality would also be addressed to the extent feasible by monitoring and adaptive management included in the proposed action. Monitoring visits should be conducted at the close of the storm season, on or about April 1 of each year. If the rainy season is unusually protracted, as it was in the El Niño years 1995 and 1998, monitoring should be repeated in early June, or should be delayed until June 1. Water quality effects are expected to moderate adverse in the short-term and minor adverse in the long-term.

Long-term (post–10 year) sediment delivery to areas downstream of the crossing site would remain elevated by comparison with existing conditions because bedload transport from the upper watershed would be essentially uninterrupted after the crossing is removed. This is considered a benefit, because it represents a return to natural surface drainage function. Following the adjustment period, downstream turbidity is expected to approach prerestoration levels; the crossing does not control transport of suspended load from upstream sources, and removing it would probably have little effect on long-term turbidity levels.

Activities to construct the trail reroute would not affect surface water resources. In addition, construction of a sustainable trail would reduce potential for erosion and gullying that would result in sediment mobilization and delivery to stream resources.

Effects on Groundwater Hydrology and Quality under Alternative 1

[5] I.e., a storm producing a flood event in excess of the 2-year channel-forming discharge.

Groundwater Effects at Limantour Beach Marsh Site. There will be no short-term and long-term effects on groundwater at Limantour Beach Marsh under Alternative 1 because the project site is not an important recharge area, and the construction window would be very short. No mitigation is required.

Groundwater Effects at Muddy Hollow Site. There would be no short-term effects on groundwater at Muddy Hollow under Alternative 1, because the project site is not an important recharge area, and the construction window would be very short.

Over the longer term, removal of the dam and restoration of hydraulic connectivity/full tidal exchange at Muddy Hollow could have a small effect on the salinity of waters recharging local shallow groundwater, which could effect the pump station approximately 1 mile upstream. The present rate and volume of freshwater infiltration via the pond is unknown, but it is possible that replacing this body of standing water with stream and tidal channel habitat could decrease the volume of infiltration. Restoration would also intermittently replace freshwater infiltration with brackish/saline water, potentially increasing the salinity of local groundwater. The Muddy Hollow well and pump station are more than one mile up valley from the project area. The depth of the well (more than 100 feet) and low use levels imply that the project would not result in impacts to the existing production well. In the long term, effects to groundwater associated with treatment at the Muddy Hollow site would be adverse but negligible.

Groundwater Effects at Glenbrook Crossing Site. Alternative 1 would change the groundwater table in the local area around the project site, but would result in localized negligible effects to groundwater in the short-term, but would not effect watershed groundwater hydrology in the long-term.

Alternative 1 Contribution to Cumulative Effects on Hydrology, Hydraulics, and Water Quality

NPS would require projects listed in Table 4-1 to incorporate water quality–protection BMPs similar to those included in the proposed action, so the likelihood of substantial adverse effects on water quality during construction of any of these actions is minor. Nonetheless, to the extent that construction periods overlap, there is some potential for a short-term cumulative effect on water quality in the Drake's Bay/Drake's Estero watershed. Because incremental contributions should be small, however, the short-term impact would be a minor adverse effect.

To the extent that they would directly or indirectly affect surface or groundwater hydrology or quality, the actions listed in Table 4-1 are expected to result in incremental benefits to hydrologic and estuarine process. This would be particularly true of the Drake's Estero road crossing improvements, the restoration of Horseshoe Pond to a functioning coastal lagoon, and the Glenbrook Dam and Quarry Restoration Project, together with the proposed action. Consequently, the long-term cumulative effect of these actions would include moderate benefits to surface water (stream and tidal system) hydrology and water quality, and possibly also minor benefits (certainly no detriment) to groundwater quality. Under Alternative 1, the proposed action would be an important contributor to these benefits.

Alternative 1 Conclusion on Effects on Hydrology, Hydraulics, and Water Quality

Evaluation of potential impacts to hydrology, hydraulics and water quality under Alternative 1 shows the likelihood of short-term minor to moderate localized adverse impacts as hydrologic configurations and conditions adjust as a result of the restoration activities. Shifts in water regime, channel and estuarine configuration would occur, but be muted in scale through proposed adaptive management measures including installation of passive grade control, adaptive monitoring and management actions.

In the long-term, the actions identified under Alternative 1 would be considered beneficial as natural hydrologic and estuarine process are restored to a new, functional dynamic equilibrium at these sites. The restoration actions would facilitate sustainable, naturally functioning hydrologic systems that would not require continued maintenance.

The actions proposed under Alternative 1 would not result in impairment to park hydrology, hydraulics, and water quality.

Table 4.18 Alternative 1: Overall Effects on Hydrology, Hydraulics, and water quality

Sites	Resources	Type and intensity of short term effect	Type and intensity of long-term effect
Limantour Beach Pond	Surface water effects	Minor adverse	Beneficial
	Ground water effects	No effect	No effect
	Water quality	Minor adverse	Beneficial
Muddy Hollow Pond	Surface water effects	Minor adverse	Beneficial
	Ground water effects	No effect	Negligible adverse
	Water quality	Minor adverse	Minor adverse
Glenbrook Crossing	Surface water effects	Minor adverse	Beneficial
	Ground water effects	Negligible adverse	No effect
	Water quality	Moderate adverse	Minor adverse
All Sites	Cumulative	Minor adverse	Beneficial

Alternative 2: Partial-Build Approach (Preferred Alternative at Glenbrook Crossing)

Effects on Surface Water Hydrology, Hydraulics, and Water Quality

Surface Water Effects at Limantour Beach Marsh Site. Replacing the existing embankment crossing at Limantour Beach Marsh with a boardwalk result in similar effects as those described under Alternative 1. A key difference between Alternative 1 and Alternative 2 relates to the need to support the boardwalk on pilings spaced every 6–8 feet within the tidal flat complex. While removing the earthen fill from the pond and recontouring the tidal flat would dramatically improve hydraulic function at Limantour Beach Marsh, the pilings could cause debris and sediment to accumulate in the channel over the long term, ultimately obstructing flow. This could be a minor adverse effect, but would be mitigated by including debris, sediment, and trash clearing in regular maintenance activities.

Surface Water Effects at Muddy Hollow Site. As with Alternative 1, removing the existing dam at the Muddy Hollow site would eliminate the barrier that maintains the reservoir's artificial lake environment, restoring the surface hydrologic connection between the upper reaches of Muddy Hollow Creek and the Estero de Limantour and lowering base level consistent with tidal elevations in the Estero. The key difference between Alternatives 1 and 2 is that phased removal of the dam under Alternative 2 would result in more accommodation of base level adjustment. Consequently, under Alternative 2, the channel and floodplain system would have one winter to evolve progressively downstream as water level in the reservoir is progressively lowered. Channel development would be further guided and controlled by the check structures proposed for construction on the former reservoir floor, beginning in Phase 1.

The basic processes of channel and floodplain evolution, and associated water quality effects under Alternative 2 would be similar to those described above for Alternative 1. Water quality effects during this phase could be addressed by continued adaptive management, and the level of sustained effect is expected to be minor.

Over the long term, Alternative 2, like Alternative 1, would increase the net delivery of sediment to the Estero by comparison with existing conditions, because the dam and reservoir presently interrupt the transport of all but the suspended fraction of Muddy Hollow Creek's sediment load. As described for Alternative 1, this is considered a benefit because it would represent a return to natural surface drainage function. Once the adjustment period is over, turbidity—and hence water quality—should return to pre-restoration levels; transport of suspended load, which is not substantially impeded by the dam, is not expected to change materially.

Surface Water Effects at Glenbrook Crossing Site. Alternative 2, like Alternative 1, would restore surface connectivity between the channel reaches that are now interrupted by the culverted Muddy Hollow Trail crossing. The footprint of the channel reconfiguration and of direct impacts would be smaller than that required in Alternative 1. Following removal of road fill to the disposal area, Alternative 2 minimize excavation of accumulated fill stored upstream of the road crossing approximately 100-200 linear feet, allowing the established riparian corridor to remain. Excavation upstream would be determined by the fill required downstream for channel regrading and would be placed downstream in the same manner described under Alternative 1. Limiting the upstream excavation only to the extent necessary to create the downstream gradient is a softer, more balanced approach that relies more on natural processes of erosion and sediment transport to fully restore the channel to a more functional geometry. In addition, under Alternative 2, existing mature riparian vegetation would remain in place upstream of the crossing site rather than being removed as would occur under Alternative 1. Grade control structures similar to those proposed for Alternative 1 would be installed, including two additional structures upstream.

Although the overall pattern of channel evolution would be similar to that described above for Alternative 1, sediment delivery to downstream reaches and the ponds during channel adjustment would likely be greater under Alternative 2 than under Alternative 1. As with Alternative 1, the increased load would likely include a higher proportion of coarse bedload, which is presently blocked by the crossing; this would include material remobilized from the aggraded and restored reaches, as well as "background" load delivered by ongoing flow from the upper watershed. Because coarse bedload is only intermittently mobile in streams like Glenbrook Creek where discharge varies markedly, coarse sediment is expected to move downstream in an intermittently advancing front.

As described for Alternative 1, the upstream extent of incision is difficult to predict, but the mature riparian vegetation left in place is expected to help control channel development, preventing excessive bank erosion. Headcutting would be constrained by the bedrock channel reach upstream of the crossing site. The channel is not expected to widen substantially (Jones & Stokes and nhc 2003a).

Because of increased reliance on natural process, outcomes under Alternative 2 are more difficult to predict than with Alternative 1. Patterns of erosion, sediment loading, and increased turbidity would probably be broadly similar to those envisioned for Alternative 1, although they might be greater because more channel adjustment would be required, despite the additional stability provided by vegetation left in place.

Erosion during the adjustment period would episodically effect downstream water quality in Glenbrook Creek and possibly also in the Estero, with the greatest effect felt during and immediately after storm events. Much bedload, and in particular, coarse bed load, is expected to drop out of transport before it reaches the Estero, although suspended load would be delivered this far. This effect would be addressed to the extent feasible by NPS's proposed monitoring and adaptive management program, but would likely represent a moderate effect.

Concerns about the effects of increased erosion and sediment mobility on water quality would also be addressed to the extent feasible by monitoring and adaptive management included in Alternative 2. Overall, water quality effects are expected to be moderate.

As identified for Alternative 1, long-term (post–10 year) sediment delivery to areas downstream of the crossing site would remain elevated by comparison with existing conditions because bedload transport from the upper watershed would be essentially uninterrupted after the crossing is removed. This is considered a benefit, because it represents a return to natural surface drainage function. Following the adjustment period, downstream turbidity is expected to approach prerestoration levels; the crossing does not control transport of suspended load from upstream sources, and removing it would probably have little effect on long-term turbidity levels.

Effects on Groundwater Hydrology and Quality under Alternative 2

At all three sites, effects on groundwater under Alternative 2 are expected to be very similar to those described above for Alternative 1. This includes no effect in the short and long-term at Limantour Beach Marsh, no effect in the short-term and negligible adverse in the long-term at Muddy Hollow Pond, and negligible adverse in the short-term and no effect in the long-term at the Glenbrook Crossing site.

Alternative 2 Contribution to Cumulative Effects on Hydrology, Hydraulics, and Water Quality

Under Alternative 2, the proposed action's contribution to cumulative effects on hydrology, hydraulics, and water quality would be very similar to those identified above for Alternative 1. The only substantive short-term difference would relate to the phased removal of the dam at Muddy Hollow, which would extend and could amplify the proposed action's contribution to cumulative construction-related effects on water quality. Nonetheless, short-term contributions are expected to be minor under Alternative 2 as described for Alternative 1, while long-term effects, and the proposed action's contributions to long-term effects, would represent marked benefits.

Alternative 2 Conclusion on Effects on Hydrology, Hydraulics, and Water Quality

Evaluation of potential impacts to hydrology, hydraulics and water quality under Alternative 2 shows the likelihood of short-term minor adverse impacts as hydrologic configurations and conditions adjust as a result of the restoration activities. Shifts in water regime, channel and estuarine configuration would occur, but be muted in scale through proposed adaptive management measures including installation of passive grade control, adaptive monitoring and management actions. The longer construction window proposed under Alternative 2 for Muddy Hollow would extend potential effects, and delay natural recovery and revegetation at the site.

In the long-term, the actions identified under Alternative 2 would result in minor to moderate benefits as natural hydrologic and estuarine process are restored to a new, functional dynamic equilibrium at these sites. The restoration actions would facilitate sustainable, naturally functioning hydrologic systems that would not require continued maintenance.

The actions proposed under alternative 2 would not result in impairment to park hydrology, hydraulics, and water quality.

Table 4.19 Alternative 2: Overall Effects on Hydrology, Hydraulics, and water quality

Sites	Resources	Type and intensity of short term effect	Type and intensity of long-term effect
Limantour Beach Pond	Surface water effects	Minor adverse	Beneficial
	Ground water effects	No effect	No effect
	Water quality	Minor adverse	Beneficial
Muddy Hollow Pond	Surface water effects	Minor adverse	Beneficial
	Ground water effects	No effect	Negligible adverse
	Water quality	Minor adverse	Minor adverse
Glenbrook Crossing	Surface water effects	Minor adverse	Beneficial

	Ground water effects	Negligible adverse	No effect
	Water quality	Moderate adverse	Minor adverse
All Sites	Cumulative	Minor adverse	Beneficial

Alternative 3: No Action

Under the No Action Alternative, no restoration would take place and existing management practices would continue. There would be no direct effect on hydrology, hydraulics, or water quality in surface drainages, nor would there be any direct effect on groundwater recharge, flow, or quality.

However, both the existing dam at Muddy Hollow and the existing embankment at Glenbrook Crossing are structurally unsound, and there is some concern about the potential for sudden failure during a large storm event or as a result of seismic shock, if these structures remain in place for a protracted period. Failure of the dam at Muddy Hollow would likely result in sudden release of the water impounded in the reservoir, with a potential for substantial erosion in the tidal habitats of the Estero. A large amount of sediment would probably be remobilized during and following dam failure, as well. The potential impacts evaluated as part of the action alternatives would proceed in an uncontrolled and catastrophic manner. The potential of catastrophic failure would focus the impacts, exaggerating the duration of damage and increasing the time before equilibrium is reached. Dam failure could thus have moderate to major adverse effects on surface drainage processes, water quality, and tidal habitat quality in the Estero system.

Failure of the Glenbrook embankment crossing would likely occur in conjunction with a high flow event, and could actually trigger a debris flow type response. This could result in the distribution and deposition of large volumes of material in a single event, effecting far greater areas of habitat in the process. Effects on stream process both upstream and downstream as well as impacts downstream to water quality would be similar in intensity (moderate to major adverse impacts) to those described for Muddy Hollow.

By contrast with the controlled sediment remobilization expected under Alternatives 1 and 2, effects of sudden failure at either the Muddy Hollow or Glenbrook structure would be impossible to mitigate in advance, and could only be addressed after the fact, in an emergency recovery mode.

Contribution to Cumulative Effects on Hydrology, Hydraulics, and Water Quality

Under Alternative 3, the proposed action would not contribute to construction-related water quality degradation, but it would have the potential to result in a minor adverse contribution over the long term, should either the Muddy Hollow Dam or the embankment at Glenbrook Crossing fail suddenly.

Conclusion on Effects on Hydrology, Hydraulics, and Water Quality

Evaluation of potential impacts to hydrology, hydraulics and water quality under Alternative 3 would not lead to short-term effects as a result of direct construction activities.

In the long-term, the actions identified under Alternative 3 could potentially result in minor to moderate adverse impacts to water resources. At Muddy Hollow and Glenbrook, inaction could facilitate catastrophic failures leading to moderate adverse impacts to the adjacent water resources and associated habitats. Such events would lead to large-scale complete changes in habitat, and require longer periods of time to recover. Such events, occurring in association with unnatural features, result in impacts to the stream channel or ecosystem that are not within the range of natural variability, thereby increasing the time required to recover dynamic equilibrium.

Alternative 3, however, would not result in impairment to park hydrology, hydraulics, and water quality.

Table 4.20 Alternative 3: Overall Effects on Hydrology, Hydraulics, and water quality

Sites	Resources	Type and intensity of short term effect	Type and intensity of long-term effect
Limantour Beach Pond	Surface water effects	No effect	Minor adverse
	Ground water effects	No effect	No effect
	Water quality	No effect	Minor adverse
Muddy Hollow Pond	Surface water effects	No effect	Moderate adverse
	Ground water effects	No effect	Negligible adverse
	Water quality	No effect	Moderate adverse
Glenbrook Crossing	Surface water effects	No effect	Moderate adverse
	Ground water effects	No effect	No effect
	Water quality	No effect	Moderate adverse
All Sites	Cumulative	No effect	Moderate adverse

4.3 Effects on the Biological Environment

Effects on Vegetation and Wildlife

Policies and Regulations

NPS Management Policies 2001 state "The National Park Service will maintain as parts of the natural ecosystems of parks all native plants and animals." The policies go on to state that the above statement includes flowering plants, ferns, mosses, lichens, algae, fungi, and microscopic plants, bacteria, mammals, birds, reptiles, amphibians, fishes, arthropods, worms, and microscopic animals. The NPS is to preserve and restore the natural abundance, diversities, dynamics, distributions, habitats, and behaviors of these native species. Additionally, the NPS is to prevent the introduction of exotic (non-native) species into units of the National Park System. The policy manual NPS-77 (Natural Resource Management Guidelines) also provides general guidelines on wildlife and vegetation management.

The NPS also is required to comply with the Fish and Wildlife Coordination Act; the Marine Mammal Protection Act; the Wilderness Act; the Convention on International Trade in Endangered Species; and maritime and other international agreements. The NPS also is required to comply with The Migratory Bird Treaty Act (1918) as amended, which prohibits taking, killing, or possessing migratory birds, nests, or eggs. As a refuge for tule elk, Point Reyes National Seashore is directed to participate in a Federal/State cooperative program for preservation and enhancement of tule elk in California under the Tule Elk Preservation Act (1976).

Executive Order 13112 directs federal agencies to minimize introduction and spread of exotic species to federal lands. In addition, the 2001 NPS Management Policies § 4.4.4.2, call upon NPS employees to distinguish which non-native species are most likely to cause damage to natural resources, and to give high priority to controlling the spread of these.

Heavy equipment use proposed under the action alternatives has the potential to import plant materials from outside the Park, and to transport plant materials between Project sites. The Park

would require that Best Management Practices (see Environmental Commitments section) are employed to minimize the chance of new invasive species becoming established within in the Park, or moving between sites within the Park, as a result of proposed actions.

Assessment Methodology

Baseline conditions for analysis of effects on biological resources were identified based on a combination of literature research and fieldwork. Fieldwork included

- reconnaissance-level surveys to assess the suitability of habitat on and around the restoration sites for use by common and special-status wildlife species,
- wetland delineations and special-status plant surveys (Allen and Parsons 2003; Parsons 2003a, 2003b; Parsons and Allen 2003)

Descriptors for evaluating impacts effect, duration, and intensity are shown in Table 4.21.

Table 4.21 Descriptors for Vegetation and Wildlife

Type of Effect	Beneficial: the proposed action would improve habitat for plant or animal, and protect and/or restore the natural abundance and distribution of plant or animal species Adverse: the proposed action would degrade habitat for a plant or animal, and cause a decrease in the natural abundance and distribution of a plant or animal species
Duration of Effect	Short-term: effects on the habitats of species would persist for two years or less; immediate changes in the abundance and/or distribution of special-status species may occur during the construction period, but a return to original conditions would be expected within two generations of that species Long-term: effects on the habitats of species would persist for two years or more beyond the construction period; changes in the abundance and/or distribution of special-status species would continue beyond two generations of that species
Intensity of Effect	Negligible: the proposed action would not measurably alter habitats for species, or create a measurable difference in the distribution and abundance of special-status species Minor: adverse effects to habitats of species would be perceptible, but would be localized in extent; changes in the distribution and abundance of special-status species would be minor and restricted to the Project site Moderate: adverse effects to habitats of species would be apparent and readily noticeable, but would be localized in extent; changes in the distribution and abundance of species would be moderate in intensity and restricted to the Project site and sites immediately adjacent; changes in distribution and abundance of species may be permanent, unless (if adverse) actively managed Major: adverse effects to habitats of species would be substantial, and would effect a significant portion of the Drakes Estero Watershed; changes in the distribution and abundance of species would be substantial, and would effect a large geographic area; changes in distribution and abundance of these species is irreversible, even (if adverse) with active management

Evaluation of Impacts

Build Alternatives, All Sites

Effects on Vegetation and Wildlife

At all three sites, construction activities have the potential to promote further spread of nonnative plants that are present there now, and could also introduce invasive nonnative plant species that are not now present. Such species could displace native plants, potentially changing the species composition on or around the construction site. This would represent an adverse effect, potentially ranging in severity from minor to major. Requiring the construction contractor(s) to

implement the following measures would reduce the potential for construction to spread nonnative plants to the extent feasible.

- Educating construction supervisors and mangers about weed identification and the importance of controlling and preventing the spread of noxious weed infestations.
- Cleaning construction equipment of external soil at an offsite location before the equipment is brought onsite.
- Minimizing surface disturbance to the greatest extent possible.

With these mitigation measures in place, effects are expected to be minor.

In addition, as discussed in *Hydrology, Hydraulics, and Water Quality*, construction activities have the potential to increase erosion and sedimentation, potentially decreasing water quality downstream active construction areas. However, as described in Chapter 2, the proposed action would incorporate a range of BMPs designed to protect water quality during construction, so effects are not expected exceed a minor level, and no mitigation is required.

The third concern related to construction activities is the potential for construction-related noise and vibration to disturb wildlife. The noise effects are discussed fully under *Effects related to Noise.* Adverse effects related to construction noise and vibration would be short-term and minor at all three sites under both build alternatives, and do not require additional mitigation.

Over the long term, following restoration, the proposed action would benefit water quality at all three sites by restoring tidal circulation at Limantour Beach Marsh and Muddy Hollow, and hydraulic connectivity at Glenbrook Crossing. The amount of ponded freshwater habitat would decrease at all three sites, and particularly at Muddy Hollow, but this is considered a net benefit because it would represent a return to conditions more closely resembling the area's historic habitat mosaic. More specifically, as tidal exchange is improved at Limantour Beach Marsh and Muddy Hollow, the area of available subtidal aquatic habitat would increase. These channels may be used as rearing habitat by estuarine and marine fishes, and may also provide habitat for additional phytoplankton, zooplankton, and benthic invertebrates, all of which would represent potential food sources for both common and special-status fishes.[2] All of these long-term effects are considered beneficial.

Post-restoration changes in site hydrology would result in long-term changes in vegetative communities at all three sites. Specifically, at Limantour Beach Marsh, the existing freshwater pond/marsh environment would be replaced with a more natural transition from freshwater through brackish to salt marsh habitat. At Muddy Hollow, ponded fresh water would be replaced with stream and tidal channel and floodplain/tidal marsh plain; some of the present alder-dominated riparian forest would give way to willow riparian scrub, and the upgradient extent of coastal brackish and salt marsh would increase slightly as tides are allowed their full natural range. At both of these sites, there may also be an increase in grassland and/or coastal scrub extent as areas that are now ponded become dryer; this is expected to offset the short-term loss of coastal scrub and grassland habitat that would result from demolition activities to remove the unnatural barriers at each site. In addition, at Glenbrook Crossing, the expanded riparian area now supported by the perched floodplain would decrease in extent, consistent with more functional streamflow. All of these long-term changes are considered beneficial, and no mitigation is required.

As the habitats on the three sites evolve, there would be corresponding changes in the wildlife communities that use the sites. In particular, the bird community at the Muddy Hollow site would

[2] See *Effects on Special-Status Species* below for additional discussion.

change as ponded open water is converted to intertidal marsh plain and subtidal channels. Similar changes would occur on a much more restricted scale at Limantour Beach Marsh. However, other ponds throughout the Seashore would continue to support those populations that require open freshwater (areas of ponded water include nearby Laguna Pond, upper and lower Limantour Estero). The availability of dense riparian vegetation may expand downgradient in association with newly exposed habitat. As with open water habitat, other nearby sites offer adequate riparian habitat to compensate for the small reduction. These changes in habitat availability represent a return to habitat patterns more closely resembling the historic condition and as such are considered a long-term benefit. An additional benefit expected as a result of restoration is improved dispersal of terrestrial and aquatic wildlife, including special-status species, up- and downstream of the project sites, as a result of increased habitat connectivity.

Build Alternatives' Contribution to Cumulative Effects on Vegetation and Wildlife

Construction of most of the actions listed in Table 4-1 would temporarily disrupt common habitats such as coastal shrub/nonnative grassland and would likely also disturb wildlife. To the extent that construction windows overlap, these effects would be additive, and would accrue to represent a short-term adverse cumulative effect on vegetation and wildlife. However, because of the comparatively small individual footprints of the project sites, the small number of workers and pieces of equipment involved at each site, the noise BMPs that would be required, and the limitations on tool use in the wilderness, the net level of effect is expected to be minor. The proposed action would result in minor short-term adverse effects to vegetation and wildlife.

