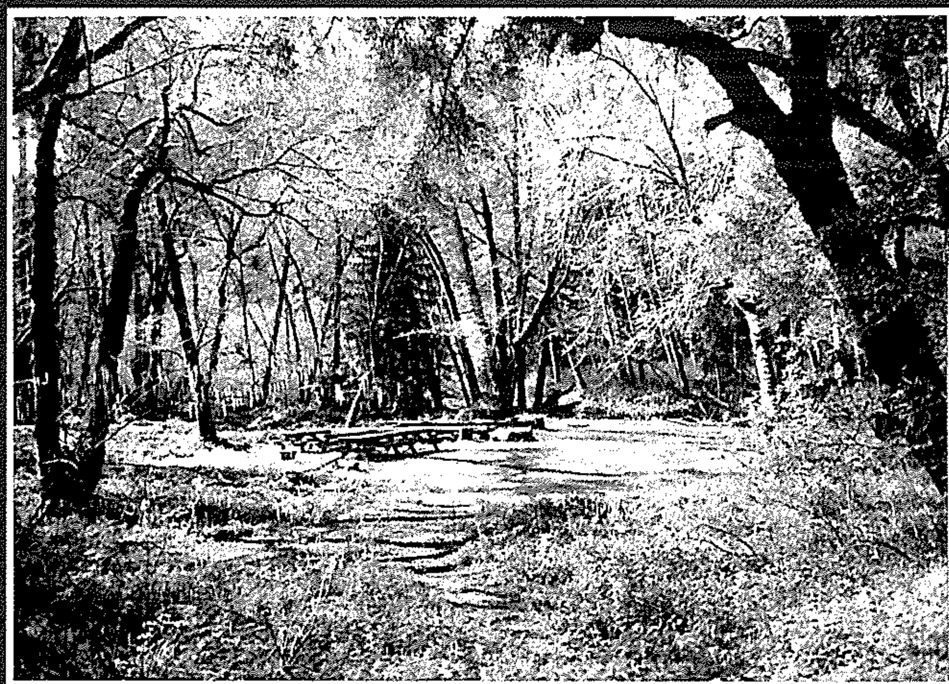
Draft

Environmental Impact Report for the



General Forest Management Plan for

Soquel Demonstration State Forest

Prepared for:
California Department of Forestry and Fire Protection

Prepared by:

Jones & Stokes Associates, Inc.

July 1995

Draft
Environmental Impact Report
for the
Soquel Demonstration State Forest
General Forest Management Plan

State Clearinghouse Number 94023033

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July 1995

This document should be cited as:

Jones & Stokes Associates, Inc. 1995. Environmental impact report for the Soquel Demonstration State Forest general forest management plan. Draft. July 1995. (JSA 94-146.) Sacramento, CA. Prepared for the California Department of Forestry and Fire Protection, Sacramento, CA.

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Executive Summary

INTRODUCTION

This executive summary presents key information contained in the draft environmental impact report (EIR) for the General Forest Management Plan (GFMP) for Soquel Demonstration State Forest (SDSF). It describes the proposed project (i.e., the actions proposed in the GFMP) and feasible alternatives to the GFMP; the environmental impacts that would result from implementing the GFMP or an alternative, including determinations of the impacts' significance; and recommended mitigation measures to avoid or reduce the significance of impacts.

PROJECT DESCRIPTION SUMMARY

Objectives of Implementing the General Forest Management Plan

The objectives of the project are to:

- provide forestry demonstration, education, and research opportunities consistent with the California Department of Forestry and Fire Protection's (CDF's) goals for demonstration state forests;

- protect and enhance natural resources by reducing watershed impacts, improving fish habitat, and developing a balanced range of habitats with emphasis on late-successional habitat;

- harvest and use timber consistent with the California Forest Practice Act and the principles of sustained yield and multiple use;

- provide for public use and recreation; and

- develop an adequate and stable source of revenue to defray the costs of protecting natural resources, constructing and maintaining improvements, and managing SDSF to fulfill the above objectives.

Summary of the Proposed Project

SDSF is located in central Santa Cruz County, approximately 8 miles northeast of Santa Cruz. SDSF's 2,681 acres are located within the watershed of the East Branch of Soquel Creek (East Branch). The forest is administered by CDF to implement programs in forestry demonstration and education, timber management, research, natural resource protection and enhancement, and recreation as described in the GFMP. This section summarizes the principal activities called for in the plan that could result in significant adverse environmental impacts.

Timber Management

The proposed project would involve ongoing timber harvesting in most areas of SDSF. Four designated old-growth redwood areas would not be harvested, and late-succession management areas would be managed to promote the development of functional old-growth habitat characteristics. Timber would be harvested at a rate of 20-35% of SDSF's estimated conifer growth rate over the period of the GFMP (i.e., the next 10 years). A harvest rate of 30% of conifer growth would yield approximately 750 thousand board-feet per year. Harvests would occur approximately every 2 years.

Harvesting and related activities (e.g., road building) would be performed in compliance in with the California Forest Practice Rules and the special rules that apply within the Southern Subdistrict of the Coast Forest District and Santa Cruz County (14 CCR Section 900 et seq.).

Natural Resource Enhancement

Natural resource enhancement would focus on avoiding or reducing watershed impacts (e.g., discharge of sediment into streams), improving fish habitat, and developing late-succession habitat. Ongoing management of SDSF involves maintaining proper drainage along roads and trails by repairing culverts, water bars, and other structures to reduce or prevent soil erosion and stream sedimentation. In addition, the GFMP calls for an active watershed remediation program as described in Chapter 2, "Project Description", and Chapter 3, "Geology, Soils, and Water Quality".

Public Use and Recreation and Education Facilities

Specific objectives for public use and development of recreation facilities at SDSF would be incorporated into a recreation master plan that would be prepared following adoption of the GFMP. Under the GFMP, public use and recreation facilities would include:

- nonmotorized public use during daylight hours;

- educational field trips for organized groups and the general public;
- construction of a forestry education center;
- acquisition and development of a new entrance to SDSF;
- construction of a small, rustic campground for occasional group use by reservation; and
- continued development and maintenance of the SDSF trail system for recreational and educational uses.

Summary Description of Alternatives Considered in This EIR

The following alternatives to the proposed project are analyzed in the draft EIR.

Alternative 1: No-Project Alternative

The No-Project Alternative would entail continuing custodial management of SDSF at an intensity consistent with a staff of one part-time forest manager. The main distinctions between the proposed project and the No-Project Alternative are that, under the No-Project Alternative, the forestwide timber harvest objective would be lower, watershed remediation efforts would be reduced, and no campground would be constructed. The 600-foot-wide late-succession management areas adjacent to Class I streams proposed in the GFMP would not be established under the No-Project Alternative.

Alternative 2: Emphasize Watershed and Late-Succession Habitat Protection

Alternative 2 would give highest priority to natural resource protection. The principal changes in management under this alternative relative to the GFMP would be the establishment of late-succession management areas adjacent to Class II streams as well as to Class I streams, accelerated recruitment of late-succession habitat forestwide by restricting timber removals to trees less than 26 inches in diameter at breast height, and the restriction of tractor log yarding to lands with low or moderate erosion hazard ratings.

Alternative 3: Emphasize Forest Management Demonstration and Recreation

Alternative 3 would give increased emphasis to timber management involving various silvicultural systems and to public recreation use at SDSF. The principal differences between this alternative and the proposed project are that, under Alternative 3, the average timber harvest rate would increase to approximately 75% of annual growthand Hihn's Mill Road would be widened, paved, and opened to motorized use by the public. SDSF would be used for amateur races and runs (pedestrian, equestrian, and bicycle), and hunting would be allowed consistent with state laws and regulations.

IMPACTS OF IMPLEMENTING THE GENERAL FOREST MANAGEMENT PLAN

Environmental impacts of implementing the GFMP or Alternative 2 or 3 are summarized in Table ES-1 (at the end of this summary). This table identifies each impact, reports the impact's significance, and specifies mitigation measures recommended to reduce those impacts. Both significant impacts and beneficial impacts of the project are summarized below.

Significant Impacts

Implementing the proposed project or Alternative 2 or 3 would result in potentially significant impacts on special-status bird species' active nest sites, demand for police and emergency services, and noise exposure on nearby residences. Construction of the new access road under all alternatives also would result in a potentially significant impact on traffic safety. Implementing Alternative 3 would result in additional potentially significant impacts on soil erosion, mass-movement risks, stream sedimentation, sedimentation of aquatic habitats, wildfire risks, land-use conflicts, safety on the paved road, and offsite views.

As shown in Table ES-1, no significant and unavoidable impacts would result from implementing the proposed project, Alternative 2, or Alternative 3. All significant or potentially significant impacts would be reduced to less-than-significant levels by implementing the recommended mitigation measures.

Beneficial Impacts

The beneficial impacts common to the proposed project and Alternatives 2 and 3 are:

- increased channel scour and reduced sediment delivery from watershed remediation,
- improved habitat for aquatic amphibians and reptiles from watershed remediation,
- increased recreation and education opportunities.

In addition, implementing the proposed project or Alternative 2 would have beneficial impacts on general wildlife and special-status species at SDSF.

Cumulative Impacts

Cumulative impacts of implementing the proposed project or Alternative 2 or 3 in conjunction with past, present, and foreseeable future projects include impacts on soil erosion in the East Branch watershed, demand for police and emergency services, recreational and educational use at SDSF, and vehicular traffic levels on the roadway system. Of these, only the impact on demand for police and emergency services was determined to be potentially significant; it would be reduced to a less-than-significant level by implementing the specified mitigation measures. The other cumulative impacts would be less than significant or beneficial (Table ES-1).

IMPACT CONCLUSIONS REQUIRED BY THE CALIFORNIA ENVIRONMENTAL QUALITY ACT

The California Environmental Quality Act (CEQA) requires that an EIR identify (based on the assessment of project impacts) the environmentally superior alternative, any irreversible environmental change that would be caused by the proposed project, and any unresolved issues and known areas of controversy involving the proposed project.

Environmentally Superior Alternative

The proposed project and Alternative 2 would result in the same potentially significant and less-than-significant environmental impacts. Although the proposed project would result in more extensive watershed remediation and fish habitat enhancement programs than Alternative 2, Alternative 2 is considered to be the environmentally superior alternative because it would avoid or reduce disturbances to soils and streams to a greater extent than the proposed project. However, this alternative would not meet the project's purpose and need as well as the proposed project because the relatively low level of timber harvesting under the Alternative 2 would result in reduced funding for watershed remediation, fish habitat improvements, construction and maintenance of recreation and education facilities, and overall forest administration. Therefore, this alternative would not meet the project's purpose and need as well as the proposed project.

Irreversible Environmental Change

Section 15126(f) of the State CEQA Guidelines requires that EIRs include a discussion of significant, irreversible environmental changes resulting from implementation of the proposed project. Irreversible commitment of resources would result from implementing the proposed project or any of the alternatives. These resources include building materials, fossil fuels, and labor that are required to conduct timber harvesting operations, implement watershed remediation measures, and construct new roads and recreation and education facilities. The proposed project generally would result in greater irreversible commitment of resources than Alternative 2 and less commitment of irreversible resources than Alternative 3. No resources committed under the proposed project or any alternative are of notably limited supply or have strategic importance.

No significant, irreversible environmental changes would result from implementing the proposed project, Alternative 2, or Alternative 3.

Unresolved Issues and Known Areas of Controversy

Section 15123(b) of the State CEQA Guidelines requires an EIR to identify known areas of controversy related to the proposed project. The most controversial issues raised during the scoping process were impacts on flooding, criminal activity in and near SDSF, landsliding, erosion, fisheries, amphibians, reptiles, and riparian resources. In addition to these environmental impacts, the need for ongoing monitoring of resource conditions and mitigation measure implementation was of substantial public concern.

These issues are largely resolved in the draft EIR. The significance of each environmental impact was determined, and feasible mitigation measures were identified to reduce each significant or potentially significant impact to a less-than-significant level. Monitoring programs for water quality and fish habitat were recommended. More detailed descriptions of monitoring efforts to be implemented will be presented in a mitigation monitoring plan that will accompany the final EIR.

Table ES-1. Summary of Impacts and Mitigation Measures

Resource Topic	Proposed Project	Alternative 2: Emphasize Watershed and Late-Succession Habitat Protection	Alternative 3: Emphasize Forest Management Demonstration and Recreation
GEOLOGY AND SOILS			
Impact	**Increased erosion from projected disturbances at SDSF**		
Level of significance	Less than significant	Less than significant	Potentially significant
Mitigation required	None	None	Implement a watershed remediation program
Impact	**Cumulative increases in erosion in the East Branch watershed from projected disturbances at SDSF in conjunction with other watershed disturbances**		
Level of significance	Less than significant	Less than significant	Less than significant
Mitigation required	None	None	None
Impact	**Increased surface erosion from diversion of runoff from natural channels caused by road and skid trail construction**		
Level of significance	Less than significant	Less than significant	Less than significant
Mitigation required	None	None	None
Impact	**Increased erosion from reduced channel capacities associated with construction of stream crossings**		
Level of significance	Less than significant	Less than significant	Less than significant
Mitigation required	None	None	None
Impact	**Increased risk of mass movements from harvesting or construction of roads, skid trails, or landings in unstable areas**		
Level of significance	Less than significant	Less than significant	Potentially significant
Mitigation required	None	None	None

Table ES-1. Continued

Resource Topic	Proposed Project	Alternative 2: Emphasize Watershed and Late-Succession Habitat Protection	Alternative 3: Emphasize Forest Management Demonstration and Recreation
Impact	**Not applicable**	**Not applicable**	**Increased surface erosion from increased runoff caused by reduced canopy interception, infiltration, and transpiration**
Level of significance			Potentially significant
Mitigation required			Limit overstory removal in areas with high or extreme erosion hazard ratings and areas with inadequate understory canopies
WATER QUALITY			
Impact	**Increased suspended sediments and turbidity from watershed disturbances within SDSF**		
Level of significance	Less than significant	Less than significant	Less than significant
Mitigation required	None	None	None
Impact	**Increased sediment discharges from mobilization of unconsolidated sediment stores caused by concentrated runoff**		
Level of significance	Less than significant	Less than significant	Less than significant
Mitigation required	None	None	None
Impact	**Increased water temperatures from removal of streamside vegetation**		
Level of significance	Less than significant	Less than significant	Less than significant
Mitigation required	None	None	None
Impact	**Not applicable**	**Not applicable**	**Temporary increases in sediment discharges from improving Hihn's Mill Road**
Level of significance			Potentially significant
Mitigation required			Conduct a site-specific evaluation of the impacts of proposed improvements and implement feasible mitigation measures to avoid significant impacts

Table ES-1. Continued

Resource Topic	Proposed Project	Alternative 2: Emphasize Watershed and Late-Succession Habitat Protection	Alternative 3: Emphasize Forest Management Demonstration and Recreation
FISHERIES			
Impact	**Increased potential for sedimentation of aquatic habitats from increased erosion associated with timber harvesting and related activities**		
Level of significance	Less than significant	Less than significant	Potentially significant
Mitigation required	None	None	Implement a fisheries monitoring program
Impact	**Changes in water temperature and primary production caused by reductions in stream shading**		
Level of significance	Less than significant	Less than significant	Less than significant
Mitigation required	None	None	None
Impact	**Reduced recruitment of large, woody debris**		
Level of significance	Less than significant	Less than significant	Less than significant
Mitigation required	None	None	None
Impact	**Reduced availability or suitability of fish habitat from changes in the timing or magnitude of streamflows**		
Level of significance	Less than significant	Less than significant	Less than significant
Mitigation required	None	None	None
Impact	**Increased channel scour and reduced sediment delivery to stream channels**		
Level of significance	Beneficial	Beneficial	Beneficial
Mitigation required	None	None	None
Impact	**Potential for direct and indirect effects on fish populations caused by recreational use on SDSF lands**		
Level of significance	Less than significant	Less than significant	Less than significant
Mitigation required	None	None	None

Resource Topic	Proposed Project	Alternative 2: Emphasize Watershed and Late-Succession Habitat Protection	Alternative 3: Emphasize Forest Management Demonstration and Recreation
VEGETATION AND WILDLIFE			
Impact	**Reduced quality or extent of riparian vegetation**		
Level of significance	Less than significant	Less than significant	Less than significant
Mitigation required	None	None	None
Impact	**Change in general wildlife use of SDSF from timber management**		
Level of significance	Beneficial	Beneficial	Less than significant
Mitigation required	None	None	None
Impact	**Reduction in special-status wildlife species' use of SDSF from timber management**		
Level of significance	Less than significant for the California red-legged frog, foothill yellow-legged frog, and southwestern pond turtle Beneficial for the Cooper's hawk, sharp-shinned hawk, long-eared owl, purple martin, and yellow warbler	Less than significant for the California red-legged frog, foothill yellow-legged frog, and southwestern pond turtle Beneficial for the Cooper's hawk, sharp-shinned hawk, long-eared owl, purple martin, and yellow warbler	Less than significant for all species
Mitigation required	None	None	None
Impact	**Loss of special-status species' active nest sites from timber management**		
Level of significance	Potentially significant	Potentially significant	Potentially significant
Mitigation required	Conduct preharvest surveys for Cooper's hawk and sharp-shinned hawk	Same as proposed project	Same as proposed project
Impact	**Habitat improvement for aquatic amphibians and reptiles from sediment remediation efforts**		
Level of significance	Beneficial	Beneficial	Beneficial
Mitigation required	None	None	None

Table ES-1. Continued

Resource Topic	Proposed Project	Alternative 2: Emphasize Watershed and Late-Succession Habitat Protection	Alternative 3: Emphasize Forest Management Demonstration and Recreation
Impact	**Disturbance to wildlife populations from public access and recreation at SDSF**		
Level of significance	Less than significant	Less than significant	Less than significant
Mitigation required	None	None	None
PUBLIC SAFETY, PUBLIC SERVICES, AND LAND USES			
Impact	**Increased risk to downstream residences and property from flooding and landslides at SDSF**		
Level of significance	Less than significant	Less than significant	Less than significant
Mitigation required	None	None	None
Impact	**Risk of wildfire**		
Level of significance	Less than significant	Less than significant	Potentially significant
Mitigation required	None	None	Develop additional water storage facilities and improve access for fire suppression equipment Develop fuelbreaks along roadways Design roads for vehicle traffic to prevent motor vehicle accidents Prevent off-road vehicle traffic
Impact	**Demand for public utilities**		
Level of significance	Less than significant	Less than significant	Less than significant
Mitigation required	None	None	None
Impact	**Increased cumulative demand for police and emergency services**		
Level of significance	Potentially significant	Potentially significant	Potentially significant
Mitigation required	Monitor demand and response capability of law enforcement and emergency services at SDSF and adjust services to meet changes in demand	Same as proposed project	Same as proposed project

Resource Topic	Proposed Project	Alternative 2: Emphasize Watershed and Late-Succession Habitat Protection	Alternative 3: Emphasize Forest Management Demonstration and Recreation
	Improve access for year-round emergency response		
Impact	**Conflicts with adjacent land uses**		
Level of significance	Less than significant	Less than significant	Potentially significant
Mitigation required	None	None	Barricade roads and trails leading to private land Install warning signs Enforce no trespass ordinance
RECREATION, EDUCATION, AND VISUAL RESOURCES			
Impact	**Increased recreational and educational use at SDSF**		
Level of significance	Beneficial	Beneficial	Beneficial
Mitigation required	None	None	None
Impact	**Cumulative increase in recreational and educational use at SDSF**		
Level of significance	Beneficial	Beneficial	Beneficial
Mitigation required	None	None	None
Impact	**Change in offsite views from timber harvesting and recreation and education development activities**		
Level of significance	Less than significant	Less than significant	Potentially significant
Mitigation required	None	None	Minimize clear-cut size or use selection method in prominently visible areas at SDSF
Impact	**Short-term impact on visual quality during timber operations**		
Level of significance	Less than significant	Less than significant	Less than significant
Mitigation required	None	None	None

Table ES-1. Continued

Resource Topic	Proposed Project	Alternative 2: Emphasize Watershed and Late-Succession Habitat Protection	Alternative 3: Emphasize Forest Management Demonstration and Recreation
Impact	**Not applicable**	**Not applicable**	**Reduced opportunities for recreating in a rustic environment**
Level of significance			Less than significant
Mitigation required			None
TRAFFIC AND NOISE			
Impact	**Addition of log-truck traffic to the roadway system**		
Level of significance	Less than significant	Less than significant	Less than significant
Mitigation required	None	None	None
Impact	**Congestion of the roadway system from other SDSF use**		
Level of significance	Less than significant	Less than significant	Less than significant
Mitigation required	None	None	None
Impact	**Congestion of the roadway system from SDSF use in conjunction with future traffic growth**		
Level of significance	Less than significant	Less than significant	Less than significant
Mitigation required	None	None	None
Impact	**Increased traffic hazards resulting from vehicles turning into and out of the new access road**		
Level of significance	Potentially significant	Potentially significant	Potentially significant
Mitigation required	Provide adequate sight distance and install appropriate traffic-control devices	Same as proposed project	Same as proposed project
Impact	**Increased demand for new parking**		
Level of significance	Less than significant	Less than significant	Less than significant
Mitigation required	None	None	None

Table ES-1. Continued

Resource Topic	Proposed Project	Alternative 2: Emphasize Watershed and Late-Succession Habitat Protection	Alternative 3: Emphasize Forest Management Demonstration and Recreation
Impact	**Increased traffic hazard resulting from addition of truck traffic to an intersection with limited sight distance**		
Level of significance	Less than significant	Less than significant	Less than significant
Mitigation required	None	None	None
Impact	**Not applicable**	**Not applicable**	**Safety conflicts between motorized and nonmotorized recreation users on new access road**
Level of significance			Potentially significant
Mitigation required			Establish and enforce 15 mph speed limit Install speed bumps
Impact	**Exposure of residences north and west of SDSF to noise from tree-felling operations**		
Level of significance	Less than significant	Less than significant	Less than significant
Mitigation required	None	None	None
Impact	**Exposure of nearby residences north and west of SDSF to noise from tractor yarding operations**		
Level of significance	Less than significant	Less than significant	Less than significant
Mitigation required	None	None	None
Impact	**Exposure of nearby residences north and west of SDSF to noise from cable yarding operations**		
Level of significance	Less than significant	Less than significant	Less than significant
Mitigation required	None	None	None

Table ES-1. Continued

Resource Topic	Proposed Project	Alternative 2: Emphasize Watershed and Late-Succession Habitat Protection	Alternative 3: Emphasize Forest Management Demonstration and Recreation
Impact	**Exposure of residences north and west of SDSF to noise from helicopter yarding operations**		
Level of significance	Potentially significant	Potentially significant	Potentially significant
Mitigation required	Locate the timber drop-off and landing areas at least 0.5 mile from the nearest occupied dwellings	Same as proposed project	Same as proposed project
Impact	**Exposure of residences in the area to noise from trucking operations**		
Level of significance	Less than significant	Less than significant	Less than significant
Mitigation required	None	None	None
Impact	**Not applicable**	**Not applicable**	**Exposure of nearby residences to noise from motor vehicle use of the main road**
Level of significance			Less than significant
Mitigation required			None

Chapter 1. Introduction

PROJECT HISTORY

In 1988, the Pelican Timber Company transferred a 2,681-acre property in central Santa Cruz County, northeast of the city of Santa Cruz, to The Nature Conservancy. The Nature Conservancy prepared a management plan describing its policies and goals for the property and provided custodial management for 2 years. In 1990, management of this property was transferred to the California Department of Forestry and Fire Protection (CDF) under Assembly Bill (AB) 1965 as Soquel Demonstration State Forest (SDSF), part of the state demonstration forest system. AB 1965 calls for intensive management at SDSF focusing on education, research, silviculture, watershed protection, and preservation of remaining old-growth redwood trees.

CDF, which is responsible for managing SDSF, is preparing a general forest management plan (GFMP) for the forest. The purpose of the GFMP is to guide the long-term stewardship of the forest, including implementation of programs in forestry demonstration and education, timber management, research, natural resource protection and enhancement, and recreation. CDF began preparing the GFMP in 1991 with assistance from an advisory committee of representatives from interested agencies and local organizations. The resulting draft GFMP was released to the public in January 1994.

PURPOSE OF THE ENVIRONMENTAL IMPACT REPORT

The California Environmental Quality Act (CEQA) (Pub. Res. Code 21000 et seq.) requires state and local government agencies to consider the environmental consequences of projects over which they have discretionary authority before taking action on such projects. For projects that could have significant environmental impacts, environmental impact reports (EIRs) must be prepared. CDF has determined that adoption and implementation of the GFMP (the proposed project) could result in significant environmental impacts and is subject to CEQA. As a result, CDF is preparing this EIR.

The objectives of this EIR are to analyze and disclose to decision makers and the public the environmental effects of implementing the draft GFMP, demonstrate to the public that the proposed project will protect the environment, identify mitigation measures to reduce or avoid adverse environmental impacts that could result from project implementation, and evaluate a reasonable range of alternatives to the draft GFMP.

Program Environmental Impact Reports and Tiering

This EIR will serve as a program EIR for the GFMP. A program EIR is prepared for an agency program or series of actions that are closely related, such as phased projects. The environmental impacts of the types of actions central to the GFMP (e.g., timber harvesting and watershed remediation) are expected to be similar over an extended period and a wide range of locations. Consequently, CDF has elected to prepare a program EIR for the proposed project.

When subsequent activities requiring discretionary permits are proposed, a determination will be made on whether additional CEQA documents are needed if significant effects exist that were not examined in the program EIR. This concept, called "tiering", refers to the covering of general matters in broader (i.e., program) EIRs with subsequent environmental documents incorporating by reference the general discussions of impacts contained in the program EIR and concentrating on the issues of relevance to the site-specific action considered in the subsequent environmental analysis (State CEQA Guidelines Section 15385).

The actions of the GFMP described in this program EIR are analyzed at a general level. Consequently, impacts identified and mitigation measures proposed for these component actions are generally not site specific. The mitigation measures recommended for the component actions that would undergo additional environmental review will be incorporated into the subsequent environmental documents.

Timber Harvesting Planning

Timber harvesting plans (THPs) for proposed timber harvest operations will be prepared, evaluated, and approved as specified in the California Forest Practice Rules. This process has been certified as functionally equivalent to CEQA (State CEQA Guidelines Section 15251). "Functional equivalence" implies that timber harvesting is exempt from CEQA requirements to prepare EIRs and negative declarations because an equivalent, alternative process for environmental assessment and protection has been established.

Preparation of THPs for future timber operations at SDSF will include the following activities:

- Stands proposed for harvesting will be evaluated to determine if they include any late-successional forest habitat in blocks exceeding 20 acres. If so, the extent and distribution of late-successional habitat in the watershed of the East Branch of Soquel Creek (East Branch) will be evaluated to determine whether the proposed harvesting would adversely affect wildlife dependent on such habitat. No harvesting operations will be undertaken that are found to have a significant adverse impact on such wildlife.

- A licensed engineering geologist will certify the locations of all proposed roads, skid trails, and landings to ensure that they are located consistent with the objective of minimizing soil erosion.

- Opportunities will be evaluated for implementing natural resource enhancement projects that would cost-effectively reduce the risk of large amounts of sediment being discharged to streams, restore fish habitat, recruit late-successional habitat, or remove exotic vegetation. Projects identified as being cost-effective will be implemented in conjunction with timber harvesting.

CDF will request that the California Board of Forestry amend the California Forest Practice Rules so that environmental assessment in future SDSF timber harvest plans can be tiered to program EIRs (i.e., focused on potentially significant impacts of actions not already covered in sufficient detail in this program EIR). If such rule changes are made, environmental assessment of proposed timber harvesting operations at SDSF will follow CEQA guidelines regarding activities tiered to program EIRs rather than the functionally equivalent timber harvest planning process. At a minimum, however, forest management at SDSF will comply with all natural resource protection standards specified in the California Forest Practice Rules.

SCOPE OF THE ENVIRONMENTAL IMPACT REPORT

CDF conducted a scoping process consistent with Section 15083 of the State CEQA Guidelines to identify issues to be analyzed in the EIR, determine the scope of the analysis of each issue, and identify alternatives to the proposed project. The scoping process involved distributing a notice of preparation for the EIR, holding a public scoping meeting, and requesting written comments from agencies and persons with interest in the GFMP. A scoping report (see Appendix A) was prepared and distributed that summarized the issues raised during the scoping process.

Based on comments received during the scoping process (see Appendix A) and on other information, CDF determined that the following topics were of concern and should be addressed in the EIR:

- geology, soils, and water quality;
- fisheries;
- vegetation and wildlife;
- land use, public safety, and public services;
- recreation, education, and aesthetics; and
- traffic and noise.

IMPACT ASSESSMENT

The impact analysis for each resource chapter identifies and compares the probable impacts of each project alternative that are related to that resource topic. These comparative analyses highlight differences or similarities in predicted impacts among the alternatives.

Direct, indirect, and cumulative impacts associated with each resource area are addressed in this EIR.

Definition of Terms

This EIR identifies the following levels of impacts:

- a beneficial impact is considered to cause a favorable change in the environment;
- a less-than-significant impact is considered to cause no substantial adverse change in the environment and requires no mitigation;
- a significant impact is considered to have a substantial adverse effect on the environment;
- a potentially significant impact is considered likely to have a substantial adverse impact on the environment, although existing information and knowledge are inadequate to warrant a significant impact conclusion; and
- a significant and unavoidable impact is considered to have a substantial adverse impact on the environment for which feasible mitigation measures are unavailable to reduce impacts to a less-than-significant level.

