Fruit Growers Supply Company
Multi-Species Habitat Conservation Plan

PREPARED FOR

Fruit Growers Supply Company

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Acronyms and Abbreviations

°C	Celsius
°F	Fahrenheit
ACD	angular canopy density
BACI	before/after/control/impact
BLM	U.S. Bureau of Land Management
BMPs	best management practices
CAL FIRE	California Department of Forestry and Fire Protection
Caltrans	California Department of Transportation
CEQA	California Environmental Quality Act
CESA	California Endangered Species Act
CETFKRB	Committee on Endangered and Threatened Fishes in the Klamath River Basin
CFPRs	California Forest Practice Rules
CHU	Critical Habitat Unit
cm/s	centimeters per second
CNDDB	California Natural Diversity Database
COMTF	California Oak Mortality Task Force
CSA	Conservation Support Area
CTM	critical thermal maxima
CWA	Clean Water Act
CWHR	California Wildlife Habitat Relationships
dbh	diameter breast height
DFG	California Department of Fish and Game
DO	dissolved oxygen
EA	Environmental Assessment
EEZ	Equipment Exclusion Zone
EIR	Environmental Impact Report

EIS	Environmental Impact Statement
ESA	Endangered Species Act of 1973
ESU	evolutionarily significant unit
FEMAT	Forest Ecosystem Management Assessment Team
FGS	Fruit Growers Supply Company
GIS	Geographic Information System
HCP	Habitat Conservation Plan
IA	Implementation Agreement
IS	Initial Study
ITPs	incidental take permits
km^2	square kilometer
KNF	Klamath National Forest
KRBFTF	Klamath River Basin Fisheries Task Force
LRMP	Land and Resource Management Plan
LSOG	late-successional and old growth forest
LSRs	late-successional reserves
LWD	large woody debris
mi/mi^2	miles per square mile
mi^2	square mile
mm	millimeters
MSP	Maximum Sustainable Production
MWAT	maximum weekly average temperature
MWHZs	mass wasting hazard zones
MWMT	maximum weekly maximum temperature
NEPA	National Environmental Policy Act
NHPA	National Historic Preservation Act
NMFS	National Marine Fisheries Service
PWA	Pacific Watershed Associates
qmd	quadratic mean diameter

RCD	Resource Conservation District
RWQCB	Regional Water Quality Control Board
SCS	Soil Conservation Service
Services	U.S. Fish and Wildlife Service and National Marine Fisheries Service
SHPO	State Historic Preservation Officer
SMZ	special management zone
SOD	Sudden Oak Death
SWRCB	State Water Resources Control Board
THP	Timber Harvesting Plan
TMDL	total maximum daily load
TSD	Technical Support Document
USDA	United States Department of Agriculture
USFS	U.S. Forest Service
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey
UUILT	upper ultimate incipient lethal temperature
WHR	Wildlife Habitat Relationships
WLPZ	Watercourse and Lake Protection Zone

CHAPTER 1

Introduction and Background

This Habitat Conservation Plan (HCP) has been prepared by Fruit Growers Supply Company (FGS) to cover commercial timberland that FGS owns and manages in Siskiyou County, California. The HCP (also referred to in this document as the "Plan") is a requirement of FGS's application to the U.S. Fish and Wildlife Service (USFWS) and the National Oceanic and Atmospheric Administration's National Marine Fisheries Service (NMFS), collectively referred to as the "Services" for incidental take permits (ITPs) pursuant to the Endangered Species Act of 1973 (ESA), as amended (incidental take is defined in Section 1.4.1). The ITPs (also referred to in this document as "Permits") will authorize take of two federally listed animal species (northern spotted owl and Southern Oregon/Northern California Coasts coho salmon) that is incidental to FGS's harvesting operations, and authorize take of two currently unlisted species (Upper Klamath and Trinity Rivers Chinook salmon and Klamath Mountains Province steelhead) should they become listed within the 50-year term of the Permits (also referred to in this document as "Permit Term"). Incidental take of listed plant species on private lands is not prohibited under the ESA and is therefore not authorized under an ITP; however, the ITP issued by USFWS will list the Yreka phlox, a federally listed plant species, as a Covered Species, in recognition of the conservation benefits provided for the species under the HCP and for purposes of extending assurances to FGS for that species under the "No Surprises" assurances rule. NMFS has management authority for coho salmon, Chinook salmon, and steelhead. The USFWS has management authority for northern spotted owl and Yreka phlox (a plant). FGS will be applying to the State of California for a Section 2081 permit for those state-listed and candidate species in which incidental take may be authorized under the California Endangered Species Act (CESA). Incidental take of state-listed species may be authorized under sections 2080 and 2081 of the California Fish and Game Code. The HCP provides a vehicle for describing and analyzing project effects as they pertain to a state Section 2081 permit.

Portions of FGS's ownership, referred to as the Hilt/Siskiyou forest, have been under the company's management since the early 1900s. FGS's Hilt/Siskiyou forest lies within the geographic range of the Yreka phlox, northern spotted owl, and coho salmon. The Yreka phlox is federally and state listed as endangered; the northern spotted owl and the Southern Oregon/Northern California Coasts coho salmon evolutionarily significant unit (ESU) are federally listed as threatened. Coho salmon are also listed as threatened by the State of California. Pursuant to the ESA, USFWS regulations prohibit the take of species listed as threatened or endangered, and USFWS regards the harvest of suitable habitat in areas occupied by northern spotted owls as having the potential for take in violation of the ESA. California Board of Forestry regulations restrict timber harvest operations in suitable habitat within occupied owl territories in order to prevent the take of northern spotted owls. Similarly for listed ESUs of coho salmon, NMFS and the California Department of Fish and Game (DFG) have prohibited take, and consider various forest management activities (such as harvest in riparian zones, road construction, and harvest on unstable slopes) as having the potential to result in take of coho salmon. Due to the federal listing of coho salmon, timber harvest activities in riparian areas are restricted within the historic range of coho salmon. The recent state listing of coho salmon further restricts activities in watersheds that support coho salmon as regulations under Section 2112 of the Fish and Game Code are implemented.

Surveys[1] of FGS lands and adjoining federal and private lands have shown that many northern spotted owl activity centers[2] are located on or have a home range[3] that extends onto the FGS ownership. Consequently, FGS's forest management activities in much of the Hilt/Siskiyou forest are restricted by the USFWS take prohibition and California Board of Forestry regulations. The severity of these restrictions, in conjunction with the large number of owl territories that are located on or overlap FGS lands, have substantially restricted FGS's management and operational flexibility since the owl was listed in 1990. These restrictions are forcing FGS to operate more intensively in other portions of its ownership in order to generate the timber volume necessary to remain economically viable. Continued operation under these management restrictions would jeopardize FGS's long-term ability to economically produce timber.

In requesting USFWS and NMFS approval of the HCP, FGS seeks to gain the management and operational flexibility necessary to administer its forest resources in a manner that will ensure the long-term sustainable production of timber. This goal is also consistent with the long-term needs of listed species in the area because FGS intends to undertake management measures that will, during the Permit Term, protect and, where needed, allow development of the functional habitat conditions that are required to support well-distributed, viable populations of the species covered by this HCP. Although this harvest strategy could result in impacts to and the incidental take of individuals of listed species over the short term, the HCP is expected to provide improved conditions and result in greater benefit than current regulations would allow over the long term.

1.1 Permit Holder/Permit Duration

FGS is applying to USFWS and NMFS for permits allowing incidental take of federally listed threatened species. The ITPs and associated Implementation Agreement (IA) will be in effect for a 50-year Permit Term, and will cover any take of species covered by this HCP that occurs incidental to FGS's timber operations on its Hilt/Siskiyou forest.

1.2 Permit Boundary

This HCP covers FGS's Hilt/Siskiyou ownership located in Siskiyou County, Northern California. The ownership consists of three management units, defined by FGS: Klamath River, Scott Valley, and Grass Lake, covering 65,340, 39,153, and 47,685 acres, respectively for a total of 152,178 acres. FGS's Klamath River and Scott Valley management units are

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[1] The DFG Northern Spotted Owl Database contains the most comprehensive compilation of northern spotted owl sightings in California, including results of protocol-level owl surveys on FGS lands and adjacent private and public lands. The database contains records beginning in 1987. For this HCP, owl records are used through 2007.

[2] For the purposes of this HCP, "activity center" is defined as the center of an area of concentrated activity of either a pair of owls or a territorial single (USFWS 1992).

[3] "Home range" is defined as the area to which an animal usually confines its daily activities. For the purposes of this HCP, the home range of northern spotted owls in the California Klamath and Cascades provinces is considered to be approximately 3,400 acres, the equivalent of a circle with a 1.3-mile radius (the provincial radius) around the activity center (USFWS 1992).

located west of Interstate 5, adjacent to and intermixed with Klamath National Forest (KNF) lands. FGS's Grass Lake management unit (also adjacent to the KNF) lies east of Interstate 5 and predominantly north of State Highway 97.

It is recognized that FGS may buy, sell, or exchange timberlands in the general area covered by the HCP during the 50-year term of the Permits. To reflect this aspect of FGS's business practices, the HCP is designed to allow some flexibility in the application of the HCP and Permits to the ownership as it adjusts over time. The HCP uses a number of defined terms to describe the area in which FGS's activities will be covered under the HCP, the area in which impacts of FGS's activities are analyzed, and the extent to which adjustments may occur to the area in which the HCP will be implemented. Those terms and their definitions are set forth in this section.

1.2.1 Definitions

- "Plan Area" means all privately owned commercial timberlands within the drainages that, over the term of the HCP, are either included within the Initial Plan Area (defined below) or are eligible for coverage by the HCP as provided in the IA (see "Adjustment Area" below). This represents the entire acreage analyzed in the HCP and the Environmental Impact Statement (EIS) prepared pursuant to the National Environmental Policy Act (NEPA) to support the HCP's provisions, allowing for additions and deletions of lands from the Plan Area over the term of the Plan and Permits. Lands within the Adjustment Area may be added to the HCP over the term of the Permits without amendment, given the proper analysis and approval by the Services, and subject to the limitation that a maximum of 10 percent of the Initial Plan Area (15,218 acres) can be added over the term of the Permits.

- "Initial Plan Area" means FGS's land ownership as of the effective date of the Permits (152,178 acres in three management units as described above). Figure 1-1 depicts the Initial Plan Area based on the ownership as of January 2012.

- "Adjustment Area" means commercial timberland within the drainages that are included in the Area of Analysis and that was not within the Initial Plan Area. This includes lands that are eligible for addition to the Plan Area through acquisition, subject to the terms and conditions imposed by the IA.

- "Area of Impact" means all acreage within a 1.3-mile (2-kilometer) radius around the FGS ownership. This 1.3-mile radius around the FGS ownership has been termed "Area of Impact" for the purposes of characterizing environmental baseline conditions and describing effects of the Covered Activities on the northern spotted owl at the local scale. The 1.3-mile distance criterion is based on the average home range size of the northern spotted owl within the California Klamath and California Cascades Provinces.

- "Area of Analysis" means all acreage within a 20-mile (30-kilometer) radius around the Initial Plan Area, truncated by physical barriers to northern spotted owl dispersal. It includes portions of Siskiyou, Shasta, and Trinity counties in California; and Jackson, Josephine, and Klamath counties in Oregon. This nominal 20-mile radius around the FGS ownership has been termed the "Area of Analysis" for the purposes of characterizing environmental baseline conditions and describing effects of the Covered Activities on the northern spotted owl at the regional scale.

1.2.2 Plan Area Adjustments Over Time

During the term of the HCP and Permits, FGS may elect to add commercial timberlands to the Plan Area within any of the identified drainages by submitting to the Services a description of the lands within the Adjustment Area that it intends to add, along with a summary of relevant biological and physical characteristics in the area proposed for addition. Lands within the "Initial Plan Area" are similar in characteristics and conservation value to lands in adjacent areas that could be brought into the Plan Area via land purchase. Fruit Growers estimates that there are approximately 338,900 acres of other privately held commercial timberlands in the drainages that could be added to the Plan Area if acquired by FGS in the future. However, expansion of the Plan Area under this process is limited to 10 percent of the Initial Plan Area (15,218 acres). Addition of lands to the Plan Area (i.e., to be covered by the HCP) in excess of the 10 percent limit or outside of the identified Adjustment Area would require an amendment to the HCP.

Further, through a notification to the Services, and subject to their review, lands covered by the HCP and Permits may be disposed of without limitation provided that the lands remain subject to the terms and conditions of the IA and HCP. The extent to which lands may be disposed of without adhering to the terms and conditions of the IA is limited to 10 percent of the Initial Plan Area (15,218 acres), and the remaining Plan Area must provide benefits and effectiveness equal to those intended in the HCP and Permits.

1.3 Species to be Covered by the Permits

FGS seeks incidental take permits that will allow for the incidental take or coverage of species included in Table 1-1. Species listed in Table 1-1 are collectively referred to as Covered Species.

TABLE 1-1
Species Covered in the FGS HCP

Species	Federal Status	Critical Habitat	State Status
Chinook salmon (*Oncorhynchus tshawytscha*) Upper Klamath and Trinity Rivers ESU	None	N/A	None
Coho salmon (*Oncorhynchus kisutch*) Southern Oregon/Northern California Coasts ESU	Threatened	Yes	Threatened
Steelhead (*Oncorhynchus mykiss*) Klamath Mountains Province ESU	None	N/A	None
Northern spotted owl (*Strix occidentialis caurina*)	Threatened	Yes	None
Yreka phlox (*Phlox hirsuta*)	Endangered	No	Endangered

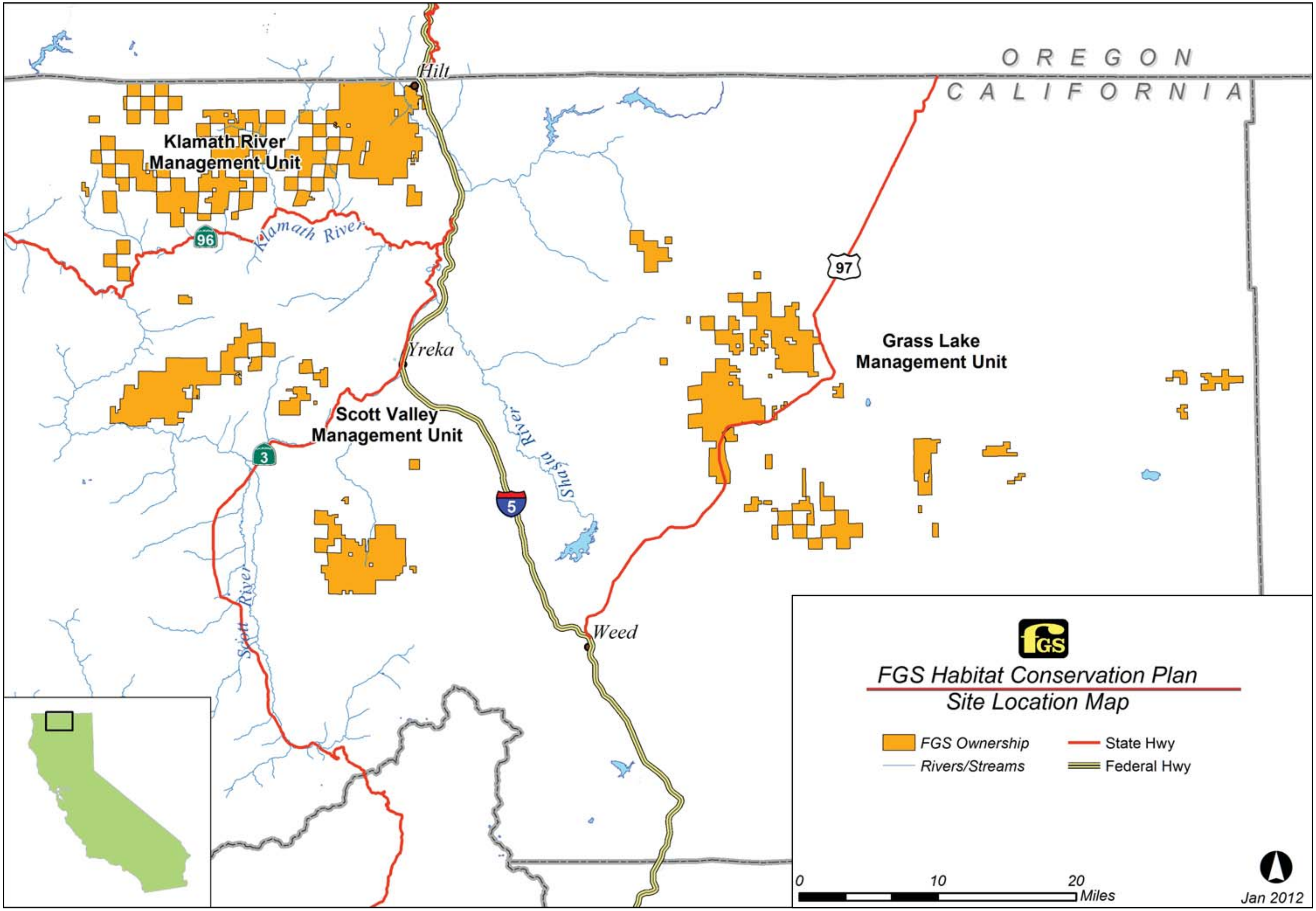

FIGURE 1-1
Initial Plan Area

1.4 Regulatory Framework

This HCP was prepared to comply with the existing regulatory framework that includes the following federal and state laws:

- Federal Endangered Species Act (ESA)
- Federal National Environmental Policy Act (NEPA)
- California Endangered Species Act (CESA)
- California Environmental Quality Act (CEQA)
- Z'berg-Nejedly Forest Practices Act and California Forest Practice Rules (CFPRs)
- Porter-Cologne Water Quality Control Act
- National Historic Preservation Act (NHPA)

The processes and requirements for each of these regulatory mechanisms are provided in the following descriptions.

1.4.1 Endangered Species Act

The ESA and its implementing regulations prohibit the take of any fish or wildlife species that are federally listed as threatened or endangered without prior approval pursuant to either Section 7, Section 10(a)(1)(A)or Section 10(a)(1)(B) of the act. The ESA defines take as, "to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or to attempt to engage in any such conduct." Federal regulations 50 CFR 17.3 and 222.102 further define the term "harm" in the take definition to mean an act that actually kills or injures a federally listed fish or wildlife species … including significant habitat modification or degradation where it actually kills or injures such species by significantly impairing essential behavioral patterns, including breeding, spawning, rearing, migrating, feeding or sheltering.

Section 10(a) of the ESA establishes a process for obtaining an incidental take permit, which authorizes nonfederal entities to incidentally take federally listed wildlife or fish subject to certain conditions. Incidental take is defined by the ESA as, "take that is incidental to, and not the purpose of, the carrying out of an otherwise lawful activity." Preparation of a conservation plan, generally referred to as an HCP, is required for all Section 10(a) permit applications. USFWS and NMFS have joint authority under the ESA for administering the incidental take program for the species they individually manage.

Section 7 of the ESA requires all federal agencies to ensure that any action they authorize, fund, or carry out is not likely to jeopardize the continued existence of any species listed under the ESA, or to result in the destruction or adverse modification of its designated critical habitat. Because issuance of a permit is a federal action, the Services must conduct an internal Section 7 consultation on the proposed issuance of the ITPs. The internal consultation is conducted after an HCP is developed by the project applicant (a nonfederal entity), and is submitted as part of a complete application package for an incidental take permit for formal processing and review.

Provisions of Sections 7 and 10 of the ESA are similar, but Section 7 requires consideration of several factors not explicitly required by Section 10. Specifically, Section 7 requires consideration of the effects on all federally listed species that may be affected by the activities covered under the ITP, whether or not such species are identified as covered species under the ITP. Section 7 also requires consideration of effects on designated critical habitat for any federally listed species, whether or not such species is identified as a covered species under the ITP. The federal ESA requires that the Services designate critical habitat to the maximum extent that it is prudent and determinable when a species is listed as threatened or endangered. The internal consultation results in a Biological Opinion prepared by the Services analyzing whether issuance of the ITP is likely to jeopardize the continued existence of any listed species or result in the destruction or adverse modification of the critical habitat of any listed species.

1.4.1.1 The Section 10 Process: HCP Requirements and Guidelines

The Section 10 process for obtaining an incidental take permit has three primary phases: (1) the HCP development phase, (2) the formal permit processing phase, and (3) the post-issuance phase.

During the HCP development phase, the project applicant prepares a plan that integrates the proposed project or activity with the protection of listed species. An HCP submitted in support of an incidental take permit application must include the following information:

- Impacts likely to result from the proposed taking of the species for which permit coverage is requested;
- Measures that will be implemented to monitor, minimize, and mitigate impacts; funding that will be made available to undertake such measures;
- Alternative actions considered that would not result in take; and
- Additional measures that the Services may require as necessary or appropriate for purposes of the plan.

The HCP development phase concludes and the permit processing phase begins when a complete application package is submitted to the appropriate permit-issuing office. A complete application package consists of (1) an HCP, (2) an IA, (3) a permit application, and (4) remittance of the application fee from the applicant. The Services must publish a Notice of Availability of the HCP package in the Federal Register to allow for public comment. The Services also prepare an Intra-Service Section 7 Biological Opinion and prepare a Set of Findings, which evaluates the Section 10(a)(1)(B) permit application in the context of permit issuance criteria (provided in the following list). The HCP, IA, and an Environmental Assessment (EA) or Environmental Impact Statement (EIS) document that has undergone a 60-day to 90-day public comment period serves as the Services' record of compliance with NEPA. A Section 10 incidental take permit is issued upon a determination by the Services that all permit requirements have been met. In making an affirmative determination, the Services must meet statutory criteria for issuing an ITP which include the following:

- The taking will be incidental.
- The impacts of incidental take will be minimized and mitigated to the maximum extent practicable.
- The applicant will ensure that adequate funding for the HCP will be provided.

- The taking will not appreciably reduce the likelihood of survival and recovery of the species in the wild.
- The applicant will provide additional measures that the Services require as being necessary or appropriate.
- The Services have received assurances, as may be required, that the HCP will be implemented.

During the post-issuance phase, the Permittee and other responsible entities implement the HCP; and the Services monitor the Permittee's compliance with the HCP, as well as the long-term progress and success of the HCP. The public is notified of permit issuance through notification in the Federal Register.

1.4.2 National Environmental Policy Act

NEPA requires that federal agencies analyze the environmental impacts of its actions (in this instance, issuance of an incidental take permit), and include public participation in the planning and review of its actions. NEPA compliance is obtained through one of three actions: (1) preparation of an EIS (generally prepared for high-effect HCPs); (2) preparation of an EA (generally prepared for moderate-effect HCPs); or (3) a categorical exclusion (allowed for low-effect HCPs). The NEPA process helps federal agencies make informed decisions with respect to the environmental consequences of their actions, and ensures that measures to protect, restore, and enhance the environment are identified as a component of their actions.

1.4.3 California Endangered Species Act

CESA prohibits the take of species listed as threatened or endangered by the California Fish and Game Commission. Under CESA, take is defined more narrowly than under the federal ESA; CESA defines take as, "to hunt, pursue, capture, or kill, or to attempt the same." Take of state listed species may be authorized under sections 2080 and 2081 of the California Fish and Game Code.

1.4.3.1 Section 2080

Under Section 2080.1, any person who obtains from the Secretary of the Interior or the Secretary of Commerce an incidental take statement pursuant to Section 1536 of Title 16 of the United States Code, or an incidental take permit pursuant to Section 1539 authorizing the take of an endangered or threatened species, can take the species if the following measures are followed:

1. Notify the director in writing that the person has received an incidental take statement or an incidental take permit issued pursuant to the federal ESA of 1973 (16 U.S.C.A. Sec. 1531 et seq.); and
2. Include in the notice to the director a copy of the incidental take statement or incidental take permit.

Within 30 days after the director has received the notice that an incidental take statement or an incidental take permit has been issued pursuant to the federal ESA, the director shall determine whether the incidental take statement or incidental take permit is consistent with Chapter 1.5 (Endangered Species) of the California Fish and Game Code. If the director determines within that 30-day period, based upon substantial evidence, that the incidental take statement or incidental take permit is not consistent with this chapter, then the taking of that species may only be authorized pursuant to Section 2081.

1.4.3.2 Section 2081

Section 2081 allows DFG to authorize, by permit, the take of endangered species, threatened species, and candidate species if all of the following conditions are met:

1. The take is incidental to an otherwise lawful activity.
2. The impacts of the authorized take shall be minimized and fully mitigated. The measures required to meet this obligation shall be roughly proportional to the level of impact of the authorized taking on the species. Where various measures are available to meet this obligation, the measures required shall maintain the applicant's objectives to the greatest extent possible. All required measures shall be capable of successful implementation. For purposes of this section only, impacts of taking include all impacts on the species that result from any act that would cause the proposed taking.
3. The permit is consistent with any regulations adopted pursuant to Sections 2112 (see below).
4. The applicant shall ensure adequate funding to implement the measures required by paragraph (2), and for monitoring compliance with, and effectiveness of, those measures.

No permit may be issued if issuance of the permit would jeopardize the species' continued existence. DFG shall make this determination based on the best scientific information, as well as other information that is reasonably available. DFG also shall include consideration of the species' capability to survive and reproduce, and any adverse impacts of the taking on those abilities in light of known population trends, known threats to the species, and reasonably foreseeable impacts on the species from other related projects and activities.

1.4.3.3 Section 2112

Section 2112 of the Fish and Game Code specifies that if a recovery strategy for coho salmon is developed that:

> "… includes policies to guide the department's issuance of memoranda of understanding pursuant to Section 2081 and the department's consultation procedures pursuant to Section 2090, the department shall develop and adopt rules and guidelines to implement those policies. The rules and guidelines shall be based upon the best available scientific evidence and shall be consistent with the recovery strategy adopted. The rules and guidelines may clearly specify conditions and circumstances under which the taking of a species listed as a threatened species or endangered species would be prohibited by the department, or, conversely, when it would not require a memorandum of understanding pursuant to Section 2081."

A recovery strategy for coho salmon has been adopted by DFG and as part of the 2008 California Forest Practice Rules under the Z'berg-Nejedly Forest Practices Act, "Measures to Facilitate Incidental Take Authorization in Watersheds with Coho Salmon" have been implemented (see Subsection 1.4.5.2 "Coho Rules" below).

1.4.4 California Environmental Quality Act

Similar to NEPA, CEQA requires environmental review of actions by state and local public agencies in California. CEQA processes closely parallel those for NEPA, with the Initial Study (IS) and Environmental Impact Report (EIR) serving as the CEQA equivalents of the EA and EIS, respectively. The CEQA Guidelines exempt certain public agency programs from the requirement to prepare environmental documents under CEQA. Such "functional equivalent" programs include the regulation of timber harvesting operations under the California Forest Practices Act (CEQA Guidelines Section 15251). As described below, preparation of a Timber Harvesting Plan (THP) is considered a functional equivalent process.

1.4.4.1 CEQA Compliance

CEQA sets out the state's general policy regarding environmental protection. It requires state agencies with approval authority over projects to determine whether such projects will have a significant effect on the environment, to consider and adopt feasible mitigation measures or alternatives that avoid or reduce significant environmental effects, and to document the evaluation process.

Two aspects of the timber harvest regulatory program have been certified as functionally equivalent programs with regard to CEQA pursuant to Public Resources Code Section 21080.5: (1) the California Board of Forestry's regulatory process of developing the forest practice rule prescriptions that will be applied in all timber operations; and (2) the California Department of Forestry and Fire Protection's (CAL FIRE) interdisciplinary THP review process. The primary requirement for state certification is that the program uses an interdisciplinary approach to ensure the integrated use of the natural and social sciences in decision making. Also, a certified program's enabling legislation must include environmental protection among its principal purposes and authorize the administering agency to adopt rules for environmental protection under standards defined by the enabling legislation (CAL FIRE 2008). For a regulatory program to obtain certification, the agency's rules and regulations must require the agency to use feasible alternatives or mitigation measures to reduce impacts, consult with other agencies, provide public notice and written responses to public comments, and other similar procedures. Significantly, the certification provisions of CEQA require consistency with the environmental protection purposes of the certified program's enabling legislation, and not just CEQA itself.

With regard to fish and wildlife resources, CEQA states a policy of ensuring that fish and wildlife populations do not drop below self-perpetuating levels. Appendix G to the CEQA Guidelines lists effects of projects that are normally considered adverse and require the adoption of feasible measures to mitigate or avoid those effects. However, CEQA also specifically provides that measures to mitigate or avoid significant impacts are limited to those which are expressly or implicitly authorized in the agency's statute.

Harvesting timber on private lands in California requires that a THP prepared by a licensed registered professional forester must be submitted to and approved by CAL FIRE. Each THP has two aspects: (1) the application of the standard CFPR prescriptions and (2) a site-specific assessment to determine whether additional measures are necessary to mitigate or avoid significant environmental impacts. As discussed, in addition to the application of the standard prescriptions, each THP must include a detailed analysis identifying the scope of the proposed timber operations, indicating whether the operations will have any significant adverse environmental impacts, including cumulative effects, on the environment, and discussing all feasible mitigation measures and alternatives that will reduce or avoid significant impacts.

When a THP is submitted, an interdisciplinary team preliminarily reviews the THP for conformity with the CFPRs. The review team normally consists of representatives of CAL FIRE, DFG, and the Regional Water Quality Control Board (RWQCB). The California Geological Survey (formerly Department of Mines and Geology) also reviews each THP for indications of potential slope instability. Based on the advice of the review team, the CAL FIRE Director will determine whether the THP is accurate and complete (CAL FIRE 2008).

After the THP's preliminary review and acceptance for filing, experts from the responsible agencies conduct a "pre-harvest inspection" (an onsite investigation to evaluate the THP). As a result of the pre-harvest inspection, site-specific mitigation measures, which are in addition to the standard protection measures of the CFPRs themselves, may be recommended to ensure environmental protection. The THP process also includes substantial public participation, including a public review and comment period. A THP is not approved unless the CAL FIRE Director determines that all significant adverse impacts, including cumulative effects, have been avoided or mitigated to a level of insignificance.

1.4.5 Z'berg-Nejedly Forest Practices Act and California Forest Practice Rules

Timber operations on private lands in California are regulated under the Z'berg-Nejedly Forest Practices Act and CEQA. The intent of the Forest Practices Act is to create a regulatory system to assure that "maximum sustained production of high-quality timber products is achieved while giving consideration" to environmental, recreational, and aesthetic qualities" (CAL FIRE 2008). Under the authority delegated by the Forest Practices Act, the California Board of Forestry adopts forest practice rules to implement the Forest Practices Act. In developing the rules, the California Board of Forestry solicits and considers recommendations from CAL FIRE, DFG, the State Water Resources Control Board (SWRCB), and other public agencies, and is required to adopt regulations to "assure the continuous growing and harvesting of commercial forest tree species and to protect the soil, air, fish, and wildlife, and water resources" (CAL FIRE 2008). When the California Board of Forestry considers and adopts the forest practice rule prescriptions, it is legislating mitigation measures and alternatives to be applied programmatically in the preparation and review of individual THPs to reduce or avoid potential impacts.

1.4.5.1 Standard Prescriptions

One result of the California Board of Forestry's programmatic consideration of potential environmental impacts has been the adoption of standard prescriptions. These prescriptions contain extensive and detailed instructions, control all private timber operations (including those that are not subject to THPs), and must be incorporated into each THP approved in California. These prescriptions cover all aspects of timber harvesting, including silvicultural methods; harvesting practice and erosion control; site preparation; watercourse and lake protection; wildlife protection; and the use, construction, and maintenance of logging roads, trails, and landings.

The CFPR's standard prescriptions include the maintenance of "watercourse protection zones" as buffers around streams and lakes. The width of the zones and the activities permitted therein are determined on a THP-by-THP basis using such factors as side-stream slope and watercourse uses. The intent of these protection zones is to provide a vegetative filter strip to capture and reduce any organic and inorganic material (including sediment) carried by runoff from the sideslopes, preserve canopy cover to maintain water temperatures appropriate for wildlife and fish habitat, provide for streambed and flow modification by woody debris, and provide vegetation diversity for fish and wildlife habitat (including vertical diversity, snags, and surface cover).

In addition, to prevent the significant degradation of the quality and beneficial uses of water, the construction, use, and maintenance of logging roads, trails, and landings are strictly regulated to minimize soil disturbances that could potentially result in erosion and sedimentation impacts. Measures to minimize soil erosion from roads include the requirements to use existing roads where feasible and minimize watercourse crossings. Similarly, tractor road-crossing facilities on watercourses that support fish are designed to provide for unrestricted passage of fish and water. Logging road drainage structures on watercourses that support fish must allow for unrestricted passage.

The CFPRs also require the retention of snags for wildlife purposes and recruitment of large woody debris for instream habitat through retention of older living trees near aquatic habitats. Specific habitat protection and harvesting prescriptions are established for wildlife species designated as "sensitive species."

1.4.5.2 Coho Rules

Recently, the California Board of Forestry, in consultation with DFG, adopted new "Protection Measures in Watersheds with Coho Salmon" [14 CCR 936.9.1] regarding forest management in watersheds where coho salmon have been documented by DFG to be present during or after 1990. These special requirements apply in addition to all other district CFPRs within qualifying planning watersheds. The measures include the following protective measures:

- Establishing wider Watercourse and Lake Protection Zones (WLPZs) along Class I (fish-bearing) and Class II (non fish-bearing aquatic habitats) watercourses;
- Higher overstory canopy coverage retention standards within WLPZs;
- Tree retention standards for recruitment of large woody debris in WLPZs along Class I watercourses; and
- Establishment of Special Management Zones where inner gorges extend beyond the WLPZ boundaries along Class I and Class II watercourses.

Additional measures have also been proposed that provide additional protection for coho salmon ("Measures to Facilitate Incidental Take Authorization in Watersheds with Coho Salmon" [14 CCR 936.9.2]). These measures are intended to facilitate the process of obtaining incidental take permits for state-listed coho salmon from DFG for timber operations under CESA. In addition to the "Protection Measures in Watersheds with Coho Salmon" summarized above, these measures include:

- Maintenance of pre-harvest levels of direct shading to pools along Class I watercourses;
- Retention of additional trees for recruitment of large woody debris within WLPZs along Class I watercourses;
- Higher canopy retention standards in WLPZs along Class II watercourses;
- Establishment of Equipment Exclusion Zones (EEZs) along Class III (intermittent) watercourses;
- Geologic review of proposed harvest activities in hydrologically connected headwall swales; and
- Inner gorge protection measures along Class III watercourses.

When implemented, these measures provide state level incidental take authority under Section 2112 of the Fish and Game Code. The DFG and NMFS participated in this rule-making process, and have indicated that on a case-by-case basis, the rules may be used to meet federal species protection programs and goals. Both agencies encouraged use of the coho salmon protective measures in this HCP.

1.4.5.3 Cumulative Impacts Assessment

The CFPRs also require that individual THPs be considered in the context of the larger forest and planning watershed in which they are located. This is required so that biological diversity and watershed integrity are maintained within larger planning units, and so that adverse cumulative impacts from timber operations and other land use activities in the area are mitigated or avoided. Cumulative impacts are assessed based upon a methodology described in the CFPRs. This methodology includes evaluation of both onsite and offsite interactions of proposed THP activities with the impacts of past, current, and reasonably foreseeable future projects. The obligation to mitigate or avoid cumulative impacts is the same as for individual impacts of the THP. Furthermore, the CFPRs allow the flexibility of applying offsite mitigation for project impacts both individual and cumulative.

Outside the CEQA context, the CFPRs provide one other significant element of environmental protection. The rules require THP submitters to evaluate areas near watercourses for sensitive conditions, and describe measures to protect the beneficial uses of water. In this regard, the rules prohibit the degradation of the "quality and beneficial uses of water" by timber operations (CAL FIRE 2008). This prohibition incorporates a significant requirement of state law relating to water quality, which is discussed in the following section.

1.4.6 Porter-Cologne Water Quality Control Act

The California Porter-Cologne Water Quality Control Act authorized the RWQCBs to establish water quality objectives necessary for the reasonable protection of "beneficial uses," which include preservation and enhancement of fish, wildlife, and other aquatic resources or preserves (SWRCB). As discussed previously, RWQCBs participate in the review of THPs. However, pursuant to RWQCB basin plans, which implement the water quality objectives, there exists an entirely separate, additional layer of state protection for fish and wildlife dependent on watercourses for habitat. In general, these basin plans provide for the permitting of waste discharges, and prohibit any waste discharges caused by land use activities (such as timber operations) in quantities considered deleterious to fish, wildlife, and other beneficial uses.

RWQCBs in timber harvesting areas have adopted strongly conditioned waivers of the requirement for timber operators to obtain waste discharge permits. The conditions generally provide that timber harvesting is exempt from waste discharge permits to the extent that the discharger is operating under an approved THP, complies with the basin plan, and that the timber operations do not violate applicable requirements of the basin plan. As noted previously, this requirement to protect beneficial uses of water is incorporated in the CFPRs. The RWQCBs may require timber operators to obtain waste discharge permits where those conditions are not met.

The SWRCB and the North Coast RWQCB have the authority and responsibility to comply with the provisions of the federal Clean Water Act (CWA) in the California's north coast region, including the areas covered by this HCP. Important provisions include the adoption of water quality standards under Section 303(c) of the CWA, and the identification of quality impaired water bodies that do not meet water quality standards under Section 303(d) of the CWA.

Section 303(d) of the CWA requires states to identify water bodies that are impaired, to identify the pollutant(s) or stressor(s) that are causing impairment, and to develop a plan to attain and maintain desired water quality standards. An "impaired" water body is one that is not meeting water quality standards and/or is not supporting the designated beneficial uses of the water body. The Klamath River is listed under Section 303(d) for nutrient, dissolved oxygen, water temperature, and microcystin concerns, which can be affected by altered hydrology caused by dams; the Scott River is listed for temperature and sediment concerns; and the Shasta River is listed for dissolved oxygen concerns. These water bodies were added to the 303(d) list based on water quality data specific to the water bodies, as well as information on the status of the fisheries in these watersheds. These listings were based on fisheries status because beneficial uses of water bodies associated with fisheries tend to be the uses most sensitive to water quality changes.

North Coast RWQCB staff members are working on developing total maximum daily loads (TMDLs) for the Klamath Basin, including the Klamath, Shasta, and Scott rivers. The TMDL process leads to a "pollution budget" designed to restore the health of a polluted body of water. The TMDL process provides a quantitative assessment of water quality problems, contributing sources of pollution, and the pollutant load reductions or control actions needed to restore and protect the beneficial uses of an individual water body impaired from loading of a particular pollutant. More specifically, a TMDL is defined as the sum of the individual waste load allocations for point sources, load allocations for non-point sources, and natural background such that the capacity of the water body to assimilate pollutant loading (the loading capacity) is not exceeded (40 CFR 130.2). The TMDL process involves: (1) development of a Technical TMDL and Technical Support Document (TSD); (2) implementation of the TMDL; and (3) monitoring.

1.4.6.1 Technical TMDL and TSD

A Technical TMDL presents background and analysis to support calculations of the loading capacity and load allocations for an impaired water body. A Technical TMDL does not include implementation or monitoring plans. A TSD is a report developed by Regional Water Board staff that meets all federal requirements for a TMDL, but with no implementation or monitoring plan and no action on the part of the RWQCB or SWRCB. Upon completion by the RWQCB, the TSD is forwarded to the U.S. Environmental Protection Agency (EPA), which then develops the TMDL based upon the information contained in the TSD.

1.4.6.2 Implementation

Upon completion of the technical TMDL and/or TSD, the state is charged with ensuring the necessary actions are taken so that the loading of the pollutant of concern does not exceed the TMDL and associated load allocations. Several mechanisms are available to implement the actions necessary to meet a TMDL. These mechanisms include:

- Regulatory action(s) of the RWQCB, such as a permit, waiver, or enforcement order.
- Regulatory action(s) of another state, federal, or local agency. A Memorandum of Understanding may be appropriate to describe the specific regulatory actions to be taken.
- Non-regulatory action(s), such as third party agreements and self-determined pollutant control.
- Amendments of the Basin Plan in the form of an Action Plan, which describes the steps necessary to meet the TMDL. A Basin Plan amendment is necessary when rule making is required to address the pollutant(s) and meet the TMDL. Additionally, TMDLs shall be incorporated into the state's continuing planning process, of which the Basin Plan is the primary venue, in accordance with Sections 303(d)(2) and 303(e)(3) of the federal CWA.

1.4.6.3 Monitoring

Monitoring is necessary to ensure information is available to assess progress toward attainment of the desired water quality conditions. A monitoring plan is a vital component of any implementation strategy.

Table 1-2 lists the status of TMDLs for the Klamath, Scott, and Shasta rivers as of February 2012.

TABLE 1-2
Status of Selected TMDLs in the Klamath River Watershed

Water Body Cal Water Numbers	Impairment	Implementation Plan Completed	TMDL Established*
Klamath River, 10510000 and 10530000	Nutrients	12/28/2010 – RWQCB	12/28/2010 – RWQCB
	Temperature	12/28/2010 – RWQCB	12/28/2010 – RWQCB
	Dissolved Oxygen (DO)	12/28/2010 – RWQCB	12/28/2010 – RWQCB
	Microcystin	12/28/2010 – RWQCB	12/28/2010 – RWQCB
http://www.waterboards.ca.gov/northcoast/water_issues/programs/tmdls/klamath_river/			
Scott River 10540000	Sediment	09/08/2006 – RWQCB	09/08/2006 – RWQCB
	Temperature	09/08/2006 – RWQCB	09/08/2006 – RWQCB
http://www.waterboards.ca.gov/northcoast/water_issues/programs/tmdls/scott_river/			
Shasta River 10550000	DO	01/26/2007 – RWQCB	01/26/2007 – RWQCB
	Temperature	01/26/2007 – RWQCB	01/26/2007 – RWQCB
http://www.waterboards.ca.gov/northcoast/water_issues/programs/tmdls/shasta_river/			

*TMDL established means EPA approval of the TMDL.

Source: North Coast Regional Water Quality Control Board Web site (February 2012):
http://www.waterboards.ca.gov/northcoast/water_issues/programs/tmdls/

1.4.7 National Historic Preservation Act

The NHPA authorizes the Secretary of the Interior to maintain a National Register of Historic Places and to approve state historic preservation programs that provide for a State Historic Preservation Officer (SHPO) with adequate qualified professional staff, a state historic preservation review board, and public participation in the state program.
Section 106 of the NHPA requires federal agencies to take into account the effects of their undertakings on historic properties. The procedures in Section 106 define how federal agencies meet these statutory responsibilities. The section 106 process seeks to accommodate historic preservation concerns with the needs of federal undertakings through consultation among the agency official and other parties with an interest in the effects of the undertaking on historic properties.

CHAPTER 2

Description of Covered Activities

This section describes FGS's activities that are covered under this HCP and associated ITPs, which include forest practices and related land management activities on FGS's Hilt/Siskiyou forest (the Plan Area), and those activities necessary to carry out all mitigation and conservation measures identified in the HCP and/or the ITPs. Timber management is the primary activity in the Plan Area, occurring on approximately 152,000 acres. Covered activities include activities associated with timber harvest, road construction and maintenance, silviculture, stand regeneration, harvest of minor forest products, and fire prevention. Collectively, these are referred to as Covered Activities. In addition to the ESA and CESA, the Covered Activities occurring on FGS's ownership are subject to numerous other state and federal environmental and public safety laws. All Covered Activities will be implemented in accordance with this HCP and ITPs, the CFPRs, and other applicable federal and state regulations.

2.1 Timber Harvest

Timber harvest includes activities necessary to the logging and transport of timber products (primarily ponderosa pine, sugar pine, Douglas fir, and white fir): felling and bucking of timber, yarding timber, salvage and transport of timber products.

2.1.1 Felling and Bucking of Timber

The cutting of trees (felling) is the first step in any timber harvest operation, and bucking is cutting the felled tree in predetermined log lengths. Felling and bucking are generally done with chain saws by crews working in pairs. On gentle terrain, mechanical felling machines (feller-bunchers) can be used to fell the trees and place them in a pile for moving to the log landing.

2.1.2 Yarding Timber

Yarding, also known as skidding, is moving logs from where they are felled or piled to the log landing. Generally, tractor-based systems are use on relatively gentle terrain; cable yarders are used on steeper slopes; and helicopters are used in areas where access is otherwise prohibitive.

2.1.2.1 Ground-based Yarding

Ground-based yarding usually involves the use of tracked or rubber-tired tractors (skidders) to move logs to the landing. The skidders are usually equipped with mechanical grapple attachments or wind lines to grasp the logs, and they follow constructed "skid trails" on all but the mildest terrain. Skidding is generally done in a downhill direction, and occasionally is used for uphill yarding where it is limited to short distances. If logs will be moved only a short distance, a shovel or a hydraulic boom log loader may be used. A shovel is a tracked excavator that has been fitted with a grapple for grasping logs. The shovel may move a short distance off the truck road to pick up felled logs and pass them back to the truck road using the boom structure. Construction of skid trails is not necessary when using the boom loader. Ground-based yarding is typically conducted on slopes less than 55 percent.

2.1.2.2 Cable Yarding

Cable yarding generally involves the use of steel cables to skid logs to a truck road or log landing using a yarder that is set up on the truck road or landing. A yarder has a vertical tower that is held in place by a number of guylines. The skidding cables, which are operated using powered drums, are used to haul or skid the logs to the landing. The tower is used to elevate and lift the cables, hence providing lift to logs as they are yarded to the landing. High-lead systems are designed to lift only the lead end of logs so that the logs do not dig into the soil surface as they are yarded. This system is typically used for short yarding distances. Skyline systems involve the use of a skyline cable that runs from the top of the tower to an anchor located at some elevated point beyond the harvest area. Logs are attached to a carriage that rides on the skyline cable, providing increased lift to suspend logs above the ground surface. Logs are generally yarded uphill with cable systems, but occasionally these systems are used for downhill yarding. Cable yarding is typically conducted on slopes greater than 55 percent.

2.1.2.3 Aerial Yarding

Aerial yarding by helicopter is used where roads cannot be constructed to provide access to a harvest unit for conventional (ground-based or cable) yarding systems. Aerial logging suspends logs from long cables and transports them to the landing with virtually no ground disturbance. In general, it is not necessary for the helicopter to land in the loading area. However, a separate service landing is needed that provides a clean, rocked, debris- and dust-free area to protect the helicopter’s engine(s) from damage. This yarding technique is usually reserved for steep (greater than 65 percent) and/or unstable terrain, although lack of a road right-of-way may trigger its use.

2.1.2.4 Loading and Landing Operations

After logs are yarded to a landing or roadside, there may be additional saw work to remove limbs, buck long pieces into shorter segments, or to remove broken sections. These operations are conducted either with hand labor (chain saws) or a mechanical delimber. Logs are then loaded onto log trucks using a shovel or front-end loader (a wheeled bucket loader equipped with log forks instead of a bucket). Some log trucks have their own loading system (self-loaders).

2.1.3 Salvage of Timber Products

Dead, dying, and downed trees are periodically salvaged. Salvage is primarily related to road maintenance, fire damage, insect damage, or storm damage. Generally the economics and logistics involved in the potential harvest determine the feasibility of salvage operations. Salvage operations are feasible when damaged or weakened trees occur adjacent to ongoing logging operations, or are in heavy enough concentrations over a large enough area to justify sending in a salvage logger. It is typically not feasible to harvest individual occurrences of one or two trees, or trees that have been dead for more than 2 years. Salvage operations typically occur in isolated locations throughout the Plan Area, and consist of harvesting dead and dying conifers as individuals or in small groups.

2.1.4 Transport of Timber Products

Timber products are most commonly transported along roads via truck and trailer. Maintenance activities on these haul roads are described below.

2.2 Road Construction and Maintenance

Activities for maintenance, improvement, construction, and closure of roads and landings include the following:

- Construction of new roads in connection with timber management, including clearing vegetation from road rights-of-way, removing trees, grubbing (removing stumps and surface organics), grading, and compaction
- Extraction of rock, sand, and gravel from small borrow pits for use in road construction and maintenance
- Drainage facility repair and/or upgrade, and erosion control
- Construction of stream crossing (bridges, culverts, fords, and a variety of temporary crossings)
- Maintenance or reconstruction of surfaced roads, seasonal roads, culverts, bridges, fords, cuts, and fillslopes
- Closure of roads, temporarily (abandoned) or permanently (decommissioned)
- Dust abatement activities, such as treating road surfaces with materials commonly used for dust abatement, including but not limited to lignin, calcium chloride, magnesium chloride, and water
- Construction and maintenance of water holes used for water drafting (a short-duration, small-pump operation that withdraws water from streams or impoundments to fill conventional tank trucks or trailers)
- Water drafting for dust abatement, road construction, and routine maintenance

2.3 Silviculture

Silviculture is the culture and management of forest trees. FGS's silvicultural practices are designed to maintain and enhance the productivity of its timberlands by promoting prompt regeneration of harvested areas and rapid forest growth. Silvicultural treatments vary by stand age, stand condition, site class, and species composition. Not all treatments are applied to every site.

FGS forest inventory serves as the foundation for long-term planning by identifying stands of generally homogeneous site, stocking, and silvicultural potential. Periodic forest conditions are currently estimated at the landscape level by a Maximum Sustainable

Production (MSP) analysis (a sustained yield planning framework is required under the California Forest Practice Rules [14 CCR 933.11a]). For planning purposes, stands of similar conditions are combined and a range of feasible silviculture is modeled for each of these units with yields reported at the mid-point of each decade. Once a given silviculture is applied, it limits the range of future opportunities for a given stand. The current MSP analysis is intentionally non-spatial so that silviculture can be developed at the landscape level and applied at the stand level on the basis of need. Each stand is part of a modeling unit in which a range of silvicultural practices are designated by acres by decade. The forester applies silviculture within these limits and within other spatial constraints, such as for areas protected for other resources.

2.3.1 Forest Management Regimes

The general categories of silviculture include even-aged regeneration, even-aged thinning, and uneven-aged treatments. Even-aged regeneration occurs on a 50- to 80-year rotation and produces stands that will remain in young seral stages for 20 to 50 years depending on site potential and stocking retained. These units are generally small, from 10 to 30 acres, and scattered on the landscape. In most cases, even-aged regeneration targets marginally stocked and/or deteriorating stands to improve their long-term productivity. Harvest methods include seed tree, shelterwood, and clearcutting methods. Regeneration occurs artificially through planting nursery-grown seedlings, or naturally by seed trees retained within harvest units. Seed trees are retained to propagate certain species or characteristics (for example, rust resistance). Even-aged thinning units are intermediate treatments of mid-seral even-aged stands designed to accelerate growth of trees. Uneven-aged harvests are generally designed to maintain a distribution of tree sizes at a stocking level that maximizes board foot growth at the stand level. Site potential determines the desired stocking level. Uneven-aged silviculture is used to harvest trees individually or in small groups with the goal of developing or maintaining a variety of age classes within a stand. Typically, sites are restocked through natural regeneration and, where necessary, supplemented by planting seedlings obtained from a nursery.

2.3.2 Silvicultural Methods

The types of silvicultural methods commonly employed by FGS throughout its ownership and its application in the development of the Sustainable Production Analysis are consistent with the methods defined and regulated in the CFPRs.

2.3.2.1 Clearcutting

The clearcutting regeneration method involves the removal of a stand in one harvest. Under the CFPR's, regeneration after harvesting shall be obtained by direct seeding, planting, sprouting, or natural seed fall[1]. When practical, clearcuts shall be irregularly shaped and variable in size to mimic natural patterns and features found in landscapes. Even-aged regeneration harvests have been allocated to portions of most merchantable-sized timber types on the Hilt/Siskiyou Forest. Actual clearcut unit locations are determined during THP layout by the area foresters.

1 Age and acreage limitations for clearcuts are regulated by the California Forest Practice Rules (14 CCR 913.1)

2.3.2.2 Commercial Thin

Commercial thinning is the removal of trees in a young-growth stand to maintain or increase the average diameter of the remaining trees, promote timber growth, and/or improve forest health. Commercial thinning is used as a tool to extend the "life" of some stands before using a regeneration harvest to better balance age class distributions across the forest. Commercial thinning is used to improve stand health and growth in relatively healthy, well-stocked stands of trees large enough to be harvested for lumber (> 10 inches diameter breast height [dbh]) that exceed target stocking requirements.

2.3.2.3 Biomass Thin

This intermediate treatment is used to thin younger, overstocked, submerchantable-sized stands to improve stand health and growth. It is predominantly used in young ponderosa pine stands and in mixed conifer stands with a heavy pine component. Although some saw logs are harvested, the main product is hog fuel (an unprocessed mix of barks and wood fiber) or paper chips from trees ranging from 4 to 10 inches dbh. Biomass thinning has been periodically used in the Grass Lake management unit to improve stand condition. It is also a valuable tool to reduce wildfire potential.

2.3.2.4 Seedtree/Shelterwood Removal (Even-aged)

This silvicultural method is used where a two-tiered structure of healthy, well-stocked understory with a scattered overstory exists. Future harvests will be even-aged (one or two commercial thins followed by regeneration harvests). The benefits of using this method are improved stand health, increased growth of trees in the understory, and promoting a more regular structure. This silvicultural method is widely used in all of the management units on FGS ownership.

2.3.2.5 Selection/Group Selection (Uneven-aged)

This silvicultural method is used in heavily stocked, relatively healthy stands that have an uneven-aged structure. Merchantable trees are harvested from all size classes present. The intent is to maintain an uneven-aged structure, maintain stand health, and generate a harvest return. Harvest entries occur every 10 to 20 years. Selection harvest has also been applied to other stands throughout FGS ownership on the Hilt/Siskiyou forest, including those in watercourse protection zones and on potentially unstable slopes, including inner gorges and shallow, unstable soils.

2.3.2.6 Alternative Prescriptions

A number of alternative prescriptions are commonly used by FGS in its silvicultural management. All alternative prescriptions are analyzed and approved during the THP review process. In most cases where alternative prescriptions are employed, past management and timber harvest have created an irregular condition in stand structure and/or stocking. Standard silvicultural prescriptions as specified in the rules are difficult to apply in these irregular stands. FGS's management scheme is to maintain stand health and generate a periodic and economical harvest in these stands through the use of alternative prescriptions over the first 1 to 4 years, gradually building up inventory to a point when standard silvicultural prescriptions can be applied. These alternative prescriptions include, but are not limited to:

- Seedtree/shelterwood removal (uneven-aged)
- Modified selection
- Combination shelterwood removal/biomass thin
- Modified commercial thin
- Combination shelterwood removal/commercial thin

2.4 Stand Regeneration and Improvement

Timber stand regeneration and improvement includes activities necessary to establish, grow, and achieve the desired species composition, spacing, and rate of growth of forest stands on the ownership:

- Site preparation, prescribed burning, and slash treatment
- Tree planting
- Vegetation management
- Silvicultural thinning (includes biomass, pre-commercial, and commercial thinning)

Silvicultural thinning is described previously under silvicultural methods.

2.4.1 Site Preparation, Prescribed Burning, and Slash Treatment

Site preparation activities for even-aged regeneration involve the removal of logging residue and/or unwanted shrub and tree species. This is typically accomplished by using tractors to pile logging residue for burning, broadcast burning, or, less commonly, by mechanical methods. By removing fuels, this treatment has the additional benefit of reducing the potential for wildfire to ignite or spread. As needed, fuel breaks may be constructed to protect resources. The need and location of fuel breaks is determined by the area forester (in consultation with CAL FIRE as needed). Occasionally, site preparation also requires soil scarification for planting. This treatment applies only to regeneration harvest units where it may be necessary to ensure successful regeneration.

2.4.2 Tree Planting

Artificial regeneration is commonly used to ensure that sites are adequately stocked as per the stocking requirements specified in the CFPRs. The usual practice is to plant seedlings in those areas that have been either clearcut or burned by wildfire. Seedlings are grown at commercial nurseries from seed collected within the appropriate seed zones typically by FGS on FGS property, and/or purchased for the environmental conditions of each site where they will be planted.

2.4.3 Vegetation Management

Occasionally, sites may require one or more vegetation management treatments to reduce the impacts of unwanted competing vegetation on the growth of seedlings. Such treatments commonly involve the mechanical removal of competing brush species using tractors or hand crews. Brush is typically piled and burned, or may be chipped. FGS is not seeking coverage for herbicide use under the ITPs as the application of herbicides is governed by rules established by EPA.

2.5 Minor Forest Products

Minor forest products are occasionally harvested from the Plan Area and transported over private and public roads. These products include, but are not limited to, Christmas trees and bows, mistletoe, firewood, fence posts, poles, yew bark, stumps, root wads, and mushrooms. These are all very minor components of this forest and are regulated by contract. The management of Christmas trees includes pruning and growth control in scattered locations throughout the Plan Area. The harvest of Christmas trees is small enough to be considered a minor forest product.

2.6 Fire Prevention and Suppression

Wildfire prevention involves vegetation management and the construction of fuel breaks strategically located throughout the Plan Area. These activities are designed and implemented by the area forester on a local basis, and are therefore generally very limited in scale. The prescription typically includes thinning for shaded fuel breaks along property lines or between watersheds where FGS deems it beneficial. Wildfire suppression is typically under the authority of local, state, or federal agencies. In cases of escaped prescribed burns where local, state, or federal agencies are not involved, or for initial responses until responsible agencies have arrived, FGS employs emergency fire suppression activities, such as construction of fuel breaks by hand or bulldozer, lighting backfires, applying aerial fire suppressants, falling trees or snags, and water drafting for fire suppression.

2.7 Other Activities

In addition to FGS's forest management activities, this HCP and associated ITPs will cover certain other activities undertaken by FGS and third parties pursuant to FGS obligations (for example, easements) or authorization (leases and licenses) in the future. Generally, such activities include those consistent with the zoning of FGS's lands as Timber Production Zone. Under California's Timberland Productivity Act, a Timber Production Zone is for growing and harvesting of timber and other designated "compatible uses." Grazing is considered a compatible use, but will not be a Covered Activity under this HCP. Compatible uses include, but are not limited to, watershed management; fish and wildlife habitat improvement; and use of roads, landings, and log decks. The specific activities that would be conducted at any particular location as part of watershed, fish, and wildlife habitat improvement cannot be specified. However, representative activities are slope stabilization, fish ladder installation, instream habitat structure installation, and fencing of fish-bearing streams.

With the exception of grazing, all such activities by FGS and other parties authorized by FGS would be covered by the HCP and ITPs. With regard to road use, the HCP and ITPs will cover general road use, construction, and maintenance activities carried out on road segments owned by and under control of FGS. Construction and maintenance activities pursuant to cooperative road use and maintenance agreements between FGS and the U.S. Forest Service (USFS) would not be covered under this HCP. The USFS is developing a road use and maintenance plan through consultation with NMFS to cover roads on lands in the Klamath National Forest. Rock quarrying activities would be covered under this HCP. FGS quarries rock from a number of locations on its ownership for the purpose of obtaining material for road surfacing. FGS has four primary rock quarries on the ownership that are each less than 2 acres in size. These quarries are used solely by FGS to provide rock products used on its ownership and in road construction and maintenance activities on roads governed by cooperative agreements with the USFS. Typically up to five or more local rock sources, commonly referred to as "borrow pits," are developed as needed for road upgrades associated with THPs. Each local rock source is rarely larger than 0.5 acres in size and is most often located in the upper portions of watersheds away from Class I streams.

CHAPTER 3

Covered Species

In July 2007, a species list for Siskiyou County, California, was obtained from the Arcata USFWS Office's online database. A similar list of aquatic species was obtained from the Arcata office of NMFS. Species were considered to have "special status" if they were listed as endangered, threatened, or candidate species under the ESA. Twenty-one special status species were identified within Siskiyou County, of which the following 10 were determined to have a moderate to high potential for occurrence within the Plan Area based on current or historic observations and/or the presence of suitable habitat.

- Coho salmon (*Oncorhynchus kisutch*)
- Steelhead (*Oncorhynchus mykiss*)
- Chinook salmon (*Oncorhynchus tshawytscha*)
- Northern spotted owl (*Strix occidentalis caurina*)
- Yreka phlox (*Phlox hirsuta*)
- Bald eagle (*Haliaeetus leucocephalus*)
- Siskiyou mariposa lily (*Calochortus persistens)*
- Fisher (*Martes pennanti pacifica*)
- Siskiyou Mountains salamander (*Plethodon stormi*)
- Scott Bar salamander (*Plethodon asupak*)

This chapter, Covered Species, describes the species' legal status, range and distribution, life history, and habitat requirements such that effects of the Covered Activities and Conservation Program may be subsequently evaluated. Threats are described for the northern spotted owl and Yreka phlox, as threat reduction is a component of these species' conservation under the HCP. The following sections describe the species proposed for coverage and those not proposed for coverage under the HCP. The bald eagle, Siskiyou mariposa lily, fisher, Siskiyou Mountains salamander, and Scott Bar salamander are not proposed for coverage under this HCP. A brief description of these species is provided as well as an explanation of why they are not proposed for coverage.

3.1 Aquatic Species Covered by the HCP

FGS is seeking incidental take authorization for the following aquatic species under this HCP:

- Southern Oregon/Northern California Coasts coho salmon ESU (federally listed as threatened, 70 FR 37160)
- Klamath Mountains Province steelhead ESU (as described in the not warranted finding, 66 FR 17845)
- Upper Klamath and Trinity Rivers Chinook salmon ESU (as described in the not warranted finding, 63 FR 11482)

Life histories of these species are similar; however, the timing of various life stages differs among species and even between "runs" (races) of particular species. The general life histories presented here for each species provide the timing of the various life stages within the ESUs. Detailed information on habitat requirements of the aquatic species covered by the HCP is provided following the species descriptions.

3.1.1 Coho Salmon

3.1.1.1 Legal Status

As a result of declines in the population of coho salmon in the Southern Oregon/Northern California Coasts ESU, coho salmon within this ESU were federally listed as threatened in May 1997 (62 FR 24588). Critical habitat for this ESU was designated in May 1999 (64 FR 24049) and includes portions of the Plan Area in the FGS's Klamath River and Scott Valley management units. Natural and human factors have been implicated in the decline of coho salmon in this ESU (62 FR 24588). The State of California formally listed coho salmon north of Punta Gorda to the California-Oregon border (which includes the Plan Area) as threatened on March 30, 2005.

3.1.1.2 Range and Distribution

Coho salmon range in freshwater drainages from Hokkaido, Japan, and eastern Russia; around the Bering Sea and Aleutian Islands to mainland Alaska; and south along the North American coast to Monterey Bay, California (Laufel et al. 1986). Within California, the historical range of coho salmon was from the Oregon-California border (including the Winchuck River and Illinois River drainages in Oregon) south to the streams of northern Monterey Bay (Snyder 1931; Fry 1973), including small tributaries to San Francisco Bay (Brown and Moyle 1991). There is some evidence that they historically ranged as far south as the Pajaro River (Anderson 1995), the Big Sur River (Hassler et al. 1991), or even the Santa Ynez River (Lucoff 1980), although evidence of spawning populations south of the Pajaro River is anecdotal (Anderson 1995). Currently, the southernmost stream that contains coho salmon is Aptos Creek in Santa Cruz County (NMFS 2001).

3.1.1.3 Life History

The coho salmon is one of several species of Pacific salmon found along the west coast of North America. Like all Pacific salmon, coho are anadromous. The spawning migration of coho salmon in the Klamath River system begins in early to mid-September and continues through January, with fish reaching the upper tributaries from November through January. These fish generally prefer smaller tributaries for spawning than Chinook salmon do (DFG 2002a). Spawning takes place from November through January. Eggs incubate over winter, and emergence of fry begins in February and continues through mid-May. Juvenile coho salmon rear in small tributary streams for about 1 year, although some may spend up to 2 years in streams before outmigrating. Outmigration of smolts (young salmon at the stage of migrating from fresh water to the ocean) occurs from late March or early April through mid-June, generally peaking in April and May.

3.1.2 Steelhead

3.1.2.1 Legal Status

Steelhead in the Klamath Mountains Province ESU were proposed for federal listing as threatened. The history of petitions and agency findings regarding the Klamath Mountain Province steelhead ESU are detailed in the February 12, 2001, listing proposal (66 FR 9808). After reviewing the best available scientific and commercial information, NMFS concluded in April 2001 that the overall Klamath Mountains Province ESU did not warrant listing (66 FR 17845).

3.1.2.2 Range and Distribution

Historically, steelhead were distributed throughout the northern Pacific Ocean from the Kamchatka Peninsula in Asia to the northern Baja, California, Peninsula. This species probably inhabited most coastal streams in Washington, Oregon, and northern and central California, as well as many inland streams in these states, and Idaho (Busby et al. 1996). Presently, the distribution extends from the Kamchatka Peninsula along the Pacific coast of North America to at least Malibu Creek in Southern California. Many populations of steelhead are believed to be extirpated, and many more are thought to be in serious decline in numerous coastal and inland streams from Washington, Oregon, Idaho, and California (Nehlsen et al. 1991).

3.1.2.3 Life History

The life history of steelhead differs from that of coho and Chinook salmon in several ways. Steelhead do not necessarily die after spawning, and a small number survive to become repeat spawners. Juvenile steelhead generally have a longer freshwater rearing requirement (usually from 1 to 3 years), and adults and juveniles are both more variable in the length of time they spend in fresh and salt water. Some individuals may remain in a stream, mature, and even spawn without ever going to sea; others migrate to the ocean at less than 1 year of age, and some may return to freshwater after spending less than 1 year in the ocean. Like other anadromous salmonids, steelhead typically return to their natal streams to spawn. Fall, winter, and summer stocks (runs) are present in the Klamath River and Scott River systems, and there is considerable overlap in the timing of their life-stages. The not warranted finding for this ESU does not distinguish between runs.

In larger tributaries of the upper Klamath River (for example, the Scott River), the fall steelhead run may begin as early as September and continue through November, while the later winter steelhead run occurs from December through April. Summer steelhead migrate into Klamath River Basin rivers in May and June; hold over in deep, cold pools; and spawn the following winter. Because of their extended stay in freshwater, adult summer steelhead are vulnerable to elevated summer water temperatures and dewatering events.

Similar to other salmonids, steelhead lay their eggs in the gravel of the stream bottom where they incubate for approximately 3 to 12 weeks, depending on water temperature. Spawning occurs from January through April, with eggs incubating until emergence. After hatching, pre-emergent fry remain in the gravel for another 4 to 6 weeks; but factors such as redd (the spawning nest of trout or salmon) depth, gravel size, siltation, and temperature can speed or retard this time (Shapolov and Taft 1954). Emergence begins as early as March and can continue through July.

Juvenile steelhead of all three runs outmigrate from freshwater after spending 1 to 3 years in nursery streams (Busby et al. 1996). A large percentage of juvenile steelhead outmigrate during their first year of rearing (age 0) or after a full year of rearing (age 1+) (66 FR 9808). However, based on analysis of scales taken from returning adults, approximately 91 percent of Klamath River winter-run steelhead juveniles enter the ocean at age 2+, having spent two summers in freshwater (Hopelain 1998). Juvenile steelhead generally outmigrate from March through June, although smolts may outmigrate during nearly every month of the year.

3.1.3 Chinook Salmon

3.1.3.1 Legal Status

A status review for Chinook salmon was completed by NMFS in March 1998 (Myers et al. 1998). Within the Upper Klamath and Trinity Rivers ESU, Klamath River spring-run Chinook salmon were identified as being at a high risk of extinction (63 FR 11493). However, NMFS concluded that the overall ESU was not at risk of becoming extinct, nor was it likely to become endangered in the foreseeable future (63 FR 11482); therefore, NMFS concluded that listing of the ESU was not warranted.

3.1.3.2 Range and Distribution

Chinook salmon are known to be distributed from Central California to Kotzbue Sound, Alaska, on the North American coast; and along the Asian coast from Hokkaido, Japan, to the Anadyr River in Russia (Healey 1991). Chinook salmon also have been reported in the Mackenzie River area of Northern Canada (McPhail and Lindsey 1970) and the Coppermine River in the Canadian Arctic (Hart 1973), suggesting that Chinook salmon may be distributed even farther north and east than Kotzebue Sound.