Long-term cumulative effects on vegetation and wildlife are expected to be beneficial, because all of these actions would foster a return to conditions more closely resembling the historic habitat mosaic in the Drake's Bay/Drake's Estero watershed, and the habitat would not remain subject to catastrophic failure. The actions proposed under either Alternatives 1 and 2, would restore natural process and improve sustainability of these ecological systems. This is considered beneficial in the long-term.

Build Alternatives' Conclusion on effects on Vegetation and Wildlife

Alternatives 1 and 2 would result in similar impacts to vegetation, wildlife, and habitat as a result of the direct construction activities, short-term and long-term habitat changes. Overall the changes to vegetation and wildlife habitat are considered adverse minor in the short term, with recovery, however, the long-term effects are considered beneficial.

The build alternatives would not result in impairment to park vegetation or wildlife resources.

Table 4.22 Alternatives 1 and 2: Overall Effects on Vegetation and Wildlife

Sites	Resources	Type and intensity of short term effect	Type and intensity of long-term effect
All Sites	Vegetation	Minor adverse	Beneficial
	Wildlife	Minor adverse	Beneficial
	Cumulative	Minor adverse	Beneficial

Alternative 3: No Action

Effects on Vegetation and Wildlife

Under Alternative 3, no restoration would take place and existing management practices would continue. The sites would remain in their current condition, and would continue to support the same vegetative and wildlife communities currently present. Therefore, there would be no direct effects on vegetation and wildlife resources under the No Action Alternative.

As discussed in *Hydrology, Hydraulics, and Water Quality* above, there is some concern about the potential for failure of the Muddy Hollow dam and/or Glenbrook Crossing embankment in a large storm event or as a result of seismic shock. As discussed above, dam or embankment failure could

have substantial adverse effects on downstream channel process and water quality, with the potential for corollary (indirect) minor adverse effects on aquatic and marsh plain habitat and wildlife.

Contribution to Cumulative Effects on Vegetation and Wildlife

Under Alternative 3, cumulative effects on vegetation and wildlife would be as identified above for the build alternatives. Because no construction would take place, there would be no short-term cumulative effects on biological resources. In the long-term, if the Muddy Hollow Dam or the embankment at Glenbrook Crossing were to fail suddenly, the resulting adverse effects on aquatic and marsh plain habitats could represent minor adverse contribution to an otherwise beneficial cumulative framework.

Conclusion on Effects to Vegetation and Wildlife

Under Alternative 3, there would be no effect to existing vegetation and wildlife within the project area during the short term. In the long-term, potential failure of these earthen facilities under either flood flow or geologic hazard scenarios would result in minor adverse effects to vegetation and wildlife resources. Recovery time of these resources as a result of potential uncontrolled (catastrophic) failure would be more protracted and could prevent these areas from reaching stable physical or ecological equilibrium.

Alternative 3 would not result in impairment of park biological resources.

Table 4.23 Alternative 3: Overall Effects on Vegetation and Wildlife Resources

Sites	Resources	Type and intensity of short term effect	Type and intensity of long-term effect
All Sites	Vegetation	No effect	Minor adverse
	Wildlife	No effect	Minor adverse
	Cumulative	No effect	Minor adverse

Effects on Wetland Resources

Policies and Regulations

Wetlands are addressed specifically in this assessment because, as they serve as habitat for a high percentage of the plants and animals and they are protected by numerous laws and directives.

Section 4.6.5 of the NPS Management Policies addresses the restoration of wetlands on NPS lands, "When natural wetland characteristics or functions [of wetlands] have been degraded or lost due to previous or on-going human actions, the Service will, to the extent practicable, restore them to predisturbance conditions" (NPS 2000).

The protection of wetlands within NPS units is facilitated through the following:

- Rivers and Harbors Act § 10
- Clean Water Act § 404
- Executive Order 11990, Protection of Wetlands
- NPS Director's Order #77-1, Wetland Protection and Procedural Manual #77-1 (DO #77-1 and PM #77-1)

Section 10 of the Rivers and Harbors Act and Section 404 of the Clean Water Act authorize the U.S. Army Corps of Engineers to grant permits for construction and disposal of dredged material in waters of the United States, which includes wetlands and riparian zones. Executive Order 11988 requires that federal agencies minimize the amount of infrastructure placed in floodplains.

Executive Order 11990 requires that agencies work to minimize the destruction, loss, or degradation of wetlands. Director's Order 77-1 and Procedural Manual 77-1 provide specific procedures for implementing Executive Order 11990.

Assessment Methods

For this assessment, wetlands that could be subject to impacts were identified using the Army Corps of Engineers jurisdictional delineation and the USFWS - Cowardin Method surveyed in the field (Cowardin et al. 1979). These data layers then were overlain with the boundaries of the Project planning area. This information provided a conservative and broad estimate of the extent of known and potential wetlands within the planning area. The approximate number of acres that would be subject to impacts was estimated using standard techniques.

The parameters that were considered in the assessment of impacts on wetlands include the following:

- Plant species composition of the wetland, including abundance and species richness of invasive non-native plant species;
- Hydrologic features that maintain the wetland; and
- Wetland soils.

These parameters parallel those used by the Army Corps of Engineers when defining wetlands. It is assumed that if these parameters are altered as a result of restoration activities, the wetland would be subject to impacts, which could be either beneficial or adverse.

Descriptors for evaluating impacts effect, duration, and intensity are shown in Table 4.24.

Table 4.24 Descriptors for Wetlands

Type of Effect	Beneficial: the proposed Project would enhance or restore processes necessary for wetland vegetation, soils, or hydrology to develop, or increase the areal extent of wetlands
	Adverse: the proposed action would shift plant species composition to a higher percentage of non-wetland indicator species; alter hydrologic features/factors that are required to maintain the wetland; alter soil properties that are required to maintain the wetland; or reduce the areal extent of wetlands;
Duration of Effect	Short-term: effects on wetlands would persist for two years or less
	Long-term: effects on wetlands would persist for two years or more beyond the construction period
Intensity of Effect	Negligible: the proposed action would not measurably alter wetlands
	Minor: effects to wetlands would be perceptible, but would be localized in extent
	Moderate: effects to wetlands would be apparent and readily noticeable, but would be localized in extent; these changes may be permanent, unless (if adverse) actively managed
	Major: effects to wetlands would be substantial, and would effect a significant portion of the Drakes Estero Watershed; changes would be irreversible, even (if adverse) with active management

Impacts and Mitigation Measures

Alternative 1: Full-Build Approach (preferred alternative at Limantour Beach Marsh and Muddy Hollow)

Effects on Wetlands

The proposed action would result in minimal to no permanent loss of wetlands subject to jurisdiction or oversight either by the Corps or the California Coastal Commission (CCC). As

discussed under Chapter 3, the Corps regulates fill or excavation in wetlands either under Section 404 of the Clean Water Act or Section 10 of the Rivers and Harbor Act. The CCC oversees activities within a more broadly defined group of wetlands in coastal areas through authorities granted to the state under the federal Coastal Act. Internally, the NPS also evaluates activities within wetlands and floodplains that could potentially cause a "net loss" of wetlands. Regulatory and management oversight of activities in wetlands has increased in recent decades due to the important functions that they perform for both humans and wildlife. The proposed action would greatly enhance the functionality of wetlands present by increasing hydrologic connectivity with downstream habitats.

Wetland Effects at Limantour Beach Marsh. At Limantour Beach Marsh, the proposed action focuses on removal of fill from the area, which would not likely result in impacts to potential Corps' jurisdictional Section 404 and Section 10 wetlands and waters (see Table 4-27). The Corps has not verified this delineation, so impact estimates could change. However, the proposed action calls for very little in the way of new fill or excavation activities. Activities associated with berm removal would result in negligible adverse effects on Corps' jurisdictional wetlands and waters from either permanent or temporary "fill" and/or excavation activities.

Impacts to wetlands potentially subject to oversight by the CCC (See Table 4-28) come from temporary impacts associated with excavation that would cause a change in the type of wetland, but not permanent loss. Excavation of the existing beach access berm for installation of a bridge structure would impact 0.14 acre of Palustrine Scrub-Shrub and Emergent wetlands. However, these impacts would be temporary, with these areas expected to rapidly convert to Estuarine Emergent wetlands with the improved hydrologic connectivity between Limantour Marsh and Limantour Pond. Approximately 0.09 acre of Estuarine Emergent and 0.12 acre of Palustrine Scrub-Shrub wetlands would be excavated during removal of the already breached outer berm, but these lowered areas would transition into Estuarine Emergent wetlands similar to the adjacent marshplain. Excavation of the secondary beach access berm would temporarily impact 0.15 acre of Palustrine Scrub-Shrub, 0.16 acre of Estuarine Emergent, and 0.02 acre of Estuarine Scrub-Shrub wetlands. These areas would either rapidly reestablish following project implementation or largely become Estuarine Emergent wetlands. Excavation impacts to wetlands potentially subject to CCC oversight total 0.58 acre. Excavation activities would result in short-term minor adverse effects to wetlands. In the long-term there would be no permanent loss, and effects on potential CCC wetlands are characterized as adverse negligible.

Some additional minor impacts to wetlands would result from abandonment of the existing Pond spillway and removal of the secondary beach access berm. Abandonment of the Pond spillway would, at least on the western side of the beach access berm, cause the constructed channel (<0.01 acre) to go dry and potentially become a Corps' non-jurisdictional upland, although it is probable that it would revegetate with hydrophytic species. In addition, removal of the secondary beach access berm could potentially act to dewater some depressional wetland features that have established between a dune and the berm. Acreage of these features totals 0.11 acre. Short-term impacts to wetlands associated with construction and project implementation are considered minor adverse. Long-term impacts associated with permanent loss of wetlands subject to NPS oversight would be minor adverse.

Excavation activities associated with the California red-legged frog enhancement would either convert wetlands from seasonal to perennial or would result in excavation of upland areas to capture and hold water, thereby expanding and likely offsetting the losses described in association with the impacts discussed above. These depressional features would intersect the groundwater table and provide winter breeding habitat for the frogs.

While the proposed action would cause some short-term and long-term impacts to wetlands, it would also increase functionality of the wetlands present. The primary benefit would result from the increase in hydrologic connectivity with downstream water bodies (Limantour Estero and

Marsh), thereby boosting the potential for marine and estuarine organisms to benefit from increases in carbon export from the Laguna Creek watershed. Currently, the Pond likely plays a much smaller role comparatively than does Muddy Hollow Pond in detaining flood flows and sediment from their respective watersheds, and it is unlikely that these types of functions would increase under any restoration or management scenario. Retention of Laguna Creek flood flows probably occurs primarily on the broad floodplains of lower Laguna, along with detention of most of the creek's sediment loads. Also, as the Pond is already largely vegetated, any nutrient loading from Laguna Creek or surrounding uplands is already rapidly converted to plant matter that can be incorporated into the estuarine food web. However, increasing connectivity with downstream water bodies would greatly increase export of these and other carbon sources to the estuary and increase habitat for other important marine and estuarine food chain components such as benthic invertebrates and fish. The short-term effects to wetland function would be minor adverse. In the long-term, as sites recover, the effects of the project on wetland function would be beneficial.

Wetland Effects at Muddy Hollow. At Muddy Hollow, the proposed action would result in a very minor amount of permanent fill to Section 404 and Section 10 jurisdictional features (see Table 4-27). Activities that would affect Corps' jurisdictional wetlands include removal of the constructed spillway on the southwest side of the Pond through filling, construction of a willow or brush layer sediment trapping structure in the center of the Pond, and potentially, the installation of grade control structures in Muddy Hollow Creek that would be largely below the existing grade of the channel bottom. These actions would impact approximately 0.17 acre of Non-Tidal Waters, 0.001 acre of Non-Tidal Wetlands, and 0.002 acre of Section 10 waters. Impacts to Corps' jurisdictional wetlands from "fill" would be minor adverse in the long-term. There would be no temporary impacts (as defined by the Corps) to wetlands from fill activities such as temporary stockpiling, however short-term effects are considered minor adverse.

Impacts to wetlands potentially subject to oversight by the CCC are similar to those described above (see Table 4-28). To a large degree, the proposed action would result in more of a shift in the type of wetlands present, rather than any permanent losses through dredging, filling, or diking.

Approximately 0.08 acre of Palustrine Rock bottom would be impacted by filling of the constructed spillway channel, and most of this area would likely revert to historic upland habitats such as Coastal Scrub or Grassland, thereby making the fill a permanent loss of wetlands. In addition, removal of the dam structure would eliminate approximately 0.60 acre of Palustrine Forested wetlands that have established on the dam top and sides due to seepage. However, approximately two-thirds of this feature would probably convert into other potential jurisdictional habitats such as Estuarine and Palustrine Emergent wetlands when the Project Site is reconnected to Limantour Estero. Approximately 0.09 acre of Lacustrine Unconsolidated Bottom wetlands would be impacted by construction of the willow or brush sediment trapping structure, but this area would probably rapidly convert from Lacustrine to Palustrine Emergent and Palustrine Scrub-Shrub wetlands. A small (<0.001 acre) of Palustrine Forested may be temporarily impacted by installation of grade control structures below the existing grade of Muddy Hollow Creek to minimize future incision or deepening of the channel with dam removal. Also, approximately 0.01 acre of Estuarine Emergent wetland on the outboard side of the dam would be excavated for construction of a "starter" channel, but this impact would be temporary, with the excavated area rapidly transitioning into Estuarine Intertidal Unconsolidated Bottom. Excavation and fill impacts to wetlands potentially subject to CCC oversight total 0.78 acre. Because activities would only temporarily impact wetlands and cause a very small amount of conversion of wetland to upland habitat, impacts to CCC potential jurisdictional wetlands are characterized as minor adverse in the short and long-term.

Following drainage of the pond, it is likely that the steeper, western edge of the Pond (<0.01 acre) might convert back to historic upland conditions once it is drained, because the dam has artificially elevated water levels in this area. While these particular impacts may not be subject to regulatory oversight, the NPS is mandated to minimize losses of wetlands from a broader range of activities.

Short-term impacts to wetlands associated with construction and project implementation would be moderate adverse. Permanent impacts to or loss of wetlands subject to NPS oversight would be minor adverse in the long-term.

While the proposed action would cause some short-term and long-term impacts to wetlands, it would also greatly increase functionality of the wetlands present. The primary benefit would result from the increase in hydrologic connectivity with downstream water bodies (Limantour Estero and Marsh), thereby boosting the potential for marine and estuarine organisms to benefit from increases in carbon export from the Muddy Hollow watershed. While the Pond does currently function as a floodwater and sediment detention basin, conversion of the Open Water to vegetated marsh and riparian areas would increase the potential for the Project Site to not only detain nutrients, but transform them into plant matter that can be incorporated into the estuarine food web. Loss of open, standing water habitat would decrease primary productivity associated with algal and zooplankton communities, but it would increase food chain components such as emergent plants and benthic invertebrates. Impacts to wetland functionality would be beneficial, and long-term, although there may be some short-term, minor, adverse impacts to functioning of Project Site and downstream wetlands from increased erosion and sedimentation immediately following project implementation.

Wetland Effects at Glenbrook Creek. At Glenbrook Creek, the proposed action would cause approximately 0.19 acre of impacts to Non-Tidal Waters from elevating the downstream portion of the creek through fill and 0.03 and 0.04 acre of impacts to Adjacent Waters and Wetlands, respectively, from removal of an erosional gully through filling (Table 4-27). Impacts to Corps' jurisdictional wetlands from "fill" would be minor, adverse, and long-term. There would be no temporary impacts (as defined by the Corps) to wetlands from fill activities such as temporary stockpiling.

Impacts to wetlands potentially subject to oversight by the CCC come from both permanent and temporary impacts associated with excavation and fill (see Table 4-28). Excavation of the aggraded portion of Glenbrook Creek upstream of the road crossing would impact approximately 1.1 acre of Palustrine Forested wetland, while filling of the incised or deepened portion of Glenbrook Creek downstream of the crossing would affect 0.15 acre of Palustrine Scrub-Shrub and 0.04 acre of Palustrine Forested wetlands. Both activities are expected to result in only temporary impacts to wetlands, with stream channel and associated wetlands rapidly reestablishing following project implementation. Removal of the road crossing itself has the potential to impact less than 0.001 acre of Palustrine Forested and Palustrine Scrub-Shrub wetlands growing along the southern base of the crossing. Filling of the erosional gully would impact 0.03 acre of Palustrine Forested and 0.04 acre of Palustrine Emergent wetlands. Fill and excavation impacts to wetlands potentially subject to CCC oversight total 1.36 acres. Fill and excavation activities would result in short-term moderate adverse impacts to CCC wetlands. In the long-term, the small amount of potential permanent loss (0.07 acre) of potential CCC wetlands would result in similar, minor adverse effects.

Permanent impacts to or loss of wetlands subject to NPS oversight would be minor, adverse, and long-term.

As with the other Project Sites, while the proposed action would cause some short-term and long-term impacts to wetlands, it would also increase functionality of the wetlands present. The current culverted road crossing has created discontinuities in transport of floodwaters, sediment, and carbon matter to downstream sections of Glenbrook Creek. While the upstream sections are performing floodwater, sediment, and nutrient retention functions to some degree, the downstream sections are less able to perform these functions because the stream channel has incised or deepened in elevation, thereby disconnecting the stream from some or most of its floodplain. In addition, the incision is actually creating water quality problems through suspension of sediment. By eliminating the road crossing infrastructure and correcting the elevation differences between

the upstream and downstream sections of the creek, the proposed action would increase functionality of the downstream section of creek. These functions include detention of flood flows, dissipation of flood flow energy, retention of sediment and nutrients, and supplying organic matter and large woody debris for use as refugia and food source for aquatic organisms. In the short-term, impacts associated with the construction activities would have moderate adverse effects on wetland functionality from increased erosion and sedimentation immediately following project implementation. As the system recovers and natural process is restored, the long-term effects to wetland function are considered beneficial.

Short-Term Construction Impacts

At all three Project Sites, construction activities have the potential to have localized short-term adverse impact on wetlands. Requiring the construction contractor(s) to implement the measures identified in section 2.3, Environmental Commitments would reduce the potential for construction to adversely affect wetlands to the extent feasible. With the environmental commitments in place, project effects to wetlands are expected to be minor.

Alternative 1 Contribution to Cumulative Effects on Wetlands

In combination with activities proposed under other projects within the Seashore and vicinity, the proposed actions would have only a minor, cumulative, adverse effect on wetlands. Most of these adverse impacts would be temporary and, over the long term, the proposed projects would be expected to have a beneficial effect on wetlands and wetland functionality.

Alternative 1 Conclusion on effects on Wetlands

Overall, Alternative 1 would result in minor short-term adverse impacts associated with conversion or direct impacts as a result of construction. In the long-term, the recovery or conversion to more ecologically sustainable wetlands and habitat is considered a benefit to wetlands and wetland functionality at all the Project Sites.

Table 4.25 Alternative 1: Effect on Wetland Resources

Sites	Resources	Type and intensity of short term effect	Type and intensity of long-term effect
Limantour Beach Pond	Section 401 regulated wetlands	Negligible adverse	Negligible adverse
	CCC Regulated Wetlands	Minor adverse	Negligible adverse
	NPS DO-71 Wetlands	Minor adverse	Minor adverse
	Wetland Functionality	Minor adverse	Beneficial
Muddy Hollow Pond	Section 401 regulated wetlands	Minor adverse	Minor adverse
	CCC Regulated Wetlands	Minor adverse	Minor adverse
	NPS DO-71 Wetlands	Moderate adverse	Minor adverse
	Wetland Functionality	Minor adverse	Beneficial
Glenbrook Crossing	Section 401 regulated wetlands	Minor adverse	Minor adverse
	CCC Regulated Wetlands	Moderate adverse	Minor adverse
	NPS DO-71 Wetlands	Moderate adverse	Minor adverse
	Wetland Functionality	Minor adverse	Beneficial
All Sites	Cumulative effects	Minor adverse	Beneficial

Alternative 1 would not result in impairment to Park wetland resources.

Alternative 2: Partial-Build Approach (Preferred Alternative at Glenbrook Crossing)

Effects on Wetlands

The proposed action would have very similar effects to Alternative 1 on wetlands subject to jurisdiction or oversight either by the Corps (see Table 4-27), the CCC (see Table 4-28), or the NPS.

Wetland Effects at Limantour Beach Marsh. As with Alternative 1, the proposed action would result in negligible impacts to potential Corps' jurisdictional Section 404 and Section 10 wetlands and waters (Table 4-27). The Corps has not verified this delineation, so impact estimates could change. However, the proposed action calls for very little in the way of new fill or excavation activities. There would be negligible effects on Corps' jurisdictional wetlands and waters from either permanent or temporary "fill" and/or excavation activities.

Impacts to wetlands potentially subject to oversight by the CCC would be very similar to those described under Alternative 1, with a few exceptions (see Table 4-28). Excavation of the existing beach access berm for installation of a causeway would impact 0.31 acre of Palustrine Scrub-Shrub and Emergent wetlands, compared to 0.14 acre of wetlands for installation of a bridge under Alternative 1. As with Alternative 1, these impacts would be temporary, with these areas expected to rapidly convert to Estuarine Emergent wetlands with the improved hydrologic connectivity between Limantour Marsh and Limantour Pond. Excavation impacts to wetlands potentially subject to CCC oversight total 0.75 acre. Excavation activities would result in short-term minor adverse effects to wetlands. In the long-term there would be no permanent loss, and effects on potential CCC wetlands are characterized as adverse negligible.

Impacts to wetlands potentially subject to oversight by the NPS are identical to those described under Alternative 1. Permanent impacts to or loss of wetlands subject to NPS oversight would be minor, adverse, and long-term.

Effects of the proposed action on wetland functions would be identical to those described under Alternative 1. The short-term effects to wetland function would be minor adverse. In the long-term, as sites recover, the effects of the project on wetland function would be beneficial.

Wetland Effects at Muddy Hollow. Areal impacts to Section 404 and Section 10 jurisdictional features would be very similar to that under Alternative 1, with one exception (see Table 4-27). Phasing removal of the dam and draining of the pond would require installation of a culvert underneath the dam that would connect to the excavated channel in the existing Limantour Marsh. Inclusion of a culvert would probably result in both minor (<0.001 acre) temporary and permanent impacts to Section 404 wetlands from installation of the culvert and placement of riprap at the culvert ends, respectively. Therefore, the proposed action would impact approximately 0.17 acre of Non-Tidal Waters, 0.001 acre of Non-Tidal Wetlands, and 0.002 acre of Section 10 waters. Impacts to Corps' jurisdictional wetlands from "fill" would be minor, adverse, and long-term. There would very minor short-term impacts (as defined by the Corps) to wetlands from fill activities such as culvert installation.

Impacts to wetlands potentially subject to oversight by the CCC are identical to those described under Alternative 1 (see Table 4-28), although there would be a very minor (<0.001 acre) shift in the type of impact from excavation to fill. Short-term activities would impact wetlands and only cause a very small amount of conversion of wetland to upland habitat, resulting in minor adverse impacts to CCC potential jurisdictional wetlands. In the long-term, this conversion is characterized as a minor adverse effect.

Impacts to wetlands potentially subject to oversight by the NPS are also identical to those described under Alternative 1. Short-term impacts to wetlands associated with deconstruction and pond removal would be moderate adverse. Permanent impacts to or loss of wetlands subject to NPS oversight would be minor, adverse, and long-term.

Effects of the proposed action on wetland functions would be very similar to those described under Alternative 1, although the timeframe over which these functions would improve would be longer relative to Alternative 1. Impacts to wetland functionality would be beneficial, and long-term, although there may be some short-term, minor, adverse impacts to functioning of Project Site and downstream wetlands from increased erosion and sedimentation immediately following project implementation.

Wetland Effects at Glenbrook Creek. Impacts to Section 404 jurisdictional wetlands would be identical to those described under Alternative 1 (see Table 4-27). The proposed action would cause approximately 0.19 acre of impacts to Non-Tidal Waters from elevating the downstream portion of the creek through fill and 0.03 and 0.04 acre of impacts to Adjacent Waters and Wetlands, respectively, from removal of an erosional gully through filling. Impacts to Corps' jurisdictional wetlands from "fill" would be minor, adverse, and long-term. There would be no temporary impacts (as defined by the Corps) to wetlands from fill activities such as temporary stockpiling.

Impacts to wetlands potentially subject to oversight by the CCC would be very similar to Alternative 1 (see Table 4-28), with the exception that only limited excavation would be conducted upstream of the Glenbrook Crossing, resulting in less impact on the palustrine forested area. Therefore, impacts to wetlands potentially subject to CCC oversight are smaller than under Alternative 1, totaling 0.51 acre, approximately ½ of that affected by Alternative 1. Excavation and fill activities would result in short-term minor adverse effects to wetlands and only a small amount of potential permanent loss (0.07 acre), effects on potential CCC wetlands. Because of the fill actions, the long-term effects are also considered minor adverse.

Similarly, permanent impacts to or loss of wetlands subject to NPS oversight would be minor, adverse, and long-term.

The proposed action would have effect wetland functions as described under Alternative 1, although scaling back excavation of the upstream portion of the stream channel could extend the timeframe over which erosion from incision of the aggraded upstream channel occurs. Alternative 2 would leave the existing riparian corridor in place, and allow it to regulate sediment erosion from the project site. This could increase the amount of time during which the Project Site actually represents a source of sediment. In the short-term, increased erosion and sediment loading into the creek immediately following project implementation are considered a minor adverse effect. In the long term, the effect of the project on wetland functionality would be considered beneficial.