Baseline Conditions and the No-Project Alternative

The No-Project Alternative, combined with the description of the affected environment for each resource area, is the point of reference or baseline by which impacts of each project alternative are compared. Under the No-Project Alternative, SDSF management would continue to emphasize custodial protection of natural resources with light harvesting of primarily dead and dying trees. Because it is used as the baseline for analysis of the proposed project and project alternatives, analysis of the No-Project Alternative does not include levels of impacts and mitigation measures. The No-Project Alternative is described in more detail in Chapter 2, "Proposed Project and Alternatives".

Cumulative Impact Assessment

CEQA requires that an EIR contain a reasonable analysis of a project's significant cumulative impacts, that is, significant impacts resulting from the project in conjunction with other past, present, and future projects. Two ongoing processes could interact with elements of the proposed project to result in significant cumulative impacts. The first is the watershed impacts of soil erosion, sedimentation, and effects on fisheries and water quality in the East Branch watershed; the second is the increasing popularity of SDSF for public use.

Cumulative Watershed Impacts

As discussed in Chapter 3, erosion and sedimentation in the East Branch watershed are natural phenomena that occurred before human activity but have accelerated over the past century as a result of activities conducted by previous landowners such as logging, road construction, and conversion of land to agricultural and residential uses. The watershed assessment in this EIR distinguishes between the total levels of erosion and sedimentation projected to occur in the watershed and the proportionate levels attributable to implementation of the project alternatives.

Changes in erosion and sedimentation levels that would result from increases in watershed disturbance under the GFMP relative to levels under the No-Project Alternative are considered to be direct effects of the proposed project. In contrast, the total levels of erosion and sedimentation, including the levels attributable to historical logging, are considered part of the cumulative watershed impact evaluated in Chapter 3. Past and future offsite watershed disturbances are considered in the cumulative impact assessment primarily because of the reduced abundance of steelhead trout and coho salmon in the East Branch and throughout their ranges, and because of the potential consequences of even relatively small incremental damage to these resources.

Future Levels of Public Use

Public use of SDSF for recreation, education, and nature study has been increasing since the property was obtained by The Nature Conservancy, and this increase is expected to continue regardless of whether the improved facilities and increased service levels proposed in the GFMP are implemented. Public use of SDSF is expected to increase over the next decade in response to the following changes:

- the growth of regional population,
- the expanding popularity of mountain biking in conjunction with the outstanding mountain biking opportunities provided by the existing trail network at SDSF and the Forest of Nisene Marks State Park,

- an increasing awareness among the local and regional population of the recreation opportunities available at SDSF, and

- the unique opportunity for forest and watershed management education in a demonstration forest.

The analysis of recreation and education in Chapter 7 distinguishes between public use increases at SDSF that are attributable to the GFMP (direct effects) and those that are attributable to the projected overall increase in use (cumulative effects).

Other potential impacts related to public use levels (i.e., traffic, land use, and public safety) also take into account the projected overall use increase, but these consider only the portion of the increase attributable to direct impacts of the GFMP.

Mitigation Measures

Where the project alternatives are predicted to cause significant impacts, mitigation measures are identified. As provided in CEQA guidelines, measures are proposed that would avoid, minimize, rectify, reduce, or compensate for the predicted impacts, thereby reducing them to less-than-significant levels. The feasibility and effectiveness of the mitigation measures are described to the extent possible.

Mitigation Monitoring

Under AB 3180, which amended CEQA in 1989, agencies are required to adopt a program for reporting or monitoring mitigation measures whenever they approve a project that contains mitigation measures to reduce or avoid significant environmental impacts (Pub. Res. Code Section 21081.6). The purpose of mitigation monitoring programs is to ensure that mitigation measures incorporated into EIRs are complied with during project implementation. A mitigation monitoring plan will be included in the final EIR for the GFMP for public review before the project is approved.

ENVIRONMENTAL REVIEW PROCESS

An overview of the environmental review process for the SDSF GFMP is shown in Figure 1-1.

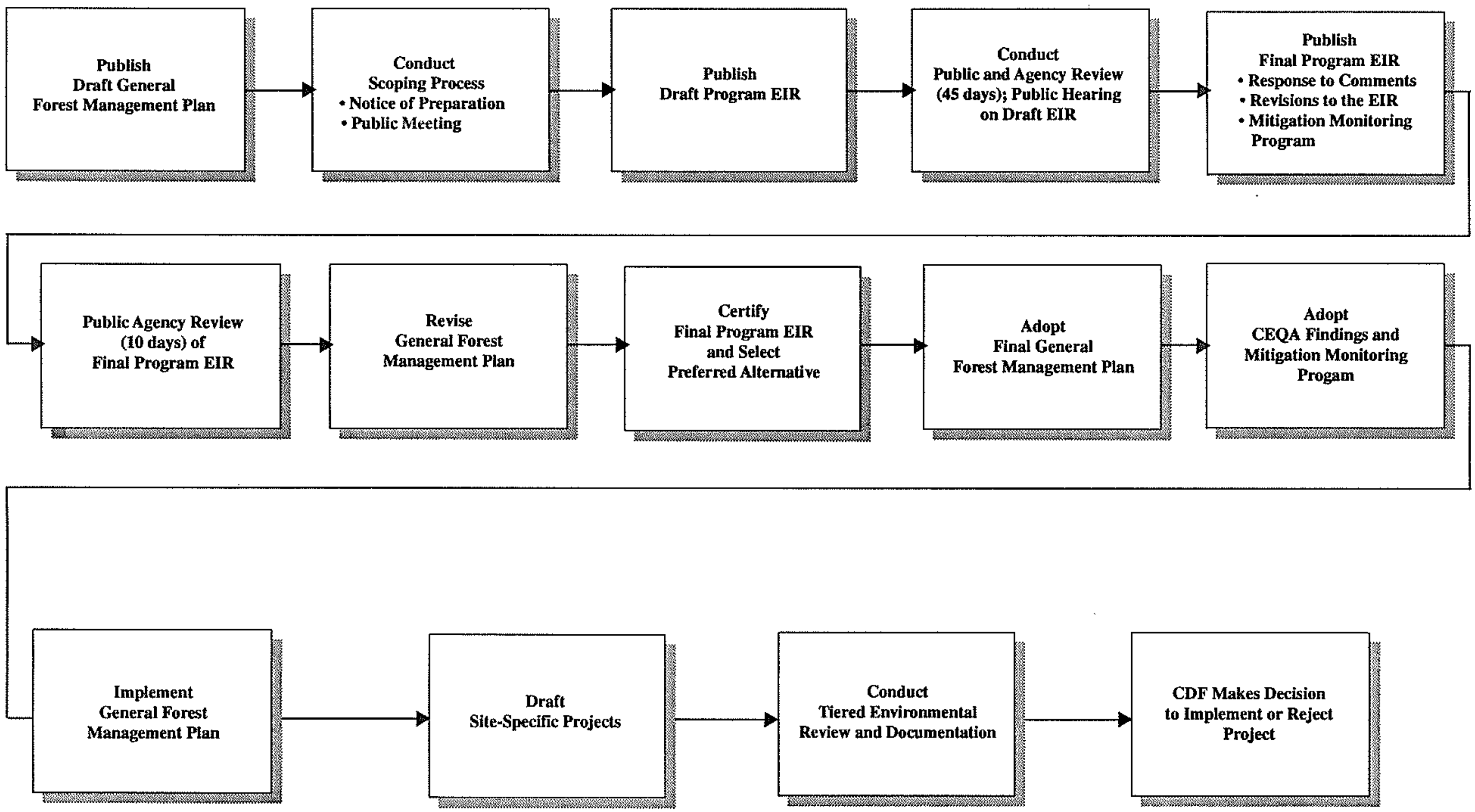

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Figure 1-1.
Overview of the Environmental Review Process

This draft EIR is being circulated for a 45-day public review period, during which agencies and the public are encouraged to submit comments on the draft document. Comments should be addressed to:

Mr. Jonathan Rae
California Department of Forestry and Fire Protection
1416 Ninth Street
Sacramento, CA 95814

Following the close of the public review period, CDF will summarize comments received on the draft EIR, prepare responses to all substantive environmental issues raised in such comments, and circulate those responses and any changes required to the draft EIR in a final EIR.

CDF will circulate the final EIR to commenting agencies for at least 10 days before certifying the EIR. The agency's decision-making process includes adopting a Statement of Overriding Considerations and a mitigation monitoring program and filing a Notice of Determination as required under CEQA.

After the final EIR is certified, the GFMP will be revised, published, and adopted in its final form. The advisory committee that worked on the draft GFMP will continue to act as liaison between CDF and the local community through final adoption of the GFMP.

Site-specific projects (e.g., THPs and recreation and education facility plans) proposed under the GFMP will undergo subsequent environmental analysis tiered to the program EIR. Public input and review will be part of the environmental review process of those projects.

Chapter 2. Proposed Project and Alternatives

PROJECT LOCATION

SDSF is located in central Santa Cruz County, approximately 8 miles northeast of the city of Santa Cruz in the watershed of the East Branch (Figure 2-1). State Routes 1 and 17 and county roads are the main access routes for forest users (Figure 2-2). The main public entrance to the forest is on Highland Way, a county road that connects Soquel-San Jose Road with Eureka Canyon Road. Landslides on Highland Way near the SDSF entrance, however, have intermittently blocked this approach for approximately the past 2 years. Nevertheless, most visitors enter SDSF from Highland Way or from the Forest of Nisene Marks State Park.

SDSF is bordered by both state and private property. The Forest of Nisene Marks State Park borders SDSF along Santa Rosalia Ridge to the south. Redwood Empire owns most of the land east of the forest, including the main entrance and parking area off Highland Way. To the north and west are private rural-residential parcels of 1-80 acres. A quarry operation borders the southwestern corner of SDSF.

PROJECT OBJECTIVES

The objectives of adopting and implementing the GFMP are to:

- provide forestry demonstration, education, and research opportunities consistent with CDF's goals for demonstration state forests;
- protect and enhance natural resources by reducing watershed impacts, improving fish habitat, and developing a balanced range of habitats with emphasis on late-successional habitat;
- harvest and use timber consistent with the California Forest Practice Act and the principles of sustained yield and multiple use;
- provide opportunities for public use and recreation; and
- develop an adequate and stable source of revenue to defray the costs of protecting natural resources, developing and maintaining improvements, and managing SDSF to fulfill the above objectives.

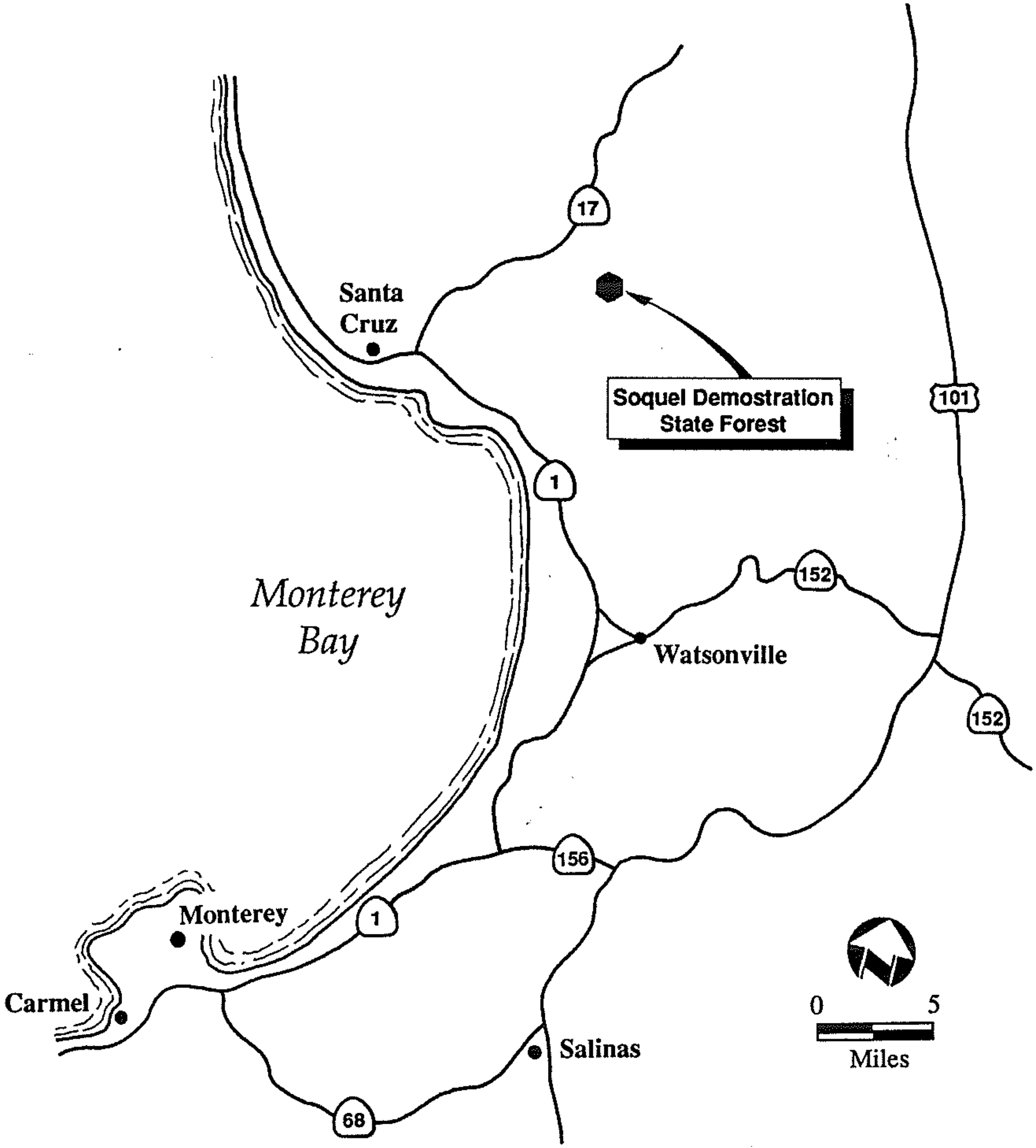

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Figure 2-1
Regional Location of
Soquel Demonstration State Forest

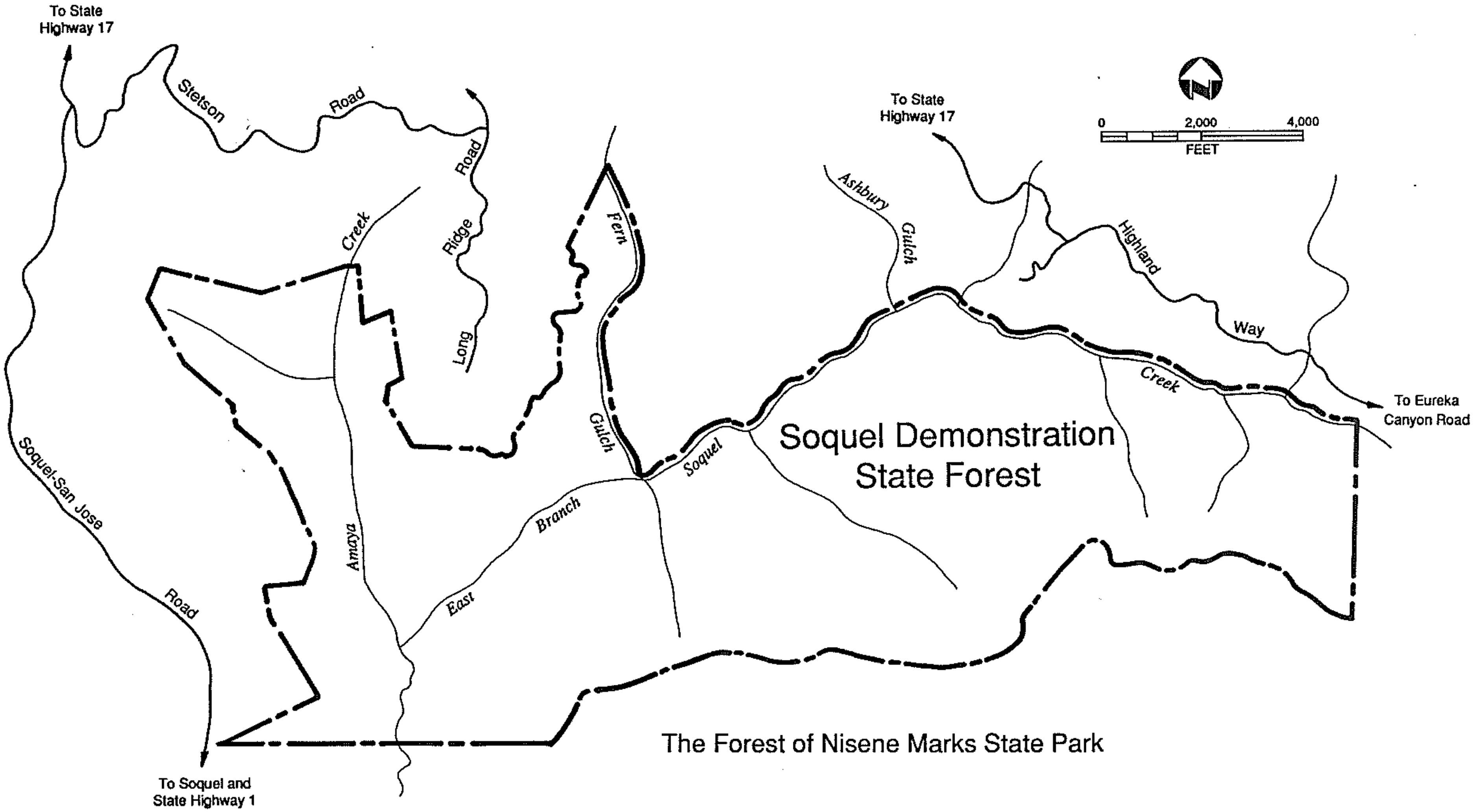

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Figure 2-2
Soquel Demonstration State Forest

PROJECT DESCRIPTION

SDSF is administered by CDF to implement programs in forestry demonstration and education, timber management, research, natural resource protection and enhancement, and recreation as described in the GFMP. The GFMP provides management direction similar to that contained in The Nature Conservancy's management plan for Soquel Creek Forest (The Nature Conservancy 1988) but consistent with a substantially higher staffing level than the one part-time position envisioned by The Nature Conservancy. This section describes the principal activities called for in this plan that could result in significant adverse environmental impacts.

Timber Management

The proposed project would involve ongoing timber harvesting in most areas of SDSF. No old-growth conifer trees will be harvested at SDSF. Four designated old-growth redwood areas would not be harvested (Figure 2-3). These areas are defined to include the land within the driplines of the old-growth trees and a 150-foot-wide buffer zone surrounding the area. The largest of the old-growth redwood areas (located at Badger Springs) covers approximately 10 acres. The three remaining areas encompass approximately 5 acres each. Logging equipment, tractor skid trails, and cable-yarding corridors (corridors clear of obstructions for transporting logs with cables) would not be allowed in the old-growth areas. Other areas could be withdrawn from the timber production land base if future planning efforts identify them as being unsuitable for logging; however, no such areas have been identified to date.

In addition to the old-growth areas, late-succession management areas have been delineated to include areas within 300 feet of the Class I streams on SDSF. These are the East Branch, Amaya Creek, and Fern Gulch (Figure 2-3). The goal of timber harvesting in late-succession management areas is to promote the development of functional old-growth habitat characteristics through infrequent, low-intensity management activities. Timber harvesting in these areas would conform to the following guidelines:

- At least 75% total shade canopy in multiple layers would be retained.
- At least 25% shade canopy in trees at least 24 inches in diameter at breast height (dbh) would be retained.
- All woody riparian (i.e., hydrophytic) vegetation would be retained except where riparian function would be enhanced by removing such vegetation.
- Large snags (i.e., standing dead trees at least 20 inches dbh and 15 feet tall) or live wildlife trees (i.e., trees that support bird nests or have cavities or large limbs that

make them valuable for nesting birds) would be recruited (created from existing, healthy trees) or retained at an average density of at least five per acre.

- At selected locations where conifers are lacking, Douglas-firs and redwoods would be planted to promote long-term recruitment of large woody debris in streams.

- Downed logs at least 24 inches in diameter and 30 feet long would be retained or recruited by felling trees at an average density of at least two per acre, and total coarse, woody debris would be retained at an average density of at least 10 tons per acre.

Site disturbance during harvesting operations in late-succession management areas would be kept to a minimum by:

- restricting tractor use and cable-yarding corridors to predesignated trails,

- hiring a registered geologist and a qualified hydrologist to review operations during timber harvest planning, and

- marking all trees to be harvested and all wildlife trees and downed logs to be retained.

The timber harvesting objective of the GFMP is to harvest and use timber while providing forestry demonstration, education, and research opportunities. Timber would be harvested at 20-35% of SDSF's estimated conifer growth rate over the period of the GFMP (i.e., the next 10 years), or approximately 1% of the standing conifer inventory. (Important features of the proposed project and the alternatives are compared in Table 2-1.) A harvest rate of 30% of conifer growth is equivalent to approximately 750 thousand board feet (MBF) per year. This harvest rate is substantially lower than SDSF's current conifer growth rate of 2,600 MBF per year (3.4 % of the inventory). Harvests would occur approximately every 2 years. For example, a biennial harvest operation could involve removing an average of 10 MBF per acre from approximately 150 acres. At this rate, approximately 35 years would be required to conduct selection harvests throughout the entire forest (i.e., a cutting cycle of 35 years). Over the long term (i.e., in 40-60 years), the harvest rate would gradually increase to approximately 65% of the conifer growth rate (2.2% of the inventory).

Harvesting at SDSF would conform to the California Forest Practice Rules and the special rules that apply within the Southern Subdistrict of the Coast Forest District and Santa Cruz County. Most harvesting would use the individual tree selection system, whereby at least 40% of all trees greater than 18 inches dbh and 50% of all trees 12-18 inches dbh would be retained in a well-distributed pattern throughout harvested stands.

The group selection system, in which as much as 0.5 acre of trees could be removed in one operation, could be used in some stands. The resulting openings would be restocked within 3 years. An average of 50% canopy closure would be maintained throughout stands

Table 2-1. Key Features of the Alternatives Considered in the EIR

Program Element and Feature	Proposed Project	Alternative 1: No-Project Alternative	Alternative 2: Emphasize Watershed and Late-Succession Habitat Protection	Alternative 3: Emphasize Forest Management Demonstration and Recreation
Timber management				
Harvesting level (MBF/year)	750	260	500	2,000
Harvesting level (% of conifer inventory)	1.0	0.3	0.6	2.6
Harvesting level (% of conifer growth)	29	10	19	75
Other policies	No old-growth conifers would be harvested	No old-growth conifers would be harvested	No old-growth conifers would be harvested	No old-growth conifers would be harvested
	Individual tree and group selection systems	Sanitation-salvage operations	Timber removal restricted to trees less than 26 inches dbh	Individual tree and group selection system; clearcuts (maximum 5 acres) permitted on low or moderate erosion hazard rating lands
	Use of existing skid trails and/or alternative yarding systems (cable, helicopter) on steep slopes to minimize erosion	Tractor or cable yarding systems only	Restriction of tractor yarding to lands with low or moderate erosion hazard ratings; use of cable or helicopter yarding on lands with high or extreme erosion hazard ratings	Use of existing skid trails and/or alternative yarding systems (cable, helicopter) on steep slopes to minimize erosion
	Certification of all proposed skid trails, roads, and landings by a licensed engineering geologist		Certification of all proposed skid trails, roads, and landings by a licensed engineering geologist	Certification of all proposed skid trails, roads, and landings by a licensed engineering geologist
Natural resource enhancement				
Watershed monitoring and enhancement	Skid trail and road inventory and erosion assessment	No harvesting within 150 feet of Class I streams, springs, or sag ponds	Same as proposed project	Same as proposed project
	Culvert inventory		Same as proposed projected	Same as proposed project
	Sediment source inventory and remediation		Similar to proposed project but less extensive	Similar to proposed project but more extensive
	Road abandonment		Similar to proposed project but less extensive	Similar to proposed project but more extensive
			No harvesting within 300 feet of Amaya Creek on slopes exceeding 50%	
Fish habitat monitoring and enhancement	Fish population and habitat inventory	Similar to proposed project but less extensive	Similar to proposed project but less extensive	Similar to proposed project but more extensive

Table 2-1. Key Features of the Alternatives Considered in the EIR

Program Element and Feature	Proposed Project	Alternative 1: No-Project Alternative	Alternative 2: Emphasize Watershed and Late-Succession Habitat Protection	Alternative 3: Emphasize Forest Management Demonstration and Recreation
	Fish habitat improvements	Similar to proposed project but less extensive	Similar to proposed project but less extensive	Similar to proposed project but more extensive
Late-successional habitat recruitment	Four designated old-growth areas would not be harvested	Four designated old-growth areas would not be harvested	Four designated old-growth areas would not be harvested	Four designated old-growth areas would not be harvested
	Late-successional management areas within 300 feet of Class I streams		Late-successional management areas within 300 feet of Class I streams and 150-feet of Class II streams	Late-successional management areas within 300 feet of Class I streams
	Creation of snags and downed logs		Creation of snags and downed logs	Creation of snags and downed logs
Removal of exotic vegetation	Removal of exotic plants and restoration of native vegetation			Removal of exotic plants and restoration of native vegetation
Public use and recreation and education facilities				
Public access	Nonmotorized access during daylight hours	Nonmotorized access during daylight hours	Nonmotorized access during daylight hours	Nonmotorized access during daylight hours
	Motorized access for campground users and educational field trips only	No public motorized access	No public motorized access	Seasonal motorized public access (April - October)
	New public access road and parking lot off Soquel-San Jose Road at the southwestern corner of SDSF	New public access road and parking lot off Soquel-San Jose Road at the southwestern corner of SDSF	New public access road and parking lot off Soquel-San Jose Road at the southwestern corner of SDSF	New public access road and parking lot off Soquel-San Jose Road at the southwestern corner of SDSF
				Paving of main forest road
New facilities	Forestry education center			Forestry education center
	Small, rustic campground		Small, rustic campground	Three small, rustic campgrounds
	Forestry education trail near the new access road	Forestry education trail near the new access road		Forestry education trail near the new access road
				Trail parallel to main forest road
Activities	Mountain biking, hiking, forestry education classes, educational field trips, equestrian activities, and camping	Mountain biking, hiking, educational field trips, and equestrian activities	Mountain biking, hiking, camping, and equestrian activities	Mountain biking, hiking, forestry education classes, educational field trips, equestrian activities, camping, amateur races and runs, and archery hunting
	Fires, smoking, use of firearms, hunting, and fishing prohibited	Fires, smoking, use of firearms, hunting, and fishing prohibited	Fires, smoking, use of firearms, hunting, and fishing prohibited	Fires, smoking, target shooting, and fishing prohibited

in which group selection harvests occurred. Although timber harvesting would focus on the removal of conifers, some hardwoods would also be removed to prevent hardwoods from dominating the residual stands.

Approximately 100 acres of SDSF timberlands that naturally support conifers but, as a result of past logging and other management, currently support pure or predominantly hardwood stands (primarily tan-bark oaks and madrones) would gradually be harvested and reforested by planting redwood and Douglas-fir seedlings. Such hardwood harvesting operations would take place on approximately 16 acres over the period of the GFMP. Individual operations would not exceed 0.5 acre.

Tractors, cable yarders, helicopters, and horses would be used to transport (or "yard") logs to level areas (or "landings"). Tractors would be the principal yarding system on slopes averaging less than 35%. On slopes averaging 35-50%, hillslope erosion would be kept to a minimum by using existing skid trails wherever possible and generally avoiding the construction of excavated skid trails (i.e., trails that require grading). On slopes averaging 35-50% where tractor logging would require extensive construction of excavated skid trails, alternative yarding systems (i.e., cable or helicopter) would be used. As discussed under "Timber Harvesting Planning" in Chapter 1, a licensed engineering geologist will participate in the preparation of all THPs to certify the locations of all proposed roads, skid trails, and landings and to ensure that they are constructed consistent with the objective of minimizing soil erosion.

Cable yarders (systems that transport logs by means of a moving cable and a stationary yarding machine) would be used primarily on slopes exceeding 50%, in unstable areas (e.g., landslide areas and unstable soils, such as unconsolidated soils and soils that expand and contract as their moisture content changes); in steeper areas adjacent to perennial streams; and in areas not accessible from existing roads where road construction is either infeasible because of environmental sensitivity or impractical because of property boundaries. According to the preliminary logging plan prepared for SDSF, approximately 1,700 acres are suitable for yarding by tractors and 900 acres are suitable for yarding by cable yarders or helicopters (Soho et al. 1994).

Lands unsuitable for either tractor or cable yarding could be yarded using helicopters. Such lands include areas where the terrain does not offer enough curvature to adequately elevate logs, areas unsuitable for road construction, and areas lacking suitable sites for landings or yarding machines.

The road network at SDSF currently comprises approximately 19 miles of existing or abandoned roads. Roads would be constructed to improve access for logging, fire protection, research, education, public safety patrols, and nonmotorized public recreation. Road construction would meet or exceed the standards specified in the California Forest Practice Rules. New roads would be one lane wide and unpaved. Approximately 22 miles of new roads are needed to complete the SDSF road network; approximately 7 miles of roads would be constructed during the period of the GFMP.

Natural Resource Enhancement

Natural resource enhancement would focus on avoiding or reducing watershed impacts (e.g., discharge of sediment into streams), improving fish habitat, developing late-successional habitat, and removing exotic vegetation.

Watershed Monitoring and Enhancement

Much of the ongoing management of SDSF involves maintaining proper drainage along roads and trails by repairing culverts, water bars, and other structures to reduce or prevent the soil erosion and stream sedimentation. In addition, the GFMP calls for an active watershed remediation program that includes monitoring watershed conditions and implementing enhancement projects.