3.1.3.3 Life History

Fall-run Chinook Salmon. Most fall-run Chinook salmon adults returning to spawn in the middle Klamath River tributaries enter the mainstem in late summer, with peak migration occurring in late August and early September. Migration rate to the tributaries is variable and may be somewhat dependent on water temperatures. Fish enter the Scott River and other Klamath River tributaries beginning in September and continue to enter the tributaries through December. The peak of the upstream migration to the Scott River is in late October. Spawning generally occurs soon after the fish arrive on the spawning grounds, but may be delayed when flow and temperature conditions are inappropriate. Eggs incubate in the gravel during the fall and winter months, and emergence of fry occurs from late November through March. Most of the juveniles begin migrating to the ocean in the spring, soon after emergence. Fall-run Chinook salmon adults generally return to the Klamath River in their third and fourth years, but five-year-olds and two-year-old males do also occur to a lesser extent (KRTAT 2003, 2004, 2006).

Spring-run Chinook Salmon. The spawning migration of spring-run Chinook salmon in the Klamath River typically begins in April and continues through June, rarely extending into

August. Migration rate to the tributaries is variable; fish reach the tributaries in June and July. The adult fish hold in deep, cold, permanent pools in tributaries until spawning in the fall, generally in October and November. Eggs incubate over winter, and emergence of fry occurs in January and February. Outmigration of fry and smolts in the Klamath River system occurs from February through mid-June. Like the fall-run, spring-run Chinook salmon adults generally return to the Klamath River in their third and fourth years, but five-year-olds and two-year-old males do also occur to a lesser extent (KRTAT 2003, 2004, 2006).

3.1.4 Habitat Requirements

The primary factor affecting aquatic Covered Species is habitat. Due to the similarity among species, habitat requirements and aquatic habitat conditions for the three species of anadromous salmonids covered by the HCP are discussed collectively. Differences in specific preferences or requirements are noted for individual species as necessary.

3.1.4.1 Water Temperature

Anadromous salmonids are coldwater species. High water temperatures can reduce growth, result in egg loss, block upstream or downstream migration, promote disease and parasite proliferation, or result in mortality. While all anadromous salmonids require cold water, preferred temperature ranges and thermal tolerances vary by species and life stage.

Bjornn and Reiser (1991) identified suitable water temperatures for Chinook salmon spawning as 5.6 to 13.9 degrees Celsius (°C) (42 to 57 degrees Fahrenheit [°F]). Although other authors have identified slightly different upper and lower bounds to the range of suitable temperatures (Bell 1986; EPA 1971; Piper et al. 1982), other reported temperature ranges for Chinook salmon spawning are similar to those noted by Bjornn and Reiser (1991).

Suitable water temperatures for spawning by steelhead and coho salmon are slightly lower than for Chinook salmon. Bjornn and Reiser (1991) identified temperatures of 3.9 to 9.4°C (39 to 49°F) as suitable for steelhead spawning, and temperatures of 4.4 to 9.4°C (40 to 49°F) as suitable for coho salmon spawning. McEwan and Jackson (1996) reported that preferred water temperatures for spawning steelhead range from 3.8 to 11.1°C (39 to 52°F). Piper et al. (1982) identified a higher range of water temperatures (50 to 55°F) as optimal for steelhead spawning.

Suitable water temperatures for egg incubation are similar to those for spawning. Bjornn and Reiser (1991) identified temperatures during incubation of 5.0 to 14.4°C (41 to 58°F) as suitable for Chinook salmon, but slightly lower temperatures of 4.4 to 13.3°C (40 to 56°F) for coho salmon. The temperature at which Chinook salmon eggs begin to experience mortality ranges from 14°C (57.2°F) (Healey 1979) to 16.7°C (62.1°F) (USFWS 1999). For steelhead, Rich (1987) identified water temperatures of 48 to 52°F (8.9 to 11.1°C) as suitable for incubation, a narrower range than reported by Brungs and Jones (1977) for rainbow trout (5 to 13°C [41.0 to 55.4°F]). Temperatures outside these ranges can increase the occurrence of abnormal fry, increase the mortality rate, and lengthen the hatching period (Spence et al. 1996).

Cool water temperatures are also necessary for juvenile salmonids while rearing in freshwater environments. In a review of laboratory studies, McBain & Trush Inc. (2002) reported that juvenile Chinook salmon growth rates are highest at temperatures from 18.3 to 21.1°C (65 to 70°F) in the presence of unlimited food, but decrease at higher temperatures.

Marine and Cech (2004) found that juveniles reared at 21 to 24°C (70 to 75°F) experienced significantly lower growth rates, impaired smoltification indices, and greater vulnerability to predation compared with juveniles reared at lower temperatures. Reported ranges of preferred temperatures for juvenile rearing and temperatures that optimize growth show considerable variation (Tables 3-1, 3-2, and 3-3). In general, steelhead are able to rear in warmer temperatures than Chinook salmon and coho salmon.

While temperatures in the ranges displayed below are considered "preferred" or produce optimum growth rates, juvenile salmonids can tolerate higher temperatures. Temperatures above optimum temperatures may reduce growth rates of juveniles, but may not cause death. Whether death to a juvenile salmonid would occur depends on how high the water temperature is, the time of exposure, temperature acclimation history, and diet.

TABLE 3-1
Optimum and Preferred Temperatures for Juvenile Coho Salmon

Temperature (°F)	Parameter	Source
58.6	Optimum growth rate	Great Lakes Fishery Laboratory 1970
59.0	Optimum growth rate	Great Lakes Research Laboratory 1973
57.2–62.6[a]	Optimum growth rate	EPA 1971
59.0	Temperature preference	Hewett and Johnson 1987
50.0–53.6	Temperature preference	Konecki et al. 1995b
53.6–57.2[b]	Temperature preference	Brett 1952
41.0–62.6[c]	Temperature preference	EPA 1971
48.0–57.9	Temperature preference	Piper et al. 1982
53.2–58.3	Temperature preference	Bell 1973
53.0–58.0	Temperature preference	Bell 1986

[a]Temperature range of most efficient growth within consumption rates believed to occur in nature for coho salmon during late summer

[b]Temperature preference of juveniles of five salmon species combined

[c]Temperature preference of juvenile salmonids in general

TABLE 3-2
Optimum and Preferred Temperatures for Juvenile Steelhead

Temperature (°F)	Parameter	Source
62.6–66.2[a]	Optimum growth rate	Brungs and Jones 1977
61.7–63.0	Optimum growth rate	Jobling 1981
55–60	Optimum growth rate	Rich 1987
63.0	Physiological optimum	Hokanson et al. 1977
50–60	Temperature preference	Piper et al. 1982
50–55	Temperature preference	Bell 1986
45.1–58.3	Temperature preference	Reiser and Bjornn 1979
55.4–66.2	Temperature preference[a]	Brungs and Jones 1977
52.3–66.6[b]	Temperature preference	Jobling 1981
50–55.4	Temperature preference	Bell 1986
62.6–68	Temperature preference	Myrick 1998; Myrick and Cech 2000

[a] Rainbow trout

[b] Final temperature preference

TABLE 3-3
Optimum and Preferred Temperatures for Juvenile Chinook Salmon

Temperature (°F)	Parameter	Source
53.0–56.0	Optimum growth rate	Rich 1987
59.9	Optimum growth rate	Jobling 1981
55.4–64.4	Optimum growth rate	Marine 1997
55.4–68	Optimum growth rate	Marine and Cech 2004
66.2	Optimum growth rate	Myrick and Cech 2002
56.4	Physiological optimum	Armour 1991
58.6	Optimum growth rate	Brett et al. 1982
45.0–58.0	Temperature preference	Bell 1986
53.1	Temperature preference[a]	Jobling 1981
45.1–58.3	Temperature preference	Reiser and Bjornn 1979
53.6–57.2[b]	Temperature preference	Brett 1952
50–57	Temperature preference	Piper et al. 1982

[a] Final temperature preference.

[b] Temperature preference of juveniles of five salmon species combined.

Table 3-4 displays the reported values of lethal temperatures for juvenile Chinook salmon, coho salmon, and steelhead that were acclimated to temperatures close to the lethal level. Two measures of temperature tolerance are used, the upper ultimate incipient lethal temperature (UUILT) and the critical thermal maxima (CTM). The UUILT represents the highest temperature at which tolerance does not increase with increasing acclimation temperature. The CTM represents the temperature at which the fish loses the ability to escape lethal conditions. For Chinook salmon, reported UUILT values are within a narrow range, 25.0 and 25.2°C (77.0 to 77.4°F) and 25.0 to 25.8°C (77.0 to 78.4°F). Coho salmon UUILT values ranged from 23.3 to 29.2°C (74 to 84.6°F). Konecki et al. (1995a) measured coho salmon CTM in the field that exceeded published thresholds from previous laboratory tests; in the laboratory, the authors found no difference in CTMs for populations from cool and warm streams, provided that all fish were acclimated to 11.1°C (52°F) for 3 months.

UUILTs reported for steelhead show considerable variation, ranging from 23.9 to 27.0°C (75.0 to 80.6°F). The CTM reported for Central Valley steelhead is somewhat higher than the UUILT reported for steelhead in other locations (Myrick 1998; Myrick and Cech 2000). Juveniles of all species can withstand temperatures higher than the species-specific UUILT, but only for short time periods.

Under natural stream conditions, fish may cope with high water temperatures by taking refuge in cooler areas of the stream (such as deep pools and areas of upwelling groundwater). Nielsen et al. (1994) found use of cool water areas by juvenile steelhead in Northern California streams. In Rancheria Creek (a tributary to the Navarro River in coastal California), juvenile steelhead moved into cool water pools when stream temperatures exceeded 23°C (73.4°F). Temperatures at the bottom of thermally stratified pools were as much as 11°C (19.8°F) cooler than in riffle areas. Nielsen et al. (1994) suggested that such cool water areas may be particularly important in southern portions of the species' range (California), where water temperatures are highest on average.

TABLE 3-4
Lethal Temperatures Reported for Juvenile Salmon and Steelhead

Species	Lethal Temperature (°F)	Reference	Comments
Coho salmon	77	Brett 1952	Fish were acclimated to 73.4°F, and 50 percent mortality occurred in 9,000 minutes.
	78.1	Bell 1986	Unknown acclimation temperature and exposure time.
	78.4	Reiser and Bjornn 1979	Cited Bell (1973) as source for lethal temperature. Unknown acclimation temperature and exposure time.
	82.8–84.6[a]	Konecki et al. 1995a	No difference in CTM for populations from cool and warm streams provided that all fish were acclimated to 52°F.
Steelhead	75.4	Reiser and Bjornn 1979	Cited Bell (1973) as source for lethal temperature. Unknown acclimation temperature and exposure time.
	80.6[b]	Charlon et al. 1970	Calculated from regression equation.
	77–79.7[b]	Jobling 1981	Jobling (1981) lists lethal temperatures reported in five studies. The range of values is shown here.
	75	Bell 1986	Unknown acclimation temperature and exposure time.
	78	Piper et al. 1982	Unknown acclimation temperature and exposure time.
	81.5–85.8[a]	Myrick 1998	Depending on ration and acclimation temperature
	84.9–85.6[a]	Myrick and Cech 2000	Hatchery steelhead acclimated to 60.8°F.
	87.1–87.8[a]	Myrick and Cech 2000	Wild steelhead acclimated to 60.8°F.
Chinook salmon	77.4	Reiser and Bjornn 1979	Cited Bell (1973) as source for lethal temperature. Unknown acclimation temperature and exposure time.
	77.2	Brett 1952	Fish were acclimated to 24°C (75.2°F) and 50 percent mortality occurred in 12,300 minutes.
	77	Bell 1986; Piper et al. 1982	Unknown acclimation temperature and exposure time.

[a]Rainbow trout

[b]CTM

Belchik (1997) investigated the occurrence of cool water areas and their use by juvenile salmonids in the Klamath River during July and August. Cool water areas were primarily found at the mouths of tributaries. During afternoon hours, the difference between temperatures in cool water areas and the mainstem Klamath River ranged from 1.1 to 12.4°C (2.0 to 22.3°F). Juvenile steelhead, coho salmon, and Chinook salmon were found in cool water areas, but were not observed in the mainstem. Poor visibility in the mainstem precluded an assessment of the relative use of cool water areas versus the mainstem at different temperatures. Aerial surveys using thermal infrared and color videography in the Scott River Basin have shown that coldwater seeps exist throughout the basin (Watershed Sciences 2004). It is unknown whether juvenile salmonids use these areas of cooler water.

3.1.4.2 Channel Conditions

In general, the size and steepness of streams used by anadromous salmonids depends on the species' size and swimming ability. Chinook salmon, the largest anadromous salmonid species in the Klamath River system, are strong swimmers. Chinook salmon prefer to spawn in areas where the velocity ranges between 30 and 91 centimeters per second (cm/s) (1 to 3 feet per second) and depths exceed 24 cm (0.8 foot) (Bjornn and Reiser 1991). Fry occupy channel margins while moving downstream during high spring flows and usually do not overwinter in streams. Conditions preferred by Chinook salmon are most commonly found in mainstem rivers and large tributaries.

Steelhead spawn in tributary streams, and will use channels with a gradient up to 20 percent and as little as 1 meter wide, provided sufficient space and substrate for redd construction is available. Water depths greater than 24 cm (0.8 foot) are preferred (Bjornn and Reiser 1991). Fry initially prefer slow, shallow waters along channel margins, but move to deeper, faster water with coarse substrate and surface turbulence as they grow (Raleigh et al. 1984).

Coho salmon prefer small, gravel-bottomed tributaries for spawning (Schuett-Hames and Pleus 1996), and generally do not use stream reaches with gradients greater than 3 percent (Reeves et al. 1989). Coho salmon require considerably less space for redds than either Chinook salmon or steelhead, and may spawn in streams less than 1 meter wide if suitable gravels are available. Juvenile coho salmon exhibit a strong preference for pools all year, and commonly migrate into off-channel habitats such as side channels, sloughs, or beaver ponds in the winter (Cederholm and Scarlett 1981; Peterson 1980). These features are most common in unconfined channels that occupy alluvial valleys.

3.1.4.3 Off-channel Habitat and Refugia

Off-channel habitat and backwaters are favored by several species of salmonids, particularly coho salmon, as winter refugia and rearing habitat (Cederholm and Scarlett 1981). Side channels form when low- to moderate-gradient, unconfined channels migrate laterally across a floodplain. Side channels are old channels that often receive groundwater inflow and are periodically reconnected to the mainstem during high flows. Backwaters are areas of low current velocity that are partially separated from the main channel by gravel bars or large woody debris (LWD).

3.1.4.4 Pools

Pools provide habitat that is important to all species and life stages of anadromous salmonids. For many species and age-classes of juvenile salmonids, pools are important for rearing habitat (Bustard and Narver 1975; Tschaplinski and Hartman 1983; Heifetz et al. 1986; Bugert and Bjornn 1991; Heggenes et al. 1991a, 1991b). By providing shelter from predators and refugia during summer low flow periods, deep pools are beneficial to salmonid juveniles (Bugert et al. 1991; Heggenes et al. 1991b). Pools also provide areas of reduced velocity that are used by juveniles for winter rearing (Bisson et al. 1988; Heggenes et al. 1991b; Shirvell 1990) and by adults during migration and spawning (Bjornn and Reiser 1991).

Different pool characteristics are preferred by the different age classes and species of salmonids. Young coho salmon favor deep pools with abundant cover during their freshwater residence period (Sandercock 1991). Young-of-the-year trout and salmon are common in dammed and plunge pools, older trout are more common in scour pools, and coho salmon are abundant in all pool types (Bisson et al. 1982, 1988). The abundance of juvenile coho salmon is strongly influenced by the amount and quality of available pools (Carmen et al. 1984; Murphy et al. 1986).

Several different but related measures of the quantity of habitat available in pools have been used to assess habitat suitability for anadromous salmonids, including pool area, pool frequency, and pool spacing. Although the relationship between these measures and fish use, productivity, and population viability remains uncertain, these measures contribute to an overall understanding of habitat requirements for these species.

Pool Area. Studies using the habitat classification system of Bisson et al. (1982) indicate that pools in unmanaged systems in western Washington and southeast Alaska generally constitute 39 to 67 percent of the stream surface area. Peterson et al. (1992) summarized a number of these studies (Table 3-5) and suggested that 50 percent of the surface area in pools is typical in streams with gradients less than 3 percent draining unmanaged forests. Studies conducted primarily on low-gradient coastal streams and streams on the west side of the Cascade Mountains, however, do not likely reflect conditions in the higher-gradient streams typically found in interior areas such as FGS's lands and areas east of the Cascades. For example, streams in northeast Oregon that support steelhead and Chinook salmon tend to be of higher gradient where pool habitats constitute from 12 to 39 percent of the stream area (Carlson et al. 1990). These observations are similar to those of Richmond (1994), who found that pools made up 11 to 30 percent of the total stream area in alluvial mountain channels draining unmanaged forests in Colorado. These results suggest that even in unmanaged forests, streams on the east side of the Cascade Crest have less pool area than streams on the west side.

In managed landscapes, pool area is likely lower. Pool area reported for coastal streams in California was less than in the areas previously described, and ranged from 11 to 13 percent in alluvial mountain channels to 19 percent in a steep headwater tributary (Wohl et al. 1993). The upper and middle drainages of these rivers were logged extensively between 1940 and 1955 (Wohl et al. 1993).

TABLE 3-5
Percent Pool Area in Unmanaged Streams

Source	Pools (%)*	Bank Full Width (meters)	Gradient (%)	Location
Bilby and Bisson 1987	58.8	Not indicated	Not indicated	Washington
Carlson et al. 1990	28	4.1	2.0	Northeast Oregon
	39	4.0	2.1	
	21	4.5	3.5	
	27	6.1	3.8	
	29	4.5	4.4	
	12	4.1	4.5	
	16	2.3	5.4	
	37	4.0	5.6	
	20	3.8	6.5	
	18	3.8	7.1	
	12	3.0	7.4	
Grette 1985	81.1	Not indicated	0.8–1.5	Olympic Peninsula
Heifetz et al. 1986	56	6.5	0.1–3.0	Southeast Alaska
Johnson et al. 1986	49	Not indicated	2.5	Southeast Alaska
Murphy et al. 1984	39	8.3	1.0	Southeast Alaska
	50	10.3		
	67	6.6		
Ralph et al. 1994	51	3–19	1–18	Washington
Trip and Poulin 1986	32.7	Not indicated	1.1–6.0	Queen Charlottes
	25.7		2.7–9.2	
Sullivan et al. 1987	20	11	3	Washington
	30	18	4	
	65	7	4	
	40	5	5	

Note: Criteria used to define a pool vary considerably among studies
*Percent of stream surface area composed of pools
Source: Peterson et al. 1992

While the importance of pools to fish is recognized, none of the studies described investigated the relationship between the amount of pool surface area and the productivity and viability of fish populations in the various streams. Therefore, identification of a threshold or suitable range of pool surface area conditions necessary for supporting fish is inappropriate. Instead, pool area provides one element in the overall context, and can be used to draw only general inferences about the quality of the aquatic habitat for fish.

Pool Frequency and Spacing. Carlson et al. (1990) observed that streams draining unmanaged forests on the east side of the Cascade Mountains have pool frequencies ranging from 128 to 576 pools per mile (Table 3-6). Pool spacing ranges from 0.62 to 4.35 channel widths per pool (Carlson et al. 1990). The surveyed streams were typically narrow, of moderately high-gradient, and of low stream order, corresponding most closely to the high-energy mountain channels previously described. In alluvial mountain channels draining unmanaged forests in Colorado, pool spacing ranged from 2.8 to 9.0 channel widths per pool (Richmond 1994). Pool frequencies in "reference"[1] streams in the Scott River Basin ranged from 11 to 157 pools per mile, with pool spacing ranging from 1.1 to 8.5 channel widths per pool (USFS, unpublished data). As described previously, the relationship between pool frequency (or spacing) and fish use, productivity, and population viability is unknown.

TABLE 3-6
Pool Frequency and Pool Spacing in Unmanaged Streams in Northeast Oregon

Bank Full Width (meters)	Gradient (%)	Pool Frequency (pools per mile)	Pool Spacing (channel widths per pool)
4.1	2.0	128	3.05
4.0	2.1	288	1.39
4.5	3.5	576	0.62
6.1	3.8	128	2.05
4.5	4.4	272	1.31
4.1	4.5	176	2.22
2.3	5.4	160	4.35
4.0	5.6	464	0.86
3.8	6.5	160	2.63
3.8	7.1	208	2.02
3.0	7.4	208	2.56

Source: Carlson et al. 1990

3.1.4.5 Substrate

Channel substrate is a function of parent material, the rate of sediment delivery, and the transport capacity of the channel. The size and quality of substrate influences where and how successfully salmonids spawn and fry develop. A number of forest practices can increase sediment delivery to streams (Everest et al. 1987). Forest roads are a major contributor to sediment input in some basins (Reid and Dunne 1984; Cederholm et al. 1980), while other processes such as slope failures and bank erosion are more important in other basins (Scrivener and Brownlee 1989). Basin geology is another factor that can affect the amount of fine sediment in streambed gravels, and substrate composition often differs among basins with different parent materials (Peterson et al. 1992).

No single measure of channel substrate can fully describe suitability. Kondolf (2000) notes that gravel requirements of salmonids differ with life stage, thus the appropriate measure will vary with the functions of gravel at each life stage. For example, to assess whether gravels are small enough for redd construction, the median grain size may be compared with median gravel sizes used for spawning at other locations. To determine if the proportion of interstitial fine sediment could interfere with incubation or emergence, the proportion of fines in the potential spawning gravel should be corrected for likely cleansing

[1] Reference streams were identified by the USFS. These streams drain areas largely unmanaged and considered pristine. Conditions in reference streams were used for comparison to conditions in managed streams in the analysis area.

effects during redd construction before comparing to standards of incubation and emergence success. Substrate suitability should also address whether the proportion of fines could increase during incubation through infiltration, or whether adequate downwelling and upwelling currents are present.

The suitability of gravel substrate for spawning depends mostly on fish size; larger fish, such as Chinook salmon, can use larger substrate materials than can smaller fish, such as coho salmon and steelhead. However, while larger fish may be capable of spawning in steep channels with coarse sediment, they may choose to use smaller gravels in lower-gradient reaches instead. A compilation of data on gravel characteristics within redds and spawning gravels (Kondolf and Wolman 1993) indicates that salmonids use a wide range of substrate sizes for spawning. Chinook salmon use gravels with median particle sizes (D_{50}) ranging from 10.8 to 78 millimeters (mm) (0.4 to 3.1 inches). Coho salmon use smaller gravels with D_{50} ranging from 5.4 to 35 mm (0.2 to 1.4 inches). Steelhead use gravels with D_{50} ranging from 10.4 to 46 mm (0.4 to 1.8 inches) (Kondolf and Wolman 1993). Geometric mean diameter (d_g) of particle sizes used by Chinook salmon, coho salmon, and steelhead ranged from 6.8 to 62.7 mm (0.3 to 2.5 inches), 2.7 to 25.3 mm (0.1 to 1 inch) and 6.9 to 31.1 mm (0.3 to 1.2 inches), respectively (Kondolf and Wolman 1993).

Gravel sizes used by fish may be determined largely by availability (Kondolf and Wolman 1993). Also, fish may select spawning gravels based on factors other than particle size (such as depth, velocity, and/or cover). Gravel composition in spawning reaches may be modified during spawning, and the gravel composition in salmonid egg pockets and redds often differs from that in general spawning reaches (Everest et al. 1987; Chapman 1988; Young et al. 1989). Available information specific to egg pockets of salmonid redds indicates that the particle size and permeability within egg pockets exceed those measures in the surrounding gravels and within the periphery of redds (Chapman 1988). These findings indicate that random samples from within the stream reach may not accurately reflect the gravel composition within spawning reaches or substrate conditions within the redd itself.

Substrate conditions within the redd can affect the survival to emergence of salmonids. In general, survival to emergence, which is expressed as a percentage, decreases as the amount of “small” particles in the substrate increases (Lotspeich and Everest 1981; Shirazi and Seim 1981; Tappel and Bjornn 1983; Chapman 1988; Young et al. 1991). These “small” particle sizes may result in reduced survival to emergence by limiting inter-gravel flow, which reduces dissolved oxygen levels and concentrates embryo waste products, or by entrapping alevins (newly hatched salmon still attached to the yolk sac), within the streambed (Bjornn and Reiser 1991). Survival to emergence has been related to a number of measures of sediment composition (such as d_g, fredle index [f_i], and percentage of fine particles less than a given size [often < 0.85 mm]) with varying degrees of success. These evaluations have produced results that are quantitatively inconsistent among and within various fish species (Chapman 1988).

The percentage of sediments less than a certain size (for example, 0.85 mm), may not be a reliable predictor of survival to emergence (Young et al. 1991), because more than one size fraction can be damaging to incubating salmonids (Peterson et al. 1992). Survival to emergence can vary substantially at a fixed amount of fines less than one size (for example, < 0.85 mm) while the amount of other size fractions (for example, 0.85 to 9.5 mm) changes (Tappel and Bjornn 1983). While the percentage of fine sediment less than a certain size may not be the best measure of substrate composition for predicting survival to emergence, the majority of information from laboratory and field studies is specified in this manner. The existing data on the intra-gravel environment within spawning reaches and individual redds do not allow for quantitative estimates of survival to emergence to be made with known accuracy and precision (Chapman 1988; Young et al. 1991).

Although estimates of survival to emergence based on various measures of gravel composition are unreliable (Chapman 1988; Young et al. 1991), studies have shown a relationship between the amount of fine sediments and embryo survival. Peterson et al. (1992) reported approximate survival to emergence at 11 percent and 16 percent fines less than 0.85 mm for a number of studies. These studies indicate that survival to emergence is highly variable, but generally decreases with increasing fines. Embryo survival of steelhead and Chinook salmon is apparently reduced when fine sediments (< 6.35 mm) exceed 25 to 30 percent of the substrate particles (Bjornn and Reiser 1991). A target value of 27 percent depth fines, measured with a McNeil core, was used in the South Fork Salmon River (Idaho) TMDL development (EPA 1992). Reiser and Bjornn (1979) suggested that sediment particles smaller than 6.4 mm in diameter should make up less than 25 percent by volume for suitable spawning gravels. All of these recommendations are based on methods that determine the percentage of fine sediments by volume as opposed to the percentage of stream surface area occupied by fine sediment.

3.1.4.6 Large Woody Debris

The importance of LWD to aquatic complexity and fish abundance is well documented (Andrus et al. 1988; Bilby and Ward 1989; Robison and Beschta 1990; Hicks et al. 1991; Ralph et al. 1994). LWD also plays an important role in non-fish bearing channels. These channels are generally smaller and steeper (higher gradient), and have the capacity to deliver sediment directly to fish-bearing streams. While not providing habitat for fish in these channels, LWD functions to dissipate stream energy and store sediment that could affect habitat quality in downstream areas.

Functioning aquatic habitat reflects the interaction of a number of watershed and in-channel processes. The presence of in-channel LWD strongly influences many of these processes and is known to be important for maintaining quality fish habitat. Over the long term, much of the LWD that creates and maintains aquatic habitat elements is likely derived from catastrophic events such as major floods and landslides (Murphy 1995). However, LWD is also recruited when individual trees fall into the stream channel from adjacent forest stands. The probability that a tree will enter the stream upon falling is a function of the distance from the stream channel and the height of the tree. Most LWD recruited in this fashion comes from areas close to the stream channel (McDade et al. 1990; McKinley 1997). The ability of riparian forests to deliver large wood is low at distances greater than one site-potential tree height, (i.e., a tree that has attained the average maximum height possible given site conditions where it occurs), away from the channel measured along the slope (Forest Ecosystem Management Assessment Team [FEMAT] 1993).

The amount of in-channel LWD necessary to maintain suitable habitat conditions for anadromous salmonids is unknown, and is likely variable depending on factors such as forest type, watershed geology and topography, channel type, climate, and fish species. Juvenile coho salmon are strongly associated with woody debris during freshwater rearing, particularly during the winter when they seek deeper pools and side channels with abundant cover (Sandercock 1991; Bustard and Narver 1975; Heifetz et al. 1986). In contrast, juvenile Chinook salmon often move downstream to estuary areas shortly after emergence (Healey 1991), and are therefore likely less influenced by LWD loadings than coho salmon.

The amount of LWD observed in streams varies with channel width (Robison and Beschta 1990; Bilby and Ward 1989, 1991) and by channel type (Murphy and Koski 1989). LWD loading within streams also fluctuates over time in response to episodic events such as windthrow, flooding, and debris torrents that can add or remove LWD from stream channels. Forest management in riparian areas can influence the amount and characteristics of LWD in streams. While similar LWD loadings (total number of pieces) can be achieved in streams draining managed and unmanaged forests, the mean diameter of LWD produced by managed forest stands is generally lower (Ralph et al. 1994). In a study by Young et al. (2004), distributions of LWD along 13 western Montana streams were clumped, and piece abundance was similar despite differences among streams' disturbance history, providing evidence of the episodic nature of LWD loadings. The authors also found no relation between the abundance of LWD in the riparian zone and instream LWD. In their size comparison of instream LWD to riparian LWD, instream LWD pieces were larger in diameter, suggesting that the largest instream pieces were legacies of previous stands.

Bilby and Ward (1989) reported on levels of LWD observed in streams draining old-growth Douglas fir forests in western Washington. Observed levels of LWD in streams of comparable size were highly variable (see Figure 2 in Bilby and Ward 1989), indicating that even in old-growth forests, LWD loadings vary considerably from site to site. In general, LWD loading decreases with increasing channel width. Bilby and Ward (1991) performed the same type of study in managed forests for comparison to unmanaged forests. While a marked reduction in the amount of instream LWD was found in streams along managed forests, and particularly for larger streams (> 10 meters [33 feet] wide), this reduction can be attributed to selective removal of logs during undocumented salvage operations that typically occurred as part of forest harvest operations. These studies focused on discerning the effects of stream size and management on LWD characteristics, and not on LWD loadings necessary to support fish. Data on fish use and abundance were not collected.

Robison and Beschta (1990) reported LWD loadings for streams draining undisturbed Sitka spruce (*Picea sitchensis*) and hemlock (*Tsuga* spp.) forests in southeast Alaska ranging from 25 to 42 pieces per 100 meters (7.6 to 12.8 pieces per 100 feet) in channels of comparable size to those in the Bilby and Ward (1989) study. These loadings included LWD overhanging the stream channel, which was not included in the loadings reported by Bilby and Ward (1989). Murphy and Koski (1989) reported LWD loadings from 14.6 to 45.8 pieces per 100 meters (4.5 to 14.0 pieces per 100 feet) in seven watersheds in southeast Alaska vegetated with undisturbed old-growth forests of western hemlock (*Tsuga heterophylla*) and Sitka spruce. Loadings varied with channel type and channel width. In contrast to the studies by Bilby and Ward (1989, 1991), LWD loadings generally increased with increasing channel width. As with Bilby and Ward (1989, 1991), these studies did not investigate fish use and abundance relative to LWD loadings.

Studies conducted during development of the Callahan Ecosystem Analysis (USFS 1997) collected data on LWD levels in reference streams draining pristine areas of the upper Scott and Salmon River basins. LWD levels observed in the reference streams were much lower than observed in old-growth areas of Washington and southeast Alaska (Table 3-7), indicating that unmanaged forests in the Klamath River Basin may not produce LWD loadings comparable to old-growth forests in the Pacific Northwest. In addition, Harmon et al. (1986) compiled data on LWD volume in streams draining unmanaged forests of several types and from several regions. The volume of LWD in streams was highly variable, but streams draining Douglas fir forests in the Klamath Mountains (California) had about half as much instream LWD as comparable streams in the Cascade Mountains (Oregon), further suggesting the LWD loadings are typically lower in interior portions of California than in other Pacific Northwest streams.

The riparian management objective specified in PACFISH (USFS and BLM 1995) for the amount of LWD providing good habitat for anadromous fish is 20 pieces per mile, greater than 12 inches in diameter, and 35 feet in length. This and other riparian management objectives were developed using stream inventory data (USFS and BLM 1995). It is stated that "each of the interim objectives must be met or exceeded before general habitat conditions would be considered good for anadromous fish," (USFS and BLM 1995). However, there is some latitude in assessing the importance of individual habitat elements. For example, fewer pieces of large wood may constitute good habitat in headwater steelhead streams with an abundance of pools created by large boulders (USFS and BLM 1995). For the Klamath National Forest, the USFS (1994) identified 20 large pieces of wood (minimum length 35 feet and minimum diameter 12 inches) per 1,000 feet as a management goal for east-side streams.

The channel-width-dependent regression equation of Bilby and Ward (1989) has also been used to suggest "target" conditions for LWD in Washington streams (Peterson et al. 1992). Use of this relationship to develop target levels, however, assumes that the average level of LWD observed in streams draining old-growth forests provides suitable habitat conditions for anadromous salmonids. However, use of the regression equation obscures the amount of variability in LWD loading that exists among channels of comparable width (Figure 3-1).

3.1.4.7 Habitat Access

Anadromous salmonids require access to suitable spawning areas to reproduce; juveniles also disperse during their freshwater rearing stage and may move upstream or downstream following emergence. Access to spawning and rearing areas can be restricted naturally by factors such as stream gradient, depth, or geologic formations (such as waterfalls). Other potential barriers to salmonids include dams built without fish passage facilities, improperly constructed stream crossings, and stream sections that go dry due to diversion activities. Seasonal timing may determine whether human activities significantly affect habitat access for anadromous salmonids. For example, seasonal dams may not restrict access provided they are removed during the migration period(s). Likewise, dewatering creates a barrier only if it occurs during the migration period(s). Each species differs in its ability to pass potential obstructions; for example, adult steelhead are remarkable jumpers and can pass barriers up to 15 feet (4.6 meters) high (Powers and Osborn 1985). In contrast, coho salmon generally do not use stream reaches with gradients greater than 3 percent (Reeves et al. 1989).

TABLE 3-7
LWD Frequency in Unmanaged Streams by Channel Width

Channel Width (meters)	LWD (pieces/100 meters)[a]								
	Studies in Peterson[b]								Callahan Reference[c]
	1	2	3	4	5	6	7	8	
1				18.4				60	
2							48	26	
3									
4	61.05	25					52		11
5	47.56	25	62						5.3–9.4
6	38.77			38.9					
7	32.62		37				73		
8	28.09					29.5			
9	24.62	41							1.9–3.4
10	21.88					32.8			1.9–6.0
11	19.66		20	25.6		31.1			
12	17.84								
13	16.31	34							
14	15.01								
15	13.89				17.3	14.6		11	
16	12.92			22.6					
17	12.08								2.6
18	11.34		39						
19	10.66				34.3				
20						44.5			
21									
22									
23									
> 23		42			30.17	45.8		3	

[a]Criteria used to define LWD vary among studies as specified in subsequent notes. Blank cells indicate that no values could be specified.

[b]Studies cited in Peterson et al. 1992:

1. Bilby and Ward (1989) – western Washington (minimum 10 cm diameter and 2 meter length).
2. Robison and Beschta (1990) – southeast Alaska (minimum 20 cm diameter and 1.5 meter length).
3. Estimated from plots in Sullivan et al. (1987) – Washington.
4. Ralph et al. (1994 TFW Ambient Monitoring Data) – Washington (minimum 10 to 50 cm diameter and 3 meter length).
5. Cederholm et al. (1989) – Olympic Peninsula, Washington (minimum 10 cm diameter and 3 meter length).
6. Murphy and Koski (1989) – southeast Alaska (minimum 10 cm diameter and 1 meter length).
7. Fox (1992) – Mt. Rainier National Park, Washington (minimum 10 cm diameter and 3 meter length).
8. Bilby and Wasserman (1989) – Washington.

[c]Callahan reference streams from Callahan Ecosystem Analysis (USFS 1997) (minimum 10 cm diameter).

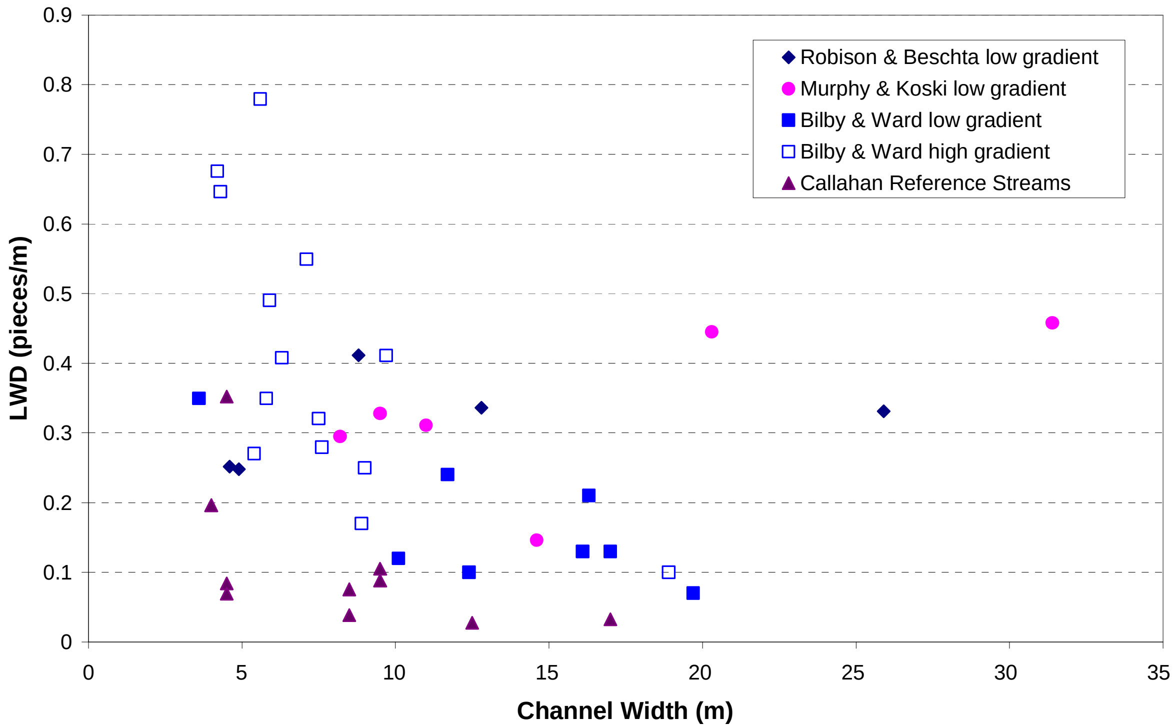

FIGURE 3-1
LWD Loadings in Streams of Varying Channel Width Draining Old-growth and Unmanaged Forests
Sources: Bilby and Ward 1989; Robison and Beschta 1990; Murphy and Koski 1989; Callahan reference streams, USFS 1997

3.2 Terrestrial Species Covered by the HCP

FGS is covering the following two terrestrial species under this HCP:

- Northern spotted owl (federally listed as threatened)
- Yreka phlox (state and federally listed as endangered)

3.2.1 Northern Spotted Owl

3.2.1.1 Legal Status

The USFWS listed the northern spotted owl as "threatened" under the ESA on June 26, 1990 (55 FR 26114-26194). In making this determination, the USFWS concluded that the northern spotted owl was "threatened throughout its range by the loss and adverse modification of suitable habitat as a result of timber harvesting exacerbated by catastrophic events such as fire, volcanic eruption, and wind storms" (55 FR 26114-26194). Special rules for the conservation of the northern spotted owl on non-federal lands were proposed on February 17, 1995, and modified on May 10, 1996 (60 FR 9483 and 61 FR 21426, respectively). An updated draft recovery plan for the species was issued on April 26, 2007 (USFWS 2007a), a final recovery plan was published in May 2008 (USFWS 2008), and a revised recovery plan for the northern spotted owl was published in June 2011 (USFWS 2011).

3.2.1.2 Range and Distribution

Northern spotted owls are associated with coniferous forests from southwestern British Columbia south through the coastal mountains and east and west Cascades of Washington, Oregon, and California. In California, northern spotted owls are present in coastal areas as far south as Marin County. In the interior portion of its range in California, the northern spotted owl extends to the southern end of the Cascades Range. The northern spotted owl's current range is approximately the same as its historical range (Thomas et al. 1990).

3.2.1.3 Life History

The following description of life history addresses life cycle and reproduction, survivorship and mortality, diet, and home range size.

Life Cycle and Reproduction. The northern spotted owl is relatively long-lived, has a long reproductive life span, invests significantly in parental care, and exhibits high adult survivorship relative to other North American owls (Forsman et al. 1984; Gutiérrez et al. 1995). Northern spotted owls are sexually mature at 1 year of age, but rarely breed until they are 2 to 5 years of age (Miller et al. 1985; Franklin 1992; Forsman et al. 2002). Breeding females lay one to four eggs per clutch, with the average clutch size being two eggs; however, most northern spotted owl pairs do not nest every year, nor are nesting pairs successful every year (55 FR 26114–26194; Forsman et al. 1984; Anthony et al. 2006). The small clutch size, temporal variability in nesting success, and delayed onset of breeding all contribute to the relatively low fecundity of this species (Gutiérrez 1996).

Courtship behavior usually begins in February or March, and females typically lay eggs in late March or April. The timing of nesting and fledging varies with latitude and elevation (Forsman et al. 1984). After they leave the nest in late May or June, juvenile northern spotted owls depend on their parents until they can fly and hunt on their own. Parental care continues after fledging into September (55 FR 26114–26194; Forsman et al. 1984). During the first few weeks after the young leave the nest, the adults often roost with them during the day. By late summer, the adults are rarely found roosting with their young, and usually only visit the juveniles to feed them at night (Forsman et al. 1984).

Natal dispersal of northern spotted owls typically occurs in September and October, with a few individuals dispersing in November and December (Miller et al. 1997; Forsman et al. 2002). Natal dispersal occurs in stages, with juveniles settling in temporary home ranges (Forsman et al. 2002; Miller et al. 1997). The median natal dispersal distance is about 10 miles for males and 15.5 miles for females (Forsman et al. 2002). Dispersing juvenile northern spotted owls experience high mortality rates, exceeding 70 percent in some studies (55 FR 26114-26194; Miller 1989). Known or suspected causes of mortality during dispersal include starvation, predation, and accidents (Miller 1989; 55 FR 26114-26194; Forsman et al. 2002). Parasitic infection may contribute to these causes of mortality, but the relationship between parasite loads and survival is poorly understood (Hoberg et al. 1989; Gutiérrez 1989; Forsman et al. 2002).

Survivorship and Mortality. The average life span for northern spotted owls is 15 to 20 years (USFWS 1992). Causes of mortality are poorly known. Northern spotted owls are susceptible to predation by a variety of avian and mammalian predators. Potential avian predators include northern goshawks (*Accipiter gentilis*), Cooper's hawks (*Accipiter cooperi*), red-tailed hawks (*Buteo jamaicensis*), great horned owls (*Bubo virginianus*), barred owls (*Strix varia*), golden eagles (*Aquila chrysaetos*), and ravens (*Corvus corax*). Fisher (*Martes pennanti*) may eat northern spotted owl eggs, and are the only mammal identified as a predator of northern spotted owls (Courtney et al. 2004).

Forsman et al. (2002) reported a high proportion (49 percent) of juvenile mortality during dispersal, and attributed the majority of these deaths to predation by raptors, particularly great horned owls. Other sources of mortality were, in descending importance, mammalian predation, starvation, and accidents (primarily automobile collisions) (Forsman et al. 2002).

Diet. Northern spotted owls are mostly nocturnal, although they also forage opportunistically during the day (Forsman et al. 1984; Sovern et al. 1994). Northern spotted owls prey predominantly on small mammals, but primary prey species vary throughout the owl's range (Barrows 1980; Forsman et al. 1984; Ward et al. 1998; Lujan et al. 1992; Zabel et al. 1995). The most common species of mammalian prey are northern flying squirrels (*Glaucomys sabrinus*), bushy-tailed woodrats (*Neotoma cinerea*), and dusky-footed woodrats (*N. fuscipes*). Other mammalian prey include red tree voles (*Phenacomys longicaudus*), terrestrial voles (*Microtus* spp., *Clethrionomys californicus*.), mice (*Peromyscus* spp.), shrews (*Sorex* spp), chipmunks (*Tamias senex*), pocket gophers (*Thomomys bottae*), brush rabbits (*Sylvilagus* spp), and snowshoe hares (*Lepus americanus*) (Barrows 1980; Forsman et al. 1984; Ward et al. 1998). Birds and insects are regularly found in owl pellets but at low frequencies (Barrows 1980; Ward et al. 1998). Generally, dusky-footed woodrats (*Neotoma fuscipes*) are a major part of the diet in the Oregon Klamath, California Klamath, and California Coastal provinces (Forsman et al. 1984, 2001, 2004; Ward et al. 1998; Hamer et al. 2001). Studies of home ranges conducted within the California Klamath and California Cascades provinces have concluded that woodrats are the principle prey species of owls in the Plan Area (Solis and Gutiérrez 1990; Carey et al. 1992; Helppi 1995; Zabel et al. 1995; Bingham and Noon 1997).

Home Range Size. Northern spotted owls are territorial and usually monogamous. A territory is the area defended by an owl, whereas the home range includes areas used for foraging. Home ranges of adjacent pairs can overlap (Forsman et al. 1984; Solis and Gutiérrez 1990), suggesting that the defended area is smaller than the area used for foraging. The home range often extends up draws and includes riparian zones, but in general, is often characterized as a circle around an activity center using the minimum convex polygon method (Hayne 1949). The activity center can be a roost or nest site, and is considered to be the center of the owl's home range.

Numerous studies have investigated home range size of the northern spotted owl throughout its geographic range (Lehmkuhl and Raphael 1993; Zabel et al. 1995; for review see Lujan et al. 1992). Home-range sizes vary geographically, generally increasing from south to north, which is likely a response to differences in habitat quality (55 FR 26114-26194). Estimates of the median size of northern spotted owl home ranges vary from 2,955 acres in the Oregon Cascades (Thomas et al. 1990) to 14,211 acres on the Olympic Peninsula (USFWS 1994). Northern spotted owls use smaller home ranges during the breeding season, and often dramatically increase their home range size during fall and winter (Forsman et al. 1984; Sisco 1990).

Geographic patterns of home range size broadly reflect geographic variation in the primary prey species. Studies have shown that home range size is related, at least in part, to the primary prey species and prey availability (for example, Zabel et al. 1995; Carey et al. 1992). Flying squirrels are often the principal prey species in northern portions of the owl's range (British Columbia to central Oregon), and home ranges are generally largest in these areas (Thomas et al. 1990; Lujan et al. 1992). In contrast, woodrats, primarily dusky-footed woodrats, predominate in the owl's diet in southern Oregon and northwestern California, and owl home ranges are generally smaller in these areas (Carey et al. 1992; for review see Thomas et al. 1990). Zabel et al. (1995) suggested that because woodrats occur at higher densities and are larger than flying squirrels, owls may not need to travel as far to fulfill their energy requirements. Consequently, in areas where woodrats are the principal prey, owls may be expected to have smaller home ranges than in areas where flying squirrels are the principal prey. In study areas dominated by late-successional forest in the southern Oregon Coast Range and California Klamath Province, the proportion of the diet containing woodrats explained 41 percent of the variation in northern spotted owls' home range size (Zabel et al. 1995).

The median home range in the Plan Area is approximately 3,398 acres, equivalent to the area of a circle with a radius of 1.3 miles (Irwin et al. 2004). For purposes of this HCP, and for California's Klamath and Cascade provinces in general, the USFWS has defined the home range size of the northern spotted owl to be a 1.3-mile (2,092-meter) radius around the activity center (USFWS 2005). While actual use of the landscape is likely concentrated within a smaller area and less circular shaped boundary, the USFWS has determined that this scale captures the owls' use of linear drainages and other important habitat features, such as mesic forest on lower slope positions (Johnson 2005). The USFWS uses a circle of 0.5-mile radius from the activity center to delineate the most heavily used area (500-acre core) during the nesting season.

3.2.1.4 Threats

A panel of species experts was assembled by the USFWS Spotted Owl Recovery Team in 2006 to aid in determining the current threats facing the northern spotted owl. The panelists unanimously identified past habitat loss, current habitat loss, and competition from barred owls as the most pressing threats to the northern spotted owl (USFWS 2007a, USFWS 2008, USFWS 2011). The following description of current threats to the northern spotted owl was derived from the draft, final, and revised northern spotted owl recovery plans (USFWS 2007a; USFWS 2008, USFWS 2011).

Barred Owls. Evidence suggests that barred owls are exacerbating the northern spotted owl population decline, particularly in Washington, portions of Oregon, and the northern coast of California (Gutiérrez et al. 2004; Olson et al. 2005, as reported in USFWS 2011). Results from several studies conclude that barred owls appear to be competing with northern spotted owls for prey and habitat (USFWS 2011). Hybridization between the barred owl and the northern spotted owl has not materialized as a significant problem (Courtney et al. 2004). Barred owls have been expanding their range, and early research suggests they may be displacing the northern spotted owl (Kelly et al. 2003). Historically, barred owls were distributed from the southern states into the northeastern United States, but the species has expanded into the northwestern states, and now completely overlaps the range of the northern spotted owl (Crozier et al. 2006). The draft, final, and revised northern spotted owl recovery plans (USFWS 2007a; USFWS 2008, USFWS 2011) identified the barred owl as a significantly greater threat to northern spotted owl recovery than previously reported in either the 5-year review (USFWS 2004b) or the status report (Courtney et al. 2004), citing significant negative effects on the reproduction, survival, and number of occupied territories of the northern spotted owl.

Barred owls have been observed to attack northern spotted owls, and individual northern spotted owls may actively avoid barred owls, thereby allowing barred owls to take over northern spotted owl territories (Hamer 1988; Dunbar et al. 1991). The presence of barred owls also could cause northern spotted owls to be less vocal, thereby interfering with the ability of northern spotted owls to find mates. These and other mechanisms suggest a relationship between the increase in barred owls and decrease in northern spotted owls occurring over the past few decades (Courtney et al. 2004).

While additional research is needed to quantitatively evaluate the effect of the presence of barred owls on northern spotted owl populations, there is a “preponderance of evidence” suggesting that barred owls are having a negative effect on the population (USFWS 2007a, USFWS 2008, USFWS 2011).

Historic Levels of Old-Growth/Mature Forest and Rates of Loss. Historical timber harvest and land-conversion were identified as the primary causes of an estimated 60 to 88 percent decline in northern spotted owl habitat from the 1800s to 1990 (USFWS 2007a, USFWS 2008, USFWS 2011). Fragmentation of forests also showed a dramatic increase from the 1930s and 1940s through 2005 (Davis and Lint 2005). The 2005 evaluation showed that fragmentation in California decreased, likely as a result of fire suppression in fire-dependent provinces.

Ongoing Loss of Suitable Habitat. While few studies have been performed since 1990 to quantify the rate of removal of suitable habitat for northern spotted owls, remote sensing of forest cover across the Pacific Northwest indicated a steep decline in harvest rates from the late 1980s and early 1990s on state, federal, and private industrial forest lands (Bigley and Franklin 2004). This decline may not equate directly to removal of northern spotted owl habitat, but shows the trends in timber harvesting during that time.

The USFWS performed trend analysis for habitat of the northern spotted owl based on the results of the Pacific Northwest remote sensing. The trends indicated an overall decline of approximately 2.11 percent in the amount of suitable habitat on federal lands as a result of range-wide management activities from 1994 to 2003 (USFWS 2007a; USFWS 2008). The Oregon Klamath Province experienced a decline of 53,468 acres since 1994 (6.8 percent decline), followed by the California Cascades Province, with a decline of 5,091 acres since 1994 (5.77 percent declines) (USFWS 2007a; USFWS 2008). These losses represent an average annual rate of decline of 0.76 percent and 0.64 percent, respectively (USFWS 2007a; USFWS 2008). Raphael (2006) estimated that range-wide loss of northern spotted owl habitat from non-federal lands occurred at a rate of 8.0 percent since 1994 (12.0 percent in Washington, 10.7 percent in Oregon, and 2.2 percent in California).

Habitat Loss as a Result of Natural Events. Natural events resulted in the loss of approximately 224,041 acres of suitable northern spotted owl habitat range-wide from 1994 to 2003. This loss of approximately 3.03 percent was attributed to wildfire (75 percent), and disease and insects (25 percent). Very little loss from wind throw was reported (USFWS 2007a).

According to the USFWS (2007a), 70 different fires contributed to the loss of habitat as a result of natural disturbances. Only 14 of 70 fires resulted in losses of suitable nesting and roosting habitat that exceeded 1,000 acres. In general, the Oregon Klamath Province suffered the highest losses of habitat from wildfire. Ninety-six percent of habitat loss in this province is attributed to the Biscuit Fire, which burned approximately 113,667 acres of habitat on three administrative units of the Rogue River basin in 2002 (USFWS 2004a).

The effects of wildfire on northern spotted owls and their habitat vary by location and by fire intensity. Low-severity fires generally result in habitat mosaics improving northern spotted owl habitat, while high-severity fires commonly result in the loss of northern spotted owl habitat. Mixed-severity fires vary in their impact to northern spotted owl habitat and may result in delayed mortality of trees, making impacts difficult to determine until well after the fire is over (USFWS 2004a).

Disease. While there are no documented cases of West Nile virus in wild northern spotted owls, experts expect that it will eventually spread throughout their range (USFWS 2004a; Blakesley et al. 2004). The virus has spread rapidly across the United States, and is now within the range of the northern spotted owl in northwestern California and Washington (Alan Franklin and John Marzluff, personal communication as reported in Courtney et al. 2004). The effects of the disease, susceptibility to infection, and mortality rates of affected individuals may vary by species; therefore, future impacts of West Nile virus on northern spotted owl populations are unknown. Wild birds may develop resistance to West Nile virus through immune responses (Deubel et al. 2001).

Blakesley et al. (2004) offer competing scenarios for the likely outcome of northern spotted owl populations being infected by West Nile virus. One possibility is that northern spotted owls can tolerate severe, short-term population reductions caused by the virus. An alternative scenario is that the virus will cause mortality resulting in long-term population declines and extirpation from parts of the northern spotted owl's current range.

3.2.1.5 Habitat Requirements

The following description of habitat requirements addresses habitat association and home range composition, nesting structures, nesting habitat, foraging habitat, and dispersal habitat.

Habitat Association and Home Range Composition. Throughout its range, northern spotted owls are associated with conifer and mixed-conifer forest types, including western hemlock–Douglas fir forests of coastal Washington and Oregon, Douglas fir and mixed-conifer types of California and Oregon, and redwood forests of coastal California. Although the particular plant species composition varies, the structural characteristics of forests inhabited by northern spotted owls are generally similar.

Northern spotted owls generally have been found to occupy areas with greater amounts of mature and old-growth forest than are found randomly selected sites within the forest landscape (Franklin and Gutierrez 2002). With the exception of the Eastern Cascades in Washington, studies summarized by Courtney et al. (2004) found that northern spotted owl activity centers were found in association with mature and old-growth forest, and that a diversity of stand ages and structures in addition to mature and old-growth forest appears to be important for habitat quality in the Klamath Province. A general comparison of the biotic and abiotic habitat features associated with high and low northern spotted owl use is presented in Table 3-8. Habitat associated with high owl use is generally comprised of a number of habitat attributes, and isolated attributes do not necessarily constitute good owl habitat.

Research by Franklin et al. (2000) appeared to show a tradeoff between the benefits to survival conferred by interior older forest, and benefits to reproduction conferred by less interior older forest and more convoluted edge. These results contrast with those of Ripple et al. (1997), who found that an index of reproductive rate increased with increasing proportion of old conifer forest in the landscape.

Zabel et al. (2003) found the probability of owl occupancy to be associated with the amount and relative proportion of nesting/roosting and foraging habitat within a 200-hectare (0.8 square mile) circle; beyond a certain point, increases in nesting and roosting habitat (typically older forest stands) do not increase the probability of owl occupancy. Zabel et al. (1995) found more owl locations in unsuitable habitat within 100 meters (328 feet) of suitable habitat than at random points. Zabel et al. (1995) hypothesized that because woodrats are the primary prey of owls in the Klamath Province study area, and woodrats are most abundant in young forest stands, owls foraged for woodrats along edges between young and older forest stands. Also in the Klamath Province, Ward et al. (1998) found that northern spotted owls selectively foraged where dusky-footed woodrats were most abundant, generally edges between late and early seral stages of mixed-conifer forest.

TABLE 3-8
Comparison of General Biotic and Abiotic Habitat Attributes Associated with High and Low Likelihood of Use by Northern Spotted Owls

Attribute	High likelihood of use	Low likelihood of use	References
Biotic			
Canopy structure	Multi-layered	Single layer	Thomas et al. 1990; Gutiérrez et al. 1995
Tree species	Mixed conifer, Douglas fir	Ponderosa pine	Irwin et al. 2006
Canopy closure	High (> 60 percent)	Low (< 40 percent)	Solis and Gutiérrez 1990; Thomas et al. 1990; Sierra Pacific Industries 1991; Gutiérrez et al. 1998; Irwin et al. 2006
Average tree size	10.5 to 18.5 inches quadratic mean diameter	N/A	Sierra Pacific Industries 1992; Farber and Crans 2000; Irwin et al. 2006
Total basal area	$\geq$ 152 feet^2 /acre	< 52 feet^2 /acre	Gutiérrez et al. 1992; Irwin et al. 2006
Large tree basal area (>35-inch dbh)	47 to 210 feet^2 /acre	N/A	Solis and Gutiérrez 1990; White 1996; LaHaye and Gutiérrez 1999
Total tree density	450 to 489 trees /acre	N/A	Irwin et al. 2006
Large tree density (>26-inch dbh)	6.8 to 7.2 trees/acre	N/A	Irwin et al. 2006

TABLE 3-8
Comparison of General Biotic and Abiotic Habitat Attributes Associated with High and Low Likelihood of Use by Northern Spotted Owls

Attribute	High likelihood of use	Low likelihood of use	References
Abiotic			
Elevation	< 5000 feet	> 6000 feet	Irwin et al. 2006
Slope position	Lower 1/3 of slope	Upper 1/3 of slope	Blakesley et al. 1992; Irwin et al. 2006
Aspect	Northern	Southern	Solis and Gutiérrez 1990; Irwin et al. 2006
Distance to water	Near	Far	Solis and Gutiérrez 1990; Carey et al. 1992; North et al. 2000; Irwin et al. 2006

Nesting Structures. Northern spotted owls do not construct their own nests. Rather, they exploit abandoned raptor or raven nests, or natural structures such as broken-top trees or cavities. In northwestern California, most nests were in broken-top trees (60 percent), followed by tree cavities (20 percent), and then platform nests (20 percent) (LaHaye and Gutierrez 1999). Trees typically used for nesting were typically large (> 100 cm, or 40 inches diameter at breast height [dbh]) conifers. Irwin et al. (2000) found that 73 percent of nest trees were greater than 80 cm (32 inches) dbh, supporting the suggestion that northern spotted owls tend to select large trees for nesting.

Nesting and Roosting Habitat. Nesting habitat for the northern spotted owl has been intensively studied, and roosting habitat has been investigated to a lesser extent. Nest sites are typically in old growth/late-seral forest stands with dense canopy closure, although younger forest stands are also used. In northwestern California, northern spotted owls selected mature and old-growth forest stands for nesting and roosting (Blakesley et al. 1992), while in the western Cascades of Oregon, about half of 44 nest sites were in old-growth/late-seral stands (≥ 80 years old), with the remaining nests in mid-seral stands from 40 to 80 years old (Irwin et al. 2000). In the California Coast Range and Klamath provinces, the canopy closure at nest sites averaged 75 percent (LaHaye and Gutiérrez 1999). Stands used by owls for nesting and foraging in the western Cascades of Oregon had canopy closure greater than 80 percent (Irwin et al. 2000).

The Plan Area is within the California Klamath and California Cascades ecological provinces. Studies in the Klamath Province in Oregon found that of 20 nest sites investigated, all were in old conifer forest (Ripple et al. 1997). On commercial timberlands in the California Klamath and Cascade provinces, stand structure was measured at 12 northern spotted owl nests, two nests immediately adjacent to the timberland, and two northern spotted owl roost sites. Mean canopy closure within one hectare plots was 67 percent (range 48–80) using a sighting tube (Farber and Crans 2000).

Northern spotted owls select sheltered roosts to avoid inclement weather, summer heat, and predation (Forsman 1976, 1980; Barrows and Barrows 1978; Barrows 1981; Forsman et al.

1984; Ting 1998). This owl has a narrow thermal neutral zone (Ganey et al. 1993, Weathers et al. 2001), and during summer months selects cool, shady roosts to minimize exposure to warm temperatures (Forsman 1976, 1980; Barrows and Barrows 1978; Barrows 1981; Forsman et al. 1984; Solis 1983; Ting 1998). During warm weather, northern spotted owls seek roosts in shady recesses of understory trees, and occasionally will roost on the ground (Barrows and Barrows 1978; Forsman et al. 1984; Gutiérrez et al. 1995). In winter, they roost relatively high in the canopy near the bole of trees with overhanging branches to shelter themselves from precipitation. On sunny winter days, they occasionally seek roosts with sun exposure (Sisco 1984). During the course of a day, northern spotted owls may move short distances in response to temperature changes or to avoid direct sunlight (Ting 1998).

Foraging Habitat. Foraging habitat has been more difficult to define than nesting habitat. Foraging habitat has been characterized through radio-telemetry studies with the assumption that nighttime owl locations represent foraging habitat. Owls appear to exploit a wider range of forest structures for foraging than for nesting and roosting (Thomas et al. 1990). In the Oregon Coast Range and Klamath provinces, Carey et al. (1992) found that old-growth forest was used by owls disproportionately to its availability on the landscape. However, owls foraged in some young forest stands more than expected, primarily in stands where woodrats were abundant. Both Zabel et al. (1995) and Ward et al. (1998) found that owls foraged near edges between young and older forest stands, and suggested that they selectively foraged in these areas to prey on woodrats. Glenn et al. (2004) found probability of foraging use to be greater near riparian areas near older conifer forests. Studies by Irwin et al. (2000) identified the amount of woody debris and the number of large snags as the most important structures influencing use for foraging. They also identified slope position and proximity to riparian areas to be important determinants of foraging use.

Both adult and juvenile owls have been observed drinking. Drinking has been observed primarily during summer and is possibly associated with thermoregulation (Gutiérrez et al. 1995). However, Weathers et al. (2001) suggested that the species requires more water than most birds, and may obtain nearly 40 percent of its required water by drinking.

Dispersal Habitat. Forsman et al. (2002) reported that juvenile northern spotted owls may search for potential nesting territories for 5 years or more, and that juvenile owl search strategies vary from local sampling of available territory near the natal site, to wide-ranging sampling of many distant territories up to 120 kilometer (km) (75 miles) from the natal site. Dispersal distances of greater than 100 km (62 miles) are rare. Forsman et al. (2002) found that the average effective dispersal distance was 4.1 km (2.5 miles) for males and 6.8 km (4.2 miles) for females.

Forsman et al. (2002) could not discern a consistent dispersal pattern for northern spotted owls in their study, but concluded that juveniles do disperse over fragmented forest landscapes. They concluded that the preservation of closely spaced old forests amidst non-forested areas or young forest areas is an adequate conservation strategy, and that narrow strips of protected forest areas (“conservation corridors”) may be needed for dispersal between northern spotted owl territories separated by large areas of unsuitable habitat.

3.2.2 Yreka Phlox

3.2.2.1 Legal Status

Yreka phlox was listed as endangered by the State of California in 1986 and has been recognized as being rare and endangered by the California Native Plant Society since 1980. Region 5 of the USFS and the U.S. Bureau of Land Management (BLM) Redding Field Office have recognized Yreka phlox as a Sensitive Species since at least 1979 (USFWS 2006). On April 1, 1998, the USFWS published a proposed rule in the Federal Register to list Yreka phlox as endangered under the ESA (63 FR 15820-15825). On February 3, 2000, the final rule determining federal endangered status for this species was published (65 FR 5268-5275). The final recovery plan for the species was issued in July 2006 (USFWS 2006).

3.2.2.2 Range and Distribution

Yreka phlox is an endemic known only from the vicinity of Yreka, California. The plant occurs on lands owned and managed by industrial timber companies, other private landowners, the USFS, California Department of Transportation, and the City of Yreka. It is currently known to occur at five locations, which are generally referred to as the China Hill, Soap Creek Ridge, Cracker Gulch, Greenhorn Creek, and Jackson Street occurrences.[2] Detailed descriptions of these known locations are provided in Chapter 4.

In addition, a single 1930 collection indicates a possible historical location near Etna or Echo Mill, near Soap Creek Ridge (USFWS 2006). However, most of the habitat in these areas does not appear suitable for Yreka phlox, and surveys near Etna and Mill Creek have failed to relocate this occurrence (Adams 1987). It has been suggested that the locality information for the collection may be incorrect (DFG 1986).

Based on the characteristics of known and reported Yreka phlox occurrences (soils derived from ultramafic parent materials, elevations from roughly 750 to 1,220 meters [2,500 to 4,000 feet] from the Yreka area to the Etna area), areas with soil derived from ultramafic rock that occur within roughly 13 km (8 miles) of any point along a line drawn from Paradise Craggy southwest through Yreka to Etna are considered to have the greatest potential to support Yreka phlox (USFWS 2006). Adams (1987) conducted a relatively extensive survey of federal lands with ultramafic soils within this area, but did not identify any new occurrences, besides the two that were known at that time. Since the species was federally listed in 2000, three new occurrences have been discovered. However, large areas of potential habitat that occur on private lands have not been surveyed. In addition, there are some unsurveyed areas of potential habitat on publicly owned and managed lands.

3.2.2.3 Life History

Yreka phlox has received little scientific study, and its biology is poorly known. Little or no information exists on seed dispersal, seed germination, or seedling establishment in the wild, or even how long Yreka phlox plants typically live. What is known about the life history of Yreka phlox is summarized here from the recovery plan (USFWS 2006).

[2] A location/occurrence consists of a group of at least 200 individual plants that is separated from any other Yreka phlox locality by at least 0.40 km (0.25 mi).

Each year prior to flowering, the plant produces new leaves and stems. The species blooms from late February to June. During this period, plants produce hundreds of rose-pink to white flowers (Ferguson et al. 2006). One seed can form in each compartment of the ovary, and each flower may produce up to three seeds. However, Ferguson et al. (2006) observed only a single seed within the fruit capsule, which fills the entire ovary at the time of maturation. By mid-summer, aboveground parts of plants become dry and nonphotosynthetic. In the next season, new growth from the tips of these dry, nonphotosynthetic shoots may occur.

Flowers of Yreka phlox are bisexual (produce both pollen and ovules). Ferguson et al. (2006) found that this species does not self-pollinate, and relies on insects to vector pollen to set fruit and produce seed. To date, insect representatives from four orders (Lepidoptera, Hymenoptera, Diptera, and Coleoptera [butterflies, bees, flies, and beetles, respectively]) have been observed visiting phlox flowers. Other phlox species are pollinated by butterflies (Scott 1997), moths (Wisconsin Department of Natural Resources 2005), and hummingbirds (Oregon State University 2005).

3.2.2.4 Threats

The primary threats to Yreka phlox involve the destruction of plants or the modification of habitat from activities such as residential development, road construction and maintenance, timber management, competition with exotic invasive weeds, fires suppression activities, herbicide application, domestic animal grazing, illegal collection and vandalism, and off-road vehicle use. Additionally, because of its limited distribution, Yreka phlox is susceptible to extinction or extirpation from a significant portion of its range as a result of random events such as fire, drought, and disease. The recovery strategy for this species depends primarily on the removal or reduction of existing threats, identification and neutralization of future threats, and development of techniques to reestablish populations in case of unforeseen future population losses (USFWS 2006).