Short-Term Construction Impacts

Impacts to wetlands from construction activities would be very similar to those described under Alternative 1, although, at Muddy Hollow, the timeframe of construction would be extended from to two or more seasons and thereby increase the potential for an adverse effect. As with Alternative 1, the construction contractor(s) would be required to implement best management practices to reduce the potential for construction to adversely affect wetlands to the extent feasible. With these mitigation measures in place, effects are still expected to be adverse minor.

Alternative 2 - Contribution to Cumulative Effects on Wetlands

In combination with activities proposed under other projects within the Seashore and vicinity, the proposed actions would have result in minor, cumulative, adverse effect on wetlands. Most of these adverse impacts would be temporary and, over the long term, the proposed projects would be expected to have beneficial effects on wetlands and wetland functionality.

Alternative 2 - Conclusion on effects on Wetlands

Alternative 2 would result in minor short-term adverse impacts associated with conversion or direct impacts as a result of construction. The extended duration associated with Muddy Hollow and the smaller impact area at Glenbrook do not change the overall impacts to wetlands between Alternative 1 and 2. In the long-term, the recovery or conversion to more ecologically sustainable wetlands are considered beneficial to wetlands and wetland functionality at all the Project Sites.

Table 4.26 Alternative 2: Effect on Wetland Resources

Sites	Resources	Type and intensity of short term effect	Type and intensity of long-term effect
Limantour Beach Pond	Section 401 regulated wetlands	Negligible adverse	Negligible adverse
	CCC Regulated Wetlands	Minor adverse	Negligible adverse
	NPS DO-71 Wetlands	Minor adverse	Minor adverse
	Wetland Functionality	Minor adverse	Beneficial
Muddy Hollow Pond	Section 401 regulated wetlands	Minor adverse	Minor adverse
	CCC Regulated Wetlands	Moderate adverse	Minor adverse
	NPS DO-71 Wetlands	Moderate adverse	Minor adverse
	Wetland Functionality	Minor adverse	Beneficial
Glenbrook Crossing	Section 401 regulated wetlands	Minor adverse	Minor adverse
	CCC Regulated Wetlands	Moderate adverse	Minor adverse
	NPS DO-71 Wetlands	Moderate adverse	Minor adverse
	Wetland Functionality	Minor adverse	Beneficial
All sites	Cumulative effects	Minor adverse	Beneficial

Alternative 2 would not result in impairment to Park wetland resources.

Table 4.27 Potential area of impact on Corps regulated wetlands within the Project Area from implementation of Alternatives 1 and 2.

	Wetlands Subject or Potentially Subject to Corps' Jurisdiction (acres)						
	Tidal Water	Tidal Wet	N-T Water	N-T Wet	Adj Water	Adj Wet	Section 10
Muddy Hollow							
Alternative 1			0.17	0.001			0.002
Alternative 2			0.17	0.001			0.002
Limantour Beach Marsh							
Alternative 1							
Alternative 2							
Glenbrook Creek							
Alternative 1			0.19		0.03	0.04	
Alternative 2			0.19		0.03	0.04	

Table 4.28 Potential area of excavation or fill on CCC regulated wetlands within the Project Area from implementation of Alternatives 1 and 2.

	Wetlands Potentially Subject to CCC Oversight (acres)										
	L1UB	PRB	PEM	PEM/ SS	PSS	PSS/ PFO	PFO	E2UB	E2E M	E2SS	Total
Muddy Hollow											
Alternative 1	0.09	0.08					0.60		0.01		**0.78**
Alternative 2	0.09	0.08					0.60		0.01		**0.78**

Limantour Beach Marsh											
Alternative 1				0.07	0.35				0.14	0.02	**0.58**
Alternative 2				0.16	0.43				0.14	0.02	**0.75**
Glenbrook Creek											
Alternative 1			0.04		0.15		1.17				**1.36**
Alternative 2			0.04		0.15		0.32				**0.51**

Alternative 3 – No Action

Effects on Wetlands

Wetland Effects at Muddy Hollow, Limantour Beach Marsh, and Glenbrook Creek. Currently, wetland conditions within the three Project Sites are dependent on the stability of existing structures retaining water and maintaining current hydrologic profiles. While the Limantour Beach pond dam is relatively stable, the Glenbrook Crossing is degraded, with water piping around the culvert and seeps through the embankment causing sloughing of the road. While the size of Muddy Hollow Pond has decreased since construction of the dam, most sediment deposition is occurring further up-valley, and current surface area would likely remain consistent. The dam has been identified as in "seriously deficient condition" (BOR 2000).

Despite this, it is reasonable to believe that in the short-term, facilities and wetlands would remain in their current, stable condition. of the streambed channel downstream of the road crossing appears to be disconnecting the floodplain terrace from the creek and, thereby, potentially decreasing the extent of wetlands subject to CCC and NPS oversight. In addition, incision downstream of the road crossing is also reducing the amount and type of wetland functions performed by this portion of Glenbrook Creek as described in Chapter 3 under Wetlands. Should the NPS continue to maintain the road crossing infrastructure, it is likely that this degradation trend would continue, causing losses of wetlands and wetland functions.

Continued degradation of the facilities at Glenbrook and Muddy Hollow could result in catastrophic failure and uncontrolled impacts to the habitat downstream. Should the culvert and crossing catastrophically fail during a storm, substantial portions of the floodplain wetlands (Section 404 Non-Tidal Wetlands and/or Palustrine Forested) that have established upstream of the crossing on aggraded sediments would likely be lost through erosion as the streambed channel incised or dropped in elevation in order to move into equilibrium with the downstream portion of the channel, which is much lower in elevation. In addition, this erosion would cause this portion of the creek to act as a source of sediment rather than a sink and thereby potentially increase downstream water quality problems.

The Muddy Hollow Pond dam also has the potential to fail catastrophically, although it is in better condition than the Glenbrook Creek culvert and crossing. Should this fail during a storm, there would be potential for a substantial amount of sediment from the Pond to move downstream into the established Coastal Salt Marsh, thereby impacting these wetlands. Rapid draining of the Pond, combined with decreases in elevation of the Pond bottom due to sediment movement, could encourage extensive incision of the highly aggraded, deltaic materials in Muddy Hollow Creek, thereby impacting the extensive floodplain wetlands (Section 404 Non-Tidal Wetlands; Palustrine Forested) present there. As with Glenbrook Creek, this erosion would cause this area to act as a source of sediment rather than a sink and thereby potentially increase water quality problems in Limantour Estero.

Somewhat similar problems would occur if the Limantour Beach Marsh berm failed, although the amount of incision and sediment remobilization would be considerably less than at Muddy

Hollow. Therefore, the impacts to wetlands and wetland functions both within the Project Site and downstream of it in Limantour Marsh would be much lower.

Maintenance of the existing structures at Glenbrook Creek and Muddy Hollow Project Sites could be considered negligible in the short-term. In the long-term, high potential for catastrophic failure and severe impacts on wetlands and wetland functions would result in moderate adverse effects. At Limantour Beach Marsh, maintenance of the existing structure would be considered a long-term, minor, adverse effect on wetlands, because the effects of any catastrophic failure would be considerably less than at the other two Project Sites.

Alternative 3 - Contribution to Cumulative Effects on Wetlands

In combination with activities proposed under other projects within the Seashore and vicinity, maintenance of the existing structures would have a short-term, adverse, negligible effect on wetlands within PRNS and adjoining coastal areas. However, the possible catastrophic failure of at least two of the structures proposed for removal (Glenbrook Creek crossing, Muddy Hollow dam would potentially result in minor adverse cumulative impacts in the long term.

Alternative 3 - Conclusion on Effects on Wetlands

Overall, the No Action Alternative would have adverse, negligible impacts in the short-term and localized minor to moderate, adverse impacts on wetlands and wetland functionality in the long-term. The severity of impact for each Project Site depends to a large degree on the potential for and consequences of catastrophic failure of the existing infrastructure. Limantour Beach Marsh has the lowest potential for catastrophic failure of the culverted berm, and failure would have the least impact on Project Site and downstream and upstream wetlands. Conversely, the potential for catastrophic failure, and associated impacts are much higher at Glenbrook Creek and Muddy Hollow, and should these structures fail, these and adjoining areas would be likely to incise and thereby cause more extensive losses of wetlands and wetland functions.

The No Action Alternative would not result in impairment to Park wetland resources.

Table 4.29 Alternative 3: Effect on Wetland Resources

Sites	Resources	Type and intensity of short term effect	Type and intensity of long-term effect
Limantour Beach Pond	Section 401 regulated wetlands	No effect	Minor adverse
	CCC Regulated Wetlands	Negligible adverse	Minor adverse
	NPS DO-71 Wetlands	Negligible adverse	Minor adverse
	Wetland Functionality	Negligible adverse	No effect
	Cumulative effects	No effect	Minor adverse
Muddy Hollow Pond	Section 401 regulated wetlands	No effect	Moderate adverse
	CCC Regulated Wetlands	Negligible adverse	Moderate adverse
	NPS DO-71 Wetlands	Negligible adverse	Moderate adverse
	Wetland Functionality	Negligible adverse	Moderate adverse
	Cumulative effects	No effect	Minor adverse
Glenbrook Crossing	Section 401 regulated wetlands	No effect	Moderate adverse
	CCC Regulated Wetlands	Negligible adverse	Moderate adverse
	NPS DO-71 Wetlands	Negligible adverse	Moderate adverse
	Wetland Functionality	Negligible adverse	Moderate adverse
	Cumulative effects	No effect	Minor adverse
All Sites	Cumulative effects	No effect	Minor adverse

Effects on Special Status Species

Federal and State Guidance. NPS Management Policies (NPS, 2000) provide a higher level of protection for animal species listed as threatened or endangered by the Federal Endangered Species Act: "The National Park Service will identify and promote the conservation of all federally listed threatened, endangered, or candidate species within Park boundaries and their critical habitats... The National Park Service also will identify all state and locally listed threatened, endangered, rare, declining, sensitive, or candidate species that are native to and present in the Parks, and their critical habitats... All management actions for protection and perpetuation of special status species will be determined through the Park's resource management plan."

Additionally, Park managers are to ensure that Park operations do not adversely impact endangered, threatened, candidate, or sensitive species and their critical habitats, within or outside the Park and must consider federal and state listed species and other special-status species in all plans and NEPA documents (NPS-77 Natural Resource Management Guidelines).

The Federal and California State Endangered Species Acts (ESAs) define the plant and animal species that are to be especially protected due to their imperiled status. These mandates list the protected animals as threatened or endangered, and protect habitat necessary to their continuance. The acts are administered by:

- The U.S. Fish and Wildlife Service (Federal ESA, terrestrial and freshwater species),
- The National Oceanic and Atmospheric Administration's Marine Fisheries Service (Federal ESA, marine and anadromous fishes), and
- The California Department of Fish and Game (California ESA).

The Federal and California State Endangered Species Acts categories for special-status species defined below in Table 4.30.

Table 4.30 Federal and California State ESAs Definitions

***Federal endangered**:* Any species that is in danger of extinction throughout all or a significant portion of its national range.
Federal threatened: Any species that is likely to become an endangered species within the foreseeable future throughout all or a significant portion of its national range.
California endangered: Any species that is in danger of extinction throughout all or a significant portion of its range in the state.
California threatened: Any species that is likely to become an endangered species with the foreseeable future throughout all or a significant portion of its state range.
California rare (plants only): A native plant that, although not currently threatened with extinction, is present in small numbers throughout its range, such that it may become endangered if its present environment worsens.

Furthermore, the Federal Endangered Species Act may specify *critical habitat* – habitat necessary for the survival of a listed species, subspecies, or population – and may limit human activities in these designated areas.

The Federal Endangered Species Act requires federal agencies to consult with the USFWS before taking actions that (1) could jeopardize the continued existence of any federally listed plant or animal species (e.g., listed as threatened or endangered) or species proposed for listing, or (2) could result in the destruction or adverse modification of critical or proposed critical habitat. The USFWS provided upon request a list of species that must be considered for this document.

Under the National Environmental Quality Act, PRNS is required to consider whether an action may violate federal, state, or local laws or requirements imposed for the protection of the environment. For this reason, species listed under the California Endangered Species Act (i.e., those considered endangered or threatened) by the California Department of Fish and Game are included in this analysis. Species proposed for listing in either of the two categories are also included.

The Federal Migratory Bird Treaty Act enacts the provisions of treaties between North American and European countries. Over 800 bird species are protected under the legislation. It mandates federal agencies to consider impacts to protected breeding birds during implementation of projects on Federal lands, including disruption to nesting and egg-laying activities.

Local and Non-Governmental Guidance. The California Native Plant Society (CNPS) lists plant species which merit special protection but which may or may not appear on Federal and California Endangered Species lists. PRNS considers impacts to CNPS-listed species when undertaking a construction or restoration project. The Seashore also recognizes a number of species as locally rare or of special concern, even though they are not officially listed. Species in these categories, as well as those listed by the Federal of California ESAs, are collectively referred to in this document as "special-status species."

The Federal and California State Endangered Species Acts categories for special-status species are defined in Table 4.31.

Table 4.31 California Native Plant Society Definitions

CNPS List 1A:	Presumed Extinct in California
CNPS List 1B:	Rare or Endangered in California and Elsewhere
CNPS List 2:	Rare or Endangered in California, More Common Elsewhere
CNPS List 3:	Need More Information
CNPS List 4:	Plants of Limited Distribution

Assessment Methods

Point Reyes National Seashore supports 27 federally protected species. Within the Project Areas of the Coastal Watershed Restoration – Geomorphic Restoration Project special status species are known to occur, including:

- Coastal California steelhead (*Oncorhynchus mykiss,* federally listed Threatened Species; FT)
- Essential Fish Habitat for coho salmon (*Oncorhynchus kisutch*; federally listed Threatened Species; FT).
- California red-legged frog (*Rana aurora draytonii,* federally listed Threatened Species; FT)
- Critical Habitat for the California red-legged frog
- Western snowy plover (*Charadrius alexandrinus nivosus;* federally endangered Species; FE)

- Breeding habitat for listed neotropical migrant bird species and habitat protected through the Neotropical Migratory Bird Act.

Baseline conditions of these species and their habitat has been identified based on a combination of literature review and field surveys. Fieldwork included:

Reconnaissance-level surveys to assess the suitability of habitat in and adjacent to the Project sites for use by common and special-status wildlife species, wetland delineation and special-status plant species (Parsons and Allen *numerous)*, and California red-legged frog surveys (Fellers and Guscio 2002)

Potential effects of the proposed action on special-status species was assessed qualitatively, based on the professional judgment of PRNS employees in light of existing environmental conditions and familiarity with similar, completed projects. Temporary, construction-related effects are distinguished from long-term effects related to post-restoration adjustments in habitat patterns. Descriptors for evaluating impacts effect, duration, and intensity are shown in Table 4.32.

Table 4.32. Descriptors for Special Status Species

Type of Effect	Beneficial: the proposed action would improve habitat for a special-status plant or animal, and protect and/or restore the natural abundance and distribution of a special-status plant or animal species Adverse: the proposed action would degrade habitat for a special-status plant or animal, and cause a decrease in the natural abundance and distribution of a special-status plant or animal species
Duration of Effect	Short-term: effects on the habitats of special-status species would persist for two years or less; immediate changes in the abundance and/or distribution of special-status species may occur during the construction period, but a return to original conditions would be expected within two generations of that species Long-term: effects on the habitats of special-status species would persist for two years or more beyond the construction period; changes in the abundance and/or distribution of special-status species would continue beyond two generations of that species
Intensity of Effect	Negligible: the proposed action would not measurably alter habitats for special-status species, or create a measurable difference in the distribution and abundance of special-status species Minor: adverse effects to habitats of special-status species would be perceptible, but would be localized in extent; changes in the distribution and abundance of special-status species would be minor and restricted to the Project site Moderate: adverse effects to habitats of special-status species would be apparent and readily noticeable, but would be localized in extent; changes in the distribution and abundance of special-status species would be moderate in intensity and restricted to the Project site and sites immediately adjacent; changes in distribution and abundance of species may be permanent, unless (if adverse) actively managed Major: adverse effects to habitats of special-status species would be substantial, and would effect a significant portion of the Drakes Estero Watershed; changes in the distribution and abundance of special-status species would be substantial, and would effect a large geographic area; changes in distribution and abundance of these species is irreversible, even (if adverse) with active management.

Evaluation of Impacts

Build Alternatives – Alternative 1 and 2

Effects on Special-Status Plants

No federally threatened or endangered plant species are identified within the project work areas.

As discussed in Chapter 3, three special-status plants have been identified as having the potential to occur at the project sites: the Point Reyes bird's-beak (FSC), fragrant fritillary (FSC), and Marin checker lily (FSC). In order to minimize potential construction-related effects on these species, a qualified botanist would survey the sites before construction begins. Where possible,

rare plant sites would be identified and construction fencing would exclude the plants from the work area. Site planning would avoid, to the greatest extent possible, impacts to these special status plant species. With these measures in place, effects should not exceed the minor level.

Over the long term, restoration would improve and/or expand habitats that may support populations of Point Reyes bird's-beak, Marin checker lily, and fragrant fritillary, including coastal salt marsh, grasslands, and scrub habitats. Consequently, the proposed action is expected to have an overall beneficial effect on these special-status plants. No mitigation is required.

Build Alternatives' Contribution to Cumulative Effects on Special-Status Plants

The proposed restoration actions as part of the build projects would avoid direct impacts to special status plants. There are two projects identified in the cumulative effects (Table 4-1) including the Glenbrook dam and quarry restoration and Giacomini Restoration that also include habitat supporting the fragrant fritillary and Point Reyes birds-beak. The proposed activities under the build alternatives would actually expand salt marsh habitat (benefiting the Point Reyes birds-beak) which would also occur as a part of the Glenbrook Dam and Quarry Restoration and Giacomini Restoration. The cumulative impacts to special status species would be negligible adverse in the short-term, and beneficial in the long-term.

Build Alternatives' conclusions on Effects on Special-Status Plants

The project would not result in impacts to federally threatened or endangered plant species. The project would, to the greatest extent possible, avoid direct impacts to special status plants, but deconstruction activities could result in short-term minor adverse effects associated with changes to circulation and depositional patterns. The project build alternatives would result in smoothing of physical and ecological gradients, and in the long-term would result in expansion of habitat beneficial to special status plants in the area.

Alternative 1 or Alternative 2 would not result in impairment of park special-status plant species.

Table 4.33 Alternatives 1 and 2: Overall Effects on Special Status Plants

Sites	Resources	Type and intensity of short term effect	Type and intensity of long-term effect
All Sites	Threatened or Endangered Plants	No effect	No effect
	FSC plants	Minor adverse	Beneficial
	Cumulative	Negligible adverse	Beneficial

Alternative 3 – No Action

Effects on Special-Status Plants

Under the No Action alternative, there would not be any direct actions that would result in impacts to special status plant species.

Alternative 3 - Contribution to Cumulative Effects on Special-Status Plants

Alternative 3 would not contribute to cumulative impacts to special status species associated with projects identified under Table 4-1.

Build Alternatives' conclusions on Effects on Special-Status Plants

Alternative 3 would not result in impacts or impairment to special status plant species in the short-term or in the long-term.

Table 4.34 Alternative 3: Overall Effects on Special Status Plants

Sites	Resources	Type and intensity of short term effect	Type and intensity of long-term effect
All Sites	Threatened or Endangered Plants	No effect	No effect

FSC plants	No effect	No effect
Cumulative	No effect	No effect

Build Alternatives – Alternative 1 and 2

Effects on Special-Status Fishes

Coastal California steelhead (FT) are the only special-status fish species with the potential to be affected by the project. Steelhead are known to be present in the Glenbrook, Muddy Hollow, and Laguna watersheds. In order to ensure that no steelhead are not adversely affected by construction activities, a qualified biologist would monitor dewatering and would relocate any steelhead found in dewatered reaches to nearby suitable habitat, as described under *Environmental Commitments* in Chapter 2. Dewatering pump intakes would be screened to ensure that no fish are injured by pumping. Relocation would follow applicable CDFG and NOAA Fisheries guidelines. With these measures in place, minor adverse effects (likely indirect) on steelhead are possible with the capture and movement of individuals from the construction zone. Following restoration, the proposed action would have a long-term beneficial effect on steelhead, by improving inland passage and rearing habitat at Limantour Beach Marsh, Muddy Hollow, and particularly at Glenbrook Crossing.

The project area also includes areas (particularly Muddy Hollow and Limantour Beach Pond) that could support the tidewater goby (FE). The proposed restoration activities within these two areas could create or enhance habitat to support the tidewater goby. The restoration activities would not effect the species in the short term but could result in beneficial effects supporting or enhancing habitat in the long-term.

Given the similarity of the species and habitat utilization, the effects to steelhead habitat are identical to those for Magnuson-Stevens Fishery Conservation and Management Act Essential Fish Habitat (EFH). The more flexible life-history of steelhead trout is likely the reason that they remain in these watersheds while coho have been lost. Restoration actions would address a number of impediments to fish passage. The short-term minor adverse impacts associated with construction would result in greater available access to habitat resulting in long-term beneficial effects to EFH.

Build Alternatives' Contribution to Cumulative Effects on Special-Status Fish

In the short-term, combined effects from the restoration actions would result in short-term minor cumulative effects. The long-term cumulative effect on special-status species is regarded as a benefit because, as identified above, all of these actions would foster a return to conditions more closely resembling the historic habitat mosaic in the Drake's Bay/Drake's Estero watershed. This would be particularly true for steelhead and potential coho, which would benefit from improvements in lagoonal/estuarine habitat and inland passage. Under either build alternative, the proposed action would be an important contributor to this beneficial effect.

In the Drakes Bay watershed, the large-scale geomorphic and hydrologic adjustments could result cumulatively in minor adverse short-term impacts to EFH within the Drakes Bay area. In the long-term, restoration of natural hydrologic process and removal of fish passage impediments would be beneficial to EFH within the Drakes Bay area.

Build Alternatives' conclusions on Effects on Special-Status Fish

Restoration actions under the build alternatives would result in increased sediment loading following deconstruction, but would restore habitat and access to habitat available to the fish in the long-term. Based on this analysis, the project build alternatives would result in short-term minor effects to special status fish (namely steelhead) and EFH within the project watersheds. The proposed actions, intended to restore hydrologic connectivity and access to the Muddy Hollow and Glenbrook watersheds would result in long-term beneficial effects to steelhead, potential coho salmon habitat, and EFH.

Alternative 1 or Alternative 2 would not result in impairment of park special-status fish species.

Table 4.35 Alternatives 1 and 2: Overall Effects on Special Status fish species

Sites	Resources	Type and intensity of short term effect	Type and intensity of long-term effect
All Sites	Steelhead	Minor adverse	Beneficial
	Tidewater goby	No effect	Beneficial
	EFH	Minor adverse	Beneficial
	Cumulative	Negligible adverse	Beneficial

Alternative 3 – No Action

Effects on Special-Status Fish

Steelhead are known to be present in the Glenbrook, Muddy Hollow, and Laguna watersheds. These species would not be directly effected under Alternative 3. The project sites pose differing conditions effecting the long-term success of steelhead.

Under no action, the habitat barrier at the Glenbrook Crossing would remain, with conditions worsening over time and posing increased potential for catastrophic failure and impacts. At Muddy Hollow and Limantour Beach marsh, the dam structures are considered impediments to fish migration from the ocean back to freshwater streams. The dams do not allow for natural salinity gradients to which the fish may adjust, rather the dams are sites where distinct and abrupt water conditions are located. This effect has been described as a physiological barrier to fish passage (SWRCB 1995). Fish that reside within Muddy Hollow pond would remain, though the habitat is not permanent, as the earthen dam would continue to degrade in the long-term.

The project area also includes areas (particularly Muddy Hollow and Limantour Beach Pond) that could support the tidewater goby (FE). The potential for restoration of these species would not likely be possible without potential restoration activities identified as Alternatives 1 and 2.

The existing structures impede access to Magnuson-Stevens Fishery Conservation and Management Act Essential Fish Habitat (EFH). Under no action, these impediments would remain.

In the long-term, potential for catastrophic failure of these facilities would result in moderate adverse effects as the changes to habitat evaluated under the build alternatives would be compounded by the additional sediment contained in the dam or crossing structures.

Alternative 3 - Contribution to Cumulative Effects on Special-Status Fish

In the short-term, the no action alternative would not contribute to cumulative impacts to the special status fish species and EFH. In the long-term, potential catastrophic (unplanned) failure would result in minor cumulative adverse impacts to special status fish species and EFH.

Alternative 3 - Conclusions on Effects on Special-Status Fish

Under the no action alternative, there would be no effect on special status fish species and EFH in the short term. In the long-term, the potential for catastrophic failure would result in minor to moderate adverse impacts to steelhead and EFH in the project area.

Alternative 3 would not result in impairment of park special-status fish species.