Watershed condition monitoring would include the following elements:

- A forestwide inventory would be conducted of all existing roads and skid trails to identify segments that could divert substantial runoff on highly erodible soils. Roads and major skid trails would be mapped and rated according to erosion risk. The inventory of existing roads would be completed by June 30, 1997, and the inventory of existing major skid trails would be completed by June 30, 1998.

- An inventory would be conducted of all culverts at SDSF to compile data on their condition; adequacy of size; likelihood of blockage (based on the abundance of large, woody debris near the uphill end); and schedule for inspection, maintenance, replacement, and, if appropriate, abandonment. This inventory would be completed by December 31, 1997.

- An inventory would be conducted of areas where large amounts of sediment are being stored (especially along roads, skid trails, landings, and stream crossings). This inventory would add to the information on sediment sources that has already been compiled (Manson and Sowma-Bawcom 1992). SDSF staff members would document the locations, extent, and condition of additional sediment sources. A licensed engineering geologist would review the database periodically to identify feasible remedial actions for each potential source, assess the likelihood of substantial sediment discharge to streams, recommend remediation, and assign each site a priority for implementation. This inventory would be completed by December 31, 1997. New landslides would be added to the database and assigned a treatment priority as they occurred.

Watershed enhancement projects would be implemented based on the information provided by natural resource monitoring surveys. Such projects would be implemented in conjunction with ongoing timber operations according to a schedule determined in consultation with the California Department of Fish and Game (DFG) and the California Division of Mines and Geology.

The principal potential source of sediment at SDSF is unstabilized landslides. Several unstabilized landslides occur naturally at SDSF and have their toes along the East Branch and Amaya Creek. Landslides along existing roads near the East Branch and Amaya Creek could also move downslope into the streams, especially if saturated as a result of large storms. Stabilizing all landslides is not feasible because most are inaccessible and provide limited opportunity for implementing control measures. However, some landslides along existing roads (e.g., Hihn's Mill Road) can be stabilized by improving drainage from the toe of the landslide (e.g., by installing drains), buttressing the toe (e.g., by placing boulders or smaller rocks at the toe), or by removing mass (e.g., trees or logs) from the head of the slide.

Another major potential source of sediment is perched sediments that were pushed into their current positions by early log yarding, primarily steam-donkey logging during the 1920s and 1930s. Some of these sediment storage areas are located near the mouths of ephemeral streams tributary to the East Branch on the north side of the stream; others are perched midslope. A major storm event could cause such sediments to wash into the East Branch.

Nonfunctional and undersized culverts are another potential source of sediment. Culverts normally transport streamflows beneath roads; however, blocked culverts during peak flows often result in substantial road damage and erosion. During the storms of January 1995, approximately 75% of SDSF's culverts were blocked by debris. Future culvert blockages would be reduced by installation of trash racks at the upstream end of each culvert and through SDSF's ongoing winter maintenance program.

A fourth potential sediment source is actively eroding gullies. Such areas could be remediated by revegetation or by the placement of large, woody debris or riprap to reduce the headward migration of gullies.

Each timber harvesting operation conducted under the GFMP would include sediment source remediation. Such remediation is most economical when it makes use of heavy equipment being used for nearby harvesting operations. The forest manager would consider the locations of high-priority remediation sites when selecting areas for upcoming harvests. In some cases, however, remediation at locations other than timber harvest areas could constitute offsite mitigation for the watershed impacts of harvesting.

In addition to sediment source remediation, the watershed would be rehabilitated by abandonment of forest roads that are not needed for ongoing management. Road abandonment consists of removing culverts, installing appropriate drainage structures (e.g., water bars), recontouring stream crossings to their natural shape, and installing barriers at the intersections of abandoned roads and permanent roads. Most roads in SDSF not needed for ongoing management have already been abandoned. Approximately 1-2 miles of old road beds would be abandoned under the GFMP. In addition, approximately 10 miles of road proposed for construction would be abandoned eventually. Abandoned roads would be restored to serviceable condition when needed for future timber harvesting or other management activities.

Fish Habitat Monitoring and Enhancement

Fish habitat at SDSF would be enhanced through monitoring of fish populations and habitat and implementation of habitat enhancement projects in conjunction with ongoing timber operations. A fish population and habitat inventory would be compiled to determine whether timber management is affecting fish populations or habitat. The inventory would assess fish populations, residual pool depths and volumes, and aquatic ecological conditions (e.g., by using the Rapid Bioassessment Procedure developed by the U.S. Environmental Protection Agency and used by DFG). This inventory would be ongoing.

Fish habitat in SDSF is limited by the scarcity of pools, which provide important habitat during summer when streamflows are low and water temperatures are high. Fish habitat improvements would focus on installing structures such as vortex rock weirs and log deflectors to increase pool formation by promoting channel scour.

Vortex rock weirs consist of rock boulders installed in a partial V formation with the narrow end facing upstream. The resulting acceleration of streamflow between the boulders facilitates local bed-load transport while, at the same time, the redirection of flow toward midchannel promotes scour and pool formation. Log deflectors are logs protruding from the bank near the stream surface that are anchored to boulders or other stationary objects in the channel. Local bed scour occurs as the stream flows under the deflector. In addition to promoting pool formation, the logs can enhance habitat by providing cover for fish and reduce bank erosion.

In some areas, fish habitat is limited by the scarcity of large, woody debris. In such areas, large downed logs would be maintained or recruited by felling trees. Douglas-firs and redwoods also would be planted in some streamside areas that are dominated by hardwoods to promote long-term recruitment of large, woody debris.

Late-Successional Habitat Recruitment

Late-successional management areas along Class I streams would be managed to promote the development of functional old-growth habitat characteristics through infrequent, low-intensity management activities. Additionally, snags and downed logs would be created throughout SDSF by girdling, topping, and felling live trees.

Removal of Exotic Vegetation

In areas where the predominant vegetation is exotic plants such as French broom, the exotic plants would be removed and native vegetation restored. Badger Springs and the nearby Hihn's Mill Road corridor are candidates for such treatments. Exotic plants would be removed primarily with nonherbicide treatments such as hand or mechanical weeding.

Public Use and Recreation and Education Facilities

Specific objectives for public use and development of recreation and education facilities at SDSF would be incorporated into a recreation master plan to be prepared following adoption of the GFMP. This section describes the aspects of public use and recreation and education facilities in the draft GFMP that are most likely to have an impact on the environment. The recreation master plan could call for development of features such as a forestry education center, additional points of access, trails, campgrounds, picnic areas, or kiosks.

Nonmotorized public access to SDSF would be allowed during daylight hours. In addition, authorized campers would be allowed to drive their motor vehicles to and from designated campgrounds; no other use of motor vehicles by recreationists would be allowed in SDSF. Campground use would generally be restricted to April-October. Mountain biking, hiking, forestry education classes, educational field trips, equestrian activities, and camping are expected to be the principal activities engaged in by visitors. Fires (except in designated campgrounds), smoking, discharging of firearms, hunting (except archery pig hunting), and fishing would not be permitted. Loop trails and signs would direct visitors away from adjacent private property.

Educational field trips would be conducted for organized groups and the general public. Field trips would involve public motor vehicle use. The frequency of such trips is expected to increase from the current level of approximately eight trips per year to 25-50 trips per year within 10 years. Each field trip would accommodate 10-30 people. A forestry education center consisting of educational exhibits, storage space for educational materials, administrative space, classrooms, and overnight accommodations would serve those on educational field trips. Subsequent environmental documentation under CEQA for the forestry education center would be conducted before the center was constructed.

The GFMP calls for acquisition and development of a new access road to SDSF; construction of a small, rustic campground; and creation of a forestry education center. The most likely location of the new access road is on Soquel-San Jose Road at the southwestern corner of SDSF, through parcels owned by the Noren family and CHY Company. Under the GFMP, the 9-acre Noren parcel would probably be acquired. A public access route through the adjacent CHY Company parcel would probably be obtained by CDF through a land exchange or a right-of-way easement.

The intersection of the proposed access road and Soquel-San Jose Road would be improved to reduce traffic hazards resulting from the increased frequency of vehicles turning off the county road at this intersection. Existing roads leading from the intersection to SDSF would be improved to enhance traffic service and safety. Approximately 0.2 mile of new road would be constructed to link Amaya Creek Road with an existing road through CHY Company property.

A parking lot covering approximately 1 acre would be constructed on the Noren parcel adjacent to the proposed intersection. The road would be gated and closed to public motorized traffic at the parking lot. The access road and parking lot would initially be covered with loose rock; their surfaces would eventually be paved. A short forestry education trail, including a wheel chair-accessible path, interpretive exhibits, a picnic area, and restrooms, would be constructed.

The access road would cross Hester Creek approximately 200 feet from the proposed intersection and cross the East Branch approximately 2 miles from the intersection. Bridges to be constructed at these crossings would be designed in consultation with DFG.

A campground would be constructed for occasional use by groups using SDSF for education, nature study, and recreation. Although the exact location of the proposed campground has not been determined, it could be located at one of the three sites identified in GFMP. The campground would encompass approximately 2 acres, accommodate a maximum of 40 people, and be available for use by authorized groups by reservation only. Initially, it would be available for approximately 12 weekend or weekday periods per year; use could be increased to accommodate 20 groups per year over the period of the GFMP if adequate resources became available for campground management.

ALTERNATIVES TO THE PROPOSED PROJECT

In addition to the proposed project, the EIR analyzes the following project alternatives:

- Alternative 1: No-Project Alternative,
- Alternative 2: Emphasize Watershed and Late-Succession Habitat Protection, and
- Alternative 3: Emphasize Forest Management Demonstration and Recreation.

These alternatives were developed based on comments received during scoping sessions for the EIR and subsequent evaluations. Table 2-1 summarizes the project features of each alternative. These alternatives are described in more detail below.

Alternative 1: No-Project Alternative

The No-Project Alternative would entail custodial management of SDSF at an intensity consistent with a staff of one part-time forest manager. The main distinctions between the proposed project and the No-Project Alternative are that the forestwide timber harvest objective would be lower, sediment-source stabilization efforts would be reduced, and no campground would be developed under the No-Project Alternative. In addition, the timber production land base would be reduced somewhat in that no timber harvesting would occur within 150 feet of Class I streams, springs, or sag ponds.

Timber management would mimic the natural processes of tree mortality and regeneration. Harvesting would consist of sanitation-salvage operations, involving only the harvesting of trees that have recently died or that display declining vigor. The harvest rate would be approximately 10% of the conifer growth rate (or 260 MBF per year) (Table 2-1). Approximately 6 MBF per acre would be removed in a typical biennial harvesting operation that would cover 90 acres. The length of the cutting cycle would be approximately 50 years. Yarding systems would be limited to tractor and cable yarders; no helicopters or horses would be used.

Resource enhancement activities would focus on instream fish habitat improvements, such as the pool formation activities discussed for the proposed project. Because of the low timber harvesting rate under this alternative, extensive watershed remediation would not be financially feasible.

Fewer public use opportunities and less development of recreation and education facilities would take place under the No-Project Alternative than under the GFMP. No campground or forestry education center would be constructed, and no motorized public use would be allowed. Forest staff to support recreation and education facilities and activities would be minimal because of the lack of financial resources. Road construction and access route development would be the same as under the GFMP.

Alternative 2: Emphasize Watershed and Late-Succession Habitat Protection

Alternative 2 would give highest priority to natural resource protection. The principal changes in management of SDSF under this alternative compared to under the GFMP would be the exclusion of timber harvesting from the inner gorge of Amaya Creek, the establishment of late-succession management areas adjacent to Class II streams, recruitment of late-succession habitat forestwide by restricting timber removals to trees less than 26 inches dbh, and restriction of tractor yarding to lands with low or moderate erosion hazard ratings.

Amaya Creek's channel contains the greatest concentration of sediment and woody debris among the tributaries of the East Branch (Singer and Swanson 1983). Under Alternative 2, no timber would be harvested or equipment used within 300 feet of Amaya Creek on slopes exceeding 50%.

In addition to the 300-foot-wide late-succession management areas adjacent to each side of Class I streams called for under the GFMP, Alternative 2 would establish 150-foot-wide late-succession management areas adjacent to each side of all Class II streams. These areas would be managed to achieve the same stand structures proposed for these areas under the GFMP.

Development of late-succession forest structures would also be promoted by restricting timber harvesting to trees less than 26 inches dbh. Exceptions to this restriction would be made to allow removal of dead or dying trees that pose hazards to human safety or property. Otherwise, large, dead or dying trees would be retained for their wildlife value.

Timber harvesting would focus on removing understory trees of 18-26 inches dbh. The harvest rate under Alternative 2 would be approximately 20% of conifer growth (i.e., 500 MBF per year), or 0.6% of conifer inventory (Table 2-1). The average harvest level would be approximately 6 MBF per acre, with biennial harvesting areas averaging 170 acres for a cutting cycle of approximately 25 years. Use of tractors and other heavy equipment would be restricted to areas of low or moderate erosion hazard, as determined through timber harvesting planning.

Entrance and campground development would be the same as under the proposed project. The watershed remediation program would be less extensive under Alternative 2 than under the proposed project because less revenue from timber harvesting would be available to fund these programs and facilities. No forestry education center would be constructed.

Alternative 3: Emphasize Forest Management Demonstration and Recreation

Alternative 3 would give increased emphasis to timber management involving a variety of silvicultural systems and to public recreation use at SDSF. The principal differences between this alternative and the proposed project are that under Alternative 3, the average timber harvest rate would increase to approximately 75% of the conifer growth rate (2,000 MBF per year), or 2.6% of the conifer inventory (Table 2-1), and Hihn's Mill Road would be widened, paved, and opened to motorized use by the public. Late succession management areas would be established adjacent to Class I streams.

The timber harvest objective would be achieved by harvesting approximately 300 acres every 2 years. As a result, the length of the cutting cycle would be reduced from 35 years under the proposed project to 18 years. The rate of new road construction would be increased in proportion to the timber harvest rate to provide access to timber stands proposed for harvest. Hardwood stands would be harvested and converted to conifer stands on an accelerated basis relative to the rate proposed under the GFMP.

To enable CDF to implement silvicultural systems other than the selection systems permitted under the special Santa Cruz County rules, SDSF would be designated by the California Board of Forestry as "experimental forest land". This designation would suspend the functional equivalence of the timber harvest planning process relative to the CEQA process and require that proposed timber harvesting conform directly with CEQA. By suspending application of the Santa Cruz County rules, clearcuts could exceed 0.5 acre. Under this alternative, clearcuts of as much as 5 acres would be implemented to facilitate investigations of the feasibility of such operations and of their environmental consequences. No clearcutting would occur in areas of high or extreme erosion hazard rating, however.

Watershed and fish habitat enhancement projects similar to those prescribed by the GFMP would be implemented under Alternative 3, but funding levels and the extent of such projects would be increased substantially. The objective of intensifying the natural resource enhancement program at SDSF would be to maintain the level of environmental protection provided under the GFMP while increasing the rates of timber harvesting and road construction.

Motorized public use of the main forest road would be allowed between April and October; nonmotorized use would be permitted year round. The campground described under the GFMP would be open for public use by reservation from April through October. Locked gates would be installed at all intersections with the main forest road to prevent motorized use of SDSF and restricted private roads.

SDSF would be used for amateur races and runs (pedestrian, equestrian, and bicycle). Approximately six such events would occur annually.

Hunting would be allowed consistent with state laws and regulations. Other use restrictions applicable under the GFMP, including restrictions on target shooting, would apply under Alternative 3 as well.

The main forest road would be widened to provide turnouts and paved from Soquel-San Jose Road to Highland Way. The main forest road would consist of Hihn's Mill Road (from Highland Way to Amaya Creek Road) and several shorter road segments through SDSF and the CHY Company and Noren parcels that would connect Hihn's Mill Road to Soquel-San Jose Road. A trail with a sandy road-base surface would be constructed parallel to the main forest road for use by equestrians and cyclists. Three small, rustic campgrounds would be developed to serve equestrians, researchers, and other visitors. A forestry education center would be constructed as under the proposed project.

Chapter 3. Geology, Soils, and Water Quality

ENVIRONMENTAL SETTING

Drainage

SDSF is located in the watershed of the East Branch. The watershed assessment area for this EIR includes the East Branch watershed from its confluence with the West Branch of Soquel Creek to its headwaters at the summit of the Santa Cruz Mountains (Figure 3-1). This area comprises 8,640 acres and 11.5 miles of the East Branch (Poole 1993). The watershed assessment area is the geographic context for assessing the cumulative watershed effects of the proposed project in conjunction with other past, present, and future projects in this chapter and Chapter 4, "Fisheries".

The principal watercourses in the watershed assessment area are the East Branch, Ashbury Gulch, Fern Gulch, Amaya Creek, and Hinckley Creek. The East and West Branches join to form the main stem of Soquel Creek approximately 2 miles downstream from the southern boundary of SDSF. Soquel Creek discharges into Soquel Lagoon, which in turn flows into the Pacific Ocean near Capitola.

Geomorphology and Mass Movement Hazard

The Santa Cruz Mountains formed from rapid tectonic uplift and active downcutting of streams. The range's characteristic, oversteepened slopes; frequent, major seismic events; frequent, extreme rainfall events; and occasional forest fires have resulted in repeated slope failures and a high rate of sediment discharge into streams. Stream channels are constantly being downcut by the flushing of unconsolidated material and scouring of channel-bottom bedrock. The inner gorge zones of streams in the watershed are especially prone to mass movements such as rotational and sheet landslides. (Manson and Sowma-Bawcom 1992.)

SDSF is underlain by five Tertiary-period, marine sedimentary bedrock units. The eastern portion of the forest is underlain by bedded arkosic sandstone and siltstone of the Butano Sandstone series. The central portion is formed of mudstone, shale, and sandstone of the San Lorenzo Formation and the Vaqueros Sandstone series. The western portion of SDSF is underlain by the Lambert Shale series and siltstone and sandstone of the Purissima Formation.

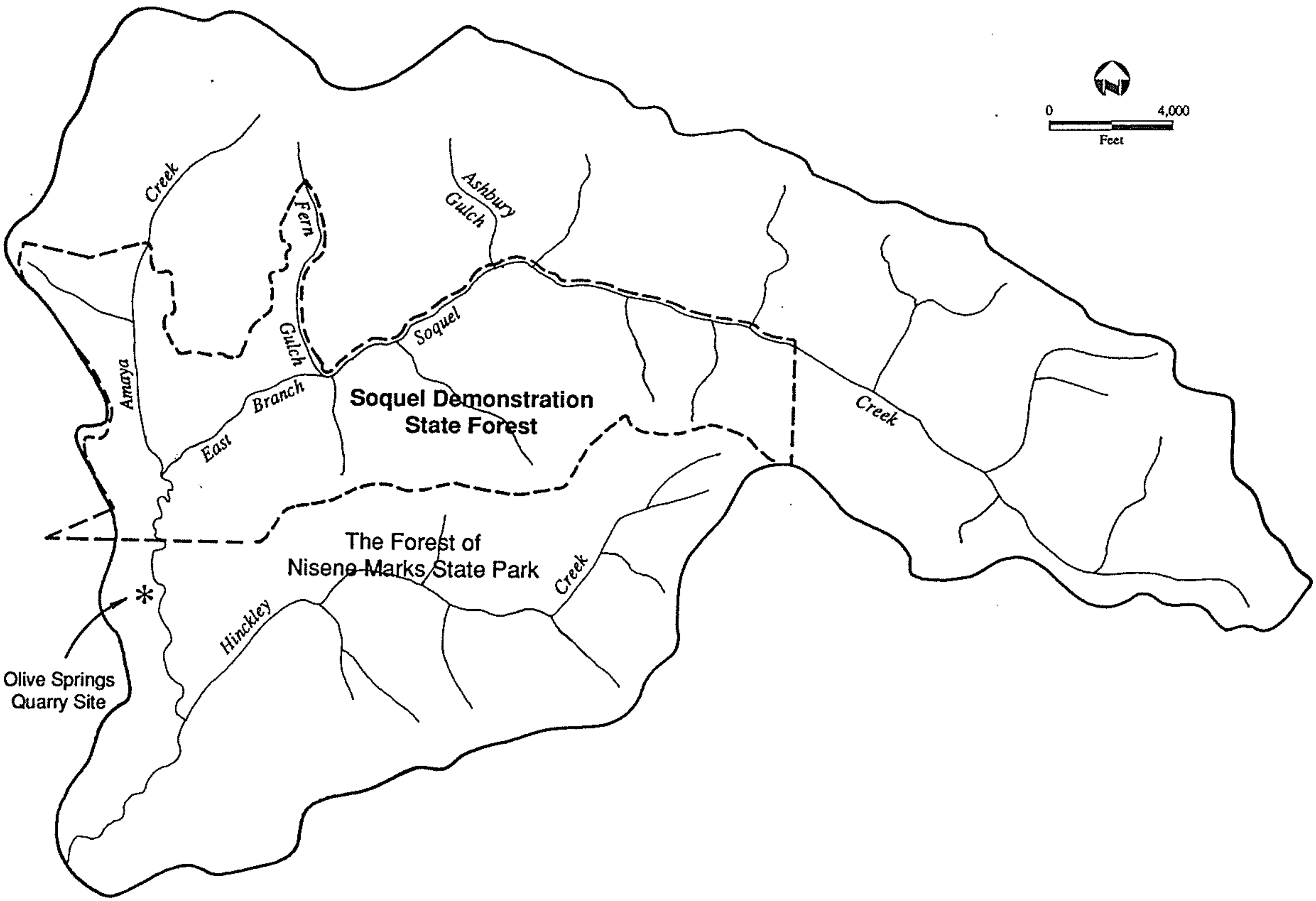

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Figure 3-1
The East Branch Watershed

Butano Sandstone conglomerate is present in the southwestern corner of SDSF. (Manson and Sowma-Bawcom 1992.)

Igneous formations are present in localized areas near Amaya Creek, Fern Gulch, Badger Springs, and Hinckley Creek. These formations are extremely erodible.

The portion of the East Branch watershed upstream from the eastern boundary of SDSF is an open, V-shaped valley containing a low-gradient sag of the San Andreas Fault Zone. The valley's northeastern side is steeper than its southwestern side. Between the eastern SDSF boundary and Ashbury Gulch, the watershed is a relatively symmetric valley aligned parallel to the San Andreas Fault with an average stream gradient of 7%. (Poole 1993.)

The East Branch watershed northeast of Ashbury Gulch is characterized by steep bluffs and inner gorge slopes that are prone to shallow debris slides and avalanches. Hillsides south of the East Branch have relatively gentle slopes. Large, relatively stable deposits from previous landslides are a dominant feature adjacent to the south bank of the East Branch (within SDSF), whereas smaller, relatively unstable deposits from debris slides are the predominant landform along the north bank (outside of SDSF). (Manson and Sowma-Bawcom 1992.)

The East Branch canyon upstream from Fern Gulch is parallel to and coincident with segments of the San Andreas Fault. Repeated seismic activity along this fault has resulted in large-scale landsliding that has greatly modified the drainage pattern of the area (Manson and Sowma-Bawcom 1992). Large, unconsolidated stores of sediments formed by past steam-donkey logging are located along the East Branch near the mouths of ephemeral streams and upslope of the creek. Severe storms could mobilize such sediment stores and transport them into the creek channel.

The portion of the watershed between Ashbury Gulch and the southern SDSF boundary is a flat-bottomed alluvial valley, the side slopes of which have gradually eroded to form a widening stream terrace. Channel gradients in this reach average 2.7%, decreasing with the distance downstream. This portion of the watershed cuts across the fold zone between the San Andreas and Zayante Faults. (Poole 1993.)

From the southern SDSF boundary to the confluence of the East Branch with Hinckley Creek, the channel consists of stream terrace deposits enclosed within valley walls that are steeper on the east slope than on the west slope. The gradient of this reach gradually decreases from 2% to 0.5% near the confluence with the West Fork. (Poole 1993.)

Amaya Creek flows through a steep-sided, largely symmetrical, V-shaped valley. The stream channel is relatively wide, with an average width of 40 feet and an average gradient of 4% (Poole 1993). Its banks are formed largely of old landslide deposits. More recent slides have moved large volumes of sediment and logs into the channel, temporarily blocking the stream and forming numerous log jams. Unstable landslide deposits along much of the streamcourse may be reactivated by intense rainfall or undercut by stream erosion or road construction (Manson and Sowma-Bawcom 1992). Massive tension cracks on the hillslopes above the channel indicate that large landslides are likely to occur (Cafferata and Poole 1993). Sediment wedges comprising thousands of cubic yards of material have formed behind some log jams on Amaya Creek (Singer and Swanson 1983).

Hinckley Basin is a symmetrical, V-shaped, narrow channel bottom that has very steep hillslopes with stream gradients ranging from 10% near its upper end to 1.5% at its lower end (Poole 1993). Large, unstable sediment deposits occur along the channel with massive log jams at the toe of each major slide. Smaller debris jams are also abundant along Hinckley Creek (Cafferata and Poole 1993).

Unstable cutslopes occur along Highland Way and Hihn's Mill Road. The Loma Prieta earthquake caused rock falls along these cutslopes, leaving exposed slide blocks of fractured bedrock that are highly susceptible to failure (Manson and Sowma-Bawcom 1992).

Landslide hazard is reduced by the dense perennial vegetation that covers more than 90% of the watershed assessment area. Vegetational transpiration accelerates soil drying following storms and reduces mass movement hazards associated with saturated soils. No fires have affected the watershed's vegetative cover for more than 35 years.

Soils and Erosion Hazard

A total of 20 soils and soil associations have been mapped by the U.S. Soil Conservation Service (SCS) within the watershed analysis area (Table 3-1). Of these, 14 are within the boundaries of SDSF. According to the SCS map, steep slopes are the dominant topographic feature in the watershed assessment area and at SDSF. In the watershed assessment area, 12% of the lands have slopes of less than 30%, 29% have slopes of 31-50%, and 59% have slopes of 51-75% (Table 3-1). The distribution of SDSF lands by slope class is approximately the same as that for the entire watershed assessment area (Table 3-1).

A more recent slope map (Figure 3-2) developed by digitizing U.S. Geological Survey topographic data indicates that the SCS map of soil associations substantially overstates the steepness of terrain at SDSF (University of California, Berkeley 1995). According to the more recent map, 33% of SDSF lands have slopes of less than 30%, 38% have slopes of 31-50%, and 29% have slopes greater than 50%. This distribution of slope classes conforms relatively closely to the observations of terrain conditions on which the preliminary logging plan was based (Soho et al. 1994).

CDF has developed an erosion hazard rating (EHR) system for use in preparing THPs. This system is used to identify areas where high soil erodibility warrants special harvesting

Table 3-1. Distribution of Soil Associations, Slope Classes, and Erosion Hazard Ratings for the East Branch Watershed and Soquel Demonstration State Forest

Soil Survey Unit	Soil Name	Slope Class (%)	CDF Erosion Hazard Rating	East Branch Watershed, Acres	SDSF, Acres
111	Ben Lomond sandy loam	15-50	moderate	304	49
112	Ben Lomond sandy loam	50-75	extreme	1,051	343
113	Ben Lomond/Catelli-Sur	30-75	high	94	0
114	Ben Lomond/Felton	30-50	high	221	24
115	Ben Lomond/Felton	50-75	high	572	462
140	Hecker gravelly sandy loam	30-50	high	419	0
141	Hecker gravelly sandy loam	50-75	high	1,192	0
142	Lompico/Felton	5-30	moderate	585	186
143	Lompico/Felton	30-50	moderate	974	566
144	Lompico/Felton	50-75	high	1,068	535
145	Lompico Variant loam	5-30	moderate	54	0
149	Madonna loam	15-30	moderate	73	18
150	Maymen stoney loam	15-30	moderate	43	0
151	Maymen stoney loam	30-75	high	609	46
156	Nisene/Aptos	15-30	moderate	87	53
157	Nisene/Aptos	30-50	high	365	148
158	Nisene/Aptos	50-75	extreme	745	185
165	Riverwash	0-5	low	72	26
167	Santa Lucia shaly clay loam	5-30	low	26	0
183	Zayante coarse sand	30-50	moderate	86	37

Source: U.S. Soil Conservation Service 1980.

prescriptions or equipment limitations. The EHR system takes into consideration the following soil characteristics:

- topographic slope,
- soil detachability and permeability,
- soil depth to bedrock or other restrictive layer,
- soil armoring by rocks and stones,
- vegetative cover following harvesting, and
- intensity of severe rainstorms.

The delineations (Figure 3-3) and tabulations (Table 3-1) of SDSF lands by EHR class based on the SCS soil survey are imprecise because the large SCS mapping units are not homogeneous with respect to soil type and slope class. Instead, the SCS delineations comprise spatially complex combinations of diverse soil types and slope classes. Large units shown as having high erosion hazard include extensive areas of soils with low or moderate erosion hazards. In addition, erosion rates at SDSF are dominated by mass movements (as opposed to surface soil erosion), which are not closely correlated with CDF erosion hazard ratings (Rice and Lewis 1993). Finally, erosion hazards are moderated by relatively deep litter layers (averaging 2-8 inches beneath conifer stands) and by the perennial vegetation that covers more than 90% of the watershed.

Watershed Disturbance

Past and Present Disturbance

Timber harvesting began in the East Branch watershed in the 1870s. Clearcutting was the predominant harvesting system used through the 1940s, when selective harvesting began. By that time, nearly all of the watershed's old-growth timber had been removed. Log yarding was originally accomplished using oxen, followed by steam donkeys and later by crawler tractors. Many of the principal roads through the East Branch watershed were constructed during this period. Approximately 20% of the area is dominated by chaparral and has never been harvested. (Cafferata and Poole 1993.)

Selective harvesting of second-growth forest by cable and tractor yarding has occurred on approximately 790 acres of the watershed over the past 10 years (Drinkard pers. comm.).