3.2.2.5 Habitat Requirements

The primary factor affecting the distribution of Yreka phlox is habitat. Yreka phlox grows on serpentine soils at elevations from 880 to 1,340 meters (2,800 to 4,400 feet) in association with other plants tolerant of serpentine soils, particularly Jeffery pine (*Pinus jeffreyi*), incense cedar (*Calocedrus decurrens*), and junipers (*Juniperus* spp.) (65 FR 5268-5275). As a serpentine endemic, Yreka phlox is found only on soils derived from ultramafic parent rocks, including serpentinite and peridotite. Ultramafic rocks and their derivatives have high concentrations of magnesium and iron, and often have high concentrations of chromium and nickel. Most plants cannot grow on serpentine soils due to excessive magnesium and nickel, and low calcium and nutrient (nitrogen, phosphorus, and potassium) levels. However, some plants, like Yreka phlox, adapt to these conditions and are wholly or largely restricted to them (Kruckeberg 2002).

In and near Yreka, serpentine soils are shallow to moderately deep, and have moderate to high erosion hazard ratings (Soil Conservation Service [SCS] 1983). Yreka phlox is known to occur on five soil types, as classified and described in the Soil Survey of Siskiyou County, California, Central Part (SCS 1983). Soils associated with specific phlox occurrences include soil type numbers 143 (Dubakella-Ipish Complex, 5 to 30 percent slopes) 144 (Dubakella-Ipish Complex, 30 to 50 percent slopes) 178 (Lithic Xerorthents-Rock Outcrop Complex, 0 to 65 percent slopes), 213 (Rock Outcrop-Dubakella Complex, 30 to 50 percent slopes), and 237 (Weitchpec Variant-Rock Outcrop Complex, 5 to 65 percent slopes). Specific conditions at each occurrence are described in the recovery plan (USFWS 2006).

3.3 Species Not Covered in the HCP

The following section describes species not proposed for coverage under the HCP, and an explanation of why they are not proposed for coverage.

3.3.1 Bald Eagle

On July 28, 2007, the USFWS removed the bald eagle from the federal list of endangered and threatened wildlife. The bald eagle was listed as an endangered species by the State of California in 1971, and remains listed by the State of California.

Bald eagles require large bodies of water, such as lakes and large rivers, for nesting and wintering. One active bald eagle nesting site is located west of Grass Lake on FGS land. In a May 19, 2004, consultation letter, the DFG (2004), identified the following protection measures for the nesting site:

- Continuation of a previously established primary zone around the nest site. Any timber harvesting proposed within the primary zone must be approved by DFG.
- Maintenance of the main haul road located adjacent to the primary zone shall only be conducted outside of the bald eagle nesting period (August 16 through January 14).
- Continuation of a previously established secondary zone around the nest site.
- With the exception of log hauling on the main road, west of the primary zone, no timber operations shall occur in the primary or secondary buffer zones during the bald eagle nesting period.
- The existing short-spur road and small landing within the primary zone, and adjacent to the headwater spring that is the source of the Class II stream, shall not be enlarged beyond their present size.
- FGS shall submit a California Natural Diversity Database form to include bald eagle reproductive success or failure for years when logs are hauled past the primary zone during the bald eagle critical breeding period (January 15 to August 15).
- In the event that the reproductive effort has failed, or the young fledge earlier than August 15 (as determined by a CAL FIRE-approved biologist), the timing restrictions may be adjusted.

- Further consultation with DFG will be required if (1) the bald eagles nest in a different tree, or (2) FGS proposes timber harvesting within the primary zone.

The Plan Area contains only low-order drainages such as ephemeral and intermittent streams, and does not support the large aquatic features eagles typically use. Bald eagles may use the Plan Area on a transient basis, but are unlikely residents. Based on the protection measures for the identified bald eagle nest and the low likelihood for indirect adverse impacts to bald eagles on the majority of the Plan Area, this species is not covered in the HCP.

3.3.2 Siskiyou Mariposa Lily

Siskiyou mariposa lily is designated as a candidate species by the USFWS, a sensitive species by Region 5 of the USFS, a rare species by the State of California, and a critically imperiled species by the State of Oregon. As a result of information gained during the 2003 field season, namely the observation of juvenile plants across the California range, the USFWS downgraded the candidate status from listing priority 2 to priority 5 (70 FR 24869). The species is restricted to three occurrences in the Klamath/Siskiyou Range located near the border of California and Oregon. All three occurrences are found on open ridgeline rock outcrops and shallow talus soils. It appears to occur in greater numbers on north-facing slopes. The Cottonwood Creek Drainage occurrence is located within FGS's Klamath River Management Unit. Based on the downgraded candidate status and uncertainty of future listing, FGS chooses not to include the Siskiyou mariposa lily as a Covered Species in the HCP.

3.3.3 Fisher

The fisher (*Martes pennanti*) is a medium-sized terrestrial carnivore in the weasel family (Mustelidae) and is a candidate for federal listing. On April 8, 2004, the USFWS issued a 12-month petition finding, which determined that listing the species was warranted but precluded (69 FR 18769 and 18792). The fisher is a Species of Special Concern in California. Fishers are distributed throughout coniferous and mixed forests of Canada and northern portions of the United States. The fisher's current range is divided into two populations separated by about 420 km (260 miles) (Zielinski et al. 1997). One population is in northwestern California in portions of Del Norte, Siskiyou, Humboldt, Trinity, and Shasta counties, and across into Oregon in Curry, Josephine, and Jackson counties. The other is in the southern Sierra Nevada in portions of Mariposa, Madera, Fresno, Tulare, Kern, Mono, and Inyo counties. The southern Sierra Nevada population appears isolated from the northern population (Zielinski et al. 1997). Fishers have large home ranges, with those of males considerably larger than those of females (reviewed in Powell and Zielinski 1994; Zielinski et al. 2004; Truex et al. 1998). Truex et al. (1998) found that home range sizes were largest in their eastern Klamath study area in Northern California where habitat quality was generally considered poor. Zielinski et al. (2004) found that females had home ranges almost three times larger in their Northern California study area in the Coast Ranges than in their southern Sierra Nevada study area. Both studies concluded that home range size is influenced by habitat quality and prey availability. Fishers are known to occur on the FGS ownership, although their abundance and distribution is poorly understood. FGS chooses not to include the fisher as a Covered Species because it is not listed, and because so little is known about fishers' use of the FGS ownership that effects of the Covered Activities cannot be evaluated, nor a meaningful conservation program developed for this species. FGS intends to coordinate with the USFWS to study the species presence and use on its ownership.

3.3.4 Siskiyou Mountains Salamander

The Siskiyou Mountains salamander is a member of the Del Norte salamander (*Plethodon elongatus*) species complex in the lungless salamander family (Plethodontidae) (DFG 2005a). This species is associated with rocky, forested areas, particularly thick, moss-covered talus. The Siskiyou Mountains salamander (*Plethodon stormi*) was considered rare in 1971 and listed as threatened under CESA in 1985. DFG petitioned for delisting of the species in 2005 due to recent studies showing that the range and abundance of the salamander is greater than previously known (DFG 2006). The Siskiyou Mountains salamander remains listed as threatened by the State of California.

The Siskiyou Mountains salamander was petitioned for emergency listing under the ESA in 2004, at which time petitioners requested that the Scott Bar salamander also be considered for listing if the Siskiyou Mountains salamander and the Scott Bar salamander were later determined to be separate species. Following the petition, Mead et al. (2005) recognized the Scott Bar salamander (*Plethodon asupak*) as a species separate from the Siskiyou Mountains salamander. After a thorough review of all available scientific and commercial information, the USFWS found that listing the Siskiyou Mountains salamander and Scott Bar salamander was not warranted (73 FR 4379). FGS chooses not to include the Siskiyou Mountains salamander as a Covered Species because it is not federally listed, and because little is known about the species' presence and use of the FGS ownership, such that effects of the Covered Activities cannot be evaluated, nor a meaningful conservation program developed for this species.

3.3.5 Scott Bar Salamander

The Scott Bar salamander was first described in 2005 (Mead et al. 2005). This species, once considered a subspecies of the Siskiyou Mountains salamander, is now considered morphologically and genetically distinct enough from closely occurring *P. elongates* and *P. stormi* to be given full species status (Mead et al. 2005). The Scott Bar salamander occurs in a small area of the Siskiyou Mountains in northern Siskiyou County (mostly south and southeast of the range of *P. stormi*). The Scott Bar salamander has the same habitat associations as the Siskiyou Mountains salamander. The Scott Bar salamander is currently not afforded protection under the ESA but is a state-listed threatened subspecies of the Siskiyou Mountains salamander under CESA. FGS chooses not to include the Scott Bar salamander as a Covered Species because it is not federally listed, and because little is known about the species' presence and use of the FGS ownership, such that effects of the Covered Activities cannot be evaluated, nor a meaningful conservation program developed for this species.

CHAPTER 4

Environmental Baseline

This section describes the environmental baseline for species covered in the HCP. The environmental baseline begins with Section 4.1, which provides a description of the historical context for the Plan Area. Existing physical environmental conditions in the Plan Area, such as climate, hydrology, topography, roads, and vegetation, are described in Sections 4.2 through 4.7. Aquatic Covered Species and their habitats in the Plan Area are described in Section 4.8, followed by a description of terrestrial Covered Species and their habitats in Section 4.9. The aquatic and terrestrial sections are organized differently. The aquatic section describes each species' status and distribution, both regionally and in the Plan Area; describes channel types in the Plan Area; and lastly, discusses the aquatic habitat elements in the Plan Area that are common to all of the aquatic Covered Species. In the most basic sense, *habitat* is what plants and animals call home, and consists of the elements it needs to survive. These elements may be tied to such things as temperature, substrates, sources of food, refuge from predators, places to reproduce, and other living and non-living factors.

The northern spotted owl description is organizationally more complex, because the species population and habitat status must be understood at three landscape scales (range wide, regional, and local), to adequately assess the effects of the Covered Activities and Conservation Program on the species in subsequent chapters. The local and regional scales are defined using the terms *Area of Impact* and *Area of Analysis*, respectively, and are described in Section 4.9.1. The range of the northern spotted owl is divided into 12 physiographic provinces from Canada to northern California, and from the Pacific Coast to the eastern Cascades. The regional and local scales containing the Plan Area are within the California Klamath Province and California Cascades Province. Demographic characteristics, habitat characteristics, amount of federal reserve lands, and threats are distinctly different between the two provinces, and thus warrant separate discussion. Lastly, stand conditions specific to FGS's Klamath River Management Unit, Scott Valley Management Unit, and Grass Lake Management Unit are described.

The Yreka phlox description consists of the regional status and distribution, including threats, and the status and distribution of the species in the Plan Area.

4.1 Historical Context

This section presents a summary of past human activities and disturbance regimes that have altered the landscape within the Plan Area to provide the historical context of how conditions have been altered through time. Existing conditions in the Plan Area are largely the result of past management practices and natural disturbance regimes. Many factors have combined to alter the present environment from conditions that existed prior to Anglo-American settlement of the Klamath and Scott River basins. Human-induced changes have been the result of timber operations, mining, grazing, and dams and diversions. Other factors that have influenced the current conditions within the Plan Area are the underlying geology, flood history, and the past fire regime. The historical vegetative condition is described briefly to provide context. Much of this information was drawn from the Beaver Creek (USFS 1996a), Horse Creek (USFS 2002), Callahan (USFS 1997), and Lower Scott (USFS 2000) ecosystem analyses.

4.1.1 Timber Operations

Early logging operations used steam donkeys (steam powered hoists), log chutes, horses, and oxen to transport logs. Yarding was typically conducted in a downhill direction, toward the mills located along the streams. Steam donkeys were eventually replaced with steam engines and railroad track, allowing logs to be transported longer distances. By the late 1930s and 1940s, railroad logging declined and railroad grades were converted to road systems for logging trucks. More modern yarding techniques developed, allowing logs to be yarded uphill away from streams to landings located higher on the hill slope. Extensive new road development and reconstruction of existing roads began in the late 1950s and continued to the mid-1980s by private timber companies and the USFS, primarily for timber harvest.

Through 1971, timber harvest concentrated on old-growth stands. Requirements for logging included snag removal and stream cleaning. Large sugar pine and ponderosa pine were the preferred logs because they were easy to mill. Mills were designed to accommodate logs more than 20 inches in diameter. During the 1950s, mills were refurbished to cut dimensional lumber and fir trees became desirable. Since passage of the Forest Practices Act in 1972, timber management has focused on younger, more productive forests. Mandatory protective measures for natural resources have been implemented, including designated stream protection zones, canopy retention standards, stream crossing standards, and other protective best management practices.

4.1.2 Mining

Gold mining within the Klamath and Scott watersheds was the primary resource for extraction from the mid-1850s through the 1930s. Hydraulic mining began in the area sometime after 1850, and operations were often concurrent with hard-rock and dredge mining. Giant “monitors” were used to wash away entire hillsides. This form of mining may have existed into the 1930s along with dredge and small-scale, depression-era placer mining. Large-scale dredge mining, however, continued in the upper reaches and tributaries of the Scott River until the 1950s (USFS 1997).

Mining was very destructive to fish habitat in the lower Klamath basin in the 1800s (Committee on Endangered and Threatened Fishes in the Klamath River Basin [CETFKRB] 2004). Hydraulic mining diverted creeks to supply water to high pressure nozzles that leveled entire hillsides and rearranged much of the riparian areas in the basin. Waterborne soil, rocks, minerals, and debris were directed into sluices containing mercury, which extracted the gold. Sluicing and hydraulic mining operations increased turbidity and siltation, which adversely affected benthic invertebrates, smothered salmon redds, destroyed riparian areas, and filled pools with sediment. Deforestation associated with mining destabilized hillslopes, and increased erosion, flooding, and fires. Miners also directly impacted aquatic resources through overfishing, damming, and stream diversions (Malouf and Findlay 1986). Mining activities in the 1800s caused extensive changes to the

Scott Basin, including the main stem, South Fork, Oro Fino, Shackleford, and French creeks (CETFKRB 2004). Yuba dredges caused some of the most visible damage to the basin from 1934 to 1950 (Sommarstrom et al. 1990). Taft and Shapovalov (1935) identified severe damage to fish habitat caused by Yuba dredges, which usually left the coarsest boulders on the surface of the streambed, armoring the finer sediments underneath (CETFKRB 2004). Elemental mercury, which was used to extract gold, was released into the environment and continues to be found in the environment. Methyl mercury, which forms in anoxic environments, is a neurotoxin, and the form of mercury that is most easily bioaccumulated in organisms. Juvenile coho salmon are sensitive to methyl mercury, and early life stages may be adversely affected by low concentrations of methyl mercury and other mining contaminants (USFWS 1991; Buhl and Hamilton 1991; Devlin and Mottet 1992; Buhl and Hamilton 1990).

It was also known that the Klamath Mountains in California had large low-grade chromite and manganese deposits (USFS 2002). Chromite was needed during World War II for making lighter and stronger steel alloys for airplanes, military tanks, oil-refining tanks, projectiles, and automobile engines. In 1942, the War Production Board shut down nonessential gold mines and shifted to the extraction of these strategic metals. By late 1944, however, the federal government terminated price subsidies, and large-scale chromite mining was discontinued.

4.1.3 Grazing

Domestic livestock were brought to Northern California more than 150 years ago. Miners and homesteaders raised livestock to supply food for local residents and for transportation to distant markets. As the Scott Valley area became settled and ranches were established, cattle and sheep were moved into the adjacent mountains to forage. In the early 1900s, grazing was largely unregulated, and livestock numbers were as much as five times higher than what is currently permitted on the Klamath National Forest (USFS 1996a, 2000, 2002). In the past, the longer grazing seasons of February through December (compared to the present April to October grazing season) allowed animals to graze plants in the more sensitive times of spring and early winter. Continued high use of the mountain rangelands created degraded conditions in some areas, and forage production was reduced. The land affected by grazing today is a much smaller portion of the Klamath National Forest (USFS 1996a, 2000, 2002).

4.1.4 Dams and Diversions

Many dams were built in the Klamath River system to divert water for mining, agriculture, and domestic use. These dams and diversions blocked salmon and steelhead from more than 200 miles of spawning and rearing habitat along Klamath River tributaries (California Department of Water Resources 1960). Unscreened or poorly screened water diversions and ditches resulted in a significant loss of juvenile fish, which Taft and Shapovalov (1935) reported as the "most serious present loss of trout and salmon." During a review of Klamath River ditches, most were found to contain juvenile fish (Taft and Shapovalov 1935). In an early survey of diversions in the Klamath Basin, the Scott River was reported to have 70 diversions, most of which were unscreened (Taft and Shapovalov 1935). Many other diversions, screened and unscreened, were located in tributaries of the Klamath and Scott rivers. Early fish habitat surveys in the basin noted that the vast majority of screened diversions needed repair (Taft and Shapovalov 1935).

The state began efforts to screen the diversions in Scott Valley as early as the 1930s. A permanent program was initiated in the 1970s with the establishment of an improved DFG Stream Improvement Headquarters established in Yreka. The DFG constructed 30 fish screens in the Scott River watershed on important diversions from the 1970s through the mid-1990s (Siskiyou Resource Conservation District [RCD] 2005a). Since 1992, the Siskiyou RCD has installed a total of 62 fish screens (Siskiyou RCD 2008). Combined with the 30 fish screens the DFG constructed and maintains, 92 of the estimated 120 active diversions are screened. An estimated 13 active diversions remain unscreened in the uppermost portions in the watershed. All fish screens constructed by the Siskiyou RCD meet federal and state screening criteria.

4.1.5 Flood History

Floods have been a major influence on the condition of streams and rivers in the Klamath River Basin. Large floods are documented for parts of the Klamath River in 1861, 1864, and 1875. Early explorers documented floods in the 1700s (USFS 2002). Examination of the stream flow data from the Salmon River near its confluence with the Klamath River between 1912 and 1997 indicates that major floods occurred in 1953, 1955, 1964, 1970, 1971, 1972, 1974, and 1997; the largest peak flow occurred during the 1964 event when flows reached 100,000 cubic feet per second (cfs). Other flood events were much smaller; the daily mean flow in the 1953 event was about 43,000 cfs, and the 1955 event was 64,000 cfs. In 1970, 1971, 1972, and 1974, the peak daily mean flows were 41,000, 55,000, 44,000, and 54,000 cfs, respectively. The second highest peak flow on the Salmon River occurred in 1997, when flows reached a peak of about 70,000 cfs (USFS 2002). The flood of January 1, 1997 was approximately a 25-year flood for the Scott River subbasin as measured at the U.S. Geological Survey (USGS) gage at the lower end of Scott Valley (Appendix B in USFS 1997). The floods of 1955, 1964, 1970 to 1974, and 1997 are associated with landslide episodes on the Klamath National Forest (USFS 2002).

4.1.6 Fire Regime

Few forested regions have experience fires as frequently and with such high variability in severity as those in the Klamath Mountains (Taylor and Skinner 1998). The fire regime prior to European settlement (1850) within the Klamath area can be described as having frequent fires with return intervals of 1 to 25 years. Lightning and American Indian burning were the predominant causes of ignition (USFS 1996a, 1997, 2000, 2002). The pre-European fire regime can be described as having mostly low- to moderate-intensity fires, with only small areas burning at high intensity. Fire return intervals were shorter on exposed sites and longer on sheltered sites. The steepness of the slopes and vegetation that had adapted to a history of frequent fires contributed to the varying intensities. Fire worked as both a thinning agent and an agent of decomposition. Although most vegetation (mixed conifers) promoted lower intensities when burned at frequent intervals, stand-replacing events occurred in some areas.

Fire frequency, intensity, and size occurring within the Plan Area have changed since the fire-suppression era (1950 to present) (Fry and Stephens 2006). Prior to the fire-suppression era, fires occurred frequently; and in most of the vegetation assemblages covering large portions of the Klamath Mountains, they were of generally low to moderate and mixed severity (Skinner et al. 2006). Fires occurring in the fire-suppression era are less frequent and have greater intensity, resulting in a more homogeneous affect on the habitat by damaging and removing all vegetation (Fry and Stephens 2006). Aspect, stand diameter, elevation, and topography are all factors that influence fire intensity within the Klamath region (Taylor and Skinner 1998; Fry and Stephens 2006; Alexander et al. 2006).

4.1.7 Vegetation

Prior to European settlement, much of the Plan Area was maintained in an open mixed conifer forest. Ponderosa pine was the dominant conifer species found in open lower elevation stands on south and west aspects. Douglas fir was most prevalent on moister sites, especially on north and east aspects (USFS 1996a, 2002). Due to the historic fire regime, north and east aspects supported denser stands than south and west, but were less dense than current stands (USFS 1996a, 2002). True fir was found on colder sites above 5,000 feet elevation, and the mixed conifer forest blended into hardwoods on drier sites below 3,000 feet. Under the historical fire regime, brush fields within the Plan Area were periodically replaced, but fire suppression has resulted in much denser and larger vegetation here as well. Depending on the level and types of human activities conducted, these vegetation communities have been altered to varying degrees.

The fire-suppression era, beginning at about the same time as the first commercial harvest activities, has allowed dense conifer stands to develop, and more litter and downed woody material accumulation than that under the historical fire regime (USFS 1996a, 2002). The lack of fire favors regeneration of Douglas fir and white fir over pine species. Currently, dense stands of Douglas fir and white fir are found in some areas that were historically open, pine-dominated stands.

4.2 Land Ownership and Use

FGS's Hilt/Siskiyou ownership is intermixed with federal and other private lands (Figure 4-1). The KNF accounts for the largest proportion of adjacent federal land; although a small portion of FGS lands are bordered by lands managed by the BLM. Much of FGS's Klamath River Management Unit is in "checkerboard" land—land in alternating sections typical of lands granted to the railroad in the nineteenth century—with USFS lands and other private landowners. FGS's Scott Valley and Grass Lake Management Units generally consist of larger, more contiguous blocks surrounded by USFS lands or private landowners. Adjoining privately owned lands are managed for commercial timber harvest in a manner similar to the FGS ownership, or are agricultural lands with rural residential use. Land use within the Plan Area is summarized in Table 4-1 as percentage of total drainage area.

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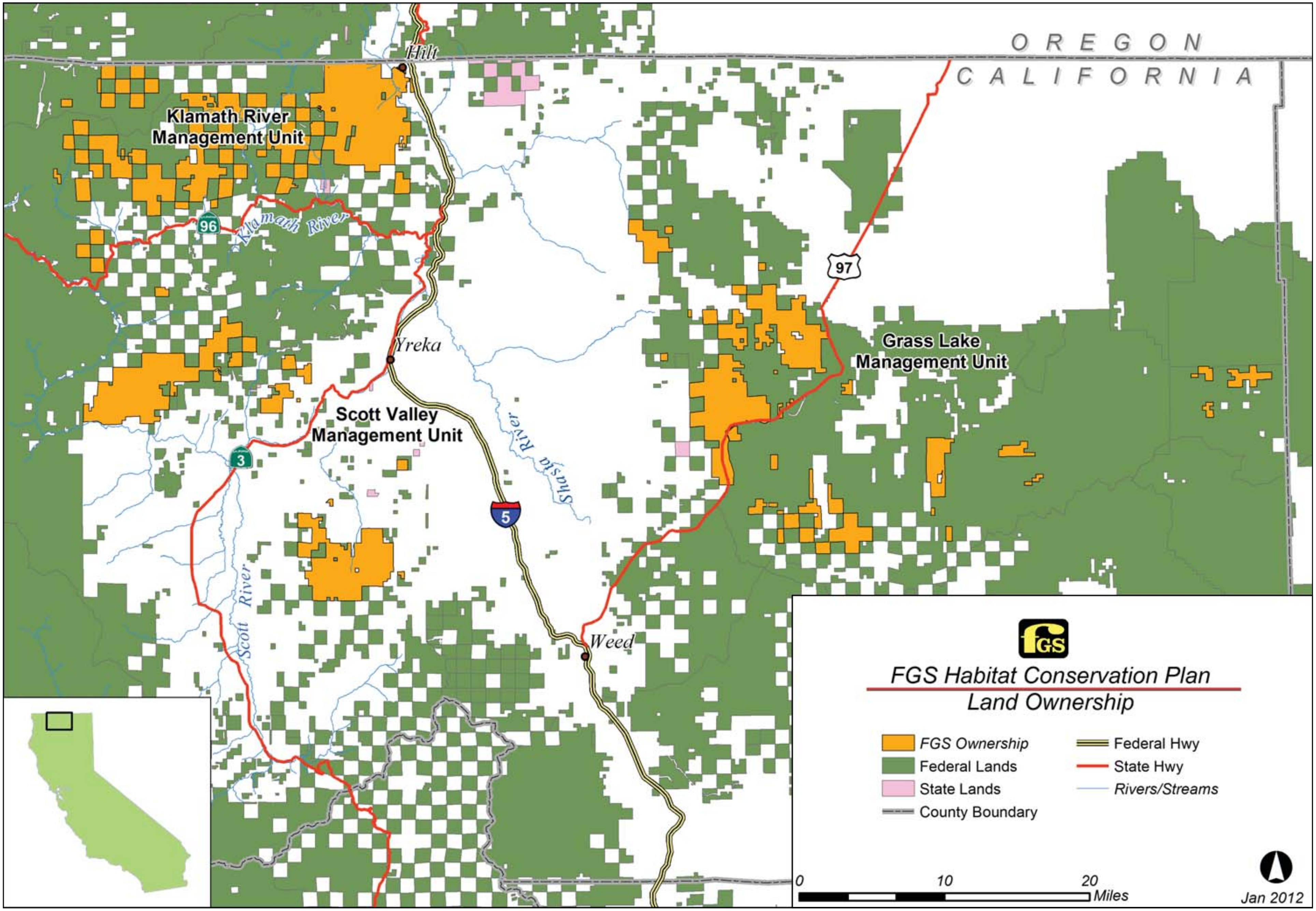


FIGURE 4-1
Site Location Map

TABLE 4-1
Land Use in the Plan Area as a Percentage of Total Drainage Area

Drainage	Agriculture	Commercial	Federal	Highway	Recreational	Residential	Rural Residential	Timberland	Urban	Other
Antelope Creek	2%	0%	56%	0%	0%	0%	15%	28%	0%	0%
Antelope Sink	12%	0%	83%	0%	0%	0%	3%	2%	0%	0%
Beaver	0%	0%	64%	0%	0%	0%	2%	34%	0%	0%
Big Ferry	0%	0%	51%	0%	0%	0%	13%	36%	0%	0%
Bogas Creek	59%	0%	27%	0%	0%	0%	2%	12%	0%	0%
Canyon	0%	0%	55%	0%	0%	0%	9%	36%	0%	0%
Cottonwood	27%	0%	26%	0%	0%	0%	1%	45%	0%	0%
Doggett	6%	0%	38%	0%	0%	0%	0%	55%	0%	0%
Dona	2%	0%	39%	0%	0%	0%	19%	41%	0%	0%
Dutch Creek	3%	0%	24%	0%	0%	0%	12%	61%	0%	0%
Duzel	38%	0%	1%	0%	0%	0%	61%	0%	0%	0%
EF Scott	15%	0%	32%	0%	0%	0%	34%	19%	0%	0%
Elliott Creek	0%	0%	72%	0%	0%	0%	2%	26%	0%	0%
Empire Creek	0%	0%	48%	0%	0%	0%	10%	42%	0%	0%
Fourmile Hill	0%	0%	98%	0%	0%	0%	0%	2%	0%	0%
Garner Mtn	0%	0%	88%	0%	0%	0%	1%	12%	0%	0%
Glass Mtn	4%	0%	88%	0%	0%	0%	1%	8%	0%	0%
Grass Lake	48%	0%	20%	0%	0%	0%	1%	30%	0%	1%
Headwaters	20%	0%	39%	0%	0%	0%	7%	33%	0%	0%
Horse	2%	0%	64%	0%	0%	0%	6%	27%	0%	0%
Horsethief	12%	0%	74%	0%	0%	0%	1%	13%	0%	0%
Indian	17%	0%	34%	0%	0%	0%	22%	26%	0%	0%

TABLE 4-1
Land Use in the Plan Area as a Percentage of Total Drainage Area

Drainage	Agriculture	Commercial	Federal	Highway	Recreational	Residential	Rural Residential	Timberland	Urban	Other
Juanita Lake	22%	0%	56%	0%	0%	0%	5%	17%	0%	0%
Little Shasta	39%	0%	41%	0%	0%	0%	0%	20%	0%	0%
Lumgrey Creek	0%	0%	42%	0%	0%	0%	33%	24%	0%	0%
McConaughy	23%	0%	8%	0%	0%	0%	69%	1%	0%	0%
Meamber	5%	0%	0%	0%	0%	0%	20%	74%	0%	0%
Middle Klamath	36%	0%	44%	0%	0%	0%	12%	8%	0%	0%
Mill	0%	0%	47%	0%	0%	0%	5%	48%	0%	0%
Moffett	15%	0%	17%	0%	0%	0%	32%	35%	0%	0%
NW Mt Shasta	33%	0%	56%	0%	2%	0%	5%	3%	0%	0%
Pat Ford	0%	0%	49%	0%	0%	0%	10%	41%	0%	0%
Patterson	3%	0%	27%	0%	0%	0%	10%	60%	0%	0%
Rattlesnake	32%	0%	22%	0%	0%	0%	24%	22%	0%	0%
Seiad	1%	0%	72%	0%	0%	0%	10%	18%	0%	0%
Shasta Valley	71%	0%	15%	0%	0%	1%	5%	6%	1%	0%
Shasta Woods	12%	0%	70%	0%	0%	0%	2%	15%	0%	0%
Willow Creek	92%	0%	5%	0%	0%	0%	0%	3%	0%	0%

Federal lands of the KNF are managed for multiple uses including recreation, fish and wildlife habitat, timber harvest, and visual resources under the KNF Land and Resource Management Plan (LRMP) (USFS 1994). The LRMP was largely based on the *Record of Decision for the Final Supplemental Environmental Impact Statement on Management of Habitat for Late-Successional and Old-Growth Forest Related Species within the Range of the Northern Spotted Owl signed April 14, 1994* (Record of Decision) (USDA and USDI 1994). Under the LRMP, the USFS will manage about 22 percent of the KNF as late-successional reserves (LSRs), with the objective of providing for the viability needs of late-successional species using an ecosystem-based approach. About 35 percent of the KNF is considered matrix lands that are managed for multiple-use purposes, including timber harvest, fish and wildlife resources, recreation, and visual resources. The remaining 43 percent of the KNF consists of other congressionally designated areas and administratively withdrawn areas. Many of these areas (such as wilderness areas, backcountry areas, riparian reserves, cultural areas, and research natural areas) will be managed in a manner consistent with achieving late seral conditions (USFS 1994).

Riparian reserves on the KNF are designated primarily along perennial and intermittent streams, lakes, ponds, seeps, springs, and wetlands. They are also designated in unstable and potentially unstable non-riparian areas that are primary contributors of sediment and wood to aquatic systems. In riparian reserves, riparian-dependent resources are of primary concern, with management standards and guidelines applied to maintain or restore riparian functions. In keeping with the Record of Decision, riparian reserves are at least 300 feet wide along fishbearing (Class I)[1] streams, and at least 150 feet wide along perennial, non-fishbearing (Class II) streams. Along intermittent streams and around unstable or potentially unstable areas, riparian reserves are at least 100 feet wide. Timber harvest is generally prohibited in riparian reserves unless it is consistent with or necessary to achieve the Aquatic Conservation Strategy objectives set forth in the Northwest Forest Plan. Other land uses, such as grazing and mineral operations, are similarly restricted in that they must be conducted in a manner compatible with the Aquatic Conservation Strategy objectives. Riparian reserves encompass an estimated 458,000 acres (27 percent) of KNF (USFS 1994).

4.3 Climate

The climate in FGS's Klamath River Management Unit can be characterized as temperate Mediterranean, with hot, dry summers and cool, moist winters. Precipitation in the Klamath River watershed varies greatly, from around 20 inches per year in the upper watershed to as much as 100 inches per year near the coast. FGS's Klamath River Management Unit lies near the middle of this range; precipitation increases with elevation within the unit. Precipitation in the Klamath River Management Unit ranges from an average of around 30 inches per year in the lower elevations near the Klamath River to about 75 inches per year at the highest elevations, with approximately 90 percent falling between October and May (USFS 1996a, 2002). Summer precipitation occurs primarily during thunderstorm activity; high-intensity, short-duration thunderstorms are common (USFS 1996a, 2002). Below 3,500 feet in elevation, most precipitation is rainfall; and above 4,000 feet, winter precipitation is predominately snowfall. Higher-elevation terrain in the

[1] Stream classes used in this HCP are those defined in the California Forest Practice Rules (CAL FIRE 2008)

Klamath River watershed receives large winter and spring snowpacks, and can be associated with high amounts of runoff during warm winter storms (CETFKRB 2004).

The Scott River watershed also has hot, dry summers and cool, wet winters characteristic of Mediterranean climates. Rainfall is somewhat less than along the Klamath River. Figure 4-2 presents the average monthly distribution of annual precipitation recorded at the USFS Callahan weather station. Approximately 90 percent of precipitation falls between October and May; peak precipitation occurs in December and January. Although most precipitation occurs winter through spring, there may be short periods of locally intense rainfall from summer thunderstorms (USFS 1997, 2000). In the valleys, precipitation is significantly lower than in the surrounding mountains. Average annual precipitation ranges from below 20 inches at the lowest elevations along the Scott River, to more than 60 inches at the highest elevations at the western and southern extents of the watershed (North Coast RWQCB 2005). Winter precipitation is mostly rain at the lower elevations, below about 4,000 feet, with a rain-snow transition zone between about 4,000 feet and 5,000 feet. Snow typically accumulates in the rain-snow transition zone, but is frequently melted by midwinter rains. The higher elevations, especially above 6,000 feet, have short summers and relatively long winters with deep snowpacks.

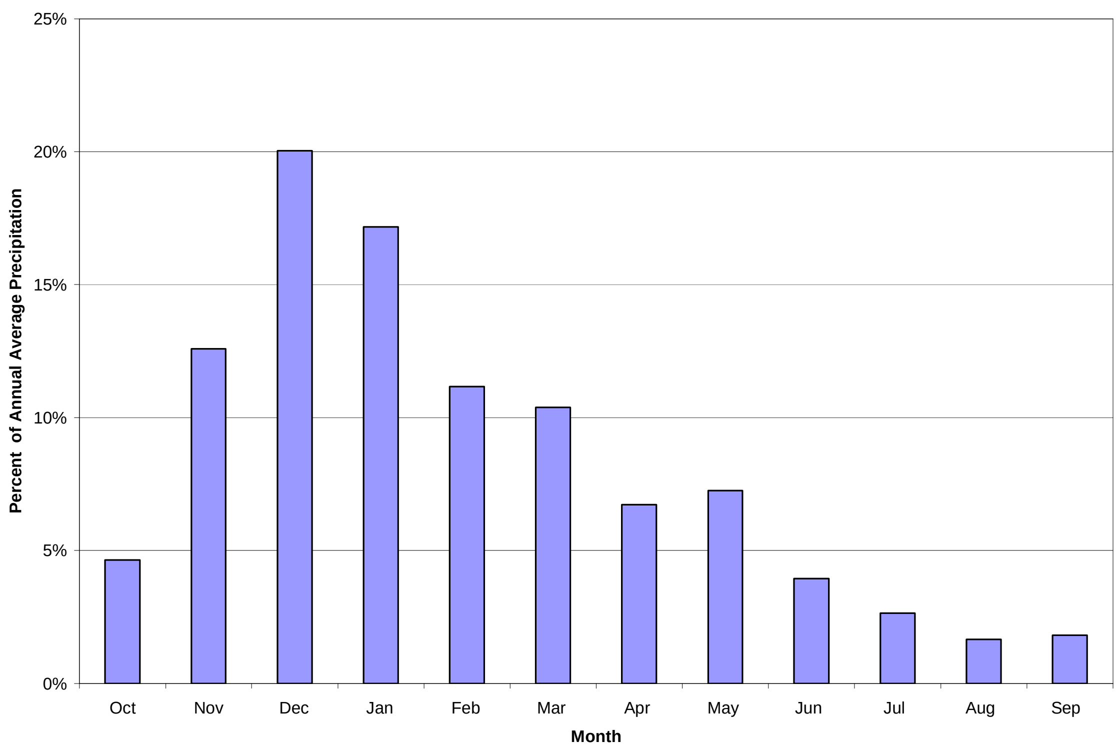


FIGURE 4-2
Monthly Distribution of Average Annual Precipitation (1943 to 2006)
Source: USFS Callahan Weather Station, Siskiyou County, California

The topographic characteristics of the basin make the Scott River watershed particularly susceptible to severe flooding caused by rain-on-snow events. A significant portion of the basin is between 4,500 and 5,500 feet in elevation, which is the range of elevation most susceptible to rain-on-snow events (North Coast RWQCB 2005). The largest floods on record (1861, 1955, 1964, 1974, and 1997) were associated this type of event (USFS 2000).

The Grass Lake Management Unit receives considerably less precipitation than the Klamath River and Scott Valley Management Units. In the western portions of the Plan Area, annual precipitation averages about 30 to 35 inches, whereas precipitation in the eastern portions averages 20 inches or less per year (Ruffner 1978).

4.4 Hydrology and Surface Water Resources

The majority of the Plan Area lies within the Klamath River Basin, which drains approximately 40,000 square kilometers (km^2) (15,444 square miles [mi^2]) in California and Oregon. Flows in the Klamath River are regulated by Iron Gate Dam, located upstream of the Plan Area. Below Iron Gate Dam, the Shasta River, Scott River, Trinity River, and Salmon River make major contributions to flows in the Klamath River. Streams in FGS's Klamath River Management Unit eventually feed into the Klamath River, and in the Scott Valley Management Unit, streams empty into the Scott River, a major tributary to the Klamath River. FGS's Klamath River Management Unit includes the northern side of the Klamath River watershed from Cottonwood Creek downstream to the confluence with the Scott River (Cottonwood Creek joins the Klamath River just upstream of the confluence with the Shasta River). Flows have been measured by USGS in the Klamath River below Iron Gate Dam since 1960 (Figure 4-3). Comparable USGS flow records exist for the Scott River at Fort Jones and the Shasta River at Yreka (Figures 4-4 and 4-5, respectively). No public flow gages are located in the area of FGS's Klamath River Management Unit; therefore, consistent and reliable hydrologic information for the Klamath River is scarce for this area.

Generally, highest flow levels in area streams occur during the spring and early summer in association with snowmelt; lowest flow levels (baseflows) occur during the fall before winter storms commence. Summer flows decrease to low levels in August to September, regardless of whether the winter was wet or dry, in response to a combination of hot days with no precipitation and intensive use of water for agriculture in Scott Valley (USFS 2000).

The 2002 to 2005 data collected in Scott River, Mill Creek, Kidder Creek, and Shackleford Creek (Figure 4-6) provide a good example of a normal yearly flow pattern in the Scott Valley Management Unit. The yearly flow pattern in FGS's Klamath River and Grass Lake Management Units is likely to be similar to that in the Scott River and its tributaries.

Baseflows were measured at 13 locations in the Plan Area in the Klamath River (10 locations) and Scott Valley (3 locations) Management Units during the fall from 1997 to 2003 (Table 4-2).

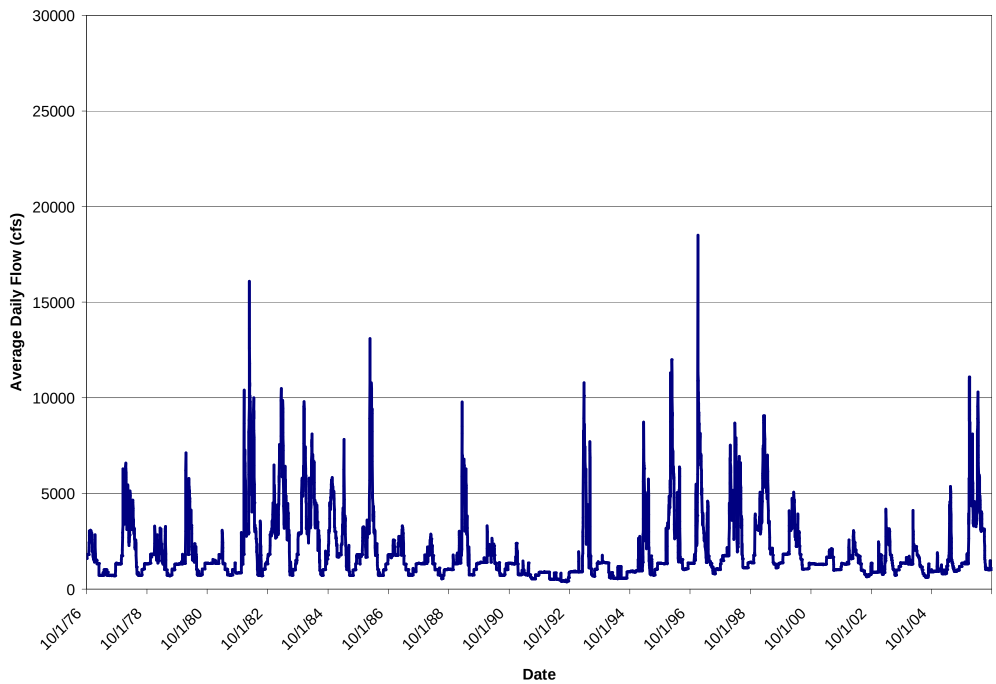


FIGURE 4-3
Average Daily Flows in the Klamath River below Iron Gate
Source: USGS

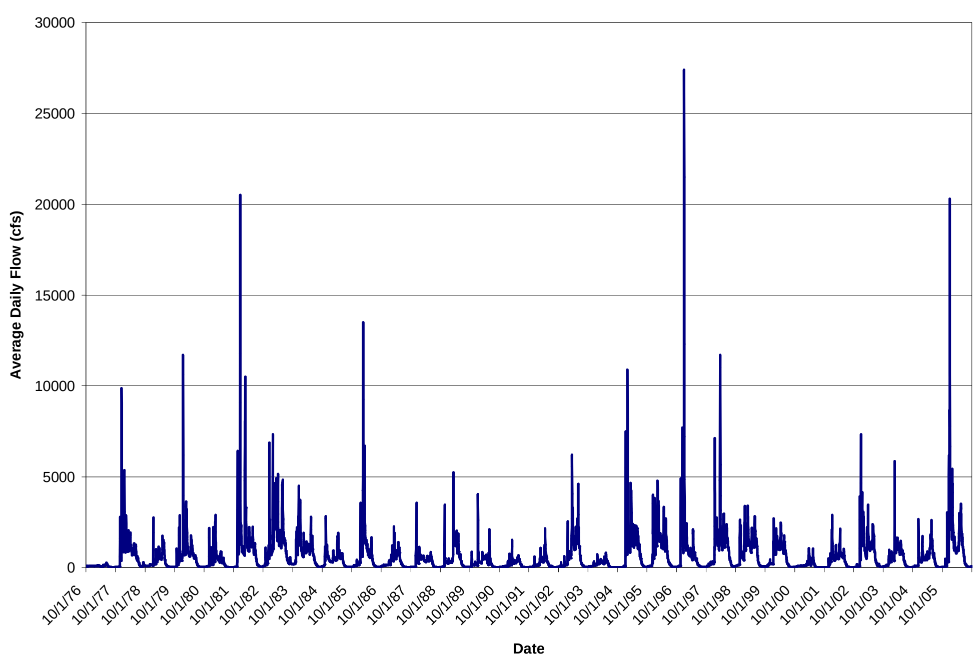


FIGURE 4-4
Average Daily Flows in the Scott River at Fort Jones
Source: USGS

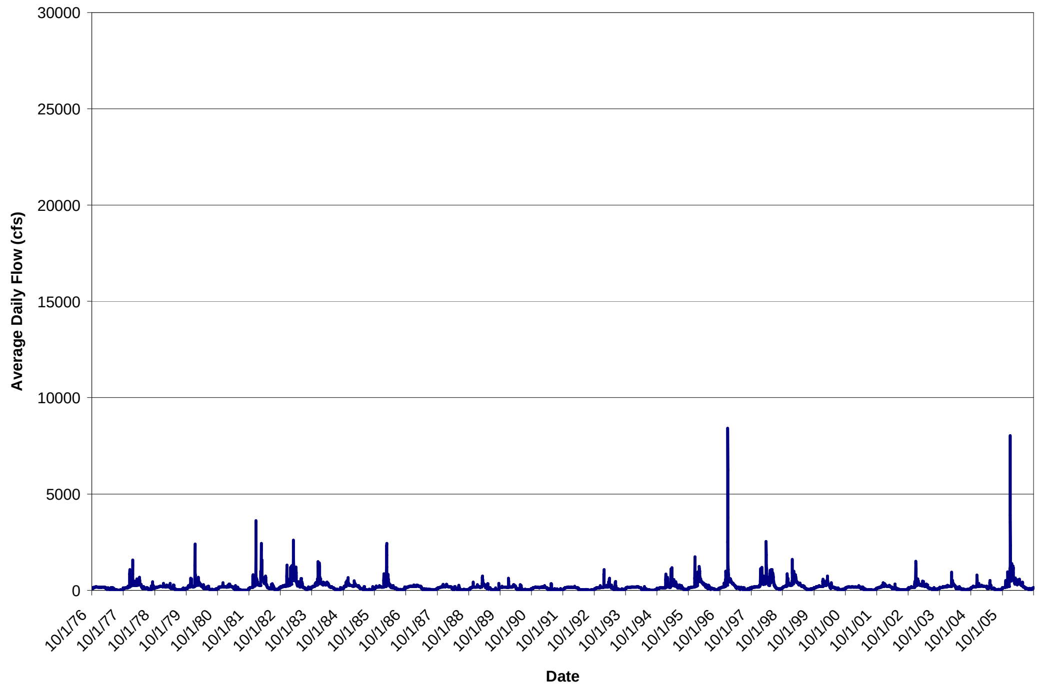


FIGURE 4-5
Average Daily Flows in the Shasta River at Yreka
Source: USGS

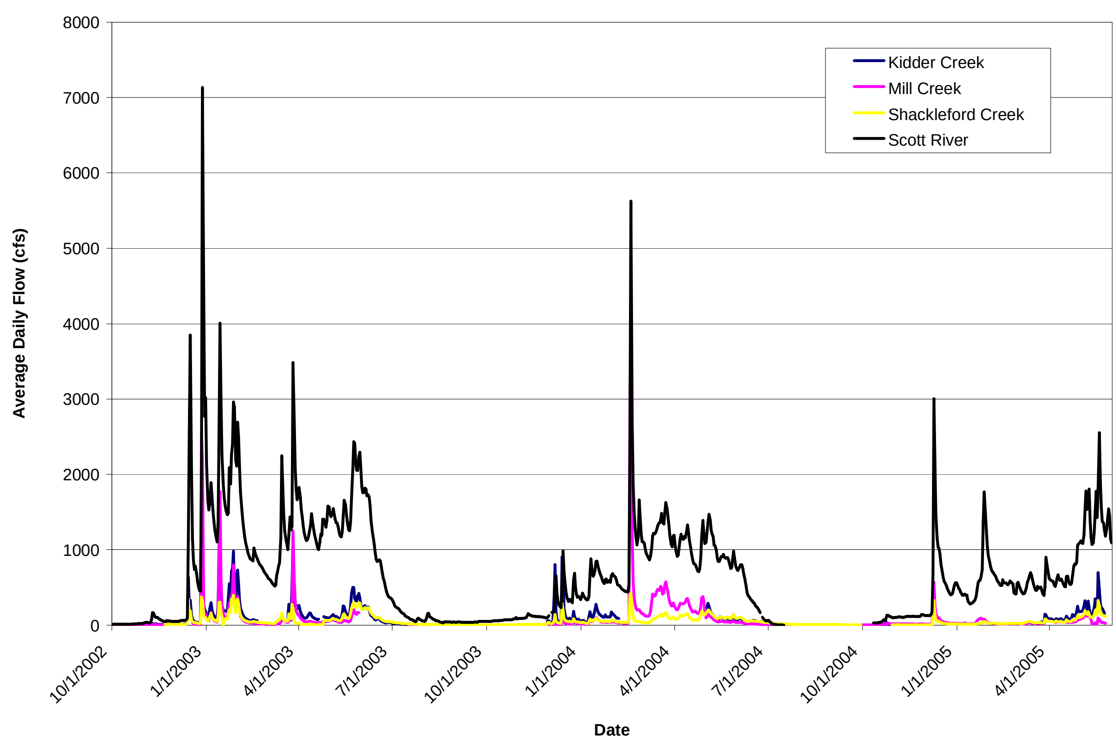


FIGURE 4-6
Discharge Data for October 2002 to April 2005 for Scott River (USGS) and its Tributaries
Kidder Creek, Mill Creek, and Shackleford Creek (Shaw 2005)

TABLE 4-2
Baseflows Measured from 1997 to 2003 in Plan Area Streams

Management Unit and Stream	Stream Class*	Baseflows (cfs)
Klamath River		
Bear Creek	II	2.0–4.6
Beaver Creek (mouth)	I	60.0–240.0
WF Beaver Creek (lower)	I	12.9–63.3
WF Beaver Creek (upper)	I	4.6–10.1
WF Cottonwood Creek	I	1.9–3.7
Doggett Creek	I	4.7–11.0
Hungry Creek	I	2.0–4.6
Kohl Creek	I	2.5–10.5
Little Soda Creek	II	0.3–0.5
Middle Horse Creek	II	4.5
Scott Valley		
Meamber Creek	II	0.4
Moffett Creek	I	0.7–1.3
Sissel Gulch	I	0.3

* Stream classes used in this HCP are those defined in the California Forest Practice Rules (2008)
Class I = fishbearing
Class II = perennial, non-fishbearing

For the purposes of this HCP, individual "drainages" were identified using CALWATER watersheds, which are standardized watershed boundaries established by CAL FIRE. Typically, they are relatively small areas (2,500 to 10,000 acres) that include a major stream segment and its tributaries. Individual drainages were defined that encompassed the area from a tributary stream's headwaters to its confluence with the Scott River, Klamath River, or Shasta River (Figure 4-7). Multiple CALWATER watersheds were combined for most drainages to encompass the area from the stream's headwaters to the confluence. For two drainages (Cottonwood Creek and Beaver Creek), the corresponding USFS watershed boundaries are used because CALWATER watershed designations do not extend into Oregon where these streams originate.

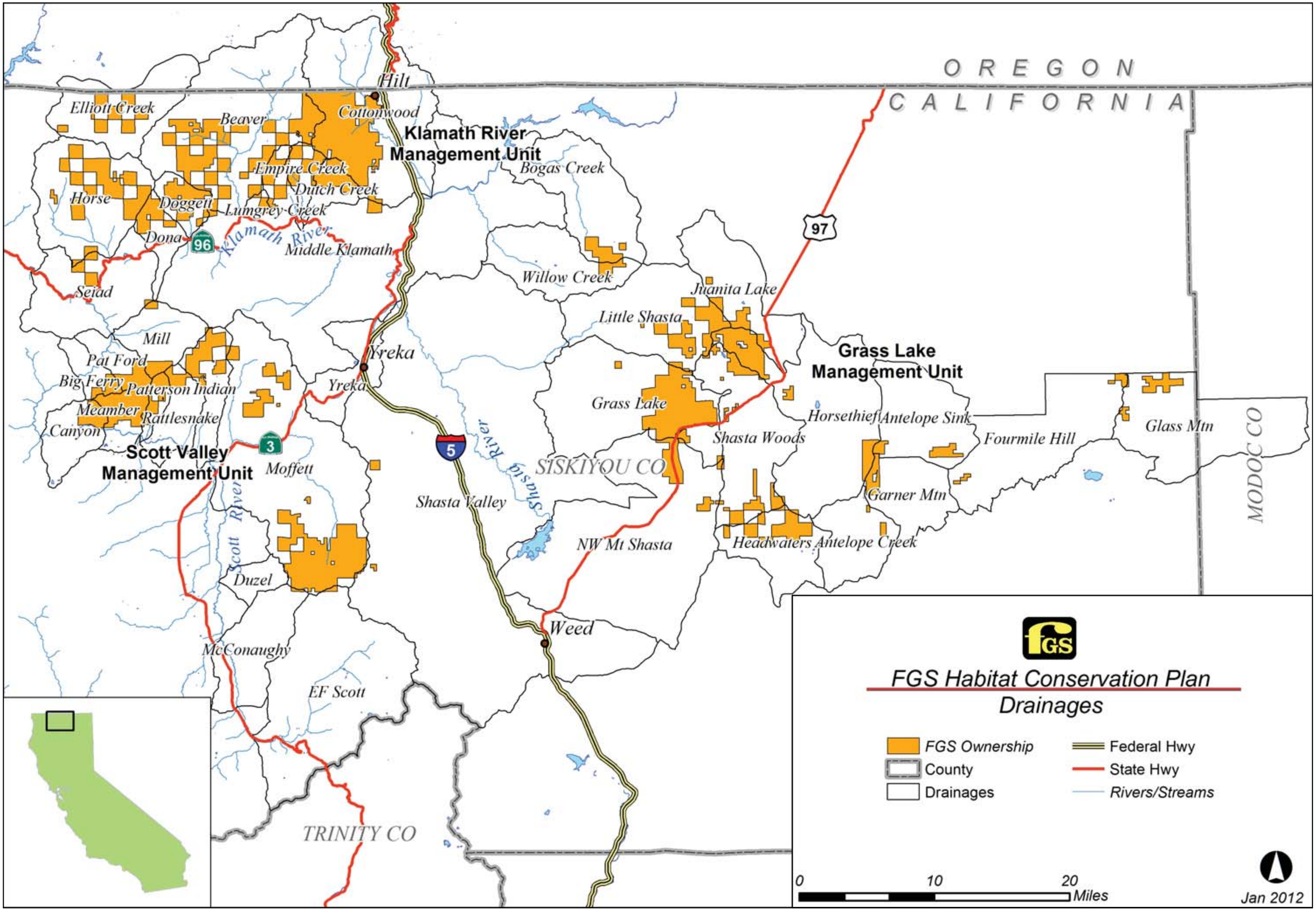


FIGURE 4-7
Individual Drainages and the FGS Ownership

4.5 Topography, Geology, Geomorphic Terrains, and Soils in the Plan Area

4.5.1 Topography

Paleozoic and Mesozoic bedrock in the Klamath Mountain physiographic province is folded, faulted, and chemically altered by metamorphism, volcanism, and igneous intrusion (Irwin 1966; Wright and Fahan 1988; Hacker et al. 1993; Wright and Wyld 1994; Cashman and Elder 2002). Prominent mountain ranges in the region include the Siskiyou, Salmon, Scott Bar, and Marble. Elevations in the Klamath River Management Unit range from 520 meters (1,705 feet) at the confluence of Horse Creek and Klamath River to 2,170 meters (7,120 feet) at Condrey Mountain. Elevations in the Scott Valley Management Unit range from 530 meters (1,740 feet) near Scott Bar to 1,850 meters (6,070 feet) at the divide between Indian Creek and Mill Creek in the Scott Bar Mountains. The Grass Lake Management Unit, located in the western portion of the California Cascade Range–Modoc Plateau physiographic province, is characterized by volcanic deposits and young shield volcanoes including the Whalebacks, Miller Mountain, Goosenest, and Ball Mountain (Norris and Webb 1976). With the exception of Mount Shasta (4,316 meters [14,161 feet]), elevations range from 610 meters (2,000 feet) at the Shasta River and Klamath River confluence to 2,600 meters (8,530 feet) at the Whalebacks.

4.5.2 Geology

FGS's Klamath River and Scott Valley Management Units lie within the geologically complex Klamath Mountain physiographic province. South of the Siskiyou Mountain divide, the Klamath River watershed is dominated by the Condrey Mountain schist, formed of metamorphosed marine sediments and volcanic ash. In the northeast portion, a mixture of resistant and less-resistant Paleozoic ultramafic and metamorphic rocks of amphibolite, greenschist, and metasedimentary serpentinite have been intruded by granitic rocks of Jurassic age that are commonly weathered into highly erodible decomposed granitic soil mantle. Diverse lithologies also outcrop in the Cottonwood Creek subwatershed, and include limestone, marble, granite, marine sandstone, conglomerate, and shale, and a variety of Tertiary volcanic and pyroclastic rocks. The Scott River watershed is predominantly underlain by metasedimentary and metavolcanic rocks interspersed with schist and decomposed granite. Lower elevations of the Scott Valley are covered with unconsolidated Quaternary alluvium (Wagner and Saucedo 1987). FGS's Grass Lake Management Unit, located in the western portion of the California Cascade Range–Modoc Plateau physiographic province, is characterized by volcanic deposits and young shield volcanoes, including the Whalebacks, Miller Mountain, Goosenest, and Ball Mountain. Lithologic units in this region are composed primarily of resistant Quaternary andesitic and basaltic lava flows, and pyroclastic deposits of the High Cascade volcanics underlain by more weakly resistant Tertiary volcanic tuffs and breccias of the Western Cascade volcanics (Wagner and Saucedo 1987).

4.5.3 Geomorphic Terrains

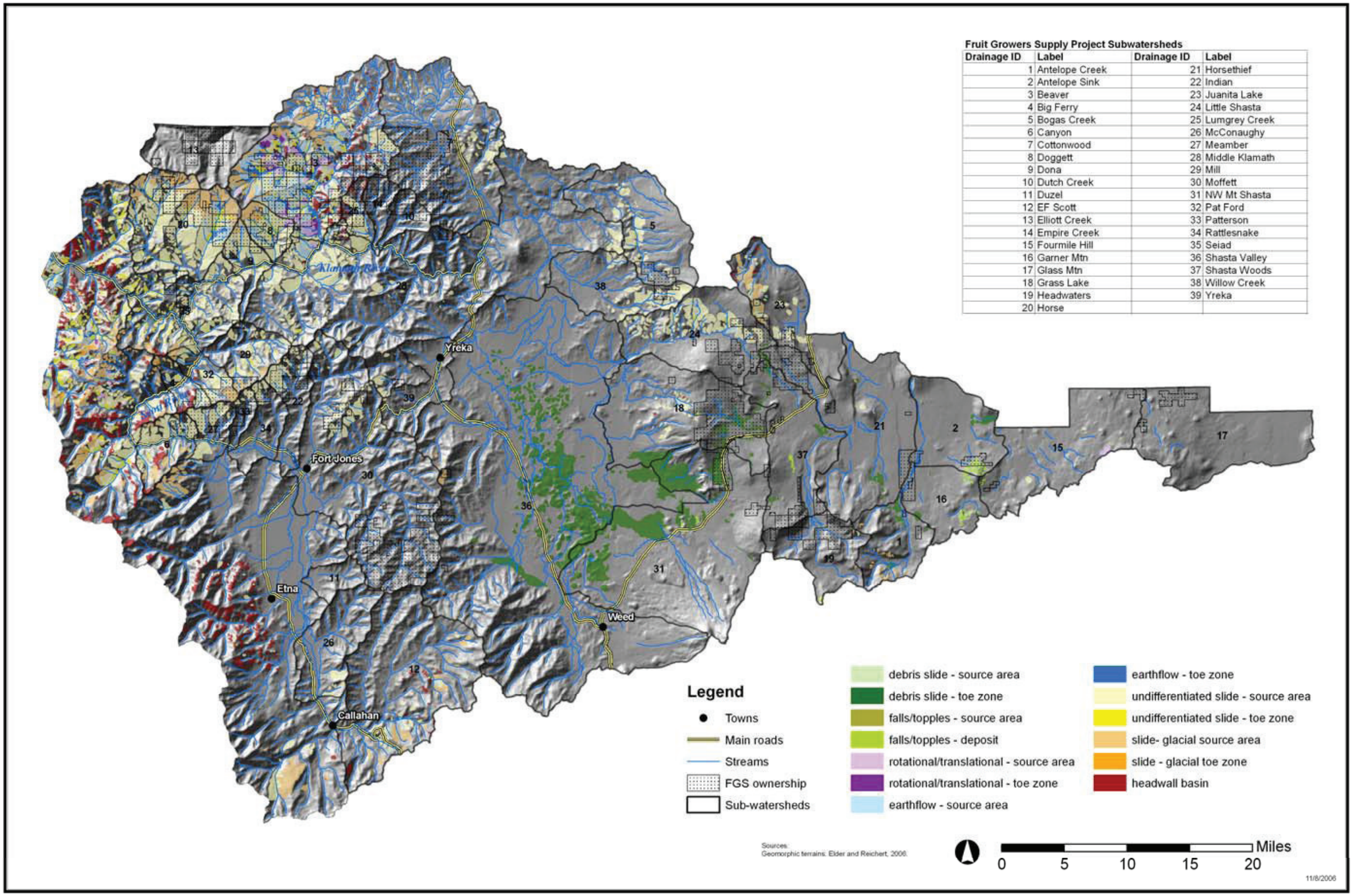
Geomorphic terrain classification is a method widely used by industry and resource agencies throughout the Pacific Northwest for stratifying the landscape into units with characteristic landforms and dominant erosion processes that influence sediment production and delivery under natural and management-related conditions (Chatwin et al. 1994; Reid and Dunne 1996; Bleier et al. 2003; North Coast RWQCB 2005; Elder and Reichert 2006; Green Diamond Resource Company 2006; Washington DNR 2006). Geomorphic terrains integrate physical controls such as bedrock geology, geologic history, hydrology, and climate; and therefore, typically have a predictable distribution within larger geologic terrains or physiographic provinces. Geomorphic terrains are an effective means of extrapolating relative rates of sediment production and delivery to similar areas where field measurements are unavailable.

The Klamath National Forest identified landform types associated with mass wasting in the region based on attributes such as hillslope gradient and form, dominant geomorphic processes, and observed mass wasting (USFS 2003; Elder and Reichert 2006). FGS used these landform types to stratify the Plan Area into geomorphic terrains (Figure 4-8). FGS further aggregated geomorphic terrains in the Plan Area into three dominant mass wasting terrains: (1) shallow-seated landslide terrain; (2) deep-seated landslide terrain; and (3) complex landslide-prone terrain. Delineation of mass wasting terrains and the related terminology describing dominant geomorphic processes in the Plan Area are consistent with the classification systems of Selby (1993), Cruden and Varnes (1996), Keaton and DeGraff (1996), and California Department of Mines and Geology (CDMG) Note 50 (1999). These classification systems are based on the materials (bedrock versus soil), kinematics (depth and rate of movement), size, activity state, and distribution of mass wasting. The geomorphic terrains found in the Plan Area are described below and summarized by drainage in Table 4-3.

4.5.3.1 Shallow Landslide Terrains

Shallow landslides typically occur as rapid mass movements along planar or undulating zones of failure—generally greater than 65 percent in steepness and less than 1.5 meters (5 feet) deep—and incorporate the overlying unconsolidated soil mantle (soil, colluvium, and weathered bedrock). Shallow landslide terrain often is associated with steep slopes in sedimentary terrain. Shallow slope failures are commonly triggered by elevated pore water pressures in response to high intensity and/or long duration rainfall events, or by undercutting of streamside slopes by fluvial processes during high stream flow. Roads that over-steepen slopes and alter surface runoff patterns are a common anthropogenic cause of increased shallow landsliding. Shallow landslide terrain includes landforms mapped by the Klamath National Forest as debris slides, falls and topples, and colluvial slopes.

Debris Slides. Source areas and toe zones of debris slides, debris avalanches, and debris flows are grouped into a common geomorphic terrain called “debris slides.” Debris slides are relatively uncommon in the Plan Area and are found primarily in the Grass Lake Management Unit. Source areas include the slide scar region (excluding the transport zone), and toe zones including all deposits and fan lobes (Elder and Reichert 2006).