Table 4.36 Alternative 3: Overall Effects on Special Status fish species

Sites	Resources	Type and intensity of short term effect	Type and intensity of long-term effect
Muddy Hollow Pond	Steelhead	No effect	Moderate adverse

	Tidewater goby	No effect	Minor adverse
	EFH	No effect	Moderate adverse
Limantour Beach Pond	Steelhead	No effect	Minor adverse
	Tidewater goby	No effect	Minor adverse
	EFH	No effect	No effect
Glenbrook Crossing	Steelhead	No effect	Moderate adverse
	Tidewater goby	No effect	No effect
	EFH	No effect	Moderate adverse
All Sites	Cumulative	No effect	Minor adverse

Build Alternatives – Alternative 1 and 2

Effects on Special-Status Amphibians

The only special-status amphibian likely to be affected by the proposed action is the California red-legged frog. Red-legged frogs typically aestivate during the mid-summer period and would be unlikely to use aquatic and shoreline habitat during at least the early portion of the construction window, although they might return to the area before construction was completed. If California red-legged frogs are present within the construction area during the construction period, earthwork or other activities may result in direct mortality or injury. Installation of construction fencing around sensitive habitats (see Chapter 2) would reduce potential effects on the frog by confining construction activities and traffic to the immediate construction footprint. The NPS would also have a qualified biological monitor onsite during key parts of the construction window.

In addition to the known sites, the USGS-BRD is currently surveying Wilderness sites within the Seashore, and has documented 11 sites where CRLF use was not previously documented (Fellers and Osbourn, 2004). The completion of biologic and geomorphic investigations describing factors contributing to habitat suitability and sustainability within Wilderness and other breeding habitat within the Seashore would result in the development of a prioritized list and plan to maintain the highest quality Wilderness CRLF breeding habitat.

A biological assessment (BA) is currently in preparation for the proposed action. As part of the BA process, NPS would work with USFWS to identify appropriate mitigation for adverse impacts on red-legged frogs and their habitat.

Muddy Hollow Pond

At the Muddy Hollow Pond, restoration actions would result in permanent removal of the dam facility and conversion of the pond (critical breeding habitat) to a more naturally graded tidal and freshwater marsh area. Surveys at the site (Fellers and Guscio 2002) have identified individuals using the pond, though no breeding activities or tadpoles have been observed. The pond does contain bass and trout that could be effective predators against establishment of a large population. The proposed actions at Muddy Hollow Pond may affect, and are likely to adversely affect the California red-legged frog and potential critical breeding habitat.

Limantour Beach Pond

At the Limantour Beach Pond, restoration actions would result in permanent removal of the dam facility and conversion of the pond habitat to a more naturally graded tidal and freshwater marsh area. Surveys at the site (Fellers and Guscio 2002) identified breeding actions at the pond, and estimated a total of 50 individuals using the pond. The proposed actions at the Limantour Beach Pond may affect, and are likely to adversely affect the California red-legged frog and critical breeding habitat.

As part of the proposed restoration, existing topographic depressions to the east of the existing pond would be accentuated (through excavation) to intersect the groundwater table. It has been observed that frogs using seasonally saline habitat will move to adjacent habitat when necessary.

In addition to creating appropriate water regime, the habitat enhancement would include placement or planting of pond edge plants to provide cover and structure for the frogs.

Glenbrook Crossing

At the Glenbrook Crossing site, restoration actions would result in short-term impacts to critical non-breeding habitat. The project actions would modify, but not change the long-term habitat condition at this project site. These actions may effect, but are not likely to adversely effect the California red-legged frog or its critical non-breeding habitat.

Build Alternatives' Contribution to Cumulative Effects on Special-Status Amphibians

Some of the proposed marsh restoration activities associated with Horseshoe Pond, Giacomini Wetland, and the Coastal Restoration Project would result in the conversion of freshwater or low salinity aquatic environments to estuarine aquatic habitat. Based on field surveys projects at Horseshoe, Limantour Beach Pond, and Giacomini would result in impacts to pond habitat that are known to support the California red-legged frog. In addition, Muddy Hollow Pond is considered critical habitat, however field surveys (Guscio and Fellers 2002) documented only limited use of the pond by the CRLF.

More than 120 sites within the park have been documented to support California red-legged frog breeding. The proposed project activities would result in the conversion of two currently freshwater resources into estuarine habitat. As documented at Horseshoe Pond, the CRLF may continue to use this type of habitat, even under brackish water conditions. Cumulatively, planned projects within the park would potentially result in changes or conversion of habitat at three documented breeding habitat sites.

The cumulative impacts of activities occurring within the Drakes Bay area would result in minor adverse impacts to the California red-legged frog. This project would not jeopardize the persistence of California red-legged frogs in the project area or within the park.

Build Alternatives' conclusions on Effects on Special-Status Amphibians

The effects of changing habitat associated with the proposed restoration activities would result in localized short-term moderate adverse effects on the California red-legged frogs and the critical habitat at Limantour Beach Pond and Muddy Hollow Pond. In the long-term, enhancement actions adjacent to Limantour Beach Pond are expected to offset long-term impacts, resulting in minor adverse effects to the individuals. At the Glenbrook Crossing, non-breeding habitat would be effected, and only temporarily. The actions at Glenbrook Crossing would result in localized minor adverse effects in the short-term, with long-term beneficial effects as the system moves towards natural equilibrium. The proposed action alternatives would not result in impairment of park special-status amphibian species. The build alternatives would not jeopardize the persistence of California red-legged frogs in the project area or within the park.

Table 4.37 Alternatives 1 and 2: Overall Effects on Special Status Amphibians

Sites	Resources	Type and intensity of short term effect	Type and intensity of long-term effect
Muddy Hollow Pond	CRLF	Minor adverse	Minor adverse
	CRLF Critical Habitat	Moderate adverse	Moderate adverse
Limantour Beach Pond	CRLF	Moderate adverse	Minor adverse
	CRLF Critical Habitat	Moderate adverse	Moderate adverse
Glenbrook Crossing	CRLF	Minor adverse	Beneficial
	CRLF Critical Habitat	Minor adverse	Beneficial
All sites	Cumulative effects	Minor adverse	Minor adverse

Alternative 3 – No Action

Effects on Special-Status Amphibians

Under no action, there would not be effects to California red-legged frog or habitat as a result of direct activities at any of the project locations. In the long-term, degradation of earthen dam facilities and normal weather may result in loss of dam facilities (Muddy Hollow Pond) or intrusion of salt water flow through dune breaching (Limantour Beach Pond). Any of these potential impacts would occur in the long-term.

Alternative 3 - Contribution to Cumulative Effects on Special-Status Amphibians
In the short-term, the no action alternative would not contribute to cumulative impacts to the California red-legged frog. In the long-term, potential catastrophic (unplanned) failure would result in minor cumulative adverse impacts to these resources in conjunction with projects identified in Table 4-1.

Alternative 3 - Conclusions on Effects on Special-Status Amphibians
Under the no action alternative, there would be no effect on special status amphibians in the short term. In the long-term, the potential for catastrophic failure would result habitat loss similar to that described for the build alternatives, and therefore minor to moderate localized adverse impacts at these sites.

Alternative 3 would not result in impairment of park special-status amphibians.

Table 4.38 Alternative 3: Overall Effects on Special Status Amphibians

Sites	Resources	Type and intensity of short term effect	Type and intensity of long-term effect
Muddy Hollow Pond	CRLF	No effect	Minor adverse
	CRLF Critical Habitat	No effect	Minor adverse
Limantour Beach Pond	CRLF	No effect	Moderate adverse
	CRLF Critical Habitat	No effect	Moderate adverse
Glenbrook Crossing	CRLF	No effect	Minor adverse
	CRLF Critical Habitat	No effect	Minor adverse
All sites	Cumulative effects	No effect	Minor adverse

Build Alternatives – Alternative 1 and 2

Effects on Special-Status Reptiles

The northwestern pond turtle (*Clemmys marmorata marmorata*) is the only special-status reptile that has been identified as having the potential to occur on or adjacent to the restoration sites. The construction period for the proposed project overlaps with the active period for northwestern pond turtle (March–October/November). Therefore, the operation of construction equipment in or adjacent to aquatic habitat that may be used by the species could result in injury or mortality of pond turtles. Actions identified in the environmental commitments, including site fencing would limit the potential for direct impacts to the pond turtles. The deconstruction activities would result in changes to the existing habitat and are considered a localized moderate adverse effect at Muddy Hollow Pond and Limantour Beach Pond in the short-term.

Over the long term, the shift in habitat patterns anticipated as a result of restoration would result in a loss of habitat for northwestern pond turtle, most notably at Muddy Hollow Pond. These changes would result in minor adverse effects on the turtle in the long-term.

There is not likely an effect on the turtle as a result of activities at the Glenbrook Crossing site.

Build Alternatives' Contribution to Cumulative Effects on Special-Status Reptiles
The northwestern pond turtle has been documented in many park ponds including both brackish and freshwater conditions. Northwestern pond turtles are known to occur in aquatic habitats that range in salinity content from fresh to brackish to seawater. Turtles typically nest in grassy upland areas adjacent to ponds. The operations associated with the pond deconstruction could result in indirect impacts to the turtle. The deconstruction activities, in combination with actions at the Horseshoe Pond restoration site represent minor adverse cumulative impacts in short term. As habitat stabilizes, there would likely be some, though reduced use in association with the restored habitat, resulting in long-term negligible adverse cumulative effects on special status reptiles.

Build Alternatives' conclusions on Effects on Special-Status Reptiles
The build alternatives would result in indirect impacts on the northwestern pond turtle through changes in habitat at Muddy Hollow and Limantour Beach Pond. These changes represent a localized moderate adverse impact in the short-term and minor adverse impacts in the long-term within the project area. The project actions at Glenbrook Crossing would not effect the northwestern pond turtle.

Alternative 1 or Alternative 2 would not result in impairment of park special-status reptile species.

Table 4.39 Alternatives 1 and 2: Overall Effects on Special Status Reptiles

Sites	Resources	Type and intensity of short term effect	Type and intensity of long-term effect
Muddy Hollow Pond	Northwestern Pond Turtle	Moderate adverse	Moderate adverse
Limantour Beach Pond	Northwestern Pond Turtle	Moderate adverse	Moderate adverse
Glenbrook Crossing	Northwestern Pond Turtle	No effect	No effect
All Sites	Cumulative effects	Minor adverse	Negligible adverse

Alternative 3 - No Action

Effects on Special-Status Reptiles

The northwestern pond turtle is the only special-status reptile that has been identified as having the potential to occur on or adjacent to the restoration sites. Under no action, there would be no direct effects to special status reptile species. In the long-term, potential failure of facilities (particularly Limantour Beach Pond and Muddy Hollow Pond) could result in minor impacts to the potential habitat and use by the northwestern pond turtle.

Alternative 3 - Contribution to Cumulative Effects on Special-Status Reptiles
The northwestern pond turtle (*Clemmys marmorata marmorata*) has been documented in many park ponds including both brackish and freshwater conditions. Northwestern pond turtles are known to occur in aquatic habitats that range in salinity content from fresh to brackish to seawater. Turtles typically nest in grassy upland areas adjacent to ponds. In the short-term, Alternative 3 would not result in cumulative impacts to special status reptiles. In the long-term, the potential for catastrophic failure could result in minor adverse cumulative impacts on special status reptiles.

Alternative 3 - Conclusions on Effects on Special-Status Reptiles
In the short-term the no action alternative would not result in direct or indirect impacts on the northwestern pond turtle within the project area. In the long-term, potential catastrophic failure could result in minor long-term impacts to the special status reptile species. The project actions at Glenbrook Crossing would not effect the northwestern pond turtle.

Alternative 3 would not result in impairment of park special-status reptile species.

Table 4.40 Alternatives 3: Overall Effects on Special Status Reptiles

Sites	Resources	Type and intensity of short term effect	Type and intensity of long-term effect
Muddy Hollow Pond	Northwestern Pond Turtle	No effect	Minor adverse
Limantour Beach Pond	Northwestern Pond Turtle	No effect	Minor adverse
Glenbrook Crossing	Northwestern Pond Turtle	No effect	No effect
All Sites	Cumulative effects	No effect	Minor adverse

Build Alternatives – Alternative 1 and 2

Effects on Special-Status Birds

With the concern about western snowy plover and migratory bird nesting disturbance in mind, NPS would not initiate construction until August 1. Surveys would be conducted at sites where construction may be initiated prior to August 1 to verify that no late-nesting birds are present on or immediately adjacent to the restoration sites. Surveys would be conducted by a qualified biologist and would use approved methods. If nesting migratory birds or active nests are identified during the surveys, NPS would delay the onset of construction at the affected site until the young have fledged and left the nest.

Only one site, the Limantour Beach Pond is near beach that would be used by the plovers for nesting. Limantour Beach Pond and Muddy Hollow Pond are near marsh habitat that plovers could use for foraging activities in the fall. SNPL surveys extend to mid-September. Since 2000, no SNPL have been observed nesting on the Limantour Beach Area. Before initiating work at the Limantour Beach Project site, a biological monitor would walk the site prior to starting equipment to insure that there are no feeding plovers at the site.

However, several special-status bird species may use habitats at the restoration sites, including the tricolored blackbird, osprey, salt marsh common yellowthroat, and California black rail. Noise, vibration, visual, and proximity-related disturbances associated with construction could adversely affect any of these species. The principal concern in this regard would be the potential for disruption of nesting; disturbance of nesting pairs can cause them to abandon their young, reducing breeding success. At other times, these species are highly mobile and would be expected to relocate if disturbed. With the concern about nesting disturbance in mind, NPS would not initiate construction until August 1, after the close of the migratory bird nesting period. Surveys would be conducted at sites where construction would be initiated prior to August 1 to verify that no late-nesting birds are present on or immediately adjacent to the restoration sites (see Chapter 2). Surveys would be conducted by a qualified biologist and would use approved methods. If nesting migratory birds or active nests are identified during the surveys, NPS would delay the onset of construction at the affected site until the young have fledged and left the nest. With these environmental commitments in place, negligible adverse effect on special-status birds is expected during construction. No effects would likely occur in the long-term.

Key long-term effects on bird habitat, including habitat used by special-status birds, are discussed above in *Effects on Vegetation and Wildlife*.

Build Alternatives' Contribution to Cumulative Effects on Special-Status Birds

The proposed build alternatives would be conducted after the breeding season for special status birds has concluded. This would avoid direct cumulative impacts to potential special status bird species in the project area. As a result, this project in combination with those identified in Table 4-1 would result in negligible short-term cumulative effects, and no effect in the long-term.

Build Alternatives' conclusions on Effects on Special-Status Birds

Analysis of Alternatives 1 and 2 indicates that there would not be impacts to bird reproduction and nesting, associated with project construction window. For resident birds, construction noises would persist for a period of 2-3 weeks at each site, but construction would avoid direct impacts. Standard mitigations to avoid impacts to the western snowy plover would include morning surveys adjacent to the work area. If snowy plovers are encountered, equipment would not be started until after the plovers fly away from the area.

The project would result in negligible short-term effects on special status birds, and as a result of restoration of marsh habitat at Limantour Beach Pond and Muddy Hollow, potential black rail, salt marsh common yellowthroat, and sora habitat would expand in the local area. The long-term effects therefore would be beneficial to the special status bird species and their habitat. Because of the timing of the project, the actions at Glenbrook crossing would not result in impacts to special status bird species in the short or long-term.

Alternative 1 or Alternative 2 would not result in impairment of park special-status bird species.

Table 4.41 Alternatives 1 and 2: Overall Effects on Special Status Birds

Sites	Resources	Type and intensity of short term effect	Type and intensity of long-term effect
All Sites	Federal T&E birds	Negligible adverse	No effect
	Special status birds	Negligible adverse	No effect
	Cumulative	Negligible adverse	No effect

Alternative 3 - No Action

Effects on Special-Status Birds

Under no action, there would not be impacts to special status birds as a result of construction activities. In the long-term, there is potential for these facilities to fail, unexpectedly and catastrophically. These uncontrolled failures could result in minor adverse impacts to the habitat (riparian and marsh) that supports a variety of special status bird species.

Alternative 3 - Contribution to Cumulative Effects on Special-Status Birds

The no action alternative would not contribute to short-term cumulative effects to special status bird species. In the long-term, unplanned, catastrophic failure could result in negligible cumulative adverse impacts to the habitat supporting special status bird species.

Alternative3 - Conclusions on Effects on Special-Status Birds

Analysis of Alternatives 3 indicates that there would not be impacts to bird reproduction and nesting as the result of construction activities. In the long-term, the potential for catastrophic failure would result in minor impacts to the habitat of special status bird species.

Alternative 3 would not result in impairment of park special-status bird species.

Table 4.42 Alternative 3: Overall Effects on Special Status Birds

Sites	Resources	Type and intensity of short term effect	Type and intensity of long-term effect
All Sites	Federal T&E birds	No effect	Minor adverse
	Special status birds	No effect	Minor adverse
	Cumulative	No effect	Negligible adverse

Build Alternatives – Alternative 1 and 2

Effects on Special-Status Mammals

The Point Reyes mountain beaver is the only special-status mammal that has been identified as having the potential to occur in the vicinity of the project sites; the species is known to use colluvial hollows in the project watersheds. However, the Limantour Beach Marsh, Glenbrook Crossing, and Muddy Hollow sites are not in areas considered suitable habitat for the mountain beaver. There is potential that the trail reroutes associated with both Muddy Hollow and Glenbrook crossing would cross colluvial hollows providing potential habitat. In order to avoid disturbance of mountain beavers during construction at the higher-elevation Glenbrook Crossing site, a qualified biologist would perform preconstruction surveys for the species in the vicinity of these routes. If individuals of the species are found, NPS staff would identify a suitable route within the general area to avoid direct impacts to the habitat. With this measure in place, short-term effects on the Point Reyes mountain beaver would be negligible.

The proposed action would have no long-term effect on the Point Reyes mountain beaver or its habitat.

Build Alternatives' Contribution to Cumulative Effects on Special-Status Mammals

The cumulative impacts on special status mammals would not result in any additional impacts to special status mammals, particularly the Point Reyes Mountain Beaver. Negligible cumulative short-term effect on special-status mammals may occur.

Build Alternatives' conclusions on Effects on Special-Status Mammals

The build alternatives would result in the potential for indirect impacts, and would be negligible in the short term, but in the long-term no effect on Point Reyes mountain beaver is likely. Alternative 1 or Alternative 2 would not result in impairment of park special-status mammal species.

Table 4.43 Alternatives 1 and 2: Overall Effects on Special Status Mammals

Sites	Resources	Type and intensity of short term effect	Type and intensity of long-term effect
All Sites	Special status mammals	Negligible adverse	No effect
	Cumulative	Negligible adverse	No effect

Alternative 3 – No Action

Effects on Special-Status Mammals

Under no action, there would be no effects to special status mammal species in the short or long-term.

Alternative 3 - Contribution to Cumulative Effects on Special-Status Mammals

The cumulative impacts on special status mammals would not result in any short-term or long-term impacts to special status mammals, particularly the Point Reyes Mountain Beaver.

Alternative3 - Conclusions on Effects on Special-Status Mammals

The no action alternative would not result in the potential for direct or indirect impacts, and would be no effect to special status mammal species in the short or long-term. Alternative 3 would not result in impairment of park special-status mammal species.

Table 4.44 Alternative 3: Overall Effects on Special Status Mammals

Sites	Resources	Type and intensity of short term effect	Type and intensity of long-term effect

All Sites	Special status mammals	No effect	No effect
	Cumulative	No effect	No effect

Build Alternatives – Alternative 1 and 2

Effects on Special-Status Invertebrates

Special status invertebrate species that could occur within the project area include Myrtle's silverspot butterfly (FT) and the globose dune beetle (FSC). The project is within the range of the Myrtle's silverspot butterfly at PRNS. However, the majority of the species habitat is upland nectar and breeding host plants. Therefore, it is not anticipated that construction activities would result in the take of the species, but could result in minimal indirect habitats through the loss of habitat. The Limantour Beach Pond project site includes dune habitat that could support the globose dune beetle.

Build Alternatives' Contribution to Cumulative Effects on Special-Status Invertebrates

The cumulative impacts on special status invertebrates would not result in any additional impacts to the myrtle's silverspot butterfly in the short or long-term. The project could affect small areas of dune habitat that could support globose dune beetle and impacts are considered minor adverse. The short-term cumulative impacts to the Myrtle's silverspot butterfly are considered to be negligible, with no effect on the species in the long-term.

Build Alternatives' conclusions on Effects on Special-Status Invertebrates

The build alternatives would result in the potential for indirect impacts, and would be minor in the short term, but in the long-term no effect on special status invertebrates is likely. For this reason, it is concluded that the proposed build actions would result in minor short-term impacts to special status invertebrate species. In the long-term, restoration of more natural conditions and processes would result in beneficial effects to special status invertebrate species, specifically the globose dune beetle.

Alternative 1 or Alternative 2 would not result in impairment of park special-status invertebrate species.

Table 4.45 Alternatives 1 and 2: Overall Effects on Special Status Invertebrates

Sites	Resources	Type and intensity of short term effect	Type and intensity of long-term effect
All Sites	Special status invertebrates	Negligible adverse	Beneficial
	Cumulative	Negligible adverse	Beneficial

Alternative 3 - No Action

Effects on Special-Status Invertebrates

Under no action, there would be no short or long-term effects on special status invertebrate species as a result of direct action.

Build Alternatives' Contribution to Cumulative Effects on Special-Status Invertebrates

Under no action, there would be no cumulative short or long-term effects on special status invertebrate species as a result of direct action

Build Alternatives' conclusions on Effects on Special-Status Invertebrates

Under no action, there would be no short or long-term effects on special status invertebrate species as a result of direct action

Alternative 3 would not result in impairment of park special-status invertebrate species.

Table 4.46 Alternative 3: Overall Effects on Special Status Invertebrates

Sites	Resources	Type and intensity of short term effect	Type and intensity of long-term effect
All Sites	Special status invertebrates	No effect	No effect
	Cumulative	No effect	No effect

4.4 Effects on the Social Environment

Effects on Cultural Resources

Policies and Regulations

Overview

Federal Agencies are mandated to protect cultural resources by the National Historic Preservation Act, Section 106. Although NHPA § 106 requires a slightly different impact analysis than does the National Environmental Policy Act (NEPA), compliance obligations under these two federal mandates are typically integrated into a single NEPA assessment document. These differences are described below under "Assessment Methods."

The NHPA requires that before initiating an action, the NPS must evaluate the project's potential adverse effects on resources eligible for listing on the National Register of Historic Places. In addition, the NPS must solicit comments from the Advisory Council on Historic Preservation, the California State Historic Preservation Office (SHPO), and other interested parties. The NPS and the SHPO must come to an agreement regarding mitigation for adverse effects on historic resources. This agreement must be outlined in a Memorandum of Agreement between the two agencies.

The Native American Graves Protection and Repatriation Act (NAGPRA) prescribes procedures for appropriate treatment of Native American burials and associated grave goods. These requirements have been incorporated into the mitigation measures identified in the following analysis.

In addition, NPS Director's Order #28 provides guidance for managing archeological resources, cultural landscapes, historic and pre-historic structures, museum objects, and ethnographic resources. When evaluating potential impacts to these resources, NPS managers must consider the resources' significance, context, and integrity.

NPS policy and legislation directs the agency to consult with local tribal government prior to initiating an action that may effect the human environment.

Assessment Methods

Under Section 106 of the NHPA the NPS must evaluate a project's potential direct impacts, operational impacts, and indirect impacts on cultural resources.

Direct effects are those where the actions associated with the project are the cause of the impacts.

Operational effects occur as a result of associated operations like staging.

Indirect effects are ones where the actions result in changes to local context such that cultural resources would be affected. As such, direct and operational effects for cultural resources are the equivalent of direct impacts under NEPA, while indirect effects on cultural resources correspond to indirect and cumulative impacts.

Different from NEPA, NHPA § 106 process considers only the adverse effects upon cultural resources, not potentially beneficial ones. A qualitative scale of impact intensity (negligible, minor, moderate, major) is also foreign to the Section 106 process - effects are either adverse (when the integrity of the historic property is diminished due to the undertaking) or they are not. Duration is not typically factored when assessing effects during the Section 106 process.

Cultural resources investigations performed for the proposed action included a records search, consultation with Native American representatives with interest in the project area, and field survey work. The following paragraphs provide additional detail.

To identify known cultural resources in the project area, Archaeological Services Center conducted a records search at the Northwest Information Center of the California Historical Resources Information System, housed at Sonoma State University in Rohnert Park. The records search covered the entire APE. Resources consulted included the state database of previous studies and previously recorded cultural resources sites; the NRHP; the California Register of Historic Resources; *California Historical Landmarks* (California Office of Historic Preservation 1990); *Historic Spots in California* (Hoover et al. 1990); and *Five Views: An Ethnic Historic Site Survey for California* (California Office of Historic Preservation 1988). Results were summarized in a report by Newland (2004).

In November and December of 2001, the entire APE was subjected to archaeological survey under the direction of Michael Newland from the ASC. Frank Ross of the Federated Indians of the Graton Rancheria and Mark Rudo, an NPS archaeologist, also participated in the survey. A combination of reconnaissance and intensive survey techniques was used; in particular, areas where vegetation permitted, and potentially sensitive areas, were intensively examined.

On February 18, 2003, Mark Rudo and Jessica Maxey of the NPS surveyed the reported location of CA-Mrn-236/H. Their survey covered the site location as identified by Jablonowski et al. (1999) and the surrounding area to a diameter of approximately 5 meters from the visible surface materials, and included surface scraping and random troweling to a depth of approximately 5 inches. Results of this survey are described under *Cultural Resources* in Chapter 3.