Based on aerial photograph interpretations conducted for this EIR, historical conversions of forest land to pasture, orchard, vineyard, residential, and industrial uses within the watershed assessment area were estimated to total approximately 1,700 acres. The only large industrial facility in the watershed is Olive Springs Quarry, which comprises 150 acres adjacent to the East Branch 0.5 mile upstream from the Hinckley Creek confluence (Cafferata and Poole 1993).

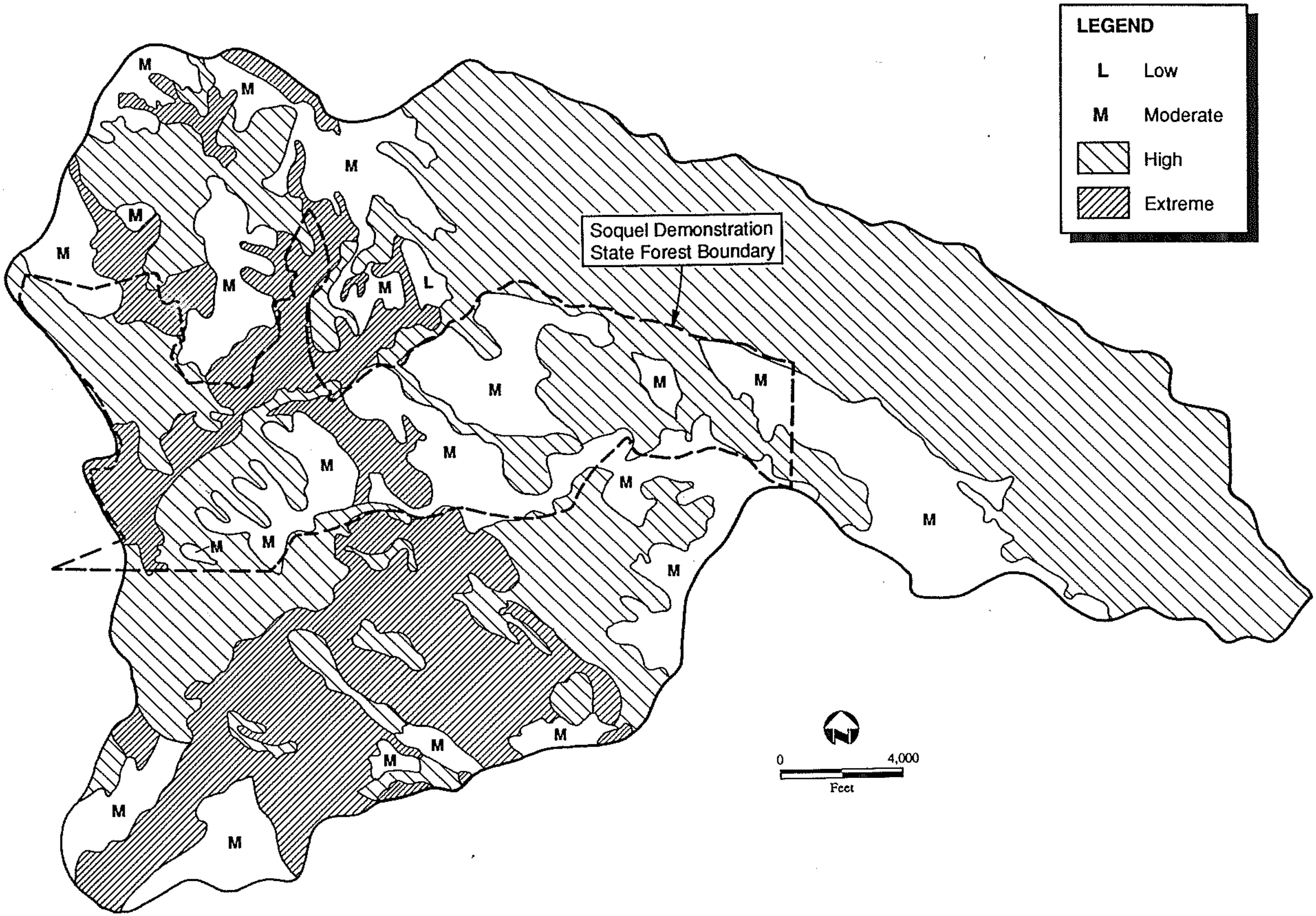

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Figure 3-3
Soil Erosion Hazard Ratings in the East Branch Watershed

Future Disturbance

Timber harvesting levels depend on the availability of marketable timber and on market conditions, which determine the price of logs. During the past decade, log prices have risen and dropped several times. As a result, this period is sufficiently representative for projecting future harvesting rates in the watershed.

In all, 790 acres were selectively harvested in the watershed analysis area between 1984 and 1994. Based on this harvesting rate, selective harvesting is projected to occur within the watershed at the average rate of 79 acres per year over the 10-year lifetime of the GFMP. The extent of new logging roads needed to be constructed to provide access to these harvest areas was estimated at 1 mile per year based on the average density of roads in surrounding forest lands.

Rural-residential development is expected to continue in the northern portion of the East Branch watershed. Approximately 1,600 acres of the watershed are in parcels of less than 40 acres, some of which have already been developed for residential use.

Olive Springs Quarry has received a permit to expand its quarrying operation by 16 acres (LSA Associates 1983).

Cumulative Watershed Effects and Erosion Rates

In seismically active areas, periodic earthquakes result in the generation of abundant unconsolidated material that is prone to mass movement, especially when soils become saturated. In montane forest ecosystems undisturbed by human activity, soil erosion rates vary substantially over time based on hillslope stability, vegetative cover, and occurrences of severe storms. Although extremely variable, erosion rates in the East Branch watershed have been high relative to more stable landforms for thousands of years.

Human actions can affect erosion rates. Forest management activities (e.g., road construction and logging) often increase soil erosion by altering drainage patterns, forming unstabilized soil deposits, reducing water infiltration and transpiration, and increasing runoff. Residential development and agricultural and rangeland uses are also important sources of erosion in the region. Watershed remediation activities at SDSF (e.g., road abandonment and revegetation) are intended to reduce human-caused increases in erosion rates.

Cumulative watershed effects (CWEs) are the additive offsite effects of related land management activities on water quality and aquatic habitat. Streams that drain highly disturbed watersheds often display evidence of CWEs, such as elevated rates of sedimentation, unstable stream channels, and fluctuating channel bed loads. The effects of individual actions (e.g., a timber harvest) on water quality and aquatic habitat are typically greater in highly disturbed watersheds than in pristine watersheds.

Cafferata and Poole (1993) estimated erosion rates in the East Branch watershed based on previous research conducted in California's north coast region and the assumption that total erosion is the sum of ongoing surface (i.e., sheet, rill, and small gully) erosion and occasional "critical" erosion events (i.e., large gullies and mass movements producing at least 100 cubic yards of sediment per acre) (Lewis and Rice 1989, Rice and Lewis 1991, Rice 1993). Because forest roads are often an important source of erosion, independent estimates of surface and critical erosion rates were developed for road corridors and for forested hillslopes off of road corridors. Separate erosion rates were also estimated for forest and nonforest lands.

The East Branch watershed assessment resulted in an estimated level of total erosion (i.e., surface erosion and critical events) of 27,848 cubic yards per year (3.2 cubic yards per acre per year). Of this total, roads account for 46%, forested lands 13%, and nonforest lands 41%. (Cafferata and Poole 1993.)

These estimated erosion rates were revised for the purposes of this EIR as described below under "Impact Assessment Methods". Based on these revisions, the annual erosion rate for the 8,640-acre watershed assessment area was estimated at 24,200 cubic yards, a 13% reduction from Cafferata and Poole's estimate. The revised estimate is based on the assumption that future watershed disturbance levels (e.g., logging and road construction) would continue as they have in the past (i.e., that the No-Project Alternative would be implemented).

Water Quality

Soquel Creek exhibits water quality characteristics typical of coastal streams in the central coast region. During low-flow periods, turbidity is typically low. During and following substantial storm events, which typically occur only between November and April, erosion, channel scouring, and sediment transport increase suspended sediment loads and turbidity temporarily.

The Central Coast Regional Water Quality Control Board (CCRWQCB) is the state agency responsible for regulating waste discharges within the Soquel Creek watershed and for specifying the beneficial uses of Soquel Creek and setting water quality objectives to protect those uses. The beneficial uses identified in the CCRWQCB basin plan for Soquel Creek are:

- municipal and domestic water supplies,
- irrigation and stock watering,
- industrial supply,
- groundwater recharge,
- contact and noncontact recreation;
- wildlife habitat,
- cold freshwater habitat, and
- fish migration and spawning habitat.

Suspended sediments and turbidity do not affect municipal drinking water quality at SDSF because the only public water purveyor within or downstream from the East Branch watershed (Soquel Creek Water District) obtains its water supply through groundwater extraction (Goddard pers. comm.). Six diversions from the East Branch have been permitted for industrial and agricultural uses (Cafferata and Poole 1993).

CCRWQCB has regulatory responsibility to prevent adverse water quality impacts resulting from land uses, including forest management. The principal objectives in the basin plan that relate to forest management are those regarding sediment, turbidity, and temperature. The objectives for sediment and turbidity prohibit changes in suspended sediment load, suspended sediment discharge rate, or turbidity that would cause a nuisance or adversely affect beneficial uses. In addition, a numerical objective expressed in terms of Jackson turbidity units (JTU) applies to turbidity. This objective states that:

- where natural turbidity is 0-50 JTU, increases in turbidity attributable to controllable factors shall not exceed 20%;
- where natural turbidity is 51-100 JTU, controllable increases shall not exceed 15%; and
- where natural turbidity is greater than 100 JTU, controllable increases shall not exceed 10%. (Central Coast Regional Water Quality Control Board 1989.)

Although water quality assessments were conducted for lower Soquel Creek in 1981 and 1982 (Brown and Caldwell 1981, 1982), the results were inconclusive as to the natural turbidity ranges for the East Branch during low- and high-flow periods. Based on the low turbidity observed in the East Branch during field visits conducted for this EIR in August 1994, however, the area's natural turbidity during low-flow periods is less than 50 JTU.

The CCRWQCB temperature objective states that changes in natural receiving-water temperature are prohibited unless such changes can be shown not to adversely affect beneficial uses. Additional objectives addressing dissolved oxygen, oil and grease, toxicity, pesticides, and bacteria are summarized in Table 3-2. (Central Coast Regional Water Quality Control Board 1989.)

Section 208 of the federal Clean Water Act requires states to implement best management practices (BMPs) and water quality management plans to control nonpoint sources of water pollution, such as sedimentation resulting from forest management. The California State Water Resources Control Board (SWRCB) implements California's Section 208 program and is authorized to certify BMPs and submit them to the U.S. Environmental Protection Agency for approval. In June 1984, the SWRCB conditionally certified the California Forest Practice Rules as BMPs (California State Water Resources Control Board 1987).

In 1988, the SWRCB executed a management agency agreement with the California Board of Forestry and CDF to enhance water quality by improving the timber harvest planning

Table 3-2. Nonturbidity Water Quality Objectives for Soquel Creek and Its Tributaries

Parameter	Objective
Dissolved oxygen	Concentration shall not to be reduced below 5.0 milligrams per liter (mg/l) at any time; median values should not fall below 85% of saturation
Oil and grease	Concentrations shall not result in a visible film or coating on the surface of the water or on objects in the water that cause nuisance or otherwise adversely affect beneficial uses
Toxicity	Water shall remain free of toxic substances in concentrations that are toxic to, or produce detrimental physiological responses in human, plant, animal, or aquatic life; discharges of ammonia shall not cause concentrations to exceed 0.025 mg/l
Pesticides	No individual pesticide or combination of pesticides shall reach concentrations that adversely affect beneficial uses; there shall be no increase in pesticide concentrations found in bottom sediments or aquatic life
Bacteria	Fecal coliform concentration, based on a minimum of five samples for any 30-day period, shall not exceed a logarithmic mean of 200 per 100 milliliters, nor shall more than 10% of all samples during any 30-day period exceed 400 per 100 milliliters

Source: Central Coast Regional Water Quality Control Board 1989.

process (Central Coast Regional Water Quality Control Board 1989). As part of this effort, regional water quality control board staff members participate in THP review teams and assist the director of CDF in evaluating timber harvest operations and their environmental impacts.

IMPACTS AND MITIGATION MEASURES

Geology and Soils

The principal watershed-disturbing activities proposed by the GFMP are construction and reconstruction of forest roads, construction of skid trails and landings, and timber harvesting and yarding. Regardless of which alternative is implemented, these activities will comply with the California Forest Practice Rules. Although this regulatory system has resulted in enormous improvement in natural resource protection relative to past forest practices, opportunities remain to reduce watershed impacts through implementation of better forest practices, particularly with regard to the location, construction, and maintenance of roads and skid trails (California State Water Resources Control Board 1987; Durgin et al. 1989). Resource protection measures proposed in the GFMP and additional mitigation measures recommended below are intended to avoid adverse watershed impacts or reduce them to less-than-significant levels.

The following section assesses impacts on soils and landforms that could result from implementation of the GFMP or alternatives. Specific impacts discussed below include:

- surface erosion from increased rates of runoff caused by changes in canopy interception, infiltration, and transpiration;
- surface erosion from concentration of runoff caused by the formation of artificial drainage patterns associated with road, skid trail, and landing construction;
- streambank erosion from constricted channel capacities associated with construction of stream crossings;
- increased risk of mass movements from vegetation removal or construction of roads, skid trails, or landings in slide-prone areas; and
- increased sediment discharge from concentrated runoff leading to mobilization of unconsolidated sediment stores.

Impact Assessment Methodology

Direct and indirect impacts of forest management activities on soils and landforms were assessed by evaluating the extent of disturbance within SDSF associated primarily with logging and road construction under the proposed project or an alternative relative to that under the No-Project Alternative. Cumulative watershed impacts were assessed by evaluating projected disturbance levels throughout the East Branch watershed under the proposed project or an alternative relative to disturbance levels under the No-Project Alternative. These evaluations considered the naturally high rates of erosion attributable to the high risk of mass movements on SDSF lands.

Landscape-Level Impact Assessment. Direct, indirect, and cumulative impacts on soils and landforms of proposed actions were assessed at the landscape level primarily by using the methods developed by Rice and Lewis for assessing erosion from forested landscapes in California (Lewis and Rice 1989, Rice and Lewis 1991, Rice 1993). This method assumes that the total rate of erosion is the sum of ongoing surface erosion and large-scale ("critical") erosion events on harvest areas and along road corridors. It further assumes that the risk of critical erosion events along road corridors is related to terrain slope, road curvature, and soil hue, and that the risk of large-scale events on harvest areas is related to slope, hillside curvature, and parent rock strength. Data collected on these variables at selected sample locations serve as input to equations that are used to predict the erosion rates attributable to critical events. In contrast to the predictive model approach used to assess critical events, surface erosion rates are estimated based directly on field measurements of past erosion. (Rice 1993.)

Information from simulations of critical events using the predictive models is combined with the estimates of past surface erosion to derive coefficients representing average total erosion levels for roads and harvest areas. These coefficients express erosion levels in cubic yards of soil per acre of harvest area and per mile of road corridor. Individual coefficients are estimated for roads in use, roads not in use, recently harvested areas, forest areas not recently harvested, and nonforest areas.

The coefficients are expressed in cubic yards per year (annualized) by dividing the erosion levels by factors representing the return period for the projected erosion level, presumably a combination of the expected average length of time between large-scale events and the average period during which the observed surface erosion occurred. The return period is assumed to equal the length of time between harvest entries. (Rice 1993.)

Rice and Lewis's method was used to assess the significance of impacts on the East Branch watershed (Cafferata and Poole 1993). This application was based on data collected at 49 road plots and 26 harvest-area plots in the watershed. Road plots were selected by mapping all road segments in the watershed, inventorying and stratifying all road segments by use classification (i.e., forestry versus residential travel), and randomly selecting a predetermined number of plot locations within each use stratum. Harvest-area plots were selected by offsetting a random distance from each road plot located in potentially harvestable timberland. Cafferata and Poole annualized their coefficients based on return periods of 10-50 years for roads and 20-75 years for harvest areas. Their estimated erosion rates and the corresponding return periods are shown in Table 3-3.

Table 3-3. Estimated Erosion Rates and Corresponding Recurrence Periods for the East Branch Watershed

Category	1993 Assessment		Current Assessment[b]	
	Erosion Rate[a, c]	Recurrence Period (years)	Erosion Rate[c]	Recurrence Period (years)
Forest land recently harvested	5.6	20	11.0	5
Forest land not recently harvested	50.8	75	8.25	5
Nonforest land	4.6	1	4.9	5
Forestry roads in use	3,600	10	1,900	5
Abandoned forestry roads	1,514	50	234	5
Nonforestry roads	1,403	30	140	5

[a] From Cafferata and Poole 1993.

[b] Used in this EIR.

[c] Cubic yards per acre for forest and nonforest lands, cubic yards per mile for roads.

Cafferata and Poole's estimated erosion coefficients were revised for use in this EIR. The revisions addressed three aspects of their approach considered likely to bias or reduce the consistency of their results: the inclusion of data from an anomalous harvest-area sample plot, the approach used to annualize the erosion coefficients, and the assumed erosion rate for nonforest areas.

One of the harvest-area plots analyzed by Cafferata and Poole had a large gully that accounted for almost 90% of the total surface erosion observed at all 26 plots. Large gullies sometimes result from disturbances related to forest management; although such events are rare, landscape-level estimates of total erosion rates should take into account the potential occurrence of such gullies. The gully in question would more properly be classified as a critical event than as surface erosion, however, because it accounted for 1,035 cubic yards of eroded soil, which far exceeds the minimum volume for critical events (100 cubic yards per acre). For this EIR, the average surface erosion level for harvest areas was reestimated based on data from the 25 plots that remained after the anomalous observation was excluded from the data set. As a result of removing this observation, the average level of surface erosion at harvest plots was revised from 45.2 cubic yards per acre to 5.6 cubic yards per acre.

Further justification for revising downward Cafferata and Poole's estimate of surface erosion is provided by its magnitude relative to their estimate of erosion attributable to critical events. Cafferata and Poole's surface erosion estimate of 45.2 cubic yards per acre is more than eight times larger than the estimated average for critical events (5.6 cubic yards per acre). In Coast Range watersheds, erosion rates for critical sites typically exceed those for surface erosion (Rice 1991).

The second revision to Cafferata and Poole's results for this EIR concerns the approach for annualizing the erosion coefficients. Rice's approach consists of dividing the sum of predicted critical erosion and observed surface erosion levels by the length of the reentry period for logging (Rice 1993). This procedure is based on the assumption that logging-related disturbance destabilizes a volume of soil, which is eventually eroded in response to rainfall and other natural processes. The soil surface subsequently stabilizes, until it is disturbed again by the next logging entry. In applying this method to the East Branch watershed, Cafferata and Poole (1993) used divisors ranging from 10 to 75 years, based on rough approximations of the reentry period.

The approach used in this EIR for annualizing erosion levels is based on the assumption that soil destabilized by logging disturbance is eroded primarily by storms sufficiently severe to cause landsliding. Based on meteorological records for the Santa Cruz Mountains and other research (Cain 1980), such storms are assumed to recur approximately every 5 years. Consequently, erosion levels taken from Cafferata and Poole's results for land disturbed by harvesting were annualized for this EIR by dividing by 5. Harvested areas were assumed to recover from disturbance after 5 years, following which the surface erosion rate was assumed to be reduced by 50%. SDSF lands are expected to recover from the effects of logging relatively rapidly because the proposed harvesting is relatively light and the rapid revegetation associated with redwood sprouting is effective in stabilizing harvested areas. Erosion attributable to critical events was assumed to be unaffected by either logging disturbance or recovery from such disturbance. This assumption was based on the finding that site conditions are more important than management history in determining the erosional consequences of logging (Rice and Lewis 1991).

The third revision to Cafferata and Poole's results concerns their estimate of the annual erosion rate for nonforest areas. Exclusive of roads, nearly all nonforest areas in the East Branch watershed support permanent vegetative cover (chaparral, annual grasses, or turf) or permanent crops (orchards or vineyards). Cafferata and Poole estimated the average annual erosion rate for nonforest lands at 4.6 cubic yards per acre, more than 16 times greater than their estimate for recently disturbed forest lands. The rate assumed for nonforest lands appears excessive, considering the extent of vegetative cover and the low disturbance levels that characterize these lands. Using a relatively high estimate for nonforest lands could result in attributing an excessive share of the watershed's total erosion to nonforest lands, which would be unaffected by the proposed project. The erosion rate for nonforest lands was consequently reduced to 0.98 cubic yard per acre per year for this EIR, in conformance with Rice's (1993) estimate based on data from nine undisturbed basins.

The erosion rates used in this EIR and those used by Cafferata and Poole are shown in Table 3-3.

The area affected by logging and roads was estimated for each alternative based on the preliminary logging plan prepared for SDSF by CDF (Soho et al. 1994) and the harvest rates and cutting cycles described in Chapter 2. The logging plan (Figure 2-3) shows the locations of existing and proposed roads and summarizes the amount of new roads required to gain access to all lands at SDSF considered suitable for timber management. Fewer new roads would be required under Alternative 2 than under the other alternatives because relatively more land would be logged using cable systems, which allow wider spacing of roads than tractor logging. The portion of the proposed roads expected to be constructed during the 10-year period of the GFMP was estimated based on the assumptions that all proposed roads would be constructed during the first cutting cycle (i.e., the period required to conduct harvests throughout all SDSF timberlands) and that the rates of harvesting and road construction would be constant over the cutting cycle.

Localized Impact Assessment. Localized impacts on soils and landforms are the direct and indirect impacts of the increased risks of surface erosion and mass movements related to timber harvesting and construction of roads, skid trails, and landings in particularly sensitive settings, such as soils with high or extreme EHRs and areas prone to landslides. These impacts were analyzed by comparing the projected extent of disturbances in such areas under the proposed project or an alternative relative to projected levels under the No-Action Alternative.

Criteria for Determining Significant Impacts

Soil losses attributable to surface erosion and mass movements adversely affect the environment directly by diminishing the productive capacity of the land, and indirectly by diminishing the beneficial uses of water and the productive capacity of aquatic habitats. In the East Branch watershed, high erosion rates are natural occurrences; high rates of soil loss do not, in themselves, constitute a significant adverse environmental impact.

Within the East Branch watershed, the impacts of soil movement on aquatic habitats are more critical than their impacts on the productive capacity of forestlands. In particular, the reduced abundance of steelhead trout and coho salmon in the East Branch watershed and throughout their ranges relative to past levels is the basis for establishing the criterion used in this EIR to determine the significance of soil losses resulting from proposed forest management.

The localized erosion impacts discussed below that pertain primarily to disturbances of sensitive areas are a subset of the watershed processes assessed by Rice and Lewis's landscape-level model. In other words, the erosion rates estimated by that model, which were based on conditions observed throughout the East Branch watershed, take into account disturbances of highly erodible and unstable areas, as well as other disturbances. The localized impacts are discussed below primarily to provide a more detailed explanation of the mechanisms by which proposed forest management activities cause soil erosion to increase. The significance of these impacts is determined based on the quantitative projections of the landscape-level model.

As with any model, results obtained from the landscape-level erosion model used for this EIR must be interpreted in relation to the model's reliability as a representation of reality. Because of the extreme variability and complexity of erosion processes in coastal montane forests, and because of the limited availability of empirical data for developing the model and its other simplifying assumptions, the model is inherently imprecise compared to models of more predictable processes. Its results should be considered indicators of the relative differences in average long-term erosion levels between alternatives rather than as accurate measures of expected annual erosion rates.

As discussed above, an impact on geology and soils would be considered significant if implementing the proposed project or a project alternative would result in:

- any increase in erosion that is expected to result in an appreciable increase in sediment discharge to the East Branch or its tributaries or
- changes in sedimentation that exceed by at least 5% corresponding rates projected to result under the No-Project Alternative.

Alternative 1: No-Project Alternative

Impact: Increased Erosion within the East Branch Watershed and SDSF from Disturbances Caused by Proposed Harvesting and Road Construction. Under the No-Project Alternative, SDSF management would receive custodial management. Timber harvesting would be conducted at a level adequate to provide a stable source of revenue to support custodial management. Except for old-growth redwood groves and streamside areas, the entire property would eventually be subjected to light selective harvesting focusing on removal of trees of low vigor that are not needed for wildlife habitat. Approximately 20% of the existing conifer timber volume would be removed from an average of 45 acres per year. At this rate, approximately 50 years would be required to conduct harvests throughout SDSF. Logs would be yarded using tractors and cable systems. An average of 0.41 mile of road would be constructed annually to increase access to harvest areas.

Operation of heavy logging equipment such as tractors also compresses the soil surface, which reduces permeability and concentrates runoff. The California Forest Practice Rules address tractor operations to reduce adverse soil impacts. For example, they require that skid trails be limited in number and width to the minimum necessary for log removal, and that tractors shall normally not be operated on unstable soils, slide-prone areas, or slopes exceeding 65% (50% on soils with high or extreme EHRs). Construction of skid trails on steep slopes can be an important source of sediment primarily because of the extensive excavation typically required by such construction.

The watershed remediation program would focus on projects to improve instream fish habitat and on abandonment of unneeded roads.

The estimated annual erosion rate for SDSF lands under the No-Project Alternative is approximately 12,000 cubic yards. As discussed below under "Water Quality", 41% of this eroded soil (5,000 cubic yards) is projected to be discharged annually into streams (Table 3-4).

Disturbance to lands in the East Branch watershed outside of SDSF would result from selective timber harvesting on 79 acres per year. Based on East Branch watershed conditions that reflect natural conditions in conjunction with past disturbances and projected future disturbances on watershed lands within and outside SDSF, erosion associated with surface erosion and critical events throughout the watershed would average approximately 24,200 cubic yards per year over the next 10 years. Of this amount, approximately 9,600 cubic yards (41%) would be discharged into streams (Table 3-4).

For purposes of comparison, erosion was projected for the East Branch watershed assuming that no future harvesting or road construction would occur at SDSF. Under this assumption, total annual erosion in the watershed is estimated at 23,600 cubic yards, a 2.5% reduction relative to the No-Project Alternative. Based on an average sediment delivery ratio of 41%, implementing the No-Project Alternative would increase annual sediment discharges into streams by approximately 9,700 cubic yards relative to the rate if no additional disturbances occurred at SDSF (Table 3-4). The minimal changes in erosion and sedimentation in the watershed attributable to disturbances under the No-Project Alternative are consistent with the conclusion of Rice and Lewis (1991) that "site conditions are more important than management practices in determining the erosional consequences of logging or road construction".

Impact: Increased Surface Erosion Related to Diversion of Runoff from Natural Channels Caused by Road and Skid Trail Construction. The surfaces of roads and skid trails concentrate runoff because they are highly impermeable, straight, and (particularly skid trails)

Table 3-4. Projected Annual Erosion and Sedimentation Rates for Soquel Demonstration State Forest and the East Branch Watershed (cubic yards per year)

Alternative	SDSF		Watershed	
	Erosion	Sedimentation	Erosion	Sediment
1 (no project)	12,000	5,000	24,200	9,600
Proposed project	12,300	5,000	24,400	9,800
2	12,500	5,100	24,800	10,000
3	13,300	5,300	25,600	10,200
No future disturbance at SDSF	11,700	NA	23,600	9,600

steep. As a result, instead of flowing through natural channels, runoff flows down these surfaces, which did not conduct substantial runoff before their construction and hence have relatively deep layers of soil susceptible to erosion. Fill slopes, in particular, are prone to gully formation.

Accelerated erosion rates may also occur at locations where runoff leaves the road. Concentrated flows at such locations can displace berms at the outer edge of the road bed and fill material downslope from the road bed, and sometimes cause large-scale erosion at points of discharge. Runoff from roads, when combined with natural flows, may also exceed the capacity of culverts installed at downslope stream crossings. Such exceedances often result in large-scale erosion events at stream-crossing structures.

At SDSF, gully formation related to roads and skid trails was frequently observed during field visits conducted for this EIR. Such conditions are commonly associated with decades-old skid trails that were apparently constructed with no regard for their erosional consequences. In addition, several locations along Hihn's Mill Road have a high risk of severe erosion because of inner ditches, culverts, and outside berms. During the storms of January 1995, approximately 75% of the culverts at SDSF were blocked by debris; in the future, such blockages will be prevented by installation and maintenance of trash racks at culverts.

A major focus of the California Forest Practice Rules is to reduce the potential for increased erosion rates and related water quality impacts from road and skid trail construction. The rules include requirements to:

- use existing roads wherever possible;
- avoid constructing roads with grades exceeding 15% (except for short pitches not to exceed 20%);
- restrict logging roads to a single lane;
- minimize erosion of fill slopes through proper road design, installation of drainage structures and energy dissipators, and stabilization of fill material;
- avoid sidecasting of fill on steep slopes; and
- maintain roads and drainage structures.

Impact: Increased Erosion from Reduced Channel Capacities Caused by Construction of Stream Crossings. Structures installed to facilitate crossing of streams by vehicles usually reduce the capacities of the channels to transport water. Stream crossings on skid trails are usually temporary structures that dam the channel. During large storms, ponding behind such dams increases erosional pressures at and adjacent to the crossing.

Stream crossings on roads usually include culverts. When a culvert's capacity is exceeded by a sufficiently large storm, or when the culvert becomes blocked by debris, ponding increases erosional pressures that eventually cause a break at a weak point, such as the low point of the adjacent road bed. Under these conditions, gullies often form in the road bed and at adjacent downslope fill sites. In extreme cases, the entire crossing structure may be washed away. The subsequent release of ponded water can, in turn, cause extensive streambank erosion and, in some cases, gully formation down the road bed.