Fruit Growers Supply Project Subwatersheds

Drainage ID	Label	Drainage ID	Label
1	Antelope Creek	21	Horsethief
2	Antelope Sink	22	Indian
3	Beaver	23	Juanita Lake
4	Big Ferry	24	Little Shasta
5	Bogas Creek	25	Lumgrey Creek
6	Canyon	26	McConaughy
7	Cottonwood	27	Meamber
8	Doggett	28	Middle Klamath
9	Dona	29	Mill
10	Dutch Creek	30	Moffett
11	Duzel	31	NW Mt Shasta
12	EF Scott	32	Pat Ford
13	Elliott Creek	33	Patterson
14	Empire Creek	34	Rattlesnake
15	Fourmile Hill	35	Seiad
16	Garner Mtn	36	Shasta Valley
17	Glass Mtn	37	Shasta Woods
18	Grass Lake	38	Willow Creek
19	Headwaters	39	Yreka
20	Horse		

FIGURE 4-8
Geomorphic Terrains in the HCP Area

TABLE 4-3
Geomorphic Terrain Area in Drainages

Management Unit[a]	Drainage	Geomorphic Terrain Area in FGS Ownership (km^2)																Total FGS Ownership Area, km^2	Total Watershed Area[h], km^2	FGS ownership as % of total watershed area
		Shallow-seated Landslides					Deep-seated Landslides					Complex Landslide-Prone Terrain								
												Complex Slump – Earthflow[f]								
		Debris Slides[b]		Falls/Topples[c]		Colluvial Slopes	Rotational/ Translational Slide[d]		Earthflow[e]		Block Slide	Undifferentiated Slide		Slide – Glacial		Headwall Swale	Inner Gorge[g]			
		source area	toe zone	source area	deposit (talus)		source area	toe zone	source area	toe zone		source area	toe zone	source area	toe zone					
Grass Lake	Antelope Creek	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	0.08	1.5	77.8	2%
	Antelope Sink	—	—	—	0.51	—	—	—	—	—	—	—	—	—	—	—	—	6.3	114.6	5%
	Bogas Creek	—	—	—	—	—	—	—	0.22	—	—	0.06	—	—	—	—	—	8.0	139.8	6%
	Fourmile Hill	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	3.0	177.9	2%
	Garner Mtn.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	5.6	77.5	7%
	Glass Mtn.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	8.0	194.2	4%
	Grass Lake	—	5.70	—	0.13	—	—	—	—	—	—	0.02	—	—	—	—	—	48.9	223.0	22%
	Headwaters	—	—	—	—	—	—	—	—	—	—	—	—	0.00	—	—	0.00	19.2	85.2	23%
	Horsethief	—	0.31	—	—	—	—	—	—	—	—	—	—	—	—	—	—	27.1	236.9	11%
	Juanita Lake	0.25	—	—	—	—	—	—	—	—	—	0.61	—	0.75	—	—	—	8.3	113.7	7%
	Little Shasta	—	0.25	—	0.01	—	—	—	0.17	—	—	3.08	—	—	—	—	—	24.8	159.2	16%
	NW Mt. Shasta	—	4.13	—	—	—	—	—	—	—	—	—	—	—	—	—	—	13.5	405.8	3%
	Shasta Valley	—	—	—	—	—	—	—	—	—	—	—	—	0.44	—	—	—	4.9	1125.4	0%
	Shasta Woods	—	0.14	—	—	—	—	—	—	—	—	—	—	—	—	—	—	18.1	147.6	12%
	Willow Creek	—	—	—	—	—	—	—	—	—	—	1.65	—	—	—	—	—	3.9	101.3	4%
	Grass Lake Total	**0.25**	**10.53**	**0**	**0.65**	**0**	**0**	**0**	**0.40**	**0**	**0**	**5.42**	**0**	**1.19**	**0**	**0**	**0.08**	**201.1**	**3379.8**	**6%**

TABLE 4-3
Geomorphic Terrain Area in Drainages

Management Unit[a]	Drainage	Geomorphic Terrain Area in FGS Ownership (km^2)																Total FGS Ownership Area, km^2	Total Watershed Area[h], km^2	FGS ownership as % of total watershed area
		Shallow-seated Landslides					Deep-seated Landslides					Complex Landslide-Prone Terrain								
												Complex Slump – Earthflow[f]				Headwall Swale	Inner Gorge[g]			
		Debris Slides[b]		Falls/Topples[c]		Colluvial Slopes	Rotational/ Translational Slide[d]		Earthflow[e]		Block Slide	Undifferentiated Slide		Slide – Glacial						
		source area	toe zone	source area	deposit (talus)		source area	toe zone	source area	toe zone		source area	toe zone	source area	toe zone					
Klamath River	Beaver	0.07	—	—	—	—	6.54	1.49	10.22	2.67	—	17.51	2.96	1.01	0.61	1.36	6.21	68.5	281.9	24%
	Cottonwood	—	—	—	—	—	—	—	—	—	—	0.13	—	—	—	—	1.01	65.9	257.1	26%
	Doggett	0.00	—	—	—	—	0.67	0.24	0.61	—	—	8.65	1.79	1.35	0.25	—	1.95	16.1	31.1	52%
	Dona	0.00	—	—	—	—	—	—	0.65	—	—	7.23	0.04	0.86	—	—	0.70	10.1	34.2	30%
	Dutch Creek	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	0.47	12.0	26.1	46%
	Elliott Creek	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	18.2	86.2	21%
	Empire Creek	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1.59	10.8	24.4	44%
	Horse	0.43	—	—	—	—	0.03	—	3.08	0.85	—	16.17	1.60	7.44	0.29	—	2.94	39.1	157.7	25%
	Lumgrey Creek	0.02	—	—	—	—	0.05	—	—	—	—	3.59	0.06	—	—	0.49	0.84	10.2	22.2	46%
	Middle Klamath	—	—	—	—	—	—	—	—	—	—	1.02	0.01	—	—	0.16	0.68	7.1	620.8	1%
	Seiad	—	—	—	—	—	—	—	—	—	—	0.85	0.02	—	—	—	0.79	5.8	136.7	4%
	Klamath River Total	**0.52**	**0**	**0**	**0**	**0**	**7.29**	**1.72**	**14.57**	**3.52**	**0**	**55.16**	**6.47**	**10.66**	**1.15**	**2.01**	**17.18**	**263.7**	**1678.5**	**16%**

TABLE 4-3
Geomorphic Terrain Area in Drainages

Manage-ment Unit[a]	Drainage	Geomorphic Terrain Area in FGS Ownership (km^2)																Total FGS Owner-ship Area, km^2	Total Water-shed Area[h], km^2	FGS owner-ship as % of total water-shed area
		Shallow-seated Landslides					Deep-seated Landslides					Complex Landslide-Prone Terrain								
												Complex Slump – Earthflow[f]								
		Debris Slides[b]		Falls/Topples[c]		Colluvial Slopes	Rotational/ Translational Slide[d]		Earthflow[e]		Block Slide	Undifferentiated Slide		Slide – Glacial		Headwall Swale	Inner Gorge[g]			
		source area	toe zone	source area	deposit (talus)		source area	toe zone	source area	toe zone		source area	toe zone	source area	toe zone					
Scott Valley	Big Ferry	—	—	—	—	—	—	—	—	—	—	2.53	0.01	0.05	—	0.58	0.14	5.2	25.4	20%
	Canyon	0.03	—	—	—	—	—	—	—	—	—	4.65	0.34	—	—	—	0.27	8.0	52.3	15%
	Duzel	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	0.0	26.5	0%
	EF Scott	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	0.7	294.8	0%
	Indian	—	—	—	—	—	—	—	—	—	—	5.61	0.07	—	—	—	2.00	16.1	56.1	29%
	McConaughy	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	0.5	97.0	1%
	Meamber	—	—	—	—	—	—	—	—	—	—	7.80	0.05	—	—	—	0.00	20.4	33.2	61%
	Mill	—	—	—	—	—	—	—	—	—	—	0.33	0.00	1.51	0.06	—	0.44	5.8	57.8	10%
	Moffett	—	—	—	—	—	—	—	—	—	—	3.02	0.05	—	—	—	0.57	79.2	379.8	21%
	Pat Ford	—	—	—	—	—	—	—	—	—	—	2.58	—	2.37	—	—	0.07	8.7	30.9	28%
	Patterson	—	—	—	—	—	—	—	—	—	—	1.25	—	—	—	—	—	8.5	16.3	52%
	Rattlesnake	—	—	—	—	—	—	—	—	—	—	1.55	0.01	—	—	—	0.65	4.4	46.3	10%
	Scott Valley Total	**0.03**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**29.31**	**0.54**	**3.93**	**0.06**	**0.58**	**4.31**	**158.0**	**1181.8**	**13%**
Total FGS		0.80	10.53	—	0.65	—	7.29	1.72	14.97	3.52	—	89.89	7.01	15.79	1.21	2.58	21.57	**177.5**		
Total watershed		5.74	171.10	0.25	3.19	1.36	17.83	5.88	41.35	8.03	—	370.77	28.39	85.19	5.75	13.62	173.80	**932.3**		
% FGS		14%	6%	0%	20%	0%	41%	29%	36%	44%	0%	24%	25%	19%	21%	19%	12%	**19%**		

[a]Table includes subwatersheds that have FGS land ownership only.
[b]The source area and toe zone of debris slides, debris avalanches, and debris flows are included within the debris slide classification.
[c]The source area and toe zone of rockslides and rock falls are included within the falls/topples classification.
[d]The rotational/translational slide classification, within the deep-seated landslide category, includes both individual/discrete slides and complex type rotational/translational slides.
[e]The earthflow classification includes ~4.5 km^2 of slide - earthflow terrain, located within FGS's ownership in the Horse, Beaver, and Dogget Creek watersheds.
[f]Complex slump-earthflow terrain includes all mass wasting processes designated by Elder and Reichert (2006) as "undifferentiated slides" and "slide-glacial."
[g]Inner gorge area overlaps with other geomorphic terrain categories and is not used to sum total FGS or watershed areas.
[h]Total terrain area may be greater than the sum of geologic terrain data shown and suggests that the drainage may contain unmapped areas.

Debris slides and debris avalanches are characterized by downslope movement of unconsolidated rock, soil, and/or colluvium along a relatively shallow (typically less than 4.6 meters [15 feet]) failure plane. Debris slides and debris avalanches commonly occur on steep slopes (e.g., > approximately 40 percent) where non-cohesive, unconsolidated materials overlie weakly resistant bedrock having slope parallel bedding planes or joint fractures. Debris slides can occur individually or coalesce into large complex features. Steep, arcuate unvegetated scars form in the head region, and lower gradient hummocky deposits typically form in toe slopes. Secondary erosion of slide scars may continue for years before vegetation stabilizes the slope. Revegetated slide scars are prone to reactivation and may be unstable for many years after initial failure.

Debris flows are characterized by rapid failure of supersaturated soil, rock, colluvium, and organic material along linear zones within steep and unstable, low order drainages. Debris flows are typically initiated by debris slides on adjacent hillslopes, earthquakes, or by mobilization of material in steep stream channels during intense rainfall events. Debris flows occasionally scour to bedrock along steep gradient torrent tracks and deposit debris in lower gradient channel reaches. Debris flows can deliver substantial quantities of sediment to stream channels, resulting in blockage of fish passage. Earthquakes are a rare occurrence in the Plan Area.

Falls and Topples. Falls are characterized by rapid detachment of soil or rock from near vertical slopes along failure planes where little to no shear displacement occurs. The displaced mass typically moves forward by free falling, bouncing, or rolling. Rock debris typically accumulates in lower gradient, downslope areas where gravitational transport is greatly reduced. Falls and topples may lead to debris slides or flows depending on the geometry and composition of the displaced mass and the slope angle on which the material is deposited. The falls and topples terrain includes rockslides and rockfalls compiled by Elder and Reichert (2006). The source area includes the near-vertical margin of bedrock outcrops, whereas the toe zone includes talus deposits at the base of the slope. Falls and topples are uncommon in the Plan Area.

Colluvial Landforms. Colluvial landforms are low gradient slopes composed of unconsolidated soil mantle and rock debris accumulated in response to gravity-driven downslope movement. Movement associated with these landforms typically involves soil creep, slope wash, and surface erosion. Landslide potential depends on colluvial deposit thickness, slope gradient, and hydrologic conditions. The colluvial slopes terrain includes all colluvial slopes and colluvial aprons compiled by Elder and Reichert (2006). Colluvial slopes, identified at the scale of the available geologic database, are uncommon in the Plan Area.

4.5.3.2 Deep-seated Landslide Terrains

Deep-seated landslides are broad, complex mass-wasting features that persist through gradual movement of cohesive soils and/or incompetent bedrock. Deep-seated landslide morphology is characterized by crescent-shaped major and minor scarps; flat-lying and backtilted blocks; benched topography; and lobate accumulation zones with hummocky topography, seepage lines and springs, ponding, and deflected or irregular drainage patterns. Deep-seated landslides differ from shallow landslides in that: (1) failure is typically along a concave surface or diffuse shear zone at depth, typically greater than 1.5 meters (5 feet); (2) internal deformation occurs in incompetent, weathered, or deformed bedrock;

and (3) mass movement is typically slow. Deep-seated landslides are typically larger than shallow landslides and include various movement types (e.g., rotational-translational, earthflow, block slide) and states of activity (active and dormant). Deep-seated landslide and complex slump-earthflow terrain are the dominant mass-wasting terrains in the Plan Area, occurring primarily in metamorphic terrain with lesser area associated with mafic and ultramafic, granitic, and volcanic geologic terrains.

Rotational-translational Slides. Rotational-translational slides are characterized by rotation of a relatively homogeneous slide mass above a curved slide plane that extends below the soil mantle into bedrock. Rotational-translational slides typically have an arcuate main scarp and a series of mid-slope benches above a hummocky toe slope deposit. Failures of this type may contain multiple slide blocks with both rotational and translational modes of failure, and may propagate downslope by earthflow processes. Rotational/translational terrain includes landforms that are mapped as "complex rotational/translational" (Elder and Reichert 2006) and occur primarily within FGS's Klamath River management unit.

Earthflows. Earthflows are characterized by slow, semi-viscous movement of a highly-plastic mass, resulting in undulating and hummocky topography with low to moderate gradient. The depth of failure varies, but is characterized by a thick zone of distributed shear at the base. Irregular and poorly defined drainage is common. Earthflows are typically slow, incremental mass movement events by soil mantle creep; they are often initiated by high intensity, short duration rainfall events. Rapid, catastrophic failure is less common. The degree of activity is usually variable, with more active slide masses indicated by disrupted trees (e.g., leaning, split, pistol-butted, jack-strawed) and hydrophilic vegetation. Earthflow terrain includes landforms that are mapped as "earthflow" and "slide–earthflow" (Elder and Reichert 2006). These landforms are relatively common in the Plan Area, especially in FGS's Klamath River management unit.

Block Slides. Block slides are characterized by displacement of large blocks of rock material that remain relatively undeformed during translation along a planar slide plane. Block slides are relatively uncommon features within the Plan Area.

4.5.3.3 Complex Landslide-prone Terrains

Complex slump-earthflow. Complex slump-earthflow terrain includes landforms mapped as undifferentiated slides and slide–glacial (Elder and Reichert 2006). These map units are characterized by unconsolidated soil and rock debris deposits formed by a variety of glacial and mass-wasting processes, primarily slump, and earthflow. Complex slump-earthflow terrain is identified by irregular to hummocky topography with low to moderate gradient. Landforms mapped as complex slump-earthflow terrain are classified by Elder and Reichert (2006) as dormant features that lack distinct source area scarps and internal benches. Debris slide activity is locally common along steeper slopes within the complex, especially where stream erosion removes toe support.

Headwall Swales. Headwall swales are characterized by headwater areas with convergent topography, where thick soils and subsurface drainage concentrate along the axis of a Class III watercourse or valley. Headwall swales may extend upslope as far as the ridgeline, and typically terminate at the point of channel initiation. These landforms often have distinct to subtle concave morphology. Valley sideslopes leading into the headwall basin are often steep, typically 65 percent or greater, and exhibit planar to slightly irregular slope form.

Emergent groundwater may exist at or near down valley changes in hillslope gradient. Headwall swales in-filled with thick accumulations of colluvium typically evacuate by rapid, shallow mass-wasting processes. Headwall swales having steep side slopes that are connected to a narrow, steep gradient watercourse by a linear depression have greater potential to deliver sediment to aquatic habitat than those that occupy low gradient reaches, or are comprised of shallow soil mantle or exposed bedrock

Inner Gorges. Inner gorge slopes are defined as steep slopes (typically 65 percent and greater) that extend from the stream channel up to the first break in slope. Inner gorges are commonly formed by incision into competent, homogeneous bedrock due to base-level lowering by active stream erosion. Coalescing debris slides are the dominant erosion process forming the characteristically steep, planar slopes. Inner gorges less commonly form at the incised toe of large, deep-seated mass slope failures and related deposits. Landslide potential is low where bedrock is exposed, and higher where non-cohesive soils or colluvium mantles the hillslope. Stream bank erosion, removal of tree root strength, and anthropogenic over-steepening of inner gorge or steep streamside slopes can trigger and/or accelerate instability. In the Klamath River and Scott Valley Management Units, inner gorge slopes are often coincident with toe slopes of large, dormant deep-seated mass wasting landforms.

Complex landslides are commonly mapped on slopes composed of weakly resistant, inherently unstable bedrock within Metamorphic, Mafic/Ultramafic and Granitic geologic terrain areas. Shallow and complex landslide-prone terrain mapped in volcanic terrain of the Cascade-Modoc plateau province are likely correlative to mass wasting originating from Mount Shasta or during climatic regimes uncommon today.

4.5.4 Soils

Soil types are generally consistent with the underlying geology and geomorphic terrains previously described; soils in FGS's Grass Lake Management Unit are of volcanic origin, whereas soils in the Klamath River and Scott Valley Management Units are derived from metamorphic and intrusive igneous parent material (United States Department of Agriculture [USDA] Soil Conservation Service 1978).

Schist bedrock of the Condrey Mountain formation weathers to soils rich in silt and clay-size particles. These soils range from shallow and rocky on ridgetops to very deep on landslide deposits (USFS 1995). Because of the fine textures and high mica content, these soils are particularly susceptible to compaction and exhibit low shear strengths.

The metavolcanic and metasedimentary rocks found in the Plan Area weather slowly relative to other parent material. Soils formed on these parent materials tend to be shallow, and are composed of silts and clays containing variable amounts of rock fragments. The most common soils found on these parent materials are the Kindig-Nuens and Marpa-Kinkel-Boomer complexes. Soils in the Moffett Creek area formed on the Duzel and Moffett Creek formations occupy similar map units, but produce calcareous alluvium (USDA Soil Conservation Service 1978).

Soils formed on ultramafic bedrock (peridotite and serpentinite) rapidly weather to clay. Soils derived from serpentine are rich in magnesium, less productive, and often depauperate in vegetation as a result of this nutrient imbalance (Buol et al. 1980). These soils range from shallow, gravelly loams on ridgetops to deep, potentially unstable deposits in concave hollows. They are mapped as the Dubakella-Ipish complex in the Siskiyou County soil survey (USDA Soil Conservation Service 1978).

Soils derived from granitics are among the most erodible of soil types (Sommarstrom et al. 1990). Mineral reserves tend to be low in soils derived from granitics and drainage is excessive; thus, their ability to support coniferous vegetation is moderate. Granite residuum occurs in the northeast portion of FGS's Klamath River Management Unit.

The arkosic sandstone and shale of the Hornbrook formation weathers to clayey soils due to the high feldspar content. These soils are high in nutrient reserves (Buol et al. 1980), and the ability to support coniferous vegetation is good.

4.6 Roads in the Plan Area

Details concerning roads throughout the Plan Area are provided in the following discussions:

- Road Network
- Road Density and Stream Crossings
- Road Inventories
- Restoration Efforts

4.6.1 Road Network

Throughout the drainages that contain the Plan Area, nearly 4,500 miles of roads have been identified, but only about one-third (about 1,350 miles) of these roads are on FGS lands (Table 4-4). The remaining 3,150 miles of road are on lands controlled by the USFS, other governmental agencies, or private interests. FGS is solely responsible for maintenance of more than 1,100 miles of road in the Plan Area. About 250 miles of road on FGS lands are maintained under cooperative road agreements with USFS (co-op roads). Only the approximately 1,100 miles of road for which FGS is solely responsible for maintenance are covered under this HCP.

The co-op roads are owned and controlled by the USFS, but are maintained jointly by two or more parties under a Road Right-of-Way Construction and Use Agreement. Under this agreement, construction and maintenance activities are shared between the cooperators (for example, FGS, Siskiyou County) and the USFS. As these roads are under the jurisdiction of the USFS, they are constructed and maintained in accordance with USFS standards. The majority (55%) of co-op roads are found in the Beaver, Cottonwood, and Horse drainages. Co-op roads account for more than 40 percent of the road mileage on FGS lands in the Beaver, Dona, and Horse drainages, and 45 percent of the small amount of road (i.e., 1.96 miles) on FGS lands in the Antelope Creek watershed (Grass Lake Management Unit). Figures 4-9 through 4-11 illustrate the roads in the Plan Area that are maintained solely by FGS and roads that are maintained under cooperative road agreements with USFS (co-op roads). FGS's road standards included in this HCP will not apply to the co-op roads. The USFS is developing a road use and maintenance plan through consultation with NMFS to cover roads on lands in the Klamath National Forest.

TABLE 4-4
Miles of Road and Road Density in Drainages

Drainage	Miles by Owner					FGS Density (mi/mi^2)	Overall Density (mi/mi^2)
	Federal	FGS	Other Private	State	Total		
Klamath River							
Beaver	266	179	65		509	6.8	4.7
Cottonwood	55	173	97		324	6.8	3.3
Doggett	18	47	4		69	7.6	5.8
Dona	15	27	15		56	6.8	4.2
Dutch Creek	3	27	7		37	5.7	3.6
Elliott Creek	39	41	12		92	5.8	2.8
Empire Creek	11	29	1	1	42	7.0	4.5
Horse	98	100	19		217	6.6	3.6
Lumgrey Creek	12	28	2		41	7.1	4.8
Middle Klamath	188	6	166		360	2.5	1.5
Seiad	33	8	43		85	3.7	1.6
Scott Valley							
Big Ferry	2	11	0		13	5.3	1.3
Canyon	28	17	37		82	5.7	4.1
Duzel	2		9		11		1.1
EF Scott	48	0	101		149	0.1	1.3
Indian	22	41	28		91	6.6	4.2
McConaughy	9	1	32		42	6.8	1.1
Meamber	0	51	25		76	6.5	5.9
Mill	27	16	38		81	7.2	3.6
Moffett	58	145	141		344	4.7	2.3
Pat Ford	5	27	1		32	7.9	2.7
Patterson	6	18	4		28	5.4	4.4
Rattlesnake	7	10	31		48	6.0	2.7
Grass Lake							
Antelope Creek	34	2	39		75	3.5	2.5
Antelope Sink	23	12	2		37	4.8	0.8
Bogas Creek	19	19	6		45	6.3	0.8
Fourmile Hill	103	6			109	4.8	1.6
Garner Mtn	33	13	3		48	5.8	1.6
Glass Mtn	63	13	4		80	4.2	1.1
Grass Lake	35	86	74		196	4.6	2.3
Headwaters	25	36	24		85	4.8	2.6
Horsethief	107	40	28		175	3.8	1.9
Juanita Lake	32	15	11		57	4.8	1.3
Little Shasta	57	48	46		151	5.0	2.5
NW Mt Shasta	61	12	26		99	2.4	0.6
Shasta Valley	14	9	234		257	4.5	0.6
Shasta Woods	116	32	23		172	4.6	3.0
Willow Creek	1	7	37		45	4.7	1.2
TOTAL	**1,676**	**1,348**	**1,435**	**1**			

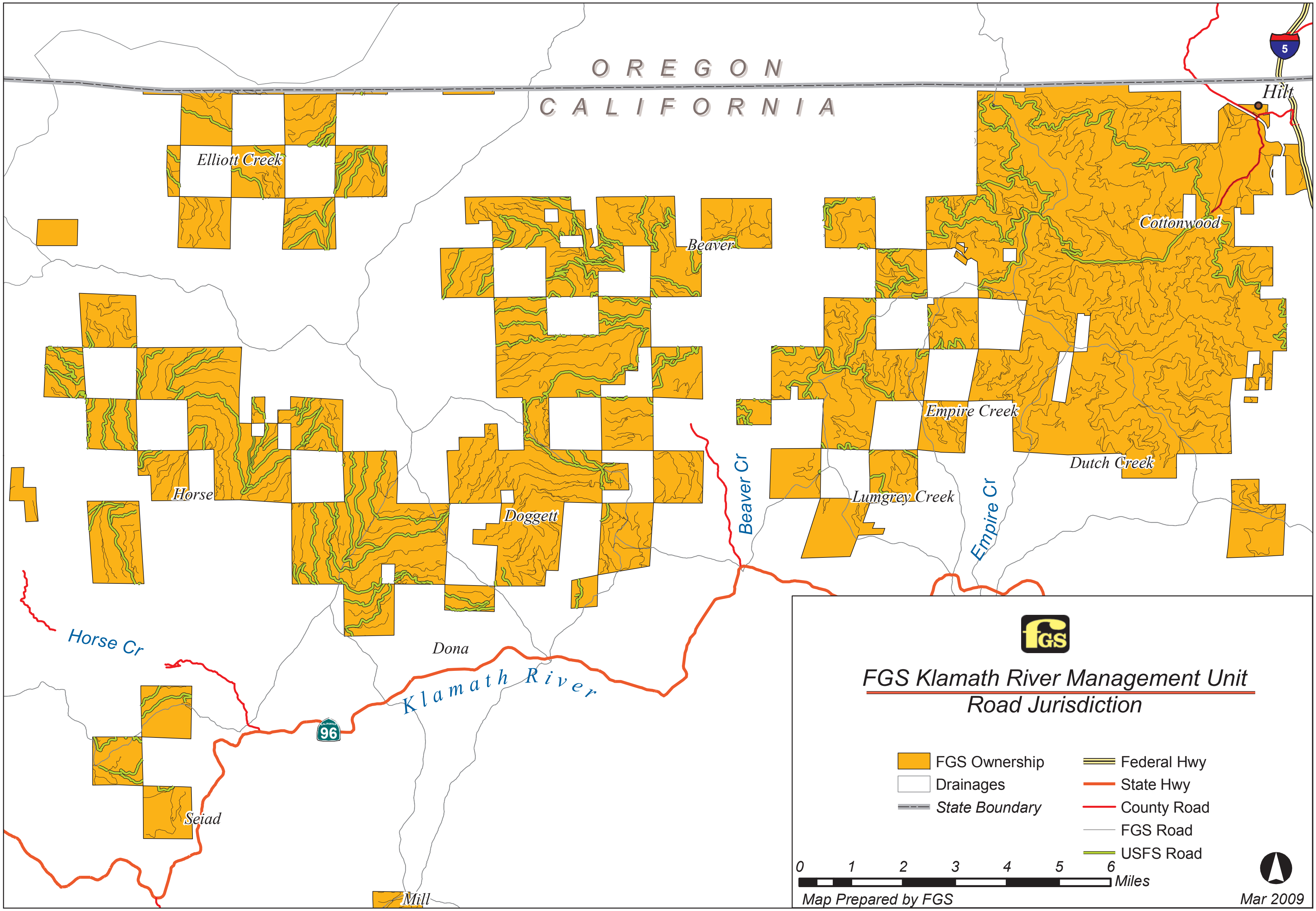


FIGURE 4-9
Road Jurisdiction in the Klamath River Management Unit

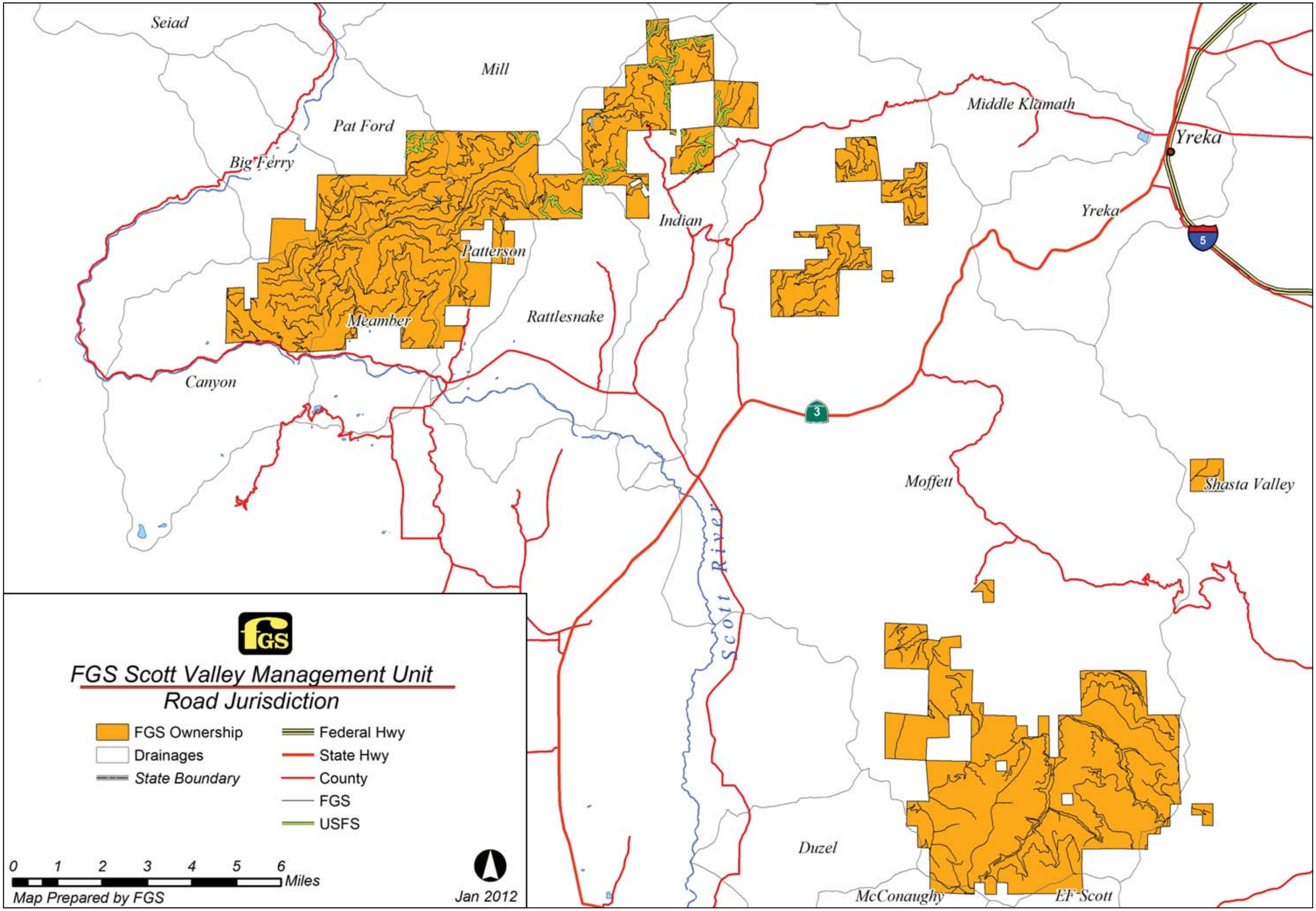


FIGURE 4-10
Road Jurisdiction in the Scott Valley Management Unit

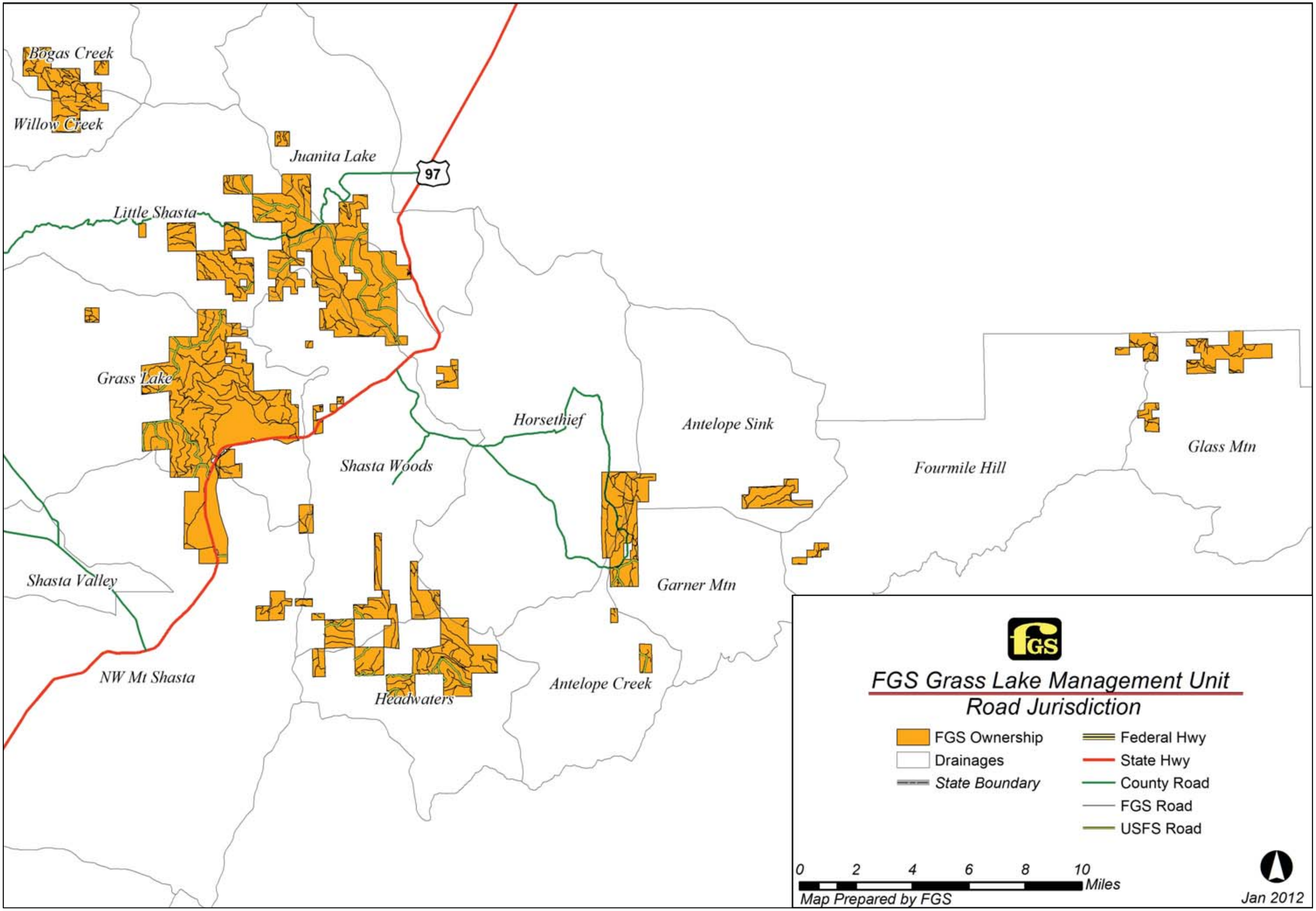


FIGURE 4-11
Road Jurisdiction in the Grass Lake Management Unit

CH2MHILL.

The majority (71 percent) of roads in drainages containing FGS lands are classified as local or secondary roads; arterial main lines account for around 16 percent of the total road mileage. County roads account for around 9 percent of the total road mileage, with state highways and federal highways accounting for 2.5 percent and around 1 percent of the total, respectively.

4.6.2 Road Density and Stream Crossings

The density of roads in the individual drainages ranges from 0.6 to 5.9 miles per square mile (mi/mi^2) (see Table 4-4). On the FGS ownership, road density generally ranges from 4 to 7 mi/mi^2 depending on the watershed. The highest road densities are in the Doggett and Lumgrey Creek watersheds in the Klamath Management Unit, and the Mill and Pat Ford watersheds in the Scott Valley Management Unit, where road densities exceed 7.0 mi/mi^2. Overall road density on the FGS ownership is 5.4 mi/mi^2. In general, as the density of roads in a drainage increases, the likelihood of road-related erosion and mass movement increases. However, many factors other than road density affect the likelihood that roads will contribute sediment to streams, including surfacing, type of construction (such as cut-and-fill, full bench), proximity to streams, intensity and seasonality of use, and frequency and type of water collection facilities (Weaver and Hagans 1994).

The number of stream crossings on fishbearing streams on the FGS ownership is limited (Table 4-5). A crossings inventory conducted by the applicant reports a total of 49 crossings of fish-bearing streams in the Plan Area; 40 crossings are within the range accessible by anadromous fish. Of the crossings within the range of anadromy, 16 are bridges; there are 13 culverts, nine fords, and two crossings that have been decommissioned. There are five crossings that form partial barriers, four that form temporal barriers, and none are considered total barriers. Not all of the crossings are under FGS control, some are on roads governed by cooperative maintenance agreements with the USFS (cooperative roads). The DFG Passage Assessment Database (September 2006) contains a total of 27 potential barriers on the FGS ownership. An evaluation of fish passage at Class I stream crossings on the FGS ownership conducted by FGS found that there are five crossings that form partial barriers and four that form temporal barriers to fish passage on their ownership that will be addressed under the HCP.

TABLE 4-5
Number of Stream Crossings in the Plan Area

Drainage	Stream Class				
	1 (Fishbearing)			2	3
	FGS	Co-op	County		
Klamath River					
Beaver	1	8	0	178	155
Cottonwood	11	1	2	74	155
Doggett	2	0	0	76	77
Dona	1	0	0	42	24
Dutch Creek	0	0	0	13	11
Elliott Creek	0	1	0	67	4

TABLE 4-5
Number of Stream Crossings in the Plan Area

Drainage	Stream Class				
	1 (Fishbearing)			2	3
	FGS	Co-op	County		
Empire Creek	3	0	0	13	13
Horse	2	0	0	159	62
Lumgrey Creek	0	0	0	7	26
Middle Klamath	0	0	0	6	6
Seiad	0	0	0	2	14
Scott Valley					
Big Ferry	0	0	0	9	34
Canyon	0	0	0	10	46
Indian	1	0	0	10	75
Meamber	0	0	0	24	96
Mill	0	0	0	3	11
Moffett	7	0	0	42	204
Pat Ford	0	0	0	5	21
Patterson	0	0	0	6	29
Rattlesnake	0	0	0	7	18
Grass Lake					
Antelope Creek	0	0	0	0	0
Antelope Sink	1	0	0	0	1
Bogus Creek	0	0	0	2	13
Fourmile Hill	0	0	0	0	2
Garner Mtn.	4	0	0	0	3
Glass Mtn.	0	0	0	0	13
Grass Lake	2	0	0	17	16
Headwaters	1	1	0	4	2
Horsethief	0	0	0	5	3
Juanita Lake	0	0	0	1	1
Little Shasta	0	0	0	1	9
NW Mt. Shasta	0	0	0	0	7
Shasta Valley	0	0	0	0	6
Shasta Woods	0	0	0	1	1
Willow Creek	0	0	0	3	2

4.6.3 Road Inventories

FGS has conducted comprehensive road inventories on its ownership in three drainages (Table 4-6). These inventories have been conducted using common methodologies to identify and prioritize sites with the potential to deliver sediment to area streams. Road improvements recommended during the inventories include surfacing, drainage improvement (shaping, sloping), traffic controls, decommissioning, stabilization of slumps and slides, and upgrading stream crossings (bridges, fords, culverts). Future road-related erosion was reported for the three drainages, including road surface, crossings, ditch, fill-slope, and cut-bank erosion sources. Doggett reported a total potential volume of erodible sediment of 3,985 cubic yards, most of this concentrated on fewer than 10 sites. Inventories in the Cottonwood drainage reported a total volume of 916 cubic yards, most of this is concentrated on fewer than 10 sites. Inventories in the Moffett drainage indicated 7,600 cubic yards of erodible sediment was potentially deliverable from 126 sites.

The number of road miles where road surface drainage is directly connected to an adjacent stream (hydrologic connectivity) was assessed during the comprehensive road surveys in the Doggett and Cottonwood drainages. Hydrologic connectivity of roads on the FGS ownership was reported for the Doggett and Cottonwood drainages. Connectivity was reported as 13 percent in Cottonwood (4 miles) and 14 percent in Doggett (7.6 miles). Many of the connected sites are in the form of inside ditches located on USFS co-op road segments over which FGS has no jurisdiction. The remainder of connected segments consists of short segments located at stream crossings.

TABLE 4-6
Road Inventories Conducted by FGS

Drainage	Year	Surveyor	Acres	Miles	Stream Crossings
Moffett	2001	SHN	31,358	42.9	77
Doggett	2001	RM	7,673	54.07	134
West Fork Cottonwood	2002	RM	8,222		0

4.6.4 Restoration Efforts

FGS has targeted the high-potential sediment delivery sites for improvement projects, and road improvement projects have been completed in several drainages, as described in Table 4-7.

TABLE 4-7
Road Improvement Projects Completed by FGS

Drainage	Description	Quantity	Total Cost
Klamath River			
Beaver	Road design: miles of road drainage improvement	20.1	$577,500
Beaver	Stream crossings: bridges, fords, culverts	3	$186,000
Beaver	Stabilize: slides and slumps	8	$190,000

TABLE 4-7
Road Improvement Projects Completed by FGS

Drainage	Description	Quantity	Total Cost
Cottonwood	Road design: miles of road drainage improvement	17	$472,500
Doggett	Surface: miles of rocked road	87.5	$226,500
Doggett	Stream crossings: bridges, fords, culverts	3	$199,500
Doggett	Stabilize: slides and slumps	1	$86,000
Elliott Creek	Road design: miles of road drainage improvement	2	$18,432
Elliott Creek	Surface: miles of rocked road	4	$55,944
Elliott Creek	Stabilize: slides and slumps	1	$8,234
Horse	Road design: miles of road drainage improvement	7.2	$216,000
Horse	Stabilize: slides and slumps	6	$232,500
Scott Valley			
EF Scott	Road design: miles of road drainage improvement	16	$227,000
EF Scott	Surface: miles of rocked road	2.8	$55,800
EF Scott	Stream crossings: bridges, fords, culverts	16	$12,800
Indian	Road design: miles of road drainage improvement	2	$60,000
Indian	Surface: miles of rocked road	1	$6,000
Meamber	Road design: miles of road drainage improvement	0.33	$9,900
Meamber	Stream crossings: bridges, fords, culverts	3	$65,800
Moffett	Road design: miles of road drainage improvement	9.6	$185,500
Moffett	Surface: miles of rocked road	1	$1,800
Moffett	Stream crossings: bridges, fords, culverts	42	$30,000
Moffett	Stabilize: slides and slumps	1	$50,000
Moffett	Decommission: long-term road closure and stabilization	13.7	$411,000
Rattlesnake	Road design: miles of road drainage improvement	0.25	$1,250
Grass Lake			
Little Shasta	Surface: miles of rocked road	3	$5,400

4.7 Vegetation

Vegetation characteristics (tree size [dbh], canopy coverage) within the Plan Area are described below using the vegetation classification system described in the Wildlife Habitat Relationships (WHR) system (Mayer and Laudenslayer 1988).

4.7.1 Upland Forest

The forest communities of FGS's Klamath River and Scott Valley Management Units are dominated by second-growth mixed evergreen forests consisting of three or more species of conifers. Conifer species of the mixed evergreen forest include Douglas-fir (*Pseudotsuga menziesii*), incense-cedar (*Calocedrus decurrens*), white fir (*Abies concolor*), ponderosa pine (*Pinus ponderosa*), and sugar pine (*Pinus lambertiana*). The proportion of these species represented in the overstory depends on site-specific conditions (such as elevation, aspect, precipitation, soils, microclimate conditions, and past management). Small stands consisting of a single species (typically Douglas-fir or ponderosa pine), are scattered throughout the predominately mixed conifer forest landscape. Hardwood species such as canyon live oak (*Quercus chrysolepis*), Pacific madrone (*Arbutus menziesii*), California black oak (*Quercus kelloggii*), and Oregon white oak (*Quercus garryana*) are common in the understory. Forested areas within the Plan Area tend to be naturally fragmented due to the diverse geology, topography, and dry conditions that result in areas dominated by hardwoods or chaparral species.

Three major forest types occur in FGS's Grass Lake Management Unit: Sierran Montane Forest, Upper Montane Forest, and Northern Yellow Pine Forest (Kuchler 1988). Sierran and Upper Montane Forest types occur at higher elevations, and Northern Yellow Pine forest at lower elevations. The Northern Yellow Pine forest type, dominated by ponderosa pine and white fir, is the most common forest type in FGS's Grass Lake Management Unit. As a result of fire suppression, stands of white fir have developed in some locations previously dominated by ponderosa pine. In contrast to the forests of FGS's Klamath River and Scott Valley Management Units, hardwood species are largely absent from FGS's Grass Lake Management Unit.

Approximately 11 percent of the ownership is not considered commercial forest land, consisting of either non-stocked forest land (brush and non-commercial species) or non-forest land (bare ground, meadows, rock). The greatest percentage of non-commercial land is in the Scott Valley Management Unit (15.1 percent, primarily non-stocked forest land) followed by Grass Lake (14.3 percent) and the Klamath River (6.7 percent) Management Units.

Forests in the Plan Area have been managed for commercial timber production since the early 1900s. Consequently, forests are relatively young (less than 80 years old) with only small, isolated patches of older stands. Prior to the start of large-scale commercial logging, much of the conifer forests in the Plan Area and vicinity were older, on average, than current forest stands. However, because this region is fire-prone, it is likely that a mosaic of age classes, including a high percentage of late-seral stages, developed and persisted prior to the advent of commercial logging. Currently, less than 1 percent of the forested area in FGS's Klamath River, Scott Valley, and Grass Lake Management Units (72, 21, and 0 acres in each management unit, respectively) are in WHR size class 5 (> 24 inches dbh) and may be considered late-seral stage. From 79 to 93 percent of commercial forest stands are considered mid-seral, with average tree sizes of 6 to 24 inches dbh (WHR size classes 3 and 4).

Table 4-8 provides the acreage and percentage of the FGS ownership within each WHR size, and canopy closure class for the commercial forest land and general vegetation categories for the non-commercial forest areas. Figures 4-12 through 4-14 illustrate the distribution of WHR classes within each management unit.

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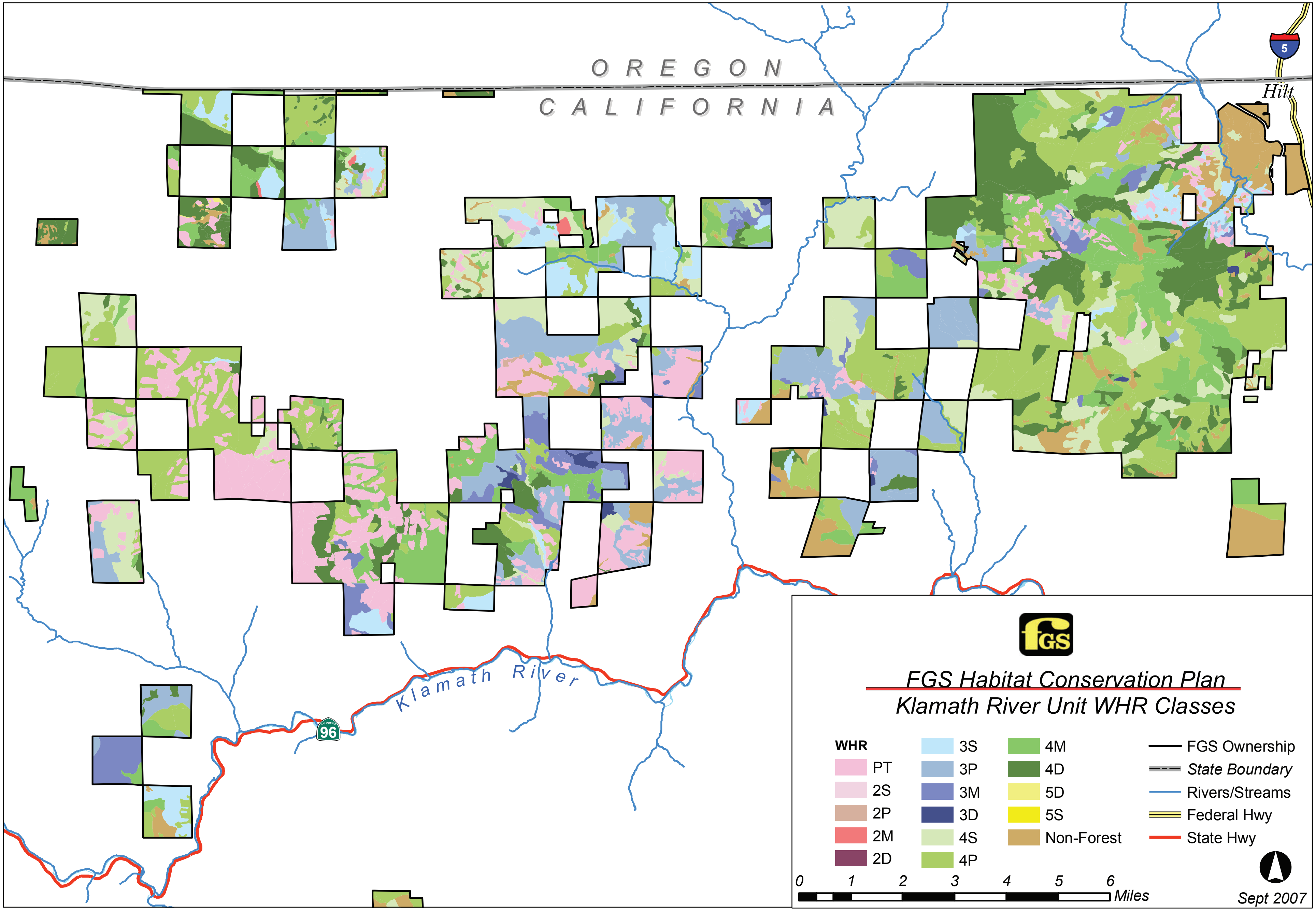

FIGURE 4-12
WHR Classes in the Klamath River Management Unit

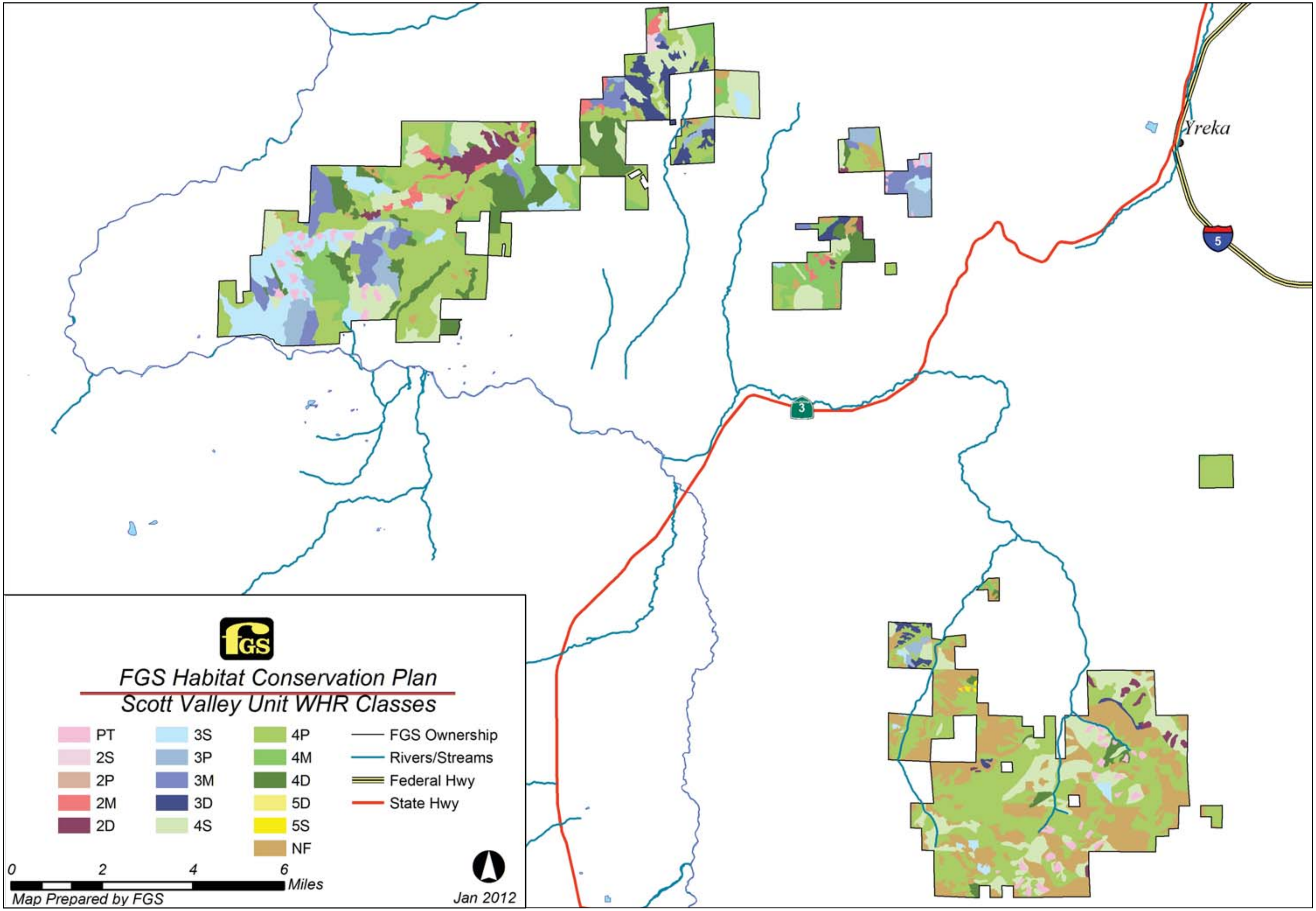

FIGURE 4-13
WHR Classes in the Scott Valley Management Unit

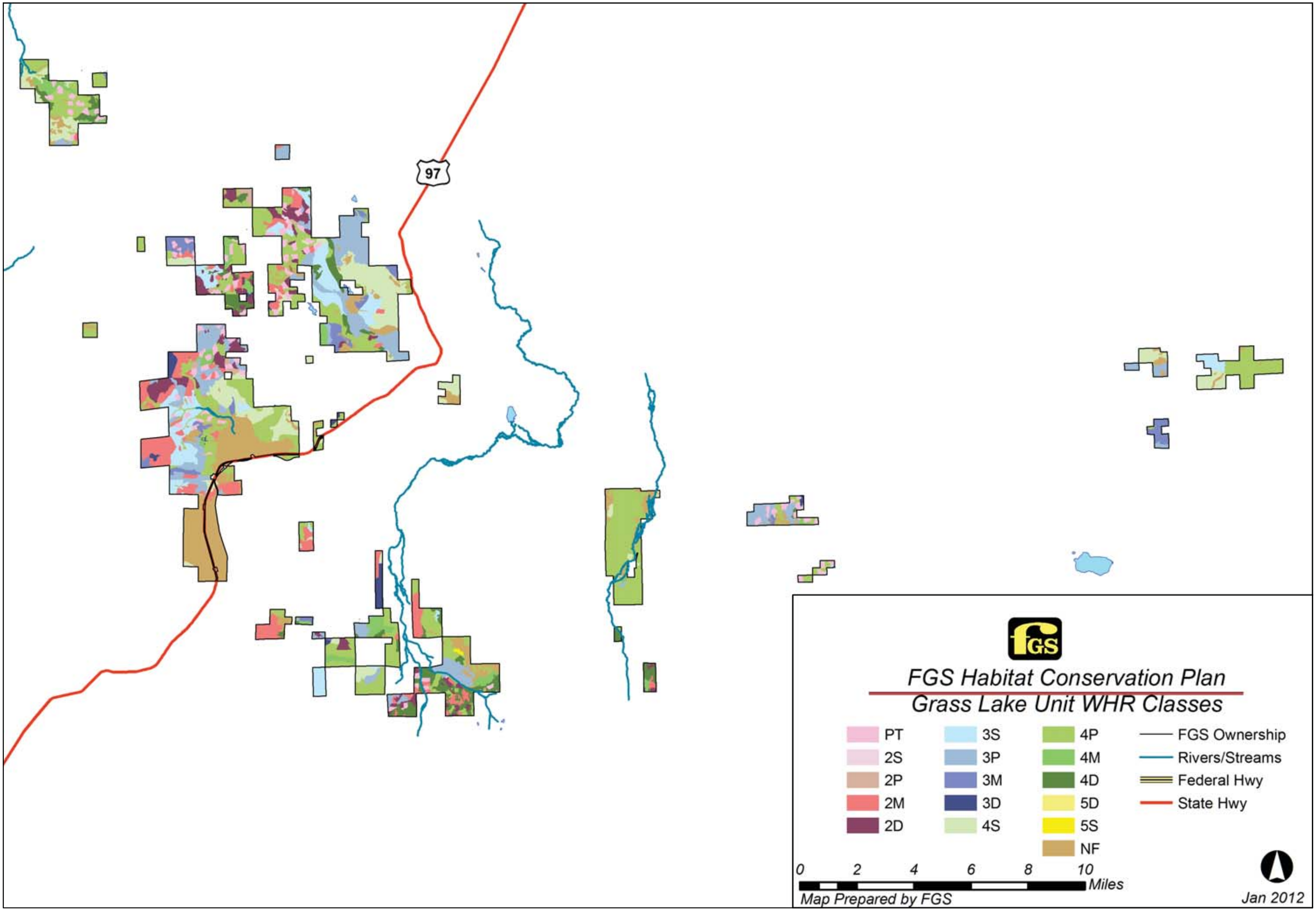

FIGURE 4-14
WHR Classes in the Grass Lake Management Unit

CH2MHILL.

TABLE 4-8
Acreage and Percentage of WHR Size Class and Canopy Closure on FGS's Ownership (2009)

	Management Unit				
Description	**Klamath River**	**Scott Valley**	**Grass Lake**	**Total**	**Percent of Ownership**
Commercial Forest Land					
PT	2,849.2	789.3	2,113.9	5,752.5	3.8%
2D	2,357.8	1,047.9	1,760.6	5,166.3	3.4%
2M	373.3	354.3	801.6	1,529.2	1.0%
2P	112.5	44.6	89.6	246.7	0.2%
2S	0.1	-	65.8	65.9	0.0%
Acres of Size Class 2	5,693.0	2,236.1	4,831.5	12,760.6	8.4%
(% of Commercial Forest)	9%	7%	12%	9%	
3D	2,911.3	1,042.3	1,071.8	5,025.5	3.3%
3M	4,216.8	1,852.4	2,586.1	8,655.3	5.7%
3P	6,056.4	3,840.7	5,049.5	14,946.6	9.8%
3S	2,590.5	2,087.1	2,732.8	7,410.5	4.9%
Acres of Size Class 3	15,775.1	8,822.5	11,440.2	36,037.8	23.7%
(% of Commercial Forest)	26%	27%	28%	27%	
4D	12,603.3	3,322.3	2,834.0	18,759.7	12.3%
4M	10,127.5	2,927.3	2,275.9	15,330.7	10.1%
4P	10,989.2	10,460.2	13,071.3	34,520.7	22.7%
4S	5,287.2	5,278.3	6,401.7	16,967.2	11.1%
Acres of Size Class 4	39,007.3	21,988.1	24,582.9	85,578.2	56.2%
(% of Commercial Forest)	64%	66%	60%	64%	
5D	23.3	-	-	23.3	0.0%
5S	48.5	21.4	-	69.8	0.0%
Acres of Size Class 5	71.8	21.4	-	93.1	0.1%
(% of Commercial Forest)	0%	0%	0%	0%	
Commercial Forest Subtotal	60,547.2	33,068.1	40,854.5	134,469.8	88.4%
Non-stocked Land (Non-commercial Forest)					
Hardwood	1,104.4	245.8	18.4	1,368.6	0.9%
Brush	667.9	4,161.0	1,567.8	6,396.8	4.2%
Juniper	-	252.5	-	252.5	0.2%
Subtotal	1,772.3	4,659.3	1,586.2	8,017.9	5.3%
Non-forest Land (Non-commercial Forest)					
Agriculture	460.1	29.6	2.2	491.9	0.3%
Bare Ground	6.7	16.3	67.5	90.5	0.1%
Borrow Pit	-	-	24.8	24.8	0.0%
Creek	65.5	-	-	65.5	0.0%
Meadow	19.9	-	-	19.9	0.0%
Range	867.8	71.5	4,223.9	5,163.2	3.4%
Rock	1,308.4	1,296.5	860.6	3,465.5	2.3%
Riparian	229.8	-	37.6	267.5	0.2%
Specific Value	32.4	-	25.8	58.1	0.0%

TABLE 4-8
Acreage and Percentage of WHR Size Class and Canopy Closure on FGS's Ownership (2009)

Description	Management Unit				
	Klamath River	Scott Valley	Grass Lake	Total	Percent of Ownership
Wet Area	29.7	11.9	2.6	44.2	0.0%
Subtotal	3,020.2	1,425.9	5,244.9	9,691.0	6.4%
Total	**65,339.8**	**39,153.3**	**47,685.7**	**152,178.7**	**100.0%**

Size Classes:

PT: Plantation stands
2: 1 to 6 inches dbh
3: 6 to 11 inches dbh
4: 11 to 24 inches dbh
5: >24 inches dbh

Canopy Closure:

D: 60 to 100%
M: 40 to 59%
P: 25 to 39%
S: 10 to 24%

Source: FGS, unpublished data

4.7.2 Riparian Forest

The plant species composition and structure of riparian forest habitat currently occurring along streams in the Plan Area varies in relation to factors such as stream characteristics, topography, elevation, and past management. Close to the valley floor, hardwoods (such as willows [*Salix* spp.] and cottonwoods [*Populus* spp.]) predominate. In some of the valley floor areas, the riparian zone composed of hardwoods forms a plant community that is distinct from drier upland areas that support chaparral species. At higher elevations, the riparian zone is characterized as a mix of conifer and hardwood species. The conifer component is similar to adjacent upslope areas; the hardwood component consists of red alders (*Alnus rubra*) and big leaf maple (*Acer macrophyllum*) along the immediate margins of the stream. Along many streams on FGS lands, particularly higher-gradient streams, riparian forest composition is largely indistinguishable from the adjacent upland mixed conifer forest.

Site-specific riparian inventories have not been conducted along all streams in the Plan Area. To provide a general indication of the condition of riparian stands, the FGS hydrology (stream) layer was buffered according to DFG Coho Recovery Plan specifications (150-foot buffers along Class I streams, 75- to 125-foot buffers along Class II streams, and 25- to 50-foot buffers along Class III streams) and overlain on the FGS 2004 Forest Inventory using GIS. The range of buffer width within a given class was dependent on percent slope of adjacent hillsides. Results of this analysis are presented in Tables 4-9 through 4-11, which summarize the number of trees per acre in various size classes in riparian stands along Class I, Class II, and Class III streams, respectively.

Site-specific information on riparian stands is available from inventories conducted on selected reaches within a few drainages in the Plan Area. Information on the number of trees per acre, basal area, quadratic mean diameter (qmd), and stream shading along these reaches is provided in Table 4-12.

4.8 Aquatic Species and Habitats

The Covered Species' legal status—and a general description of their range and distribution, life history, and habitat requirements—were presented in Chapter 3. This section builds upon that information by further describing the species' regional status and distribution in the Plan Area, channel types, and aquatic habitat elements in the Plan Area that are common to all of the aquatic Covered Species. The regional and local environmental baseline is relevant to analyzing the effects of the Covered Activities and conservation measures on the Covered Species.

Several drainages within the Plan Area are believed to support naturally reproducing runs of anadromous fish. Although FGS has substantial holdings in many of these watersheds, few of these holdings are adjacent to streams with anadromous fish runs. Typically, FGS lands are along non-fishbearing tributaries to streams that may support anadromous fish. Within the current Plan Area, FGS about 33 miles of fishbearing (Class I) streams are on the FGS ownership, including about 24, 4, and 5 miles of fishbearing streams in FGS's Klamath River, Scott Valley, and Grass Lake Management Units, respectively. The majority of streams (about 150 miles) on FGS-owned lands are non-fishbearing Class II and III streams. Anadromous salmonids are found in about 14 miles of stream on the FGS ownership, primarily in the Klamath River Management Unit. No anadromous salmonids are found on the FGS ownership in the Grass Lake Management Unit. The remaining miles of fishbearing stream support only resident fish species. The majority (68%) of non-anadromous fishbearing streams on the FGS ownership are in steep headwater streams in the Klamath River management unit; 26 percent of the non-anadromous fishbearing streams are located behind long-standing dams in the Grass Lake management unit and the remaining 5 percent of these streams are seasonally inaccessible streams in the Scott Valley management unit.

TABLE 4-9
Riparian Buffer Characteristics within 150 Feet of Class I Streams Based on the 2004 Forest Inventory

		Trees per Acre			
Drainage	**Acres**	**4–10 inches**	**12–16 inches**	**18–22 inches**	**24+ inches**
Klamath River					
Beaver	319.1	81.5	12.8	4.3	3.3
Cottonwood	448.5	66.4	17.8	8.0	2.5
Doggett	42.1	65.0	14.7	3.7	2.0
Dona	17.4	100.7	8.7	6.3	1.0
Dutch Creek	0.0				
Elliott Creek	82.5	82.6	12.7	8.7	7.0
Empire Creek	0.0				
Horse	82.9	56.3	10.9	5.0	1.0
Lumgrey Creek	10.2	249.0	15.0	5.0	1.5
Seiad	3.1	236.0	25.0	2.5	0.0
Scott Valley					
Big Ferry	0.0				
Canyon	26.3	129.0	21.0	5.0	1.3
EF Scott	197.0	96.9	22.9	4.1	1.0
Indian	8.5	0.0	0.0	0.0	0.0

TABLE 4-9
Riparian Buffer Characteristics within 150 Feet of Class I Streams Based on the 2004 Forest Inventory

		Trees per Acre			
Drainage	**Acres**	**4–10 inches**	**12–16 inches**	**18–22 inches**	**24+ inches**
Meamber	0.0				
Mill	0.0				
Moffett	239.0	86.8	16.0	4.3	0.3
Pat Ford	0.0				
Patterson	0.0				
Rattlesnake	0.0				
Grass Lake					
Antelope Creek	13.3	160.7	37.0	6.7	0.7
Antelope Sink	86.5	58.0	9.0	5.0	0.3
Bogus Creek	49.2	27.8	15.8	7.5	1.0
Fourmile Hill	0.0				
Garner Mtn.	149.9	52.1	23.8	10.1	1.4
Glass Mtn.	0.0				
Grass Lake	111.6	87.2	14.6	3.0	0.3
Headwaters	116.2	79.6	18.4	5.2	2.1
Horsethief	0.0				
Juanita Lake	0.0				
Little Shasta	0.0				
NW Mt. Shasta	0.0				
Shasta Valley	0.0				
Shasta Woods	0.0				
Willow Creek	0.0				

Note: FGS hydrology layer buffered according to DFG Coho Recovery Plan specifications and overlain on the FGS 2004 Forest Inventory.

TABLE 4-10
Riparian Buffer Characteristics within 75 to 125 Feet of Class II Streams Based on the 2004 Forest Inventory

		Trees per Acre			
Drainage	**Acres**	**4–10 inches**	**12–16 inches**	**18–22 inches**	**24+ inches**
Klamath River					
Beaver	1062.8	74.5	10.4	4.2	2.0
Cottonwood	676.2	93.8	22.3	11.2	3.3
Doggett	319.0	60.0	15.8	8.1	3.3
Dona	201.2	32.2	9.0	5.0	2.8
Dutch Creek	113.0	90.8	16.1	11.0	3.9
Elliott Creek	459.1	56.8	14.2	9.4	7.5
Empire Creek	132.6	140.2	17.5	5.9	2.2
Horse	825.5	40.9	9.4	3.7	1.3
Lumgrey Creek	88.2	100.0	14.8	4.9	1.7
Middle Klamath	74.3	94.3	15.3	4.5	1.8
Seiad	65.0	132.6	23.2	6.9	2.6
Scott Valley					
Big Ferry	85.3	79.9	15.3	7.1	3.2

TABLE 4-10
Riparian Buffer Characteristics within 75 to 125 Feet of Class II Streams Based on the 2004 Forest Inventory

		Trees per Acre			
Drainage	**Acres**	**4–10 inches**	**12–16 inches**	**18–22 inches**	**24+ inches**
Canyon	19.7	193.5	31.5	7.5	2.0
EF Scott	225.6	85.8	14.4	3.3	0.3
Indian	75.3	92.3	13.9	6.0	1.1
Meamber	185.4	130.0	24.8	10.4	2.6
Mill	42.3	87.1	16.0	3.5	0.9
Moffett	462.7	79.8	15.4	4.0	0.4
Pat Ford	7.4	128.0	18.0	9.5	2.0
Patterson	61.1	134.0	23.1	12.4	4.5
Rattlesnake	62.0	110.2	19.0	5.6	2.4
Grass Lake					
Antelope Creek	0.0				
Antelope Sink	0.0				
Bogus Creek	62.5	49.3	21.9	7.1	0.9
Fourmile Hill	0.0				
Garner Mtn.	0.0				
Glass Mtn.	0.0				
Grass Lake	169.4	93.1	14.3	3.8	0.7
Headwaters	26.8	172.7	56.3	10.3	0.7
Horsethief	81.1	116.2	14.7	3.2	0.4
Juanita Lake	13.1	188.0	15.0	0.0	0.0
Little Shasta	4.9	129.9	26.1	9.6	1.0
NW Mt. Shasta	0.0				
Shasta Valley	17.1	73.9	5.3	1.3	0.3
Shasta Woods	32.1	83.9	17.5	3.0	0.0
Willow Creek	42.9	59.4	10.3	4.1	0.5

Note: FGS hydrology layer buffered according to DFG Coho Recovery Plan specifications and overlain on the FGS 2004 Forest Inventory

TABLE 4-11
Riparian Buffer Characteristics within 25 to 50 Feet of Class III Streams Based on the 2004 Forest Inventory

		Trees per Acre			
Drainage	**Acres**	**4–10 inches**	**12–16 inches**	**18–22 inches**	**24+ inches**
Klamath River					
Beaver	295.3	85.8	12.7	5.4	1.9
Cottonwood	272.4	80.6	16.9	8.7	2.5
Doggett	120.9	54.1	15.9	4.5	1.9
Dona	51.7	41.6	8.5	5.0	2.1
Dutch Creek	34.7	95.3	13.5	8.3	3.8
Elliott Creek	8.4	41.8	6.8	5.3	2.8
Empire Creek	22.6	160.6	19.5	6.5	2.7
Horse	116.1	67.8	14.8	6.0	1.9
Lumgrey Creek	68.0	96.6	14.7	4.6	1.5
Middle Klamath	38.5	57.9	7.6	1.9	0.3
Seiad	102.3	86.8	18.7	5.5	2.1

TABLE 4-11
Riparian Buffer Characteristics within 25 to 50 Feet of Class III Streams Based on the 2004 Forest Inventory

Drainage	Acres	Trees per Acre 4–10 inches	12–16 inches	18–22 inches	24+ inches
Scott Valley					
Big Ferry	61.1	70.9	11.5	5.6	2.2
Canyon	28.2	114.5	26.0	5.5	1.0
EF Scott	135.1	101.6	18.8	4.2	0.6
Indian	190.3	76.8	13.1	5.0	1.2
Meamber	149.0	131.4	23.1	8.6	1.8
Mill	39.3	50.7	10.0	3.3	0.8
Moffett	547.2	79.7	14.6	4.2	1.0
Pat Ford	16.5	95.0	16.1	5.3	1.1
Patterson	80.0	104.2	20.5	10.0	3.3
Rattlesnake	60.6	84.9	16.8	6.2	2.0
Grass Lake					
Antelope Creek	0.0				
Antelope Sink	0.0				
Bogus Creek	31.4	58.1	11.9	6.1	1.3
Fourmile Hill	8.6	64.0	18.0	2.0	0.0
Garner Mtn.	5.9	82.5	24.0	12.5	1.0
Glass Mtn.	36.3	182.3	15.1	2.9	0.3
Grass Lake	38.5	58.1	8.1	2.4	0.3
Headwaters	1.1	168.0	25.7	10.0	0.7
Horsethief	5.9	80.1	17.1	2.2	0.0
Juanita Lake	2.2	94.0	7.5	0.0	0.0
Little Shasta	23.5	71.5	10.8	4.3	0.4
NW Mt. Shasta	34.7	0.0	0.0	0.0	0.0
Shasta Valley	13.9	63.6	6.6	1.0	0.3
Shasta Woods	7.0	122.4	22.4	2.8	0.2
Willow Creek	3.6	139.0	18.5	7.5	1.0

Note: FGS hydrology layer buffered according to DFG Coho Recovery Plan specifications and overlain on the FGS 2004 Forest Inventory

TABLE 4-12
Riparian Zone Characteristics in the Plan Area, 1997 to 2003

Stream	Trees per Acre Conifer	Trees per Acre Hardwood	Trees per Acre Total	Basal Area per Acre Conifer	Basal Area per Acre Hardwood	Basal Area per Acre Total	QMD	Shade* %
WF Beaver Creek	32.3	198.0	230.3	34.4	71.4	105.8	9.2	76
WF Cottonwood Creek	78.8	103.4	182.2	69.6	63.6	133.1	12.0	91
Doggett Creek	18.4	143.9	162.3	34.5	80.3	114.8	11.6	99
Moffett Creek	54.4	36.3	90.7	53.8	40.3	94.0	13.8	56
Patterson Creek	22.3	129.0	151.3	26.8	42.5	69.3	9.2	64

*Average canopy closure measured at thalweg of pools using a hemispherical densitometer

4.8.1 Coho Salmon

4.8.1.1 Regional Status and Distribution

The status and life stage distribution of coho salmon is not well known in the middle Klamath River Basin. The status of wild fish is particularly uncertain. Small wild populations may persist in a few tributaries, but many populations are influenced by hatchery operations (Weitkamp et al. 1995). Between Iron Gate Dam and Seiad Valley, coho salmon populations are known to occur in Bogus Creek, Little Bogus Creek, Shasta River, Humbug Creek, Little Humbug Creek, Empire Creek, Beaver Creek, Horse Creek, and Scott River (NMFS 2002).