For the purpose of this evaluation, Section 106 effect categories are considered, and a qualitative scale is used to show impact intensity. Descriptors for evaluating impacts effect, duration, and intensity are shown in Table 4-47.

Table 4-47. Descriptors for Cultural Resources Effects

Type of Effect	Beneficial—The proposed action would protect the significant characteristics of cultural resources from adverse effects, or would restore them to some desired condition.

	Adverse—The proposed action would result in adverse changes in the significant characteristics of cultural resources. Adverse changes may include perceptible and measurable effects, as well as imperceptible psychological or emotional effects.
Duration of Effect	Short-term—Changes would be limited to the construction period and would be reversible.
	Long-term—Changes would be permanent and irreversible.
Intensity of Effect	Negligible—The proposed action would result in barely perceptible changes in the significant characteristics of the resource.
	Minor—The proposed action would result in perceptible and measurable changes in the significant characteristics of the resource, but would affect only a small percentage of its significant characteristics, and would not reduce its interpretive potential.
	Moderate—The proposed action would result in perceptible and measurable changes in the significant characteristics of the resource, but would affect only a moderate percentage of its significant characteristics, and would not reduce its interpretive potential.
	Major—The proposed action would result in perceptible and measurable changes in a substantial proportion of the significant characteristics of the resources; the changes could or would reduce its interpretive potential.

Evaluation of Impacts

Build Alternatives

Limantour Beach Marsh

Removal of the existing crossing and southerly embankment spur and construction of a new bridge or boardwalk would occur adjacent to CA-Mrn-236/H, a prehistoric campsite and historic-period ceramic scatter (see *Cultural Resources* in Chapter 3 for a description of this feature). Disturbing or damaging CA-Mrn-236/H would represent an adverse effect on cultural resources. In order to minimize potential effects on the site, NPS archaeological staff has defined an appropriate avoidance area and would clearly delimit it with temporary construction fencing or other barriers for the duration of site preparation and construction activities. No ground disturbing work would occur within the site boundaries. With these measures in place, effects to CA-Mrn-236/H would be avoided.

Because the project area has a long history of human occupation and numerous previously recorded sites are present within a short distance of Limantour Beach Marsh, additional unknown cultural resources may be present, and could be inadvertently unearthed, damaged, or destroyed during ground-disturbing activities required for project construction. Damage to, or destruction of, previously unknown cultural resources could represent an adverse effect. To avoid or minimize any such effect, NPS would require the construction contractor to implement the following measures to protect cultural resources (See *Environmental Commitments* - Section 2.3).

With these measures in place, effects on unknown cultural resources would be mitigated to the extent feasible. In addition, because the project is focused on the removal of placed fill in historic tidal or wetland areas, the chances that additional sites would be excavated is low.

Although there are no known human burials within the immediate site vicinity, because of Point Reyes' long history of human occupation, there is some potential for ground-disturbing activities required for project construction to inadvertently unearth unknown buried human remains. Damage to, or destruction of, human remains would represent an adverse effect. To avoid or minimize effects related to disturbance of human remains, NPS would require implementation of

the following measures, as specified in the Native American Graves Protection and Repatriation Act (43 CFR, Part 10, Subpart B, Section 10.4).

With these measures in place, effects on human remains would be mitigated to the extent feasible and are expected to be minor. However, because the act of unearthing buried human remains may constitute the majority of the impact, some potential for effects of greater severity remains.

Muddy Hollow and Glenbrook Crossing

Because no known sites are present within the APE at Muddy Hollow or Glenbrook, the potential for Alternative 1 or 2 to disturb or damage cultural resources is less than at Limantour Beach Marsh. However, because of the Point Reyes area's long history of human use, unknown resources, including human burials, may be present, and disturbing or damaging such resources would constitute an adverse effect. In order to protect unknown cultural resources, NPS would implement the same measures for unknown cultural resources and human remains required (and described above) for Limantour Beach Marsh. With these measures in place, potential adverse effects on cultural resources would be mitigated to the extent feasible, and are expected to be negligible. However, because the act of unearthing buried cultural resources, particularly human remains, may constitute the majority of the impact, some potential for effects of greater severity remains.

Build Alternatives' Contribution to Cumulative Effects on Cultural Resources

Throughout coastal California, the Native American cultural legacy, including culturally important sites and traditional cultural practices, has been substantially affected by land management over the past several decades. However, consistent with NPS's vision and mission, actions listed in Table 4-1 incorporate environmental commitments (Section 2-3) to minimize their potential to contribute to this pattern of long-term loss and degradation. It is not possible to provide complete assurance that construction would not disturb unknown, buried cultural resources, but mitigation included in NPS actions provides procedures to minimize the resulting damage, consistent with applicable federal and state laws and regulations. Consequently, no cumulative short- or long-term effect on cultural resources in the Drake's Bay/Drake's Estero watershed is anticipated as a result of the actions listed in Table 4-1. No further analysis is required.

Build Alternatives' conclusion regarding Cultural Resources

Under Alternatives 1 and 2, the proposed restoration designs would avoid impacts to documented cultural resource areas. The analysis concludes that the project would result in no short-term or long-term effects on cultural resources. If operations reveal previously undocumented resources, the NPS would implement management measures described above to ensure that resources are preserved and protected in an appropriate manner. Alternative 1 or Alternative 2 would not result in impairment of park cultural resources.

Table 4.48 Alternatives 1 and 2: Overall Effects on Cultural Resources

Sites	Resources	Type and intensity of short term effect	Type and intensity of long-term effect
Limantour Beach Pond	Cultural resources	No effect	No effect
Muddy Hollow Pond and Glenbrook Crossing	Cultural resources	No effect	No effect
All Sites	Cumulative	No effect	No effect

Alternative 3: No Action

Under the No Action Alternative, no restoration would take place and existing management practices would continue. Ongoing maintenance activities such as road and trail repairs and maintenance would still have some potential to result in damage to unknown cultural resources

and to CA-Mrn-236/H, but this potential would remain unchanged from existing conditions. There would be no effect on cultural resources.

Contribution to Cumulative Effects on Cultural Resources

As discussed above, no cumulative short- or long-term effect on cultural resources specific to the Drake's Bay/Drake's Estero watershed is anticipated, and no further analysis is required.

No Action Alternative conclusion regarding Cultural Resources

Under Alternative 3, no action would take place within the project area therefore, no effect on cultural resources would occur as a result of this project. Alternative 3 would not result in impairment of park cultural resources.

Table 4.49 Alternative 3: Overall Effects on Cultural Resources

Sites	Resources	Type and intensity of short term effect	Type and intensity of long-term effect
All Sites	Cultural resources	No effect	No effect
	Cumulative	No effect	No effect

Effects Related to Noise

Policies and Regulations

NPS Policies

NPS Director's Order #47 addresses the problem of excessive or inappropriate levels of noise on park lands. It requires park managers to

- measure baseline acoustic conditions,
- determine which existing or proposed human-made sounds are consistent with park purposes,
- set acoustic management goals and objectives based on those purposes, and
- determine which noise sources are impacting the park and need to be addressed by management.

It also charges park managers with evaluating and addressing self-generated noise, and with constructively engaging with those responsible for other noise sources that impact parks to explore what can be done to better protect parks.

Assessment Methods

"Operation" of the restored areas, including inspection and maintenance visits, is not expected to generate substantial noise, or to materially change the level of introduced noise at the project sites by comparison with existing conditions. Consequently, analysis of project-related noise impacts focused on construction-related noise, including noise related to construction traffic and noise generated by onsite construction activities. Noise impacts were evaluated qualitatively, based on experience with similar projects in open-space settings.

Table 4-50 summarizes the descriptors used to evaluate noise-related effects.

Table 4-50. Descriptors for Noise Effects

Type of Effect	Beneficial—The proposed action would preserve or improve existing noise levels at and surrounding the project site.
	Adverse—The proposed action would increase noise levels at and surrounding the project site.
Duration of Effect	Short-term—Noise increases would be limited to the construction period.
	Long-term—Noise increases would persist after the construction period. Project operation would generate noise.
Intensity of Effect	Negligible—Noise increases would be barely perceptible, and would affect only the immediate project site.
	Minor—Noise increases would be perceptible but small, and would affect a very limited area around the project site.
	Moderate— Noise increases would be perceptible and could be annoying, or would affect a larger area.
	Major—Noise increases would be substantial or would affect a large area or population.

Evaluation of Impacts

Build Alternatives 1 and 2, All Sites

Construction required to restore the three project sites would result in temporary, intermittent increases in the level of ambient noise in areas adjacent to the sites. Because these sites—in particular Limantour Beach Marsh and Muddy Hollow—are located on heavily used recreational trails, they are frequently visited by recreators as well as park staff, and construction noise could be disruptive or disturbing to recreational use. However, the construction window would be comparatively short, and recreational access to the immediate vicinity of active restoration construction sites would be curtailed during construction, with trails temporarily closed to prevent recreational traffic to the sites. In addition, as discussed in Chapter 2, NPS is committed to implementing a number of BMPs to reduce construction noise as much as possible.

As discussed in *Biological Resources* above, noise and vibration from pile-driving is expected to be the most disruptive aspect of construction noise generation. Pile driving would be limited to a comparatively short period during the overall construction window, but could still be experienced as a localized moderate adverse impact, and could substantially detract from the recreational experience. To address this effect, NPS plans to publicize the timing of construction activity in general, and pile driving in particular, via the park website, the park newsletter, and signage at the restoration sites. With these measures in place, noise disruption from construction would be mitigated to the extent feasible, and effects are expected to be minor.

Where conversion of habitat occurs, the project would affect the long-term biophony of the area. At Muddy Hollow Pond, the conversion of a freshwater pond to intertidal marsh would result in a different species complex using the area, and thus, a change in the natural sounds produced by the wildlife. While the results of the build alternatives would result in changes to the biophony of the area, the impacts are considered negligible adverse in the short term, but a new biophony would develop at these areas following completion of the restoration, and thus, no effect in the long-term.

Build Alternatives - Contribution to Cumulative Noise Effects

To the extent that construction periods overlap, the actions listed in Table 4-1 could result in a small cumulative effect on noise levels in the Drake's Bay/Drake's Estero watershed. The actions

most likely to overlap are the Drake's Estero Road Crossing Improvements and the Glenbrook Dam and Quarry Restoration Project, together with the proposed action. All of these actions would require earthwork, and would have the potential to increase noise levels. However, the duration of construction on the actions identified as potentially overlapping would be comparatively short, and the total number of pieces of equipment operating at one time would be extremely limited. In addition, the nature of the equipment that could be used at the Glenbrook Quarry site would be restricted by the minimum tool requirements for work in designated wilderness areas, and NPS would require contractors to adhere to noise-reduction BMPs similar to those described for the proposed action. Cumulative noise effects are thus expected to be minor, and would be of comparatively short duration. Under either build alternative, the proposed action's contribution, although potentially important relative to the overall cumulative noise effect, would nonetheless be minor, and would not require additional mitigation.

No long-term cumulative effect on noise levels in the Drake's Bay/Drake's Estero watershed has been identified. No further analysis is required.

Build Alternatives - Conclusion on Noise Effects

Under either Alternative 1 or Alternative 2, and in combination with the proposed environmental commitments, short-term adverse minor effects would occur on the natural soundscape. Following construction, no additional operations at the site would affect the soundscape, therefore there is no effect in the long-term. The action alternatives would not result in impairment of the park soundscape resource.

4.51 Alternatives 1 and 2: Overall Effects on Soundscapes

Sites	Resources	Type and intensity of short term effect	Type and intensity of long-term effect
All Sites	Soundscape	Minor adverse	No effect
	Cumulative	Minor adverse	No effect

Alternative 3 - No Action

Under the No Action Alternative, no restoration would take place and existing management practices would continue, including vegetation removal at Muddy Hollow Dam. Therefore, the No Action Alternative would not affect ambient noise conditions or biophony at any of the project sites.

Contribution to Cumulative Noise Effects

Because no construction would take place under the No Action Alternative, there would be no contribution to short-term cumulative noise effects. As discussed above, no long-term cumulative noise effect has been identified for the Drake's Bay/Drake's Estero watershed, and no further analysis is required.

Conclusion on Noise Effects

Under Alternative 3 no construction would occur, therefore there would be no effect to the soundscape in both the short-term and long-term. Alternative 3 would not result in impairment of the park soundscape resource.

Table 4.52 Alternative 3: Overall Effects on Soundscapes

Sites	Resources	Type and intensity of short term effect	Type and intensity of long-term effect
All Sites	Soundscape	No effect	No effect
	Cumulative	No effect	No effect

Effects on Public Health and Safety

Policies and Regulations

Dam Safety

Dam safety is overseen by the U.S. Bureau of Reclamation. On National Seashore lands, maintenance of dams is prescribed and implemented through NPS and U.S. Bureau of Reclamation inspection programs. Muddy Hollow Pond is a dam included in the NPS dam inventory and is surveyed and documented on a regular basis.

Mosquito Control and Mosquito-Borne Disease

The Marin-Sonoma Vector Control Districts (VCDs) is responsible for controlling mosquitoes as pest species and disease vectors within its jurisdiction. The VCD would not have jurisdiction on state or federal lands.

Decisions about when and how to control mosquitoes as a nuisance to human populations are undertaken at the discretion of the VCD with jurisdiction. Factors influencing the decision may include the number of service calls received from a given locality, the proximity of mosquito sources to population centers, and the density of mosquito larvae present in a mosquito production source. Once a recurring mosquito production source has been identified the VDC usually adopts a regular schedule of abatement activities.

Any proposed abatement activities by the VCD adjacent to, or on park lands would have to be coordinated through the NPS and comply with Integrated Pest Management guidelines and would likely require separate environmental compliance.

Assessment Methods

Because construction would be required to comply with applicable health and safety codes, and public access to the construction sites would be restricted, construction is not expected to affect public health or safety materially. Public health and safety analysis accordingly concentrated on long-term effects.

This analysis addressed two issues:

- current and continuing safety of the existing dam and embankment structures, and
- effects on mosquito population levels and the potential for spread of mosquito-borne diseases.

Effects on dam safety were evaluated qualitatively, based on professional judgment in light of current engineering practice. Effects on mosquito populations and mosquito-borne disease transmission were evaluated on the basis of the potential for restoration to create or expand habitats conducive to mosquito reproduction.

Table 4-53 summarizes the descriptors used to evaluate effects on public health and safety.

Table 4-53. Descriptors for Public Health and Safety Effects

Type of Effect	Beneficial—The proposed action would result in a reduction in human health or safety concerns, or would improve human health or safety.

	Adverse—The proposed action would result in additional or exacerbated public health or safety concerns.
Duration of Effect	Short-term—Effects on human health or safety would be transitory, persisting for less than 1 month, such as safety concerns related to smoke from a prescribed burn.
	Long-term—Effects on human health or safety would be lasting or permanent, such as contamination of a water source for domestic use.
Intensity of Effect	Negligible—Effects would be imperceptible or undetectable.
	Minor—Impacts would be detectable but not substantial, and would be localized, potentially affecting a only small number of persons.
	Moderate—Effects would be readily apparent and appreciable, but would not necessitate limits on activities.
	Major— Effects would be very noticeable or would necessitate limits on activities. Effects would be recognizable as clearly introducing a substantial public health or safety hazard.

Evaluation of Impacts

Build Alternatives 1 and 2, All Sites

Effects on Dam and Embankment Safety

As described in Chapter 3, no embankment safety concerns have been identified at Limantour Beach Marsh. There is some concern about the long-term stability of the embankment at Glenbrook Crossing, and the U.S. Bureau of Reclamation (USBR) has assessed the structural condition of the Muddy Hollow dam as "seriously deficient" and has suggested that "consideration should be given to deactivation." Both build alternatives would result in removal of the dam and embankment, and consequently would result in a long-term benefit to public safety. No mitigation is required.

Effects on Mosquito Populations and Mosquito-Borne Disease

At present, the existing culverted embankments at Glenbrook Crossing foster periods of extended ponding. Substantial impoundment is of course also present above the dams at Muddy Hollow and Limantour Beach Pond. Ponded areas may have some potential to support mosquito breeding, and because recreational opportunities are available at and adjacent to each site, there may be some existing risk to public health and safety due to mosquito borne-disease. However, the sites are largely exposed to the wind, and winds are often high throughout the region, probably resulting in wind-driven mixing of the ponded waters, which would limit larval survival and reduce the sites' value for mosquito productivity. The nearby Marin-Sonoma VCD does not consider the area a threat for mosquito-borne disease, and to date NPS has not identified a need for mosquito abatement at any of the sites.

Restoration would reduce ponding on all three sites. In particular, at Limantour Beach Marsh and Muddy Hollow, tidal circulation and natural mixing between salt and fresh water would be greatly improved. As a result, the potential for mosquito breeding at these sites would decrease, representing a long-term benefit to public health. No mitigation is required.

Build Alternatives' Contribution to Cumulative Effects on Public Health and Safety

No cumulative short-term effect related to public health or safety has been identified as a result of the actions listed in Table 4-1. In the long-term, removal of facilities subject to dam safety inspection and hosts to mosquito reproduction would result in beneficial cumulative effects.

Build Alternatives' conclusion on Public Health and Safety

Both Alternative 1 or Alternative 2 would result in the removal of facilities that pond water. Based on the analysis above, the action alternatives would result in short term minor impacts to public health and safety as a result of construction activities and closures, and beneficial long-term effects with the removal of these structures. Alternative 1 or Alternative 2 would not result in impairment of park public health and safety.

Table 4.54 Alternatives 1 and 2: Overall Effects on Public Health and Safety

Sites	Resources	Type and intensity of short term effect	Type and intensity of long-term effect
All Sites	Dam safety	Minor adverse	Beneficial
	Mosquito effects	Beneficial	Beneficial
	Cumulative	No effect	Beneficial

Alternative 3: No Action

Under the No Action Alternative, no restoration would take place and existing management practices would continue. Although vegetation removal would continue at Muddy Hollow, the dam would remain in place, and would continue to pose a safety hazard. Mosquito breeding habitat would remain unchanged under the No Action Alternative. Consequently, there would be no effect on existing public health and safety levels under the No Action Alternative.

In the long-term, potential catastrophic failure could occur at the Muddy Hollow Pond and Glenbrook Crossing sites, which could result in increased risk to public health and safety as sites are either closed or warnings posted.

Contribution to Cumulative Effects on Public Health and Safety

No cumulative short- or long-term effect related to public health and safety has been identified as a result of the actions listed in Table 4-1. No further analysis is required.

Conclusion on Public Health and Safety

Alternative 3 would result in no effect in the short-term, and the potential for minor adverse effects to public health and safety in the long term. Alternative 3 would not result in impairment of park public health and safety.

Table 4.55 Alternative 3: Overall Effects on Public Health and Safety

Sites	Resources	Type and intensity of short term effect	Type and intensity of long-term effect
All Sites	Dam safety	No effect	Minor adverse
	Mosquito effects	No effect	No effect
	Cumulative	No effect	No effect

Effects on Recreational Use

Policies and Regulations

Because the project sites are located within the Point Reyes National Seashore, recreational land uses at and near the proposed sites have been designated by the General Management Plan for the Seashore (National Park Service 1980). Key provisions include the designation of Limantour Beach as a primary beach use and access site. In addition, the Glenbrook Crossing site and the

portions of the Muddy Hollow and Estero Trails planned for realignment are located in designated wilderness areas, where uses are restricted to those considered low-impact.

Assessment Methods

Effects on recreational use and the visitor experience were analyzed qualitatively, based on NPS's understanding of current recreational use at and around the proposed restoration sites. Short- and long-term effects were addressed separately.

Table 4-45 summarizes the descriptors used to evaluate effects on recreational use and the visitor experience effects.

Table 4-56. Descriptors for Recreational Use and Visitor Experience Effects

Type of Effect	Beneficial—The proposed action would enhance visitor participation, the quality of the visitor experience, or service level.
	Adverse—The proposed action would reduce visitor participation; degrade the quality of the visitor experience; or reduce service level.
Duration of Effect	Short-term—Direct effects at any one site (such as closures) would be 90 days or less in duration and would be related to construction activities.
	Long-term—Direct effects could persist for more than 90 days at any one site.
Intensity of Effect	Negligible—The proposed action would result in little or no noticeable change in the visitor experience.
	Minor—The proposed action would result in changes in the visitor experience but would not appreciably limit or enhance critical characteristics.
	Moderate—The proposed action would change the visitor experience appreciably, such as by altering one more critical characteristics, or by appreciably reducing or increasing the number of participants.
	Major—The proposed action would eliminate or would greatly enhance more than one critical characteristic, or would greatly reduce or increase participation.

Evaluation of Impacts

Build Alternatives 1 and 2, All Sites

Short-Term Effects

Recreational opportunities at each site would be temporarily restricted during restoration construction. In particular, the trail network that serves the Muddy Hollow and Glenbrook Crossing sites would not be accessible via these sites, and beach access at Limantour would also be unavailable during the construction period. Proposed trail reroutes would also maintain access to current trails and would actually improve upon existing trail conditions. These closures would short-term and trails would be reopened for continued access to the larger trail network throughout the park following construction. Moreover, the trail network in the central portion of the Seashore would still be accessible from a number of trailheads located off of Sir Francis Drake Boulevard and Mount Vision Road. The remaining beaches throughout the park, including Point Reyes Beaches North and South, Kehoe Beach, and McClure's Beach, as well as the South access to Limantour Beach, would remain open and accessible throughout this period. Therefore, **effects on recreation during construction are considered minor,** and no mitigation is required.

Long-Term Effects

Restoration proposed for the Muddy Hollow and Glenbrook Crossing sites includes rerouting portions of the Estero and Muddy Hollow Trails, respectively. The proposed realignments have been designed to maintain or enhance the current visitor experience. Consequently, trail reroutes in and of themselves are not expected to alter the quality of the visitor experience materially. In addition, the trail reroutes would be located and constructed using recommended, sustainable trail construction techniques, resulting in a better quality trail requiring less maintenance. This is considered a beneficial effect on long-term recreational use. No mitigation is required.

As described in Chapter 2, the bridge or boardwalk proposed to replace the existing paved embankment would become a gateway access to Limantour Beach. The bridge or boardwalk would be ADA-compliant and would include safety railings, while still accommodating equestrian traffic. As such, it has been designed to offer improved safety for users, and better access for handicapped and infirm visitors, including wheelchair users. Because of these improvements in safety and accessibility, either build alternative would improve recreational opportunities and enhance the visitor experience at Limantour Beach Marsh.

Following construction, all trailheads accessed from the Limantour Beach Marsh site would still be available. The existing paved spur trail would be partially or completely removed under both build alternatives. As discussed in Visual Resources above, this would represent an aesthetic benefit to the site. There would be no impact on recreational use or access as a result of removing the spur trail, because it currently terminates at an abrupt dead end and does not provide access to any existing recreational amenities or opportunities.

Under both build alternatives, restoration at Muddy Hollow would remove the existing dam and would substantially alter habitat patterns on and adjacent to the site. The pond area now supports a large stand of riparian and freshwater marsh vegetation that provides habitat for a large variety of birds and offers outstanding opportunities for recreational birdwatching. Following project implementation, the existing impoundment would no longer be present; pond habitat would be replaced over time by stream and tidal channels with associated riparian, wetland, and floodplain habitat. As discussed in *Biological Resources* above, these changes in vegetation are expected to alter the species that may be viewed at this site. Because there are a number of other ponded freshwater bodies within the Seashore, including Laguna Pond and upper and lower Limantour Estero Ponds, where opportunities to view similar bird communities would continue to be available at the Seashore. While alternative viewing locations are present in the Seashore, access, with the exception to sites in the Olema Valley are more remote. In addition, the restored site would be inhabited by different populations of birds that would provide birdwatching opportunities. However, some birders may experience the loss of current birdwatching opportunities as an adverse effect of moderate intensity. To ensure that this concern is mitigated to the extent feasible, NPS is committed to working with the birding community to develop informational signage that explains the reasons for the change and identifies other nearby birding opportunities.

Build Alternatives' Contribution to Cumulative Effects on Recreational Use

Construction of most of the actions listed in Table 4-1 would require restriction or closure of access during all or part of the construction period. Thus, to the extent that construction periods overlap, the listed actions could affect recreational use in the Drake's Bay/Drake's Estero watershed. As identified above, the actions most likely to overlap are the Drake's Estero Road Crossing Improvements and the Glenbrook Dam and Quarry Restoration Project, together with the proposed action. Effects could be moderate relative to the Drake's Bay/Drake's Estero watershed area, but would be minor in the larger context of the park. The proposed action's contribution would represent a substantial portion of the cumulative effect, but would be mitigated to the extent feasible by NPS's commitments to provide noticing and signage to assist park visitors in finding alternate recreational sites, and would be of limited duration. It is thus considered minor on balance, and no further mitigation is required.

As identified above, actions listed in Table 4-1 would have long-term incremental benefits for recreational use at Point Reyes, and their cumulative effect would also be beneficial. Under either build alternative, the proposed action would be a substantial contributor to this net benefit.