The California Forest Practice Rules contain requirements intended to avoid erosion associated with capacity exceedances at stream crossings, including requirements to:

- minimize the number of stream crossings;
- construct and maintain stream crossings to prevent diversion of overflow down the road bed and to minimize erosion from blockage of drainage structures;
- remove all temporary skid trail stream crossings before the winter period begins; and
- restore affected areas to their natural conditions when stream crossings have been removed.

Impact: Increased Risk of Mass Movements from Harvesting or Construction of Roads, Skid Trails, or Landings in Unstable Areas. Landforms that are very steep or consist of unstabilized landslide deposits are prone to mass movements. Timber harvesting in such areas increases the risk of landslides by reducing transpiration, which increases the likelihood of soil saturation, and by removing tree roots that hold the soil in place. Construction of roads, skid trails, or landings in unstable areas, particularly at the toes of landslides, also increases the risk of mass movement by disturbing the land mass that buttresses the landslide and by increasing the potential for soil saturation by altering drainage patterns.

Unstable areas occur most extensively in SDSF along Amaya Creek and the East Branch.

California Forest Practice Rules addressing the risk of mass movements focus on avoiding unstable areas and installing adequate drainage structures when constructing roads, skid trails, and landings.

Proposed Project

Impact: Increased Erosion from Projected Disturbances at SDSF. Under the proposed project, watershed disturbances would result from selective harvesting on an average of 75 acres per year and construction of an average of 0.58 mile of road per year. Logs would be yarded by tractors, cable systems, helicopters, and horses. In addition, approximately 3 acres would be disturbed for development of a campground and a parking lot. Streamcourses would be protected by establishing late-succession management areas adjacent to Class I streams, wherein no riparian vegetation would be removed (except to enhance riparian function) and at least 75% of existing shade canopy would be retained. Additional watershed enhancements would include stabilizing existing landslides, unconsolidated sediment stores, and gullies; improving maintenance of culverts; and abandoning approximately 11 miles of forest roads. Watershed remediation activities would be implemented in conjunction with each timber harvest operation.

Not counting erosion and sedimentation reductions attributable to the watershed remediation program, the proposed project would result in an erosion rate at SDSF of approximately 12,300 cubic yards per year. Of this amount, approximately 5,000 cubic yards would be discharged into streams (Table 3-4). Relative to the No-Project Alternative, sedimentation at SDSF is expected to increase by less than 2% under the proposed project. This impact is less than significant.

Mitigation: No mitigation is required.

Impact: Cumulative Increases in Erosion in the East Branch Watershed from Projected Disturbances at SDSF in Conjunction with Other Watershed Disturbances. Based on estimated levels of watershed disturbance, total erosion in the watershed is projected at 24,400 cubic yards per year, approximately 1% more than under the No-Project Alternative. This projection does not account for reductions in soil loss expected to result from the watershed remediation program, however, which would be funded at a substantially higher level under this alternative than under the No-Project Alternative. This impact is less than significant.

Mitigation: No mitigation is required.

Impact: Increased Surface Erosion from Diversion of Runoff from Natural Channels Caused by Road and Skid Trail Construction. Under the proposed project, average annual road construction would increase by 41% relative to the No-Project Alternative. Skid trail construction would increase by approximately 67%, the amount by which the harvest area would increase. In addition to the construction restrictions required by the rules, the GFMP specifies that tractor use will be limited to preclude construction of excavated skid trails on slopes exceeding 35% and that locations of all proposed roads, skid trails, and landings will be certified by a licensed engineering geologist. Compliance with the California Forest Practice Rules, in conjunction with implementing a forestwide inventory and risk evaluation of existing roads and skid trails; avoiding excavated skid trail construction on slopes exceeding 35%; and having all road, skid trail, and landing locations certified by a licensed engineering geologist, would ensure that this impact would be less than significant.

Mitigation: No mitigation is required.

Impact: Increased Erosion from Reduced Channel Capacities Associated with Construction of Stream Crossings. Under the proposed project, levels of stream crossing construction would be unchanged relative to those under the No-Project Alternative. Because more funding would be available for watershed remediation under the proposed project than under the No-Project Alternative, however, more opportunities would be available to reduce erosion impacts associated with construction of stream crossings. This impact is less than significant.

Mitigation: No mitigation is required.

Impact: Increased Risk of Mass Movements from Harvesting or Construction of Roads, Skid Trails, or Landings in Unstable Areas. The risk of mass movements caused by forest management activities would increase under the proposed project from that of the No-Action Alternative because of the proposed project's relatively high rates of harvesting and road construction. This impact would be effectively minimized through compliance with applicable California Forest Practice Rules and is considered less than significant.

Mitigation: No mitigation is required.

Alternative 2: Emphasize Watershed and Late-Succession Habitat Protection

Impact: Increased Erosion from Projected Disturbances at SDSF. Under this alternative, selective timber harvesting would occur on an average of 85 acres per year and road construction would average 0.71 mile per year. Although the average volume of timber harvested under this alternative would decline by 33% relative to the proposed project, the average area disturbed by harvesting would increase to compensate for the less intensive level of harvesting (6 MBF per acre versus 10 MBF per acre under the proposed project). Because the harvested area would be more extensive, less time would be required to harvest the entire forest. Road construction would thus be accelerated relative to the proposed project, despite the need for fewer miles of new roads because of increased use of cable yarding.

The watershed remediation program would be similar to that under the proposed project, but fewer projects would be implemented because of funding restrictions imposed by reduced timber revenues. Exclusive of erosion and sedimentation reductions attributable to the watershed remediation program, the projected average annual rates of erosion and sedimentation for SDSF are approximately 12,500 cubic yards and 5,100 cubic yards, respectively (Table 3-4). Sedimentation would thus increase relative to the No-Project Alternative by less than 3%. This impact is less than significant.

Mitigation: No mitigation is required.

Impact: Cumulative Increases in Erosion in the East Branch Watershed from Projected Disturbances at SDSF in Conjunction with Other Watershed Disturbances. Exclusive of erosion reductions attributable to remediation efforts, erosion rates within the East Branch watershed would average approximately 24,800 cubic yards per year under Alternative 2 (Table 3-4). The sedimentation rate would be approximately 10,000 cubic yards per year, an increase of 1.5% relative to the No-Project Alternative. This impact would be less than significant.

Mitigation: No mitigation is required.

Impact: Increased Risk of Mass Movements from Harvesting or Construction of Roads, Skid Trails, or Landings in Unstable Areas. Although under this alternative harvesting would increase by more than 80% and construction of roads, skid trails, and landings would increase by more than 70% relative to the No-Project Alternative, relatively little disturbance would occur in unstable areas. As a result, this impact would be less than significant.

Mitigation: No mitigation is required.

Impact: Increased Surface Erosion from Diversion of Runoff from Natural Channels Caused by Road and Skid Trail Construction. Although road and skid trail construction would increase by approximately 70% over the period of the GFMP, relatively few new roads or skid trails would be constructed in areas with high or extreme EHR because no tractor logging would occur on such lands. As a result, this impact would be less than significant.

Mitigation: No mitigation is required.

Impact: Increased Erosion from Reduced Channel Capacities Associated with Construction of Stream Crossings. Under Alternative 2, this impact would be approximately the same as under the No-Action Alternative and would be less than significant.

Mitigation: No mitigation is required.

Impact: Increased Risk of Mass Movements from Harvesting or Construction of Roads, Skid Trails, or Landings in Unstable Areas. Although disturbances related to harvesting and construction would increase under this alternative relative to the No-Project Alternative, relatively little disturbance would occur in unstable areas. Consequently, this impact would be less than significant.

Mitigation: No mitigation is required.

Alternative 3: Emphasize Forest Management Demonstration and Recreation

Impact: Increased Erosion from Projected Disturbances at SDSF. Under this alternative, a maximum of 150 acres would be disturbed by harvesting and 1.19 miles of new road would be constructed in a typical year. Possible clearcuts of as much as 5 acres would create forest openings. Such openings typically affect runoff rates more than selective harvests of comparable size; by removing relatively large timber volumes per acre, however, the use of clearcuts would substantially reduce the total area disturbed by harvesting in a specified year.

Because timber revenues would be relatively large under this alternative, the watershed remediation program would be funded at a substantially higher level than under the other alternatives. Without considering the proposed watershed remediation program, annual erosion and sedimentation rates projected for SDSF under this alternative are approximately 13,300 and 5,300 cubic yards, respectively. The sedimentation rate would thus increase by 6.3% relative to the No-Project Alternative. In the absence of more specific information regarding the watershed remediation program, this impact is considered potentially significant.

Mitigation:

- **Implement a Watershed Remediation Program.** The erosion impacts of this alternative would be substantially reduced by implementing a watershed remediation program, including the activities proposed for this alternative and the mitigation measure recommended below to reduce localized erosion impacts.

Implementing this measure would reduce this impact to a less-than-significant level.

Impact: Cumulative Increases in Erosion in the East Branch Watershed from Projected Disturbances at SDSF in Conjunction with Other Watershed Disturbances. Without accounting for erosion reductions attributable to watershed remediation, erosion and sedimentation are projected to occur throughout the watershed at annual rates of 25,600 and 10,200 cubic yards, respectively, under this alternative. This rate exceeds the rate for the No-Project Alternative by 3.6%. This impact would be less than significant.

Mitigation: No mitigation is required.

Impact: Increased Surface Erosion from Increased Runoff Caused by Reduced Canopy Interception, Infiltration, and Transpiration. Under this alternative, the areas disturbed by harvesting and road and skid trail construction would increase approximately threefold relative to the No-Project Alternative. This increase in the extent of harvesting, in conjunction with the application of clearcutting, is likely to increase runoff substantially. This impact is considered potentially significant. The following mitigation is required.

Mitigation:

- **Limit Overstory Removal in Areas with High or Extreme Erosion Hazard Ratings and Areas with Inadequate Understory Canopies.** CDF should limit overstory removal so that the forest canopy coverage following logging is at least 70% of the preharvest canopy coverage, including both the overstory and the understory. In areas with high or extreme EHRs, CDF should limit harvesting so that total forest canopy covers at least 60% of the harvest area following logging operations.

Implementing this mitigation measure would reduce this impact to a less-than-significant level.

Impact: Increased Surface Erosion from Diversion of Runoff from Natural Channels Caused by Road and Skid Trail Construction. Under this alternative, road and skid trail construction would increase approximately threefold relative to the No-Project Alternative. Compliance with the California Forest Practice Rules, however, in conjunction with implementing a forestwide inventory and risk evaluation of existing roads and skid trails; avoiding excavated skid trail construction on slopes exceeding 35%; and having an engineering geologist certify all road, skid trail, and landing locations, would ensure that this impact would be less than significant.

Mitigation: No mitigation is required.

Impact: Increased Erosion from Reduced Channel Capacities Associated with Construction of Stream Crossings. Under Alternative 3, this impact would be approximately the same as under the No-Action Alternative and would be less than significant.

Mitigation: No mitigation is required.

Impact: Increased Risk of Mass Movements from Harvesting or Construction of Roads, Skid Trails, or Landings in Unstable Areas. Timber harvesting and construction of roads, skid trails, and landings would increase approximately threefold under this alternative relative to the No-Project Alternative. This impact would be potentially significant. The following mitigation is required.

Mitigation:

- **Avoid Constructing Roads, Skid Trails, or Landings in Unstable Areas.** CDF should avoid constructing roads, skid trails, or landings in areas mapped as slides by Manson and Sowma-Bawcom (1992). Cable or helicopter yarding should be used in such areas to reduce the need for additional roads and skid trails.

- **Minimize Mass-Movement Risk in Unstable Areas by Retaining Vegetation.** To reduce the risk of mass movement caused by reduced transpiration rates and elimination of the soil-stabilizing capacity of tree roots, CDF should remove no more than 30% of the preharvest timber volume during harvest operations on areas mapped as slides by Manson and Sowma-Bawcom (1992). CDF should not harvest timber in areas mapped as inner gorges unless such harvesting is needed to reduce the threat of imminent landslide. Inner gorges are areas adjacent to streams with slopes exceeding 65% from the streambed uphill to the first break in slope.

Implementing these measures would reduce this impact to a less-than-significant level.

Water Quality

Impact Assessment Methodology

Water quality impacts resulting from implementation of the GFMP and its alternatives include increases in suspended sediments and turbidity associated with sedimentation and increases in water temperature resulting from increased solar radiation associated with removal of streamside shade. The assessment of changes in suspended sediments and turbidity was based on sediment delivery coefficients estimated by Cafferata and Poole (1993) for the East Branch watershed using the approach developed by Rice (1993).

In the absence of applicable sedimentation data for Soquel Creek, Cafferata and Poole used data collected for the nearby San Lorenzo River, which was found to be a satisfactory surrogate for the East Branch watershed. Based on the San Lorenzo River data, but taking into account the limited roadway system, timber harvesting, and residential development in the Soquel River basin relative to levels in the San Lorenzo River basin, the average sedimentation rate for the Soquel Creek basin was estimated to be 1.4 cubic yards per acre per year. Sediment delivery ratios (i.e., the fraction of eroded soil that is eventually discharged into surface waters) were estimated at 40% for road plots and 39% for harvest plots, rates that are substantially higher than for most forested watersheds. As with the erosion rates calculated for the East Branch watershed using Rice and Lewis's methodology, sediment delivery ratio estimates were strongly influenced by a few of the observations. (Cafferata and Poole 1993.) Using relatively large sediment delivery coefficients in the impact assessment ensures that water quality impacts are not underestimated.

Water temperature effects of forest management were assessed based on projected levels of removal of streamside vegetation.

Criteria for Determining Significant Impacts

Impacts of the proposed project and alternatives were considered significant if they would:

- result in violations or exceedances of state water quality standards or objectives or
- appreciably impair water quality relative to its quality under the No-Project Alternative.

Alternative 1: No-Project Alternative

Impact: Increased Suspended Sediments and Turbidity from Watershed Disturbances within SDSF. Under the No-Project Alternative, sedimentation of SDSF streams from watershed disturbances would be limited primarily by implementing the erosion control and streamcourse protection standards specified in the California Forest Practice Rules. Standards applicable to erosion control are discussed above under "Geology and Soils".

The principal mechanism prescribed by the California Forest Practice Rules to protect streamcourses and water quality is watercourse and lake protection zones (WLPZs), which are designated adjacent to streams in which vegetation removal and other disturbances are restricted. WLPZs for Class I streams (the East Branch, Amaya Creek, and Fern Gulch in SDSF) range from 75 feet to 150 feet wide (along each side of the stream), depending on the slope of adjacent land. WLPZ widths for other perennial streams are normally 50-100 feet, depending on slope class. Within WLPZs, timber operations must leave at least 75% of the ground surface covered and undisturbed. No heavy equipment may normally be used within WLPZs for harvesting or log yarding; any exceptions to this rule must be explained and justified in the THP.

Under the No-Project Alternative, sediment discharges to streams within SDSF are projected to average 5,000 cubic yards per year.

Impact: Increased Sediment Discharges from Mobilization of Unconsolidated Sediment Stores Caused by Concentrated Runoff. Large stores of unconsolidated, perched sediments are located near the mouths of several intermittent and ephemeral streams tributary to the East Branch and Amaya Creek. Other such stores are located midslope. Most of these stores probably resulted from steam-donkey yarding during the 1920s and 1930s. These deposits are susceptible to sliding during severe storms. Peak runoff rates in the affected streams have probably been substantially increased by alteration of natural drainage patterns, as discussed above under "Geology and Soils". Because of their proximity to Class I streams, mobilization of perched sediment stores is likely to result in large sediment discharges.

Impact: Increased Water Temperature from Removal of Streamside Vegetation. To avoid temperature-related water quality degradation, the California Forest Practice Rules specify forest canopy retention standards. For Class I streams, 50% of the overstory and 50% of the understory canopy in WLPZs must be retained in a well-distributed pattern following harvest operations. For other streams, 50% of the total canopy must be retained in a well-distributed, multistoried configuration.

Proposed Project

Under the proposed project, late-succession management areas would be designated within 300 feet of Class I streams. Within these areas, protection measures would be implemented that exceed the requirements of the California Forest Practice Rules. In particular, forest canopy would be managed to maintain at least 75% coverage; in areas where canopy coverage is less than 75%, no timber removals would be allowed. In addition, all woody riparian vegetation would normally be retained; exceptions would be allowed only to enhance riparian function (e.g., to replace existing vegetation with conifers).

As described in Chapter 2 under "Proposed Project", a forestwide inventory of areas where large volumes of sediments are being stored will be completed by December 31, 1997. Such sediment stores will be evaluated for their potential to be mobilized by high rates of runoff and discharged into streams, and for the potential cost-effectiveness of their removal or stabilization. Such removal and stabilization projects will be implemented in conjunction with future timber harvests as part of SDSF's watershed remediation program.

Impact: Increased Suspended Sediments and Turbidity from Watershed Disturbances within SDSF. Because the level of watershed disturbance would increase under the proposed project relative to the No-Action Alternative, annual sediment discharges within SDSF are projected to increase by approximately 1.4%. This increase is negligible relative to the natural year-to-year fluctuations in sediment discharges and, considering the limited accuracy of the landscape-level model used to estimate sedimentation, would not constitute a definitive increase in sediment discharges. This impact is less than significant.

Mitigation: No mitigation is required.

Impact: Increased Sediment Discharges from Mobilization of Unconsolidated Sediment Stores Caused by Concentrated Runoff. A principal objective of the watershed remediation program to be implemented under the proposed project is to identify and remediate sources of sediment at risk of being mobilized that could be removed or stabilized cost-effectively. Risks of sediment discharge from mobilization of unconsolidated sediment stores would thus decrease under the proposed project relative to the No-Project Alternative. This impact is less than significant.

Mitigation: No mitigation is required.

Impact: Increased Water Temperature from Removal of Streamside Vegetation. Because late-succession management areas would be designated under the proposed project, water temperature increases would be smaller under the proposed project than under the No-Action Alternative. This impact is less than significant.

Mitigation: No mitigation is required.

Alternative 2: Emphasize Watershed and Late-Succession Habitat Protection

Late-succession management areas established adjacent to Class I streams under the proposed project would also be established adjacent to Class II streams under this alternative.

Impact: Increased Suspended Sediments and Turbidity from Watershed Disturbances within SDSF. Watershed disturbances would increase under this alternative

Chapter 4. Fisheries

SOQUEL CREEK WATERSHED AND ITS FISHERIES

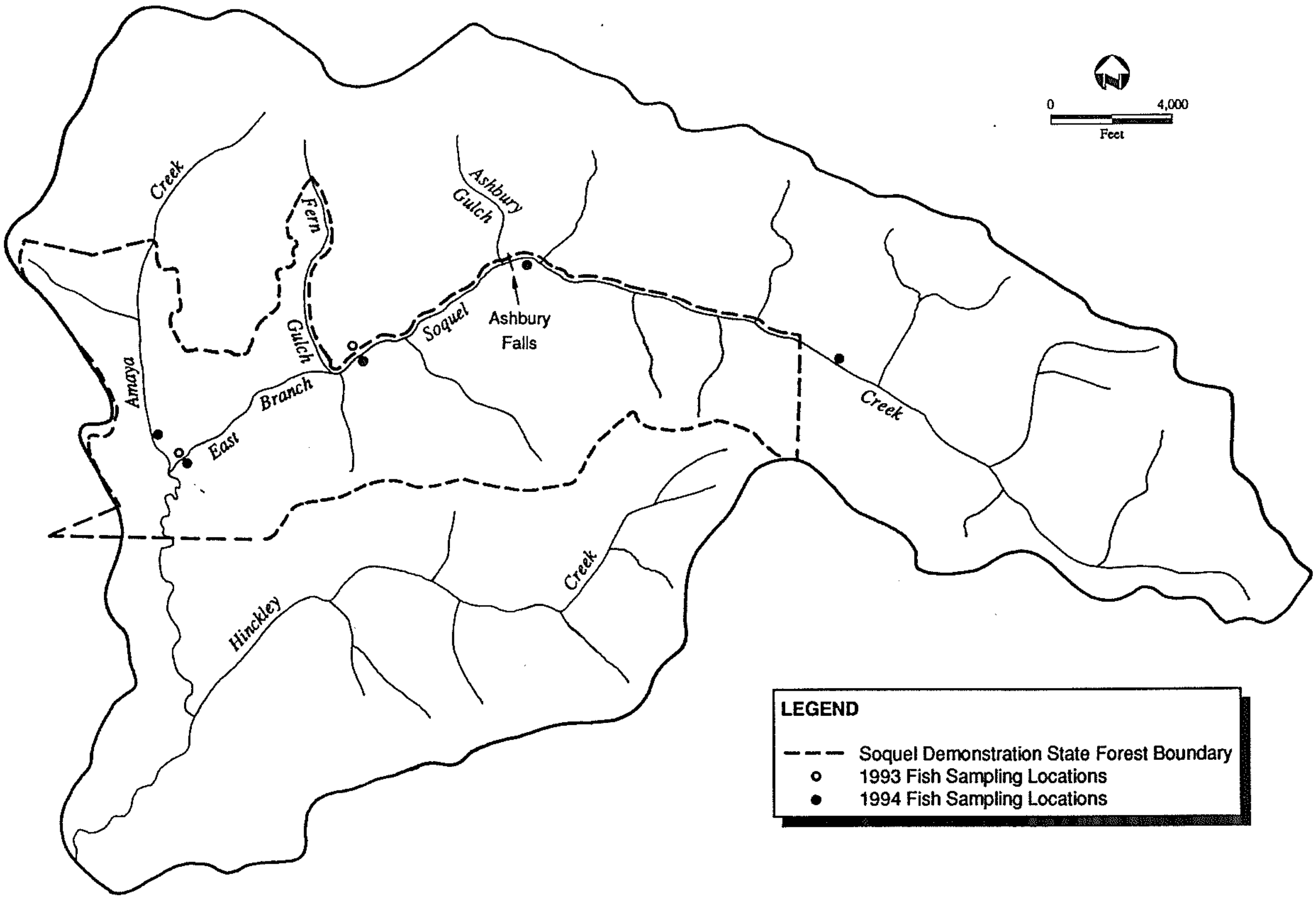
The Soquel Creek watershed comprises approximately 42 square miles (Cafferata and Poole 1993) and includes the West and East Branches of Soquel Creek and several other tributaries. Soquel Creek discharges into a coastal lagoon near Capitola.

The East Branch is approximately 12 miles long from its confluence with the West Branch to its headwaters; it drains approximately 13.5 square miles (Cafferata and Poole 1993) (Figure 4-1). Within SDSF, the East Branch flows for approximately 5.5 miles and drains approximately 4.2 square miles (Cafferata and Poole 1993). Sub-basins tributary to the East Branch are Amaya Creek (2.5 square miles), Fern Gulch (0.7 square mile), and Hinckley Creek (3.4 square miles) (Singer and Swanson 1983). Amaya Creek and Fern Gulch are the only major tributaries to the East Branch within SDSF and are approximately 2.5 and 2.0 miles long, respectively. The lower portion of Fern Gulch and the East Branch above Fern Gulch form SDSF's northern boundary.

Hinckley Creek, which joins the East Branch downstream (south) of SDSF, drains approximately 3.5 square miles. Hinckley Creek is approximately 4 miles long and is located almost entirely within the Forest of Nisene Marks State Park.

Because the East Branch, Amaya Creek, and Fern Gulch support sustained or seasonal fish populations and provide habitat for fish spawning and migration, they are designated Class I streams based on CDF's stream classification system. Resource protection measures required by the California Forest Practice Act (e.g., streamside zones in which logging practices are restricted) are most stringent for Class I streams.

Ten fish species are known to have occurred in the Soquel Creek basin. Two of these species, the anadromous coho salmon (*Oncorhynchus kisutch*) and steelhead trout (*Oncorhynchus mykiss*) (seagoing rainbow trout), are recreationally and economically important species in California. Coho salmon, however, have been largely, if not completely, eliminated from the drainage (D. W. Alley & Associates 1992). Soquel Creek was originally one of the most important steelhead spawning and rearing streams in Santa Cruz County (Titus et al. in prep.). Because coho salmon and steelhead trout populations have been declining throughout their range, the National Marine Fisheries Service (NMFS) is considering proposing them for listing under the federal Endangered Species Act. These species are discussed in greater detail below.



Jones & Stokes Associates, Inc.

Figure 4-1
Approximate Fish Sampling Locations on Amaya Creek and the East Branch

Native nongame fish species that occur in Soquel Creek and its tributaries are also important ecologically. They are the Sacramento sucker (*Catostomas occidentalis*), California roach (*Lavinia symmetricus*), coast range sculpin (*Cottus aleuticus*), prickly sculpin (*Cottus asper*), threespine stickleback (*Gasterosteus aculeatus*), and Pacific lamprey (*Lampetra tridentata*). Resident rainbow trout (*Oncorhynchus mykiss*) also occur within the drainage and are the only native game species found upstream of barriers to anadromous fish migration.

Soquel Lagoon provides spring and summer rearing habitat for steelhead trout, coho salmon, and Pacific staghorn sculpin (*Leptocottus armatus*). In addition, the lagoon provides habitat for tidewater goby (*Eucyclobius newberryi*) (D.W. Alley & Associates 1992). A state species of special concern, the tidewater goby is listed as endangered under the federal Endangered Species Act (Pine pers. comm.). This species is discussed in greater detail below.

Steelhead Trout

Distribution and Abundance

Juveniles. Steelhead trout is the most economically important and widespread fish species in the Soquel Creek basin. Although information on its distribution in the basin is not conclusive, steelhead trout probably occupy all of the major tributaries to Soquel Creek and most of its smaller ones, at least during prolonged wet periods. Steelhead trout use the East Branch as far upstream as Ashbury Falls for spawning, rearing, and migration. Resident rainbow trout occur in the East Branch upstream from Ashbury Falls.

The most definitive information on the distribution and abundance of juvenile and young-of-the-year (YOY) steelhead trout in the Soquel Creek basin is from a recent survey conducted by D.W. Alley and Associates (1994). Because this study replicated the methods of an earlier study (Harvey and Stanley Associates 1982), it provides a reasonable basis for describing the recent trend in trout densities. Results indicate that combined YOY and juvenile steelhead trout abundance has increased slightly (from 3.9 to 4.1 trout per 10 feet of stream length) since 1981. These results indicate that the Soquel Creek steelhead trout population has not declined over the past 13 years (D.W. Alley & Associates 1994).

The East Branch was originally the most productive steelhead trout fishery in the Soquel Creek basin. In surveys of the lower 7 miles of the East Branch conducted by DFG in 1959, average juvenile steelhead trout abundance was estimated at 3.2 fish per 10 feet of stream length, and spawning and rearing habitats were rated in excellent condition. In 1981, estimated juvenile steelhead trout densities at selected sites of the East Branch downstream of SDSF ranged from 2 to 13 fish per 10 feet of stream length (Harvey and Stanley Associates 1982).

Information on the distribution and abundance of juvenile steelhead trout within SDSF is limited to surveys conducted by CDF and DFG in September 1993 and October 1994.

Quantitative and qualitative information on fish populations was collected for the East Branch at several locations within and upstream of SDSF and on Amaya Creek (Figure 4-1). Sampling results indicate that the combined density of YOY and juvenile steelhead trout downstream of Ashbury Falls averaged 12.1 fish per 10 feet of stream length in 1993 and 4.8 fish per 10 feet in 1994 (California Department of Forestry and Fire Protection 1994a).

Although trout densities were apparently lower in 1994 than in 1993, numbers per unit length of stream on the East Branch within SDSF appear consistent with those found in other reaches of Soquel Creek during the same period. Although juvenile steelhead trout abundance appears to be stable, the Soquel Creek basin could support steelhead trout and salmon populations as much as four times their current levels (Singer and Swanson 1983).

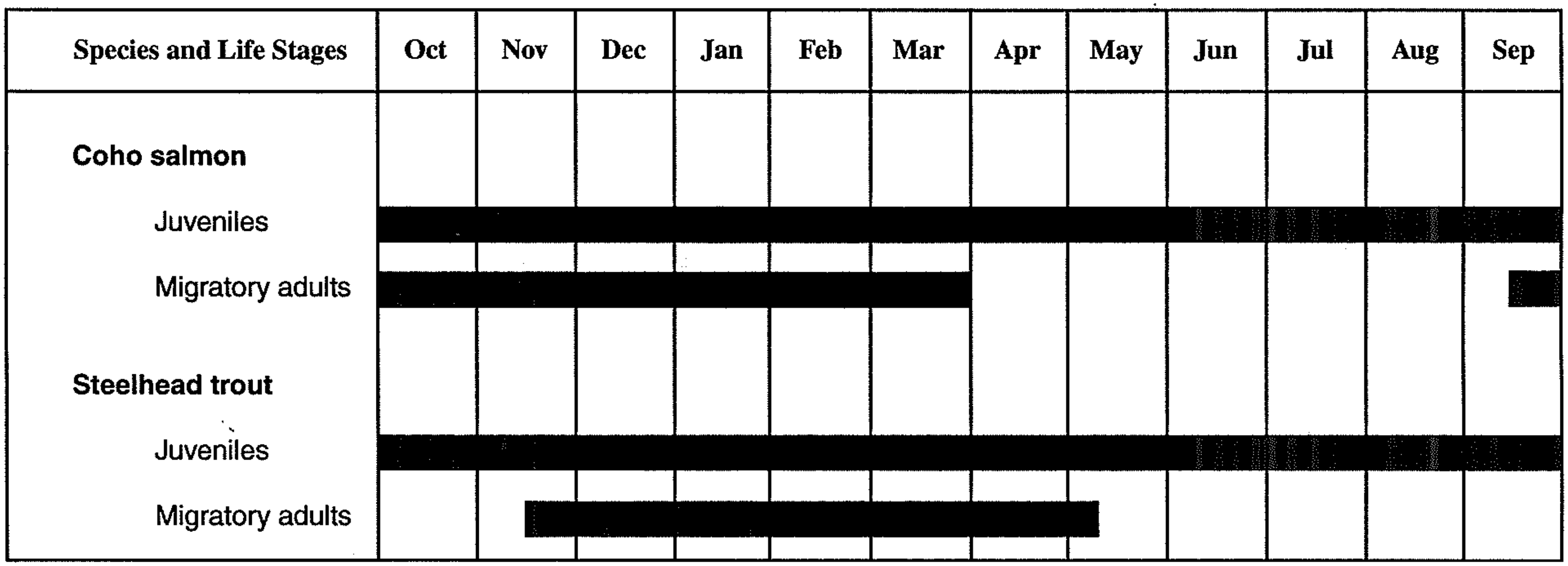
In 1957, DFG described Amaya Creek as a mostly pristine spawning and nursery stream for steelhead trout. Juvenile steelhead trout were common throughout the lower mile of the stream, and local residents reported that adults were observed migrating up Amaya Creek as far as the Stetson-Longridge Road crossing. Two years later, however, a DFG stream survey determined that Amaya Creek was severely degraded, presumably as a result of severe storms and past logging practices in the watershed. By 1959, spawning habitats in the upper two-thirds of the stream had been eliminated or degraded by siltation, and logging debris formed many migrational barriers. (Titus et al. in prep.)