As a result of declines in the population of coho salmon of the southern Oregon/northern California ESU, coho salmon within this ESU were federally listed as threatened in May 1997 (62 FR 24588). This status was reaffirmed on June 28, 2005 (70 FR 37160). Three artificial propagation programs are considered to be included in this ESU: the Cole Rivers Hatchery (ODFW stock #52), Trinity River Hatchery, and Iron Gate Hatchery coho hatchery programs (70 FR 37160). Critical habitat for this ESU was designated in May 1999 (64 FR 24049). The population of this ESU is considered to be very depressed, containing fewer than 10,000 naturally produced adults as compared to the 150,000 to 400,000 adults estimated to occur in the ESU in the 1940s (62 FR 24588). Natural and human factors have been implicated in the decline of coho salmon of the southern Oregon/northern California ESU (62 FR 24588). The State of California formally listed coho salmon as threatened north of Punta Gorda to California's border with Oregon on March 30, 2005.

4.8.1.2 Distribution in the Plan Area

No comprehensive spawning surveys have been conducted for coho salmon in streams in the vicinity of FGS's Klamath River Management Unit, and limited information is available on juvenile rearing. Juvenile coho salmon have been observed in Beaver Creek (Miller et al. 1993; FGS, unpublished data) and lower Cottonwood Creek (USFS 1993). Coho salmon are also believed to use the lower reaches of Horse Creek, Empire Creek, and West Fork Beaver Creek (USFS, unpublished data). Spawning and rearing areas have not been documented for these tributaries. During an investigation of cool water areas in the Klamath River below Iron Gate Dam, a few juvenile coho salmon were observed at the confluence of Barkhouse Creek and McKinney Creek during the summer of 1996 (Belchik 1997). Although other cool water areas were noted with similar characteristics (for example, flow and temperature differences) at the confluence of tributaries draining FGS lands (Empire/Lumgrey, Beaver, Kohl, and Horse creeks), no juvenile coho salmon were observed at these locations (Belchik 1997).

Little information is available on the distribution of coho salmon by life stage in the Scott River Basin. Coho salmon have been observed in several tributaries to the Scott River, including Canyon, Shackleford, Mill, Kidder, French, Miners, and Sugar creeks, and the South Fork Scott River and its tributary Boulder Creek (USFS, unpublished data). Coho salmon also utilize many other tributaries to the Scott River, such as Kelsey, Tompkins, Patterson, and Etna creeks (Hassler et al. 1991). The nature and extent of use by these tributaries' coho salmon is uncertain. In recent years, juvenile coho salmon have been reported in the mainstem Scott River (West et al. 1989) and lower reaches of French Creek (DFG 1994).

Surveys to determine the spawning distribution of coho salmon were conducted in 2001-2002 (Maurer 2002), 2002–2003 (Maurer 2003), 2003–2004 (Siskiyou RCD 2004), and 2004–2005 (Siskiyou RCD 2005b). The 2004–2005 surveys were the most comprehensive, and showed that the spawning distribution was more extensive than in 2001. Spawning was well distributed in 2004–2005, with spawning found higher in some tributaries than previously observed (Upper Mill Creek, Upper East Fork, Upper Sugar Creek). In addition, spawning was observed in stream reaches where spawning was not previously observed (Upper Mill Creek, Canyon Creek, Lower Kidder Creek, Lower Tompkins), as well as in new reaches established in 2004 (Lower Etna, Lower Patterson, Middle Patterson, extended tailings reach). No spawning was documented in Grouse Creek, Middle Creek, Boulder Creek (Scott Canyon), lower Boulder Creek (South Fork Scott), or Paynes Creek, or at the mouths of Fox or Boulder creeks. No spawning was observed in the survey reach on Rail Creek. Coho were observed holding and spawning in the lower 200 feet of Rail Creek (Siskiyou RCD 2005b). However, no formal survey was completed in this section of Rail Creek. With the exception of the East Fork Scott, Mill Creek, and Moffett Creek, FGS does not own any land in these drainages. Other tributaries may provide spawning habitat, but were not surveyed to determine presence or absence of coho salmon.

In 1930, DFG installed and began operating a fish-counting station in the Shasta River near its confluence with the Klamath River. This counting station has been operated annually to enumerate the return of fall-run Chinook salmon. In some years, the counting station operated later into the season to count coho salmon and steelhead. Coho salmon returns to the Shasta River have been documented in almost every year since 1934 (DFG 2002b). In the Shasta River watershed, spawning coho salmon utilize areas in the lower seven miles of the mainstem Shasta, Big Springs Creek, mainstem Shasta above Big Springs, Parks Creek (when flows are adequate), and the lower three miles of Yreka Creek (DFG 1997). In the Shasta River, juvenile coho salmon habitat is restricted by high summer water temperature to approximately 10 miles of the upper river, roughly delineated by the Siskiyou County Road A-12 crossing at river mile 22 to 1 mile upstream of the confluence of Parks Creek at river mile 32 (DFG 2002b).

Coho salmon are known or suspected to be present in about 3.7 miles of streams in the Plan Area (USFS, unpublished data) (Figures 4-15 through 4-17; Table 4-13). In most drainages where coho salmon occur in FGS streams, FGS owns a small proportion of the total length of stream supporting coho salmon. Only in the Empire Creek watershed does 25 percent or more of the total miles of stream supporting coho salmon occur on FGS lands.

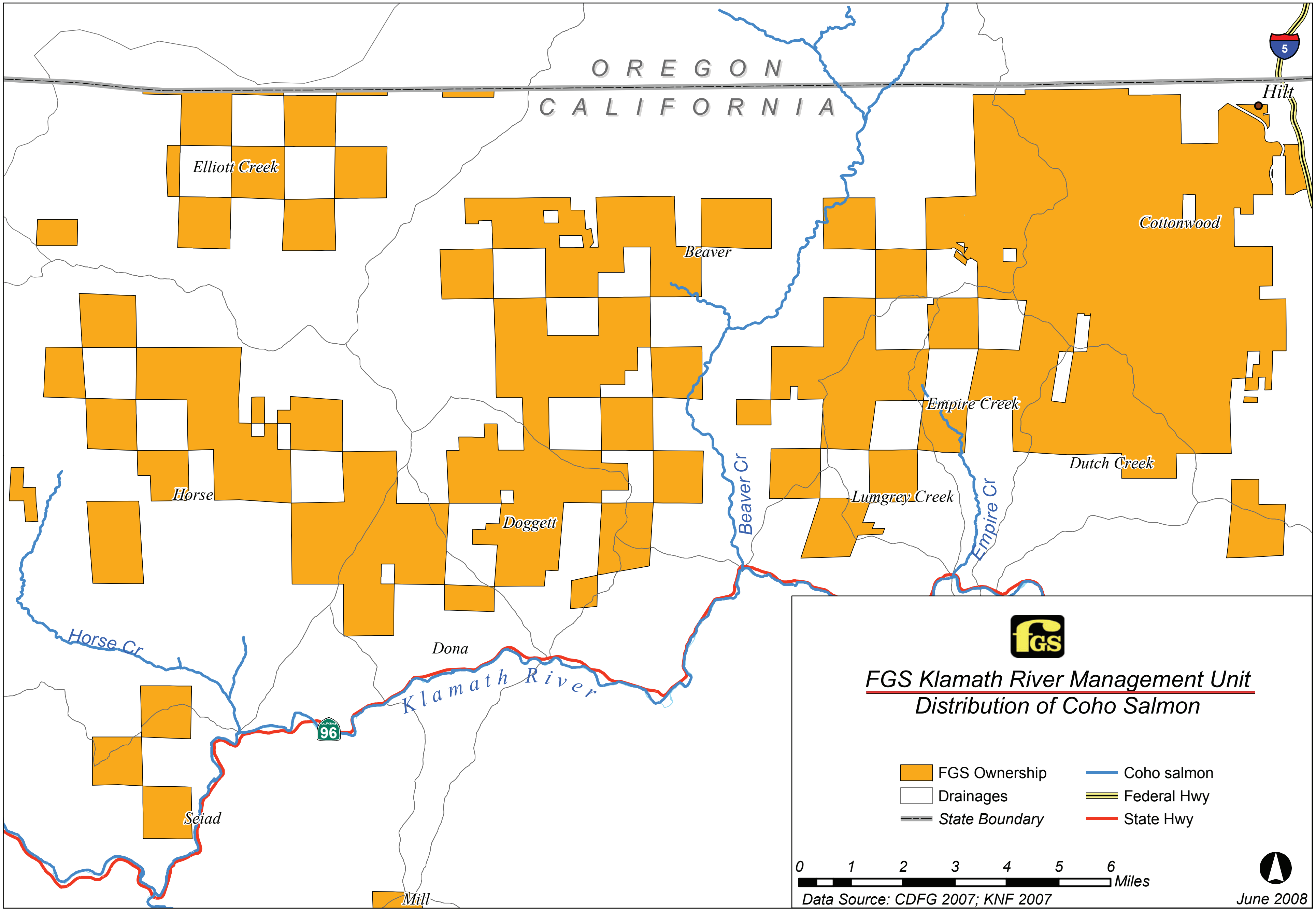

FIGURE 4-15
Distribution of Coho Salmon in the Klamath River Management Unit

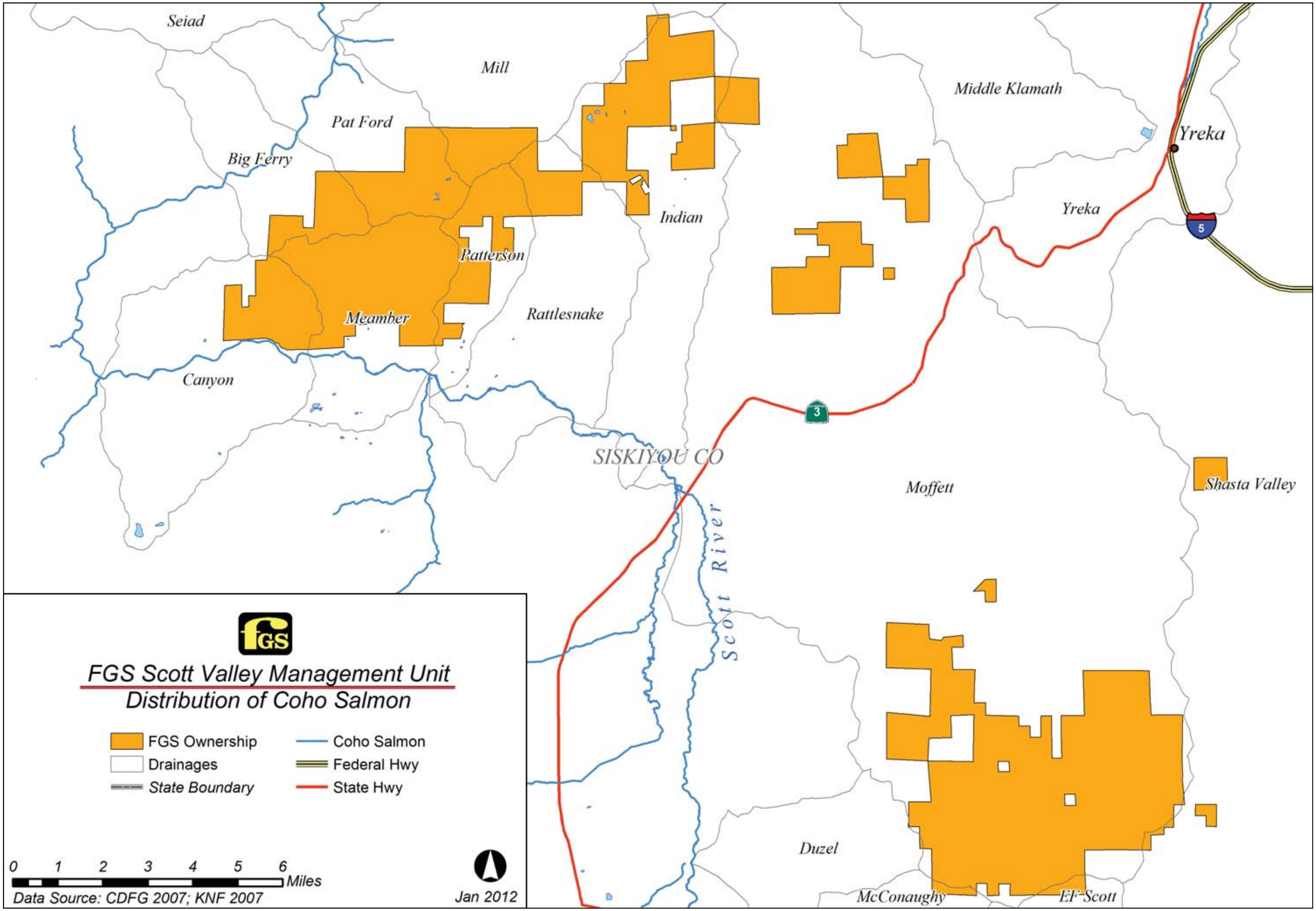

FIGURE 4-16
Distribution of Coho Salmon in the Scott Valley Management Unit

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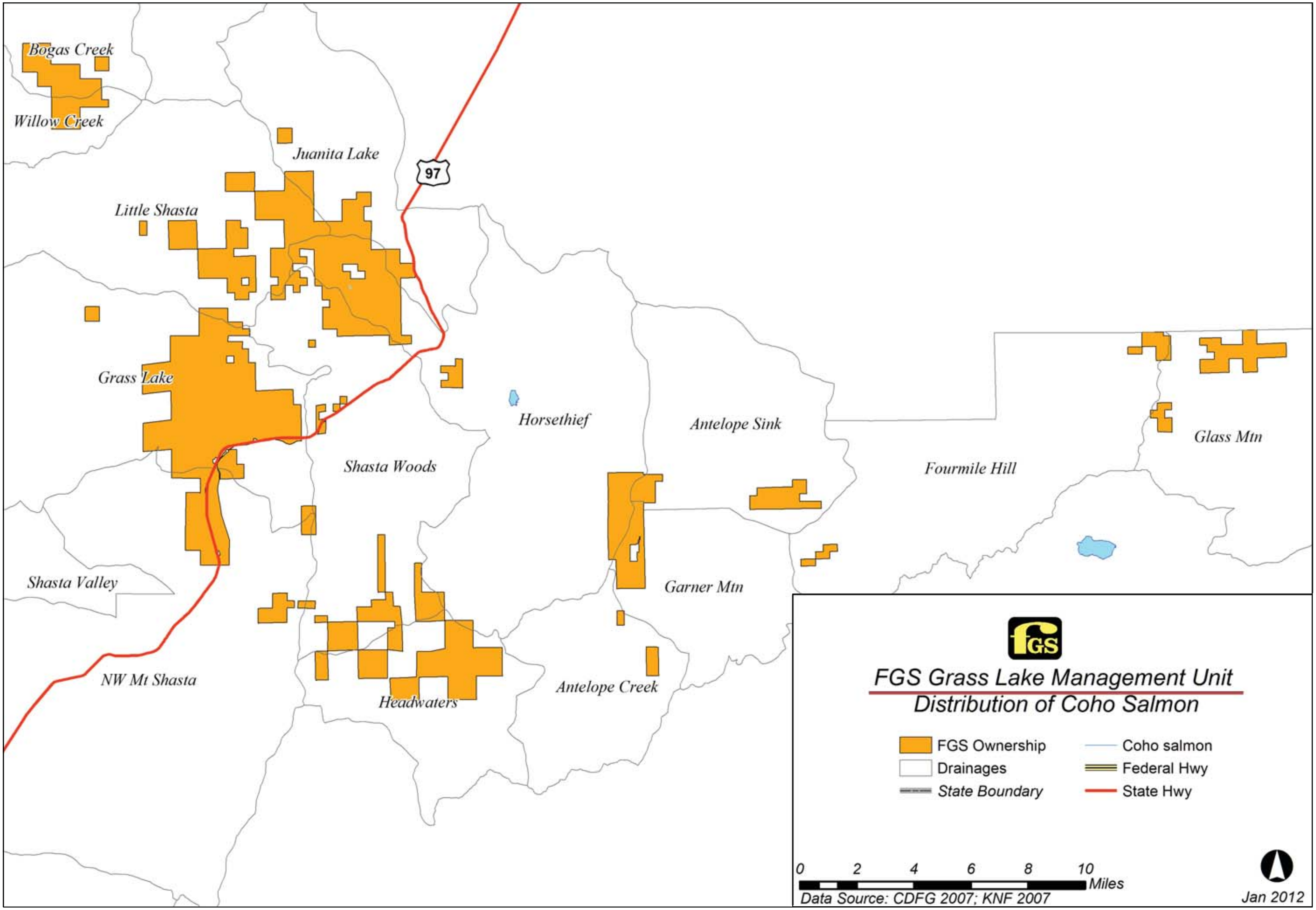

FIGURE 4-17
Distribution of Coho Salmon in the Grass Lake Management Unit

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TABLE 4-13
Miles of Stream on FGS Lands and within Drainages Known or Suspected to Support Coho Salmon

	Miles	
Drainage	**Total[a]***	**FGS Lands**
Klamath River	**119.7**	**3.7**
Beaver	23.3	2.2
Cottonwood	2.1	0.0
Doggett	0.0	0.0
Dona	3.9	0.0
Dutch Creek	0.3	0.0
Empire Creek	5.4	1.5
Horse	10.3	0.0
Lumgrey	0.0	0.0
Middle Klamath	55.7	0.0
Seiad	18.6	0.0
Scott River	**54.8**	**0.0**
Big Ferry	2.5	0.0
Canyon	5.6	0.0
Duzel	0.2	0.0
EF Scott	18.3	0.0
Indian	2.0	0.0
McConaughy	6.4	0.0
Meamber	3.2	0.0
Mill	1.4	0.0
Moffett	4.7	0.0
Pat Ford	3.6	0.0
Patterson	0.6	0.0
Rattlesnake	3.9	0.0
Grass Lake	**58.4**	**0.0**
Bogus Creek	9.6	0.0
Little Shasta	0.5	0.0
NW Mt. Shasta	0.03	0.0
Shasta Valley	40.6	0.0
Willow Creek	7.8	0.0

*Includes habitat in the mainstem Scott, Klamath, or Shasta rivers
Source: USFS and DFG, unpublished data

4.8.2 Steelhead

4.8.2.1 Regional Status and Distribution

Steelhead populations on the west coast of the United States have experienced declines in abundance over the past several decades as a result of natural and human factors. Human activities such as forestry, agriculture, mining, and urbanization have degraded, simplified, and fragmented steelhead habitat. Water diversions for agriculture, flood control, domestic, and hydropower purposes have greatly reduced or eliminated historically accessible habitat. Sedimentation from land use activities is recognized as a primary cause of habitat degradation in the range of west coast steelhead. These human-induced impacts have likely reduced the steelhead's resiliency to natural factors such as drought, poor ocean conditions, and predation. Recreational fishing and introduction of non-native predator species have also contributed to the decline of steelhead populations.

Weir records indicate that steelhead migrate into the larger tributaries of the Klamath River including the Salmon and Scott rivers, the Trinity River and its forks, Elk Creek, Clear Creek, Indian Creek, Bogus Creek, and the Shasta River. Winter-run steelhead are probably the most widely distributed of the salmonid runs in the basin because their return timing may allow them access to many of the smaller streams. Summer-run steelhead return to several tributaries in the Klamath River Basin, including the Salmon River, Wooley Creek, Redcap Creek, Elk Creek, Bluff Creek, Dillon Creek, Indian Creek, Clear Creek, forks of the Trinity River, and Canyon Creek.

Steelhead stocks in the middle Klamath River Basin are heavily influenced by hatchery fish from Iron Gate Hatchery (Busby et al. 1994). Iron Gate Hatchery primarily relies on local fish for hatchery broodstock. However, steelhead from the Trinity River in California and Cowlitz River in Washington have been used to augment the Klamath River broodstock (Klamath River Basin Fisheries Task Force [KRBFTF] 1991). Returns of steelhead to Iron Gate Hatchery have declined since 1990 (63 FR 13366). The Klamath Mountains Province steelhead ESU was previously proposed for federal listing as threatened. Although populations of the summer-run life-history type are severely depressed, after reviewing updated abundance and trend information for the ESU as a whole, NMFS concluded in April 2001 that the Klamath Mountains Province ESU did not warrant listing (66 FR 17845).

4.8.2.2 Steelhead Distribution in the Plan Area

Information on the spawning distribution of steelhead in the vicinity of FGS lands is limited due to the difficulty in observing returning fish and redds during the winter high-water periods when steelhead spawn. Steelhead have been reported to spawn in Beaver Creek (West et al. 1989), and adults have been observed holding in lower Cottonwood Creek during the summer (USFS 1993). In the mainstem Beaver Creek, most steelhead spawning has occurred relatively high in the drainage between Grouse and Soda creeks, with less spawning activity between Soda Creek and the confluence with the Klamath River (USFS 1996a). Since 1990, spawning surveys have been conducted sporadically from January to April in Beaver Creek. The relative success of completing these surveys is highly dependent on spring flow conditions. The number of steelhead redds observed in Beaver Creek from 1990 to 1993 is listed in Table 4-14.

TABLE 4-14
Steelhead Spawning Survey Results for Beaver Creek

Year	Number of Redds
1990	57
1991	3
1992	2
1993	0

Source: USFS 1996a

In the Scott River, Olson and Dix (1992) noted that the lower reaches of Shackleford and Mill creeks (downstream of FGS lands) have spawning habitat for a large number of steelhead, and suggested that these creeks served as "spawning refugia" for steelhead displaced from other portions of the Scott River Basin. Kidder Creek was noted as containing excellent spawning gravel (Scott River CRMP 1995). The Scott Valley Management Unit includes land in the Mill Creek drainage, but does not include lands in the Shackleford or Kidder Creek drainages.

In the Shasta River Basin, steelhead are known to occur in several miles of the Shasta River, Bogus Creek, the Little Shasta River, and Willow Creek. However, all of these areas are considerably downstream of the Plan Area, and there is no habitat accessible to steelhead within streams in the Plan Area.

Considerably more information is available on the distribution of juvenile steelhead. Juveniles have been observed in numerous tributary streams throughout the middle Klamath and Scott River basins (FGS, unpublished data; USFS 1996a; USFS 1993), as well as in the mainstems (Belchik 1997). West et al. (1989) reported "high densities" of juvenile steelhead in the lower reaches of Mill Creek. The composition of the steelhead populations in tributary streams in terms of hatchery and naturally produced fish is unknown.

Low flows and dewatering of tributary streams are considered major factors limiting steelhead production in the Scott River Basin (see Scott River CRMP 1995; Olson and Dix 1992; West et al. 1989). High numbers of juveniles can be produced in Kidder Creek, but may become stranded during the late summer and fall when lower reaches of the stream typically become dry (Scott River CRMP 1995).

Similarly, rearing habitat is limited in Mill Creek due to low flows (Olson and Dix 1992), and West et al. (1989) identified low flows as restricting rearing habitat in the mainstem Scott River. While instream flows are of primary concern with regard to steelhead production, high summer water temperatures and excessive sediment in the mainstem Scott River may also influence steelhead production and habitat use (West et al. 1989).

Steelhead use streams on FGS lands primarily for juvenile rearing. Fall and winter steelhead are known or suspected to be present in about 14.4 miles of streams in the Plan Area (USFS and DFG, unpublished data) (Table 4-15; Figures 4-18 through 4-20). No summer steelhead are found in the Plan Area. In most drainages, FGS owns a small proportion of the total amount of habitat for steelhead. Only in the Empire Creek watershed does more than 25 percent of the steelhead habitat occur on the FGS ownership.

TABLE 4-15
Miles of Stream on FGS Lands and within Drainages Known or Suspected to Support Winter Steelhead

	Miles	
Drainage	**Total[a]**	**FGS Lands**
Klamath River	**188.3**	**13.1**
Beaver	31.0	5.4
Cottonwood	35.5	5.7
Doggett	2.0	0.2
Dona	4.8	0.0
Dutch Creek	1.9	0.0
Empire Creek	5.8	1.8
Horse	15.3	0.0
Lumgrey Creek	2.0	0.0
Middle Klamath	68.5	0.0
Seiad	21.6	0.0
Scott Valley	**113.3**	**1.3**
Big Ferry	2.5	0.0
Canyon	5.6	0.0
Duzel	0.2	0.0
EF Scott	27.1	0.0
Indian	5.4	0.0
McConaughy	6.4	0.0
Meamber	3.2	0.0
Mill	5.6	0.0
Moffett	36.5	1.3
Pat Ford	4.9	0.0
Patterson	1.9	0.0
Rattlesnake	6.3	0.0
Grass Lake	**69.3**	**0.0**
Bogus Creek	14.4	0.0
Little Shasta	4.4	0.0
NW Mt. Shasta	0.03	0.0
Shasta Valley	42.71	0.0
Willow Creek	7.8	0.0

*Includes habitat in the mainstem Scott, Klamath, or Shasta rivers

Source: USFS and DFG, unpublished data

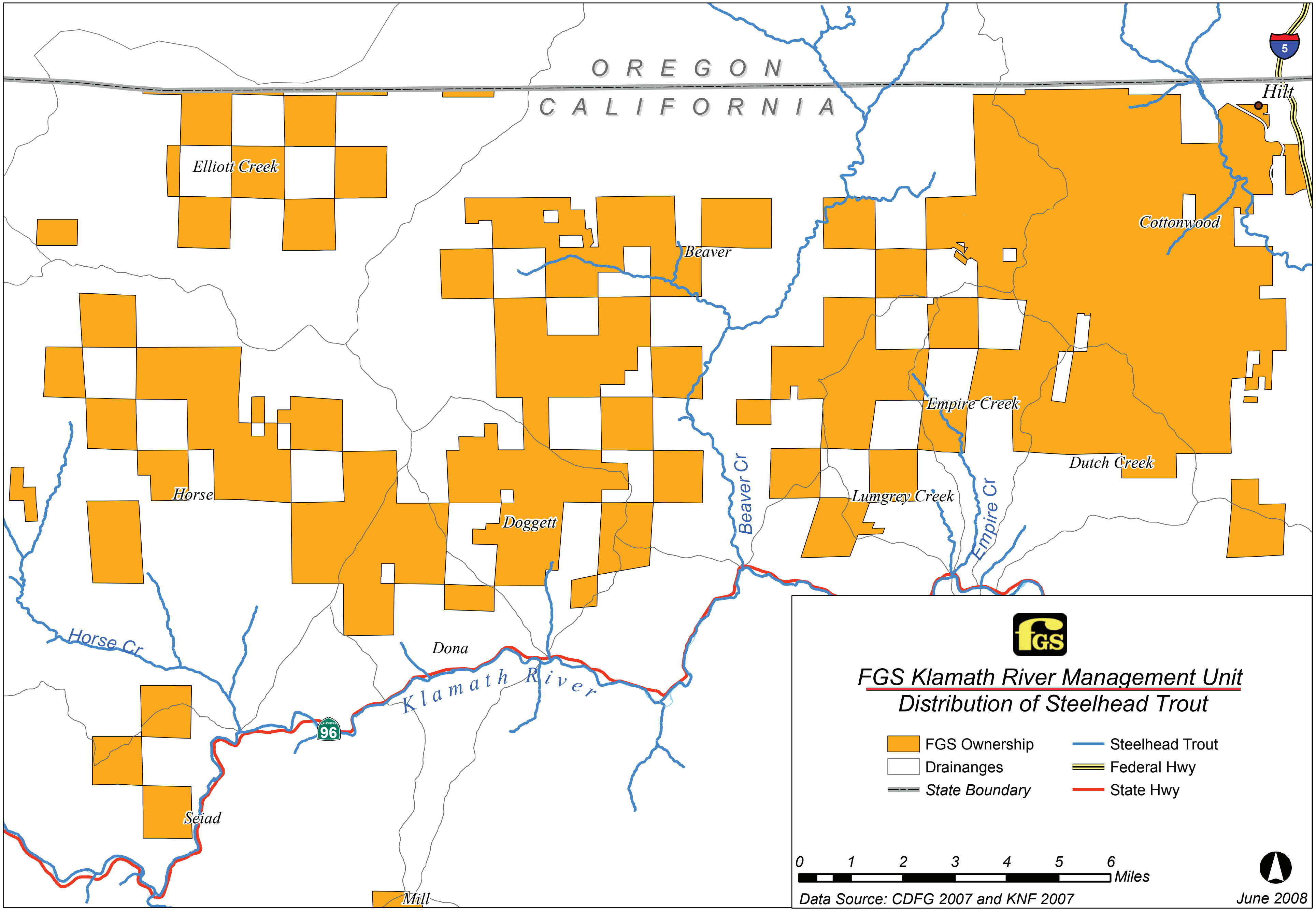

FIGURE 4-18
Distribution of Steelhead in the Klamath River Management Unit

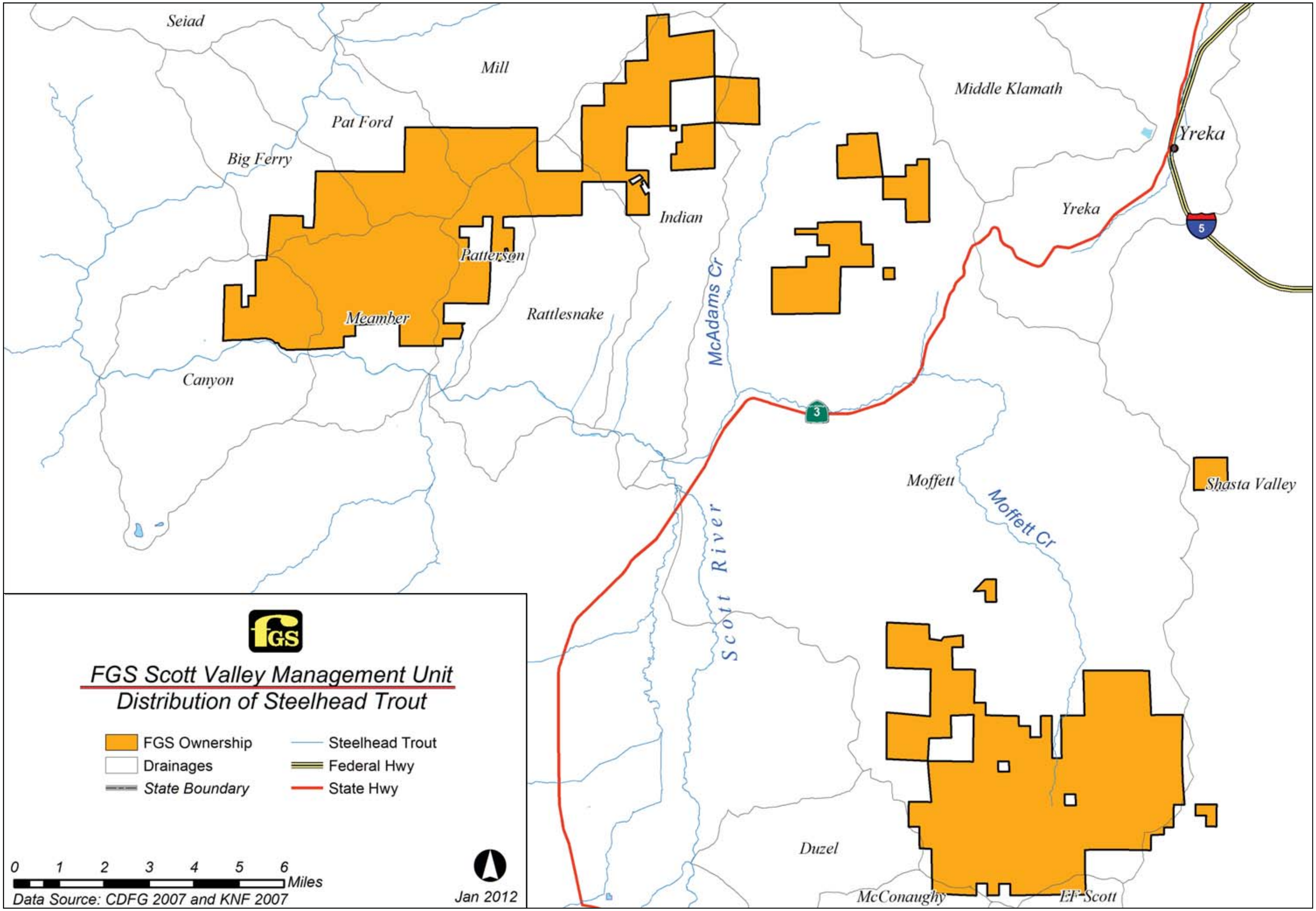

FIGURE 4-19
Distribution of Steelhead in the Scott Valley Management Unit

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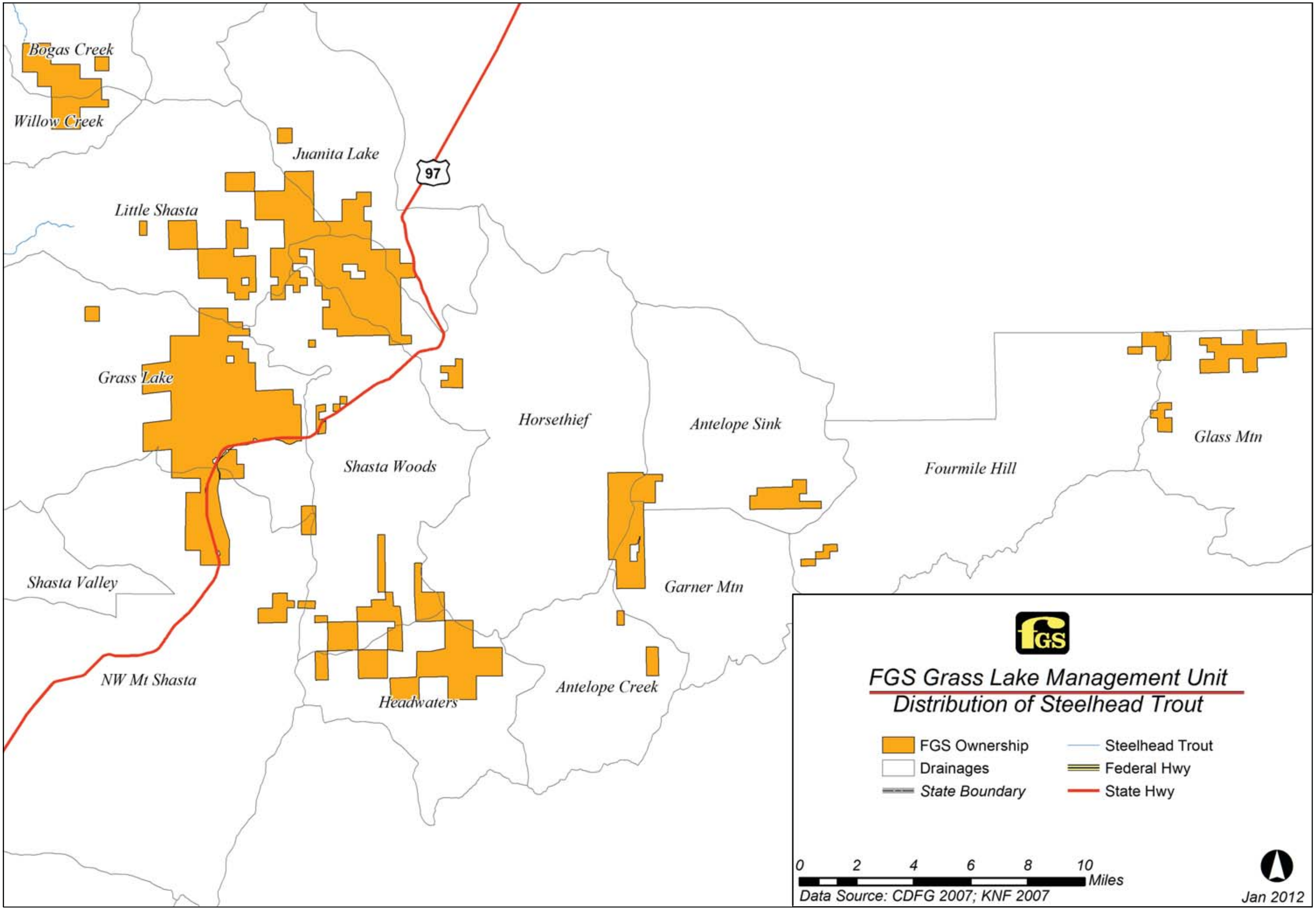

FIGURE 4-20
Distribution of Steelhead in the Grass Lake Management Unit

4.8.3 Chinook Salmon

4.8.3.1 Regional Status and Distribution

Historically, large runs of spring-run Chinook salmon were present in the Klamath River Basin, outnumbering fall-run Chinook salmon stocks substantially (Snyder 1931). Overfishing and habitat destruction nearly extirpated this run in the early 1900s (Leidy and Leidy 1984). At the time Iron Gate Hatchery operations began in 1962, a few spring-run Chinook salmon were still returning to the upper Klamath River. Efforts to maintain this run started in 1968, but were not successful (CH2M HILL 1985). Spring-run Chinook salmon existed in the Scott River into the 1950s. The Salmon River and Wooley Creek (tributary to the Salmon) may support the last viable native population of spring-run Chinook salmon in the Klamath River Basin. Tributaries to the mid-Klamath River—such as Indian Creek, Elk Creek, and Clear Creek—have small, highly variable populations of spring-run Chinook salmon (KRBFTF 1991). Fall-run Chinook salmon are now the most numerous of the Chinook salmon runs in the Klamath River Basin.

Evidence suggests that there are several distinct stock groups in the Klamath River basin represented by fish returning to Iron Gate Hatchery, Bogus Creek, the Shasta River, the Scott River, and the Salmon River, as well as the distinctly late-returning runs to the middle Klamath River tributaries below Iron Gate Dam and the lower Klamath River tributaries below Weitchpec. The Scott River produces a large proportion of the fall-run Chinook salmon in the Klamath River system as a whole. The incidence of straying by hatchery fish to the Scott River is low; thus, the Scott River run is largely composed of wild fish (KRBFTF 1991). The Chinook salmon run in Bogus Creek is heavily influenced by hatchery strays (KRBFTF 1991), and Chinook salmon spawners in other middle Klamath River tributaries (Elk, Grider, Indian, and Beaver creeks) are also believed to be largely of hatchery origin (West et al. 1989).

Compared to other anadromous salmonids, considerably more information is available on the status and distribution of fall Chinook salmon in the middle Klamath River Basin. Recent escapement estimates for middle Klamath River tributaries, Bogus Creek, and the Shasta River are shown in Table 4-16.

A status review for spring- and fall-run Chinook salmon for the Upper Klamath and Trinity rivers ESU was completed by NMFS in March 1998. Although Klamath River spring-run Chinook salmon have been identified as being at high risk of extinction (63 FR 11493), NMFS concluded at that time that the overall ESU was not at risk of becoming extinct, nor was it likely to become endangered in the foreseeable future (63 FR 11482). Thus, a proposal to list this ESU was not warranted.

4.8.3.2 Chinook Distribution in the Plan Area

Spring-run Chinook salmon are not supported by streams on FGS lands or in watersheds containing FGS lands. Although individual spring-run Chinook salmon are occasionally observed in Beaver Creek (Miller et al. 1993), the stream is not known to support a spawning population of spring-run Chinook salmon. In Beaver Creek, fall-run Chinook salmon spawning is limited to the lower 7.7 miles of the mainstem (Olson and Dix 1992); most spawning occurs between the Beaver Creek Campground and the confluence with the Klamath River (USFS 1996a). Surveys of Beaver Creek have yielded highly variable escapement estimates for fall-run Chinook salmon over the last 15 years (Figure 4-21). In addition to Beaver Creek, other streams in the vicinity of FGS's Klamath River Management Unit that support Chinook salmon are Horse Creek and possibly Cottonwood Creek, as the USFS has observed Chinook salmon fry in lower Cottonwood Creek (USFS 1993).

TABLE 4-16
Escapement Estimates for Fall-run Chinook Salmon in Middle Klamath River Tributaries, 1995 to 2002

Stream	1995	1996	1997	1998	1999	2000	2001	2002
Aikens	0	8	0	N/A	2	N/A	N/A	N/A
Beaver	817	N/A	405	327	99	168	426	98
Bluff	149	363	296	23	5	7	33	36
Boise	14	30	52	N/A	N/A	N/A	N/A	N/A
Camp	350	902	910	105	121	89	224	180
China	n/a	12	4	N/A	N/A	N/A	N/A	N/A
Clear	207	425	292	203	54	123	246	298
Dillon	106	289	172	57	24	66	140	33
Elk	285	402	480	234	84	112	200	232
Grider	348	n/a	323	141	122	492	449	224
Horse	n/a	n/a	83	75	n/a	20	0	29
Independence	4	0	23	2	N/A	N/A	N/A	N/A
Indian	408	756	688	N/A	N/A	0	149	4
Perch	N/A	10	10	N/A	N/A	N/A	N/A	N/A
Red Cap	385	1,588	709	148	47	142	139	108
Slate	0	17	4	N/A	N/A	N/A	N/A	N/A
Thompson	123	119	68	N/A	N/A	151	218	48
Ti	N/A	N/A	6	N/A	N/A	N/A	N/A	N/A
Bogus Creek	32,335	9,999	10,030	6,835	6,165	35,051	12,575	17,834
Shasta River	13,511	1,450	2,001	2,542	3,197	12,296	11,093	6,820

Source: Klamath Resource Information System, 2004

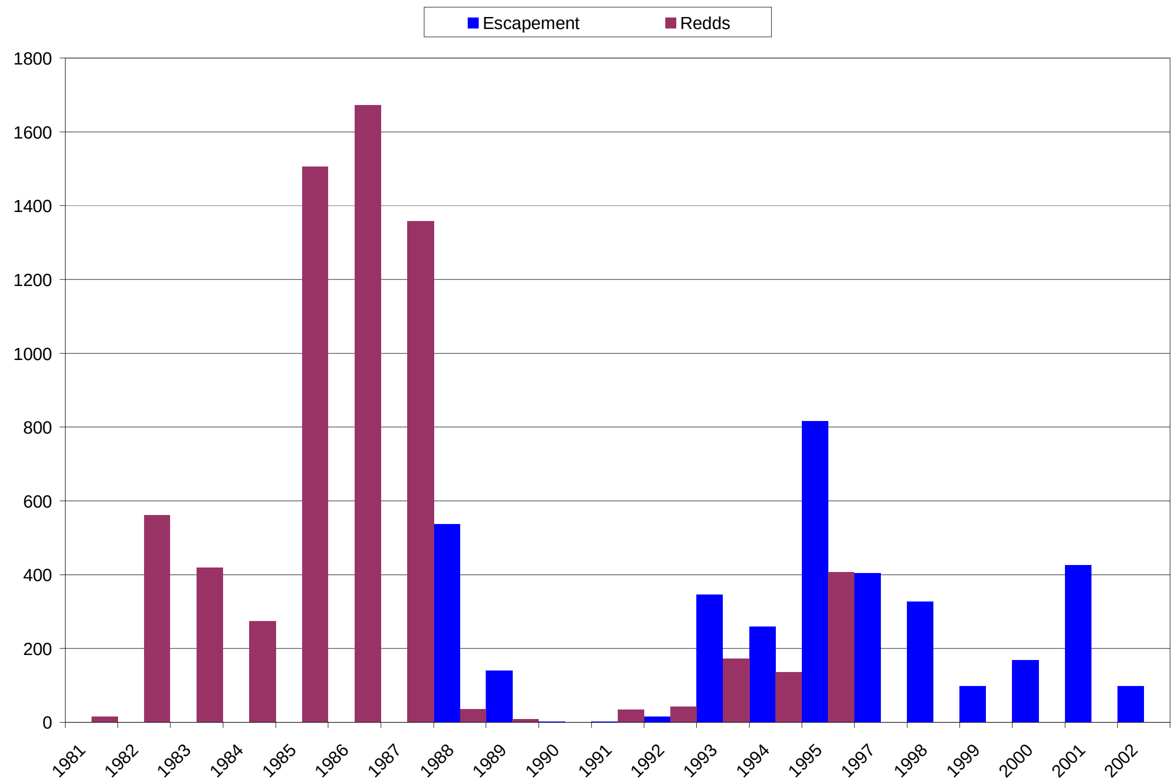

FIGURE 4-21
Escapement and Redd Estimates for Fall-run Chinook Salmon in Beaver Creek
Source: USFS 1996a; Klamath Resources Information System, 2004

Most Chinook salmon spawning in the Scott River Basin appears to be in the mainstem Scott River (Olson and Dix 1992; DesLaurier 1993). During 1992 (a high-flow year), spawning occurred as far upstream as Facey Gulch, and the distribution of spawning in the mainstem was similar to that observed in 1962 (DesLaurier 1993). Chinook salmon also spawn in the lower reaches of larger tributaries (for example, Shackleford Creek and Canyon Creek) when flows are adequate (DesLaurier 1993). Spawning activity in tributaries is often limited due to low flow levels in the fall that restrict access to spawning sites (DesLaurier 1993; Olson and Dix 1992).

In the Shasta River Basin, Chinook salmon are known to occur in several miles of the Shasta River, Bogus Creek, and Willow Creek, primarily in the lower elevation valley sections. These areas are considerably downstream of the Plan Area, and there is no habitat for Chinook salmon in the Plan Area.

FGS lands support considerably less habitat for Chinook salmon than for steelhead and coho salmon (USFS and DFG, unpublished data) (Figures 4-22 through 4-24; Table 4-17). Chinook salmon are known to be present or suspected only in the Beaver drainage, where approximately 3.4 miles of the available Chinook salmon habitat is on the FGS ownership.

TABLE 4-17
Miles of Stream on FGS Lands and within Drainages Known or Suspected to Support Fall-run Chinook Salmon

Drainage	Miles	
	Total*	**FGS Lands**
Klamath River	**119.0**	**3.4**
Beaver	20.5	3.4
Cottonwood	6.1	0.0
Doggett	0.0	0.0
Dona	3.9	0.0
Dutch Creek	0.3	0.0
Empire Creek	0.8	0.0
Horse	9.8	0.0
Lumgrey	0.0	0.0
Middle Klamath	59.2	0.0
Seiad	18.5	0.0
Scott Valley	**60.4**	**0.0**
Big Ferry	2.5	0.0
Canyon	5.6	0.0
Duzel	0.2	0.0
EF Scott	9.3	0.0
Indian	5.3	0.0
McConaughy	6.4	0.0
Meamber	3.2	0.0
Mill	0.4	0.0
Moffett	16.8	0.0
Pat Ford	2.7	0.0
Patterson	1.9	0.0
Rattlesnake	6.3	0.0
Grass Lake	**52.0**	**0.0**
Bogus Creek	14.4	0.0
Little Shasta	0.0	0.0
MW Mt. Shasta	0.03	0.0
Shasta Valley	31.3	0.0
Willow Creek	6.3	0.0

*Includes habitat in the mainstem Scott, Klamath, or Shasta rivers
Source: USFS and DFG, unpublished data

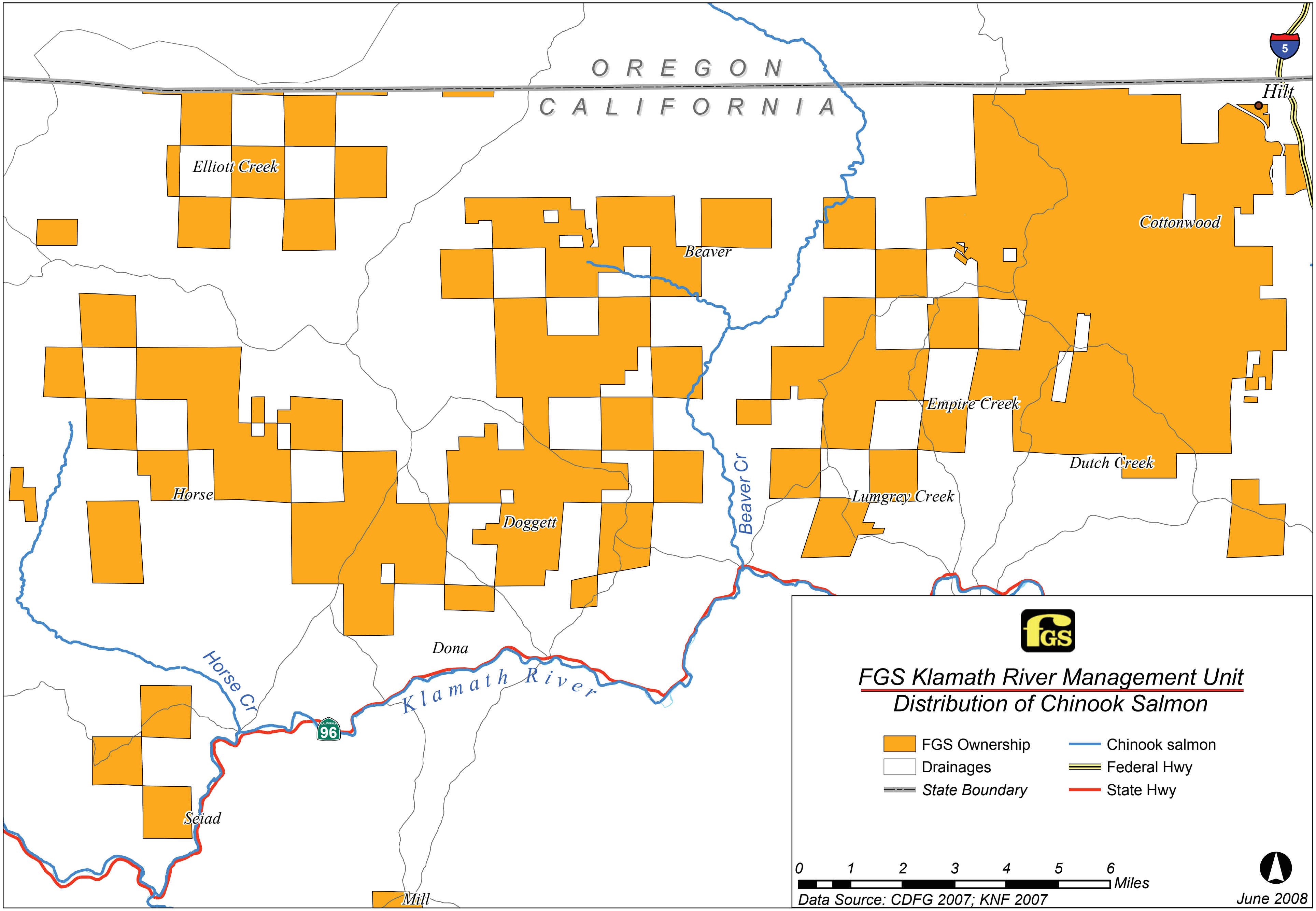

FIGURE 4-22
Distribution of Chinook Salmon in the Klamath River Management Unit

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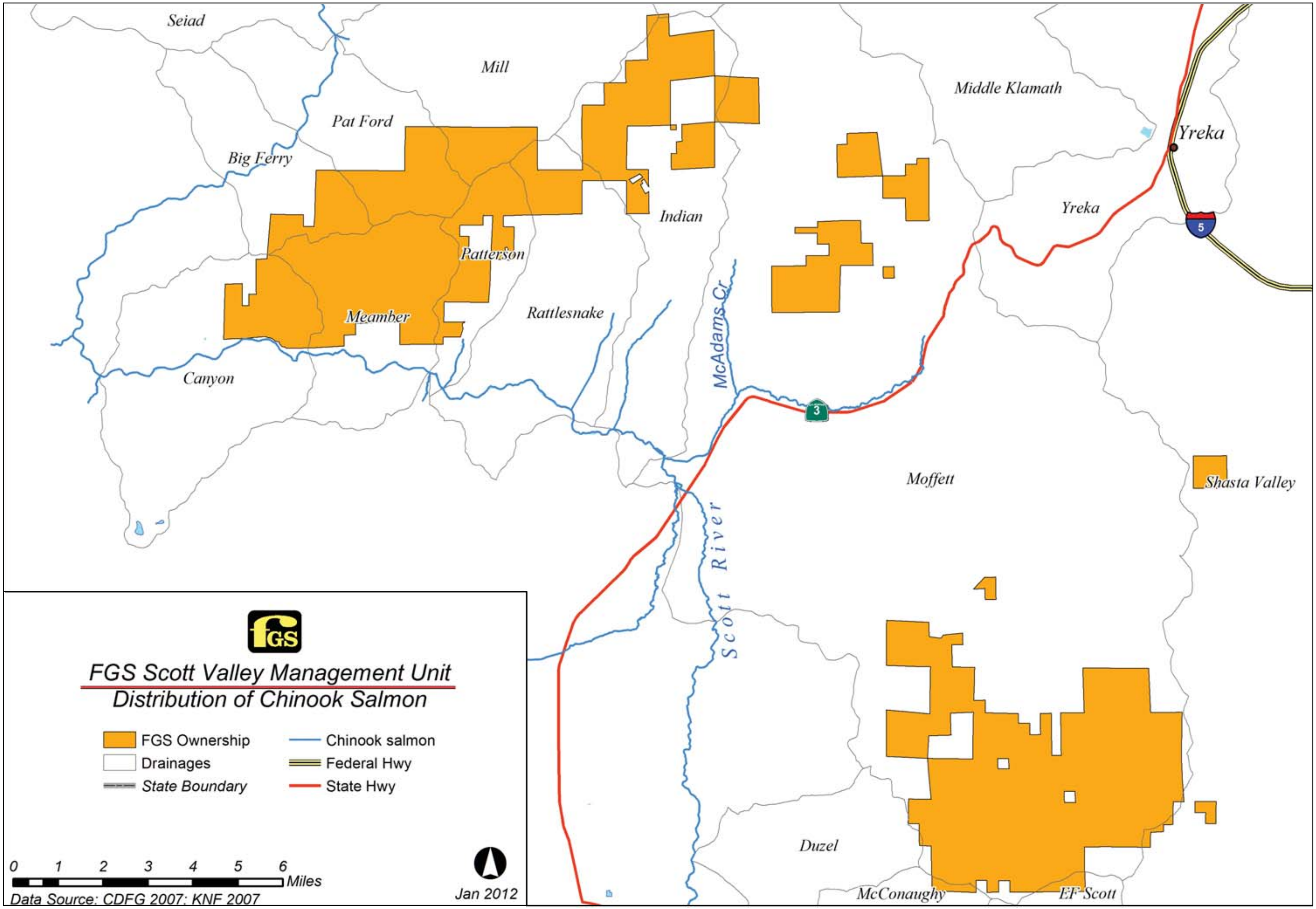

FIGURE 4-23
Distribution of Chinook Salmon in the Scott Valley Management Unit

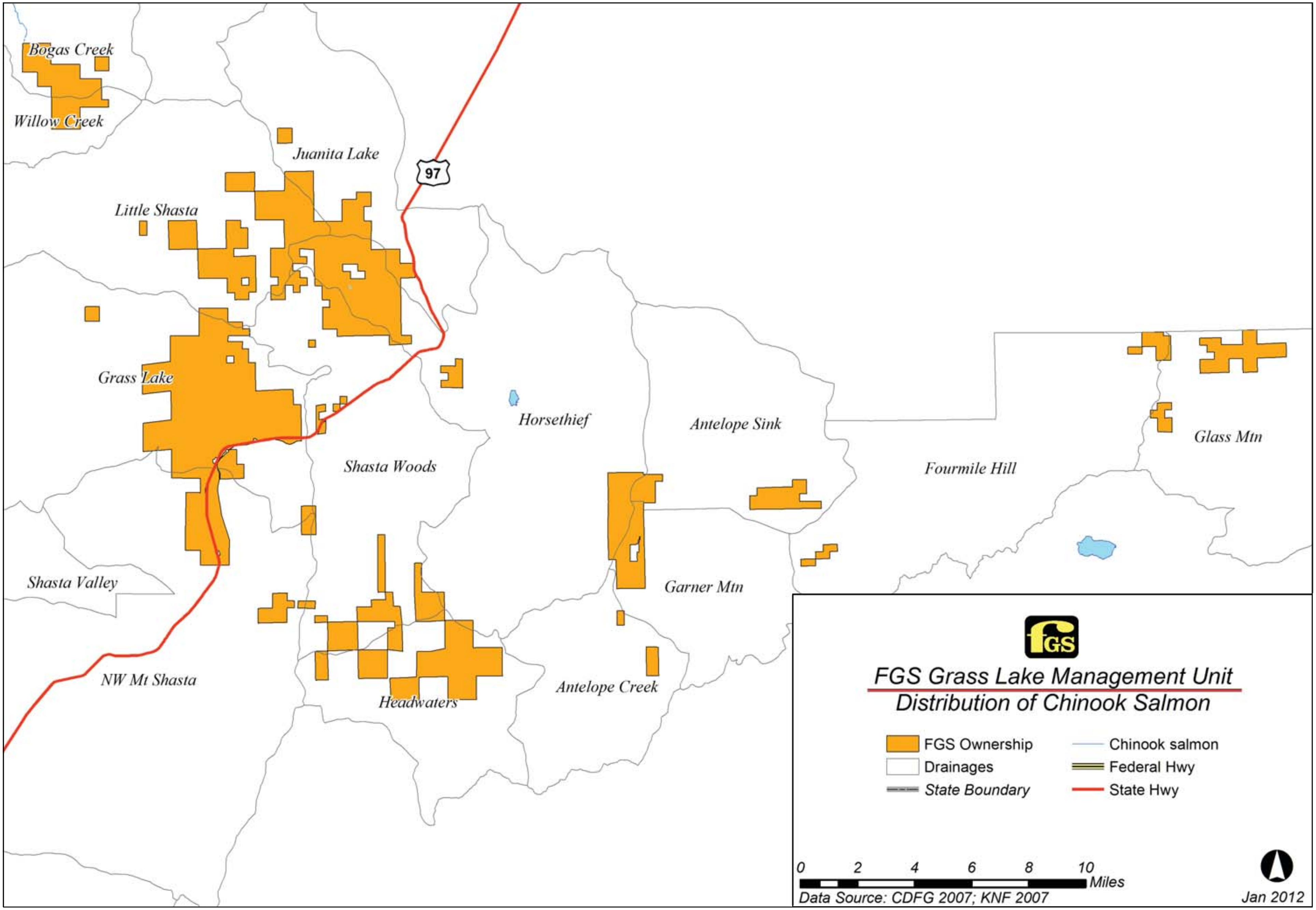

FIGURE 4-24
Distribution of Chinook Salmon in the Grass Lake Management Unit

4.8.4 Channel Types in the Plan Area

Classifying streams based on morphologic characteristics provides a method for rating the relative value of channel types to individual fish species (Murphy et al. 1987). Pertinent morphologic characteristics include landform, stream order, gradient, and confinement. Landform reflects the underlying bedrock and the long-term history of events controlling regional landscape evolution, such as glaciation or tectonic uplift. Landform determines the dominant LWD and sediment input processes. Stream order and gradient are surrogates for stream energy, which regulates the channel's ability to transport sediment and LWD. Confinement governs the channel's ability to migrate laterally, determines whether the channel receives sediment directly from sideslopes or primarily from upstream reaches, and controls the channel's capacity to form a floodplain capable of long-term sediment storage.

Using a GIS-based analysis of stream order, gradient, and confinement, seven channel types were identified in the Plan Area (Table 4-18). While management activities within a drainage may affect specific habitat characteristics (such as LWD or substrate), within some channels, the channel type is largely determined by the local topography and geology, and would be relatively unaffected by management activities (management would not change the channel type designation). Figures 4-25 through 4-27 show the location of these channel types in and around the Plan Area.

TABLE 4-18
Channel Types in the Plan Area and Amount of Anadromous Fish Habitat in Each Channel Type

Channel Type	Stream Order	Gradient	Confinement	Typical Use by Salmonids in the Plan Area	Miles of Anadromous Stream on FGS Ownership
Steep headwater tributary	1–2	8–20%	High	Steelhead spawning and rearing, resident trout	0.8
High energy mountain	2–4	4–8%	High	Steelhead rearing, resident trout	4.3
Colluvial canyon	2–4	2–4%	High	Steelhead rearing, rarely Chinook or coho salmon	2.7
Narrow alluvial mountain	2–4	1–2%	Moderate	Steelhead spawning and rearing, possibly Chinook and coho salmon	1.1
Low-gradient alluvial fan	2–4	1–4%	Unconfined	Steelhead spawning and rearing	1.1
Alluvial valley tributary	2–5	< 2%	Unconfined	Spawning and rearing of all species	2.3
Incised valley tributary	2–3	1–4%	High	Spawning and rearing of steelhead and Chinook salmon	1.3

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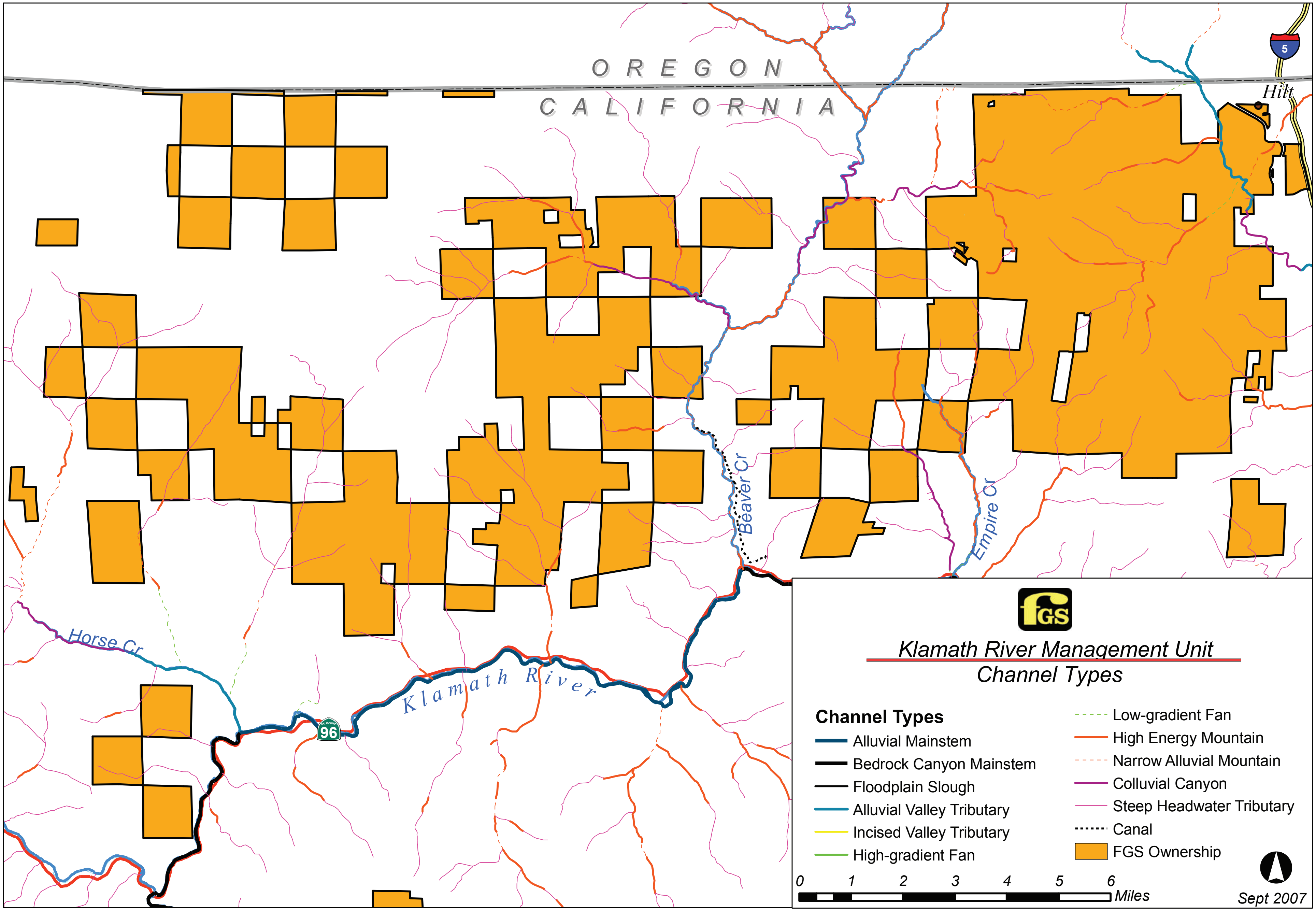

FIGURE 4-25
Channel Types in the Klamath River Management Unit

CH2MHILL

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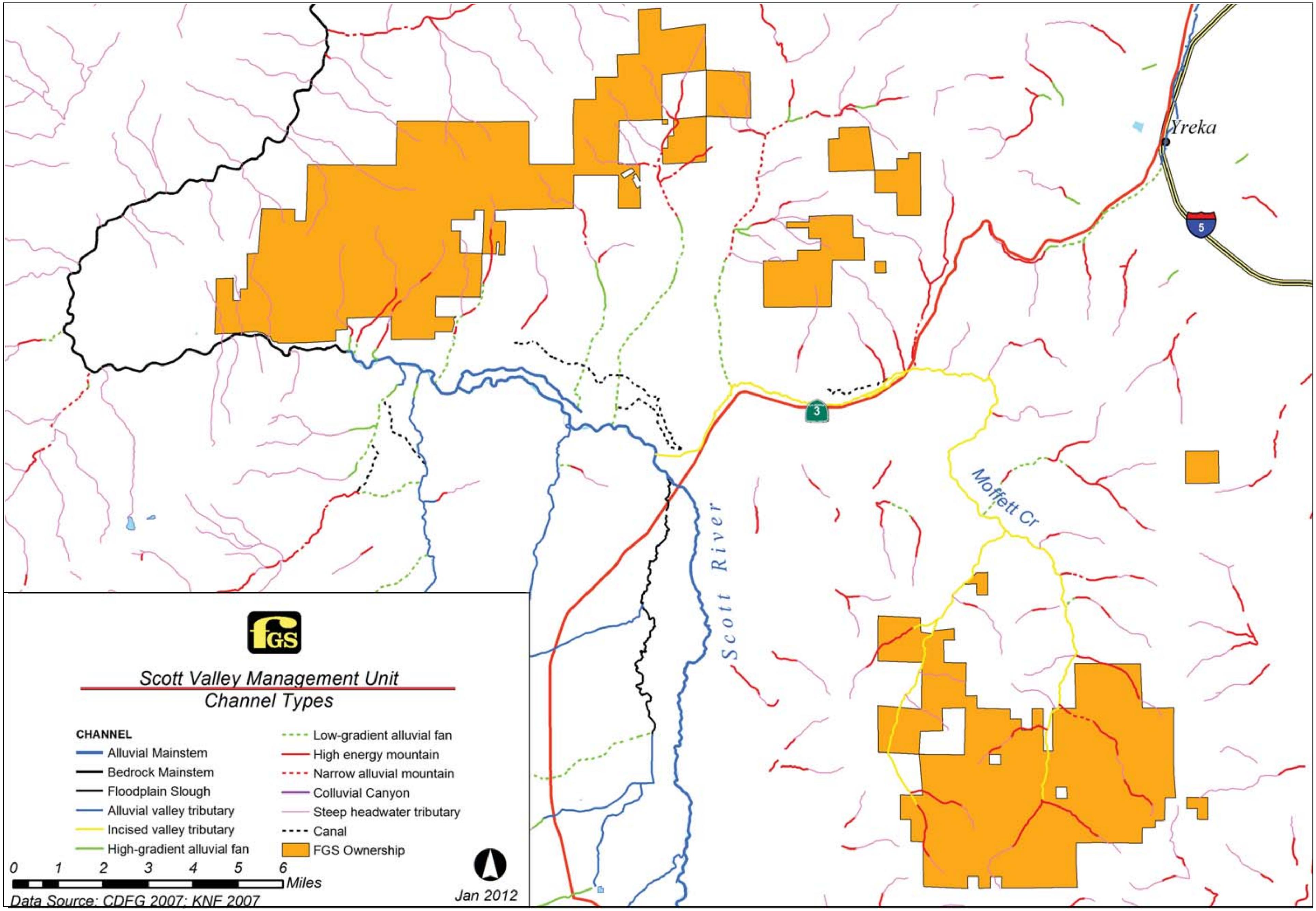

FIGURE 4-26
Channel Types in the Scott Valley Management Unit

CH2MHILL.