Conclusion on Recreational Use

Either Alternative 1 or Alternative 2 would change existing habitat features requiring new trail access corridors and shifts to current recreational uses. In the short-term, minor adverse impacts to recreation would occur as a result of temporary construction closures. In the long-term, changes to the trail network and habitat would result in new and different recreational opportunities and are considered beneficial.

Alternative 1 or Alternative 2 would not result in impairment of park recreational resources.

Table 4.57 Alternatives 1 and 2: Overall Effects on Recreational Use

Sites	Resources	Type and intensity of short term effect	Type and intensity of long-term effect
Limantour Beach Pond	Trail Access	Minor adverse	Beneficial
	Wildlife viewing	Minor adverse	Beneficial
Muddy Hollow Pond	Trail Access	Minor adverse	Beneficial
	Wildlife viewing	Moderate adverse	Negligible adverse
Glenbrook Crossing	Trail Access	Minor adverse	Beneficial
	Wildlife viewing	No effect	No effect
All Sites	Cumulative	Minor adverse	Beneficial

Alternative 3: No Action

The No Action Alternative would include no construction activities. The sites would remain in their current condition, and recreational opportunities at all three sites would remain unchanged. There would be no effect on recreational use or the visitor experience under the No Action Alternative.

In the long-term, potential catastrophic failure would result in minor to moderate impacts similar to those discussed in the build alternative scenario. Trail closures would be longer term, with similar reroute scenarios. Wildlife viewing, specifically at Muddy Hollow, would be affected in the same manner as under the build alternatives.

Contribution to Cumulative Effects on Recreational Use

Because no construction-related closures would be necessary, the No Action Alternative would not contribute to short-term cumulative effects on recreational use. Over the long term, the dam at Muddy Hollow and the crossings at Limantour Beach Marsh and Glenbrook would continue to degrade, and would be increasingly difficult and costly to maintain. The same would be true of the trail segments slated for realignment. Consequently, the No Action Alternative could ultimately make a minor adverse contribution to an otherwise beneficial long-term cumulative effect on recreational use and visitor access.

Conclusions on Recreational Use

Alternative 3 would not result in temporary closures and therefore there would be no effect to recreational resources in the short term. In the long-term, potential failure of facilities without plans to repair or replace them would result in minor to moderate adverse impacts to recreational uses, including trail access as well as wildlife viewing.

Alternative 3 would not result in impairment of park recreational uses.

Table 4.58 Alternative 3: Overall Effects on Recreational Use

Sites	Resources	Type and intensity of short term effect	Type and intensity of long-term effect
Limantour Beach Pond	Trail Access	No effect	Minor adverse
	Wildlife viewing	No effect	Minor adverse
Muddy Hollow Pond	Trail Access	No effect	Minor adverse
	Wildlife viewing	No effect	Moderate adverse
Glenbrook Crossing	Trail Access	No effect	Minor adverse
	Wildlife viewing	No effect	No effect
All Sites	Cumulative	No effect	Minor adverse

Effects on Transportation and Traffic

Policies and Regulations

The transportation element of the Marin County Plan addresses the effect of regionally important recreational uses in West Marin on LOS along key access routes. Specifically, park visitor traffic is identified as producing congestion in excess of that expected from local land uses on Sir Francis Drake Boulevard to Point Reyes.

Assessment Methods

Analysis of effects on traffic and transportation concentrated on road traffic, because Point Reyes National Seashore is not directly served by air, rail, or mass transit. Traffic effects were evaluated qualitatively, based on professional judgment in light of current understanding of likely restoration construction scenarios and visitor use in and around the restoration areas.

Analysis of traffic effects assumed that visitors access the Seashore by car, and that park facilities are primarily used by day visitors, with a small percentage of visitors overnighting at park campgrounds, and larger groups overnighting at other local accommodations. NPS's understanding is that most park users do not plan the trip prior to arrival.

Table 4-59 summarizes the descriptors used to evaluate effects on traffic.

Table 4-59. Descriptors for Traffic Effects

Type of Effect	Beneficial—The proposed action would improve traffic flow in the project area.
	Adverse—The proposed action would contribute to traffic congestion, would degrade level of service at roadways or intersections, or would result in demand for parking in excess of available supply.
Duration of Effect	Short-term—Effects would be limited to the construction period.
	Long-term—Effects would persist following the completion of construction.
Intensity of Effect	Negligible—Effects would be barely perceptible, or would be restricted to a very limited area. No applicable level of service standards would be exceeded.
	Minor—Effects would be noticeable but would be limited in severity and/or areal extent. No applicable level of service standards would be exceeded.

Moderate—Effects would be very noticeable or would affect a wide area. Applicable level of service standards could be exceeded.

Major—Level of service would be substantially degraded, or parking supply would be substantially exceeded. Applicable level of service standards would be exceeded.

Evaluation of Impacts

Alternative 1: Full-Build Approach—All Sites (Preferred Alternative at Limantour Beach Pond and Muddy Hollow Pond sites)

Effects During Construction, Alternative 1

During construction, effects on traffic flow could result from

- delivery and removal of heavy equipment to sites for earthwork,
- delivery of construction materials to the sites,
- removal of demolition debris (e.g., concrete riprap and other imported materials), and
- construction worker commute trips.

NPS has committed to ensuring that construction worker parking is managed such that there is no effect on visitor or emergency vehicle access.

Earthwork equipment (scraper, backhoe, etc.) would be trailered to the construction sites, and would then be staged onsite. Equipment mobilization and demobilization is expected to generate a maximum of about 10 trips per site (5 pieces of heavy equipment, round trip). Additional haul truck trips would be required to delivery construction materials for each site.

Equipment deliveries would use US-101 to Point Reyes-Petaluma Road to access the Point Reyes area, and the presence of large, slow-moving semi-trailers required to haul heavy earthwork equipment would be an annoyance and a potential safety hazard in heavy morning or evening commute traffic. Similar concerns could apply to materials haul trucks. To address this issue NPS intends to require the contractor to schedule equipment mobilization and demobilization during off-peak hours (see *Environmental Commitments* in Chapter 2).

Once within the Seashore, large, slow-moving semi-trailers could continue to temporarily obstruct traffic, creating potential hazards for park visitors. Safety could be a concern at the Bear Valley Road/Limantour Road intersection, where visibility is limited and traffic is controlled by stop sign only. However, the effect would be constrained since equipment would be staged onsite, and equipment haulage would take place over a very limited timeframe. Hazards and frustrations would be further reduced by requiring the restoration contractor to have equipment delivered off-peak hours, when visitor use is at a minimum (see Chapter 2). Similar constraints would reduce concerns related to delivery of construction materials and offhaulage of demolition debris. To allow adaptive management of traffic concerns, NPS would also require the Project Manger to notify NPS's ranger dispatch to inform them of equipment delivery date(s) and time(s), allowing them to monitor effects on traffic. If needed, delivery and demobilization schedules as well as the timing of materials delivery and debris removal can be modified based on feedback received.

With the environmental commitments identified above in place, effects on traffic flow during construction are not expected to exceed a minor level.

Construction workers would likely drive their own vehicles to the sites each day, so worker access would slightly increase traffic on Limantour Road, Bear Valley Road, and the regional access routes. The maximum number of workers expected per site is about 10; if all sites were under construction at the same time, a maximum of 60 additional trips per day (30 round trips per day) would be generated. This is not expected to result in any adverse affect on the quality of the visitor experience, hinder Seashore maintenance activities, or interfere with emergency response.

Construction workers would park their vehicles in the existing Limantour parking lot during restoration at Limantour Beach Marsh and Muddy Hollow. As described in *Recreation* above, this area would be closed during restoration, so construction worker parking is not expected to interfere with visitor use. Similarly, because ample parking is available in the Limantour lot, construction worker parking is not expected to affect Seashore maintenance activities or emergency response in the Limantour Beach/Muddy Hollow area.

During restoration at the Glenbrook Crossing site, construction workers would park their vehicles in the small existing Muddy Hollow Trailhead parking lot off of Limantour Road. This lot has ample capacity to accommodate the small number of workers expected at the site, and as described in *Recreation* above, the trailhead would be closed during restoration, so no effect on visitor use is anticipated as a result of construction worker parking. As described in Chapter 2, NPS would require that the contractor guarantee open access for emergency vehicles via the Muddy Hollow Road trailhead. In addition, NPS would require the contractor to shuttle workers to the active Glenbrook Crossing restoration site in order to minimize vehicle trips through the Wilderness. To ensure that construction access does not adversely affect Muddy Hollow Creek, a temporary construction crossing would be installed where the trail crosses the drainage and would remain in place for the duration of construction at the Glenbrook site.

With these environmental commitments in place, negligible adverse effect on parking availability or visitor access is expected during construction.

Long-term Effects, Alternative 1

Following restoration, visitor use and access would be restored. Visitor use is not expected to change, and maintenance activities in the vicinity of the restoration sites would be reduced at all sites except Limantour Beach Marsh. The principal potential for effects on traffic in the period following restoration would be associated with site monitoring and maintenance visits to the restoration sites themselves. Both monitoring and site maintenance visits would occur regularly but infrequently during the week, and would not increase traffic above existing levels. The restoration activities would not result in long-term effects to traffic.

Alternative 1 Contribution to Cumulative Effects on Transportation & Traffic

As identified above, of the actions listed in Table 4-1, those with construction periods most likely to overlap are the Drake's Estero Road Crossing Improvements, and the Glenbrook Dam and Quarry Restoration Project, together with the proposed action. During the overlap between construction periods, a short-term minor cumulative effect on traffic flow along access routes to the Seashore is possible, as is a minor adverse effect on traffic flow on Seashore roadways. No cumulative effect on visitor parking availability or emergency vehicle access is expected.

Under Alternative 1, the proposed action's contribution any cumulative effect that were to occur would be an important proportion of the net effect. Proposed best management practices to reduce the proposed action's effect on traffic to the extent feasible would be followed. The duration of any such contribution would be very limited, and its intensity would be minor; no additional mitigation is required.

No long-term cumulative effect on traffic has been identified as a result of the actions listed in Table 4-1. No further analysis is required.

Alternative 1 Conclusion on Transportation and Traffic

Alternative 1 would result in short-term minor adverse effects to traffic during the period of construction. However, once construction is completed, the resulting restoration is not expected to change the traffic loading patterns to or within the park, therefore no long-term effects would occur to traffic.

Alternative 1 would not result in impairment to park resources as a result of traffic.

Table 4.60 Alternative 1: Overall Effects on Traffic and Transportation

Sites	Resources	Type and intensity of short term effect	Type and intensity of long-term effect
All Sites	Traffic	Minor adverse	No effect
	Parking	Negligible adverse	No effect
	Cumulative	Minor adverse	No effect

Alternative 2: Partial-Build Approach (Preferred Alternative at Glenbrook Crossing)

Effects During Construction, Alternative 2

As with Alternative 1, the greatest potential for effects on traffic flow as a result of Alternative 2 restoration activities at all three sites would be associated with delivery of heavy equipment to sites for earthwork, delivery of construction materials to the sites, removal of demolition debris (e.g., concrete riprap and other imported materials), and construction worker commute trips.

Construction worker parking could also affect visitor and emergency vehicle access.

Equipment mobilization would be the same in Alternative 2, as Alternative 1, however, the phased implementation at Muddy Hollow would require another round of mobilization and demobilization the following construction year.

Trip generation under Alternative 2 would be similar to that expected under Alternative 1, and is not expected to result in any adverse affect on the quality of the visitor experience, hinder Seashore maintenance activities, or interfere with emergency response.

With the environmental commitments identified above in place, effects on traffic flow during construction are not expected to exceed a minor level.

As with Alternative 1, because ample parking is available in the Limantour lot, construction worker parking is not expected to affect Seashore maintenance activities or emergency response in the Limantour Beach/Muddy Hollow area during construction of Alternative 2. With these environmental commitments in place, negligible short-term adverse effects on parking availability or visitor access is expected during construction.

Long-term Effects, Alternative 2

As with Alternative 1, visitor use and access would be restored following construction under Alternative 2. Visitor use is not expected to change postrestoration, and long-term maintenance needs in the vicinity of the restoration sites would be reduced at all sites except Limantour Beach Marsh. The principal potential for effects on traffic in the period following Alternative 2 restoration would be associated with monitoring and maintenance visits to the restoration sites themselves. Both monitoring and site maintenance visits would occur regularly but infrequently during the week, and would not increase traffic above existing levels. The restoration activities would not result in long-term effects to traffic.

Alternative 2 Contribution to Cumulative Effects on Transportation & Traffic

As identified above, of the actions listed in Table 4-1, those with construction periods most likely to overlap are the Drake's Estero Road Crossing Improvements, and the Glenbrook Dam and Quarry Restoration Project, together with the proposed action. During the overlap between construction periods, a short-term minor cumulative effect on traffic flow along access routes to the Seashore is possible, as is a minor adverse effect on traffic flow on Seashore roadways. No cumulative effect on parking availability or emergency vehicle access has been identified.

As described for Alternative 1, the proposed action's contribution any cumulative effect that were to occur would be an important proportion of the net effect. Proposed best management practices to reduce the proposed action's effect on traffic to the extent feasible would be followed. Thus, the duration of any such contribution would be very limited, and its intensity would be minor; no additional mitigation is required.

No long-term cumulative effect on traffic has been identified as a result of the actions listed in Table 4-1. No further analysis is required.

Alternative 2 Conclusion on Transportation and Traffic

Alternative 2 would result in short-term minor adverse effects to traffic during the period of construction, but would include 2 construction years rather than one (Muddy Hollow phasing). However, once construction is completed, the resulting restoration is not expected to change the traffic loading patterns to or within the park, therefore no long-term effects would occur to traffic.

Alternative 2 would not result in impairment to park resources as a result of traffic.

Table 4.61 Alternative 2: Overall Effects on Traffic and Transportation

Sites	Resources	Type and intensity of short term effect	Type and intensity of long-term effect
All Sites	Traffic	Minor adverse	No effect
	Parking	Negligible adverse	No effect
	Cumulative	Minor adverse	No effect

Alternative 3: No Action

Under the No Action Alternative, no restoration would take place and existing management practices, including the need for periodic trail and road closures, would continue. Traffic and emergency access in the Point Reyes area would be unaffected.

Alternative 3 Contribution to Cumulative Effects on Transportation & Traffic

Under the No Action Alternative, no construction would take place, and there would be no contribution to short-term cumulative effects on traffic.

No long-term cumulative effect on traffic has been identified. No further analysis is required.

Alternative 3 Conclusion on Transportation and Traffic

Alternative 3 would result in short-term or long-term effects to traffic. Alternative 3 would not result in impairment to park resources as a result of traffic.

Table 4.62 Alternative 3: Overall Effects on Traffic and Transportation

Sites	Resources	Type and intensity of short term effect	Type and intensity of long-term effect
All Sites	Traffic	No effect	No effect

Parking	No effect	No effect
Cumulative	No effect	No effect

5.0 Cumulative Impacts

The Council on Environmental Quality (CEQ) NEPA regulations 1508.7 states, 'Cumulative impact is 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."

Cumulative impacts for each topic of analysis are discussed as part of Section 4. This represents an overall summary of the project and its cumulative impacts to park resources in the Drakes Bay and Estero area.

5.1 Current and Ongoing Actions

Within the project watersheds Laguna, Muddy Hollow, and Glenbrook, impacts associated with farming, dairy, or livestock operation occurred between the 1870s and 1950s. As the history of the Limantour area showed, these areas were divided for development and the infrastructure installed to support the planned community. As Point Reyes National Seashore was established, the final installation of Muddy Hollow Pond and the Glenbrook Crossing were completed and purchased as improvements by the NPS. For the most part, these watersheds have been managed as natural environment and Environmental Protection – Wilderness since the early 1980s. While a number of other man-made structures impeding natural hydrologic process failed in the 1980s, these structures persisted, but are now in need of repair or replacement. The watersheds and associated habitat has developed around these structures and is considered stable. Maintenance is required or this perceived stability is threatened. Other projects proposed within the watersheds include the Coastal Watershed Restoration – Drakes Estero Road Crossing Improvement Project would include culvert improvements at two sites within the Laguna drainage. The other sites included in that project are in the Home Ranch and East Schooner Creek watersheds. The Glenbrook Dam Removal and Quarry Restoration is planned for the failed dam structure in the estuarine portion of Glenbrook Creek. These are described briefly in Table 4-1.

Within the Drakes Estero watershed, there is ongoing dairy and beef cattle grazing, as well as some additional physical habitat restoration projects, namely Horseshoe Pond restoration to coastal lagoon.

Other activities within the Drakes Estero and Drakes Bay watershed include replacement of the waste transfer system at the Ken Patrick Visitors Center (2004), and Stabilization of the Historic Lifeboat Station Marine Railway (2005). Both of these projects are categorically excluded and would not result in impacts that influence the proposed restoration project.

5.2 Past Restoration and Monitoring Activities

Previous monitoring efforts have included post-fire watershed response monitoring within the Muddy Hollow and Glenbrook Creek watersheds (Collins and Ketcham 2001) as well as aquatic surveys for fish habitat (Cappellini and Everly 1997), California freshwater shrimp (Fong and Lo Bianco 2003), the California red-legged frog (Guscio and Fellers 2002), site botanical surveys (Parsons and Allen 2003b) and wetland assessments (Parsons 2003a; Parsons 2003b; Parsons and Allen 2003a). Extensive surveys were conducted as part of the pre-design process for the project and are summarized in the Final Feasibility Report by NHC (2004).

In association with the proposed project, adaptive management and monitoring would be conducted where geomorphic adjustment is likely to result in continued changes to the channel and habitat conditions. These monitoring efforts are intended to provide park management with information to initiate follow-up treatments that could be conducted using previously contracted hand crews.

5.3 Cumulative Impacts

This cumulative impacts section summarizes the potentially compounded impacts of implementation at all project sites by alternative. Because each of these projects (Table 4-1) is identified, individually, as a restoration of natural ecological and physical process, this section is important to ensure that cumulatively, the ecological resources can adjust to the changes in process brought about by these federal actions. It should be noted that the preferred alternative is the treatment proposed under Alternative 1 for Limantour Beach Pond and Muddy Hollow Pond, and under Alternative 2 for Glenbrook Crossing.

Alternative 1 – Full-Build (preferred alternative at Limantour Beach Marsh and Muddy Hollow)

Under Alternative 1, full-scale deconstruction activities would occur at the three project locations with trail reroute occurring in conjunction with the Muddy Hollow and Glenbrook projects). Conversion of pond to estuarine habitat at Muddy Hollow and Limantour Beach Pond sites, as well as removal of a non-conforming road crossing and culvert facility from the Philip Burton Wilderness at Glenbrook Crossing would result in minor to moderate short-term impacts at the project locations. The project activities would alter water resources and biological habitat effecting special status amphibians and fish. The proposed restoration actions represent deconstruction, and are planned to limit or reduce impacts associated with this conversion, and promote recovery in the short-term.

In conjunction with other planned projects within the Drakes Estero and Drakes Bay watershed, this alternative would result in minor short-term impacts associated with the number and timing of restoration activities within the area. In conjunction with the Coastal Watershed Restoration – Drakes Estero Road Crossing Improvements Project and Glenbrook Dam and Quarry Restoration would involve deconstruction/construction activities at each of the work areas. Most similar to

actions described under this project is the Glenbrook Dam and Quarry Restoration, which involves the removal of approximately 19,000 cubic yards of fill from the Glenbrook portion of Estero de Limantour. The materials would be placed in the adjacent spillway and quarry areas allowing for more natural features within this portion of the Wilderness area. If implemented in summer 2005, as planned, this would contribute to the cumulative Wilderness impacts, but by completing this restoration in the same year, would not extend impacts to multiple years.

In general, the projects described are distributed within smaller watersheds draining to Drakes Estero, and would result in long-term hydrologic connectivity, allowing for natural processes to facilitate sustainable habitat features.

Alternative 2 – Partial Build (preferred alternative at Glenbrook Crossing)

Under Alternative 2, deconstruction activities would occur at the three project locations. While the approaches are different for some of the sites, the cumulative impacts analysis would result in the same conclusions because the end products, including conversion of pond to estuarine habitat at Muddy Hollow and Limantour Beach Pond sites, as well as removal of a non-conforming road crossing and culvert facility from the Philip Burton Wilderness at Glenbrook Crossing would be the same. As with Alternative 1, Alternative 2 would result in minor to moderate short-term impacts at the project locations. The project activities would alter water resources and biological habitat effecting special status amphibians and fish. The proposed restoration actions represent deconstruction, and are planned to limit or reduce impacts associated with this conversion, and promote recovery in the short-term.

Cumulatively, the effects of either action alternative would result in similar cumulative impacts interactions with other projects proposed in the area. The actions proposed under Alternative 2 for Muddy Hollow would extend impacts across construction years, while at Glenbrook Crossing, the proposed actions are more limited then that proposed under Alternative 1, and are considered more compatible with Wilderness goals. If conducted in conjunction with the Glenbrook Dam and Quarry Restoration, this would contribute to the cumulative Wilderness impacts, but by completing this restoration in the same year, would not extend impacts to multiple years In general, the projects described are distributed within smaller watersheds draining to Drakes Estero, and would result in long-term hydrologic connectivity, allowing for natural processes to facilitate sustainable habitat features.

Alternative 3 – No Action

Under Alternative 3, no direct actions would be taken on any of the three project sites, and the project would not contribute to short-term cumulative impacts. Any maintenance activities required in the short term would result in negligible resource impacts. In the long-term, the potential of these structures to fail as a result of flood or geohazard would contribute to moderate cumulative long-term impacts to resources within the Drakes Estero and Drakes Bay analysis areas.

The potential for failure would remain even with regular maintenance. These impacts would be unplanned, and therefore unmitigated. In addition, potential impacts discussed as part of the action alternatives, related to the loss of habitat by California red-legged frog, wetlands and recreational uses would be realized in the long-term at some of these sites.

5.4 Short-term uses versus long-term productivity

The preferred alternative would restore natural hydrologic and shoreline process, consistent with NPS management policies (NPS 2000). The historic shoreline process supported naturally functioning estuarine (at Muddy Hollow and Limantour Beach Pond) and fluvial riparian (Glenbrook Crossing) habitat. These features impede natural hydrologic and ecological process, creating sharp gradients, inconsistent with the types of habitat and conditions that evolved in the area prior to the establishment of ranching operations and subsequent development over the last century and a half.

The proposed restoration of natural processes to these areas would result in changes to more sustainable habitat, and would require replacement or relocation of some visitor amenities including trail access. The long-term sustainability and ecological productivity of these restored areas would become a new recreational attraction and visitor use of the area.

As discussed under no action, the potential for failure of these sites, even with maintenance, remains a possibility given the potential for seismic or flood-flow events. The proposed actions would result in short-term impacts to the resources as a result of direct activities, however the long-term impacts to wetlands, California red-legged frog critical habitat, wildlife viewing, trail access, etc. would all result in the case of failure. Restoration to naturally functioning sustainable systems would support long-term ecological productivity and stability at these sites, beginning with recovery following these treatments.

6.0 Consultation and Coordination

6.1 Agencies and Organizations

This project will require consultation through the following agencies:

Federal consistency review - California Coastal Commission

Some of the sites associated with this project are within the coastal zone, and subject to federal consistency review by the CCC. Federal consistency review to ensure the project is consistent with state coastal zone management guidelines. Review of the project will be initiated in conjunction with public release Environmental Assessment.

Clean Water Act Section 401 certification - San Francisco Regional Water Quality Control Board

The San Francisco Bay Regional Water Quality Control Board is responsible for Clean Water Act 401 certification on projects that may effect water resources. Onsite visits will be conducted with staff from the Board. In conjunction with the public release of this document, the NPS would apply for CWA 401 certification from the San Francisco Regional Water Quality Control Board.

Clean Water Act Section 404 consultation and permit - US Army Corps of Engineers

The Clean Water Act provides for the restoration and maintenance of the physical, chemical, and biological integrity of the nation's waters. Section 404 of the act prohibits the discharge of fill material into navigable water of the United States, including wetlands, except as permitted under separate regulations by the U.S. Army Corps of Engineers and U.S. Environmental Protection Agency. The project will be conducted within jurisdictional wetlands as confirmed by the US Army Corps of Engineers. The project will require 404 permits through the Corps. Application for these permits under Nationwide Permit 27 will be submitted in conjunction with public release Environmental Assessment.

Endangered Species Act – Section 7 consultation

US Fish and Wildlife Service & National Marine Fisheries Service are responsible for administering the Endangered Species Act of 1973 which protects threatened and endangered species from unauthorized "take", and directs federal agencies to ensure that their actions do not jeopardize the continued existence of listed species. Section 7 of the act defines federal agency responsibilities for consultation with the U.S. Fish and Wildlife Service, or the National Marine Fisheries Service (the latter is responsible for fish and marine mammal species). Consultation requires preparation of a Biological Assessment to identify threatened or endangered species likely to be affected by the proposed action. In conjunction with the public release of this document, NPS has initiated consultation with the U.S. Fish and Wildlife Service and NOAA Fisheries regarding this project.