Surveys conducted following the heavy storms of 1982 indicated that only the lower 0.25 mile of stream was accessible to anadromous fish and that few juvenile steelhead trout occupied Amaya Creek near its confluence with the East Branch. (Titus et al. in prep.) A large logjam that is a potential barrier to migrating trout is located on Amaya Creek approximately 1,900 feet upstream of the confluence with the East Branch. Based on surveys conducted in 1994, juvenile trout density in Amaya Creek averages 0.4 trout per 10 feet of stream length (California Department of Forestry and Fire Protection 1994a).

Adults. In 1962, adult steelhead trout were estimated at between 500 and 1,000 spawning pairs based on juvenile abundance estimates (Titus et al. in prep.). D.W. Alley & Associates (1994) has developed a model that predicts the number of returning adults based on existing juvenile densities and size classes. Estimates taken from this model indicate that approximately 422 returning adults will eventually return to Soquel basin streams, based on juvenile surveys for all of the reaches conducted in 1994. This number of adults represents an 84% increase over the number predicted to return based on 1981 juvenile surveys. (D.W. Alley & Associates 1994.)

Life History

Adult steelhead trout leave the ocean to migrate up Soquel Creek on high streamflows from early November through early May, but principally from late December through late April (Figure 4-2). Spawning probably peaks from January through March. Adults spawn in shallow redds (nests) constructed in relatively clean, loose gravels that are typically located in the tails



Source: Shapovalov and Taft 1954.

Jones & Stokes Associates, Inc.

Figure 4-2
Approximate Temporal Occurrence of Coho Salmon and Steelhead Trout in Soquel Creek

of pools and at the heads of riffles because of water depth and velocity interactions. Unlike all Pacific salmon, which die after spawning, adult steelhead usually return to the ocean within a few months of spawning. Some of these adults survive one or more seasons in the ocean to spawn again (Shapovalov and Taft 1954.)

The eggs incubate and hatch within 19-80 days, with an average of 30 days. Recently hatched fish remain in the gravel for 4-6 weeks and then live in the natal stream, feeding primarily on insects, for as long as 4 years. Most juveniles spend 1-3 years in fresh water before migrating to the ocean; some of these may remain in fresh water, however, where they mature and spawn without ever entering the ocean. Because juveniles require 1-3 years of freshwater rearing before migrating, suitable conditions for steelhead trout must be maintained year round. Juveniles emigrate to the ocean as smolts (juveniles that have undergone the physical and physiological changes necessary for living in saltwater) typically between April and June and live there for 1-3 years before returning to the natal stream to spawn. (Shapovalov and Taft 1954.)

Habitat Requirements and Limiting Factors

Juvenile steelhead trout require adequate cover, residual pool depths, and food supply and water temperatures of 43-65°F. Although steelhead primarily occupy riffles, pool habitat with adequate water depth and escape cover is required during the summer low-flow period and during extended periods of drought. Deep pool habitat and suitable spawning gravels at SDSF have been reduced by sedimentation, which has increased in response to watershed disturbance. Instream woody debris, which provides escape cover for juveniles, is insufficient in some stream reaches. Summer rearing conditions are probably more restrictive for Soquel Creek's steelhead trout population than winter migrating and spawning conditions because of the increased competition for limited food and living space and the warmer water temperatures that occur in summer.

The effects of natural limiting factors on rearing juveniles are often magnified by the effects of human activities such as water diversions for municipal and agricultural purposes. Diversions further reduce streamflows, which can cause additional increases in water temperatures in the affected reaches.

Coho Salmon

Distribution and Abundance

Coho salmon were historically far less abundant than steelhead trout in the Soquel Creek basin, with spawning runs averaging 100-200 adults. Coho salmon were common in the 1950s and early 1960s, however, when DFG supplemented native stocks with hatchery fish (D.W. Alley & Associates 1992). Although adults may still enter Soquel Creek, no confirmed sightings have occurred in recent years, indicating that they may have been extirpated within the Soquel Creek basin (D.W. Alley & Associates 1992). Coho salmon populations have been declining throughout California and the Pacific Northwest, prompting DFG to classify the California coho salmon as a species of special concern.

Life History

In general, the life history of coho salmon in Soquel Creek is similar to that of steelhead trout, with several important distinctions. Coho salmon migration and spawning can occur from September through March, but primarily takes place between November and January (Figure 4-2) after the sand bar at the mouth of the creek has been removed by high streamflows or heavy equipment. Unlike steelhead trout, all adult coho salmon die after spawning. In contrast to steelhead, juvenile coho salmon spend more time in pools than in riffles. Smolts emigrate to the ocean, usually during April and May, after spending 1 year in the natal stream. They remain in the ocean for 1-3 years before returning to spawn. (Shapovalov and Taft 1954.)

Habitat Requirements and Limiting Factors

Although there are important distinctions between coho salmon and steelhead trout, their habitat requirements are similar (i.e., they require cool streams containing relatively clean gravels, abundant forage, and cover). Coho salmon production is primarily limited by high summer water temperatures and reduced streamflows; reduced summer habitat quality, especially pool filling; and predation. Erosion and sedimentation limit salmon production in the East Branch. Unlike steelhead trout, coho salmon are harvested while in the ocean by commercial and sport anglers.

Resident (Nonanadromous) Rainbow Trout

Resident rainbow trout occur in the East Branch upstream from Ashbury Falls, the upstream limit of anadromous fish migration. These resident trout can reach 10 inches in length (California Department of Forestry and Fire Protection 1994a). Rainbow trout life history and habitat requirements are similar to those of steelhead trout, except that juveniles do not emigrate to the ocean and spend their entire lives in fresh water.

Tidewater Goby

Soquel Creek lagoon provides habitat for tidewater goby. This species is endemic to California and inhabits shallow lagoons and lower reaches of coastal streams from San Diego County to Del Norte County. The tidewater goby can tolerate a wide range of salinity, from fresh water to saltwater, and water temperatures as high as 73°F. It is short-lived (approximately 1 year) and typically requires shallow water, low water velocities, high dissolved oxygen levels, sand and mud substrates, and emergent and submergent vegetation. (Moyle et al. 1989.)

Although the species is widely distributed, tidewater goby populations appear to be declining. Habitat degradation, coupled with the effects of the recent drought and the species' short life span, has contributed to its decline throughout its range. This decline has prompted DFG to designate the tidewater goby as a species of special concern and the U.S. Fish and Wildlife Service to list the species as endangered.

AMPHIBIANS AND AQUATIC INVERTEBRATES

Soquel Creek and tributaries provide habitat for pond turtles and various sensitive amphibian species, including foothill yellow-legged frog, Pacific chorus frog (formerly called Pacific tree frog), Pacific giant salamander, and California newt. Additional information on these species is presented in Chapter 5, "Vegetation and Wildlife". Aquatic invertebrates, including insects and crayfish, are also important ecologically. Aquatic insects are an important food source for fish. Because of aquatic invertebrates' intolerance for degraded habitat conditions, they are often good indicators of overall stream habitat quality.

AQUATIC HABITATS AT SOQUEL DEMONSTRATION STATE FOREST

The diversity and abundance of fish supported by a water body are largely determined by its habitat. Habitat parameters can help determine which ecological conditions are limiting in specified environments and identify habitat improvement techniques that may be beneficial (Orth 1983). Habitat parameters are also used to assess the impacts of habitat alterations. Important aquatic habitat parameters are streamflow, channel morphology and condition, habitat type, vegetative canopy, water temperature, turbidity and sedimentation, substrate composition and quality, and fish passage potential. These parameters are discussed below.

Seasonal Hydrology and Streamflow

Like most of California's coastal streams, Soquel Creek has highly variable flows. Flows during the wet period (November-March) are typically several hundred (and occasionally several thousand) times greater than dry-period (June-October) flows. Peak flows have resulted in damaging floods in downstream areas, including the village of Soquel.

Because the fish species in Soquel Creek are always present in some life form (i.e., as adults, juveniles, or eggs), adequate streamflows are needed year round for their survival. Fish populations, especially steelhead trout and coho salmon, are often limited when low flows reduce habitat availability and quality and increase their vulnerability to the effects of competition, predation, and disease. Adequate wet-period flows are also needed to provide suitable water depths and velocities for adult migration and spawning, smolt migration, and egg incubation.

Excessive water diversions reportedly have been responsible for reducing, and at times eliminating, streamflow on the East Branch and Soquel Creek (Cafferata and Poole 1993). Fish kills resulting from stream dewatering, presumably because of water diversions and overdrafting of groundwater, have been documented in the recent past. Water diversions occurring downstream of SDSF do not have an effect on streamflows (or habitat conditions) at SDSF; however, downstream diversions likely affect survival rates of emigrating juveniles and smolts, which may have a direct effect on the number of returning adults. Water diversion upstream of SDSF have the potential to affect streamflows and habitat conditions at SDSF, although no information is available on these diversions and their potential effects on the SDSF fishery.

Channel Morphology and Condition

Cafferata and Poole (1993) assessed stream channel conditions along the entire length of the East Branch and most of Amaya Creek within SDSF using methods similar to those developed by Pfankuch (1978). In general, higher average ratings indicate poorer channel stability and overall condition (Table 4-1). Rating scores for channel stability ranged from 87 (high-fair) to 137 (medium-poor).

East Branch of Soquel Creek

Cafferata and Poole (1993) divided the East Branch at SDSF into two reaches. Reach EB-b includes 2.2 stream miles from Ashbury Falls to SDSF's eastern boundary and is characterized by a relatively steep (7% average) gradient and a deeply incised and unstable channel. Landslides, bank failures, and log jams are common in this reach. Channel stability in this reach is rated as high-poor (125).

Reach EB-c extends for 3.3 miles from SDSF's southern boundary to Ashbury Falls. This reach flows through an alluvial valley with a wide, vegetated floodplain. Bank erosion is less common in this reach than in the upstream reach; although channel stability is rated as low-fair (105), it is higher for this reach than for most other reaches at SDSF.

Overall, East Branch channel conditions are rated as fair to poor with severe bank erosion and extensive occurrences of mass movements of bank sediments into the channel (Singer and Swanson 1983).

Table 4-1. Summary of Pfankuch's Stream Stability Rating System

Overall Condition	Score
Excellent	<38
Good	39-76
Fair	77-114
Poor	>114

Source: Pfankuch 1978.

Amaya Creek

Amaya Creek flows through a relatively steep (average gradient 4%), unstable, V-shaped canyon. The stream channel stability is rated as medium-poor (135). Channel attributes of particular concern are embeddedness, bank cutting, pool filling, bank mass wasting, and debris jamming (Cafferata and Poole 1993). Singer and Swanson (1983) rated this channel as having the poorest quality in the East Branch watershed.

Habitat Types

Information on existing stream habitat types of the East Branch and Amaya Creek is based on stream surveys conducted by California Polytechnic State University (CPSU) for CDF in 1994; results of this inventory are summarized in Appendix B. Surveys consisted of delineating habitat units; identifying habitat types (e.g., pool, riffle, or run); measuring the dimensions of habitat units; and measuring cover, riparian canopy, substrate composition, and other parameters.

East Branch of Soquel Creek

The entire portion of the East Branch within SDSF (5.61 miles) was surveyed in 1994. Low-gradient riffles are the most widespread habitat type, followed by runs, step-runs, main channel pools, high-gradient riffles, step-pools, and other pools (Table B-1 in Appendix B). Optimal conditions for rearing salmonids occur when the pool:riffle ratio is approximately 1:1 (Raleigh et al. 1984). The pool:riffle ratio in the East Branch averages 0.94:1, indicating that the linear extent of pools may not be an important limitation on fish habitat in the East Branch. The relationships between pool volume and depth and habitat quality are discussed below under "Residual Pool Depth and Volume".

Amaya Creek

The most extensive habitat type in the lower 1.5 miles of Amaya Creek is low-gradient riffles, followed by main channel pools, step-runs, runs, and other pools (Table B-2 in Appendix B). As indicated by a pool:riffle ratio of 0.57:1, the unavailability of pools is an important constraint on salmonid rearing opportunities in Amaya Creek.

Riparian Vegetation

Riparian vegetation enhances bank stability; provides fish with cover from predators; provides shade, which is important in moderating stream temperatures; contributes organic material to streams, which is important for aquatic insects (an important food source for fish); and is an important source of large, woody debris. Along with undercut banks and submerged vegetation, streamside vegetation is an important component of shaded riverine aquatic cover, which is a key determinant of fish habitat quality.

Riparian tree species at SDSF are sycamore, alder, cottonwood, and willow. Other tree species that grow adjacent to streams in the forest are coast redwood, Douglas-fir, tanoak, and madrone (Singer and Swanson 1983). Conifers are an important element of streamside vegetation because of their characteristic large size and resistance to decay as large, woody debris. More than 75% of the riparian vegetation at SDSF consists of deciduous trees, however (California Department of Forestry and Fire Protection 1994a).

Vegetative shading helps maintain water temperatures suitable for all fish life stages. Optimal conditions for trout occur when riparian canopy cover is in the range of 50-75% (Raleigh et al. 1984). Shade canopies approaching 75% coverage are probably more important on the East Branch than on more northern streams, where ambient water temperatures are naturally cooler. Canopy cover ranges from 70% to 85% on the East Branch and averages 76% on Amaya Creek (California Department of Forestry and Fire Protection 1994a). Canopy cover by habitat type is presented in Tables B-1 and B-2 of Appendix B for the East Branch and Amaya Creek, respectively.

Water Temperature

Fish and most other aquatic organisms typically have narrow temperature ranges suitable for their growth and survival; optimal temperature ranges often vary by life stage for a species. Although rainbow trout have been known to survive water temperatures as high as 77°F, summer maximum water temperatures lower than 65°F are optimal for rearing steelhead trout (Raleigh et al. 1984). In contrast, optimal summer water temperatures for coho salmon range from 50°F to 59°F (Laufle et al. 1986). Water temperatures during a 3-week period in July 1994 (a critically dry year) ranged from 54°F-66.5°F on the East Branch and Amaya Creek (California Department of Forestry and Fire Protection 1994a). The paucity of water temperature data on SDSF streams makes it difficult to determine whether water temperature limits fish populations in all years. Other critical times when water temperatures are important are the spawning and egg incubation periods and the smolting period in early spring.

Stream shading is likely the predominant factor affecting water temperatures on the East Branch and tributaries. Based on the observed riparian canopy densities during field surveys, water temperatures at SDSF appear to be related to factors other than SDSF stream shade values (e.g., upstream water temperatures).

Turbidity and Sedimentation

Turbidity resulting from the suspension of sediments in water reduces production of algae and aquatic plants and the visibility of organisms eaten by fish. Reduced plant production can result in decreased dissolved oxygen levels and diminished food and cover for fish and aquatic insects. High concentrations of suspended sediments can also clog respiratory structures of aquatic organisms. Turbidity also reduces the desirability of water for other beneficial uses, such as domestic, industrial, and recreational uses. High turbidity levels are often associated with high streamflows and associated increases in bank erosion and sediment delivery from disturbed upland areas.

As sediments settle, they can reduce the quality of gravels below that needed for successful steelhead trout and salmon spawning, egg incubation, and larval fish and insect survival.

The East Branch and its tributaries are naturally more turbid during winter, when runoff is high, than during summer. As discussed in Chapter 3, "Geology, Soils, and Water Quality", average turbidity levels at SDSF are probably higher now than during prehistoric times because watershed disturbances such as early log yarding, road construction, and conversion of forest land to agricultural and residential uses have increased surface instability, erosion, and sediment storage in channels.

Residual Pool Depth and Volume

Pools provide adult fish with resting and staging areas during migration, and refuge from high stream velocities during peak flows. Pools also provide refuge for juvenile fish during low-flow periods. Pool habitat quality declines as pools fill with sediment. A technique commonly used to enhance stream pool formation and pool quality is introducing woody debris, boulders, or artificial structures. (Lisle 1987.)

Because the number, depth, and volume of pools and the amount of escape cover within pools often determine the productivity of streams for fish, measures of pool habitat parameters such as average pool depth are often useful indicators of stream productivity. Salmonid abundance (or biomass) has been observed to be directly related to pool size, and abundance often declines when the pool volume and the surface area of water deeper than 1 foot are reduced (Bjornn and Reiser 1991). Pools with average depths exceeding 18 inches are considered more productive than pools with shallower average depths (D.W. Alley & Associates 1992). Based on recent stream surveys, average pool depths (i.e., pool volume divided by pool area) range from 0.66 foot to 2.9 feet on the East Branch and from 0.69 foot to 1.35 feet on Amaya Creek (Tables B-1 and B-2) (California Department of Forestry and Fire Protection 1994a).

Because summer flows are greatly reduced in coastal California streams, residual pool volumes and depths are also important determinants of a stream's carrying capacity. Residual pool volume (or depth) is the volume (depth) of water that fills the pool depression just to the height of the downstream riffle crest. Because residual pool volume and depth can be measured regardless of stream discharge level, these measurements enable direct comparisons between streams and stream reaches and across seasons and water-year types.

The relative number of pool habitats by type and residual depth for Amaya Creek and the East Branch are summarized in Tables B-3 and B-4 of Appendix B, respectively. These data suggest that pool depth may limit fish production in Amaya Creek, where 75% of the pools have residual depths of less than 18 inches (Tables B-3 and B-4). Pool depth is less likely to be a limiting factor for fish in the East Branch, however, where 68% of the pools have residual depths that exceed 18 inches; other physical or environmental factors (e.g., instream cover or food production) may have a greater influence on juvenile steelhead trout abundance in the East Branch than average pool depth.

Substrate

Substrates composed of gravel and cobbles ranging from 0.6 inch to 4.0 inches in diameter and composed of less than 5% fine sediments are required for successful steelhead trout spawning and egg incubation (Raleigh et al. 1984). Cobbles and gravel make up approximately 70% of the substrate material in the East Branch; smaller amounts of substrate are accounted for by small boulders, sands, and fines (Cafferata and Poole 1983). Gravel and sand are the predominant substrate materials in Amaya Creek (California Department of Forestry and Fire Protection 1994a). Tables B-5 and B-6 in Appendix B provide summaries of dominant substrates by habitat type for the East Branch and Amaya Creek, respectively.

As the proportion of fine sediments (particles less than 0.1 inch in diameter) increases in substrates consisting predominantly of gravels, their suitability for salmonid spawning decreases. Conditions for steelhead trout spawning are optimal when fine sediments account for less than 6% of substrate volume; when fine sediments exceed 30% of substrate volume, survival rates for embryos and emerging fry are low (Raleigh et al. 1984). Fine sediments make up an average of 11% of the surface substrate volume in the East Branch and are most predominant in stable pools downstream from Ashbury Falls; the percentage of fine sediments in the substrate is likely to be an even greater portion of the total volume (Cafferata and Poole 1993). Overall substrate quality in East Branch pools and riffles has declined relative to predisturbance levels as a result of sedimentation (Singer and Swanson 1983).

As well as affecting spawning and egg survival, fine sediments deposited on the stream bottom or in suspension can reduce insect production and abundance, thereby reducing the availability of food for fish (Hicks et al. 1991). Conditions for insect production in trout streams are usually optimal when the proportion of fine sediments is 10% or less (Raleigh et al. 1984).

Embeddedness is an index of the degree to which boulders and large cobbles are surrounded or covered by finer sediments; high sedimentation rates often lead to increased embeddedness. As embeddedness increases, the ability of the substrate to sustain life (its biotic potential) decreases. At SDSF, gravel embeddedness is greatest in Amaya Creek, followed by the East Branch upstream from Ashbury Falls and the East Branch downstream from the falls (Cafferata and Poole 1993, California Department of Forestry and Fire Protection 1994a).

Barriers to Migration

East Branch of Soquel Creek and Tributaries

Salmonid migration in the East Branch has always been limited by barriers. Shallow water, cascades, falls, and log jams can prevent adult trout and salmon from migrating into its upper reaches and tributaries. Migration barriers can be compounded by human activities. For instance, water diversions from Soquel Creek have increased the frequency and duration of low flows, which may limit passage opportunities for adult migrants through shallow riffles. Stream dewatering from water diversions has been documented on Soquel Creek as recently as 1991 and 1992. Although these events have not directly affected fish populations or aquatic habitats at SDSF because they occurred downstream of SDSF, they can indirectly affect fish populations by reducing passage opportunities for migrating juveniles and smolts; can reduce the availability and quality of rearing habitat; and can increase fish motality for individuals stranded during dewatering events. Ashbury Falls is the East Branch's upstream limit of migration for anadromous fish.

Log jams resulting from landslides are an example of barriers related to watershed disturbance. Although log jams and woody debris are important elements of fish habitat, large debris jams can block fish migration. Such conditions also increase the risk of flooding. The large jams that formed at the village of Soquel and elsewhere during a 1982 flood resulted from runoff on debris-littered slopes that transported trees into the channel (Singer and Swanson 1983). Large debris jams that could block fish migration on the East Branch and Amaya Creek have been documented (Jordan 1986, California Department of Forestry and Fire Protection 1994a). A recent survey of SDSF streams determined that log jams prohibit fish access to upstream areas of Amaya Creek (Cafferata and Poole 1993). No barrier-forming log jams were reported on the East Branch between the confluence of Amaya Creek and Ashbury Falls during stream surveys conducted in 1994 by CPSU. Fish passage could be improved by selective removal of debris jams at and outside of SDSF.

Soquel Creek Lagoon

Shoals and sand bars usually block the mouth of Soquel Creek to passage of fish and other aquatic animals during late summer and fall; during droughts, such blockages can persist throughout the year. Blockage of the mouth during fall probably delays spawning migrations by salmon and steelhead trout; blockages during late spring and summer may impede emigration of smolts.

Natural outflows from the lagoon occur when the elevation of the lagoon water surface exceeds the elevation of the outfall. A concrete outfall in the lagoon drains water through the beach mound to the ocean during low-flow periods. Fish passage is improved when lagoon water levels are adequate or when winter stormflows clear sand from the channel.

IMPACTS AND MITIGATION MEASURES

Impact Assessment Methodology

Soil erosion and resulting sedimentation of stream channels related to proposed timber harvest operations are the primary sources of potential impacts on fishery resources from implementing the GFMP. Consequently, the fisheries impact assessment is highly dependent on the results of the erosion and sedimentation modeling discussed in Chapter 3, "Geology, Soils, and Water Quality".

The impact assessment approach used in this chapter began with a review of the scientific literature regarding habitat requirements of key species. These habitat requirements were then analyzed in relation to the stream sedimentation results to assess and compare the impacts of the proposed project and the alternatives. Because data on past and present fishery resources and habitat conditions are limited, absolute changes in fish populations were not measured. Instead, the assessment focused on qualitatively evaluating fish habitat changes expected to result under the proposed project and the alternatives.

Criteria for Determining Significant Impacts

Populations of fish and other aquatic organisms may be affected by changes in habitat availability and suitability that alter species survival, growth, migration, or reproduction. Impacts on fish populations were considered significant when proposed actions would cause or contribute to substantial short- or long-term reductions in fish abundance and distribution. According to Appendix G of the State CEQA Guidelines, a project will normally have a significant impact if it would:

- substantially affect a rare or endangered species or the habitat of that species,
- interfere substantially with the movement of any resident or migratory fish species, or

- substantially diminish fish habitat.

In addition to these criteria, effects were found to be significant if the proposed project or alternative would (either alone or in conjunction with past, present, and future actions):

- cause fish populations to decline below self-sustaining levels or

- result in direct mortality, permanent or temporary habitat loss, or habitat avoidance leading to increased mortality or lowered reproductive success for individuals of important species (i.e., state-listed or federally listed threatened or endangered fish species, state or federal candidates for listing, state-designated species of special concern, federally designated sensitive species, or game species).

Finally, any appreciable net increase in soil erosion resulting from proposed ground-disturbing actions was also considered significant because of the potential for increased sedimentation of aquatic habitats.

Alternative 1: No-Project Alternative

Impacts from Timber Management Activities

Impact: Increased Potential for Sedimentation of Aquatic Habitats from Increased Erosion Associated with Timber Harvesting and Related Activities. Timber harvesting and related activities (e.g., road construction, tree felling, or log yarding) resulting in ground disturbance can increase surface erosion rates and mass wasting risks (Hicks et al. 1991). Specific mechanisms that can lead to increases in erosion are discussed in greater detail in Chapter 3, "Geology, Soils, and Water Quality".

Sediments entering watercourses, whether they settle or remain suspended, can damage aquatic habitats and reduce fish production, growth, and survival in downstream reaches. Fine sediments deposited in gravels can lower spawning success by reducing egg survival and trapping emerging fry, or reduce the availability of food in streams by limiting primary production and reducing invertebrate abundance. Fine sediments that remain in suspension can increase turbidity, which can increase fish mortality, reduce feeding opportunities for sight-feeding fish (including rearing steelhead trout and coho salmon), and lower fish production by causing fish to avoid biologically important habitat or by delaying migration to upstream spawning habitats.

Coarse sediments can alter the channel bed, channel geometry, and bank erosion rate. Stream reaches that become aggraded (i.e., accumulate bed materials) with coarse sediments typically become wider and shallower, with more riffle habitat area and less pool habitat area, volume, and depth (Hicks et al. 1991). Steelhead trout and coho salmon abundance correlate positively with pool area, volume, and depth.

Compliance with the California Forest Practice Rules would provide substantial protection for aquatic habitats at SDSF. For example, establishing WLPZs would reduce damage to aquatic habitats and promote healthy fish populations (Hicks et al. 1991). Additional resource protection measures proposed in the GFMP, in conjunction with site-specific mitigation measures to avoid or reduce adverse watershed impacts discussed in Chapter 3, could be implemented to ensure maximum resource protection.

Impact: Changes in Water Temperature and Primary Production Caused by Reductions in Stream Shading. Reductions in stream shading from the removal of streamside vegetation can noticeably affect instream water temperatures and photosynthetic rates. Because these effects can be either beneficial or adverse for fish populations, their fishery impacts may be difficult to predict (Hicks et al. 1991). Stream shading of 50-75% is considered optimal for salmonid streams (Raleigh et al. 1984).

Removal of streamside vegetation can lead to increased solar insolation (heating of water by sunlight) and instream water temperatures. Substantial increases in average temperatures or daily fluctuations in temperatures can be detrimental to steelhead trout and coho salmon, particularly if water temperatures approach or exceed the species' limits. For instance, warm temperatures may reduce juvenile growth and survival, inhibit upstream migration of adults, increase susceptibility of fish to disease, reduce metabolic efficiency, or alter species interactions (Hicks et al. 1991).

Increased solar insolation typically results in higher photosynthetic rates in aquatic habitats. Such increases can benefit fish populations with limited food supplies by causing an increase in the abundance of aquatic invertebrates, an important food source for juvenile steelhead trout and coho salmon. The benefits of increased food supply may be offset, however, by the adverse effects of warmer water discussed above.

The impacts of removing streamside vegetation on water temperature and primary productivity would be avoided under the No-Project Alternative because existing stream shading would be maintained under The Nature Conservancy's management plan, which would prohibit timber harvesting within 150 feet of Class I streams, springs, or sag ponds.

Impact: Reduced Recruitment of Large, Woody Debris. Timber management activities can reduce the source of woody material for streams, resulting in deficient amounts of large, stable woody debris in channels. Large, woody debris has an important influence on stream morphology by affecting the storing and routing of sediments used by spawning fish and the creation and maintenance of fish habitat (Hicks et al. 1991). Reduced recruitment of woody debris to the channel would decrease habitat complexity, the number and volume of pool habitats, the amount and quality of cover, and the capacity of streams to store high-quality sediments. The abundance of juvenile steelhead trout and coho salmon often correlates directly with the abundance of large, woody debris.

Concentrations of woody material in log jams can impair fish passage and reduce the capacity of channels to carry floodflows. Such flow constrictions can increase bank erosion, accelerating the lateral movement of the stream channels and contributing large volumes of sediment directly to the channel, which can reduce the availability and suitability of fish habitat.

The California Forest Practice Rules limit harvest operations within WLPZs to avoid impacts on water quality. They require retaining at least two living conifers per acre at least 16 inches dbh and 50 feet tall within 50 feet of all Class I and II watercourses. Under the No-Project Alternative, no timber harvesting would occur within 150 feet of Class I streams, springs, or sag ponds to avoid disturbing these resources.