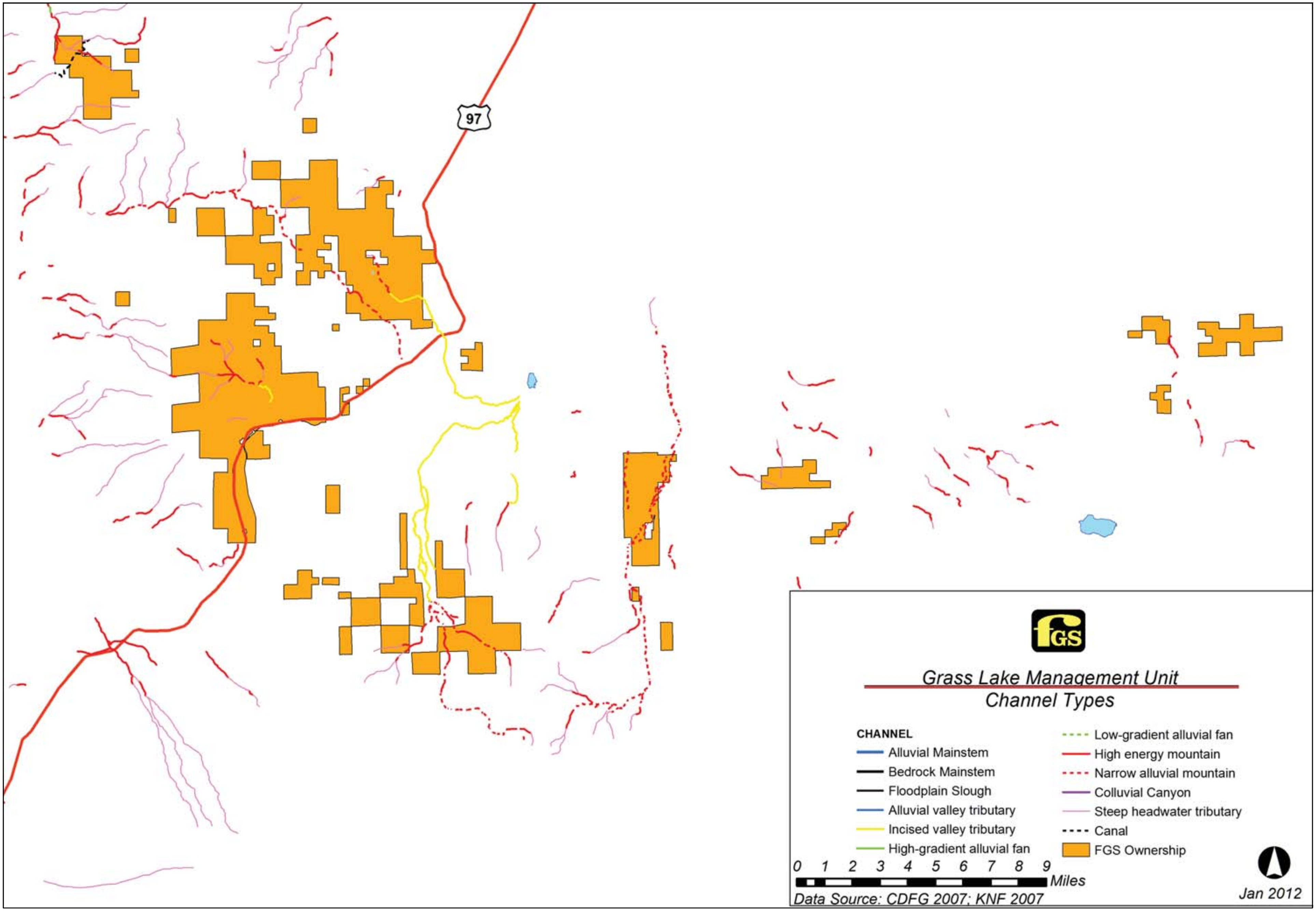

FIGURE 4-27
Channel types in the Grass Lake Management Unit

CH2MHILL.

4.8.5 Habitat Elements for the Covered Aquatic Species

4.8.5.1 Water Temperature

State and federal agencies and private landowners have recorded water temperatures in Northern California since the early 1950s. The USGS and DWR collected water temperatures annually using a variety of field techniques (Quigley et al. 2001). Historical water temperatures were largely collected prior to the 1964 flood, which had a strong impact on the channel structure. Present-day channels are generally more open and have less vegetation than prior to 1964. However, historical maximum instantaneous water temperatures are similar to maximum temperatures measured in the Scott River watershed during recent monitoring (Quigley et al. 2001).

FGS has collected water temperature data in streams throughout its Klamath River and Scott Valley Management Units since 1997. Temperature recorders were typically installed where the stream leaves FGS lands. In West Fork Beaver Creek, a temperature recorder was also located where the stream enters FGS lands. Typically, water temperature monitoring occurs from late-May or early-June through late-October, covering the time period where water temperatures are the highest and most critical for aquatic life. These data provide the most complete record of water temperature conditions for streams in the Plan Area.

Stream temperatures in the Plan Area follow the same general seasonal pattern. Temperatures are cool early and late in the summer (May and September). The warmest stream temperatures typically occur during August, corresponding with the highest air temperatures. Although water temperatures in all streams appear to follow the same general seasonal pattern, temperatures can vary considerably among streams.

Both the maximum weekly average temperature (MWAT) and maximum weekly maximum temperature (MWMT) have been used for assessing the suitability of stream temperatures for juvenile coho salmon during late summer (Sullivan et al. 2000). MWAT is the mathematical mean of multiple, equally-spaced daily temperatures over a 7-day consecutive period. MWMT is the mathematical mean of multiple, daily maximum temperatures over a 7-day consecutive period. MWATs and MWMTs for streams in the Plan Area are reported in Table 4-19. Based on the water temperatures recorded in the Plan Area, summertime temperatures rarely, if ever, exceed lethal temperature reported for anadromous salmonids. Likewise, average summer water temperatures (MWATs and MWMTs) in these streams are generally within the range considered suitable for juvenile rearing. (See Section 3.2.4 for a discussion of temperature requirements).

Chinook salmon and coho salmon spawning occurs in the fall or early winter, while winter steelhead spawning occurs from January through April. Temperature data are not available for winter months, but based on information for October, water temperatures are likely suitable for spawning by all species. Egg incubation also occurs during the winter months, and likewise, water temperatures appear suitable for this life stage. Although stream temperatures in the Plan Area are generally within the range utilized by coho salmon, temperatures in much of the mainstem and lowermost portions of tributaries downstream of the Plan Area in the Scott Valley are not suitable for coho salmon (North Coast RWQCB 2005).

TABLE 4-19
MWAT and MWMT for Streams in the Plan Area

Stream (Drainage)	MWAT (MWMT) (°C)							
	1997	1998	1999	2000	2001	2002	2003	2004
Bear Creek (Beaver)	ND	ND	13.1 (14.6)	14.5 (16.3)	15.0 (16.4)	14.9 (16.7)	14.3 (16.2)	13.7 (15.7)
Beaver Creek, mouth (Beaver)	ND	18.0 (20.9)	16.7 (19.5)	19.0 (22.5)	20.4 (24.1)	18.8 (22.1)	19.2 (22.3)	18.6 (22.0)
Doggett Creek (Doggett)	ND	ND	14.7 (16.0)	15.8 (17.2)	17.6 (19.2)	15.7 (17.1)	ND	16.0 (17.4)
Hungry Creek (Beaver)	13.2 (15.2)	13.4 (15.1)	12.9 (15.3)	13.8 (15.8)	13.9 (16.0)	13.8 (15.9)	14.3 (16.1)	17.6 (20.6)
Kohl Creek (Dona)	14.6 (16.5)	16.3 (18.2)	13.0 (14.2)	14.7 (17.4)	ND	ND	ND	ND
Little Soda Creek (Beaver)	16.7 (18.9)	17.0 (18.9)	ND	ND	ND	ND	ND	ND
Meamber Creek (Meamber)	15.7 (17.6)	ND	ND	ND	ND	ND	ND	ND
Middle Horse Creek (Horse)	ND	ND	ND	15.3 (16.7)	16.6 (18.1)	15.3 (16.7)	ND	ND
Moffett Creek (Moffett)	16.9 (22.2)	16.8 (22.7)	15.8 (22.4)	17.6 (23.6)	17.5 (20.6)	ND	ND	ND
Sissel Gulch (Moffett)	ND	ND	16.3 (22.3)	18.6 (24.0)	16.9 (24.3)*	17.9 (22.4)	ND	ND
WF Beaver Creek, lower (Beaver)	15.5 (17.8)	15.3 (28.4)*	13.8 (15.1)	15.2 (16.8)	16.1 (17.5)	14.9 (16.7)	15.6 (17.2)	15.0 (16.8)
WF Beaver Creek, upper (Beaver)	14.3 (16.8)	13.8 (15.8)	12.7 (14.3)	13.6 (16.1)	15.7 (18.1)	14.1 (16.9)	ND	ND
WF Cottonwood Creek (Cottonwood)	17.4 (20.7)	17.1 (20.0)	15.2 (18.4)	18.8 (22.4)	ND	19.1 (27.6)*	ND	ND

*Logger may have been dewatered at some time
ND = no data

4.8.5.2 Off-Channel Habitats

Off-channel and backwater habitat is most likely to occur in association with alluvial mainstem, alluvial valley tributary, and floodplain slough channels, all of which are rare in the Plan Area. Functional off-channel habitats are currently limited to the Big Slough/Lower Kidder Creek complex, which is on the Scott River floodplain outside of the Plan Area. This type of habitat is reported to have been widespread in the Scott River valley prior to settlement (Sommarstrom et al. 1990), but has likely never been abundant on FGS lands due to the absence of unconfined channel types.

4.8.5.3 Pool Habitats

Habitat typing data collected by the Oak Knoll Ranger District from 1989 to 1992 indicated that pools generally make up less than 20 percent of the surface area in the stream segments surveyed (USFS, unpublished data). The amount of pool habitat (percent of surface area) in streams in the Oak Knoll Ranger District and on FGS land is generally less than that observed in streams draining unmanaged forests in northeast Oregon (Carlson et al. 1990), but similar to the amount of pool habitat reported in alluvial mountain channels in Colorado (Richmond 1994). Data collected by FGS on pool spacing in streams in the Plan Area are summarized in Table 4-20. In the SCI protocols, pools are defined as areas of slow or no velocity during summer low flows with some form of hydraulic control at the downstream end and where the maximum depth is greater than twice the depth at the pool tail crest.

TABLE 4-20
Pool Frequency and Characteristics for Streams in FGS's Klamath River Management Unit

Stream (Drainage)	Pools per Mile	Mean Depth (m)*	Avg. Max. Depth (m)*
Klamath River Management Unit			
WF Beaver Creek (Beaver)	14.5–30.4	0.3–0.4	0.6–0.7
WF Cottonwood Creek (Cottonwood)	20.9–66.5	0.1–0.3	0.2–0.5
Doggett Creek (Doggett)	31.9–51.6	0.2–0.3	0.4
Scott Valley Management Unit			
Moffett Creek (Moffett)	82.5	0.1	0.1

*Depth measurements taken at baseflow

Source: FGS unpublished SCI data, 1997 to 2000

SCI surveys conducted in 1997 on the Scott River Ranger District indicate that pool frequencies in area streams are highly variable, ranging from 11.2 to 168 pools per mile in reference streams (streams draining largely unmanaged areas) and from 19.9 to 187.9 pools in other streams (USFS and DFG, unpublished data). Primary pool (maximum depth > 1 m) frequency in Moffett Creek was generally lower than in the reference streams, but within the range observed for other managed streams in the Scott River Basin.

4.8.5.4 Substrate

Substrate conditions in streams in FGS's Klamath River Management Unit are not well documented, although information is available for a few streams. The KNF Oak Knoll Ranger District collected stream and aquatic habitat data from numerous streams during the summers of 1989 through 1992. FGS has conducted pebble counts to determine substrate conditions in several streams on its Klamath River Management Unit and in Moffett Creek in the Scott Valley Management Unit. FGS conducted pebble counts at locations corresponding to the downstream and upstream boundaries of its ownership and a mid-ownership location. Table 4-21 summarizes the data collected on substrate composition in streams in the Klamath River and Scott Valley Management Units using pebble counts.

TABLE 4-21
Summary of Substrate Conditions in Streams in the Klamath River and Scott Valley Management Units

	Percentage of Substrate Composition by Size Class				
Stream (Survey)	**Sand < 2 mm**	**Gravels 2–64 mm**	**Cobbles 64–256 mm**	**Boulders > 256 mm**	**Bedrock**
Klamath River Management Unit					
WF Beaver (1997 SCI)	13	67	7	8	5
WF Beaver (1998 SCI)	6	25	37	22	10
WF Beaver (1998 lower)	13	30	40	14	4
WF Beaver (1998 middle)	7	40	28	14	4
WF Beaver (1998 upper)	10	56	24	8	2
WF Beaver (2000 lower)	8	45	24	18	5
WF Beaver (2000 middle)	16	36	28	15	5
WF Beaver (2000 upper)	12	49	32	7	0
WF Cottonwood (1997 SCI)	23	29	15	14	19
WF Cottonwood (1998 SCI)	27	14	36	8	15
WF Cottonwood (1998 lower)	9	30	29	3	29
WF Cottonwood (1998 middle)	20	43	32	0	5
WF Cottonwood (1998 upper)	32	50	7	5	6
WF Cottonwood (2000 lower)	16	23	20	8	33
WF Cottonwood (2000 middle)	15	46	31	8	0
WF Cottonwood (2000 upper)	28	53	7	8	4
Middle Horse (1998 middle)	12	34	28	13	13
Middle Horse (1998 upper)	6	54	26	4	10
Middle Horse (2000 lower)	25	45	18	8	4
Middle Horse (2000 middle)	17	35	14	18	16
Beaver (1998 lower)	8	26	35	27	4
Beaver (1998 upper)	4	30	51	15	0
Beaver (2000 middle)	8	32	37	14	9
Beaver (2000 upper)	18	29	36	17	0
Hungry Creek (lower)	11	15	48	26	0
Hungry Creek (middle)	22	55	11	8	4
Hungry Creek (upper)	42	53	4	1	0
Hungry Creek (2000 lower)	18	43	37	2	0
Hungry Creek (2000 middle)	18	52	21	4	5
Hungry Creek (2000 upper)	32	68	0	0	0
Scott Valley Management Unit					
Moffett Creek (lower)	3	83	11	2	1
Moffett Creek (middle)	8	73	19	0	0
Moffett Creek (upper)	17	55	24	4	0

SCI indicates pebble counts conducted throughout a 1,000-foot reach during SCI stream surveys. *Lower*, *middle*, and *upper* refer to additional pebble counts taken at the downstream, upstream, and middle portions of the FGS ownership.

WF: West Fork

Source: FGS unpublished SCI data, 1997 to 2000

Within FGS's Klamath River and Scott Valley Management Units, the percentage of fine particles (<2 mm) in the stream substrate is highly variable. Based on the limited surveys reported in Table 4-21, gravel composition in Plan Area streams appears suitable for salmonid spawning. It is important to note, however, that these results are based on pebble counts (surface conditions) from throughout a stream reach, not just from habitat units used for spawning (for example, riffles and pool tails). Using SCI protocols, FGS has also collected data on surface substrate composition in pool tail areas in Beaver, Cottonwood, Doggett, and Moffett creeks (Table 4-22). These data suggest that fine sediment may adversely affect spawning success of salmonids in these streams. However, as described above, little spawning by anadromous salmonids has been documented on the FGS ownership.

TABLE 4-22
Pool Tail Substrate Composition for Streams in FGS's Klamath River and Scott Valley Management Units

		Percentage of Substrate Composition by Size Class					
Stream	Embed	Fines < 2 mm	Gravel 2–64 mm	Cobble 65–139 mm	Rubble 140–254 mm	Boulder > 254 mm	Bedrock
Klamath River Management Unit							
WF Beaver Creek	30.3	32.0–37.0	37.0–50.3	7.7–13.8	5.0–6.1	3.6–5.0	0.0–2.3
WF Cottonwood Creek	44.0	51.4–65.3	5.8–38.0	5.5–9.2	0.9–5.8	3.1–5.5	0.7–19.4
Doggett Creek	79.8	41.2–57.9	33.9–37.9	5.2–10.7	1.4–4.3	1.7–3.9	0.2–1.9
Scott Valley Management Unit							
Moffett Creek	17.8	44.2	34.5	11.3	7.1	1.3	1.6

Source: FGS unpublished SCI data, 1997 to 2000

4.8.5.5 Large Woody Debris

Stream surveys conducted by the USFS in 1989 reported from 17.5 to 68.9 pieces of woody debris (all sizes) per 1,000 feet of stream in selected Klamath River tributaries (USFS and DFG, unpublished data). More recent investigations using USFS SCI protocols report LWD levels from 35.3 to 126.4 pieces per 1,000 feet in Beaver Creek. Levels of LWD (minimum 12-inch diameter and 35-foot length) ranged from 5.6 to 34.6 pieces per 1,000 feet in Beaver Creek (USFS, unpublished data).

Inventories conducted by FGS on West Fork Beaver Creek and West Fork Cottonwood Creek in 1997 indicate that there were approximately 3.8 pieces and 5.4 pieces of LWD greater than 12 inches in diameter per 1,000 linear feet within the bankfull channel of these streams, respectively (FGS, unpublished data). These levels are below the levels of LWD observed elsewhere in the Beaver watershed. FGS has been involved in extensive restoration efforts undertaken in Beaver Creek, Cow Creek, and the West Fork of Beaver Creek; more than 300 instream structures—including log and boulder weirs, boulder clusters, mini debris jams, and woody channel margin structures—have been placed (USFS 1996a).

FGS also has characterized LWD in other streams in its Klamath River and Scott Valley Management Units. Results of these surveys suggest that similarly sized LWD was present in three Klamath River tributary streams (Beaver, Cottonwood, and Doggett); however, Doggett Creek contained substantially greater densities of LWD, and substantially larger pieces of LWD were present in Moffett Creek (Table 4-23).

TABLE 4-23
LWD Frequency and Characteristics on FGS Ownership in the Klamath River and Scott Valley Management Units

Drainage	Instream LWD Pieces/1,000 ft (Range)*	Average Diameter Inches (Range)	Average Length Feet (Range)
Klamath River Management Unit			
Beaver	15.4 (1.8–28.9)	13.3 (8.7–25.3)	22 (16–27)
Cottonwood	17.7 (1.8–22.1)	9.6 (8.3–17.4)	18 (17–21)
Doggett	45.8 (27.4–67.8)	13.2 (11.9–15.0)	25 (22–30)
Scott Valley Management Unit			
Moffett	7.3 (3.3–11.3)	37.8 (13.0–62.8)	17 (17–18)

*LWD pieces included all wood greater than 4 inches in diameter

Source: FGS unpublished SCI data, 1997 to 2000

These data suggest that nearly all streams (including reference streams) in the Scott River Management Unit have levels of LWD below those observed in streams draining unmanaged forests in other areas (Bilby and Ward 1989; Robison and Beschta 1990; Murphy and Koski 1989; summarized in Peterson et al. 1992). Stream segments on FGS lands generally have LWD levels less than those found in the reference streams identified in the Callahan Ecosystem Analysis (USFS 1997). However, the amount of in-channel LWD necessary to maintain suitable habitat conditions for anadromous salmonids is likely variable depending on factors such as forest type, watershed geology and topography, channel type, climate, and fish species.

4.8.5.6 Habitat Access

Low flows are common in the mainstem Scott River and many tributaries during June through November, primarily due to water diversions for agricultural and domestic uses. Approximately 160 diversions greater than 0.1 cfs from the Scott River and its tributaries have been identified (Sommarstrom 1994). These diversions substantially reduce streamflow in the lower portions of the tributaries during the summer through the fall period, resulting in dewatering of sections of many streams (Etna, Patterson, Kidder, Moffett, Shackleford, and Mill creeks). In prolonged droughts, portions of the mainstem Scott River can be completely dry. Dewatering is a persistent problem in the Scott River basin (DFG 1974; West et al. 1989; Scott River CRMP 1995; North Coast RWQCB 2005) and may strand thousands of juvenile salmon and steelhead each year (Scott River CRMP 1995). Even with periodic drafting for dust abatement, road construction, and routine maintenance, FGS does not divert substantial quantities of water from streams in the Plan Area. Typically, FGS conducts water drafting from Class II streams with flows greater than 2 cubic feet-per-second, or more commonly, from off-channel water holes.

A natural bedrock waterfall that blocks passage at extremely low flows exists on Beaver Creek, near the mouth of Bumblebee Creek (Miller et al. 1993). Other passage barriers associated with diversions exist on several tributaries of the Klamath River.

A permanent structure consisting of a flashboard dam and fish ladder was built by DFG in 1983 on Cottonwood Creek, replacing a temporary gravel structure built annually by a private landowner for agricultural diversion. Water levels permitting, all species of anadromous salmonids have passage. Springtime installation of the flashboards and agricultural diversion can result in dewatering of the stream below the dam. The DFG conducts salvage operations above the dam to transport smolts to the Klamath River. Several splashboard diversions in West Fork Cottonwood Creek have been replaced with "fish-friendly" rock ladders providing passage for steelhead and access to several miles of habitat.

The USFS has modified a barrier on Horse Creek near the confluence with Middle Creek. The earthen dam has been replaced with a permanent flashboard dam, fish ladder, and diversion structure. The flashboard dam is installed in the springtime and removed to allow passage of fall-run Chinook salmon. Providing passage opens approximately 13 miles of additional Chinook salmon habitat. FGS has replaced a number of flashboard dams on West Fork Cottonwood Creek with ladder structures to provide access to 2.2 miles of summer rearing habitat in this drainage.

4.9 Terrestrial Species and Habitats

The Covered Species' legal status and a general description of their range and distribution, life history, and habitat requirements were presented in Chapter 3. This section builds upon that information by further describing the regional and local environmental baseline for the northern spotted owl and Yreka phlox. For each species, the section presents information on population status, habitat conditions, and threats. The regional and local environmental baseline provides information used to identify the potential effects of Covered Activities on terrestrial species and their habitats and to develop appropriate conservation and mitigation measures for the Covered Species.

4.9.1 Northern Spotted Owl

Northern spotted owls within and surrounding the FGS ownership are part of a series of interconnected populations that extend west to the Pacific Ocean, south to Marin County, and north into Oregon and Washington (USFWS 2011). However, within this larger context are "local populations" that exhibit unique ecological relationships (Guitierrez and Harrison 1996). These populations are important for the conservation and recovery of the northern spotted owl, and they form the basis for federal conservation strategies for this species.

For the purposes of describing the environmental baseline and assessing the effects of the Covered Activities and conservation strategies on the northern spotted owl, owl habitat and populations are characterized at three landscape scales. These landscape scales generally correspond to the range-wide, regional, and local area of the species. A text description of each follows, and the local and regional areas are graphically depicted in Figure 4-28.

- Range-wide. Encompasses the range of the species from southwest British Columbia south through the Cascade Mountains and coastal mountains in Washington, Oregon, and California, as far south as Marin County (55 FR 26114-26194).

- Regional (termed Area of Analysis). Consists of a 20-mile (30-kilometer) radius around the FGS ownership. It includes portions of Siskiyou, Shasta, and Trinity counties in California; and Jackson, Josephine, and Klamath counties in Oregon. The total area is approximately 3,304,840 acres, and occurs in both the California Klamath and California Cascades Physiographic Provinces. Fruit Growers' Klamath River and Scott Valley Management Units are within the California Klamath Province, while FGS's Grass Valley Management Unit is within the California Cascades Province.

  This nominal 20-mile radius around the FGS ownership has been termed "Area of Analysis" for the purposes of characterizing environmental baseline conditions and describing effects of the Covered Activities on the northern spotted owl, and is illustrated in Figure 4-28. This landscape scale is reflective of the demographic connectivity for the regional owl population. The 20-mile distance criterion is based on results from two field studies of natal dispersal distance (Miller et al. 1997; Forsman et al. 2002) and the review conducted by the Interagency Scientific Committee (Thomas et al. 1990). Based on these studies, a distance of 20 to 25 miles (30 to 40 kilometers) from the FGS perimeter would incorporate the majority of dispersal from the FGS perimeter, and an even greater proportion of dispersal from the interior of the FGS ownership. A distance of 20 miles (30 km) was selected as a reasonable distance to encompass the large majority of natal dispersal (and therefore demographic connectivity) of owls associated with the FGS ownership over the 50-year Permit Term. Minor adjustments were made to the Area of Analysis boundary to exclude areas on the periphery that were clearly unsuitable for owl use (e.g., urban lands and other non-habitat lands).

- Local (termed Area of Impact). Consists of a 1.3-mile (2-kilometer) radius around the FGS ownership, reflective of the local owl population that could be directly or indirectly affected by the HCP. The total area within the Area of Impact is approximately 545,030 acres. This 1.3-mile radius around the FGS ownership has been termed "Area of Impact" for the purposes of characterizing environmental baseline conditions and describing effects of the Covered Activities on the northern spotted owl, and is illustrated in Figure 4-28. The 1.3-mile distance criterion is based on the average home range size of the northern spotted owl within the California Klamath and California Cascades Provinces (USFWS 2005). As described in Chapter 3, the activity center typically consists of a roost or nest site, and is considered the center of an owl's home range. This section also includes a summary of northern spotted owl habitat on the FGS ownership.

The following description of owl population status and habitat both range-wide and within the Area of Analysis and Area of Impact is based on: published and unpublished information, stand inventories and protocol-level owl surveys within the Plan Area and adjacent federal lands, and modeling results (Zabel et al. 2003) indicating the probability of owl occupancy based on the amount and relative distribution of nesting/roosting and foraging habitat available within a 0.5-mile radius of known activity centers.

4.9.1.1 Description of Northern Spotted Owl Habitat

As part of the HCP development process, FGS worked cooperatively with the USFWS to produce an accurate Geographic Information System layer that correctly represents current northern spotted owl habitat in the Plan Area and the region. Using a combination of local data sources and models, a habitat data layer was derived for the Area of Analysis, which

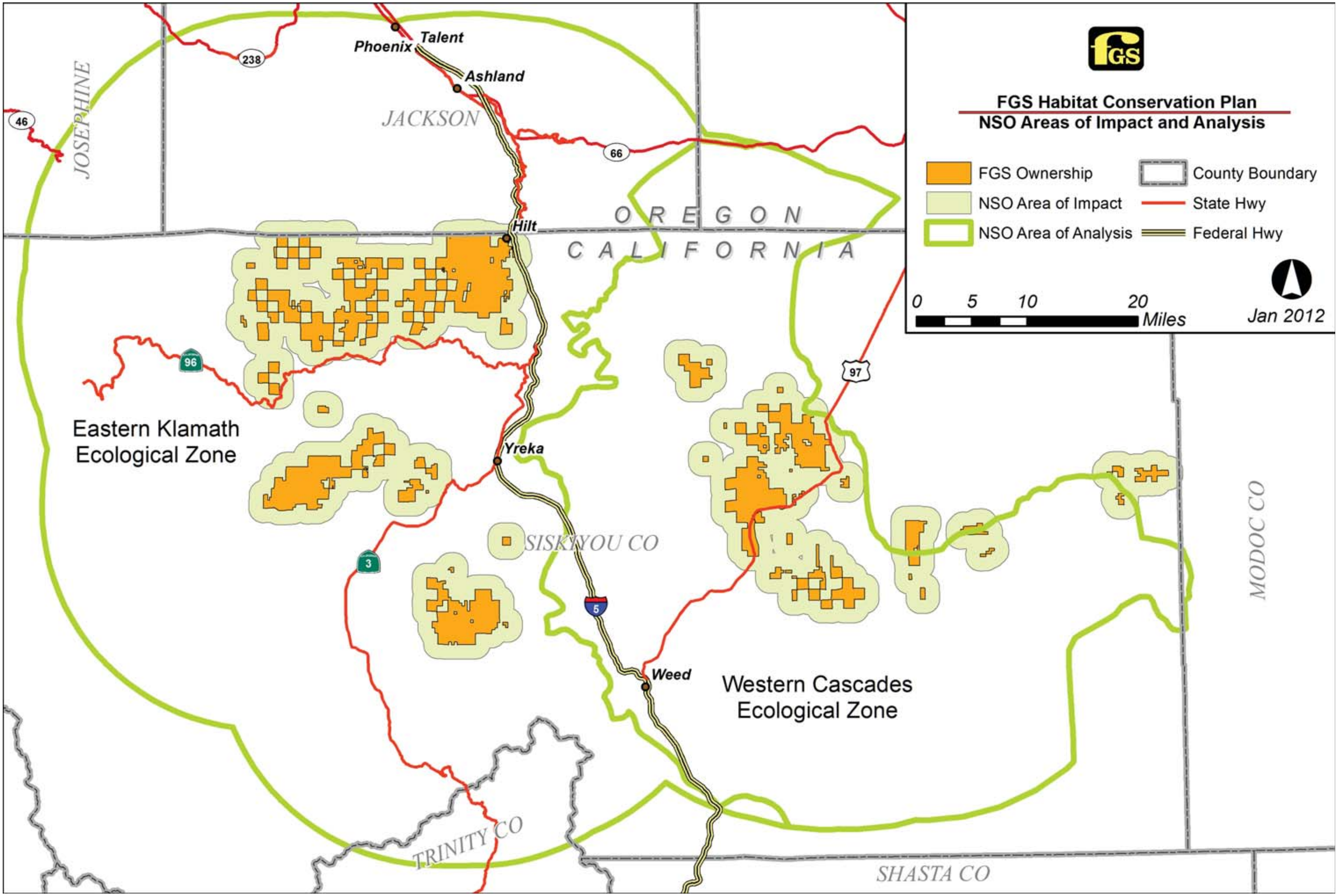

FIGURE 4-28
Area of Impact and Area of Analysis

encompasses portions of Siskiyou, Shasta, and Trinity counties in California and Jackson, Josephine, and Klamath counties in Oregon. This derived data layer represents the most current and accurate description of northern spotted owl habitat for the Area of Analysis. A description of the owl habitat layer, including data sources and methods is included in Appendix A. An overlay of the 2005 northern spotted owl baseline habitat layer with FGS's forest inventory layer provided a summary of the average stand conditions for areas identified as foraging and nesting/roosting habitat on the FGS ownership. This habitat summary is intended to characterize the range of stand conditions that are mapped as habitat for northern spotted owls by extracting stocking data from FGS's forest inventory layer using the overlay of the baseline habitat layer. In addition to other habitat elements, such as snags, down woody debris, and prey base, foraging habitat on the FGS ownership is characterized as having predominantly small trees and an average basal area of around 100 square feet per acre (range 69 to 165). Nesting/roosting habitat on the FGS ownership is characterized as having a greater number of large trees than foraging habitat and an average basal area of about 150 square feet per acre (range 108 to 174).

4.9.1.2 Range-wide Population

The range of the northern spotted owl is partitioned into 12 physiographic provinces based on recognized landscape subdivisions exhibiting different physical and environmental features (Thomas et al. 1993 as reported in USFWS 2011). The three provinces in California are the California Coast, California Klamath, and California Cascades.

Approximately 7.4 million acres of suitable habitat for the northern spotted owl were estimated to exist on federal lands in 1994. In general, the amount of northern spotted owl habitat continues to decline on a range-wide basis, although at a rate that is less than in the years prior to the species' listing, particularly on federal lands within the Northwest Forest Plan boundary (Anthony et al. 2006). The USFWS recently summarized and compared historical and current data in the Revised Recovery Plan for the Northern Spotted Owl (USFWS 2011) and in the Proposed Revised Designation of Critical Habitat for the Northern Spotted Owl (72 FR 32450-32516). Demographic data, derived from studies initiated as early as 1985, have been analyzed periodically to estimate trends in the populations of the northern spotted owl (Anderson and Burnham 1992; Forsman et al. 1996; Anthony et al. 2006).

Meta-analyses of long-term Demographic Study Areas (DSAs) throughout Washington, Oregon, and California concluded that populations in the Wenatchee, Cle Elum, Warm Springs, and Simpson study areas decreased during the period of study. There was also evidence that populations in the Rainier, Olympic, Oregon Coast Range, and HJ Andrews study areas were decreasing. Three of the 13 DSAs discussed in Anthony et al. (2006) have climatic and vegetative characteristics somewhat similar to the Plan Area; the Oregon Klamath, Northwest California, and Hoopa Tribal DSAs, all of which are located in the California Klamath Province. Northern spotted owl populations in the Oregon Klamath and Hoopa DSAs appeared to be stationary during the study, while populations within the Northwest California area appeared to decline. Fecundity and adult survival declined within the Northwest California study area while it remained the same or experienced slight increases in the other two areas. While there was no conclusion for the cause of the decline, Anthony et al. (2006) indicated that restrictions on intensive clear-cut logging in the forest management plan for the Hoopa Tribal area protected 30 percent of the forested lands for old-forest reserves and may have lead to the slight increase in fecundity and stable survival rates for the area.

Range wide, the population declined at a rate of approximately 3.7 percent per year from 1985 to 2003. Analysis of the 13 study areas in Anthony et al. (2006) indicated that the northern spotted owl populations declined at a slower rate of 2.4 percent per year on federally owned lands. Major threats to the northern spotted owl include historic and current habitat loss, and competition from barred owl (USFWS 2011). Although many populations have declined or may have declined, Courtney et al. (2004) concluded that there was little risk of extinction of the owl in the short term (15 to 20 years) because some populations of northern spotted owls remain relatively numerous, and some populations do not appear to be declining. However, in some regions (Canada and perhaps Washington state), populations are precarious with a negative population trend.

4.9.1.3 Environmental Baseline in the California Klamath Province

The following section describes regional conditions for that portion of the Area of Analysis within the California Klamath Province, including a discussion of the population, amount and quality of federal and non-federal habitat, and current threats. This section also describes local environmental baseline conditions for that portion of the Area of Impact within the California Klamath Province, including a discussion of the population, and amount and quality of habitat on the FGS ownership and adjacent federal lands. Fruit Growers' Klamath River Management Unit and Scott Valley Management Unit occur within the California Klamath Province.

Regional Scale: California Klamath Province Area of Analysis

Northern Spotted Owl Population in the California Klamath Province Area of Analysis. The number of northern spotted owl pairs within the California Klamath Province Area of Analysis was estimated by modeling the probability of occupancy of an owl pair based on the proportion of nesting/roosting and foraging habitat available within a 0.5-mile radius of an activity center (Zabel et al. 2003). Northern potted owl habitat was characterized using the 2005 USFWS/FGS northern spotted owl baseline habitat layer, collaboratively developed by FGS and USFWS. The baseline population for the California Klamath Province Area of Analysis was estimated using the 2005 USFWS/FGS northern spotted owl baseline habitat layer (see Appendix A) and the probability of occupancy model (Zabel et al. 2003) through the following process:

- Habitat polygons in the baseline habitat layer were converted to a 40 meter x 40 meter pixel habitat grid
- The probability of occupancy model (Zabel et al. 2003) was used to process the habitat grid for the Klamath Province using a logit or "moving window" assessment process which assesses the amount and proportions of northern spotted owl nesting/roosting and foraging habitats within 800 meters of each pixel.

logit=-4.357+(2.0076*(LOG([NR_ha]+1))+(0.067*[F_ha])-(0.00049*([F_ha]^2)) where :

NR_ha = hectares of nesting/roosting habitat
F_ha = hectares of foraging habitat

The probability of occupancy (Po) is calculated for each 40 meter x 40 meter pixel within the Area of Analysis.

Po=EXP(1)^logit/(1+EXP(1)^logit

- The possible number of northern spotted owl home ranges within the Area of Analysis was calculated using the sum of Po divided by the number of pixels in a home range (8,594). It was assumed for this analysis that a northern spotted owl home range contains 3,398 acres (1,375 hectares).
- Home ranges were assumed to be potentially occupied by nesting pairs, therefore the number of home ranges was multiplied by 2 to arrive at the estimated population within the Area of Analysis.
- The process was applied in the California Klamath Province, but not the California Cascades Province because the habitat typing in the California Cascades Province was not considered appropriate by the FWS for use in the predictive model.

The habitat-based probability of occupancy model (Zabel et al. 2003) was used to estimate the number of northern spotted owl pairs within the California Klamath Province Area of Analysis because the number of currently active owl sites is unknown at this scale. Results of the modeling indicated that approximately 186 activity centers (372 owls) may be supported within the California Klamath Province. Figure 4-29 illustrates the modeled probability of occupancy by northern spotted owl pairs.

Northern Spotted Owl Habitat in the California Klamath Province Area of Analysis. In addition to landscape and topographic features, vegetation and structural elements are important factors determining northern spotted owl habitat suitability (57 FR 1796). The structure and composition of coniferous vegetation within the Area of Analysis is naturally diverse and fragmented due to variation in topography and soil type, the relatively dry climate, and stochastic events such as fire. Timber harvest and fuels management have contributed to the habitat mosaic. Habitat on federal and private non-FGS land was quantified using the 2005 baseline habitat layer and is assumed to remain constant over the Permit Term. Although habitat on private non-FGS land is unlikely to remain constant, this was done to avoid speculating on the types of changes that may occur on these lands over time. Table 4-24 presents the acreage and ownership of northern spotted owl habitat within the Area of Analysis for the California Klamath Province (containing FGS's Scott Valley and Klamath River Management Units). Much of the acreage considered nesting/roosting or foraging habitat is contained in federally designated northern spotted owl Critical Habitat Units (CHUs) based on the 1992 federal designation (57 FR 1796) and refined in the Revised Designation of Critical Habitat for the Northern Spotted Owl; Final Rule (FR 73 47326, August 13, 2008), or in Late-Successional Reserves (LSRs) identified in the 1994 Northwest Forest Plan (USDA and USDI 1994).

TABLE 4-24
Northern Spotted Owl Habitat and Land Ownership in the California Klamath Province Area of Analysis

Owner	Acres of Habitat			
	Unsuitable	Foraging	Nesting/Roosting	Total
Federal	862,569	188,241	241,589	1,292,398
FGS	68,927	31,030	9,413	109,370
Other private	646,439	66,652	34,839	748,477
State	7,003	203	494	7,700
Total public	869,572	188,443	242,083	1,300,098
Total private	715,366	97,682	44,252	857,847

Data from 2005 northern spotted owl baseline habitat layer developed by FGS and USFWS

It is important to characterize the status of northern spotted owls within CHUs and LSRs because the HCP Conservation Strategy is designed to provide demographic support to northern spotted owls inhabiting lands in the federal reserve system. In 1992, the USFWS designated nearly 6.9 million acres of critical habitat for the northern spotted owl within 190 CHUs throughout Washington, Oregon, and California (USFWS 1992). The intent of the critical habitat designation was to form a network of well-distributed, large blocks of suitable habitat across the range of the northern spotted owl. In 1994, LSRs were created under the Northwest Forest Plan to provide large blocks of habitat on federal land for northern spotted owls and other species associated with late-successional forest, and were developed using conservation principles similar to those used to designate critical habitat. There was a 70 percent overlap in acreage between the 1992 CHU and 1994 LSR designations within the Area of Analysis.

In 2008, the Revised Designation of Critical Habitat for the Northern Spotted Owl; Final Rule (FR 73 47326) revised the designation of critical habitat into larger critical habitat units (e.g., Western Klamath-Siskiyou Mountains) with designated subunits that roughly correspond with the original CHU designations. There is an 83 percent overlap in acreage between current CHU subunit designations and the 1994 LSRs.

Northern Spotted Owl Federal Reserve Lands in the California Klamath Province Area of Analysis. Thirty-two of the current CHU subunits overlap with the 20-mile Area of Analysis surrounding FGS's ownership, and 17 of those are in the California Klamath Province. Figure 4-30 depicts the locations of the CHU subunits in relation to the Area of Analysis and Area of Impact for each province. Of the 32 subunits that overlap with the Area of Analysis, seven have portions that overlap with the Area of Impact. A summary of northern spotted owl habitat for these seven subunits is described in the subsequent section on federal reserve lands in the Area of Impact.

Threats to the Northern Spotted Owl in the California Klamath Province. Threats to the northern spotted owl in this region include habitat loss due to fires, federal and private management activities, displacement by barred owls, forest health (insect outbreaks and disease), and potential for avian disease. Bigley and Franklin (2004) reported a 1.17 percent reduction in northern spotted owl habitat on federal lands as a result of management activities from 1994 to 2003 in the California Klamath Province. Habitat on federal lands was reduced by 1.51 percent as a result of natural disturbances from 1994 to 2002 in the California Klamath Province (USFWS 2011).

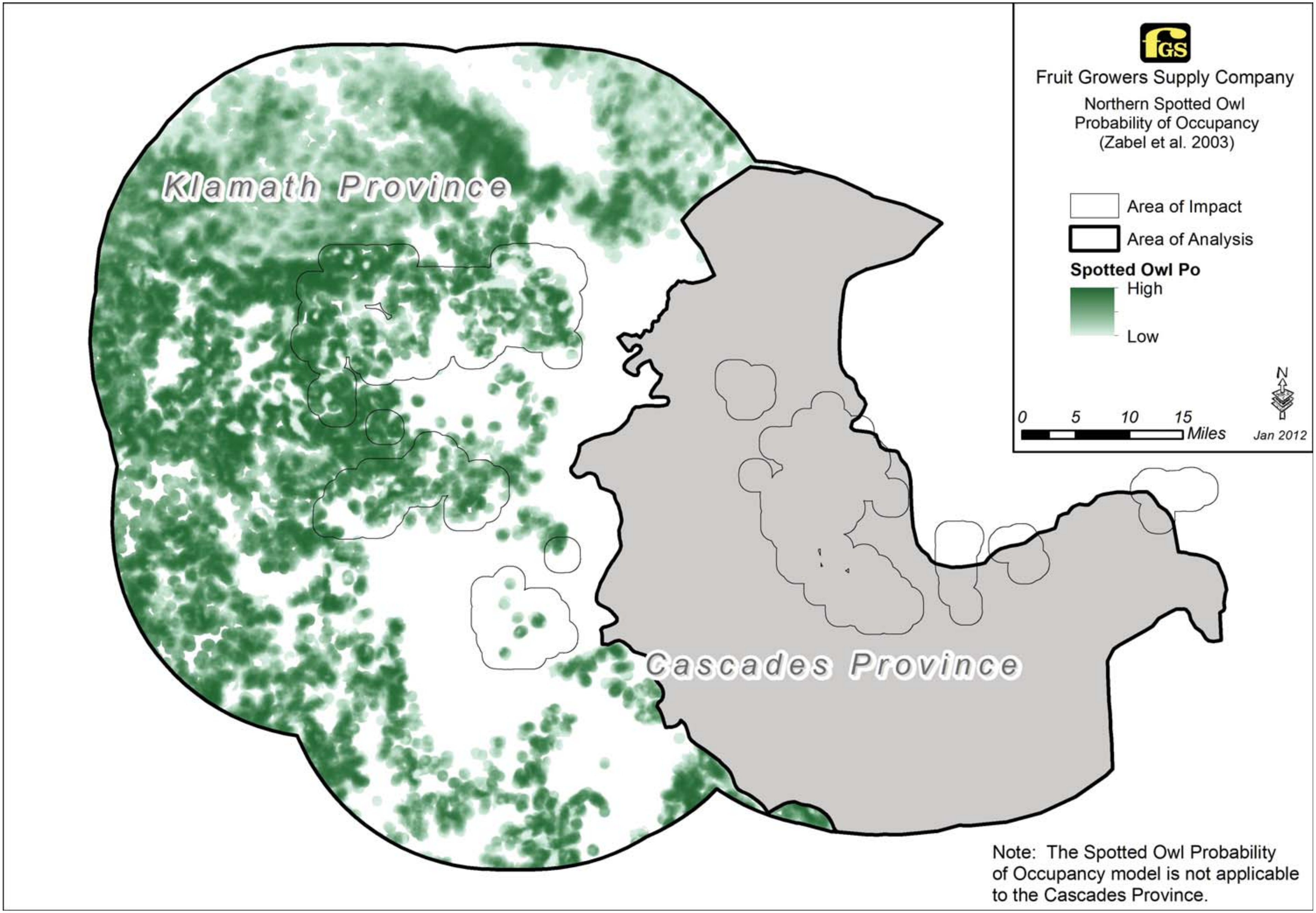

FIGURE 4-29
Northern Spotted Owl Probability of Occupancy
in the California Klamath Province

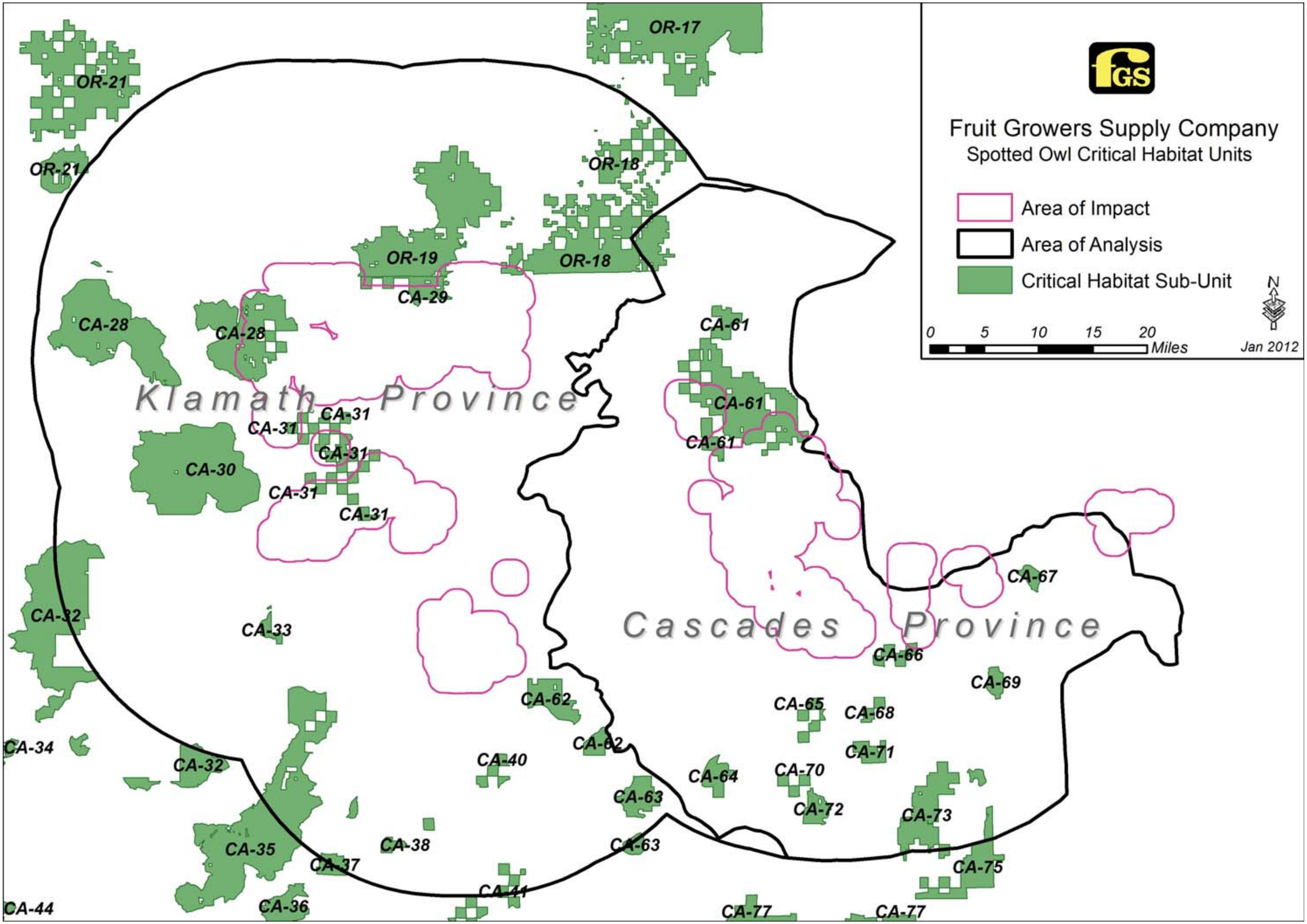

FIGURE 4-30
Northern Spotted Owl Critical Habitat Units in the HCP Area of Analysis and Area of Impact

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Fire continues to be a significant threat to northern spotted owls occupying federal lands in this region. The Final Recovery Plan for the Northern Spotted Owl (USFWS 2008) reported a reduction of 15,869 acres from 1994 to 2002 in the California Klamath Province attributable to fire, whereas only 100 acres were lost from wind, and 390 acres lost from insects and disease during the same time period. However, Agee (2007) disputed these estimates, reporting that from 1994 through 2003, this region experienced the Dillon fire (27,000 acres), Megram/Onion (125,000 acres), Jones and Happy Camp Complex (1,670 acres and 6,800 acres, respectively), and many smaller fires. He concluded that while not all acres burned with high severity, probably 30 percent of this habitat was seriously altered or destroyed as owl habitat, resulting in a loss of 48,141 acres from 1994 through 2003. Additionally, in 2006, another 170,000 acres burned. While not all of the 2006 fires burned with high severity, using an estimate of 30 percent loss, it was estimated that an additional 51,042 acres of habitat was lost to fire in this province (Agee 2007). Although there is some uncertainty as to the extent of northern spotted owl habitat loss due to fire, both estimates clearly demonstrate that fire is a threat to owls.

The extent of the recent high-severity burns appears to be different than historic burn patterns, with more area burning at high intensity (Skinner et al. 2006). Before fire suppression, fires of higher spatial complexity created openings of variable size within a matrix of forest that was generally more open than today (Taylor and Skinner 1998, as referenced in Skinner et al. 2006). This heterogeneous pattern has been replaced by a more homogeneous pattern of smaller openings in a matrix of denser forest, thus reducing spatial complexity (Skinner 1995, as referenced in Skinner et al. 2006). Studies suggest that vegetation patterns and conditions generated by pre-fire suppression fire regimes may be advantageous for the northern spotted owl (Franklin et al. 2000). The incidence of catastrophic wildfire on federal reserve lands (CHUs and LSRs) has increased from historical occurrences as a result of recent fire suppression policies. Historically, lands within the California Klamath Province experienced frequent (1 to 25 years) low- to moderate-intensity surface fires, while the current regime is characterized as infrequent (25 to 100 years) high-intensity fires.

Information on forest health is primarily based on the Klamath National Forest Late-Successional Reserve Assessment conducted by Dix et al. (1999). Mortality caused by insects and disease in the Seiad and Johnny O'Neil LSRs was localized to the southern portion of the LSRs. At upper elevations, the fir engraver beetle has been responsible for ponderosa pine and Douglas fir mortality. At lower elevations, the western pine beetle and pine engraver beetle have been primarily responsible for ponderosa pine and Douglas-fir mortality. The Johnny O'Neil LSR is at risk for future insect outbreaks due to early and mid-seral stand stocking levels.

Barred owls are present within the California Klamath Province, and have recently become established in the Area of Analysis. Barred owls were reported in southern Jackson County, Oregon (northern portion of FGS Area of Analysis), as early as 1990 (Kelly 2001), and records from the Rogue-Siskiyou National Forest and Medford BLM indicate that numerous barred owl locations have been reported in that area through 2007. Five pairs of barred owls were detected in the Oregon portion of the Mt. Ashland LSR (subunit OR-19 of the Klamath Intra-Province CHU) during 2005-2006 (USFWS unpublished data); however, annual surveys of subunits CA-29 (Klamath Intra-Province CHU), and subunits CA-28, CA-31, and

CA-30 of the Scott and Salmon Mountains CHU did not detect barred owls until 2006. In 2006 and 2007, barred owls were detected at six locations in and adjacent to these CHUs (USFWS unpublished data). Based on these reports, combined with the rate and pattern of colonization observed in the California Cascades Province, barred owls are predicted to become established in the Area of Impact within 5 years (USFWS unpublished data).

West Nile virus is the primary disease of concern for the northern spotted owl (USFWS 2011). The virus has not been detected in the California Klamath Province; however, it is now within the range of the northern spotted owl in northwestern California (Courtney et al. 2004).

Local Scale: California Klamath Province Area of Impact

Northern Spotted Owl Population in the California Klamath Province Area of Impact. The DFG Northern Spotted Owl Database contains the most comprehensive compilation of northern spotted owl sightings within the Area of Impact, including results of protocol-level owl surveys on FGS lands and adjacent private and public lands. The database contains records beginning in 1987. For this HCP, owl records are used through 2007. Information on fecundity and survivorship in the Plan Area is not currently available, as no mark-recapture programs for owls have been conducted on FGS's ownership in the California Klamath Province.

For the period from 1987 through 2007, the database contains records of 87 activity centers on or within 1.3-miles of FGS's ownership in the California Klamath Province. Of these, 13 sites were determined by USFWS to be invalid based on lack of suitable habitat or an inadequate number of detections. Therefore, 74 valid activity centers potentially supporting a total of 143 northern spotted owls are presumed to occur within the California Klamath Province Area of Impact (containing FGS's Scott Valley and Klamath River Management Units); 18 of these activity centers are located on FGS land. A quantification of northern spotted owls by reproductive status in the California Klamath Province Area of Impact is presented in Table 4-25. The 74 valid activity centers are graphically depicted in Figure 4-31. There is some uncertainty as to the exact number of active activity centers within the Area of Impact because the database only contains detections since 1987, and some activity centers may be inactive. In addition, unsurveyed habitat may support northern spotted owls that have not been detected and are not represented in the database.

TABLE 4-25
Quantification of Northern Spotted Owls by Reproductive Status in the California Klamath Province Area of Impact

Status (1987-2007)[a]	Sites[b]	Owls
Reproductive pair with young	50	100
Nesting pair	19	38
Territorial single	5	5
Not valid activity center	13	0
Total activity centers	87	143
Total valid activity centers	74	143

[a] Source: DFG Northern Spotted Owl Database
[b] For the purpose of the effects analysis, each site is considered an activity center

Northern Spotted Owl Habitat in the California Klamath Province Area of Impact. Based on the 2005 owl habitat layer, there are 92,762 acres of suitable foraging habitat, 49,394 acres of suitable nesting habitat, and 382,328 acres of unsuitable habitat within the entire 545,030-acre Area of Impact. Table 4-26 shows the acreage and ownership of northern spotted owl habitat within the California Klamath Province Area of Impact. Figures 4-32 and 4-33 illustrate the distribution of northern spotted owl habitat within the Area of Impact in the California Klamath Province (Klamath River and Scott Valley management units, respectively).

TABLE 4-26
Northern Spotted Owl Habitat and Land Ownership in the California Klamath Province Area of Impact

	Acres of Habitat			
Owner	**Unsuitable**	**Foraging**	**Nesting/Roosting**	**Total**
Federal	78,144	26,315	26,436	130,895
FGS	65,535	30,548	8,410	104,493
Other private	83,281	13,128	7,199	103,608
State	504	42	0	546
Total public	78,648	26,358	26,436	131,442
Total private	148,816	43,676	15,609	208,101

Data from 2005 northern spotted owl baseline habitat layer developed by FGS and USFWS

Northern Spotted Owl Federal Reserve Lands in the California Klamath Province Area of Impact. Five CHU subunits overlap with the California Klamath Area of Impact; these are subunits CA-29 and OR-19 in the Klamath Intra-Province CHU; subunit OR-18 in the Southern Cascades CHU; and subunits CA-28 and CA-31 in the Scott and Salmon Mountains CHU. Four of these subunits overlap with four designated LSRs (Figure 4-34). A summary of the habitat conditions in the LSRs that overlap the CHUs is described below and is based on the Klamath National Forest Late-Successional Reserve Assessment conducted by Dix et al. (1999). Information on the status of the LSRs was used because considerably more information is available on conditions in the LSRs than for individual CHUs and subunits, and because there is an 83 percent overlap in acreage between current subunit designations and the 1994 LSRs. Northern spotted owl pair goals for the newly designated CHUs and their subunits are under development by the Service but have not been finalized. However, because the distribution and total acres of the 2008 designated subunits do not significantly differ from the 1992 critical habitat designation within the Area of Analysis, it is reasonable to assume that pair goals will be comparable. Therefore, for the purpose of this document, the 1992 pair goals will be used as a surrogate for the 2008 designated subunits.

Seiad LSR (353)/Scott and Salmon Mountains CHU Subunits CA 28 and CA-30. The Seiad LSR is approximately 101,200 acres in size, making it the largest LSR within the Klamath National Forest. It contains approximately 26,240 acres of nesting/roosting habitat and 23,490 acres of foraging habitat, for a total of 49,730 acres of suitable northern spotted owl habitat. An additional 24,910 acres have the potential to provide northern spotted owl habitat. The combined habitat within the Seiad LSR and the adjacent Marble Mountain Wilderness enables this area to function as a large refugium for northern spotted owls. The amount of nesting/roosting and foraging habitat is within 10 percent of the expected range of suitable northern spotted owl habitat for the Seiad LSR. However, the acres of late-successional and old growth forest (LSOG) are below the expected functioning range, but still ranked as moderate in the amount of older forest.

Twenty-five activity centers have been located within the Seiad LSR boundary (21 pairs and 4 territorial singles); however, at least 40 percent of the LSR has not been adequately surveyed. The southern portion of the Seiad LSR overlaps considerably with subunit CA-30 (which is outside of the FGS Area of Impact) and the northern portion of this LSR overlaps considerably with the western portion of subunit CA-28. The eastern portion of CA-28 overlaps with the Klamath portion of the Johnny O'Neil LSR. In the northern portion of the Seiad LSR that overlaps with CA-28, three pairs and 4 territorial singles have been reported. In the Klamath portion of the Johnny O'Neil LSR that overlaps with CA-28, 16 pairs and one territorial single have been reported. The total of 19 owl pairs within the portions of the Seiad and Johnny O'Neil LSRs that overlap with subunit CA-28 nearly meets the pair goal of 22 for this subunit. Overall, the Seiad LSR, in combination with the Johnny O'Neil LSR, performs all the intended functions for subunits CA-28. There are some portions of critical habitat that fall outside of the LSR boundary, but overall, the intent of the critical habitat designation is exceeded by the LSR.

Johnny O'Neil LSR (354)/ Scott and Salmon Mountains CHU Subunit CA-28. The Johnny O'Neil LSR is approximately 46,840 acres in size, with 27,900 acres located on the Klamath National Forest and the remainder on the Rogue National Forest. This LSR contains approximately 20,420 acres of nesting/roosting habitat and 7,370 acres of foraging habitat, for a total of 27,790 acres of suitable northern spotted owl habitat. An additional 8,850 acres have the potential to provide owl habitat. There are large, continuous parcels of LSOG habitat throughout most portions of the Johnny O'Neil LSR, including the Horse Creek drainage in the southeast, much of the northeast portion, and a 2-mile-wide band in the northwest that runs along the Siskiyou Crest and north. The amount of nesting/roosting and foraging habitat is within the expected range of suitable northern spotted owl habitat, and the acres of LSOG forest are above the expected functioning range for the Klamath portion, but below for the Rogue portion. Overall, Johnny O'Neil was ranked at the high end of moderate for habitat connectivity, due in part to moderate amounts of mid-successional forest.

As described previously, the Klamath portion of the Johnny O'Neil LSR overlaps with the eastern portion of subunit CA-28. A total of 21 northern spotted owl activity centers have been located within the Johnny O'Neil LSR boundary, 17 of which overlap with subunit CA-28. However, approximately 20 percent of the Klamath portion has not been surveyed. Sixteen northern spotted owl pairs and one territorial single were recorded in the Klamath portion of the Johnny O'Neil LSR. The total of 19 owl pairs within the portions of the Seiad and Johnny O'Neil LSRs that overlap with subunit CA-28 nearly meets the pair goal of 22 for this subunit. There are some portions of critical habitat that fall outside of the LSR boundary, but overall, the intent of the critical habitat designation is met by the LSR.