NHPA - Section 106 documentation and compliance - California Historic Preservation Office

The National Historic Preservation Act of 1966 requires agencies to take into account the effects of their actions on properties listed in or eligible for listing in the National Register of Historic Places. The Advisory Council on Historic Preservation has developed implementing regulations (36 CFR 800), which allow agencies to develop agreements for consideration of these historic properties. The NPS, in consultation with the Advisory Council, the California State Historic Preservation Officer (SHPO), American Indian tribes and the public, has developed a Programmatic Agreement for operations and maintenance activities on historic structures. This 1995 Programmatic Agreement (available on the web at http://www.achp.gov/npspa1.html) provides a process for compliance with National Historic Preservation Act, and includes stipulations for identification, evaluation, treatment, and mitigation of adverse effects for actions affecting historic properties. In conjunction with the public release of this document, NPS will request concurrence of a determination of No Adverse Affect to cultural resources from the actions included in this Environmental Assessment.

NHPA - Section 106 review - Federated Indians of Graton Rancheria.

The initial cultural resources study was undertaken in consultation with the Federated Indians of Graton Rancheria (FIGR). A FIGR representative was involved with initial site surveys. No archaeological resources were documented at the 6 sites identified as part of this environmental analysis. Consistent with other projects, the NPS will coordinate with the FIGR if new information or resources are uncovered during implementation of this project.

Public Outreach – The Environmental Assessment will be made available to the public for a 30 day comment period. Announcement of the comment period and how to obtain the document will be made by mail to the park interested parties mailing list. Printed copies of the document would be made available upon request. In addition, the EA will be posted on the park web site, at (http://www.nps.gov/pore/pphtml/documents.html)

6.2 Consultation Requirements

This project may require consultation or permits through the following agencies:

- California Coastal Commission – Federal consistency review
- San Francisco Regional Water Quality Control Board – Clean Water Act Section 401 certification
- US Army Corps of Engineers – Clean Water Act Section 404 consultation and permit
- US Army Corps of Engineers – Rivers and Harbors Act Section 10 review
- US Fish and Wildlife Service – Endangered Species Act – Section 7 consultation

- National Marine Fisheries Service - Endangered Species Act – Section 7 consultation
- California Historic Preservation Office – Section 106 documentation and compliance
- Federated Indians of Graton Rancheria – Section 106 review

6.3 Persons Consulted

Marla Lafer - San Francisco Bay Regional Water Quality Control Board
Leslie Ferguson – San Francisco Bay Regional Water Quality Control Board
Marc D'Avignon - US Army Corps of Engineers
Dr. Bill Jackson – NPS Water Resources Division
Dr. Gary Fellers – USGS-BRD

6.4 Report Preparers

Anna Buising, Geologist, Jones & Stokes, Inc.
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6.5 Public and Agency Scoping and Summary of Issues Raised

Project scoping was conducted between February 18, 2003 and March 21, 2003. The public scoping document was mailed to the park public outreach mailing list including more than 200 recipients. Four comment letters were received. Potential impact topics that were identified through the public scoping are described below.

Ecological Restoration Concern was expressed over restoration at Muddy Hollow, in particular the intent of removing a feature heavily used by birds, for the benefit of other species such as steelhead. Ecological restoration results in benefits for some species over others. The potential impacts associated with restoration of natural process, which affects ecological conditions and sustainability are evaluated as part of the EA.

Recreational Use Muddy Hollow Pond is a large pond area easily accessible from the Limantour Parking area and is often used by bird watchers and docent led bird watching groups. The pond is one of many within the Seashore providing large areas of open water habitat for diving ducks and other birds to rest and forage during the migration seasons.

A trail network runs adjacent to the south side of Muddy Hollow Pond (Muddy Hollow Trail) and across the dam (Estero Trail). Comments noted that similar trail access to/from this area should be maintained. The proposed action alternatives include trail reroutes that will maintain access to the existing trail network.

Wildlife – Birds Muddy Hollow Pond provides habitat for a wide variety of bird and aquatic species, including, according to a local bird expert, over 20 duck species grebes, coots, American bitterns, Soras, and Virginia rails. Surrounding the edge of the pond are willow and alder that support numerous neotropical migrants along the pond edge. The habitat and use of the Muddy Hollow Pond area is evaluated as part of this EA.

Concern raised with respect to proposed actions at Muddy Hollow effecting recreational use and bird use informed the evaluation of Wildlife and Recreational Use impact sections. As stated in the purpose and need, the intent of the project is to restore natural process thereby allowing for sustainable hydrologic, shoreline, and ecological conditions at these sites. Potential impacts to these resources under the action and no action alternatives are documented. To ensure that this concern raised in the scoping letters is mitigated to the extent feasible, NPS is committed to working with the birding community to develop informational signage that explains the reasons for the change and identifies other nearby birding opportunities.

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Appendix A - Special Status Species Table

List of Federally threatened and endangered plant and animal species with potential to occur in the Coastal Watershed Restoration Project Area and vicinity. Potential to occur based on known species ranges, general habitat requirements, and historical sightings (from Coastal Watershed Restoration Project Biological Assessment), 2004.

Scientific name	Common name	Status	Habitat	Comments	Known to Occur	Subject to Impacts
Mammals						
No terrestrial or freshwater mammals. Marine mammals (Guadalupe fur seal, Steller sea lion, sei whale, blue whale, fin whale, right whale, and sperm whale) are not know or expected to occur in the project areas[1, 2]						
Birds						
Pelecanus occidentalis californicus	California brown pelican	FE	Open water and roosts on mud flats and offshore rocks; breed in Channel Islands.	Brown Pelicans do not breed at PRNS, but commonly occur in the estuaries and along the coastline in the summer, fall, and winter.	Abundant	Yes
Brachyramphus marmoratus	Marbled murrelet	FT	Mature, coastal coniferous forests for nesting; nearby coastal water for foraging; nests in conifer stands greater than 150 years old and may be found up to 35 miles inland; winters on subtidal and pelagic waters often well offshore	No suitable habitat or known occurrences in the vicinity of the proposed projects	Uncommon	No[4]
Charadrius alexandrinus nivosus	Western snowy plover	FT	Sandy beaches, salt pond levees; needs sandy, gravelly, or friable soil for nesting.	Nests on the Great Beach between North Beach and Kehoe and NW Limantour Beach (PRBO 2001). Historically nested at Drakes Beach	Yes	Yes
Diomedea albatrus	Short-tailed albatross	FE	Adults spend the summer non-breeding season at sea in the Aleutian Islands, Bering Sea, and Gulf of Alaska.	There are no known breeding colonies at PRNS and only rare sightings of individuals at sea in the vicinity of Cordell Bank near Point Reyes	Rare	No[4]
Haliaeetus leucocephalus	Bald eagle	FT	In western North America, nests and roosts in coniferous forests within a mile of a significant body of water (e.g. lake, reservoir, river, or the ocean)	Reintroduced into central coast, but PRNS currently known only as winter habitat.	No	No[4]
Sterna antillarum (=albifrons) browni	California least tern	FE	Nests on sandy, upper ocean beaches, and occasionally uses mudflats; forages on adjacent surf line, estuaries, or the open ocean	Suitable habitat exists within the action areas, but species occurrences are rare.	Rare	No[4]
Strix occidentalis caurina	Northern spotted owl	FT	Dense old-growth or mature forests dominated by conifers with topped trees or oaks available for nesting crevices	A permanent resident throughout its range; found in the north Coast, Klamath, and western Cascade Range from Del Norte County to Marin County	No	No[4]
Reptiles						
No terrestrial or freshwater reptiles. Marine turtles (loggerhead turtle, green turtle, leatherback turtle, and olive (=Pacific) Ridley sea turtle) are not known or expected to occur in the project areas[2]						
Amphibians						

Rana aurora draytonii	California red-legged frog	FT	Deep pools with dense, shrubby, or emergent vegetation	Present in numerous areas in PRNS. Area has been declared critical habitat by USFWS. First observed in Project Area in 1995.	Yes	Yes
Fish						
Eucyclogobius newberryi	Tidewater goby	FE	Found in shallow lagoons and lower stream reaches, they need fairly still but not stagnant water & high oxygen levels.	Potentially occurred but never documented in Horseshoe Lagoon or Drakes Estero system (Jacobs personal communication 2004). Site identified as potential experimental reintroduction site for tidewater goby.	No, but reintroduction proposed	No[5]
Oncorhynchus kisutch	Coho salmon – central CA coast	FT	Needs beds of loose, silt-free coarse gravel for spawning; needs cover, cool water and sufficient dissolved oxygen.	Spawn in Olema Creek, Lagunitas Creek, Devil's Gulch, and San Geronimo Creek (NDDB, 2000). Not found in any action area streams in 2002 surveys	No	No[6]
Oncorhynchus mykiss	Central CA coastal steelhead	FT	Needs beds of loose, silt-free coarse gravel for spawning; needs cover, cool water and sufficient dissolved oxygen.	Spawn in most coastal drainages in PRNS, including several streams in the Drakes Estero watershed.	Yes	Yes
Oncorhynchus mykiss	Central Valley steelhead	FT	Needs beds of loose, silt-free coarse gravel for spawning; needs cover, cool water and sufficient dissolved oxygen.	Potential for presence during migration, but highly unlikely. Will effectively be analyzed within determination for central California coastal steelhead.	No	No[6]
Oncorhynchus tshawytscha	CA coastal chinook	FT	Cold, clear water with clean gravel of appropriate size for spawning; most spawning occurs in headwater streams; migrate to the ocean to feed and grow until sexually mature	Not known to occur historically or presently within action area watersheds	No	No[6]
Invertebrates						
Speyeria zerene myrtleae	Myrtle's silverspot butterfly	FE	Dune and coastal grassland. *Viola adunca* is host plant.	Host plant and individual butterflies observed within Horseshoe Pond watershed, but not Project Area.	Yes	Yes
Syncaris pacifica	California freshwater shrimp	FE	Lowland coastal perennial streams	Found primarily in Sonoma, Marin, and Napa counties. Reported upstream in Lagunitas Creek; observed in lower Olema Creek, Walker Creek and tributary to Keys Creek (NDDB 2000, Fong and Lo Bianco 2003).	No	No[3]
Plants						
Alopecurus aequalis var. Sonomensis	Sonoma alopecurus	FE	Freshwater marshes and swamps; riparian scrub; wet meadows.	Known from fewer than five native occurrences (CNPS 2001). Present in coastal areas of PRNS.	No	No[7]
Chorizanthe robusta	Robust spineflower	FE	Coastal sand, scrub.	Known to occur within PRNS	No	No[7]

Chorizanthe valida	Sonoma spineflower	FE	Sandy areas in coastal prairie.	Thought extinct at one time; only known extant occurrence in PRNS (CNPS 2001; PRNS 2001).	No	No[7]
Layia carnosa	Beach layia	FE	Coastal dunes.	Present in PRNS (PRNS 2001).	No	No[7]
Lupinus tidestromii	Tidestrom's lupine	FE	Coastal dunes.	Present in PRNS (PRNS 2001).	No	No[7]
Trifolium amoenum	Showy Indian clover	FE	Valley and foothill grassland; coastal bluff scrub; sometimes on serpentine soil; open, sunny areas; swales	Last recorded in Olema area in 1886. Thought extinct, but rediscovered twice since 1993: only one extant as of 1996 (CNPS 2001).	No	No[7]

FEDERAL STATUS CODES

FEDERAL LISTING

FE = Listed as endangered under federal Endangered Species Act.

FT = Listed as threatened under federal Endangered Species Act.

FD = Delisted from federal Endangered Species Act.

List of Federal Species of Concern with potential to occur in the Coastal Watershed Restoration Project Area and vicinity. Potential to occur based on known species ranges, general habitat requirements, and historical sightings (from Coastal Watershed Restoration Project Biological Assessment, 2004).					
Scientific name	**Common name**	**Habitat**	**Comments**	**Known to Occur**	**Subject to Impacts**
Mammals					
Aplodontia rufa phaea	Point Reyes Mountain Beaver	This subspecies of the common mountain beaver is only known to occur in Marin County, and its range is almost entirely within Point Reyes National Seashore. North facing slopes of hills & gullies in areas overgrown with sword ferns and thimbleberries.	The Point Reyes mountain beaver inhabits moderately dense coastal scrub habitat in colluvial hollows, and may use scrub habitat in the vicinity of all three project sites.	Yes	Yes
Corynorhinus (=Plecotus) townsendii townsendii	Pacific western big-eared bat	Roosts in caves, tunnels, mines, and dark attics of abandoned buildings. Very sensitive to disturbances and may abandon a roost after one onsite visit	No documented occurrences	No	No
Eumops perotis californicus	Greater western mastiff-bat		No documented occurrences	No	No
Myotis evotis	Long-eared myotis bat	Occurs primarily in high elevation coniferous forests, but also found in mixed hardwood/conifer, high desert, and humid coastal conifer habitats	No documented occurrences	No	No
Myotis thysanodes	Fringed myotis bat	Found in a wide variety of habitats from low desert scrub to high elevation coniferous forests. Day and night roosts in caves, mines, trees, buildings, and rock crevices	No documented occurrences	No	No
Myotis volans	Long-legged myotis bat	Most common in woodlands and forests above 4,000 feet, but occurs from sea level to 11,000 feet	No documented occurrences	No	No
Myotis yumanensis	Yuma myotis bat	Found in a wide variety of habitats from sea level to 11,000 ft., but uncommon above 8,000 ft. Optimal habitat is open forests and woodlands near water bodies	No documented occurrences	No	No
Zapus trinotatus orarius	Point Reyes jumping mouse	Riparian and grassland.	Occurrence near Abbotts Lagoon and Limantour Beach (G. Fellers, 2002)	Potentially	Yes
Birds					
Agelaius tricolor	Tricolored blackbird	Open country, protected nesting substrate.	Observed east side of Tomales Point, Cypress Grove Preserve (NDDB 2000); known to winter at the D Ranch most recently (D. Adams, 2001).	Yes	No
Arenaria melanocephala	Black turnstone	Forages along the shore by probing for invertebrates using its bill. It roosts in upland areas during high tide. Nesting in the Alaskan tundra, its migration peaks in August and April.	May be found in unvegetated tidal areas of PRNS from autumn through spring	Yes	Yes

Athene cunicularia	Burrowing owl	Nests in burrows in open fields; winters in same area.	Rare but regular migrant to PRNS (Stallcup 2000).	Likely (see comment)	No
Buteo regalis	Ferruginous hawk	Breeds in open country, including prairie grassland, shrub, and steppe using a tree where available. Also nests in low hillside bushes, a ledge of a rock outcrop or cliff, or among rocks on a hillside.	Not known to breed at PRNS; winters mostly, but occurs rarely (Stallcup 2000).	Likely (see comment)	No
Calidris canutus -	Red knot	Breeds in the arctic in summer. Migrates to coastal southern/central California in autumn-spring. Favors sparsely vegetated mud and sand shorelines	Seen in small numbers at PRNS, but not at Limantour Beach site but seen in Drakes Estero.	Unlikely	No
Chaetura vauxi	Vaux's swift	Forests, especially with burned or cutover areas providing snags; nests on inside walls of hollow trees and occasionally in chimneys.	Regularly occurring migrant, not known to breed at PRNS (Stallcup 2000).	Likely (see comment)	No
Cypseloides niger	Black swift	Breeds on cliffs adjacent or behind waterfalls in canyons and sea-bluffs above surf.	Not known to breed in PRNS but migrates through (Stallcup 2000).	No	No
Elanus leucurus	White-tailed kite	Savanna, riparian woodland, marsh, partially cleared or cultivated fields, grassy foothills.	Regularly occurring resident at PRNS (Stallcup 2000).	Likely (see comment)	No
Empidonax traillii brewsteri	Little willow flycatcher	Riparian habitat	Rare but regular migrant through PRNS (Stallcup 2000).	No	Yes
Falco peregrinus anatum	American peregrine falcon	High cliffs, ledges for nesting	May breed at PRNS; observed within Project Area in the summer and fall.	Yes	No
Geothlypis trichas sinuosa	Saltmarsh common yellowthroat	Freshwater, saltwater marshes with thick, continuous cover	Breeds in coastal marshes throughout PRNS (NDDB 2000). Observed at top of west arm of Horseshoe Pond and breeds in ponds near Limantour Beach.	Yes	Yes
Haematopus bachmani	Black oystercatcher	A permanent resident on rocky shores of marine habitats. Uncommon to locally fairly common in northern and central California and on Channel Islands (Cogswell 1977).	Breeds at Point Reyes Headland and Double Point but not in Drakes or Limantour Esteros.	No	No
Histrionicus histrionicus	Harlequin duck		Occurs during winter near Point Reyes Headland in nearshore with rocky substrate	No	No
Lanius ludovicianus	Loggerhead shrike	Open fields with scattered trees, open woodland, scrub.	Regularly occurring in winter mostly; breeds at PRNS (Stallcup 2000).	Likely (see comment)	No
Laterallus jamaicensis coturniculus	California black rail	Freshwater, saltwater or brackish marshes bordering large bays	Rare but regular breeding resident (Stallcup 2000). Observed at Kehoe Marsh and upper Olema Marsh (NDDB 2000).	Unlikely	No
Limosa fedoa	Marbled godwit	A common to abundant migrant and winter visitant from mid-August to early May in estuarine habitats. Most common on estuarine mudflats, but also occurs on sandy beaches, open shores, saline emergent wetlands, and adjacent wet upland fields	Not known to breed in PRNS but migrates through (Stallcup 2000). Regularly occurs in the esteros.	Likely	No

Melanerpes lewis	Lewis' woodpecker	An uncommon, local winter resident occurring in open oak savannahs, broken deciduous, and coniferous habitats.	No documented occurrences	No	No
Numenius americanus	Long-billed curlew	Nests in prairies and grassy meadows, usually near meadows; forages on beaches and mudflats.	Regularly occurring resident (Stallcup 2000).	Yes	No
Numenius phaeopus	Whimbrel	Forages on rocky intertidal and sandy beach marine habitats, on the intertidal mudflats of estuarine habitats, and on wet meadow and pasture habitats adjacent to the immediate coast. Occasionally forages on lawns or golf courses. Inland, prefers flooded fields, wet meadows, croplands and the margins of riverine and lacustrine habitats	Not known to breed in PRNS but migrates through (Stallcup 2000). Regularly occurs in the esteros.	Likely	No
Oceanodroma homochroa	Ashy storm-petrel	Spends most of its time at sea, coming to land only to reproduce.	Breeds at Point Reyes Headland and Double Point but not in Drakes or Limantour esteros.	No	No
Riparia riparia	Bank swallow	Open country, savanna, especially near running water.	Rare but regular migrant (Stallcup 2000).	Yes	No
Rynchops niger	Black skimmer	Requires shallow, calm water for foraging, and sand bars, beaches, or dikes for roosting and nesting.	Accidental sightings in PRNS	No	No
Selasphorus rufus	Rufous hummingbird	Found in a wide variety of habitats that provide nectar-producing flowers; uses valley foothill hardwood, valley foothill hardwood-conifer, riparian, and various chaparral habitats in both northward and southward migration; montane riparian, aspen, and high mountain meadows (to tree-line and above) used in southward migration. More common in the southern deserts in southward than in northward migration.	Regular breeding resident (Stallcup 2000).	Likely	No
Selasphorus sasin	Allen's hummingbird	Chaparral, thickets, brushy slopes, open coniferous forest.	Regularly occurring breeder; summer mostly (Stallcup 2000).	Yes	No
Sterna elegans	Elegant tern	Preferred habitats are inshore coastal waters, bays, estuaries, and harbors; rarely occurs far offshore, and never inland.	Not known to breed in PRNS but forages in summer and winter (Stallcup 2000). Regularly occurs in the esteros.	Yes	Yes
Reptiles					
Clemmys marmorata mormorata	Northwestern pond turtle	Near-permanent water with basking sites	First documented in Horseshoe Pond in October 2001.	Yes	No
Phrynosoma coronatum frontale	California horned lizard	occur in several habitat types, ranging from areas with an exposed gravelly-sandy substrate containing scattered shrubs, to clearings in riparian woodlands, to dry uniform chamise	No documented occurrences	No	No

		chaparral to annual grassland with scattered perennial seepweed or saltbush			
Amphibians					
Rana aurora aurora	Northern red-legged frog	Found in ponds and intermittent and permanent streams with slow or still water. Intermittent streams must retain surface water in pools year-round in order for frogs to survive	No documented occurrences	No	No
Rana boylii	Foothill yellow-legged frog	Found in or near rocky streams in a variety of habitats, including valley-foothill hardwood, valley-foothill hardwood-conifer, valley-foothill riparian, ponderosa pine, mixed conifer, coastal scrub, mixed chaparral, and wet meadow types.	No documented occurrences	No	No
Fish					
Lampetra tridentata	Pacific lamprey	Anadromous. Spawn in low gradient sections of water, with gravel and sandy bottoms. Juvenile spend 3-4 years in mud before returning to the ocean.	No documented occurrences	No	No
Invertebrates					
Cicindela hirticollis gravida	Sandy beach tiger beetle	Coastal sand dunes.	Distribution and abundance unknown (D. Adams, 2001)	Unknown	No
Coelus globosus	Globose dune beetle	California coastal dunes; subterranean dweller.	Distribution and abundance unknown (D. Adams, 2001)	Unknown	No
Icaricia icarioides	Point Reyes blue butterfly	Lupine is host plant.	Distribution and abundance unknown, but 1992 surveys located this butterfly at Tomales Point and North Beach dunes (D. Adams, 2001).	Unknown	No
Helminthoglypta arrosa williamsi	William's bronze shoulderband snail	Poorly understood. No information found.	No documented occurrences	No	No
Helminthoglypta nickliniana awania	Nicklin's Peninsula Coast Range snail	Poorly understood. No information found.	No documented occurrences	No	No
Hydrochara rickseckeri	Ricksecker's water scavenger beetle	Known only from pond habitats scattered around the San Francisco Bay area, including Marin, Sonoma, Alameda, and Contra Costa counties.	No documented occurrences	No	No
Incisalia mossii marinensis	Marin elfin butterfly	Poorly understood. No information found.	No documented occurrences	No	No
Lichnanthe ursina	Bumblebee scarab beetle	Coastal sand dunes.	Ranges from Sonoma to San Mateo Counties. Observed at MCI/RCA site 6/00 and 7/01; distribution and abundance at PRNS unknown (D. Adams, 2001).	Unknown	No
Plants					
Abronia umbellata ssp. Brevifolia	Pink sand-verbena	Disturbed sandy areas; coastal dunes and scrub; <100 m.	Present in PRNS (PRNS 2001). Most occurrences have few plants (CNPS 2001).	Yes	No