Impact: Reduced Availability or Suitability of Fish Habitat from Changes in the Timing or Magnitude of Streamflows. Timber harvesting and related operations can affect streamflows by altering the water balance or by affecting the rate at which water moves from upland areas to stream channels (Hicks et al. 1991). Heavy equipment used for road building and log yarding can reduce water infiltration capacities of the soil and increase surface runoff, causing higher peak flows and increased sediment transport in stream channels, particularly if water discharges to the channel are synchronous. Changes in peak streamflows can also occur from roads and other areas of high soil compaction (e.g., skid trails and landings) that reroute surface runoff (Hicks et al. 1991). Substantial increases in peak flows can reduce the availability and suitability of fish habitat by causing increases in bank erosion, changes in channel geometry, changes in habitat complexity, instream cover values, and substrate quality.

Reductions in vegetative cover associated with timber harvesting can also influence the magnitude of streamflows. Harvesting reduces the vegetative transpiration rate, thus increasing the moisture content of the soil and runoff rates during storms. As a result, the rate of stormwater discharge to channels may increase, although the relative effect of land use on streamflows probably decreases with increasing streamflows caused by rare storms. Such increases in streamflow usually persist only until new root systems become established through regeneration. This effect is typically reduced in redwood forests, where tree roots usually survive harvesting.

Effects on streamflow typically increase in proportion to the portion of trees removed (Hicks et al. 1991). Although increases in soil moisture can benefit fish if summer and fall flows are increased, moist soils on logged hillsides can increase the risk of mass movements (Hicks et al. 1991).

As discussed in Chapter 3, a major focus of the California Forest Practice Rules is to avoid or reduce the potential for concentrating and diverting runoff, soil erosion and compaction, and the risk of mass movements.

Impacts from Resource Enhancement Activities

Impact: Increased Channel Scour and Reduced Sediment Delivery to Stream Channels. Installation of structures to promote channel scour, in combination with watershed remediation efforts such as road abandonment and landslide stabilization, can benefit fish by improving water quality and the availability and suitability of instream habitats.

Sediment source reduction can benefit fish by reducing the amount of sediment delivered to streams. Structures installed at selected sites to increase channel scour can also benefit fish populations by increasing pool volume and depth. Pools with greater volume and depth offer improved rearing conditions associated with increased habitat complexity, cover (which typically increases with depth), and living space, compared to pools with reduced volumes and depths.

Under the No-Project Alternative, resource enhancement opportunities would be dependent on revenue generated from timber harvesting. Based on the low timber harvesting levels proposed under this alternative, little funding would be available for fish habitat improvements.

Impacts from Public Use and Recreation

Impact: Potential for Direct and Indirect Effects on Fish Populations Related to Recreational Use on SDSF Lands. Under the No-Project Alternative, public visitation would gradually increase as a result of growing awareness of recreation opportunities at SDSF and because of development of facilities, including additional points of access, trails, and picnic areas. Indirect effects of increased public visitation on fish populations and fish habitat could be adverse. The effects of public visitation on fish and fish habitat depend on the intensity (amount of disruption per unit area of stream) and extensiveness (proportion of stream that is affected) of the impact. Because flowing water tends to attract and concentrate visitors, streams in public forest reserves are often subjected to intensive and extensive disruptions.

Some activities people engage in (e.g., discharging gray water to streams) are more disruptive to fish habitat than others. Clark and Gibbons (1991) report that recreational use can affect steelhead trout and salmon habitats in the following ways:

- riparian vegetation disturbances can influence erosion, cover, food sources, and water quality;
- instream disturbances can affect stream morphology, water quality, streamflow, substrate, and debris; and
- upland disturbances in soils and vegetation can affect runoff and erosion.

Although fishing on the East Branch is prohibited by DFG to protect steelhead trout and coho salmon populations, poaching (illegal fishing) can directly affect fish populations because of harvesting and increases in mortality from handling.

Proposed Project

Impacts from Timber Management Activities

Impact: Increased Potential for Sedimentation of Aquatic Habitats from Increased Erosion Associated with Timber Harvesting and Related Activities. Under the proposed project, watershed disturbance from timber management and public use and development of recreation facilities would increase relative to the No-Project Alternative. Total erosion in the watershed resulting from this higher level of watershed disturbance is projected to increase by approximately 1%. Overall soil loss is expected to decline, however, because the watershed remediation program would be expanded. Because the watershed remediation program would result in a net decrease in the average rate of erosion at SDSF, this impact is considered less than significant.

Mitigation: No mitigation is required.

Impact: Changes in Water Temperature and Primary Production Caused by Reductions in Stream Shading. Under the proposed project, all woody riparian vegetation would be retained in late-succession management areas except where riparian function would be enhanced by removing such vegetation. Existing riparian areas provide almost optimal stream shading, with canopy coverage averaging 76% on Amaya Creek and ranging from 70% to 85% on the East Branch. Although a small amount of harvesting could occur in late-succession management areas, existing water temperatures would be minimally affected because at least 75% of the total shade canopy would be maintained, including riparian areas. This impact is considered less than significant.

Mitigation: No mitigation is required.

Impact: Reduced Recruitment of Large, Woody Debris. Under the proposed project, late-succession management areas would be established within 300 feet of Class I streams at SDSF (i.e., the East Branch, Amaya Creek, and Fern Gulch). As under the No-Project Alternative, all woody riparian vegetation would be retained in these areas except where riparian function would be enhanced by removing such vegetation. Selective cutting in riparian areas could promote the recruitment of conifers in riparian areas, which presently have a high proportion of hardwood trees relative to conifers. Coniferous trees are more desirable than hardwoods as sources of woody debris in streams because of their larger size (i.e., length and diameter) and greater resistance to decay. Also as part of the management of late-succession management areas, large snags and downed logs would be recruited and retained, thereby increasing woody debris in streams. This impact is considered less than significant.

Mitigation: No mitigation is required.

Impact: Reduced Availability or Suitability of Fish Habitat from Changes in the Timing or Magnitude of Streamflows. The potential for watershed disturbance to affect flow timing or magnitude would be slightly greater under the proposed project relative to the No-Project Alternative because more roads would be constructed and the rate of timber harvesting would be increased.

Implementing a forestwide inventory and risk evaluation of existing roads and skid trails; avoiding excavated skid trail construction on slopes exceeding 35%; and having all road, skid trail, and landing locations certified by a licensed engineering geologist; and conforming with the California Forest Practice Rules, would ensure that road construction and timber harvesting avoid or reduce the potential for altering drainage patterns. Therefore, this impact is considered less than significant.

Mitigation: No mitigation is required.

Impacts from Resource Enhancement Activities

Impact: Increased Channel Scour and Reduced Sediment Delivery to Stream Channels. Because more funding would be available for watershed remediation and fish habitat enhancement under the proposed project than under the No-Project Alternative, more opportunities would be available to reduce erosion impacts and enhance fish habitat. This impact is considered beneficial.

Mitigation: No mitigation is required.

Impacts from Public Use and Recreation

Impact: Potential for Direct and Indirect Effects on Fish Populations Caused by Recreational Use on SDSF Lands. The risk of impacts on fish populations and fish habitat related to recreational use would be higher under the proposed project than under the No-Project Alternative because of the proposed construction and operation of a campground. Public visitation would increase only slightly under the proposed project relative to the No-Project Alternative, and accessibility to the creek is limited. Only 5% of the overall stream area is accessible to recreationists. Additionally, SDSF staff education programs and enforcement of policies would reduce the likelihood of increased use having adverse effects on fish resources. Therefore, this impact is less than significant.

Mitigation: No mitigation is required.

Alternative 2: Emphasize Watershed and Late-Succession Habitat Protection

Impacts from Timber Management Activities

Impact: Increased Potential for Sedimentation of Aquatic Habitats from Increased Erosion Associated with Timber Harvesting and Related Activities. Under Alternative 2, late-succession management areas would be established adjacent to Class II streams as well as Class I streams. This impact is less than significant.

Mitigation: No mitigation is required.

Impact: Changes in Water Temperatures and Primary Production Caused by Reductions in Stream Shading. Establishment of late-succession management areas adjacent to Class I and II streams would reduce the potential for water temperature increases to a less-than-significant level.

Mitigation: No mitigation is required.

Impact: Reduced Recruitment of Large, Woody Debris. Supplies of large, woody debris available to the stream channel are expected to be adequate under this alternative. This impact is less than significant.

Mitigation: No mitigation is required.

Impact: Reduced Availability or Suitability of Fish Habitat from Changes in the Timing or Magnitude of Streamflows. Implementation of the measures described for this impact under the proposed project as part of the Alternative 3 watershed remediation program, in conjunction with the California Forest Practice Rules and the proposed watershed remediation program, would result in this impact being less than significant.

Mitigation: No mitigation is required.

Impacts from Resource Enhancement Activities

Impact: Increased Channel Scour and Reduction in Sediment Delivery to Stream Channels. Because the fish habitat enhancement program would be expanded under this alternative relative to the No-Project Alternative, this impact is considered beneficial.

Mitigation: No mitigation is required.

Impacts from Public Use and Recreation

Impact: Potential for Direct and Indirect Effects on Fish Populations Related to Recreational Use on SDSF Lands. Public use would increase slightly under this alternative relative to the No-Project Alternative. Measures implemented by SDSF staff to educate and enforce policies for recreation at SDSF would reduce the risk to fishery resources from recreational and educational use. This impact is considered less than significant.

Mitigation: No mitigation is required.

Alternative 3: Emphasize Forest Management Demonstration and Recreation

Impacts from Timber Management Activities

Impact: Increased Potential for Sedimentation of Aquatic Habitats from Increased Erosion Associated with Timber Harvesting and Related Activities. Under this alternative, sediment deliveries are projected to increase by approximately 6% relative to the No-Project Alternative, without accounting for erosion reductions from watershed remediation activities. This impact is considered potentially significant.

Mitigation:

- **Implement a Fisheries Monitoring Program.** CDF should continue the fish population and habitat monitoring program currently in place. Ongoing monitoring should determine whether timber management is affecting fish populations or habitat. Fish population surveys should be conducted periodically, in addition to monitoring of residual pool depths and volumes, to determine current conditions and long-term trends. If the studies reveal that timber operations are adversely affecting fish populations or habitat, additional watershed remediation activities should be implemented to further reduce erosion.

Implementation of this measure would reduce this impact to a less-than-significant level.

Impact: Changes in Water Temperature and Primary Production Related to Reductions in Stream Shading. Designating proposed late-succession management areas, along with compliance with the California Forest Practice Rules, would reduce this impact to a less-than-significant level.

Mitigation: No mitigation is required.

Impact: Reduced Recruitment of Large, Woody Debris. Designating proposed late-succession management areas would provide an adequate supply of large woody debris to streams. This impact is less than significant.

Mitigation: No mitigation is required.

Impact: Reduced Availability or Suitability of Fish Habitat from Changes in the Timing or Magnitude of Streamflows. Implementation of the proposed watershed remediation program, in addition to conformance with the California Forest Practice Rules, would reduce this impact to a less-than-significant level.

Mitigation: No mitigation is required.

Impacts from Resource Enhancement Activities

Impact: Increased Channel Scour and Reduction in Sediment Delivery to Stream Channels. Funding for fish habitat improvements would be increased substantially under this alternative relative to the No-Project Alternative. This impact would be beneficial.

Mitigation: No mitigation is required.

Impacts from Public Use and Recreation

Impact: Potential for Direct and Indirect Effects on Fish Populations Caused by Recreational Use on SDSF Lands. Because the main forest road would be paved and motorized vehicle use by the public would be allowed, public visitation would increase substantially under this alternative relative to the No-Project Alternative. Funding would be available, however, to support increased patrols of SDSF and education programs for forest users. Information would be posted at entrances, campgrounds, picnic areas, and other locations to educate the public about the sensitivity of fish populations and habitat to impacts on water quality and riparian habitat. These measures would reduce the likelihood of adverse effects on fish populations caused by recreational use. Therefore, this impact is less than significant.

Mitigation: No mitigation is required.

Chapter 5. Vegetation and Wildlife

ENVIRONMENTAL SETTING

Background

Limited biological information has been systematically gathered from SDSF before or since state acquisition of the property. In 1991, CDF hired CPSU to conduct botanical and wildlife surveys of the property. The results of these surveys were presented in a report to CDF (Holland et al. 1992). In addition, David Suddjian, a local wildlife biologist, has visited SDSF on numerous occasions and has extensive knowledge of wildlife populations in the region.

Jones & Stokes Associates conducted a reconnaissance-level survey of the site on September 22 and 23, 1994, to gather information on the general structure and characteristics of the forest communities at SDSF. Limited surveys were also conducted for certain special-status wildlife species, such as foothill yellow-legged frog, California red-legged frog, and southwestern pond turtle, and habitat conditions were assessed for all other potentially occurring special-status wildlife species. Finally, knowledgeable individuals were contacted and available literature gathered concerning the biology of SDSF and the surrounding area, and a search of the DFG Natural Diversity Data Base (NDDB) was conducted.

Physiography

SDSF is approximately 6 miles north of Monterey Bay in the Santa Cruz Mountains, a coastal mountain group of the outer central Coast Ranges. The Coast Ranges are often described in terms of their elongated ranges and narrow valleys, formed by geologic faulting and folding, that are approximately parallel to the coast (Norris and Webb 1990). Elevations vary greatly and the topographical relief is considerable. Likewise, the Santa Cruz Mountains are characterized by a system of well-defined ridgelines with steep canyons and narrow valley bottoms.

Consistent with this description, SDSF consists of a narrow valley defined by Soquel Creek within a steep canyon with slopes of 30-70%. The elevation ranges from 600 feet at Soquel Creek to 2,400 feet at the ridgetops. SDSF is within the Franciscan Complex, a metasedimentary rock formation consisting primarily of sandstones with smaller amounts of shale, chert, limestone, and conglomerate (Norris and Webb 1990).

Climate

The region is characterized by a Mediterranean climate, with wet, cool winters averaging 40 inches of precipitation and dry, warm summers with nightly coastal fog. The climate is strongly influenced by the region's proximity to the Pacific Ocean. Conditions along the coast produce relatively high levels of rainfall and humidity, fog and fog-drip precipitation, and a limited range of temperatures. The maritime influence diminishes with distance from the coast, resulting in drier conditions and more variable temperatures inland.

Vegetation

Forest Types

SDSF is within the coastal redwood forest belt, near the southern extreme of the coast redwood forest vegetation type (Barbour and Major 1977). Coast redwood forest extends almost continuously from southern Oregon south into Sonoma County, California, and in more dispersed stands as far south as Monterey County (Holland 1986). This community is characterized primarily by coast redwood, with other codominant species determined primarily by latitude. In the drier, southern portions of the range, Douglas-fir is the only codominant conifer, with tanoak and madrone as the principal hardwood species. In this region, coast redwood forest is found primarily on moist slopes and drainages and is influenced by the cool marine air and fog that flow up the coastal creeks and rivers (Barbour and Major 1977).

An overview of the vegetation communities at SDSF, as described by Holland (1986), is provided below. Coastal redwood forest is the predominant vegetation type, with several other communities occurring as inclusions within redwood forest. Refer to the biological survey report prepared by CPSU (Holland et al. 1992) for a more extensive description of the vegetation types and species composition of SDSF.

Upland Redwood Forest. Upland redwood forest is the prevalent community at SDSF, occurring on the shallow, well-drained soils of steep slopes. It is characterized by coast redwood intermixed with Douglas-fir, tanoak, live oak, and madrone. Because the forest at SDSF is predominantly at an intermediate successional stage, these species are typically intermixed in the forest canopy. As the forest matures, redwoods will tend to occupy the upper canopy layer, with Douglas-firs being dispersed throughout the upper canopy layer and a secondary layer consisting of tanoak, live oak, and madrone. As the canopy becomes increasingly stratified, the understory layer will consist primarily of tanoak, redwood sorrel, California hazel, and sword fern.

Throughout much of the forest, timber harvesting has reduced the density of the redwood/Douglas-fir component within stands formerly dominated by these species. Hardwoods have established in these areas and currently are the dominant species in many stands.

Mixed Evergreen Forest. Mixed evergreen forest occurs on the upper slopes and ridgetops of SDSF, above the redwood community. It is characterized by a dense canopy of evergreen trees, primarily tanoak and madrone. Douglas-fir and live oak are codominant in some areas, particularly on steep, rocky, well-drained hillside slopes. Dominant species in the understory are toyon, poison-oak, California blackberry, vetch, and yerba buena. Almost pure stands of tanoak occur on the more xeric, rocky sites.

The mixed evergreen forest intergrades with redwood forest throughout SDSF. Species composition is very similar between the two communities in many areas, with the only significant difference being the presence or absence of coast redwood. A great deal of variation exists in the vegetation composition between stands based on topography, slope, and harvest history.

White Alder Riparian Forest. White alder riparian forest occurs along the banks of the East Branch and Amaya Creek. This community is found along rapidly flowing, well-aerated perennial streams in steep-sided, narrow canyons. Broad-leaved, deciduous trees characterize the canopy layer. The dominant species is white alder, with frequent occurrences of bigleaf maple. Less common overstory trees at SDSF are black cottonwood, California sycamore, and California bay-laurel. Willow occurs regularly along the banks of Soquel Creek.

Other Communities

Freshwater Marshes. Freshwater marshes are scattered throughout SDSF as small springs; sag ponds (forest depressions that hold water); and small, stagnant pools along the edges of Soquel Creek.

Several springs occur at SDSF. The largest of these are Badger and Sulphur Springs. Each consists of a small pool surrounded by redwood forest. Little wetland vegetation is associated with these sites.

Sag ponds are freshwater marshes that pool water and maintain wet soils for much of the year. Several sag ponds occur at SDSF. The largest of these, Amaya Pond, is located near SDSF's northwestern corner. Arroyo willow occurs in and around Amaya Pond, with other dense wetland vegetation in the understory and redwood forest surrounding the pond. Amaya Pond is also one of the few areas at SDSF that supports large conifer snags, apparently remnants of a fire in 1933.

Annual Grasslands. Annual grasslands occur as small inclusions in forested communities at SDSF. Totaling less than 5 acres, this community provides open edges to an otherwise closed forest.

Chaparral. Chaparral occurs on the upper ridgetops and dry, rocky, south-facing upper slopes of SDSF. This community consists of a variety of shrubs 1-3 meters tall, such as manzanita, chamise, buck brush, and coyote brush.

Forest Composition and Age Classes

Timbered lands at SDSF consist of the coast redwood and mixed evergreen communities. Harvesting has reduced the density (as measured by tree volume and basal area) of conifers in both of these communities. Hardwoods, primarily tanoak, dominate some stands and are an important component in virtually all stands in the forest. As forest succession continues, conifers will eventually suppress the hardwood growth and again dominate the forest landscape.

In addition to altering the structure of the forest, harvesting has also reduced the age of the forest stands. Virtually all of SDSF has been harvested at least once since the late 1800s. Before this period, most of SDSF was a late-succession redwood forest with Douglas-fir and hardwoods as secondary components. The forest structure was multi-tiered with large trees, dense canopy, and abundant large snags and downed logs. Only four small (less than 10 acres each) old-growth redwood stands remain at SDSF, the largest of which are near Badger Springs and Sulphur Springs. Most of the forest is 50-80 years old.

Table 5-1 and Figure 5-1 illustrate stand composition and age at SDSF. The map in Figure 5-1 is based on a timber stand map prepared in 1979 by Pelican Timber Company. The original map was modified based on assumptions regarding stand ages and information gathered from a reconnaissance survey conducted for this EIR.

As shown in Table 5-1, only 1% of SDSF currently supports stands that consist predominantly of trees exceeding 24 inches in dbh. Stands described as having some trees that exceed 24 inches in dbh occupy 56% of SDSF, however. The California Forest Practice Rules define late-succession forest stands to include multistoried stands and single-storied stands in which the largest (i.e., predominant and dominant) trees exceed 24 inches in dbh and that have tree canopy coverage of at least 40%. The extent of timber stands at SDSF that meet these criteria is not currently known; more complete information on the extent and distribution of late-successional stands will be provided by an ongoing forest inventory scheduled to occur in 2000.

As discussed in Chapter 1 under "Timber Harvesting Planning", stands proposed for harvesting will be evaluated to determine if they constitute late-successional forest. If so, the extent and distribution of late-successional habitat in the East Branch watershed will be evaluated to determine whether the proposed harvesting would adversely affect wildlife species that depend on such forest stands. No timber operations will be implemented at SDSF that would have a significant adverse effect on wildlife dependent on late-successional stands .

Conifer Inventory and Growth

According to an inventory conducted by SDSF staff in 1991, the average volume of redwood and Douglas-fir trees in SDSF forest stands is approximately 29 MBF per acre, of which 76% is redwood. These trees are growing at an average rate of approximately 1 MBF per acre (3.4% of the conifer inventory) per year.

Table 5-1. Distribution of Acres by Forest Type and Successional Class

Forest Type	Successional Class				
	Early[a]	Intermediate[b]	Late[c]	Unclassified	Total
Redwood	44	266	14		324
Douglas-fir	0	6	2		8
Redwood/Douglas-fir mix	43	520	8		572
Hardwood/conifer mix[d]	722	716	6		1,444
Hardwood forest				272	272
Other[e]	___	___	___	61	61
Total	809	1,509	31	333	2,681

[a] Average dbh of the tallest canopy trees less than 16 inches.
[b] Average dbh of the tallest canopy trees 16-24 inches.
[c] Average dbh of the tallest canopy trees greater than 24 inches.
[d] Predominantly harowood mixed with redwood, Douglas-fir, or redwood/Douglas-fir.
[e] Other types include riparian, shrubland, and grassland.

Forest Health

The health of forest ecosystems can be evaluated in relation to their resistance to and ability to recover from catastrophic change at the landscape level, the balance between supplies of and demands for essential resources (e.g., sunlight, water, and growing space), and the diversity of seral stages and stand structures (Kolb et al. 1994). SDSF is relatively healthy in that:

- its climate and tree species confer considerable resistance to catastrophic losses from fires or forest pests,
- its trees are generally well supplied with resources and are not stressed by excessive competition between individual trees, and
- it has a relatively balanced distribution of early and intermediate successional classes (Table 5-1 and Figure 5-1).

The forest's principal structural deficiency is the relative absence of late-successional habitats that has resulted from intensive harvesting of mature trees between the late 1800s and the 1960s.

As discussed in Chapter 6 under "Risk of Wildfire", wildfires are relatively rare occurrences at SDSF because of the forest's cool, damp climate and the active fire prevention program in place there. Only one fire is known to have occurred at SDSF during the past 30 years. Fire hazards generally increase with increasing fuel loads and increasing horizontal and vertical continuity of fuels.

Forest pest hazards at SDSF are also relatively low (Marshall pers. comm.). The damaging effects of diseases, insects, and rodents on trees have generally been confined to individual trees; no large-scale tree mortality has been attributed to forest pests (Sutfin pers. comm.). Susceptibility to such events increases when competition between individual trees, associated with excessive stocking density, deprives trees of nutrients and when stands are dominated by very old trees. Redwood trees, however, are among the longest lived trees in the world.

Wildlife

A wide variety of bird, mammal, amphibian, and reptile species are found at SDSF. Surveys conducted by CPSU (Holland et al. 1992) provide a fairly extensive overview of wildlife occurrence. The presence of many species was confirmed during reconnaissance surveys, but the CPSU species list is much more extensive. This list of wildlife species known to occur at SDSF is provided as Table 5-2.

Table 5-2. Wildlife Species Confirmed to Inhabit Soquel Demonstration State Forest

Species	Scientific Name
Amphibians	
California newt	*Taricha torosa*
California slender salamander	*Batrachoseps attenuatus*
Pacific Chorus frog	*Hyla regilla*
Foothill yellow-legged frog	*Rana boylei*
California red-legged frog	*Rana aurora draytoni*
Pacific giant salamander	*Dicamptodon ensatus*
Ensatina	*Ensatina eschscholtzi*
Arboreal salamander	*Aneides lugubris*
Rough-skinned newt	*Taricha granulosa*
Reptiles	
Western pond turtle	*Clemmys marmorata*
Western fence lizard	*Sceloporus occidentalis*
Western skink	*Eumeces skiltonianus*
Southern alligator lizard	*Gerrhonotus multicarinatus*
Northern alligator lizard	*Gerrhonotus coeruleus*
Rubber boa	*Charina bottae*
Gopher snake	*Pitouphis melanoleucus*
Western aquatic garter snake	*Thamnophis couchi*
Western terrestrial garter snake	*Thamnophis elegans*
Santa Cruz garter snake	*Thamnophis couchi* ssp. *atratus*
Ringneck snake	*Diadophis punctatus*
Birds	
Great blue heron	*Ardea herodias*
Mallard	*Anas platyrhynchos*
Turkey vulture	*Cathartes aura*
Sharp-shinned hawk	*Accipiter striatus*
Cooper's hawk	*Accipiter cooperii*
Red-tailed hawk	*Buteo jamaicensis*
Golden eagle	*Aquila chrysaetos*
Chukar	*Alectoris chukar*
California quail	*Callipepia californica*

Table 5-2. Continued

Species	Scientific Name
Band-tailed pigeon	*Columba fasciata*
Mourning dove	*Zenaida macroura*
Flammulated owl	*Otus flammeolus*
Western screech owl	*Otus kennicottii*
Great horned owl	*Bubo virginianus*
Northern saw-whet owl	*Aegolius acadicus*
Long-eared owl	*Asio otus*
Allen's hummingbird	*Selasphorus sasin*
Belted kingfisher	*Ceryle alcyon*
Acorn woodpecker	*Melanerpes formicivorus*
Downy woodpecker	*Picoides pubescens*
Hairy woodpecker	*Picoides villosus*
Northern flicker	*Colaptes auratus*
Pacific-slope flycatcher	*Empidonax difficilis*
Black phoebe	*Sayornis nigricans*
Ash-throated flycatcher	*Myiarchus cinerascens*
Steller's jay	*Cyanocitta stelleri*
Scrub jay	*Aphelocoma coerulescens*
Chestnut-backed chickadee	*Parus rufescens*
Bushtit	*Psaltriparus minimus*
Brown creeper	*Certhia americana*
Pygmy nuthatch	*Sitta pygmaea*
Bewick's wren	*Thryomanes bewickii*
American dipper	*Cinclus mexicanus*
Ruby-crowned kinglet	*Regulus calendula*
Swainson's thrush	*Catharus ustulatus*
American robin	*Turdus migratorius*
Varied thrush	*Ixoreus naevius*
Hutton's vireo	*Vireo huttoni*
Warbling vireo	*Vireo gilvus*
Orange-crowned warbler	*Vermivora celata*
Black-throated gray warbler	*Dendroica nigrescens*
Townsend's warbler	*Dendroica townsendi*
Wilson's warbler	*Wilsonia pusilla*

Table 5-2. Continued

Species	Scientific Name
Black-headed grosbeak	*Pheucticus melanocephalus*
Rufous-sided towhee	*Pipilo erthrophthalmus*
California towhee	*Pipilo crissalis*
Song sparrow	*Melospiza melodia*
Golden-crowned sparrow	*Zonotrichia atricapilla*
White-crowned sparrow	*Zonotrichia leucophrys*
Dark-eyed junco	*Junco hyemalis*
Purple finch	*Carpodacus purpureus*
Wood duck	*Aix sponsa*
Green-backed heron	*Butorides striatus*
Red-shouldered hawk	*Buteo lineatus*
Merlin	*Falco columbarius*
Anna's hummingbird	*Calypte anna*
Red-breasted sapsucker	*Sphyrapicus ruber*
Olive-sided flycatcher	*Contopus borealis*
Westrn wood-peewee	*Contopus sordidulus*
Vaux's swift	*Chaetura vauxi*
Violet-green swallow	*Tachycineta thalssina*
Common raven	*Corvus corax*
Plain titmouse	*Parus inornatus*
Winter wren	*Troglodytes troglodytes*
Wrentit	*Chamaea fasciata*
Golden-crowned kinglet	*Regulus calendula*
Blue-gray gnatcatcher	*Polioptila caerulea*
California thrasher	*Toxostoma redivivum*
Hermit thrush	*Catharus guttatus*
Cedar waxwing	*Bombycilla cedrorum*
Solitary vireo	*Vireo solitarius*
Yellow-rumped warbler	*Dendroica coronata*
Yellow warbler	*Dendroica petechia*
Western tanager	*Piranga ludoviciana*
Fox sparrow	*Passerella iliaca*
Red crossbill	*Loxia curvirostra*
Evening grosbeak	*Coccothraustes vespertinus*

Table 5-2. Continued

Species	Scientific Name
American goldfinch	*Corduelis tristis*
Lesser goldfinch	*Corduelis psaltria*
Pine siskin	*Corduelis pinus*
Mammals	
Virginia opossum	*Didelphis virginiana*
Trowbridge's shrew	*Sorex trowbridgii*
Broad-footed mole	*Scapanus latimanus*
Hoary bat	*Lasiurus cinereus*
Brush rabbit	*Sylvilagus bachmani*
Merriam's chipmunk	*Tamias merriami*
Western gray squirrel	*Sciurus griseus*
Botta's pocket gopher	*Thomomys bottae*
Pinyon mouse	*Peromyscus truei*
California mouse	*Peromyscus californicus*
Dusky-footed woodrat	*Neotoma fuscipes*
Gray fox	*Urocyon cinereoargenteus*
Raccoon	*Procyon lotor*
Long-tailed weasel	*Mustela frenata*
Striped skunk	*Mephitis mephitis*
Mountain lion	*Felis concolor*
Bobcat	*Lynx rufus*
Feral pig	*Sus scrofa*
Black-tailed deer	*Odocoileus hemionus columbianus*
Opossum	*Dipelphis marsupialis*
Shrew-mole	*Neurotrichus gibbsii*
Deermouse	*Peromyscus maniculatus*
Coyote	*Canis latrans*

The dominant plant communities and associated habitat types of an area determine that area's wildlife composition. At SDSF, the assemblage of wildlife species is determined primarily by the age and structure of the redwood and mixed evergreen forest communities. The conversion from old-growth redwood forest to earlier successional stages has altered the local wildlife assemblage. Species closely associated with late seral structure (e.g., marbled murrelet) no longer occur at SDSF; species with more general habitat needs and those associated with earlier seral stages dominate the forest fauna.