Collins Baldy LSR (355)/ Scott and Salmon Mountains Subunit CA-31. The Collins Baldy LSR is approximately 14,670 acres in size, and supports approximately 4,600 acres of nesting/roosting habitat and 4,500 acres of foraging habitat, for a total of 9,100 acres of suitable northern spotted owl habitat. An additional 2,930 acres have the potential to

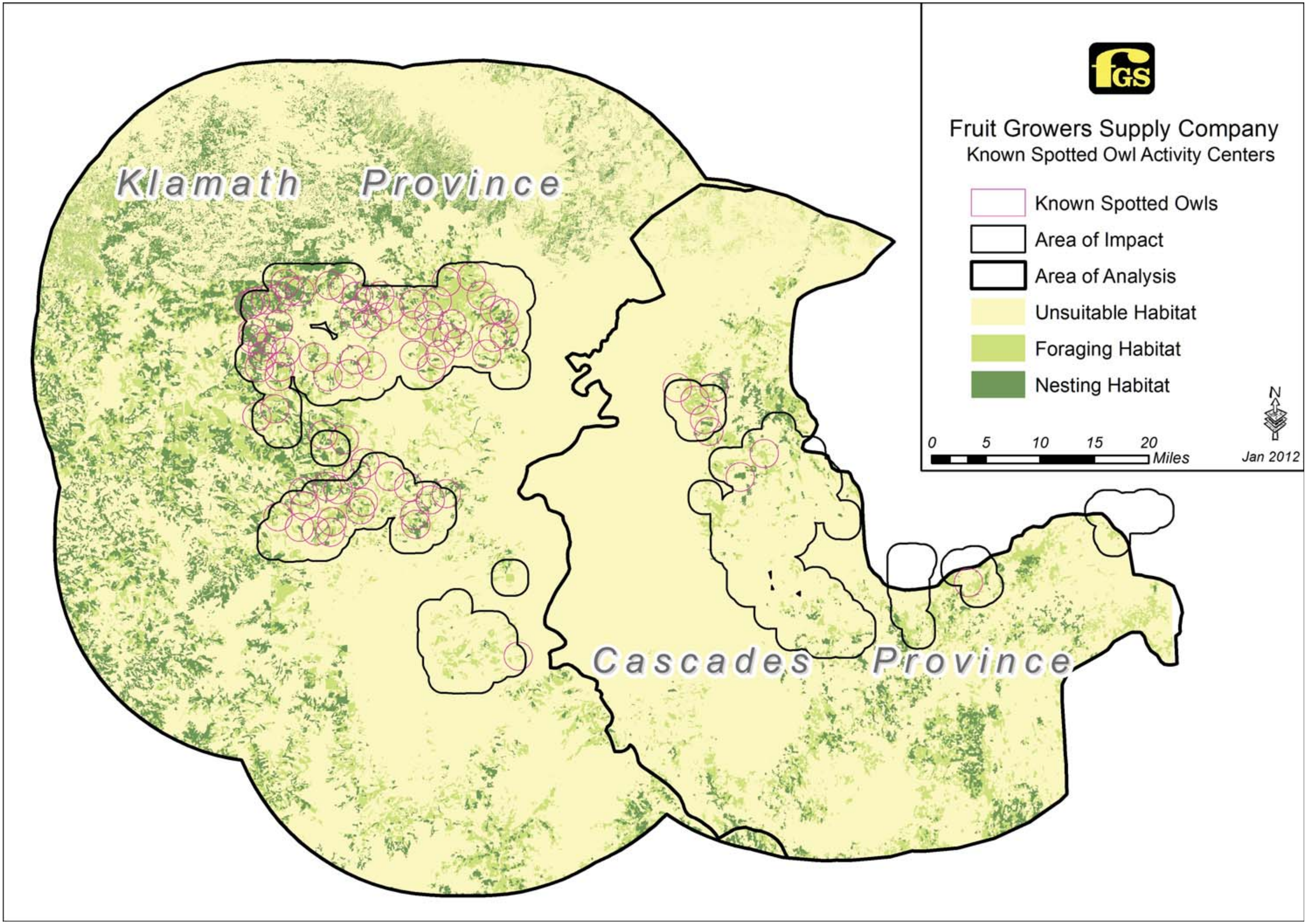

FIGURE 4-31
Valid Northern Spotted Owl Activity Centers
Within 1.3 Mile of the FGS Ownership

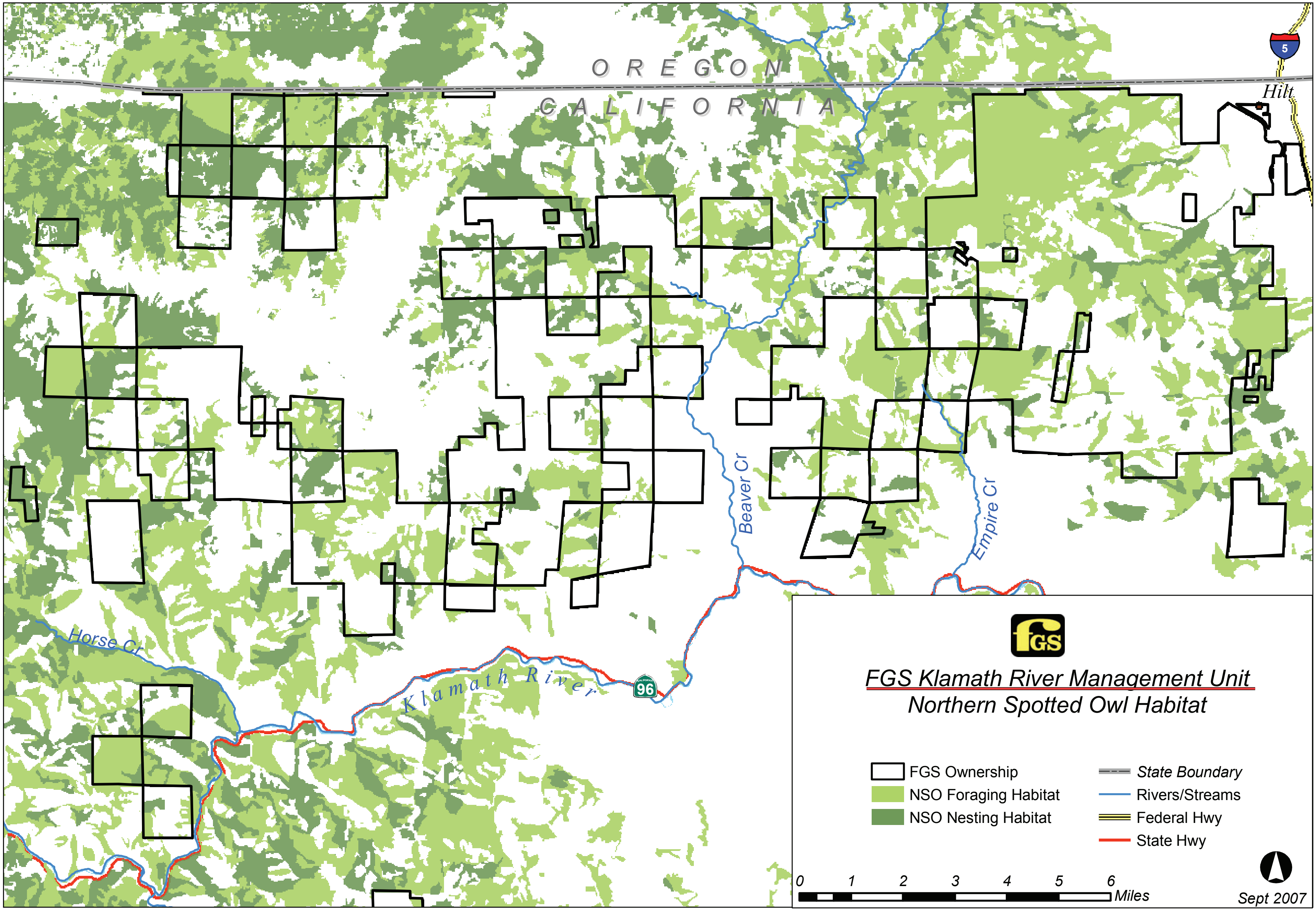

FIGURE 4-32
Northern Spotted Owl Habitat in the Klamath River Management Unit

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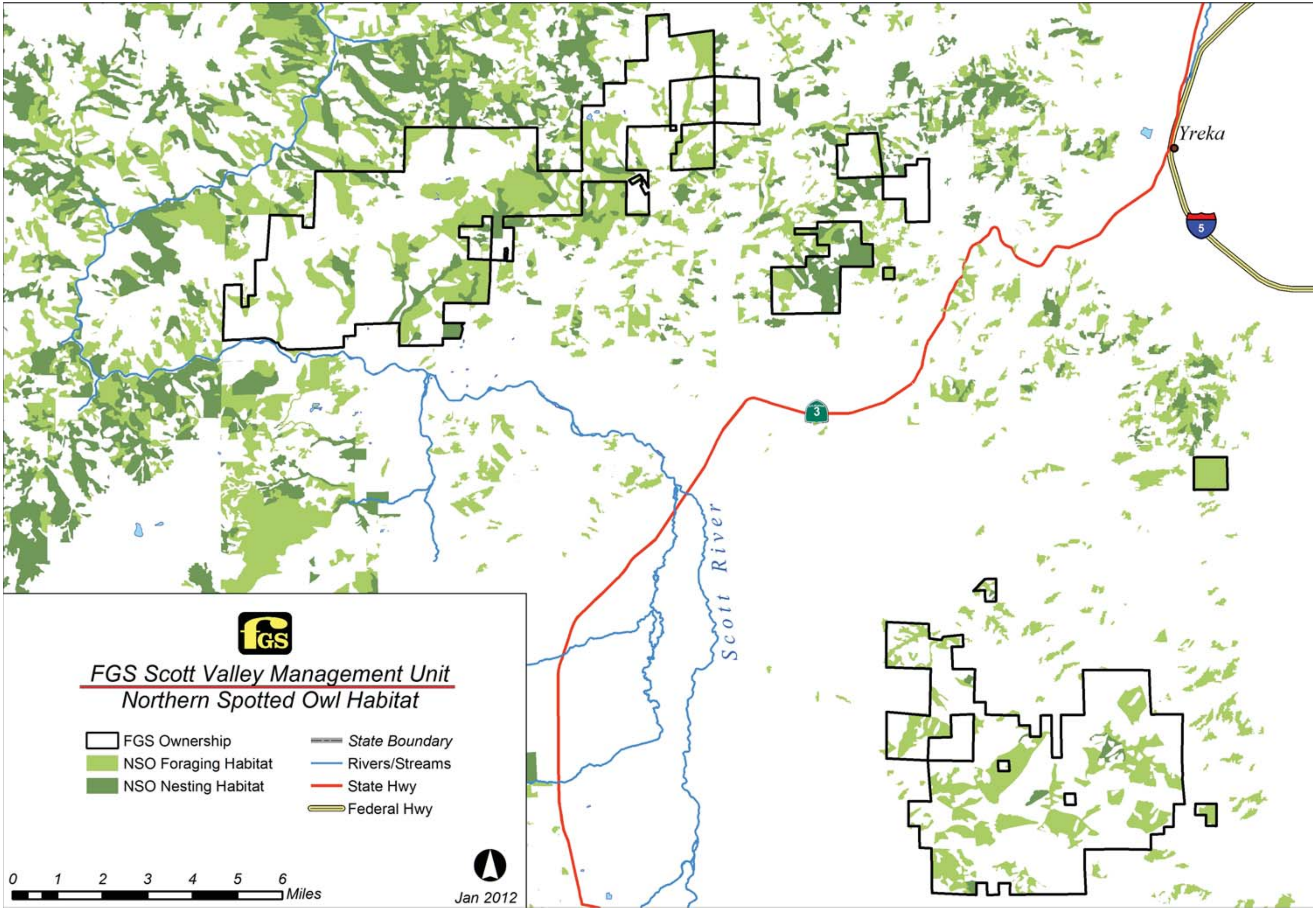

FIGURE 4-33
Northern Spotted Owl Habitat in the Scott Valley Management Unit

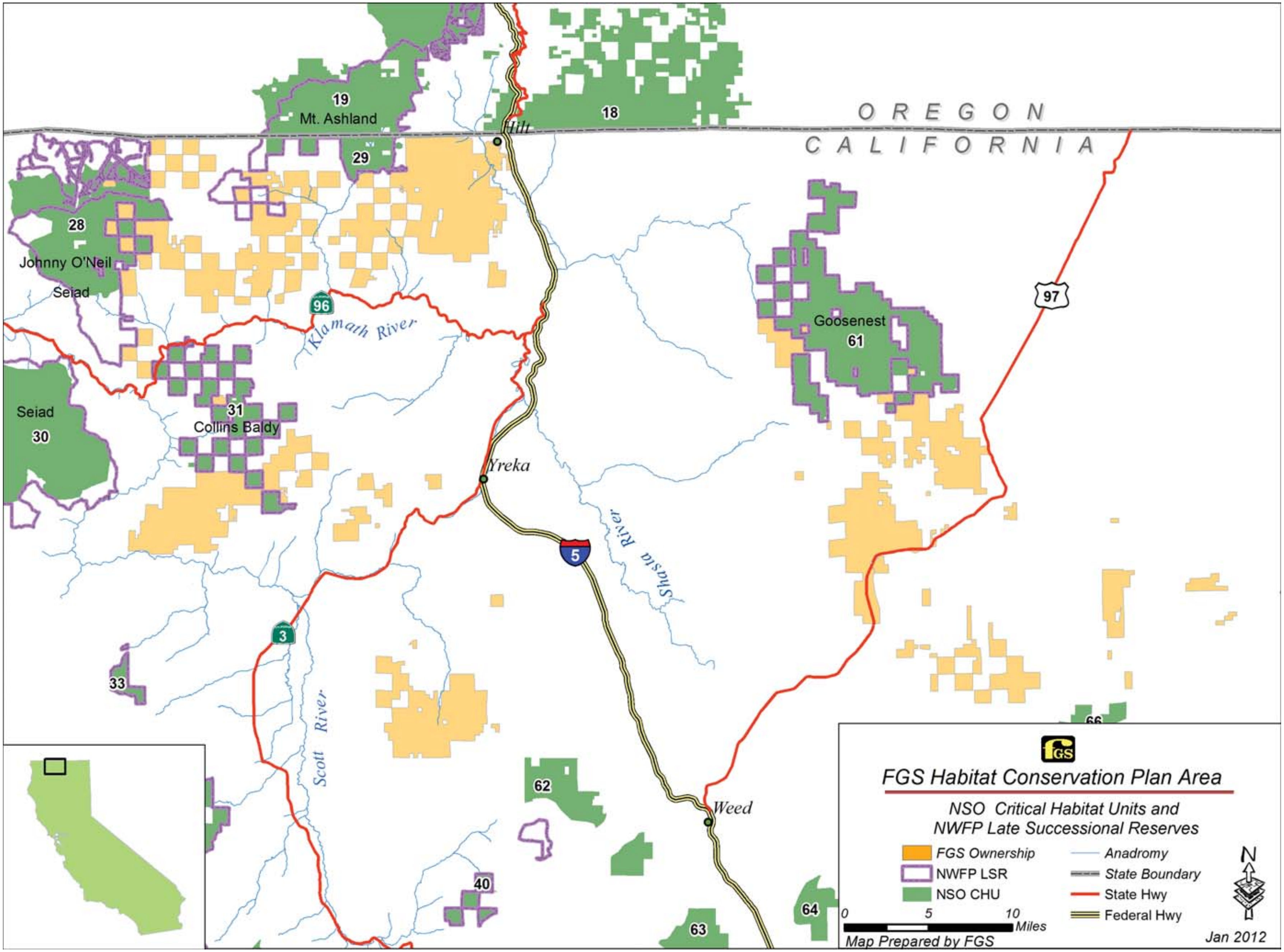

FIGURE 4-34
Northern Spotted Owl Critical Habitat Units and
NWFP Late Successional Reserves

provide northern spotted owl habitat. The habitat is fairly discontinuous because of the checkerboard ownership of private and federal lands. Late-successional habitat is currently lacking within the Collins Baldy LSR and accounts for only 1,630 acres (13 percent) of the capable ground. Relative to other LSRs, it ranks low and moderate for the proportion of LSOG habitat and combined mid-successional/LSOG habitat, respectively.

A total of 12 northern spotted owl activity centers supporting 12 owl pairs have been located within the Collins Baldy LSR. The entire LSR has been surveyed for northern spotted owls. The Collins Baldy LSR overlaps almost entirely with subunit CA-31. The 12 known owl pairs within the Collins Baldy LSR exceed the pair goal of 5 for subunit CA-31.

Overall, the Collins Baldy LSR performs the intended function of subunit CA-31 in that it extends protected habitat east toward subunit CA-61 in the Southern Cascades Unit and exceeds the CHU pair goal.

Mt. Ashland LSR (248)/Klamath Intra-Province Subunits OR-19 and CA-29. The Mt. Ashland LSR is approximately 51,512 acres in size and provides approximately 30,169 acres of suitable northern spotted owl habitat, or 58 percent of the total LSR land base. Late-successional habitat (greater than 24 inch dbh) accounts for 14,981 acres (29 percent) of the LSR and mostly occurs below 5,000 feet elevation. Another 29 percent is less optimal habitat (mid-successional stands from 17 to 24 inch dbh). This LSR is extensively fragmented by a checkerboard ownership pattern and past land use.

A total of 26 activity centers have been located within the Mt. Ashland LSR. Thirteen northern spotted owl pairs and two territorial singles were recorded in the northern portion of the LSR, while nine pairs and two territorial singles were located in the southern zone, for a total of 22 pairs and four resident singles. Complete protocol surveys have covered almost all suitable habitat within the LSR boundary. The home ranges of two activity centers in the northern portion of the LSR have less than 40 percent suitable habitat, and four activity centers south of the crest are below this minimum habitat threshold. The Mt. Ashland LSR overlaps with the subunits OR-19 and CA-29 of the Klamath Intra-Province CHU. The CHU objectives include maintaining a link between California and Oregon, and providing habitat for 20 northern spotted owl pairs. The 22 owl pairs in the Mt. Ashland LSR exceed the pair goals for subunits OR-19 and CA-29.

4.9.1.4 Environmental Baseline in the California Cascades Province

The following section describes regional conditions for the portion of the Area of Analysis within the California Cascades Province, including a discussion of the population, amount and quality of federal and non-federal habitat, and current threats. This section also describes local environmental baseline conditions for the portion of the Area of Impact within the California Cascades Province, including a discussion of the population, and amount and quality of habitat on the FGS ownership and adjacent federal lands. FGS's Grass Lake Management Unit occurs within the California Cascades Province.

Regional Scale: California Cascades Province Area of Analysis

Northern Spotted Owl Population in the California Cascades Province Area of Analysis. Unlike the California Klamath Province, the amount of northern spotted owl habitat in the California Cascades Province is limited, and protocol-level owl surveys have been conducted in the last 10 years on the majority of lands within the province that could potentially support owls. Owl probability of occupancy could not be estimated within the California Cascades Province using the Zabel et al. (2003) habitat model, because owl nesting/roosting and foraging habitat in this province is not comparable to the habitat characterizations used for model development. The USFWS considers the DFG Northern Spotted Owl Database the best source for documenting the number of owls in this province. A database query in August 2008 reported 54 activity centers within the California Cascades Area of Analysis. However, information on fecundity and survivorship in the Plan Area is not currently available, as no mark-recapture programs for owls have been conducted on FGS's ownership in the California Cascades Province. Anthony et al (2006) did not include the California Cascades Province in their demographic studies because northern spotted owl populations in this province are too low to make demographic studies of this type possible.

Northern Spotted Owl Habitat in the California Cascades Province Area of Analysis. Habitat on federal and private non-FGS land is represented by the 2005 northern spotted owl baseline habitat layer developed by USFWS and FGS. Table 4-27 presents the acreage and ownership of northern spotted owl habitat within the Area of Analysis for the California Cascades Province (containing FGS's Grass Lake Management Unit). Much of the acreage considered nesting/roosting or foraging habitat is contained in federally designated CHUs or LSRs.

TABLE 4-27
Northern Spotted Owl Habitat and Land Ownership Within the California Cascades Province Area of Analysis

	Acres of Habitat			
Owner	**Unsuitable**	**Foraging**	**Nesting/Roosting**	**Total**
Federal	453,843	76,023	33,319	563,185
FGS	37,622	4,180	619	42,967
Other private	485,634	38,111	16,371	540,116
State	630	0	0	630
Total public	454,473	76,023	33,319	563,815
Total private	523,256	42,292	16,989	583,083

Data from 2005 northern spotted owl baseline habitat layer developed by FGS and USFWS

Northern Spotted Owl Federal Reserve Lands in the California Cascades Province Area of Analysis. Fifteen of the 32 CHU subunits within the 20-mile Area of Analysis surrounding FGS's ownership are in the California Cascades Province. The location of these CHUs is depicted in Figure 4-30. One of the subunits (CA-61) of the Southern Cascades CHU is within the California Cascades Province Area of Impact, and is described in the subsequent section on federal reserve lands in the Area of Impact.

Threats to the Northern Spotted Owl in the California Cascades Province. Threats to the northern spotted owl in this region include habitat loss due to federal and private management activities, forest health issues (including overstocking, insect infestations, and forest disease), and displacement by barred owls. Bigley and Franklin (2004) reported a 5.77 percent reduction in northern spotted owl habitat on federal lands as a result of management activities from 1994 to 2003 in the California Cascades Province. Habitat was unchanged by natural disturbances from 1994 to 2002 in the California Cascade Province (USFWS 2008).

Barred owls currently pose a primary threat to northern spotted owls in the California Cascades Province. While numerous detections of barred owls were reported in the southern Oregon Cascades during the early 1990s, this species was not detected in the California Cascades Province until 1996. From 1996 to 2003, single barred owls were detected at two locations within subunit CA-61 of the Southern Cascades CHU. Surveys in 2004 detected barred owl pairs at three locations, all within northern spotted owl territory cores. Single barred owls were detected at three additional locations in and adjacent to CHU CA-1, and two locations were reported on the McCloud Ranger District of the Shasta-Trinity National Forest, immediately to the south of subunit CA-61. Between 2004 and 2007, the numbers of barred owls detected in the California Cascades Province has increased steadily (USFWS unpublished data). As of 2007, barred owls have been detected at 11 locations, and three of 12 northern spotted owl territories (within subunit CA-61) have been displaced by barred owls.

West Nile virus is the primary disease of concern for the northern spotted owl (USFWS 2011). The virus has not been detected in the California Cascades Province; however, it is within the range of the northern spotted owl in northwestern California (Alan Franklin, John Marzluff, pers. comm., as reported in Courtney et al. 2004).

Local Scale: California Cascades Province Area of Impact

Northern Spotted Owl Population in the California Cascades Province Area of Impact. The DFG northern spotted owl database contains records of 10 activity centers within 1.3 miles of FGS's ownership in the California Cascades Province. Of these, 2 sites were determined by the USFWS to be invalid based on inadequate number of detections and lack of suitable habitat. Therefore, 8 valid activity centers supporting a total of 15 northern spotted owls are estimated to occur within the California Cascades Province Area of Impact. A quantification of northern spotted owls by reproductive status in the California Cascades Province Area of Impact is presented in Table 4-28. The 8 valid activity centers are graphically depicted in Figure 4-31. There is some uncertainty as to the exact number of active activity centers within the Area of Impact because the database contains detections since 1987, and some activity centers may no longer be active. Additionally, unsurveyed habitat may support northern spotted owls that have not been detected and are not represented in the database.

TABLE 4-28
Quantification of Northern Spotted Owls by Reproductive Status in the California Cascades Province Area of Impact

Status (1987-2007)[a]	Sites[b]	Owls
Reproductive pair with young	5	10
Nesting pair	2	4
Territorial single	1	1
Not valid activity center	2	0
Total activity centers	10	15
Total valid activity centers	8	15

[a] Source: DFG Northern Spotted Owl Database
[b] For the purpose of the effects analysis, each site is considered an activity center

Northern Spotted Owl Habitat in the California Cascades Province Area of Impact. Based on the 2005 owl habitat layer, there are 92,762 acres of suitable foraging habitat, 49,394 acres of suitable nesting habitat, and 382,328 acres of unsuitable habitat within the entire 545,030-acre Area of Impact. Table 4-29 shows the acreage and ownership of northern spotted owl habitat within the Area of Impact in the California Cascades Province. Figure 4-35 illustrates the distribution of northern spotted owl habitat within the Area of Impact in the California Cascades Province (Grass Lake management unit).

TABLE 4-29
Northern Spotted Owl Habitat and Land Ownership within the California Cascades Province Area of Impact

	Acres of Habitat			
Owner	**Unsuitable**	**Foraging**	**Nesting/Roosting**	**Total**
Federal	83,092	14,220	5,737	103,050
FGS	37,622	4,180	619	42,967
Other private	33,464	4,328	993	38,785
State	140	0	0	140
Total public	83,233	14,220	5,737	103,190
Total private	71,086	8,508	1,612	81,752

Data from 2005 northern spotted owl baseline habitat layer developed by FGS and USFWS

Northern Spotted Owl Federal Reserve Lands in the California Cascades Province Area of Impact. As described above, the Revised Designation of Critical Habitat for the Northern Spotted Owl; Final Rule (FR 73 47326) revised the designation of critical habitat into larger critical habitat units (e.g., Western Klamath-Siskiyou Mountains) with designated subunits that roughly correspond with the original CHU designations. The analysis below is based on Late-Successional Reserve Assessment for the Goosenest LSR #RC-363 (USDA Forest Service 1996) but uses the revised subunit numbers for critical habitat from the revised designation. Northern spotted owl pair objectives for the newly designated CHUs and their subunits are under development by the Service but have not been finalized. However, because the distribution and total acres of the newly designated subunits do not significantly differ from the 1992 critical habitat designation within the Area of Analysis, it is reasonable to assume that pair objectives will be comparable. Therefore, for the purpose of this document, the 1992 pair objectives will be used as a surrogate for the newly designated subunits.

Two subunits (CA-61 and CA-66) in the Southern Cascades CHU are within the California Cascades Area of Impact. Subunit CA-61 overlaps with the Goosenest LSR. Considerably more information is available on conditions in LSRs than for individual CHU subunits. A very small portion (200 of approximately 3,000 acres) of subunit CA-66 is within the California Cascades Province Area of Impact, but is not considered in this analysis because this subunit does not overlap with any LSR and the marginal potential for northern spotted owl habitat on the FGS ownership in this subunit.

Goosenest LSR (363)/ Southern Cascades CHU Subunits CA-61 and CA-66. The Goosenest LSR is approximately 39,770 acres in size. Habitats considered suitable for breeding and/or foraging by northern spotted owls (dense late-successional, open late-successional, and

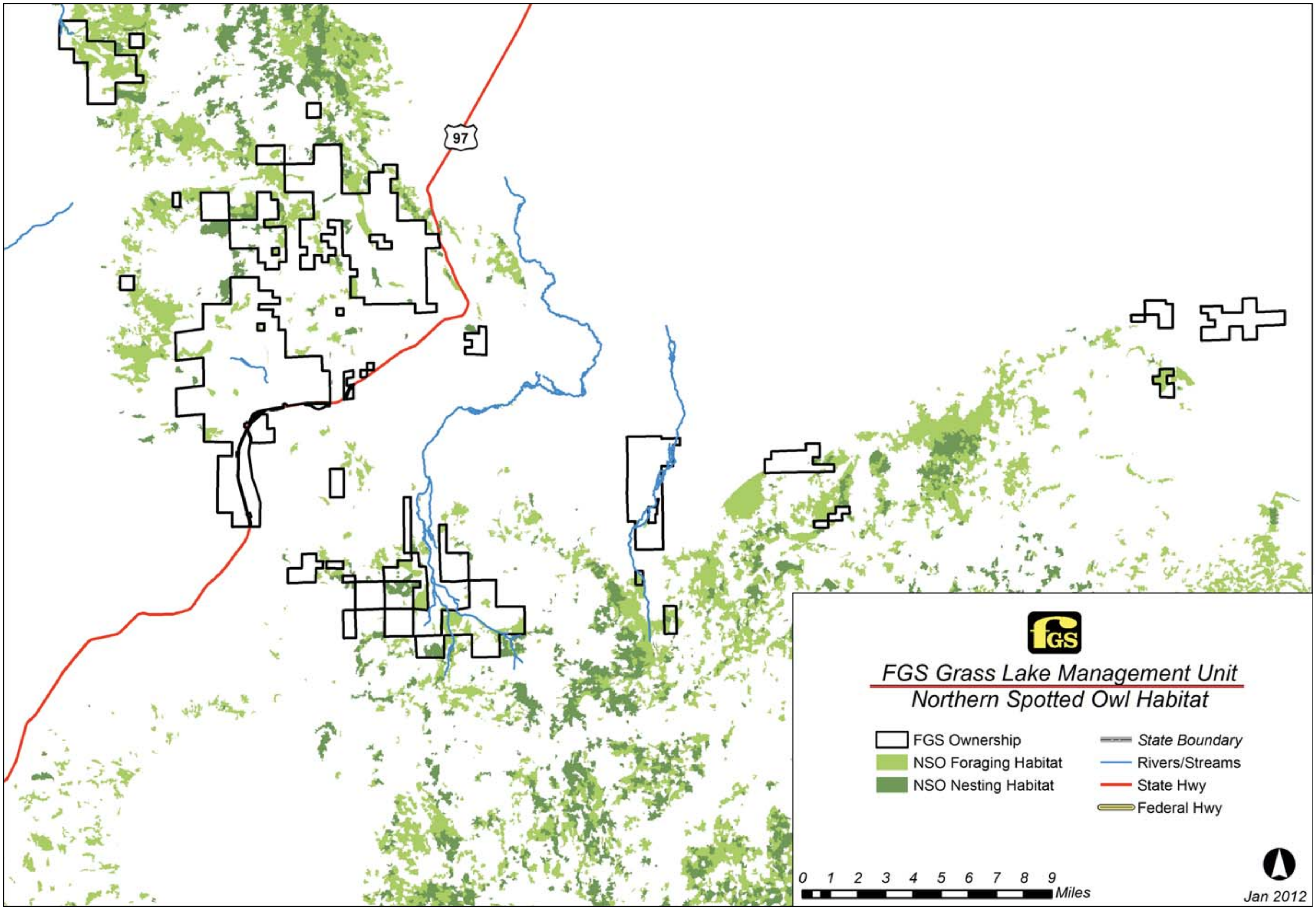

FIGURE 4-35
Northern Spotted Owl Habitat in the
Grass Lake Management Unit

dense mid-successional) occupy 14,097 acres, or about 35 percent, of the LSR area (USFS 1996b). Approximately 75 to 85 percent of the LSR is capable of producing late-successional forests with at least 20 percent canopy closure. However, low precipitation and temperatures, and high elevation reduce the overall potential of lands within the California Cascades Province to support dense late-successional habitat suitable for northern spotted owls (USDA Forest Service 1996). The majority of northern spotted owl home ranges in the Goosenest LSR are functioning poorly in terms of long-term sustainability (USFS 2005). Home ranges contain overly dense forest with suppressed understory dominated by white fir and lack large trees, particularly Douglas fir. The habitat in these home ranges is at moderate to high risk of insect attack, with subsequent increased wildfire hazard. At such high densities, stand development is unlikely to attain old-growth characteristics in the absence of fire or active management.

A total of 14 northern spotted owl activity centers have been located within the Goosenest LSR. The Goosenest LSR overlaps considerably with subunit CA-61. The 14 known activity centers (12 pairs and 2 territorial singles) within the Goosenest LSR exceed the recovery pair goal of 6 for subunit CA-61 (USFS 1996b). However, habitat conditions within most northern spotted owl home ranges in the LSR are poor in terms of long-term sustainability. Many home ranges contain overly dense forest with suppressed understory dominated by white fir and lack large trees, particularly Douglas-fir.

4.9.2 Yreka Phlox

4.9.2.1 Regional Status and Distribution

Yreka phlox was listed as “endangered” under the ESA in February 2000 (65 FR 5268-5275). Although the biology and ecology of Yreka phlox are poorly understood, field observations suggest that its populations may be stable, individual plants may be long-lived, and seedling establishment is infrequent. This species has a very limited distribution, and may be at particular risk from human land use activities such as housing development and road construction and maintenance, fire suppression activities, off-road vehicle use, illegal collection, and vandalism. Other threats include competition with exotic plants, herbicide application, grazing by domestic animals, and catastrophic natural events such as disease or fire (USFWS 2006, 2007b).

Yreka phlox is a narrow endemic known only from the vicinity of Yreka, California. The plant occurs on lands owned and managed by industrial timber companies, other private landowners, the USFS, California Department of Transportation (Caltrans), and the City of Yreka. It is currently known to occur at five locations generally referred to as the China Hill, Soap Creek Ridge, Cracker Gulch, Greenhorn Creek, and Jackson Street occurrences. The following descriptions of the populations at each occurrence are taken from the final recovery plan for Yreka phlox (USFWS 2006). In addition to the threats described for each occurrence, the listing of Yreka phlox as an endangered species indicated that inadequate existing regulatory mechanisms posed a threat to the species (65 FR 5268-5275).

China Hill. The China Hill occurrence is located on an open ridge and adjacent slopes approximately 1.6 kilometers (1 mile) northeast of downtown Yreka. An estimated 1,000 to 3,000 plants are scattered over approximately 19 hectares (47 acres). Approximately 74 percent of this occurrence is on parcels owned by the City of Yreka, while the remainder is situated on several privately held parcels currently zoned for residential development (USFWS 2007b). Threats to Yreka phlox at the China Hill site are destruction of plants and habitat due to residential development, competition with exotic plants, off-road vehicle use, garbage dumping, vandalism, and illegal collection. The China Hill occurrence is popular with local gardening groups because of its easy access; however, the number and frequency with which seeds or plants may be illegally collected is unknown. Researchers have noted herbivory of flowers within the China Hill occurrence; however, the degree to which reproduction is affected has not been determined (USFWS 2006).

Soap Creek Ridge. The Soap Creek Ridge occurrence includes at least 14 discrete suboccurrences, and is located adjacent to California State Highway 3, approximately 8 to 10 kilometers (5 to 6 miles) southwest of Yreka. The suboccurrences are located in Nunes Gulch in the Greenhorn Creek watershed, and in Blacks, Red, and Lime gulches in the Yreka Creek watershed. The entire occurrence has been estimated to contain as many as 5,000 to 10,000 plants over a 236-hectare (584-acre) area. At Soap Creek Ridge, Yreka phlox occurs on lands owned and managed by private landowners, industrial timber companies, Caltrans, and USFS. Yreka phlox habitat at the Soap Creek Ridge occurrence has been disturbed in the past by logging, a small chromium mine, fire-suppression activities, domestic animal grazing, and road construction and maintenance. Newly identified threats include herbicide application along road rights-of-way, and competition with exotic and introduced plants (USFWS 2006).

Cracker Gulch. The Cracker Gulch occurrence is located in the Yreka Creek drainage on the south side of State Highway 3. This occurrence is located approximately 0.88 kilometer (0.55 mile) from the closest suboccurrence at Soap Creek Ridge. Land ownership at this occurrence includes a small-ranch/timberland owner and an industrial timber company. The occurrence occupies approximately 5.83 hectares (14.4 acres) and is estimated to contain 500 plants. The primary threat to this occurrence is ground disturbance associated with timber harvesting. Although there is little merchantable timber within the occurrence boundary, larger trees do occur slightly downhill from the phlox plants. However, if properly planned and implemented, timber operations should not adversely affect the plants (USFWS 2006). Researchers have noted herbivory of flowers within the Cracker Gulch occurrence; however, the degree to which reproduction is affected has not been determined (USFWS 2006).

Greenhorn Creek. Plants comprising the Greenhorn Creek occurrence are found on several privately and city-owned parcels on the north and south sides of Greenhorn Creek, west of the Yreka city limits. The privately owned parcels in this area are currently zoned by Siskiyou County as Non-Prime Agricultural District land. Most are currently developed with single-family dwellings and accessory buildings. As is the case at Soap Creek Ridge, Yreka phlox occurs in several discrete suboccurrences at Greenhorn Creek. It is estimated that the total occurrence occupies approximately 8.1 hectares (20 acres) and contains approximately 1,300 to more than 2,000 plants. Threats to Yreka phlox in this occurrence include grading of suitable habitat for new homes, road construction and landscaping associated with the building of new homes, domestic animal grazing and trampling within fenced enclosures, off-road vehicle use, and invasion by competitive nonnative plants (USFWS 2006).

Jackson Street. The Jackson Street occurrence is located on a privately owned parcel near the west-central edge of Yreka, in the Little Humbug Gulch drainage. A professional botanist who visited the site in 1997 or 1998 estimated the occurrence to contain at least 200 to 300 Yreka phlox plants at that time (California Natural Diversity Database [CNDDB] 2005). However, no verified collections have been made from the site. Because access is restricted by the landowner, the current extent of occupied habitat and the condition of the occurrence are unknown. In 2003, several Yreka phlox plants were observed directly adjacent to the public right-of-way at the end of Jackson Street (CNDDB 2005). Little information is known about the threats to the Jackson Street occurrence, except that it occurs within a rural residential area. Future home and driveway construction and residential landscaping would threaten this occurrence, as would invasion by competitive nonnative plants (USFWS 2006).

4.9.2.2 Distribution in the Plan Area

Currently there are no known occurrences of Yreka phlox in the Plan Area. Based on the characteristics of known and reported Yreka phlox occurrences (soils derived from ultramafic parent materials, elevations from roughly 750 to 1,220 meters [2,500 to 4,000 feet], from the vicinity of Yreka to the vicinity of Etna), Yreka phlox could occur in other locations in the Plan Area.

4.9.2.3 Habitat in the Plan Area

Areas with soil derived from ultramafic rock that occur within roughly 13 kilometers (8 miles) of any point along a line drawn from Paradise Craggy southwest through Yreka to Etna are considered to have reasonable potential to support Yreka phlox (moderate likelihood for occurrence) (USFWS 2006). Based on proximity to extant occurrences, the portion of this area with the greatest likelihood of supporting additional occurrences extends from slightly northeast of Yreka through the Mineral Range on the northeastern edge of Scott Valley (high likelihood for occurrence). Figure 4-36 shows the distribution of soils derived from ultramafic parent materials on the FGS ownership within and outside of the area considered to have high or moderate potential to support Yreka phlox. The area with the greatest potential for Yreka phlox to occur (slightly northeast of Yreka, through the Mineral Range on the northeastern edge of Scott Valley) contains approximately 346 acres of FGS lands with soil derived from ultramafic rock. Approximately 541 acres of FGS lands with soils derived from ultramafic rock are located within 8 miles of the line drawn between Paradise Craggy to Etna, and have a moderate potential for Yreka phlox occurrence. Approximately 981 acres of FGS lands with soils derived from ultramafic rock are located outside of the high or moderate occurrence areas.

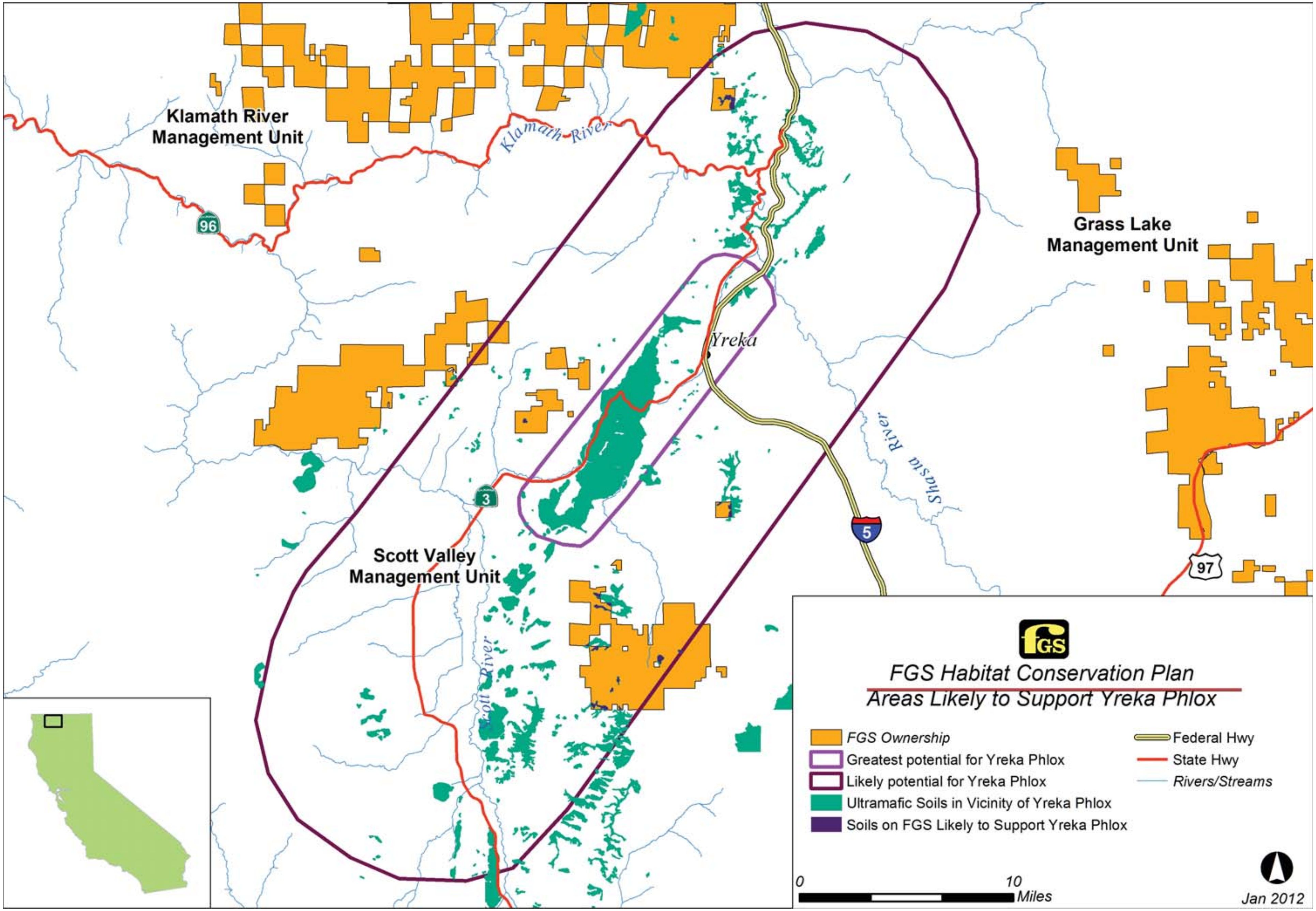

FIGURE 4-36
Areas Likely to Support Yreka Phlox

CHAPTER 5

Conservation Program

This section identifies the HCP's biological goals and objectives, sets forth the conservation program that FGS will undertake in the Plan Area, and provides a detailed explanation of the rationale for the conservation program.

- Section 5.1 presents the conservation approach and an overview of the biological goals and objectives of the aquatic and terrestrial conservation programs.
- Section 5.2 sets forth the conservation measures that FGS will undertake within the Plan Area during the term of the Permits for protection of aquatic species. These measures are referred to as the "Aquatic Species Conservation Program." The section describes: (1) implementation regions; (2) aquatic protection measures ; (3) road management measures including: road maintenance, road assessment process and priority for treatment, field inventories, documentation of fish passage problems, development of prescriptions for erosion prevention and control, prioritization of implementation of treatment prescriptions, and road design and maintenance standards; and (4) slope stability measures including default conservation measures for unstable areas, shallow mass wasting hazard zones, and deep-seated mass wasting hazard zones.
- Section 5.3 sets forth the conservation measures that FGS will undertake within the Plan Area during the term of the Permits for protection of terrestrial species. These measures are referred to as the FGS's Terrestrial Species Conservation Program, and are intended to minimize and mitigate the impacts of incidental take, and maintain and improve habitat conditions for the terrestrial Covered Species. For the northern spotted owl, the measures associated with meeting each objective are described, including demographic support, riparian management, dispersal habitat, take minimization, and threat management. For the Yreka phlox, the measures associated with meeting the objectives of adverse effect avoidance and sustainability are described.

5.1 Biological Goals and Objectives

To meet the statutory criteria for issuance of an ITP, the FGS Terrestrial and Aquatic Species Conservation Programs must, among other things: (1) minimize and mitigate the impacts of authorized incidental take of Covered Species that may result from Covered Activities to the maximum extent practicable, and (2) ensure that any such taking will not appreciably reduce the likelihood of the survival and recovery of such species in the wild. While these statutory criteria themselves are biological in nature, the Services have issued an addendum to the HCP Handbook, known as the "Five Points Policy," calling for an HCP to identify specific biological goals and objectives based on the proposed action that necessitates incidental take permit issuance and the conservation needs of the Covered Species (Final Addendum; 65 FR 35251).

Biological goals can be either habitat-based or species-based. Habitat-based goals are expressed in terms of the amount and/or the quality of habitat. Species-based goals are expressed in terms specific to individuals or specific to populations of that species. Biological objectives are more specific, and some include measurable parameters. Biological objectives are the different components needed to achieve the biological goals. Permittees are not required to achieve the HCP's biological goals and objectives to comply with their permits. Rather than being enforceable terms or conditions, the goals and objectives guide the development of the operating conservation measures.

Whether the HCP is based on prescriptions, results, or both, the permittee's obligation for meeting the biological goals and objectives is proper implementation of the HCP's conservation program. To qualify for No Surprises assurances[1], a permittee is required to implement the conservation program of the HCP; the IA, if used; and the terms and conditions of the permit. Implementation may include provisions for ongoing changes in actions either to achieve results, or due to results from an adaptive management strategy (65 FR 35251).

To minimize and mitigate the impacts of incidental take within the Plan Area as described in this HCP, and to ensure that such take does not jeopardize the Covered Species, FGS intends to undertake management measures that will, during the permit term, protect and, where needed, promote development of the functional habitat conditions that are required to support well-distributed, viable populations of the Covered Species. These measures, set forth in the Aquatic and Terrestrial Conservation Programs in Sections 5.2 and 5.3, are based on the biological goals and objectives described in this section. The biological goals and objectives cover not only the listed Covered Species, but also the unlisted ITP species under NMFS jurisdiction (Chinook salmon and steelhead). According to the Five Points Policy, each ITP species "must be addressed as if it were listed and named on the permit" (65 FR 35251).

5.1.1 Conservation Approach

This plan's biological goals and objectives are primarily habitat-based, augmented by species-specific objectives. The habitat-based components of the HCP focus on maintaining and increasing the value (amount and/or quality) of aquatic and terrestrial habitats used by the Covered Species in the Plan Area, thus enhancing survival and reproduction of the Covered Species. The habitat-based conservation approach of the HCP is augmented by species-specific objectives designed to minimize direct effects to Covered Species from forest management practices, and to minimize threats to the Covered Species. Consistent with the guidance provided by the Services, all HCP effects are evaluated on a species-by-species basis.

As recommended under the Five Points Policy, life history, habitat requirements, occurrence and distribution in the Plan Area, and overall population status of each Covered Species are used to predict the potential effects of implementing the HCP. By considering each species individually within the habitat-based framework, the adequacy of the HCP's measures in meeting the issuance criteria for each Covered Species is demonstrated.

The FGS HCP consists of two general habitat conservation programs (aquatic and terrestrial) and two species-specific strategies (for northern spotted owl and Yreka phlox). Each of these conservation programs and strategies, described in the following sections, were developed based on the potential for and magnitude of the effects the Covered Activities could have on Covered Species using each habitat.

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[1] Under the Section 10(a)(1)(B) process, private landowners are assured that if "unforeseen circumstances" arise, the Services will not require the commitment of additional land, water, or financial compensation or additional restrictions on the use of land, water, or other natural resources beyond the level otherwise agreed to in the HCP without the consent of the Permittee.

5.1.2 Overview of the Aquatic Species Conservation Program

As described in Chapter 4, few of FGS's holdings are adjacent to streams with anadromous fish runs. Within the Plan Area, FGS-owned lands contain about 33 miles of fishbearing (Class I) streams, of which 14 miles (primarily in the Klamath River Management Unit), contain anadromous salmonids. No anadromous salmonids occur on the FGS ownership in the Grass Lake Management Unit. The majority of streams (about 150 miles) on FGS-owned lands are non-fishbearing Class II and III streams. The extent of anadromous salmonid habitat contained in the FGS ownership is a fraction of that which exists in the regional landscape. Within the context of FGS's limited ability to influence the conservation of the aquatic Covered Species in these drainages, FGS will promote hydrologic and forest conditions on its ownership that contribute to a larger regional recovery strategy for these species.

As described in Chapters 3 and 4 of the HCP, the aquatic Covered Species share similar habitat requirements. The aquatic Covered Species in the HCP are all stream-dwelling species exhibiting some level of anadromy. The preferred area of freshwater habitat for these species ranges from the lowest portions of watersheds to the uppermost headwater areas. All have adapted to relatively cool water temperatures, and require streams with complex habitat both in terms of stream morphology and substrate composition. Of the fish species, Chinook salmon spend the least time in freshwater where the spawning and estuarine rearing habitats are the most critical freshwater elements. In comparison, coho salmon and steelhead generally spend up to 2 years or more of their life in freshwater habitat so that spawning, and summer and winter rearing habitats are important. The aquatic biological goals and objectives presented in the subsequent section are applicable to all of the aquatic Covered Species given their similarities in habitat requirements.

5.1.2.1 Biological Goals

To promote and maintain riparian functions, FGS will incorporate protective measures into forest management operations that minimize and mitigate sediment delivery to area streams, and within specified WLPZs, will promote overstory canopy, retain large trees, and minimize and mitigate soil disturbances. Based on the shared habitat requirements of the aquatic Covered Species, the specific biological goals of the aquatic species conservation program are to:

- Protect hydrologic and riparian processes that influence water quality, aquatic habitat, and riparian functions;
- Maintain a high level of stream shading that contributes to cool water temperature regimes that are consistent with the requirements of the individual Covered Species;
- Provide for the recruitment of LWD into streams so as to maintain and allow the development of functional stream habitat conditions;
- Minimize and mitigate human-caused sediment inputs; and
- Monitor to ensure compliance and effectiveness of the aquatic protection measures for providing those habitat conditions needed to meet the general goals that benefit the Covered Species.

5.1.2.2 Biological Objectives

As described below, there are four biological objectives of the Aquatic Species Conservation Program.

Objective 1: Hydrology. The biological objective of the HCP for hydrology is to manage the forestlands in the Plan Area in a manner that minimizes the potential for Covered Activities to alter hydrologic conditions (peak flows, low summer flows).

Objective 2: Riparian Shading. The biological objective of the HCP for riparian shading is to promote growth of stands in the WLPZs toward a more mature state with a high level of overstory canopy coverage and stream shading, thus minimizing the potential for Covered Activities to adversely affect stream temperatures in Class I or Class II streams.

Objective 3: LWD Recruitment. The biological objective for LWD is to increase the potential for recruitment of in-channel LWD on the FGS ownership through retention of trees and snags with the greatest likelihood to contribute to in-channel LWD.

Objective 4: Sediment Control. The biological objective for sediment is to minimize and mitigate soil delivery to area watercourses. This objective will be accomplished through the following.

1. Avoidance, minimization, and mitigation of sediment production and delivery to stream channels from WLPZs due to Covered Activities.
2. Control of road-related sediment production and delivery to stream channels through a systematic improvement of the existing transportation system and related infrastructure with an objective of reducing the road-related erosion delivery potential by 50 percent in the first 10 years of the Permits.
3. Avoidance, minimization, and mitigation of accelerated sediment production and delivery to stream channels from mass wasting due to Covered Activities.
4. Avoidance, minimization, and mitigation of sediment production and delivery to stream channels from stream crossings due to Covered Activities.

5.1.3 Overview of the Terrestrial Species Conservation Program

Chapter 4 describes the local and regional northern spotted owl 2005 baseline condition in terms of species population and amount of nesting/roosting and foraging habitat. The terms "Area of Analysis" and "Area of Impact" are introduced in Chapter 4 to discretely delineate these regional and local boundaries. In the California Klamath Province, approximately 27 percent of the regional land area in the Area of Analysis is considered suitable northern spotted owl habitat, of which 7 percent is located on the FGS ownership. The regional owl population in the California Klamath Area of Analysis is estimated (using DFG records and the predicted probability of occupancy model [Zabel et al. 2003]) at 186 activity centers, of which 74 valid activity centers are within the Area of Impact. For the California Cascades Province, approximately 15 percent of the regional land area is considered suitable northern spotted owl habitat, 3 percent of which is located on the FGS ownership. The regional owl population in the California Cascades Area of Analysis, according to DFG records is 54 activity centers, of which eight valid activity centers are within the Area of Impact.

As described in Chapter 4, the Yreka phlox is not known to occur on the FGS ownership, but could occur in the Scott Valley Management Unit based on soil type. Figure 4-36 in Chapter 4 depicts the areas with highest potential for Yreka phlox occurrence on the FGS ownership. Approximately 887 acres on the FGS ownership have a high to moderate potential to support Yreka phlox.

5.1.3.1 Biological Goals

The overall biological goal for northern spotted owl is to contribute to the sustainable maintenance of the local and regional populations of owls through both species and habitat objectives. The overall biological goal for Yreka phlox is to contribute to the sustainable maintenance of the local and regional populations of phlox through both species and habitat objectives.

5.1.3.2 Biological Objectives

As described below, five specific objectives were developed to meet the biological goal for the northern spotted owl. Two objectives were developed to meet the biological goal for Yreka phlox.

Northern Spotted Owl Objectives

Objective 1: Demographic Support. Consistent with USFWS expectations for private lands as stated in the Revised Recovery Plan for the Northern Spotted Owl (USFWS 2011), a biological objective of the HCP is to contribute to conservation and recovery of the northern spotted owl by providing demographic support to owl populations on nearby federal lands. This objective will be accomplished through conservation of suitable habitat within 1.3 miles of selected high conservation value activity centers located near FGS's ownership, thus providing compensatory mitigation for incidental take of owls associated with other low conservation value activity centers that may occur over the term of the HCP.

Conservation Support Areas (CSAs) will be established on FGS's ownership within the 0.5-mile radius core around high conservation value activity centers, coinciding with the area of highest likelihood of owl use. Selected nesting/roosting and foraging habitat in these areas will be maintained, and strategic locations with the potential to grow into suitable habitat will be managed to promote use by northern spotted owls in the future. FGS will provide reasonable extensions of the CSAs into the 1.3-mile-radius home range around selected activity centers to maintain connectivity with nesting/roosting habitat, and to provide foraging opportunities for owls. Extensions into the 1.3-mile radius home range will be focused primarily along riparian zones, which generally provide greater prey abundance and diversity due to increased understory vegetation and moisture.

Objective 2: Riparian Management. The biological objective of the HCP for riparian management is to provide foraging and dispersal opportunities for the northern spotted owl across the landscape by establishing WLPZs that promote growth in stands toward a more mature state with a high level of overstory canopy coverage and legacy structures, such as old large trees, snags, and downed wood.

Objective 3: Dispersal Habitat. The biological objective of the HCP for dispersal habitat is to contribute to a general trend of increased quality and quantity of northern spotted owl dispersal habitat across the ownership over the term of the Permits.

Objective 4: Incidental Take Minimization. The biological objective of the HCP for take minimization is to avoid direct take of northern spotted owls resulting from authorized timber harvesting operations. This objective will be accomplished through a combination of: (1) seasonal timing restrictions; (2) pre-harvest surveys; and (3) on-site monitoring by a qualified biologist.

Objective 5: Threat Management. The biological objective of the HCP is to manage, to the maximum extent practicable, known threats to the northern spotted owl. Significant threats to the northern spotted owl within the Plan Area include the barred owl and catastrophic wildfire. This objective will be accomplished through actions that: (1) control barred owls through management actions within the Plan Area; and (2) reduce the potential for catastrophic wildfire on the FGS ownership that could diminish the quality and amount of owl nesting/roosting, foraging, and dispersal habitat both on and off the FGS ownership.

Yreka Phlox Objectives

Objective 1: Avoidance of Adverse Effects. The biological objective of the HCP is to avoid direct or indirect adverse effects to, or destruction of known or discovered populations of, Yreka phlox resulting from timber harvesting operations. This objective will be accomplished through a combination of: (1) botanical surveys on FGS lands with soils derived from ultramafic parent material that are within the area of high to moderate likelihood of occurrence of Yreka phlox (see Figure 4-36 in Chapter 4) to identify undiscovered populations; (2) establishment of equipment exclusion zones (EEZs) around known and discovered populations; and (3) pre-activity surveys prior to Covered Activities that could adversely affect Yreka phlox as required by the State of California during THP review.

Objective 2: Sustainability. The biological objective of the HCP is to contribute to conservation and recovery of the Yreka phlox. This objective will be accomplished by development and implementation of a monitoring program for known and discovered populations of Yreka phlox on FGS lands that will provide information on species status, distribution, and threats to the populations in the Plan Area.

5.2 Aquatic Species Conservation Program

Based upon the stated biological goals and objectives, FGS has developed a comprehensive conservation program with a number of specific conservation measures to provide protection for the aquatic Covered Species. These measures are termed the "Aquatic Species Conservation Program," which will be incorporated by reference in the IA.

5.2.1 Implementation Regions

For the purposes of implementation, the Plan Area has been divided at the drainage level into three "Implementation Classes" based primarily on the range and distribution of anadromous salmonid populations and the proximity of FGS lands to known or potential habitat for coho salmon: Class A, B, and C lands. These "Implementation Classes" were developed in coordination with NMFS and DFG and indicate where various classes of conservation measures will be implemented under this HCP; they are not intended to describe the current, historic, or potential distribution of coho salmon within the regional landscape. Table 5-1 identifies drainages in each Implementation Class.

TABLE 5-1
Drainages Included in Each Implementation Class

Implementation Class	Drainage Name	FGS Ownership (acres)
A	Beaver	16,936
A	Big Ferry	1,281
A	Canyon	1,973
A	Cottonwood	16,537
A	Doggett	3,992
A	Dona	2,518
A	Dutch Creek	2,987
A	Empire Creek	2,677
A	Horse	9,695
A	Indian	3,952
A	Lumgrey Creek	2,519
A	Meamber	5,059
A	Middle Klamath	1,434
A	Mill	1,437
A	Moffett	3,503
A	Pat Ford	2,172
A	Patterson	2,103
A	Rattlesnake	1,068
A	Seiad	1,445
B	Bogus Creek	1,982
B	Duzel	11
B	EF Scott	186
B	McConaughy	124
B	Moffett	14,941
B	Shasta Valley	545
B	Willow Creek	979
C	Antelope Creek	362
C	Antelope Sink	1,558
C	Elliott Creek	4,490
C	Fourmile Hill	749
C	Garner Mtn	1,399
C	Glass Mtn	1,985
C	Grass Lake	12,127
C	Headwaters	4,748
C	Horsethief	6,648
C	Juanita Lake	2,048
C	Little Shasta	6,159
C	NW Mt Shasta	3,344
C	Shasta Valley	0
C	Shasta Woods	4,506

Class A lands (83,288 acres) include all fee-owned land, or lands in which FGS has timber rights within its Klamath River and Scott Valley Management Units that are located west of Interstate 5 and north of State Highway 3. These lands are located in drainages that currently support coho salmon or, based on the best available information, historically supported coho salmon. Class A designated lands include those portions of the Plan Area where Covered Activities can substantially influence habitat conditions for coho salmon based on the location of the FGS ownership relative to the distribution of coho salmon. Class A lands generally include stream reaches that are directly tributary to the Klamath or Scott rivers that support (or historically supported coho salmon or that are directly upstream of these coho salmon reaches.

Class A lands also include the FGS ownership in the Cottonwood drainage (32,023 acres) which currently does not support coho salmon. This drainage, at present, is blocked to anadromy as a result of agricultural diversions just up stream from its confluence with the Klamath river near the town of Hornbrook and does not currently fall under the “Protection Measures in Watersheds with Coho Salmon” [14 CCR 936.9.1] or the “Measures to Facilitate Incidental Take Authorization in Watersheds with Coho Salmon” [14 CCR 936.9.2] developed to satisfy the requirements of Section 2112 of the California Fish and Game Code. Cottonwood Creek, however, is an important tributary to the Klamath in this region and was known historically to support anadromous salmonids upstream into the Hilt basin where FGS has its ownership. Because of the historical importance of Cottonwood Creek as a tributary to the Klamath and its potential to contribute to the recovery of coho salmon, FGS lands in the Cottonwood drainage are included in the Class A designated lands.

Class B lands (18,767acres) include all fee-owned lands, or lands in which FGS has timber rights in the Bogus Creek and Willow Creek drainages, and that portion of the Moffett Creek drainage that lies south of State Highway 3. These lands are located in drainages that are within the range of anadromy, but currently do not support coho salmon and have no real potential to do so in the future. Class B designated lands are limited and are isolated parcels of the FGS ownership where the potential for Covered Activities to influence habitat conditions for coho salmon is extremely limited and where the potential to contribute to the recovery of coho salmon is likewise limited. The FGS ownership in the Moffett Creek drainage (15,760 acres) occurs in the headwaters of Moffett Creek, approximately 16.5 miles from its confluence with the Scott River below the town of Fort Jones. The majority of the Moffett Creek drainage is managed for agriculture and Moffett Creek, starting just below FGS ownership, was channelized by the U.S. Army Corps of Engineers in the 1950s and diverted for irrigation. For much of this section, the riparian area along Moffett Creek consists of alfalfa or grain fields and irrigated pasture that extends to the stream margin. For most of the year (8 or 9 months) the lower reaches of Moffett Creek (below State Route 3 in the Scott Valley) remain dewatered. Flowing water is present only during the wettest months (December through February) in most years. Current coho salmon distribution is only to the mouth of Moffett creek on the Scott River. Coho salmon above Moffett Creek are considered extirpated. Given the distance upstream from known coho habitat in the Scott River (16.5 miles) and prevailing land use and rainfall and runoff patterns, it is highly unlikely that coho salmon could be restored to reaches in the Plan Area.

The other portion of the FGS ownership designated as Class B land is the Kuck property (2,948 acres) in the headwaters of Bogus Creek, the first major tributary below Iron Gate dam on the Klamath River. Like the FGS ownership in the Moffett Creek drainage, this property is far removed from the nearest coho habitat (4.5 miles) and like Moffett Creek, Covered Activities have little potential to influence existing habitat downstream. Unlike Moffett Creek, Bogus Creek does not dry up and water flows year around. However, FGS lands in the drainage constitute less than 6 percent of the total drainage area. There is a natural barrier one mile downstream of the FGS ownership that limits the distribution of anadromous salmonids to areas downstream of the barrier. Because the FGS ownership occurs upstream of the barrier and the reaches on FGS are high energy mountain channels, there is no habitat for coho salmon on the ownership and these reaches will not contribute to the recovery of coho salmon. Both Moffett Creek and Bogus Creek contribute cold clear water to the watersheds they occur in and Covered Activities do not currently have a negative impact on downstream water temperatures.

Class C lands (50,123 acres) include all fee-owned lands, or lands in which FGS has timber rights located in the Elliott Creek drainage and those in drainages east of Interstate 5 (Grass Lake Management Unit), except in the Bogus Creek and Willow Creek drainages (described above as Class B lands). These lands are located above long-standing barriers to anadromous fish or have no direct connection to streams supporting anadromous salmonids. Consequently, there is virtually no potential for Covered Activities to influence habitat conditions for coho salmon and no opportunity for the FGS ownership to contribute to the recovery of coho salmon. That portion of the FGS ownership in the Elliot Creek drainage (4,484 acres) is in the Rogue river basin but is located upstream of the Applegate Dam, a long-standing barrier to anadromous fish. The Grass Lake Management Unit (47,685 acres) is located on a high volcanic plateau east of the Shasta valley and north of Mount Shasta. It is an arid, dry, east side Ponderosa pine/White fir forest with few streams, none of which support anadromous salmonids. Even though this Management Unit is in the Klamath River basin all streams flow into dry sinks and are not connected to the Klamath River.

5.2.2 Aquatic Protection Measures

The aquatic protection measures described in this section meet the combined objectives of the Aquatic Species Conservation Program related to hydrology, riparian shading, large woody debris recruitment, and sediment control. Sections 5.2.3 and 5.2.4 describe additional sediment control measures related to road management and slope stability on the FGS ownership.

On Class C lands, current (2008) CFPRs will be applied. The standard aquatic protection measures on Class A and Class B lands under this HCP include the Protection Measures in Watersheds with Coho Salmon [14 CCR 936.9.1] specified in Appendix I of the 2008 CFPRs. Within Class A lands, the newly adopted Measures to Facilitate Incidental Take Authorization in Watersheds with Coho Salmon, [14 CCR 936.9.2] also described in Appendix I of the 2008 CFPRs, will apply in addition to the rules under 14 CCR 936.9.1.

Aquatic protection measures developed by the DFG and amended to the CFPRs (as Appendix I of the 2008 CFPRs) are incorporated into the Aquatic Species Conservation Program. To expedite compliance and enforcement of the FGS HCP with the CFPRs, NMFS requested that the 2008 CFPR rule numbers and tracked edits to the rules language be maintained as presented in the 2008 CFPR. Therefore, the following text on aquatic conservation measures includes the original text presented in Appendix I of the 2008 CFPRs, delineated using a different font style, and with HCP–specific edits marked as deleted

(~~strikethrough~~) and added (underlined). Text that was superseded by language in this HCP, dealt with policies or procedures, or was otherwise not applicable to this HCP was omitted from the text below, resulting in the organization of some sections appearing incomplete. See the 2008 CFPRs (CAL FIRE 2008) for the complete text.

[14 CCR § 895.1] Definitions

~~**Watersheds with Coho Salmon** means any planning watershed(s) where coho salmon (Oncorhynchus kisutch) have been documented by the Department of Fish and Game to be present during or after 1990.~~

In Class A and Class B Lands ~~Watersheds with Coho Salmon~~, the following definitions apply:

Connected Headwall Swale means a geomorphic feature consisting of a concave depression, with convergent slopes typically of 65 percent or greater, that is connected to a watercourse or lake by way of a continuous linear depression. A linear depression interrupted by a landslide deposit is considered to be continuous.

Hydrologic Disconnection means the removal of direct routes of drainage or overland flow of road runoff to a watercourse or lake by directing drainage or overland flow onto stable portions of the forest floor to dissipate energy, facilitate percolation, and resist or prevent erosion or channelization.

Inside Ditch Hydraulic Capacity means the ability of an inboard ditch to contain flow from a runoff event without overflowing to the road surface or substantially downcutting the inboard ditch.

Road Decommissioning means the temporary or permanent abandonment of a road prism and associated landings resulting in maintenance-free drainage and erosion control. This includes removal or stabilization of drainage structures and fills, as well as unstable road and landing fills, hydrologic disconnection of the road prism, stabilization of exposed excavated areas or material, and application of measures to prevent and control erosion.

Road Maintenance means activities used to maintain and repair roads involving minor manipulation of the road prism to produce a stable operating surface and to ensure road drainage facilities, structures, cutbanks and fillslopes are kept in a condition to protect the road, minimize erosion, and to prevent sediment discharge into a watercourse or lake. Examples of road maintenance include shaping and/or rocking a road surface; installation and maintenance of rolling and critical dips; restoring functional capacity of inboard ditches, cross drains, or culverts; and repairing water bars.

Road Prism means all parts of a road including cut banks, ditches, road surfaces, road shoulders, and road fills.

Scour means the process of erosion by flowing water.

Sediment Filter Strip means a structure or vegetation that substantially prevents concentration, transport, and delivery of sediment to a watercourse or lake by reducing velocity and filtering water through features such as gradual slopes treated with vegetation, gentle slopes, woody debris and mulch or settling basins.

Stable Operating Surface means a road or landing surface that can support vehicular traffic and that routes water off of the road surface or into drainage facilities without concentrating flow in ruts (tire tracks), pumping of the road bed, or ponding flow in depressions. A stable operating surface shall include a structurally sound road base appropriate for the intended use. The number, placement, and design of drainage facilities or drainage structures on a stable operating surface prevents the transport of fine-grained materials from the road or landing surface into watercourses in quantities deleterious to the beneficial uses of water.

Watercourse Sideslope means the hillslope immediately adjacent to a watercourse or lake measured from the watercourse or lake transition line to a point 100 feet upslope.

Watercourse Sideslope Class means the steepness of the watercourse sideslope categorized into one of three classes: <30 percent, 30 percent – 50 percent, >50 percent). Where watercourse sideslope configurations are variable, a weighted average of the percent slope shall be used to determine the watercourse sideslope class. The weighted average shall be calculated based on distances of 200 feet or less along the watercourse.

[14 CCR § ~~916.9.1 and~~ 936.9.1] Protection Measures in ~~Watersheds with Coho Salmon~~ Class A and Class B Designated Lands

In addition to all other district Forest Practice Rules, the following requirements shall apply in any planning watershed within Class A and Class B designated lands. ~~with~~ ~~coho salmon~~:

(a) GOAL – Every timber operation shall be planned and conducted to prevent deleterious interference with the watershed conditions that primarily limit the values set forth in 14 CCR ~~916.2 [~~936.2~~]~~(a) (e.g., sediment load increase where sediment is a primary limiting factor; thermal load increase where water temperature is a primary limiting factor; loss of instream large woody debris or recruitment potential where lack of this value is a primary limiting factor; substantial increase in peak flows or large flood frequency where peak flows or large flood frequency are primary limiting factors). To achieve this goal, every timber operation shall be planned and conducted to meet the following objectives where they affect a primary limiting factor:

(1) Comply with the terms of a Total Maximum Daily Load (TMDL) that has been adopted to address factors that may be affected by timber operations if a TMDL has been adopted, or not result in any measurable sediment load increase to a watercourse system or lake.

(2) Not result in any measurable decrease in the stability of a watercourse channel or of a watercourse or lake bank.

(3) Not result in any measurable blockage of any aquatic migratory routes for coho salmon or listed species.

(4) Not result in any measurable stream flow reductions during critical low water periods except as part of an approved water drafting plan pursuant to 14 CCR 916.9.1(r) [936.9.1(r)].

(5) Consistent with the requirements of 14 CCR § 916.9.1(i) or 14 CCR § 936.9.1(i); protect, maintain, and restore trees (especially conifers), snags, or downed large woody debris that currently, or may in the foreseeable future, provide large woody debris recruitment needed for instream habitat structure and fluvial geomorphic functions.

(6) Consistent with the requirements of 14 CCR § 916.9.1(g) or 14 CCR § 936.9.1(g); protect, maintain, and restore the quality and quantity of vegetative canopy needed to: (A) provide shade to the watercourse or lake, (B) minimize daily and seasonal temperature fluctuations, (C) maintain daily and seasonal water temperatures within the preferred range for coho salmon or listed species where they are present or could be restored, and (D) provide hiding cover and a food base where needed.

(7) Result in no substantial increases in peak flows or large flood frequency.

(b) Pre-plan a Adverse cumulative watershed effects on the populations and habitat of coho salmon shall be considered. THPs The plan shall specifically acknowledge or refute that such effects exist. Where appropriate, the plan THP shall set forth measures to effectively reduce such effects.

(c) Any timber operation or silvicultural prescription within 150 feet of any Class I watercourse or lake transition line or 100 feet of any Class II watercourse or lake transition line shall have protection, maintenance, or restoration of the beneficial uses of water or the populations and habitat of coho salmon or listed aquatic or riparian-associated species as significant objectives. Additionally, for evenaged regeneration methods and rehabilitation with the same effects as a clearcut that are adjacent to a WLPZ, a special operating zone shall retain understory and mid-canopy conifers and hardwoods. These trees shall be protected during falling, yarding and site preparation to the extent feasible. If trees that are retained within this zone are knocked down during operations, that portion of the trees that is greater than 6" in diameter shall remain within the zone as Large Woody Debris. The zone shall be 25 feet above Class I WLPZs with slopes 0-30% and 50 feet above Class I WLPZs with slopes > 30%.

(d) **(1)** ~~The plan~~ THPs shall fully describe: (A) the type and location of each measure needed to fully offset sediment loading, thermal loading, and potential significant adverse watershed effects from the proposed timber operations, and (B) the person(s) responsible for the implementation of each measure, if other than the timber operator.

(2) In proposing, reviewing, and approving such measures, preference shall be given to the following: (A) measures that are both onsite (i.e., on or near the ~~plan~~ THP area) and in-kind (i.e., erosion control measures where sediment is the problem), and (B) sites that are located to maximize the benefits to the impacted portion of a watercourse or lake. Out-of-kind measures (i.e., improving shade where sediment is the problem) shall not be approved as meeting the requirements of this subsection.

(e) Channel zone requirements

(1) There shall be no timber operations within the channel zone with the following exceptions:

(A) timber harvesting that is directed to improve coho habitat through the limited use of the selection or commercial thinning silvicultural methods with review and comment by DFG.

(B) timber harvesting necessary for the construction or reconstruction of approved watercourse crossings.

(C) timber harvesting necessary for the protection of public health and safety.

(D) to allow for full suspension cable yarding when necessary to transport logs through the channel zone.

(E) Class III watercourses where exclusion of timber operations is not needed for protection of coho salmon.

(2) In all instances where trees are proposed to be felled within the channel zone, a base mark shall be placed below the cut line of the harvest trees within the zone. Such marking shall be completed by the RPF that prepared the ~~plan~~THP prior to the preharvest inspection.

(f) The minimum WLPZ width for Class I waters shall be 150 feet from the watercourse or lake transition line.