Agrostis blasdalei var. Blasdalei	Blasdale's bent grass	Coastal dunes, prairie, bluffs, and scrub.	Known from fewer than 15 occurrences (CNPS 2001). Present in PRNS (PRNS 2001).	No	No
Arabis blepharophylla	Coast rock-cress	Found on rocky coastal bluffs and ridges with thin soils. It typically lives in grasslands and steep moist places on north-facing slopes.	No documented occurrences	No	No
Arctostaphylos virgata	Marin (=Bolinas) manzanita	Associated with forest openings and scattered elsewhere, for example on the Bolinas Ridge. Blooms starting in late January.	No documented occurrences	No	No
Astragalus nuttallii var. virgatus	Nuttall's milk-vetch	No information found	No documented occurrences	No	No
Astragalus pycnostachyus var. pycnostachyus	Marsh milkvetch (=brine milk-vetch)	Coastal dunes, coastal salt marshes, seeps.	No documented occurrences	No	No
Atriplex californica -	California saltbush	Coastal strand and near edge of coastal salt marsh, coastal sage scrub, sea bluffs	No documented occurrences	No	No
Blennosperma nanum var. Robustum	Point Reyes blennosperma	Coastal prairie and scrub.	Known from fewer than 15 occurrences; some PRNS populations intermediate to B. Var. Nanum (CNPS 2001).	No	No
Calamagrostis crassiglumis	Thurber's reed grass	Mesic areas in coastal scrub and freshwater marshes.	Known in California from fewer than 10 occurrences (CNPS 2001). Present in PRNS (PRNS 2001), but threatened by grazing (CNPS 2001).	No	No
Calystegia purpurata ssp saxicola	Coastal bluff morning-glory	No information found	No documented occurrences	No	No
Campanula californica	Swamp harebell	Bogs and fens; closed-cone and North Coast coniferous forest; coastal prairie; meadows; freshwater marsh.	Mapped in several locations along the western side of Tomales Bay and Inverness Ridge (NDDB 2001).	No	No
Castilleja affinis spp. affinis	Coast Indian paintbrush	Chaparral and coastal scrub from the North Coast and outer North Coast Ranges to the foothills of the Cascade Ranges	No documented occurrences	No	No
Castilleja ambigua ssp. ambigua	salt marsh owl's clover (=johnny-nip)	Coastal salt marshes	Ranges from California North Coast in the Humboldt Bay area to the northern Central Coast in the Point Reyes area	No	No
Castilleja ambigua ssp. Humboldtiensis	Humboldt Bay owl's-clover	Coastal salt marsh.	Known only from Humboldt and Marin counties (NDDB 2001).	No	No
Castilleja exserrta ssp. latifolia	purple owl's-clover (=wideleaf Indian paintbrush)	Blooms from March to May on grassy slopes and openings in chaparral and coastal sage scrub below 3000 feet.	No documented occurrences	No	No
Ceanothus gloriosus var. Porrectus	Mount Vision ceanothus	Closed-cone coniferous forest; coastal prairie; coastal scrub; valley and foothill grassland.	Known from fewer than 15 occurrences in the Mount Vision area in PRNS (CNPS 2001; NDDB 2001).	No	No
Chorizanthe	San Francisco Bay	Sandy areas in coastal dunes, coastal prairie,	Not known from PRNS (PRNS 2001).	Chorizanthe	No

cuspidata var. Cuspidata	spineflower	and coastal scrub.		cuspidata does occur	
Chorizanthe cuspidata var. Villosa,	Wooly headed spineflower	Sandy areas in coastal dunes, coastal prairie, and coastal scrub.	Not known from PRNS (PRNS 2001).	Chorizanthe cuspidata does occur	No
Cirsium andrewsii	Franciscan thistle	Frequents wet or marshy ground along streams and seeps, sometimes on serpentine soils.	No documented occurrences	No	No
Clarkia davyi	Davy's clarkia		No documented occurrences	No	No
Collinsia corymbosa	Round-headed Chinese houses	Coastal Dunes	No documented occurrences	No	No
Cordylanthus maritimus ssp. Palustris	Point Reyes bird's-beak	Coastal salt marsh.	Present in several areas in Drakes Estero and Limantour Marsh (NDDB 2001, PRNS 2001).	No	No
Dirca occidentalis	Western leatherwood	Riparian woodlands, forest and chaparral.	No documented occurrences	No	No
Erigeron supplex	Supple daisy	Coastal bluff scrub; coastal prairie.	Possibly extirpated from the area (USFWS April 2001).	No	No
Fritilaria lanceolata var tristulis	Marin checker lily		No documented occurrences	No	No
Fritillaria liliacea	Fragrant fritillary (= prairie bells)	Often on serpentine soils in coastal scrub, coastal prairie, and valley and foothill grassland.	Present in PRNS (PRNS 2001, NDDB 2001).	No	No
Gilia capitata ssp. *chamissonis*	San Francisco (=bluehead, Chamisso's, dune) gilia	Sandy soil and dunes near the coast. Occurs in open areas in coastal scrub communities.	No documented occurrences	No	No
Gilia capitata ssp. *tomentosa*	Woolly-headed gilia	Coastal bluff scrub	Known from only three occurrences near Tomales and Salt Pt.	No	No
Gilia millefoliata	Yarrow-leaf (=manyleaf, dark-eyed) gilia	Coastal dunes	No documented occurrences	No	No
Grindelia hirsutula var. Maritima	San Francisco gumplant	Sandy, serpentine soils in coastal bluff scrub, coastal scrub, and valley and foothill grassland.	Present in PRNS (PRNS 2001).	No	No
Hesperevax sparsiflora var. *brevifolia*	Short-leaved evax	Coastal bluff scrub and Coastal dunes	No documented occurrences	No	No
Horkelia cuneata ssp. Sericea	Kellogg's horkelia	Old dunes; coastal sandhills; gen < 200 m.	Not known from PRNS (PRNS 2001). Possibly extirpated from the area (USFWS April 2001). Occurrence from Mt. Bruno area probably last remaining one in San Francisco Bay (CNPS 2001).	No	No
Horkelia marinensis	Point Reyes horkelia	Coastal dunes, prairie, and scrub.	Present in PRNS (PRNS 2001). Known from fewer than 20 occurrences (CNPS 2001).	No	No

Lilium maritimum	Coast lily	Broadleafed upland forest; closed-cone coniferous forest; coastal prairie; coastal scrub; and North coast coniferous forest.	Present in PRNS (PRNS 2001).	No	No
Limnanthes douglasii ssp. Sulphurea	Point Reyes meadowfoam	Coastal prairie; mesic areas in meadows; freshwater marsh; and vernal pools.	Known from approximately 10 occurrences (CNPS 2001). Present in PRNS (PRNS 2001).	No	No
Linanthus grandiflorus	Large-flowered (=flower) linanthus	Uncommon in open grassy flats generally in sandy soil from the North and Central Coast to the San Francisco Bay Area; < 1200 m.	No documented occurrences	No	No
Microseris paludosa	marsh microseris (=marsh silverpuffs)	Closed-cone coniferous forest, Cismontane woodland, Coastal scrub, and Valley and foothill grasslands	No documented occurrences	No	No
Monardella undulata	Curly-leaved (=curlyleaf) monardella	Coastal scrub and dune habitat. Also known from chaparral.	No documented occurrences	No	No
Perideridia gairdneri ssp. Gairdneri	Gairdner's yampah	Mesic areas in broadleafed upland forest, chaparral, valley and foothill grassland, and vernal pools.	Present in PRNS (PRNS 2001).	No	No
Phacelia insularis var. Continentis	Northcoast phacelia	Coastal bluff scrub; coastal dunes.	Known from approximately seven occurrences (CNPS 2001). Present in PRNS (PRNS 2001).	No	No
Piperia elegans spp. decurtata	Pt. Reyes rein orchid	grasses, scrub, full sun on coastal bluffs	Grows only on the Chimney Rock peninsula and near the Pt. Reyes Lighthouse	No	No
Polygonum marinense	Marin knotweed	Coastal salt marshes and brackish marshes.	Known from fewer than 15 occurrences; taxonomic status uncertain (CNPS 2001). Present in several locations in the PRNS (PRNS 2001).	No	No
Rhynchospora californica	California beaked-rush	Bogs and fens; lower montane coniferous forest; seeps in meadows; freshwater marshes.	Known from fewer than 10 occurrences (CNPS 2001). Last seen in 1945 (NDDB 2001).	No	No
Sagittaria sanfordii	Valley sagittaria (=Sanford's arrowhead)	Assorted shallow freshwater marshes and swamps.	Not known from PRNS (PRNS 2001).	No	No
Sidalcea calycosa ssp *rhizomata*	Point Reyes checkerbloom		No documented occurrences	No	No
Sidalcea hickmanii ssp. *Viridis*	Marin checkerbloom	Serpentine areas in chaparral.	Not known from PRNS (PRNS 2001).	No	No
Spartina foliosa	Pacific cordgrass (=California cordgrass)	Coastal salt marsh	Found in Drakes Estero	Yes	Yes
Stellaria littoralis	Seashore (=coast, =beach) starwort	Coastal dunes, bluffs and scrub.	No documented occurrences	No	No
Triphysaria floribunda	San Francisco owl's-clover	Serpentine areas in coastal prairie and valley and foothill grassland.	Present in PRNS (PRNS 2001).	No	No

Appendix B - Wilderness Minimum Tool

Minimum Requirement Process

Congress passed the Wilderness Act in 1964 "to secure for the American people of present and future generations the benefits of an enduring resource of wilderness… for this purpose there is hereby established a National Wilderness Preservation System to be composed of federally owned areas designated by Congress as "wilderness areas", and these shall be administered for the use and enjoyment of the American people in such manner as will leave them unimpaired for future use and enjoyment as wilderness, and so as to provide for the protection of these areas, the preservation of their wilderness character.

The Wilderness Act established certain restrictions on activities permitted within wilderness to preserve its wild and untrammeled nature and to ensure that it remain wild for future generations. Two explicit restrictions prohibited the construction of permanent roads and commercial enterprises within wilderness. Other generally prohibited activities include landing of aircraft, construction of temporary roads, the use of mechanized transport, the use of motorized equipment and the placement of structures. These restrictions are detailed in Section 4(c) of the act and apply to users and managers alike. The act did however; authorize certain narrow exceptions to these prohibitions for agencies administering wilderness areas. Specifically, agencies were permitted exception in the instance of emergencies pertaining to the health and safety of persons within wilderness, and actions necessary to meet the minimum requirement for preserving wilderness and protecting an enduring resource of wilderness.

The Minimum Requirement Analysis stems form the language in the act pertaining to actions that are minimally required to permit the agency to administer wilderness areas as wilderness. The minimum requirement applies only to the managing agency and not the public, which is explicitly bound by the restrictions of the act. The concept of Minimum Requirement flows directly from Section 4(c) of the Wilderness Act of 1964.

"Except as specifically provided for in the Act, and subject to existing private rights, there shall be no commercial enterprise and no permanent road within any wilderness area designated by this Act and except as necessary to meet <u>minimum requirements</u> <u>for the administration of the area for the purpose of this act</u> (including measures required in emergencies involving the health and safety of persons within the area), there shall be no temporary road, no use of motor vehicles, motorized equipment or motorboats, no landing of aircraft, no other form of mechanical transport, and no structure or installation within any such area." (emphasis added)

The Minimum Requirement Analysis is designed to assist program managers in making appropriate decisions affecting wilderness that are consistent with the Wilderness Act and National Park Service Management Policies.

Applicable actions include, but are not limited to, scientific monitoring, research, recreational developments (trails, bridges, signs, etc.) and activities related to special provisions mandated by the Wilderness Act or subsequent legislation. Agency policy may also influence determination of minimum requirement. National Park Service policy direction on wilderness management is contained in Section 6.3.5 of the *Management Policies 2001:*

> All management decisions affecting wilderness must be consistent with a minimum requirement concept. When determining minimum requirement, the potential disruption of wilderness character and resources will be considered before, and given significantly more weight than economic efficiency and convenience. If a compromise of wilderness resource or character is unavoidable, only those actions that preserve wilderness character and/or have localized, short-term adverse impacts will be acceptable. …the method used

must clearly weigh the benefits and impacts of the proposal, document the decision-making process and be supported by an appropriate environmental compliance document.

The Minimum Requirement Analysis is composed of two parts; 1) the determination that the proposed action is necessary for administration of the wilderness area as wilderness (the minimum requirement), and 2) the selection of the best method for implementing the action with the least impact to wilderness (the minimum tool determination). The Wilderness Act and National Park Service Policy require that generally prohibited actions undertaken in wilderness complete a Minimum Requirement Analysis. This analysis is included as a part of environmental compliance documentation, generally as an appendix to an Environmental Assessment or Environmental Impact Statement.

The key point of the Minimum Requirement Analysis is that the proposed action is necessary for the administration of the wilderness area as wilderness. The philosophical dilemma with undertaking actions within wilderness is whether a generally prohibited activity with transitory impact will, in the long run, enhance wildness and ensure the long-term viability of the area as wilderness. This is the decision that agencies and managers must make through the minimum requirement analysis and minimum tool determination. It is a measured determination that the proposed action will enhance the wildness and natural character of the area and will enhance the likelihood that the wilderness values will be better maintained and preserved in the future.

Minimum Requirement Analysis

Minimum Requirement Analysis Worksheet

Point Reyes National Seashore

Proposed Action: Coastal Watershed Restoration (Glenbrook Crossing and Estero Trail Reroute)

Project Lead: Brannon Ketcham, Hydrologist Date: 10/20/2004

PART A: Minimum Requirement (Should the action be done in wilderness)

1 IS THE ACTION AN EMERGENCY?

YES → Act according to established procedures

NO ↓

Answer: Yes ☐ No ☒

Explain:

Non-conforming structures present no immediate risk to health and safety. Restoration can proceed at the most ecologically beneficial time.

2 Does the Action conflict with legislation, wilderness goals or DFC?

YES → Do Not Undertake

NO ↓

Answer: Yes ☐ No ☒

Explain

The Point Reyes Wilderness Act amended the National Seashore enabling legislation by inserting specific reference to wilderness restoration as a goal. Section 4(c) of the Wilderness Act permits a minimum requirement/minimum-tool process for the administration of wilderness areas.

3 Can the action be accomplished with less intrusive means?

YES → Do It

NO ↓

Answer: Yes ☐ No ☒

Explain

Large non-conforming structures in wilderness were constructed with heavy equipment prior to wilderness establishment. The only feasible way to remove /restore these sites is with the use of excavation equipment.

4

Can the action be accomplished outside of wilderness?

YES

Do it There

NO

5

Proceed to PART B

Answer: Yes ☐ No ☒
Explain

The non-conforming structures are physically located within wilderness. Options for removing the non-conformities would be to either remove them or redraw the wilderness boundary to exclude them.

PART B - Determining the Minimum Requirement

Responsive Questions for Minimum Requirements Analysis:

	RESPONSIVE STATEMENT
EFFECTS ON WILDERNESS CHARACTER	
How does the project or activity benefit the wilderness resource as a whole as opposed to maximizing one resource?	The final restoration goal is removal of this non-conforming structure from the Wilderness and restoration of natural hydrologic process. This project intends to achieve this objective. The proposed trail reroutes will be constructed to a more sustainable grade and scale that allows for maintenance to be performed consistent with Wilderness standards. This work would be considered an upgrade compared to existing trails.
If this project or activity were not completed, what would be the beneficial and detrimental effects to the wilderness resource?	The Glenbrook Crossing road embankment is 280 feet long ranging from 70 to 100 feet wide at its base. The culvert is failed, with piping around it and a severe bow in its profile. The stream profile drops 15 feet at the site (11 from the outlet of the culvert to the channel below, and is a complete barrier to aquatic species. The proposed restoration will restore natural hydrologic process and hydrologic connectivity to the area. Proposed deconstruction of the facility will avoid catastrophic failure of the facility and associated impacts to the Wilderness resource. Trail reroutes will provide public access to the wilderness in a manner that is more sustainable in the long-term.
How would the project or activity help ensure that human presence is kept to a minimum and that the area is affected primarily by the forces of nature rather than being manipulated by humans?	Completion of proposed work at this site would eliminate the necessity for maintenance of this non-conforming facility within the Wilderness area, and reduce maintenance requirements on the trail systems created through the project.
How would the project or activity ensure that the wilderness provides outstanding opportunities for solitude	The construction actions would likely take 30-60 days to complete. This would represent a short-term intrusion on the values of wilderness and solitude. In the long-term

or a primitive and unconfined type of recreation? (i.e. does the project or activity contribute to people's sense that they are in a remote place with opportunities for self-discovery, adventure, quietness, connection with nature, freedom, etc.)	these actions and removal of non-conforming structures is considered a benefit to Wilderness.	
MANAGEMENT SITUATION		
What does your management plan, policy, and legislation say to support proceeding with this project?	PORE Guidelines for Management (1990), the PORE GMP, and enabling legislation recognize that restoration of natural process is likely necessary within the Wilderness area. The planned restoration is intended to insure that natural process is sustained, and that NO FURTHER manipulation is required at this location.	
How did you consider wilderness values over convenience, comfort, political, economic or commercial values while evaluating this project or activity?	The site is within Wilderness and is a reason that this site is a priority for treatment. Restoration is intended to enhance wilderness values.	
SHOULD WE PROCEED?	**YES:** **Go to Step 2**	**NO:** **Stop**

Step 2 -

What is Proposed: Removal of unnatural structures impeding natural hydrologic function. • Removal of Muddy Hollow Dam and Reroute of Estero Trail* *(trail reroute in Wilderness) • Limantour Marsh Channel Restoration (Not in Wilderness) • Glenbrook Crossing restoration and trail reroute (in Wilderness)			
Location: Estero Trail in the vicinity of Muddy Hollow Muddy Hollow Trail at Glenbrook Creek		When will the action occur: Start: 8/2005 End: 10/2005	
☐ Method 1	☐ Method 2	☒ Method 3	☐ Method 4
Use of motorized equipment or mechanical transport	Use of non-motorized equipment or non-mechanical transport	Combination of Methods 1 & 2	Other methods

Rational for Method

The project is needed to restore natural conditions and increase estuarine habitat at Point Reyes. At each of these sites, construction across stream or estuarine habitat impedes natural process and

is not consistent with long-term park and NPS management objectives. These sites impede or block access to watersheds that support, or have the potential to support, federally threatened coastal California steelhead and coho salmon. Muddy Hollow Dam and Limantour Beach dam restrict tidal action from more than five acres of coastal marsh habitat. The Glenbrook crossing is a non-conforming structure within the Philip Burton Wilderness and is a barrier to fish passage.

Prior to establishment of the Seashore, much of the entire designated Wilderness was part of intensive agriculture; including grazing and cropping and in many areas logging was common. Roads, ponds and other facilities were constructed and many still persist within the Wilderness. Many of these facilities, particularly roads and dams, have had a significant effect upon the natural functioning of the wilderness ecosystem. This has been especially evident in regard to hydrologic functioning, erosion and sedimentation and their impacts upon wildlife. Evaluation of physical conditions and process in the wilderness indicate that in many areas, particularly associated with roads and stream crossings, the pre-Wilderness land uses continue to influence and impede natural process, and thus the wilderness character and quality.

Point Reyes National Seashore enabling legislation (Point Reyes Act of Sept 13, 1962) tasks the National Park Service "…to save and preserve, for the purpose of public recreation, benefit, and inspiration, a portion of the diminishing shoreline of the United States that remains undeveloped". Subsequently, the Point Reyes Wilderness Act (PL 94-567) amended the Seashore's enabling legislation to include the following language "*…SEC. 7. (a) Section 6(a) of the Act of September 13, 1962 (76 Stat. 538), as amended (16 U.S.C. 459c-6a) is amended by inserting "without impairment of its natural values, in a manner which provides for such recreational, educational, historic preservation, interpretation, and scientific research opportunities as are consistent with, based upon, and supportive of the* ***maximum protection, restoration and preservation of the natural environment with the area"*** *immediately after "shall be administered by the Secretary."*

Clearly, preservation and restoration of natural processes at Point Reyes and within the Point Reyes (Phillip Burton) Wilderness have been given great importance by Congress. The Wilderness Act though, contains a dilemma between the mandates of remaining "untrammeled" but "natural". The issue becomes to what extent does restoration for naturalness conflict with untrammeled? If non-conforming intrusions to wilderness are permitted to perpetuate, with their continued effect upon ecosystem function, then the area is neither untrammeled nor natural. Actions taken to correct non-conforming, ecologically disruptive conditions may have a short-term affect upon wilderness character, but in the long-term will remove the "imprint of man" and increase naturalness.

Considering restoration within Wilderness includes weighing the impacts of implementation with those of leaving the site alone. Particularly with facilities, such as road crossings, culverts, and dams, the implications of these man-made facilities being a part of wilderness reduces the strength of the overall Wilderness objective of 'untrammeled by man".

The Glenbrook Crossing site is located approximately one mile inside of the Wilderness Boundary. It is accessible on the Muddy Hollow Trail (former road). The 20-25 foot high road embankment, 5-foot diameter culvert and 11 foot outfall are considered non-conforming wilderness features. These facilities, the materials that allow them to remain, and the equipment used to construct them are considered non-conforming with the wilderness character.

In addition to the facility deconstruction, actions at Muddy Hollow and Glenbrook Crossing would require trail reroutes through the Wilderness. Current trails are primarily converted roads leading to large-scale drainage and maintenance issues. The proposed reroutes would be constructed to a scale more appropriate for wilderness, and more sustainable/compatible with the Wilderness designation.

Section 4(c) of the Wilderness Act of 1964 prohibits certain activities in wilderness but, at the same time allows the agencies to engage in those activities in some situations as long as it meets the minimum requirement for administration of the area as wilderness. Section 4(c) states:

"… except as necessary to meet minimum requirements for the administration of the area for the purpose of this Act (including measures required in emergencies involving the health and safety of persons within the area), there shall be no temporary road, no use of motor vehicles, motorized equipment or motorboats, no landing of aircraft, no other form of mechanical transport, and no structure or installation within any such area."

Through this Wilderness Act language, Congress acknowledged that there are times when exceptions are allowed to meet the minimum required administration of the area as wilderness. The minimum tool requirements analysis required determines the least impacting way of administering the wilderness. The wilderness manager may authorize any of the generally prohibited activities or uses listed in Sec. 4(c) of the Wilderness Act if they are determined to be the minimum necessary to do the job and meet wilderness management objectives.

Impacts to wilderness resources and wilderness character

The creation of a stable stream channel and floodplain and safe and stable stream crossing at Glenbrook Creek will result in a short-term impact to wilderness character. This impact will be manifested through the use of mechanized equipment and mechanical transport to the restoration site. Utilization of construction equipment will alter the ambient sound quality and the character of the local soundscape during the deconstruction/restoration phase of the project. An increase in airborne dust can be expected. Visitor access to the area will be restricted during the time when the deconstruction and restoration work is taking place for an estimated 30-60 days.

Impacts are expected to be of short duration and transitory. Impacts will be mitigated to the greatest extent possible.

Muddy Hollow

The Muddy Hollow Pond is within the Natural Zone and would not result in impacts to Wilderness resources. The trail reroute that would occur in conjunction with the restoration activities at the site would be located primarily within the Wilderness area.

The trail reroute would take advantage of existing slopes to construct a trail that would be sustainable in the long-term. Many trails in the park are adapted from old roadbeds and are problematic to maintain. Where new routes are installed, the construction techniques and scale are designed to allow for better trail maintenance in the long-term.

The proposed method of installing the trail reroute is through the use of a specialized trail building machinery. The use of this machinery would reduce costs of implementation, but create a trail that would be sustainable and could be maintained through the employment of hand crews. Currently, trails within these areas are former roads. The scale and condition requires use of mechanized equipment to maintain water bars and drainage devices along the most problematic sections. The use of mechanized equipment to create a sustainable trail would result in minor short-term adverse effects on wilderness, but in the long-term, the sustainable trail would reduce the need for mechanized equipment to actually maintain the facility. The long-term effect of this trail reroute on wilderness resources and values is considered beneficial.

Glenbrook Crossing

Glenbrook Crossing and the associated trail reroute are located approximately one mile into the Wilderness area from the proposed access at Upper Muddy Hollow parking area. The intent of

actions at this location are to remove a non-conforming structure from the Wilderness and restore natural hydrologic process to Glenbrook Creek.

The construction activities are estimated to take three weeks, requiring daily access to the site and work at the site. The contractor would be required to stage at the parking area and run a shuttle between the access and the site to minimize trips between the sites.

At the Glenbrook site, there is a 15-foot vertical elevation difference in the bed of the creek at the road crossing location. Under Alternative 2, the downstream reach would be treated in a similar manner as described in Alternative 1, though the extent of treatment may only extend 600 feet below the crossing, rather than 850 described in Alternative 1. The channel would be filled creating a 2-3% grade with constructed boulder/woody debris structures installed at or below grade to reduce potential downcutting and to provide structure in the newly created channel bed. Upstream, the restoration actions would include limited excavation upstream up to approximately 200 feet, as well as installation of two boulder/woody debris structures. The volumes excavated upstream would be balanced with the fill requirements necessary downstream.

This limited upstream excavation would reduce potential direct effects on existing riparian habitat and depend on this heavily vegetated area to provide some level of stability in the bed profile. Compared with Alternative 1, the work is less intrusive and depends on natural process to develop a level of stability. The tradeoff, however, is that the sediment transport levels would also be higher, as the system adjusts over time. The level of construction effort and manipulation is extensive, but is far less extensive than the approach described under Alternative 1. While the same equipment would be required, the duration of construction and extent of intrusion associated with construction activities are reduced from Alternative 1. In addition, Alternative 2 leaves much of the upstream riparian complex and allows for the channel to more completely evolve through natural dynamic processes. When considering these treatments and minimization of impacts where possible, the short-term impacts are considered minor at this site. In the long-term, the removal of non-conforming structure and restoration of natural process is considered beneficial.

Currently, a visitor on the trail does not necessarily realize the scale or effect of the former road facility on the creek or natural process. These actions, though extensive, would create opportunities to educate the public about wilderness, non-conforming structures, restoration, and protection. The construction activities would be a visible action that would prompt visitor interest and allow for dissemination of this information.

The trail reroute would be located upstream of the existing crossing, and would take advantage of existing slopes to construct a trail that would be sustainable in the long-term. Many trails in the park are adapted from old roadbeds and are problematic to maintain. Where new routes are installed, the construction techniques and scale are designed to allow for better trail maintenance in the long-term.

The proposed method of installing the trail reroute is through the use of a specialized trail building machinery. The use of this machinery would reduce costs of implementation, but create a trail that would be sustainable and could be maintained through the employment of hand crews. Currently, trails within these areas are former roads. The scale and condition requires use of mechanized equipment to maintain water bars and drainage devices along the most problematic sections. The use of mechanized equipment to create a sustainable trail would result in minor short-term adverse effects on wilderness, but in the long-term, the sustainable trail would reduce the need for mechanized equipment to actually maintain the facility. The long-term effect of this trail reroute on wilderness resources and values is considered beneficial.

Impact Mitigations

- Deconstruction/restoration use of mechanized construction equipment will be scheduled at times so as to minimize disruption to the public from noise and dust.
- All construction equipment will be equipped with approved mufflers and spark suppression devices.
- Construction equipment will be cleaned prior to arrival on site to reduce the potential importation of non-native weed species.
- Construction access will be flagged and limited to old roadbeds and non-riparian areas to the greatest extent possible. If access or staging must occur in wetland/riparian areas, access within these areas will be minimized to reduce impacts
- Construction sites will be watered as necessary to reduce fugitive dust.
- Educational materials explaining the restoration and the minimum requirement process for wilderness will be made available to park visitors at public contact points within the seashore. Notices and informational materials will be placed at normal access points to the construction zone to inform visitors of the rational and duration of temporary closures.

Minimum Requirements Worksheets

Approvals	Signature	Name	Position	Date
Prepared by:		William Shook	Chief of Natural Resources	10/22/04
Recommended by:		Brannon Ketcham	Hydrologist	10/22/04
Approved by:		Don Neubacher	Superintendent	