Although the forest is structurally less diverse than it was before harvesting, a greater number of species probably occur within the forest communities now because of the diversity of habitat types representing early- and mid-successional forest stages. The presence of hardwoods, for example, adds to the diversity of habitat types and the wildlife species associated with them. For example, acorn woodpecker, scrub jay, plain titmouse, Bewick's wren, and California towhee are species closely associated with hardwood forests. Over time, as succession reduces the hardwood component, the forest will become increasingly dominated by even-aged conifers, reducing available habitat for these and other hardwood-associated species and reducing overall wildlife diversity.

Some species groups, although not necessarily dependent on old-growth structure, are adversely affected by timber harvesting if certain habitat components are reduced. For example, very few snags are found at SDSF because of the young age of nearly all stands. Snags are particularly important to primary cavity-nesting birds (e.g., woodpeckers) and secondary cavity-nesting birds (e.g., nuthatches and chickadees). Habitat is currently limited for these species at SDSF because of the lack of snags.

Other species groups are found in association with nonforested habitats, such as creeks and ponds. East Branch and Amaya Creek provide habitat for various amphibians and reptiles, including California newt, Pacific chorus frog, foothill yellow-legged frog, southwestern pond turtle, and western aquatic garter snake. Streamside vegetation is also important to most of these species for breeding and cover.

Special-Status Wildlife Species

Special-status species are animals that are legally protected under the state and federal Endangered Species Acts or other regulations and species that are considered sufficiently rare by the scientific community to qualify for such listing. Special-status species are species in the following categories:

- animals listed or proposed for listing as threatened or endangered under the federal Endangered Species Act (50 CFR 17.11 and various notices in the Federal Register [proposed species]);

- animals that are Category 1 or 2 candidates for possible future listing as threatened or endangered under the federal Endangered Species Act (54 FR 554, January 6, 1989);

- animals listed or proposed for listing by the State of California as threatened or endangered under the California Endangered Species Act (14 CCR 670.5);

- animals designated as species of special concern to DFG; and

- animals fully protected in California (California Fish and Game Code, Section 3511 [birds], 4700 [mammals], and 5050 [reptiles and amphibians]).

Table 5-3 lists the special-status species with potential to occur at SDSF along with their legal status and habitat associations.

The following is a discussion of the distribution, habitat requirements, and potential for occurrence of each of these species.

Marbled Murrelet

Status and Distribution. The marbled murrelet is state listed as endangered and federally listed as threatened. In California, this species forages in marine and pelagic habitats and nests in coastal conifer forests within approximately 40 miles of the coast from Santa Cruz County to the Oregon border (Paton et al. 1990). The species' distribution is also dependent on the presence of late-seral coastal forests (Carter and Erickson 1988, Nelson 1989, Paton and Ralph 1988, Sealy and Carter 1984).

Timber harvest activities, including the removal of coastal late-seral-stage forests, are considered the primary reason for the population decline of the marbled murrelet (Marshall 1988). Other possible contributing factors are mortality from gill net fishing, oil pollution, and conversion of coastal habitat to agricultural and residential uses.

Habitat Requirements. Breeding birds require mature, coastal coniferous forest for nesting and coastal waters for feeding (Sealy and Carter 1984, Carter and Erickson 1988, Paton and Ralph 1988). In California, Oregon, and Washington, marbled murrelets nest on large, horizontal, moss-covered limbs in mature and old-growth stands near the coast (Marshall 1988). Murrelets are not found in young or mixed-age forests, and are found in California exclusively in old-growth redwood forest stands (Ralph et al. 1990). The requirement of large, horizontal limbs could be the primary factor in the species' selection of older forest stands. The use of old-growth forests and the distribution of the species could be primarily a function of the availability of this habitat component, rather than a preference for old-growth forests in general. Little information is available, however, concerning the microhabitat requirements of the species. Most records of nesting and roosting marbled murrelets are from within a few miles of the coast, with more isolated occurrences as far as 40 miles inland (Paton et al. 1990).

Table 5-3. Special-Status Wildlife Species with Potential to Occur at Soquel Demonstration State Forest

Species	Legal Status[a] Federal/State	Habitat Association
Marbled murrelet	T/E	Nests in old-growth conifer forest; forages in pelagic habitats
Golden eagle	--/CSC	Nests in cliffs and trees in forests and woodlands; forages in grasslands, shrublands, and chaparral
Cooper's hawk	--/CSC	Nests and forages in woodlands and forests; also forages in open habitats
Sharp-shinned hawk	--/CSC	Nests and forages in conifer forest habitats
Long-eared owl	--/CSC	Nests and forages in riparian and woodland habitats
Purple martin	--/CSC	Nests and forages in woodland and forest habitats
Yellow warbler	--/CSC	Nests and forages in riparian habitats
Foothill yellow-legged frog	C2/CSC	Occurs in streams with rocky substrate
California red-legged frog	P/CSC	Occurs in slow-moving streams, pools, and ponds
Southwestern pond turtle	C1/CSC	Occurs in pools, ponds, and lakes

[a]Status codes:

Federal

E = endangered.
P = proposed for listing as threatened or endangered.
C1 = Category 1 candidate for listing as threatened or endangered.
C2 = Category 2 candidate for listing as threatened or endangered.

State

CSC = species of special concern.
T = threatened.

Little information is available concerning the size, spatial configuration, and isolation of stands or on the overall fragmentation of late seral forests and its effect on murrelet nesting or roosting. Detection rates have been found to increase with percent old growth and decrease with percent clear cut (Hamer and Cummins 1990), and detections are significantly fewer in fragmented forests (Nelson 1990). Data from Paton and Ralph (1988) and Ralph et al. (1990) suggest that marbled murrelets more commonly occupy stands greater than 500 acres and rarely occupy stands smaller than 60 acres. Further studies are required to accurately determine the lower limits of size and configuration of old-growth stands that could support nesting murrelets. Currently, surveys are required on all stands that support suitable habitat structure and that are at least 10 acres (Ralph et al. 1993).

Information about the movements of marbled murrelets from feeding areas to inland roosting and nesting sites is also lacking. Limited survey data and incidental observations suggest that birds may use drainages as movement corridors to and from feeding and nesting areas. The degree to which this may influence the use of isolated stands along drainages compared to other stands is unknown.

Occurrence at SDSF. No records are known of marbled murrelets occurring at SDSF. Our reconnaissance-level surveys of the area indicate that the young successional stage of the forest does not provide suitable habitat structure for this species. This is supported by Suddjian (pers. comm.), who has conducted more extensive surveys of SDSF and the surrounding lands, and by protocol-level surveys in selected areas of SDSF by the CPSU researchers (Holland et al. 1992).

Marbled murrelets are known to occur in Santa Cruz County and are found in relatively large numbers at Big Basin State Park. That site, however, supports old-growth redwood forest with habitat structure suitable for marbled murrelet nesting and roosting. SDSF probably supported a marbled murrelet population before harvesting altered the habitat structure of the area. This is particularly likely because Soquel Creek flows directly into the Pacific Ocean, providing an accessible travel corridor.

Golden Eagle

Status and Distribution. The golden eagle is designated by DFG as a species of special concern. Golden eagles are sparsely distributed throughout most of California, occupying primarily mountain and desert habitats. Approximately 500 breeding pairs are estimated to nest in California (California Department of Fish and Game 1987).

Golden eagle populations have declined in California primarily because of the loss of large, unfragmented habitat areas. Human disturbance of nest areas may have also contributed to statewide declines (Thelander 1974).

Habitat Requirements. Golden eagles construct their nests on cliff ledges; on high, rocky outcrops; or in large trees. Grassland, oak savanna, and open woodland and chaparral habitats provide suitable foraging habitat where golden eagles hunt for rabbits and squirrels.

Occurrence on the SDSF. No golden eagles are known to nest at SDSF, and none were observed during our reconnaissance surveys. A golden eagle was observed at SDSF during the CPSU study (Holland et al. 1992), however. Although suitable nesting trees exist throughout the forest, open foraging habitat is limited, precluding frequent use of the area by golden eagles. The species nests regularly, although in low densities, throughout the central Coast Ranges. Golden eagles are not commonly found in heavily forested areas such as SDSF and the surrounding area because these areas lack sufficient open foraging habitat.

Cooper's Hawk

Status and Distribution. The Cooper's hawk is designated by DFG as a species of special concern. Cooper's hawks breed throughout most of California, including the central Coast Ranges. The largest populations are found in areas of broken woodland, foothill riparian forest, and abundant habitat edges.

Cooper's hawks originally nested in lowland riparian woodland in the Central Valley and coastal valleys. Population declines have been attributed primarily to the loss of lowland riparian forests in these areas (Remsen 1978). Pesticide contamination may have also contributed to declines. Populations have recovered in the Sierra Nevada foothills since the 1960s (Robbins et al. 1986). The effects of logging on Cooper's hawk populations are not well documented; however, because of low breeding densities in north coast forests, logging activity along the coastal redwood belt has probably not contributed substantially to declines.

Habitat Requirements. The Cooper's hawk usually nests in deciduous riparian forest; oak woodland; or young- to mid-seral-stage, even-aged conifer forest, usually near streams or other open water (Reynolds 1983). The species typically maintains home ranges of 40-1,000 acres, with averages of 600-700 acres (Johnsgard 1990). Nests are relatively small and inconspicuous, built near the trunks of pole-size trees. Cooper's hawks hunt for birds and small mammals in both wooded and open habitats. Thus, nests are usually located in patchy woodland areas with abundant habitat edges and open areas.

Occurrence at SDSF. One adult Cooper's hawk was observed during reconnaissance surveys of SDSF. This species was also observed during the CPSU study (Holland et al. 1992).

Suitable habitat for the Cooper's hawk occurs throughout SDSF. The early- to mid-successional forests provide ideal conditions for nesting and foraging. The mosaic of conifer forests, oak woodlands, riparian forest, and inclusions of grassland and chaparral provide highly suitable conditions for Cooper's hawks and their prey.

Sharp-Shinned Hawk

Status and Distribution. The sharp-shinned hawk is designated by DFG as a species of special concern. This species breeds primarily in mid- to high-elevation conifer forests and coastal forests of northern California. The sharp-shinned hawk winters throughout the state.

Sharp-shinned hawks may never have been abundant in California during the breeding season. Although a decline had been noted since the early part of this century (Grinnell and Miller 1944), no data clearly identify possible causes. Population declines have been attributed, at least in part, to timber harvesting (Remsen 1978), but to what extent this has affected statewide populations is undetermined. Pesticide effects, as described for the Cooper's hawk, also may have affected this species in the 1960s.

Habitat Requirements. Sharp-shinned hawks usually nest in deciduous riparian habitat or in young successional stands of even-aged conifers that are cool, well shaded, and have little ground cover (Moore and Henny 1983). Nests are usually situated on north-facing slopes and are often associated with a watercourse (Reynolds et al. 1982). Home ranges of breeding individuals range from approximately 150 to 1,000 acres (Johnsgard 1990).

Occurrence at SDSF. No sharp-shinned hawks were observed during reconnaissance surveys. CDF has apparently detected this species at SDSF, however (Holland et al. 1992).

Breeding records exist of sharp-shinned hawks throughout the outer portions of the central Coast Ranges from Marin to Monterey County (Zeiner et al. 1990). Most records are from higher elevation conifer forest habitats. Suitable habitat for the Cooper's hawk occurs throughout SDSF. In general, early- to mid-successional forests provide suitable conditions for nesting and foraging; however, because most stands are dominated or codominated by hardwoods, creating a dense midstory, SDSF is considered only moderate-quality habitat for sharp-shinned hawks.

Long-Eared Owl

Status and Distribution. The long-eared owl is designated a species of special concern to DFG. In California, this species breeds in the Great Basin, Sierra Nevada foothills, central Coast Ranges, and isolated locales in Southern California. The species is known to occur in Santa Cruz County.

Declines of long-eared owl populations in California are generally attributed to loss or degradation of lowland riparian forests and other woodland habitats (Remsen 1978). No evidence indicates that conversion of forested lands to earlier successional stages from timber harvesting has contributed to declines of long-eared owl populations. Disturbances to riparian systems from logging operations, however, could eliminate breeding habitat for the species.

Habitat Requirements. Long-eared owls are found in oak woodland, riparian, and mixed conifer forest habitats. The species requires dense nesting and roosting cover and open foraging habitat (Johnsgard 1988). Thus, nests are usually found in dense riparian, oak woodland, or conifer forest habitats adjacent to large, open grasslands or agricultural fields.

Occurrence at SDSF. No long-eared owls were observed during reconnaissance surveys. CDF has records of the species at SDSF, however (Holland et al. 1992).

Streamside vegetation along portions of Soquel and Amaya Creeks supports suitable breeding habitat for long-eared owls. Very little open foraging habitat exists on or immediately surrounding the forest, however, possibly precluding local nesting of the species.

Purple Martin

Status and Distribution. The purple martin is designated by DFG as a species of special concern. This is an uncommon nesting species in wooded habitats in the Coast Ranges, portions of the Cascade Range, and the Sierra Nevada foothills (Zeiner et al. 1990).

Statewide population declines are attributed to nest site competition with the introduced European starling (which is greatly intensified in lands converted to agriculture, where starlings feed preferentially) and the removal of snags (Remsen 1978). Little information is available from the central and Coast Ranges of California concerning the status of purple martins; however, because purple martins use snags and hollowed trees as nesting and roosting sites, timber harvest operations have reduced available habitat for this species along the central and north coasts.

Habitat Requirements. Purple martins nest in a variety of woodland habitats, including foothill and montane hardwoods, valley and montane hardwood-conifer, riparian, and conifer forest, including redwood forest. This species usually nests in old woodpecker cavities, often in large-diameter, tall, old trees and snags near water. Nest sites are often found in older, multilayered, open forests and woodlands (Zeiner et al. 1990). This species is also known to nest in drainage holes beneath overpasses in several north coast areas and in the Sacramento area. Although purple martins require old trees or snags, they do not otherwise require late-succession forests.

Occurrence at SDSF. No purple martins were observed during reconnaissance surveys, and no records exist of purple martins at SDSF. Because the entire forest has been harvested at least once in the past 100 years, the young successional stage of the forest provides few nesting opportunities for purple martins. Few snags and broken-top trees are found at SDSF to provide habitat for primary-cavity nesters (e.g., woodpeckers) and secondary-cavity nesters (e.g., chickadees, nuthatches, and purple martins).

Yellow Warbler

Status and Distribution. The yellow warbler is designated by DFG as a species of special concern. Its current breeding range in California includes the Great Basin, Sierra Nevada, Cascade Range, Klamath Mountains, Coast Ranges, and northern Sacramento Valley (Zeiner et al. 1990). The yellow warbler is locally common in the central and northern Coast Ranges (Remsen 1978).

The two main reasons for declines in yellow warbler populations are the loss of riparian forests, particularly in the Sacramento and San Joaquin Valleys, and nest parasitism by the introduced brown-headed cowbird (Remsen 1978). Along the north coast and in the Cascade Range, populations are thought to be relatively stable, not having suffered from declines similar to those in the interior lowlands.

Habitat Requirements. Yellow warblers nest in riparian scrub and riparian forest habitats from lowland riparian areas to the mixed north-slope forest zone. Breeders are closely associated with alder-cottonwood-willow stands in riparian cover (Harris 1991), but they will apparently also nest in shrub- to sapling-size Douglas-fir forest (Meslow and Wight 1975). Nests are typically placed in shrubs and low trees in deciduous riparian habitat (Beedy and Granholm 1985, Zeiner et al. 1990). Taller trees are also used as perches (Marcot 1979). The species forages mainly in deciduous riparian habitat, but also in adjacent stands of woodlands and conifer forests (Marcot 1979).

Occurrence at SDSF. No yellow warblers were observed during reconnaissance surveys and no records of nesting yellow warblers at SDSF were found.

The alder riparian forest along Soquel and Amaya Creeks provides suitable habitat for yellow warblers. The species could nest within the riparian forest along both of these watercourses at SDSF.

California Red-Legged Frog

Status and Distribution. The California red-legged frog is proposed for federal listing as an endangered species. The species is also designated as a special of special concern by DFG.

The California red-legged frog was originally found in scattered populations throughout much of California west of the Sierra Nevada and below 4,000 feet in elevation (Stebbins 1972). Its range extended from coastal Marin County inland into Shasta County, and south into northwestern Baja California, Mexico. Habitat loss and degradation have resulted in the species' extirpation from approximately 75% of its original range (57 FR 45761, October 5, 1992). The red-legged frog has been extirpated from the floor of the Central Valley and has probably been eliminated from more than half of the drainage systems of the Central Valley where it once occurred (Hayes and Jennings 1986).

Although the red-legged frog's disappearance has been linked to the species' exploitation as food and the loss of wetlands, the causes for its decline are poorly understood (Hayes and Jennings 1988). Several factors that have probably contributed to the decline are overharvest, habitat loss, and an increase in introduced fish and bullfrog populations. Areas such as the San Joaquin Valley were particularly affected by early wetland reclamation and species harvest (Jennings and Hayes 1984). Continued loss of wetland habitats threatens remaining populations.

Habitat Requirements. California red-legged frogs require cold pond habitats with emergent and submergent vegetation (Storer 1925, Stebbins 1972). Habitats with the highest densities of frogs are deep-water ponds (at least 3 feet deep) with dense stands of overhanging willows and a fringe of cattails (Jennings 1988, Hayes and Jennings 1988, Jennings et al. 1992). Red-legged frogs occur most frequently in intermittent waters that lack fish and bullfrogs (Hayes and Jennings 1988).

California red-legged frogs lay their eggs in clusters around aquatic vegetation from December to early April. The larvae require approximately 3-5 months to complete metamorphosis (Storer 1925). Adults are highly aquatic when active but are less dependent on permanent water bodies than are other frog species (Brode and Bury 1984). Adults may estivate during dry periods in rodent holes or cracks in the soil. Although California red-legged frogs typically remain near streams or ponds, they can travel overland during rains.

Occurrence at SDSF. One red-legged frog was captured and photographed during stream surveys along Soquel Creek in July 1994. This specimen was captured in a pool near Ashbury Falls at the eastern end of SDSF. Although none were found during reconnaissance surveys in September 1994, the specimen photographed in July 1994 was confirmed to be a California red-legged frog.

Potential habitats at SDSF for California red-legged frog include portions of Soquel and Amaya Creeks. The ponds formed from springs are too small to sustain breeding populations, and the sag ponds do not maintain adequate quantities of pooled water long enough throughout the year. In general, habitat conditions along the creeks are more conducive to foothill yellow-legged frogs than to California red-legged frogs; however, suitable pools exist in some areas, particularly along Soquel Creek near the eastern end of SDSF.

Foothill Yellow-Legged Frog

Status and Distribution. The foothill yellow-legged frog is a Category 2 candidate for federal listing as threatened or endangered and is designated by DFG as a species of special concern. This species is found throughout the northern and central Coast Ranges and Sierra Nevada foothills.

Population declines are attributed primarily to human disturbances in the Sierra Nevada foothills, including dam building and flood control, mining, farming and canal building, urban development, and the introduction of predatory fish (Jennings 1988). Population declines are not as apparent in the Coast Ranges as in the Sierra Nevada, suggesting that habitats there are less degraded. No information suggests that timber harvest has contributed to statewide declines.

Habitat Requirements. The foothill yellow-legged frog inhabits partly shaded, shallow streams with rocky substrate that is at least cobble size (Hayes and Jennings 1988). This species is typically associated with valley-foothill hardwood, valley-foothill hardwood-conifer, valley-foothill riparian, ponderosa pine, mixed conifer, coastal scrub, mixed chaparral, and wet meadow habitat types (Zeiner et al. 1990).

Occurrence at SDSF. The foothill yellow-legged frog was found during reconnaissance surveys on Soquel and Amaya Creeks (six individuals were observed during spot checks along both creeks). They occur regularly, but in low densities, throughout both streams. Both streams are shallow with rocky substrates and abundant streamside vegetation.

Southwestern Pond Turtle

Status and Distribution. The southwestern pond turtle is a Category 2 candidate for federal listing as threatened or endangered and is designated by DFG as a species of special concern. In California, this subspecies of the western pond turtle is found south of the San Francisco Bay and west of the crest of the Sierra Nevada.

Agricultural activities, urban development, flood control, and water diversion projects are the primary causes of population declines (U.S. Fish and Wildlife Service 1992). Although logging activities can affect the quality of aquatic habitats, no evidence suggests that timber harvest has contributed to statewide or regional population declines.

Habitat Requirements. The southwestern pond turtle inhabits a wide range of fresh or brackish, permanent and intermittent water bodies. It typically occurs in slow-moving streams, pools, and ponds with adjacent vegetation, logs, or other debris to serve as basking and cover habitat.

Occurrence at SDSF. No pond turtles were observed at SDSF during reconnaissance surveys. One pond turtle was observed in June 1994 near the southern boundary of SDSF along the East Branch. The species is also known to occur just downstream from SDSF in ponds created by the Olive Spring Quarry. Pond turtles probably travel upstream along Soquel Creek and occur at least irregularly at SDSF. In general, Soquel Creek provides suitable habitat for pond turtles, particularly near the western end of the forest, where deep ponds have formed along the perimeter of the creek. Much of the creek, however, is too shallow to permit regular use by pond turtles. Amaya Creek may be too narrow, too shallow, and at too steep a grade to support pond turtles.

IMPACTS AND MITIGATION MEASURES

Vegetation

Impact Assessment Methodology

The principal impact that proposed forest management and public use would have on SDSF's vegetation resources is the potential destruction of riparian vegetation resulting from increased public use. Impacts on riparian vegetation are assessed by evaluating the intensity of riparian disturbance expected to result from public use and forest management.

The California Forest Practice Rules restrict the average annual rate of timber harvesting on forest properties to a level less than the annual rate of forest growth projected to be sustainable 100 years in the future. This rule ensures that short-term harvesting does not reduce the property's future capacity to produce forest products.

Changes in Riparian Vegetation. Riparian vegetation is important because it provides high-value wildlife habitat, supports stabilization of streambanks, provides erosion control, and influences water quality. Impacts on riparian vegetation are assessed by evaluating the potential for vegetation disturbance from hikers and other forest visitors.

Criteria for Determining Significant Impacts

Impacts on vegetation are considered significant if implementing the proposed project or project alternative would result in:

- any reduction in SDSF's future capacity to produce forest products or
- any appreciable reductions in the extent or quality of riparian vegetation in SDSF resulting from public use.

Alternative 1: No-Project Alternative

Impact: Reduced Quality or Extent of Riparian Vegetation. Under the No-Project Alternative, public use at SDSF is expected to increase to approximately 10,300 visitor-days from its current level of 4,200 visitor-days. Because of the attractiveness of streamside environments, some of these visitors are expected to hike along streams, even though no fishing is allowed at SDSF. Such use often results in the development of informal footpaths through sensitive riparian vegetation. Once such paths become visible, they tend to attract even more users.

individual has been recorded), the foothill yellow-legged frog occurs more frequently but also in relatively low densities, and the southwestern pond turtle is known to occur only along the extreme downstream portion of the East Branch.

Stream sedimentation resulting from timber harvesting could adversely affect these species and other aquatic amphibians by interfering with the reproductive cycle, particularly the egg formation stage. However, the low harvest levels proposed under the No-Project Alternative and the establishment of the 150-foot watercourse protection zone would minimize the extent of stream sedimentation from timber harvesting.

Impact: Loss of Special-Status Species Active Nest Sites from Timber Management. Cooper's hawk and sharp-shinned hawk nests could be subject to disturbance or direct removal during the breeding season from timber harvest activities. This could result in the loss of young in the nest and a reduction in reproductive performance for these species.

Impact: Habitat Improvement for Aquatic Amphibians and Reptiles from Sediment Remediation Efforts. Sediment remediation efforts proposed under the No-Project Alternative could provide substantial benefit to aquatic wildlife species. The reduced harvest levels under this alternative, however, would generate less income to fund remediation efforts compared with the project alternatives.

Impact: Disturbance to Wildlife Populations from Public Access and Recreation at SDSF. Under the No-Project Alternative, the elements of the public use and recreation program with the greatest potential to affect wildlife resources on the SDSF include:

- increase of educational field trips for organized groups and
- development of a new access to SDSF, with a 1-acre parking lot on an adjacent property to be acquired by SDSF.

Currently, the SDSF is open to nonmotorized recreation only. Daytime hiking, mountain biking, running, and horseback riding occur along main roads at SDSF. The No-Project Alternative will increase public use by increasing organized group field trips and improving access into the area. Wildlife at SDSF, however, is currently subjected to low levels of human disturbance from recreational activities and adjacent private landowners. Also, most recreational activities at SDSF occur along forest roads. Off-road areas of the forest do not currently receive substantial levels of direct disturbance from recreational activities, and this situation is not expected to change under the No-Project Alternative.

Proposed Project

Impact: Change in General Wildlife Use of SDSF from Timber Management. Differences in the timber management program between the proposed project and the No-Project Alternative with the greatest potential to affect wildlife resources on the SDSF include:

- selective timber harvest of 750 MBF per year on a 35-year cutting cycle,
- retention of remnant old-growth stands,
- management of a 600-foot-wide corridor along Soquel and Amaya Creeks and Fern Gulch as late-successional forest,
- retaining and creating snags and downed logs within the late-successional forest management areas,
- removal of small patches of dense hardwoods replanting with redwood and Douglas-fir, and
- construction of 7 miles of one-lane roads.

Selective harvesting, as described under the proposed project, is not necessarily incompatible with maintaining current wildlife populations at SDSF. Currently, the SDSF is a dense, even-aged forest, which limits the diversity and abundance of wildlife species. The selective harvest system, while removing a substantial number of trees throughout the forest, would ensure that sufficient tree density and canopy cover would be retained. The proposed project would involve thinning dense conifer stands, enhancing the structural diversity of the forest, creating habitat edges, and creating small openings in the forest, while retaining much of the tree density and overstory characteristics. The proposed project also involves creating snags during harvest operations.

The proposed 600-foot-wide late-successional riparian management corridors would enhance the corridor areas for species that are dependent on or use late-successional habitat components, such as large trees with high canopy closure, snags, and downed logs, that are extremely limited at SDSF now. This type of forest management would eventually enhance wildlife species diversity. For example, both primary and secondary cavity-nesting birds are uncommon at SDSF because of the lack of large snags. Management of the late-successional corridors would provide this type of habitat immediately through direct management efforts and in the long term through natural processes.

Road construction that will facilitate logging, fire protection, public safety, and recreation would permanently remove some conifer forest and hardwood habitat. The amount of habitat removed for road construction is not considered substantial enough to have a measurable effect on wildlife populations.

Some changes in species composition and population sizes would occur because of the changes in habitat characteristics discussed above. However, the combination of increased structural diversity from a selective harvest program, addition of late-successional management areas, and removal of small patches of dense hardwoods would result in greater habitat diversity at SDSF, which could also result in greater species diversity and more stable wildlife populations overall. Therefore, the timber management program under the proposed project would not result in a significant adverse impact on general wildlife populations at SDSF and could have beneficial effects compared with the No-Project Alternative.

Mitigation: No mitigation is required.

Impact: Reduction in Special-Status Wildlife Species Use of SDSF from Timber Management

Marbled Murrelet. Establishment of the late-successional forest management areas under the proposed project would not substantially affect old-growth forest characteristics within the next 10 years. Therefore, the timber management program under the proposed project would not affect marbled murrelets.

Cooper's Hawk. The selective harvest program under the proposed project is not necessarily incompatible with Cooper's hawk occurrence. The proposed timber management program would retain at least 40% of all trees greater than 18 inches dbh and 50% of all trees between 12 and 18 inches dbh in the selective harvest areas, and would retain and enhance large areas of forests along the Class I watercourses. In general, the harvesting program will enhance Cooper's hawk habitat at SDSF by thinning stands, opening up potential nesting and foraging areas, creating habitat edges, and retaining and enhancing stands along watercourses. Therefore, the timber management program under the proposed project would not result in a significant adverse impact on the Cooper's hawk and could have a beneficial impact compared with the No-Project Alternative.

Sharp-Shinned Hawk. Thinning dense conifer stands through a selective harvest program and replacing patches of dense oak forests with conifers is not incompatible with sharp-shinned hawk occurrence. Sharp-shinned hawks prefer early to mid-successional stands with an open understory. Thus, as with the Cooper's hawk, the proposed project could enhance sharp-shinned hawk habitat by thinning dense stands. Together with the retention and enhancement of the 600-foot-wide late-successional riparian management area along the Class I watercourses, the proposed timber management program will not result in a significant adverse effect on the sharp-shinned hawk and could have beneficial effects compared with the No-Project Alternative.

Long-Eared Owl. The timber harvest program under the proposed project will retain riparian habitats, thin some forested stands, and create some small openings. Although this will not necessarily be sufficient to attract breeding long-eared owls to the SDSF, they are considered measures that will improve habitat conditions for the species. Therefore, the proposed project will not result in a significant adverse impact on the long-eared owl and could have a beneficial effect compared with the No-Project Alternative.

Purple Martin. Actions under the proposed project would enhance purple martin habitat by managing for late-successional stands along the Class I watercourses and by creating snags for potential nesting sites. Thus, habitat for purple martins will be improved through project activities. The proposed timber management program would not result in a significant adverse impact on the purple martin and could have a beneficial impact.