(g) Within a WLPZ for Class I waters, at least 85 percent overstory canopy shall be retained within 75 feet of the watercourse or lake transition line, and at least 65 percent overstory canopy within the remainder of the WLPZ. The overstory canopy must be composed of at least 25% overstory conifer canopy post-harvest. Harvesting of hardwoods shall only occur for the purpose of enabling conifer regeneration.

(h) For Class I waters, any plan involving timber operations within the WLPZ shall contain the following information:

> **(1)** A clear and enforceable specification of how any disturbance or log or tree cutting and removal within the Class I WLPZ shall be carried out to conform with 14 CCR ~~916.2 [~~936.2~~]~~(a) and ~~916.9.1 [~~936.9.1~~]~~(a).
>
> **(2)** A description of all existing permanent crossings of Class I waters by logging roads and clear specification regarding how these crossings are to be modified, used, and treated to minimize risks, giving special attention to allowing fish to pass both upstream and downstream during all life stages.
>
> **(3)** Clear and enforceable specifications for construction and operation of any new crossing of Class I waters to prevent direct harm, habitat degradation, water velocity increase, hindrance of fish passage, or other potential impairment of beneficial uses of water.

(i) Recruitment of large woody debris for aquatic habitat in Class I ~~coho salmon-bearing~~ waters shall be ensured by retaining the ten largest dbh conifers (live or dead) per 330 feet of stream channel length that are the most conducive to recruitment to provide for the beneficial functions of riparian zones. The retained conifers shall be selected from within the THP area that lies within 50 feet of the watercourse transition line. Where the THP boundary is an ownership boundary, a class I watercourse, and the WLPZ on both sides of the watercourse currently meets the stocking standards listed under 14 CCR § ~~912.7 [~~932.7~~, 952.7]~~(b)(2)}; the five (5) largest dbh conifers (live or dead) per 330 feet of stream channel length that are the most conducive to recruitment to provide for the beneficial functions of riparian zones within the THP area shall be retained within 50 feet of the watercourse transition line.

The RPF may propose alternatives to substitute smaller diameter trees, trees that are more than 50 feet from the watercourse transition line, or other alternatives on a site specific basis. The RPF must explain and justify in the THP why the proposed alternative is more conducive to current and long-term Large Woody Debris recruitment, shading, bank stability, and the beneficial functions of riparian zones.

(j) Where an inner gorge extends beyond a Class I WLPZ and slopes are greater than 55%, a special management zone shall be established where the use of evenaged regeneration methods is prohibited, and a minimum average overstory canopy of 60% shall be retained. This zone shall extend upslope to the first major break-in-slope to less than 55% for a distance of 100 feet or more, or 300 feet as measured from the watercourse or lake transition line, which ever is less. All operations on slopes exceeding 65% within an inner gorge of a Class I or II watercourse shall be reviewed by a Professional Geologist prior to ~~plan~~ THP approval, regardless of whether they are proposed within a WLPZ or outside of a WLPZ to ensure that proposed activities do not present a greater risk of sediment delivery from mass wasting.

(k) From October 15 to May 1, the following shall apply: (1) no timber operations shall take place unless the approved plan incorporates a complete winter period operating plan pursuant to 14 CCR § ~~914.7(a) [~~934.7(a)~~]~~, (2) unless the winter period operating plan proposes operations during an extended period with low antecedent soil wetness, no tractor roads shall be constructed, reconstructed, or used on slopes that are over 40 percent and within 200 feet of a Class I, II, or III watercourse, as measured from the watercourse or lake transition line, and (3) operation of trucks and heavy equipment on roads and landings shall be limited to those with a stable operating surface.

(l) Construction or reconstruction of logging roads, tractor roads, or landings shall not take place during the winter period unless the approved plan incorporates a complete winter period operating plan pursuant to 14 § CCR ~~914.7(a) [~~934.7(a),~~954.7(a)]~~ that specifically address such road construction. Use of logging roads, tractor roads, or landings shall not take place at any location where saturated soil conditions exist, where a stable logging road or landing operating surface does not exist, or when visibly turbid water from the road, landing, or skid trail surface or inside ditch may reach a watercourse or lake. Grading to obtain a drier running surface more than one time before reincorporation of any resulting berms back into the road surface is prohibited.

(m) All tractor roads shall have drainage and/or drainage collection and storage facilities installed as soon as practical following yarding and prior to either (1) the start of any rain which causes overland flow across or along the disturbed surface within a WLPZ or within any ELZ or EEZ designated for watercourse or lake protection, or (2) any day with a National Weather Service forecast of a chance of rain of 30 percent or more, a flash flood warning, or a flash flood watch.

(n) Within the WLPZ, and within any ELZ or EEZ designated for watercourse or lake protection, treatments to stabilize soils, minimize soil erosion, and prevent the discharge of sediment into waters in amounts deleterious to aquatic species or the quality and beneficial uses of water, or that threaten to violate applicable water quality requirements, shall be applied in accordance with the following standards:

(1) The following requirements shall apply to all such treatments.

(A) They shall be described in the ~~plan~~ THP.

(B) For areas disturbed from May 1 through October 15, treatment shall be completed prior to the start of any rain that causes overland flow across or along the disturbed surface.

(C) For areas disturbed from October 16 through April 30, treatment shall be completed prior to any day for which a chance of rain of 30 percent or greater is forecast by the National Weather Service or within 10 days, whichever is earlier.

(2) The traveled surface of logging roads shall be treated to prevent waterborne transport of sediment and concentration of runoff that results from timber operations.

(3) The treatment for other disturbed areas, including: (A) areas exceeding 100 contiguous square feet where timber operations have exposed bare soil, (B) approaches to tractor road watercourse crossings between the drainage facilities closest to the crossing, (C) road cut banks and fills, and (D) any other area of disturbed soil that threatens to discharge sediment into waters in amounts deleterious to the quality and beneficial uses of water, may include, but need not be limited to, mulching, rip-rapping, grass seeding, or chemical soil stabilizers. Where straw, mulch, or slash is used, the minimum coverage shall be 90%, and any treated area that has been subject to reuse or has less than 90% surface cover shall be treated again prior to the end of timber operations. The RPF may propose alternative treatments that will achieve the same level of erosion control and sediment discharge prevention.

(4) Where the undisturbed natural ground cover cannot effectively protect beneficial uses of water from timber operations, the ground shall be treated by measures including, but not limited to, seeding, mulching, or replanting, in order to retain and improve its natural ability to filter sediment, minimize soil erosion, and stabilize banks of watercourses and lakes.

(o) As part of the ~~plan~~ THP, the RPF shall identify active erosion sites in the logging area, assess them to determine which sites pose significant risks to the beneficial uses of water, assess them to determine whether feasible remedies exist, and address in the plan THP feasible remediation for all sites that pose significant risk to the beneficial uses of water.

(p) The erosion control maintenance period on permanent and seasonal roads and associated landings that are not abandoned in accordance with 14 CCR § ~~923.8 [~~943.8~~]~~ shall be three years.

(q) Site preparation activities shall be designed to prevent soil disturbance within, and minimize soil movement into, the channels of watercourses. Prior to any broadcast burning, burning prescriptions shall be designed to prevent loss of large woody debris in watercourses, and vegetation and duff within a WLPZ, or within any ELZ or EEZ designated for watercourse or lake protection. No ignition is to occur within any WLPZ, or within any ELZ or EEZ designated for watercourse or lake protection. When burning prescriptions are proposed, the measures or burning restrictions which are intended to accomplish this goal shall be stated in the ~~plan~~ THP and included in any required burning permit. This information shall be provided in addition to the information required under 14 CCR § ~~915.4 [~~935.4~~]~~.

(r) Water drafting ~~for timber operations~~ from within a channel zone of a natural watercourse or from a lake shall conform with NMFS water drafting guidelines. Water drafting for a THP shall comply with the following standards:

(1) The RPF shall incorporate into the THP:

(A) a description and map of proposed water drafting locations,

(B) the watercourse or lake classification, and

(C) the general drafting location use parameters (i.e., yearly timing, estimated total volume needed, estimated total uptake rate and filling time, and associated water drafting activities from other THPs).

(2) On Class I and Class II streams where ~~the RPF~~ FGS has estimated that:

(A) bypass flows are less than 2 cubic feet per second, or

(B) pool volume at the water drafting site would be reduced by 10%, or

(C) diversion rate exceeds 350 gallons per minute, or

(D) diversion rate exceeds 10% of the above surface flow;

No water drafting shall occur unless ~~the RPF~~ FGS prepares a water drafting plan to be reviewed and, if necessary a stream bed alteration agreement issued, by DFG and approved by the Director of CAL FIRE. The Director of CAL FIRE may accept the project description and conditions portion of an approved “Streambed Alteration Agreement” issued under the Fish and Game Code (F&GC 1600 et seq.) which is submitted instead of the water drafting plan described in 14 CCR § ~~916.9.1 [~~936.9.1~~]~~ (r)(2)(D)(1-5).

The water drafting plan shall include, but not be limited to:

1. disclosure of estimated percent streamflow reduction and duration of reduction,

2. discussion of the effects of single pumping operations, or multiple pumping operations at the same location,

3. proposed alternatives and discussion to prevent adverse effects (e.g. reduction in hose diameter, reduction in total intake at one location, described allowances for recharge time, and alternative water drafting locations),

4. conditions for operators to include an operations log kept on the water truck containing the following information: Date, Time, Pump Rate, Filling Time, Screen Cleaned, Screen Conditions, and Bypass flow observations,

5. a statement by the RPF for a pre-operations field review with the operator to discuss the conditions in the water drafting plan.

(3) Intakes shall be screened in Class I and Class II waters. Screens shall be designed to prevent the entrainment or impingement of all life stages of fish or amphibians. Screen specifications shall be included in the ~~plan~~ THP.

(4) Approaches to drafting locations within a WLPZ shall be surfaced with rock or other suitable material to avoid generation of sediment.

(s) No timber operations are allowed in a WLPZ, or within any ELZ or EEZ designated for watercourse or lake protection, under exemption notices except for:

(1) hauling on existing roads,

(2) road maintenance,

(3) operations conducted for public safety,

(4) construction or reconstruction of approved watercourse crossings,

(5) temporary crossings of dry Class III watercourses which do not require a “Streambed Alteration Agreement” under the Fish and Game Code, or

(6) harvesting recommended in writing by DFG or NMFS to address specifically identified forest conditions. Recommendations shall be predicated on the finding that harvest activities provide equal or greater protection for coho salmon and achieve the goal of this section.

(t) No timber operations are allowed in a WLPZ, or within any ELZ or EEZ designated for watercourse or lake protection, under emergency notices except for:

(1) hauling on existing roads,

(2) road maintenance,

(3) operations conducted for public safety,

(4) construction or reconstruction of approved watercourse crossings,

(5) temporary crossings of dry Class III watercourses which do not require a “Streambed Alteration Agreement” under the Fish and Game Code,

(6) harvesting recommended in writing by DFG or NMFS to address specifically identified forest conditions~~,~~. Recommendations shall be predicated on the finding that harvest activities provide equal or greater protection for coho salmon and achieve the goal of this section,

(7) the harvest of dead or dying conifer trees subject to the following conditions:

(A) Recruitment of large woody debris for aquatic habitat in Class I ~~coho salmon-bearing~~ waters shall be ensured by retaining the ten largest dbh conifers (live or dead) per 330 feet of stream channel length that are the most conducive to recruitment to provide for the beneficial functions of riparian zones. The retained conifers shall be selected from within the area of operations that lies within 50 feet of the watercourse transition line. Where the area of operations is bounded by an ownership boundary that corresponds with a class I watercourse, and where the WLPZ on both sides of the watercourse currently meets the stocking standards listed under 14 CCR § ~~912.7 [~~932.7~~]~~(b)(2), the five (5) largest dbh conifers (live or dead) per 330 feet of stream channel length that are the most conducive to recruitment to provide for the beneficial functions of riparian zones shall be retained within 50 feet of the watercourse transition line within the area of operations.

The RPF may provide alternatives to substitute smaller diameter trees, trees that are more than 50 feet from the watercourse transition line, or other alternatives on a site specific basis. The RPF must provide with the notice an explanation and justification why the alternative provided is more conducive to current and long-term Large Woody Debris recruitment, shading, bank stability, and the beneficial functions of riparian zones.

(B) Within any WLPZ, ELZ, or EEZ designated for Class II or III watercourse protection, a minimum of two dead, dying, or diseased conifer trees per acre at least 16 inches diameter breast high and 50 feet tall shall be retained within 50 feet of the watercourse transition line.

(C) Trees to be harvested or retained shall be marked by, or under the supervision of, an RPF prior to timber operations within the WLPZ or ELZ/EEZ.

(D) Within the WLPZ or ELZ/EEZ, if the stocking standards of 14 CCR § ~~912 [~~932~~]~~.7 are not met upon completion of timber operations, unless the area meets the definition of substantially damaged timberlands, at least ten trees shall be planted for each tree harvested but need not exceed an average point count of 300 trees per acre.

(u) No salvage logging is allowed in a WLPZ without ~~an approved HCP, a PTEIR, an SYP, or~~ an approved plan that contains a section that sets forth objectives, goals, and measurable results for streamside salvage operations.

(1) This section does not apply to emergency operations under 14 CCR § 1052.

(v) Nonstandard practices (i.e., waivers, exceptions, in-lieu practices, and alternative practices) shall comply with the goal set forth in subsection (a) above as well as with the other requirements set forth in the rules.

(w) The Director of CAL FIRE may approve alternatives that provide equal or better protection for coho salmon and achieve the goal of this section.

(1) Any alternative proposed under this subsection for timber operations in a watershed with coho salmon shall only be included in a plan: i) after consultation and written concurrence from DFG prior to plan submittal, and ii) with a clear demonstration of compliance with the issuance criteria described under Fish and Game Code § 2081(b) as determined by DFG.

(2) The Director of CAL FIRE shall not accept for inclusion in a plan any alternative practice as described in this section where two or more agencies listed in 4582.6 of the PRC and 14 CCR § 1037.3 have submitted written comments which lead to the Director of CAL FIRE's conclusion that the proposed alternative will not meet the goal of this section and the agency(ies) participated in the review of the ~~plan~~ THP, including an on-the-ground inspection.

[14 CCR § ~~916.9.2~~ and 936.9.2] Additional Protection Measures ~~to Facilitate Incidental Take Authorization~~ in Class A Designated Lands~~Watersheds with Coho Salmon~~

(c) Class I Watercourse and Lake Protection Measures – The following shall apply to all Class I watercourses and lakes within ~~watersheds with coho salmon~~ Class A designated lands.

(1) Within a WLPZ for Class I watercourses and lakes, sufficient trees shall be retained to maintain the preharvest level of direct shading to pools. The percentage of shade provided by Group A species shall not be reduced relative to other species.

(2) Recruitment of large woody debris for aquatic habitat in Class I ~~coho salmon-bearing~~ watercourses shall be ensured by retaining the ten (10) largest dbh conifers (live or dead) per 330 feet of stream channel length on each side of the watercourse. The retained conifers shall be selected from within the ~~plan~~ THP area that lies within 100 feet of the watercourse transition line. Where the ~~plan~~ THP boundary is an ownership boundary, a class I watercourse, and the WLPZ on both sides of the watercourse currently meets the stocking standards listed under 14 CCR § ~~912.7 [~~932.7~~]~~(b)(2); the ten (10) largest dbh conifers (live or dead) per 330 feet of stream channel length within the ~~plan~~ THP area shall be retained within 100 feet of the watercourse transition line.

(d) Class II Watercourse and Lake Protection Measures –

(1) Any timber operation or silvicultural prescription within 100 feet of any Class II watercourse or lake transition line shall have protection, maintenance, or restoration of the beneficial uses of water or the populations and habitat of coho salmon or listed aquatic or riparian-associated species as significant objectives.

(2) Where an inner gorge extends beyond a Class II WLPZ and watercourse sideslopes are greater than 55 percent, a special management zone shall be established where the use of evenaged regeneration methods is prohibited, and a minimum average overstory canopy of 60% shall be retained. This zone shall extend upslope to the first major break-in-slope to less than 55 percent for a distance of 100 feet or more, or 200 feet as measured from the watercourse or lake transition line, which ever is less. All operations within the special management zone shall be reviewed by a Professional Geologist to ensure that proposed activities do not present a greater risk of sediment delivery from mass wasting. ~~prior to plan approval and disclosed and incorporated in the plan as appropriate.~~

(3) The following shall apply to all Class II watercourses and lakes mapped on current 1:24,000 scale U.S. Geological Survey topographic map within ~~watersheds with coho salmon~~ Class A lands:

(A) Inner Band: From 0-50 feet, retain a minimum of 85 percent post-harvest overstory canopy. The overstory canopy must be composed of at least 25 percent overstory conifer canopy post-harvest.

~~**(B)** Outer Band with 0-30 percent watercourse sideslope: From 50-75 feet, retain a minimum of 65 percent postharvest overstory canopy. The overstory canopy must be composed of at least 25 percent overstory conifer canopy post-harvest.~~

(B)~~**(C)**~~ Outer Band ~~with 31-50 percent watercourse sideslope~~: From 50-100 feet, retain a minimum of 65 percent post harvest overstory canopy. The overstory canopy must be composed of at least 25 percent overstory conifer canopy post-harvest.

~~**(D)** Outer Band with > 50 percent watercourse sideslope: From 50-125 feet, retain a minimum of 65 percent post-harvest overstory canopy. WLPZ width may be reduced to 100 feet for helicopter or cable yarding operations. The overstory canopy must be composed of at least 25 percent overstory conifer canopy post-harvest.~~

(e) Class III Watercourse Protection Measures – The following shall apply to all Class III watercourses within ~~watersheds with coho salmon~~ Class A lands in or adjacent to harvest units where evenaged management, rehabilitation of under-stocked stands, or variable retention prescriptions are proposed.

> **(1)** establish a minimum 25-foot-wide ELZ on each side of the watercourse for slopes less than or equal to 30% and a minimum 50-foot-wide ELZ on each side of the watercourse for slopes greater than 30%
>
> **(2)** retain all trees situated within the channel zone and trees that have boles that overlap the edge of the channel zone;
>
> **(3)** within the ELZ, at least 50 percent of the understory vegetation shall be left post-harvest in an evenly distributed condition;
>
> **(4)** within the ELZ; retain all snags, large woody debris, and countable trees 10 inches dbh or less, except where necessary to allow for cable yarding corridors, safety, or crossing construction;
>
> **(5)** within the ELZ, prohibit initiation of any burning;
>
> **(6)** allow cable yarding when necessary to transport logs through a Class III ELZ;
>
> **(7)** tractor yarding is prohibited within the ELZ, except for the use of feller-bunchers and shovel yarding that minimize soil compaction and disturbance and;
>
> **(8)** within the ELZ, retain at least 15 square feet basal area per acre of hardwoods where it exists before harvest, including the largest hardwoods available for this purpose. Retain all hardwoods when less than 15 square feet basal area per acre is present before harvest.

(f) Where harvesting is proposed on a connected headwall swale, it shall be reviewed by a Professional Geologist to ensure that proposed activities do not present a greater risk of sediment delivery from mass wasting:

> **(1)** only the selection regeneration method allowed under 14 CCR § ~~913.2 [~~933.2~~]~~ (a) (2) (A) or the commercial thinning intermediate treatment allowed under 14 CCR § ~~913.3 [~~933.3~~]~~ (a) may be utilized in that area with a minimum average overstory canopy of 60%,

(2) Areas of ground based yarding shall be delineated on the ground as an equipment exclusion zone and marked prior to the preharvest inspection.

(3) All proposed road construction or reconstruction shall be reviewed by a Professional Geologist to ensure that proposed activities do not present a greater risk of sediment delivery from mass wasting. ~~and disclosed and incorporated in the plan as appropriate prior to plan approval.~~

(g) Where an inner gorge extends from a Class III watercourse, the use of evenaged regeneration methods is prohibited, and a minimum average overstory canopy of 60% shall be retained. All operations on the inner gorge shall be reviewed by a Professional Geologist to ensure that proposed activities do not present a greater risk of sediment delivery from mass wasting.

[14 CCR § ~~923.9.1 and~~ 943.9.1] Measures for Roads and Landings in ~~Watersheds with Coho Salmon~~ Class A and Class B Designated Lands

In addition to all other district Forest Practice Rules, the following requirements shall apply in any planning watersheds within Class A and Class B designated lands ~~coho salmon~~:

(a) Where logging road or landing construction or reconstruction is proposed, the ~~plan~~ THP shall state the locations of and specifications for road or landing abandonment or other mitigation measures to minimize the adverse effects of long-term site occupancy of the transportation system within the watershed.

(b) Unless prohibited by existing contracts with the U.S.D.A. Forest Service or other federal agency, new and reconstructed logging roads shall be no wider than a single-lane compatible with the largest type of equipment specified for use on the road, with adequate turnouts provided as required for safety. The maximum width of these roads shall be specified in ~~the plan~~ any associated THP. These roads shall be outsloped where feasible and drained with water breaks or rolling dips (where the road grade is inclined at 7 percent or less), in conformance with other applicable Forest Practice Rules.

(c) Logging Road Watercourse Crossing Drainage structures on watercourses that support fish shall allow for unrestricted passage of all life stages of fish that may be present, and shall be fully described in ~~the plan~~ any associated THP in sufficient clarity and detail to allow evaluation by the review team and the public, provide direction to the LTO for implementation, and provide enforceable standards for the inspector.

(d) Any new permanent culverts installed within class I watercourses shall allow upstream and downstream passage of fish or listed aquatic species during any life stage and for the natural movement of bedload to form a continuous bed through the culvert and shall require an analysis and specifications demonstrating conformance with the intent of this section and subsection.

(e) The following shall apply on slopes greater than 50%:

> **(1)** Specific provisions of construction shall be identified and described for all new roads.
>
> **(2)** Where cutbank stability is not an issue, roads may be constructed as a full-benched cut (no fill). Spoils not utilized in road construction shall be disposed of in stable areas with less than 30 percent slope and outside of any WLPZ, EEZ, or ELZ.
>
> **(3)** Alternatively, roads may be constructed with balanced cuts and fills if properly engineered, or fills may be removed with the slopes recontoured prior to the winter period.

(f) In addition to the provisions listed under 14 CCR ~~923.1(e)~~ ~~[~~943.1(e)~~]~~, all permanent or seasonal logging roads with a grade of 15% or greater that extends 500 continuous feet or more that are appurtenant to a THP or to be constructed or reconstructed shall have specific erosion control measures stated in ~~the plan~~ any associated THP.

(g) Where situations exist that elevate risks to the values set forth in 14 CCR ~~916.2(a), [~~936.2(a)~~]~~ (e.g., road networks are remote, the landscape is unstable, water conveyance features historically have a high failure rate, culvert fills are large) drainage structures and erosion control features shall be oversized, low maintenance, or reinforced, or they shall be removed before the completion of the timber operation. The method of analysis and the design for crossing protection shall be included in the ~~plan~~ THP.

(h) Tractor Road Crossing facilities on watercourses that support fish shall allow for unrestricted passage of all life stages of fish that may be present, and for unrestricted passage of water. Such crossing facilities shall be fully described in sufficient clarity and detail to allow evaluation by the THP review team and the public, provide direction to the LTO for implementation, and provide enforceable standards for the inspector.

[14 CCR § ~~923.9.2 and~~ 943.9.2] Measures ~~to Facilitate Incidental Take Authorization in Watersheds with Coho Salmon~~ for Roads and Landings in Class A Designated Lands

(c) An assessment of road surface and drainage conditions for all road segments within the ~~plan~~ THP area and appurtenant to proposed operations shall be included in the ~~plan~~ THP.

> **(1)** The assessment shall contain a list of site-specific, field inventory information including proposed treatment of

existing or potential sediment sources for all crossings, ditch relief culverts, road surfaces, road cuts, road fills, landings, turnouts and inboard ditches.

(A) Field inventory information shall be obtained by an RPF or supervised designee while traversing the road segments.

(2) The assessment shall be subject to approval by the Director of CAL FIRE, with written concurrence by DFG. Additional field inventory, work sites, and/or alternative treatments may be required.

(3) The results of the road assessment shall be used to, construct, reconstruct, or decommission road segments prior to filing a work completion report. Maintenance needs identified during and after the road assessment shall be addressed as soon as is feasible.

(d) Within WLPZs, any new road or landing construction, reconstruction, new watercourse crossings, use of Class I fords or opening of old roads (except for the purpose of decommissioning) will be subject to approval by the Director of CAL FIRE, with written concurrence by DFG. The Director of CAL FIRE will only approve such practices where protection for aquatic habitat provided by proposed practices is at least equal to the protection provided by the use of alternate routes or locations outside of the WLPZ.

(e) The guidelines and performance standards for road decommissioning methods described in the California Salmonid Stream Habitat Restoration Manual, 1998, 3rd edition; pages X-53 through X-59 (published by State of California, Resources Agency, California Department of Fish and Game) shall be followed.

(f) The following design features shall be included in the maintenance, construction, reconstruction, or decommissioning of roads, except where site-specific alternatives are explained, justified, and approved by the Director of CAL FIRE, with written concurrence by DFG. The Director of CAL FIRE may only approve alternatives where the consequences for aquatic habitat are no greater than would result from the standard measures. Except for maintenance needs that arise from October 15 to June 1, all work described below shall be completed before October 15 in the year that work begins.

(1) Road surfaces shall be outsloped with rolling dips, wherever feasible.

(2) All road segments shall be hydrologically disconnected, to the extent feasible, from watercourses and lakes by site specific application of the following: outsloping, rocking, installation of rolling dips, cross drains, and/or waterbars, except where site specific alternatives are explained and justified in the ~~plan~~ THP, and approved by the Director of CAL FIRE, with written concurrence by DFG. All of these features shall drain to stable sediment filter strips.

(3) Crossings and associated fills shall be removed or reconstructed where there is evidence of failure potential or sediment delivery to Class I, II, or III watercourses and lakes.

(4) Culverts shall be replaced or removed if they are crushed, perforated, piping, separated, not adequate to carry water from the fifty-year flood level, located in unstable fill, or causing erosion that may be expected to deliver sediment to Class I, II, or III watercourses and lakes. Replaced culverts shall be installed at or as close to the original stream grade and slope as feasible.

(5) Each road approach to a watercourse crossing shall be treated to create and maintain a stable operating surface, and to avoid the generation of fines during use, in accordance with subsection (A) through (F) below. The road approach encompasses either of the following areas, whichever is less: **(i)** the area from the watercourse channel to the nearest drainage facility, but not less than 50 feet; or **(ii)** the area from the watercourse channel to the first high point on the road where road drainage flows away from the watercourse.

(A) Road surfaces on the following shall consist of high-quality, durable, compacted rock or paving: **(i)** permanent roads **(ii)** seasonal roads crossing Class I watercourses **(iii)** roads used for hauling (logs, rock, heavy equipment) from October 15 to June 1.

(B) Road surfaces on the following shall be treated with either: rock, slash, seed and straw mulch, seed and stabilized straw, or seed and slash: **(i)** all seasonal roads used for hauling in the current year **(ii)** all seasonal roads used from October 15 to June 1 for purposes other than hauling

(C) Approaches to temporary crossings shall be rocked as needed after crossing removal to avoid rutting or pumping fines during use.

(D) Ditches exhibiting downcutting along the following shall be lined with high-quality, durable rock: **(i)** permanent roads **(ii)** seasonal roads crossing Class I watercourses **(iii)** roads used for hauling from October 15 to June 1.

(E) Ditches along the following shall be treated to prevent scour: **(i)** seasonal roads used for hauling in the current year **(ii)** seasonal roads used from October 15 to June 1 for purposes other than hauling.

(F) Bare soil on associated fill slopes, shoulders and cuts shall be treated to minimize erosion.

(6) Sediment discharge from unstable or eroding cutbanks, fillslopes and landing fills will be prevented by pulling, buttressing, or other means and by installing and maintaining effective erosion control materials.

(7) Bridges (including associated fill, rip rap, and abutments) and bridge approaches showing evidence of failure potential or sediment delivery to Class I, II, or III watercourses and lakes shall be repaired, replaced, or removed.

(g) Erosion control materials shall be applied in sufficient quantity prior to the onset of measurable precipitation with reapplication as needed to avoid any visible increase in surface erosion or turbidity in Class I, II or III receiving watercourses and lakes.

(h) All roads in Class I WLPZs shall exhibit a rocked or paved stable operating surface. The surface shall consist of high quality, durable, compacted rock, or paving. The road surface and base shall be maintained to avoid generation of fines during use.

(i) **(1)** No road or landing construction, reconstruction, or decommissioning shall be undertaken from October 15th to May 15th, or at any time outside this period when saturated soil conditions exist, except as provided in subsection ~~(2) or~~ (3).

(3) The RPF may propose site-specific exceptions that are explained and justified in the ~~plan~~ THP, and approved by the Director of CAL FIRE, with written concurrence by DFG. The Director of CAL FIRE will only approve exceptions where the protection provided for aquatic habitat by the proposed practices is at least equal to the protection provided by the above time period or conditions. Access without specific approval by the Director of CAL FIRE is allowed to correct emergency, road-related problems demanding immediate action.

(j) Use of unpaved roads shall cease when precipitation is sufficient to generate overland flow off the road surface, use of any portion of the road results in rutting of the road surface, or a stable operating surface can not be maintained.

(k) **(1)** Resumption of road use shall only occur when there is a stable operating surface.

(2) Resumption of road or landing construction or reconstruction, shall not occur until the soil conditions allow a stable operating surface to be developed.

(l) **(1)** All roads within the ~~plan~~ THP area and appurtenant to proposed operations shall be inspected

(A) by ~~the LTO~~ FGS at least twice annually – once between June 1st and October 15th and at least once after October 15th following the first storm event producing bankfull stage- prior to completion of operations;

(B) by the timberland owner during the same time period for the remainder of the prescribed maintenance period.

(2) The inspection shall be started as soon as conditions permit access (in accordance with 14 CCR § ~~923.9.2~~ ~~[~~943.9.2~~]~~(k)) to ensure that drainage structures and facilities are functioning to hydrologically disconnect the road prism from waters.

(3) Inspection results and follow up corrective measures shall be documented and shall be provided to CAL FIRE and DFG.

(m) Decommissioned roads shall be inspected following the first storm event producing bankfull stage after decommissioning and again prior to filing the completion report. The purpose of the inspection will be to verify the effectiveness of treatments in preventing sediment discharges to waters and to ensure treatments are functioning to restore natural drainage and hillslope stability. If treatments are found to be ineffective prior to the end of the prescribed maintenance period, further treatments shall be applied if the volume of sediment prevented from entering a channel by additional treatments is greater than that incurred by re-entering the site.

(n) During road inspection and maintenance, measures shall be employed to ensure the following: waterbars fully capture run-off from road surfaces and discharge it without gully formation or sediment delivery to waters; culverts (including crossdrains) are not occluded by debris; inboard ditches are not downcutting or scouring; cutbank erosion is minimized, and the fine sediment present on road surfaces is prevented from delivery to Class I, II, or III watercourses and lakes.

(o) Routine corrective work that prevents diversion of water from a watercourse or ditch or helps maintain a stable operating surface (e.g., repairing inboard ditches, cross drains, water bars, road surface and fill, unblocking of culverts) shall be performed as soon as possible, regardless of the time of year. Vehicle access for routine corrective work shall only be permitted in accordance with 14 CCR § ~~923.9.2 [~~943.9.2~~]~~(k). Other maintenance needs of lower priority shall be undertaken between June 1st and October 15th.

(p) Forest floor discharge sites below the outlets of drainage facilities on all roads within the ~~plan~~ THP area and appurtenant to proposed operations shall be inspected by ~~the LTO~~ FGS for evidence of sediment delivery to Class I, II, or III watercourses and lakes at least twice annually; once between June 1 and October 15, and at least once after October 15 following the first storm event producing bankfull stage discharges prior to filing the notice of completion report. If evidence of sediment delivery is present, additional cross drains, waterbars, or rolling dips shall be installed to reduce the discharge volume to the site.

(q) Grading of road surfaces shall occur only when necessary to achieve a uniform, stable, and well-drained operating surface. Inboard ditches shall be graded only when they are blocked or lack adequate inside ditch hydraulic capacity, or driver safety is a concern. Where feasible, blading the segment of ditch between the watercourse and first drainage facility shall be avoided.

5.2.3 Road Management Plan

All logging roads and landings on the ownership or under the control of FGS within the Plan Area shall be planned, located, constructed, reconstructed, used, maintained, or decommissioned in a manner that (1) is consistent with long-term enhancement and maintenance of the forest resource, (2) best accommodates appropriate yarding systems and economic feasibility, (3) minimizes damage to soil resources and fish and wildlife habitat, and (4) prevents degradation of the quality and beneficial uses of water.

To this end, FGS will use existing roads whenever feasible, strive to minimize total mileage, minimize disturbance to natural features, avoid wet areas and unstable areas, and minimize the number of watercourse crossings.

The following road management measures have been developed to assess the existing transportation system for treatment prioritization, establish best management practices to prevent and control erosion production, and to systematically improve the transportation system and related infrastructure.

5.2.3.1 Road Maintenance

All roads on the FGS ownership will be subject to periodic and regular maintenance. FGS has developed a Draft Road Management Plan – Operations Guide that compiles all road measures from the CFPRs previously described for coho salmon, the long-term 1600 streambed alteration agreement being prepared in consultation with DFG, and BMPs currently used by FGS. The Draft Road Management Plan – Operations Guide also includes maintenance schedules and inspection guides, and is included as Appendix B.

5.2.3.2 Road Assessment Process and Priority for Treatment

FGS will identify road-related sediment sources in accordance with the prioritization process set forth in this subsection for the Plan Area.

1. Drainage level road erosion inventories of roads owned and controlled by FGS will be conducted in all drainages within the Plan Area containing Class A designated lands. Inventories will follow a schedule produced through prioritization based on methodology that uses a landscape-level assessment of risk of sediment delivery to streams from road-related erosion, an assessment of resources at risk, and proposed timber management operations. The assessment classifies each drainage on a relative scale and establishes a priority for conducting detailed road erosion inventories (Table 5-2).

2. The road erosion inventory will map individual sites and quantify the sediment delivery potential. The inventories will meet the requirements described in Measures for *Roads and Landings in Class A Lands* [14 CCR 943.9.2]. Results of the inventories will be used to prioritize sites for treatment as described in the following section, termed "Prioritization of Implementation of Treatment Prescriptions."

3. All drainage level road erosion inventories will be completed within 10 years of issuance of the Incidental Take Permits, with the top five priority drainages (see Table 5-2) completed in the first 5 years. Within these priority drainages, treatment of the sites leading to stabilization of at least 50 percent of the potential sediment delivery volume identified during the inventories will be completed within 5 years of the inventory, in conjunction with timber operations, and based on the prioritization described below. In addition, road erosion inventories will be conducted in drainages containing Class B designated lands within 15 years of ITP issuance.

TABLE 5-2
Priority for Drainage-level Road Erosion Inventories on Class A Designated Lands

Rank	Drainage	H+V Road Miles	Miles Coho Habitat Downstream of FGS*	Miles Steelhead Habitat in Stream	Inventory Schedule	Treatment Schedule
1	Beaver	93	12	30.9	<5 years	5-10 years
2	Horse	40	6	13.5	<5 years	5-10 years
3	Cottonwood	92	2	35.6	<5 years	5-10 years
4	Empire	15	4.5	5.8	<5 years	5-10 years
5	Dutch	15	0	1.9	<5 years	5-10 years
6	Middle Klamath	0	0	67	5-10 years	10-15 years
7	Seiad	0	0	21.6	5-10 years	10-15 years
8	Mill	5	1	5.6	5-10 years	10-15 years
9	Moffet	65	2	36.5	5-10 years	10-15 years
11	Rattlesnake	8	0	6.3	5-10 years	10-15 years
12	Canyon	0	0	5.6	5-10 years	10-15 years

TABLE 5-2
Priority for Drainage-level Road Erosion Inventories on Class A Designated Lands

Rank	Drainage	H+V Road Miles	Miles Coho Habitat Downstream of FGS*	Miles Steelhead Habitat in Stream	Inventory Schedule	Treatment Schedule
13	Meamber	28	0	5.3	5-10 years	10-15 years
14	Indian	25	0	5.3	5-10 years	10-15 years
15	Pat Ford	4	0	4.9	5-10 years	10-15 years
16	Dona	12	0	4.9	5-10 years	10-15 years
17	Big Ferry	18	0	2.5	5-10 years	10-15 years
18	Lumgrey	17	0	2	5-10 years	10-15 years
19	Doggett	28	0	2	5-10 years	10-15 years
20	Patterson	0	0	1.9	5-10 years	10-15 years

Habitat excludes mainstem rivers.
*Derived by DFG

5.2.3.3 Field Inventories

FGS will conduct field inventories to identify and quantify road-related sediment sources. During the field assessment, the location of each road feature that exhibits potential to deliver sediment to a stream will be identified and mapped. A data form will be completed for each potential sediment delivery site, and the data will be stored in a GIS database. A report will be generated for each drainage that summarizes the field inventories, and prioritizes treatment sites.

5.2.3.4 Documentation of Fish Passage Problems

FGS will document any potential fish passage problems, including culverts that are impeding fish passage, during the field inventory. Methods used to evaluate fish passage will include those specified in Chapter IX of the California Salmonid Stream Habitat Restoration Manual (DFG 1998).

5.2.3.5 Development of Prescriptions for Erosion Prevention and Control

FGS will develop reasonable and feasible erosion prevention and control prescriptions for each source of treatable erosion that is identified in the field. The prescription for each site will involve temporary or permanent decommissioning, or road upgrading, and will include the following kinds of information:

- Location or identifier
- Road class
- Source type
- Future erosion volume
- Potential delivery (percentage) or delivery volume
- Prescription type
- Prescription details

5.2.3.6 Prioritization of Implementation of Treatment Prescriptions

FGS will prioritize road-related sediment sources for treatment based on the following factors: (1) volume of future sediment delivery, (2) treatment immediacy (risk to Covered Species), and (3) treatment cost-effectiveness. Implementation will be carried out consistent with the Aquatic Protection Measures in Section 5.2.2 and to the standards and protocols set forth in the Draft Road Management Plan – Operations Guide (Appendix B).

5.2.3.7 Road Design and Maintenance Standards

FGS will follow the design and maintenance criteria as specified in the FGS Draft Road Management Plan – Operations Guide (Appendix B). This document includes the standards set forth in Section 5.2.2, as well as specifications for design and maintenance of stream crossings, road surface drainage, road decommissioning, and erosion control, including inspection schedules.

5.2.4 Slope Stability Measures

Slope stability measures focus on project-level identification of unstable (historically active) and active slopes/landslides and the application of specific management prescriptions to those areas described below as shallow or deep-seated mass wasting hazard zones (MWHZs). Mass wasting hazards and sediment delivery related to complex mass wasting hazards (i.e., inner gorges and headwall swales) in the Plan Area are addressed under the Aquatic Protection Measures previously described (14 CCR 936.9.1 and 14 CCR 936.9.2). Mass wasting hazards and sediment delivery directly related to the road network in the Plan Area are addressed under the Road Management Measures (Section 5.2.2).

The purpose of the slope stability conservation measures is to: (1) minimize and mitigate sediment delivery to aquatic habitat from management-related landslides, (2) minimize the erosion potential of identified mass wasting hazard zones, and (3) minimize the potential for activation from landslide-prone terrains.

1. FGS will apply default conservation measures for "slide areas," "unstable areas," and "unstable soils" as defined in 14 CCR 895.1 (collectively termed "unstable areas" for the purposes of this HCP) that provide protections equivalent to or greater than the current (2008) CFPRs.

2. In drainages containing Class A or Class B designated lands, FGS will apply terrain-specific conservation measures (Sections 5.2.4.2 and 5.2.4.3) to address instability associated within explicit mass wasting hazard zones. These terrain-specific default conservation measures are based on slope processes and geomorphic landforms associated with both shallow and deep-seated mass wasting hazards.

5.2.4.1 Default Conservation Measures for Unstable Areas

In all "unstable areas" that are identified at the project level, FGS will:

- Locate and delineate known unstable areas on topographic maps at a scale sufficient to transfer to a GIS database.

- All operations on unstable areas shall be reviewed by a Professional Geologist or Certified Engineering Geologist to ensure that proposed activities do not present a greater risk of sediment delivery.

- Prohibit clearcut harvest within MWHZ boundaries.
- Limit timber operations on slides or unstable areas.
- Prohibit new road and landing construction or operation of heavy equipment within delineated MWHZ boundaries without prior field review or approval from a Professional Geologist or Certified Engineering Geologist.
- Avoid loading overburden within 30 feet upslope of delineated MWHZs.
- Avoid tractor site preparation in the vicinity of MWHZs during the winter wet weather period, or during other periods when saturated soil conditions exist.
- Avoid fire break construction using heavy equipment in the vicinity of MWHZs during winter wet period, or during other periods when saturated soil conditions exist.
- Conduct road construction, maintenance, and decommissioning in a manner to avoid concentrating surface runoff onto any delineated MWHZ.
- Prohibit redirecting water drainage from roads, skid trail, and landings onto any delineated MWHZs.
- Avoid operating heavy equipment on unstable areas. Where unavoidable, specific measures will be developed to minimize the effect of operations on slope instability.
- Avoid heavy equipment operations on slopes greater than 65 percent or slopes greater than 50 percent, where the EHR is high or extreme without approved explanation and justification prior to usage.
- Prohibit heavy equipment operations on slopes steeper than 50 percent leading directly to a watercourse or lake without flattening sufficiently to dissipate water flow or trap sediment.
- Limit heavy equipment to existing tractor roads that do not require reconstruction on slopes with moderate EHR that average greater than 50 percent over 20 acres.
- Prohibit the placement of fill onto slopes greater than 65 percent.
- Minimize the placement of sidecast on slopes greater than 65 percent.
- Drainage structures and drainage facilities on logging roads shall not discharge on erodible fill or other erodible material unless suitable energy dissipaters are used.
- Install additional erosion control structures where necessary to control management induced sediment delivery to area watercourses.
- Prescribe measures to minimize movement of soil and the concentrated surface runoff on any slopes 65 percent or steeper, or on slopes greater than 50 percent on slopes within 100 feet of a WLPZ boundary where roads and landings traverse more than 100 feet of linear distance.

5.2.4.2 Shallow Mass Wasting Hazard Zones

Deterministic slope stability modeling (termed SHALSTAB) was used in combination with available landslide inventories and geomorphic mapping to identify potential shallow mass wasting hazards at the drainage level. Appendix C, which is an excerpt from an unpublished report prepared by Stillwater Sciences for FGS, describes the methods and results of the SHALSTAB model. Areas with a log q/T <-2.5 were considered to have a "moderate" potential for shallow mass wasting and areas with a log q/T <-2.8 were considered to have a "high" potential. Trained personnel (i.e., Certified Engineering Geologist, Professional Geologist, or trained Registered Professional Forester) will examine areas with a moderate or high potential for shallow mass wasting during THP layout and identify shallow MWHZs for additional protection. Terrain-specific conservation measures will be applied to shallow MWHZs field verified as unstable with reasonable potential to deliver sediment directly to a watercourse.

Identification of Active Shallow Mass Wasting Hazard Zones. During THP layout and design, trained personnel (i.e., Certified Engineering Geologist, Professional Geologist, or trained Registered Professional Forester) will clearly delineate, in the field and on relevant THP maps, all hydrologically connected unstable shallow MWHZs that exhibit a preponderance of the following physical hillslope characteristics consistent with active shallow landslides:

- Horizontal or vertical ground displacement;
- Near-vertical or slightly rounded head or lateral scarps with internal tension cracks;
- Slide scar with exposed bare mineral soil or that is partially revegetated;
- Extremely steep slopes (greater than 65 percent) with near vertical scarp displacement;
- Disrupted or deformed trees (i.e., tilted, leaning, or split); and
- Hydrologic connectivity to a watercourse.

Terrain-specific Measures for Active Shallow Mass Wasting Hazard Zones. Within areas of the THP that meet any of the above criteria identifying a shallow mass wasting hazard zone, and that are field verified as unstable with reasonable potential to deliver sediment directly to a watercourse, FGS will apply the following measures in combination with the default measures for unstable areas (Section 5.2.4.1):

- Prohibition of the use of even-aged regeneration methods, and a minimum average canopy of 60% shall be retained. All operations on active shallow landslides shall be reviewed by a Professional Geologist or Certified Engineering Geologist to ensure that proposed activities do not present a greater risk of sediment delivery.

- Avoidance of new road or skid trail construction or major road reconstruction without field review and approval by a Professional Geologist or Certified Engineering Geologist.

- Minimization of undercutting or removal of buttressed slide materials (i.e., slide deposits or colluvium).

- Application of bank stabilization measures in areas of management accelerated active bank erosion so as to not alter stream channel geomorphology.

- Prohibition of heavy equipment operations in the vicinity of shallow MWHZs without field review and approval from a Professional Geologist or Certified Engineering Geologist.

These measures will be implemented unless the Professional Geologist or Certified Engineering Geologist, based on geologic review of the MWHZ, recommends implementation of alternative conservation measures that are equally or more effective or more efficiently minimize the risk of sediment delivery and associated impacts to aquatic habitat.

5.2.4.3 Deep-Seated Mass Wasting Hazard Zones

Active and dormant deep-seated and complex landslide-prone terrain in the HCP area are compiled by Elder and Reichert (2006) as part of an effort by the USFS to map landforms in the Klamath National Forest and surrounding areas. The compilations of landform mapping by Elder and Reichert (2006), used in combination with aerial photographic interpretation during the term of the HCP (see Monitoring Requirements in Chapter 7), will be used as a screening tool to identify potential deep-seated mass wasting hazards at the drainage level while recognizing that other relevant data may also be used to identify areas of potential mass wasting concern (e.g., staff knowledge, previous THPs, etc). Trained personnel (i.e., Certified Engineering Geologist, Professional Geologist, or trained Registered Professional Forester) will examine these potential deep-seated mass wasting hazards (i.e., earthflows, undifferentiated slides and headwall basins, rotational/translational slides) during THP layout and identify deep-seated MWHZs for additional protection. Terrain-specific conservation measures will apply to deep-seated MWHZs field verified as unstable with reasonable potential to deliver sediment directly to a watercourse.

Identification of Active Deep-seated Mass Wasting Hazard Zones. During THP design, professionally trained personnel (i.e., Certified Engineering Geologist, Professional Geologist, or trained Registered Professional Forester) will clearly delineate, in the field and on relevant THP maps, all identified hydrologically connected unstable deep-seated MWHZs that exhibit a preponderance of the following physical hillslope characteristics consistent with active deep-seated landslides:

- Horizontal or vertical ground displacement along arcuate head scarps;
- Near-vertical or slightly rounded head and lateral scarps and secondary scarps;
- Arcuate slide scar with exposed bare mineral soil or that is partially revegetated;
- Hummocky topography having shallow gradient, undulating slopes (slide mass);
- Disputed or deformed trees (i.e., sweeping, leaning, pistol-butted, jack-strawed, or split);
- Drainages, diversions, or poorly developed drainage patterns;
- Concentrated subsurface water, springs, or seeps in the slide mass;
- Hydrophilic or pioneering vegetation;
- Hydrologic connectivity to a watercourse; and
- Low gradient slopes located below an inflection point within a convex, lobate landform and directly downslope of deep-seated landslides.

Terrain-specific Measures for Active Deep-seated Mass Wasting Hazard Zones. Within areas of the THP that meet any of the above criteria identifying a deep-seated mass wasting hazard zone, and that are field verified as unstable with reasonable potential to deliver sediment directly to a watercourse, FGS will apply the following terrain-specific measures in combination with the default measures for unstable areas (Section 5.2.4.1):

- Prohibition of the use of even-aged regeneration methods, and a minimum average canopy of 60% shall be retained. All operations on active deep seated landslides shall be reviewed by a Professional Geologist or Certified Engineering Geologist to ensure that proposed activities do not present a greater risk of sediment delivery.

- Retention of an uneven-aged stand structure within slide mass and toe slopes of deep-seated MWHZ boundaries.
- Establishment of an EEZ within deep-seated MWHZ boundaries and extend the EEZ 30 feet upslope of the head scarp.
- Minimization of undercutting or removal of buttressed slide materials especially in toe slopes of any deep-seated MWHZ without field review and approval from a Professional Geologist or Certified Engineering Geologist.
- Prohibition of loading slide material, slide mass margins, or toe slopes of unstable deep-seated MWHZ with excavation spoils, road fill, or surface runoff.

These measures will be implemented unless the Professional Geologist or Certified Engineering Geologist, based on geologic review of the MWHZ, recommends implementation of alternative conservation measures that are equally or more effective or more efficiently minimize the risk of sediment delivery and associated impacts to aquatic habitat.

5.2.4.4 Training

RPFs preparing timber harvest plans for Covered Lands will be trained to address issues relating to the conservation measures set forth in this section. The training for RPFs will be administered by a qualified California Professional Geologist or a Certified Engineering Geologist and will consist of identification of unique conditions found on Covered Lands.

5.3 Terrestrial Species Conservation Program

Based on the stated biological goals and objectives, FGS developed a comprehensive conservation program with a number of specific conservation measures to provide protection for the northern spotted owl and Yreka phlox. Collectively these measures are termed the "Terrestrial Species Conservation Program," and they reflect all the binding, enforceable commitments FGS will make to satisfy the requirements of Section 10(a) of the Endangered Species Act. The Terrestrial Species Conservation Program will be incorporated by reference in the section of the IA that describes all FGS's conservation planning commitments that must be made and carried out to qualify for and comply with the ITPs that FGS is seeking.

5.3.1 Northern Spotted Owl

The following subsections describe the specific measures associated with each of the biological objectives for northern spotted owls.

5.3.1.1 Objective 1: Demographic Support

The following measures are associated with the demographic support objective:

- FGS will establish 24 Conservation Support Areas on its ownership to provide demographic support to northern spotted owls associated with strategic activity centers located within 1.3 miles of the FGS ownership (Area of Impact), and whose home ranges overlap with CHUs. Figure 5-1 identifies the location of these CSAs while Appendix D contains maps showing the distribution of northern spotted owl habitat within each

CSA and the extent of the FGS ownership. The rationale and process for selecting strategic activity centers to be protected by CSAs is described in Chapter 6.

- FGS will promote and maintain the following general conditions and habitat features on its ownership within the CSAs:
  - A multi-layered mature forest to provide a more stable and moderate microclimate
  - Areas composed of tree species associated with use by northern spotted owls (i.e., Douglas-fir with mistletoe infections to provide nesting platforms, hardwoods to provide food and shelter for prey)
  - Variable and increasing average tree diameter
  - A large tree component (more than 26 inches dbh)
  - Variable tree densities
- FGS will ensure that specific habitat standards for both nesting/roosting and foraging habitat are met within the entire CSA (which includes lands owned by others) before harvest can occur on its ownership in a CSA (see below).
- Harvest on the FGS ownership within CSAs will be restricted, and any harvest on the FGS ownership within the CSAs will require evaluation for compliance with the HCP provisions, and written approval by the USFWS.
- FGS will prioritize conservation efforts on lower elevation, northern-facing slopes near the nest site. FGS will prioritize management of owl habitat on its ownership within the lower third of mesic slopes near riparian zones, including designated WLPZs.
- Existing large hardwoods on the FGS ownership within CSAs will be retained to provide nesting structures for owls and food for prey species.
- Large down woody material on the FGS ownership within CSAs will be retained to provide nesting and foraging habitat for northern spotted owl prey species.
- Existing snags on the FGS ownership within CSAs will be retained. Snags that are judged to be a safety hazard may be felled and left onsite.

Conditions for allowable harvest within the 500-acre core area. If there are more than 250 acres of nesting/roosting habitat and more than 150 acres of foraging habitat within the overall 500-acre core area (regardless of ownership), then harvest can occur on lands owned by FGS in the core area of the CSA. All existing substrate for northern spotted owl nest structures (tree deformities, mistletoe brooms, tree cavities) will be maintained within the 500-acre core area where it does not create a hazard for public safety.

Nesting/roosting habitat is defined as having the following attributes:

- ≥150 ft^2/acre of basal area
- ≥ 60 percent canopy closure
- ≥ 15 inches average quadratic mean diameter (qmd)
- ≥ 8 trees/acre (or ≥ 30 ft^2/acre basal area) of large conifers ≥ 26 inches dbh
- Multi-layered canopy, nesting substrates, snags, down woody material, decadent trees

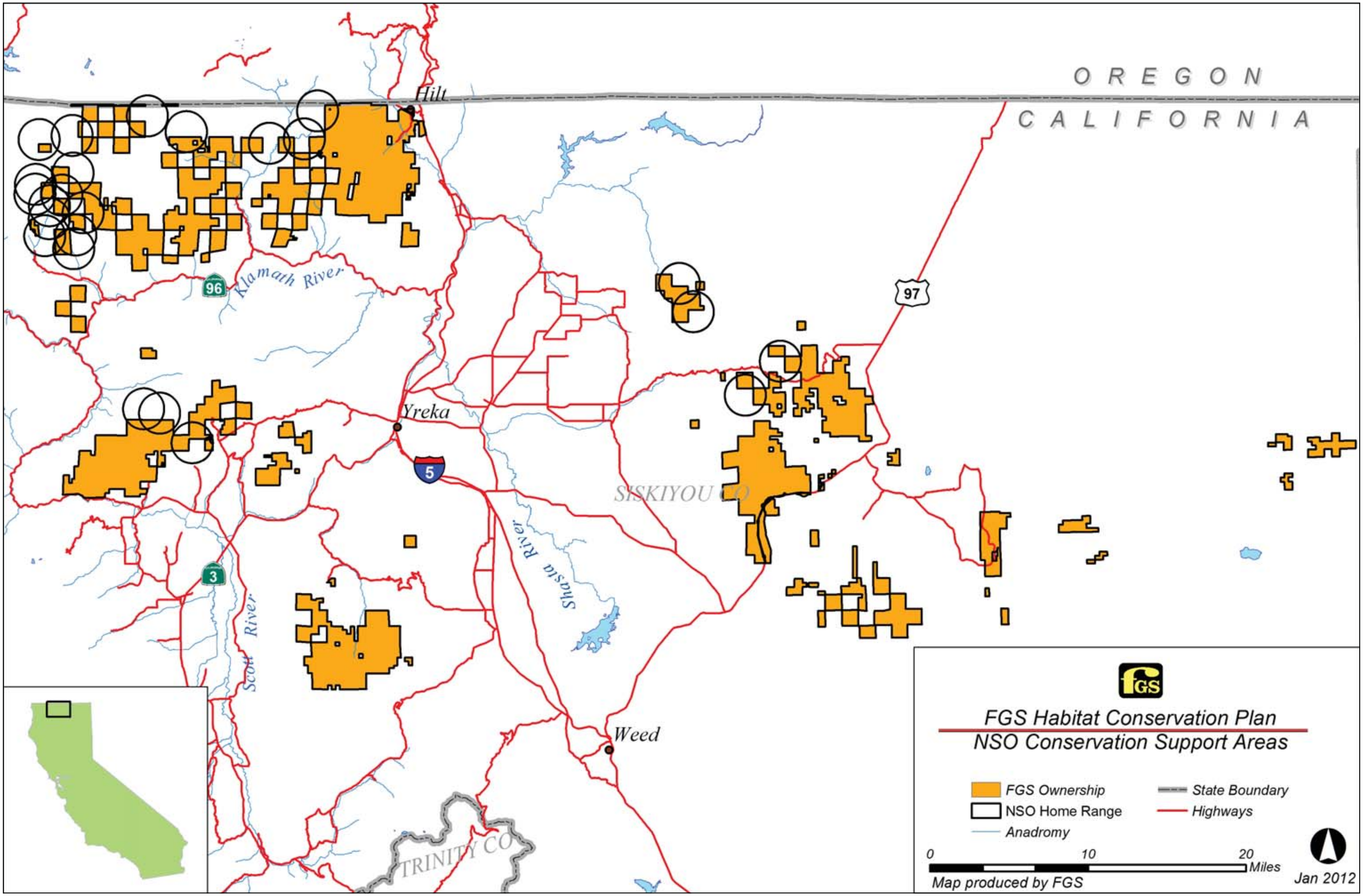

FIGURE 5-1
Northern Spotted Owl
Conservation Support Areas

Of the 250 acres of nesting/roosting habitat in the core area of the CSA (regardless of ownership), at least 100 acres must be high quality habitat with greater than or equal to 210 ft^2/acre of basal area, and at least 100 acres must be of at least moderate quality with 180 to 210 ft^2/acre of basal area for harvest to occur on lands owned by FGS in the CSA.

Foraging habitat is defined as having the following attributes:

- 80 to 180 ft^2/acre of basal area
- ≥ 40 percent canopy closure
- ≥ 13 inches average qmd
- ≥ 5 trees/acre (≥ 20 ft^2/acre basal area) of large conifers ≥ 26 inches dbh

Of the 150 acres of foraging habitat, at least 60 acres must be high-quality foraging habitat with 150 to 180 ft^2/acre of basal area and greater than or equal to 60 percent canopy closure.

At least 40 acres can be of moderate-quality, with 120 to 150 ft^2/acre of basal area and greater than or equal to 40 percent canopy closure.

Where there is currently less than 250 acres of nesting/roosting habitat and/or less than 150 acres of foraging habitat within the overall 500-acre core area, specific areas on the FGS ownership within the CSA with the potential to develop into suitable owl habitat over the term of the Permits were identified as part of the CSA selection process and are shown on maps included in Appendix D. Harvest in these areas will be restricted until the habitat thresholds are met. High priority for conservation was given to areas at low elevations, and on north-facing slopes near riparian zones that are relatively contiguous with the activity center.

These harvest restrictions are based on habitat targets, for the CSA as a whole (regardless of ownership), established to promote a high probability of occupancy by northern spotted owl nesting pairs at known activity centers with high conservation value to the federal conservation strategy. The habitat targets guide management and stand development on FGS land within the core area. Harvest will be restricted on the entire FGS ownership within the CSAs because any harvest conducted by FGS within the CSAs will require evaluation and written approval by the USFWS. Overall, 78 percent of the total FGS ownership in the core areas of the CSAs will be managed to provide suitable owl habitat in support of the federal conservation strategy. The remaining portion of the FGS ownership in the core areas of the CSAs was either identified as non-habitat, could not be reasonably expected to provide habitat over the term of the Permits, or was of low priority given the amount and quality of habitat elsewhere in the CSA. Fruit Growers' habitat commitments associated with the core area and home range of each CSA are summarized in Table 5-3.

While silvicultural practices will be tailored to individual activity centers, FGS will manage its lands within the CSAs to develop and maintain northern spotted owl habitat as described above to promote heterogeneous habitat conditions within the 500-acre core area around an activity center (i.e., promote variable basal areas and canopy closures). The habitat commitments in Table 5-3 will be incorporated into FGS's management of its land within the 500-acre core area in CSAs around the strategic activity centers. As stands develop over the term of the Permits, the actual areas of suitable habitat may shift spatially due to natural events or silvicultural activities. If an area identified for conservation as foraging habitat grows into nesting/roosting habitat, then FGS can harvest this or other nesting/roosting habitat in the CSA down to the high quality foraging habitat standards, provided that their commitments for nesting/roosting and foraging habitat are met and at least 250 acres of nesting/roosting habitat and 150 acres of foraging habitat is maintained within the overall 500-acre core area, regardless of ownership.

Upon evaluation and written concurrence by the USFWS, exceptions may be made on a case-by-case basis for CSAs that lack the acreage or site potential to meet this requirement. Timber harvest on the FGS ownership in a CSA would not be allowed if such harvest would result in FGS being unable to meet its habitat commitment (see Table 5-3) post-harvest. Any harvest conducted by FGS within the CSAs will require evaluation and written approval by the USFWS for compliance with the HCP provisions.

TABLE 5-3
FGS Habitat Commitments in CSAs Supporting High Conservation-value Activity Centers (acres)

Activity Center ID	Suitable Northern Spotted Owl Habitat 500-Acre Core Area	Suitable Northern Spotted Owl Habitat Home Range (3,396 Acres)*
SK002	211	931
SK028	35	319
SK040	9	379
SK044	27	572
SK061	0	158
SK063	2	201
SK097	34	320
SK099	1	305
SK100	118	207
SK153	168	809
SK238	0	66
SK262b	152	477
SK284	130	652
SK291	11	72
SK352	58	679
SK378	33	62
SK428	16	327
SK446	48	435
SK462	110	701
SK503	38	483
SK512	16	137
SK530	28	321
SK531	108	1,055
SK548	4	277

*Acres in home range include the 500- acre core area around the activity center. The home range is the area of land within a 1.3-mile-radius around an activity center. The acreage listed in this table is the represents the amount of habitat that will be maintained on FGS property only. The remainder of the 500 acre (core) and 3,396 acre (home range) areas include FGS lands that were not designated for conservation in the CSAs (e.g., nonhabitat, suitable habitat not prioritized for conservation), are located on lands that are owned by others (private, federal, and state), and may include overlap with adjacent CSAs.

Conditions for Allowable Harvest within the Home Range. If there is more than 600 acres of nesting/roosting habitat (as defined above for the core area) and more than 1,050 acres of foraging habitat (with at least 730 acres of high- and moderate-quality foraging habitat, as defined above for the core area) within the 3,396-acre home range, then harvest can occur outside of these habitat retention areas. By definition, the home range includes the acreage identified above for the 500-acre core area around the activity center. Where there is currently less than 600 acres of nesting/roosting habitat and/or less than 1,050 acres of foraging habitat within the entire 3,396-acre home range, specific areas on FGS' ownership within the CSA with the potential to develop into suitable owl habitat over the term of the permits were identified as part of the CSA selection process and are shown on maps included in Appendix D. Harvest in these areas will be restricted until the habitat thresholds are met. High priority for conservation was given to areas that provide connectivity with nesting/roosting habitat in the 500-acre core area and with other owl activity centers, and with a high likelihood of use by northern spotted owls (lower third of mesic slopes near riparian zones, including designated WLPZs) to provide additional foraging opportunities for owls.

These harvest restrictions are based on habitat targets, for the CSA as a whole (regardless of ownership), established to promote a high probability of occupancy by northern spotted owl nesting pairs at known activity centers with high conservation value to the federal conservation strategy. The habitat targets guide management and stand development on FGS land within the home range and any harvest conducted by FGS within the CSAs will require evaluation and written approval by the USFWS. Overall, 41 percent of the total FGS ownership in the home ranges of the CSAs will be managed to provide suitable owl habitat in support of the federal conservation strategy. The remaining portion of the FGS ownership in the home ranges of the CSAs was either identified as non-habitat, could not be reasonably expected to provide habitat over the term of the Permits, or was of low priority given the amount and quality of habitat elsewhere in the CSA. FGS' habitat commitments associated with the home range of each CSA are summarized in Table 5-3.

While silvicultural practices will be tailored to individual activity centers, the habitat commitments in Table 5-3 will be incorporated into the management of CSAs within the 1.3-mile radius home range around each strategic activity center. The amount and location of nesting/roosting and foraging habitat will change through time as stands age and grow. If an area in the CSA identified for conservation as foraging habitat grows into nesting/roosting habitat, then FGS can harvest this or other nesting/roosting habitat in the CSA down to the high quality foraging habitat standards, provided that its commitments for nesting/roosting and foraging habitat in the home range are met and at least 600 acres of nesting/roosting habitat and 1,050 acres of foraging habitat is maintained within the entire 3,396-acre home range area, regardless of ownership.

Upon evaluation and written concurrence by the USFWS, exceptions may be made on a case-by-case basis for CSAs that lack the acreage or site potential to meet this requirement. Timber harvest on the FGS ownership in a CSA would not be allowed if such harvest would result in FGS being unable to meet its habitat commitment (see Table 5-3) post-harvest. Any harvest conducted by FGS within the CSAs will require evaluation and written approval by the USFWS for compliance with the HCP provisions.

5.3.1.2 Objective 2: Riparian Management Objective

The following measure is associated with the riparian management objective:

- FGS will establish WLPZs or EEZs along all stream classes, and implement the management prescriptions described in the Aquatic Species Conservation Program over the term of the Permits. The WLPZs will provide foraging habitat and dispersal corridors for the northern spotted owl. No additional riparian management measures are included in the Terrestrial Species Conservation Strategy.

5.3.1.3 Objective 3: Dispersal Habitat Objective

The following measure is associated with the dispersal habitat objective:

- Consistent with the USFWS's expectations for conservation efforts on private lands, as stated in the "Revised Recovery Plan for the Northern Spotted Owl *(Strix occidentalis caurina)"* (USFWS 2011), FGS will promote forest management practices that develop and maintain dispersal habitat across its ownership to provide connectivity between the CSAs and nearby federal lands.

Northern spotted owls disperse through a wide variety of forest conditions, including younger stands and open patches. Dispersal habitat, at a minimum, consists of stands with adequate tree size and canopy closure to provide protection from avian predators and at least minimal foraging opportunities (USFWS 1992). However, northern spotted owls tend to favor foraging habitat (CWHR category 4M; average tree diameters ≥11 inches; and conifer overstory trees with closed canopies of ≥40 percent canopy closure) with open space beneath the canopy to allow flight (USFWS 2008). Forsman et al. (2002) found that northern spotted owls could disperse through highly fragmented forest landscapes. The stand-level and landscape-level attributes of forests needed to facilitate successful dispersal have not been thoroughly evaluated (Buchanan 2004) and a more complete description of dispersal habitat may be determined in the future. There is little evidence that small openings in forest habitat influence the dispersal of spotted owls, but large, non-forested valleys such as the Willamette Valley apparently are barriers to both natal and breeding dispersal (Forsman et al. 2002).

5.3.1.4 Objective 4: Take Minimization Objective

The following measures are associated with the take minimization objective:

- FGS will not conduct timber operations or create a noise disturbance in conducting Covered Activities within 0.25 mile of active northern spotted owl nest sites during the breeding season beginning February 1 and ending August 31. "Active northern spotted owl nest site" is defined as the nest tree of a pair of nesting northern spotted owls. Road use and maintenance within 0.25 mile of an active northern spotted owl nest site may occur during the breeding season, but will require evaluation by the USFWS. Other timber operations and other Covered Activities on FGS land within 0.25 mile of an active northern spotted owl nest site may commence without restriction after August 31 for activity centers authorized for take.

- To help ensure protection of active northern spotted owl nest sites on FGS lands and on adjacent land within 0.25-mile of a FGS' timber harvest plan boundary, FGS will conduct up to three protocol surveys each year of operation at known activity centers if necessary to determine site occupancy and reproductive status and survey suitable habitat within 0.25-mile of Covered Activities planned for operations during the active breeding season. Survey results must be reviewed and approved by the USFWS prior to operations. For activity centers where two consecutive years of protocol surveys indicate the site is not currently occupied, and no northern spotted owls are detected within 0.25-mile of the timber harvest plan boundary, Covered Activities may occur during the breeding season for the following two years without conducting additional surveys. Surveys are not required for Covered Activities occurring outside of the breeding season.
- To help assure that all active northern spotted owl nest sites on FGS lands and on adjacent lands within 0.25-mile of a THP boundary established by FGS are identified, FGS will use the most recent information on northern spotted owl location from DFG, the USFWS, and private timber companies with adjacent land, during the preparation of each THP. FGS will also provide training on northern spotted owl identification and signs of northern spotted owl presence for field personnel that will be conducting THP preparation and timber operations to increase the probability that previously unknown owl sites within or adjacent to THPs are identified. All new northern spotted owl activity centers located through surveys or incidentally will become "known" activity centers, and will be subject to the survey and avoidance provisions above. If there is no response from an activity center during three consecutive years of protocol-level northern spotted owl surveys, the USFWS will evaluate the habitat quality and quantity within the home range to determine its occupancy status.

5.3.1.5 Objective 5: Threat Management Objective

The following measures are associated with the threat management objective and apply to CSAs established on the FGS ownership:

- FGS will implement the following barred owl control measures:
  - FGS will conduct barred owl monitoring using current USFWS-approved survey protocols every 4 years within the CSAs as long as deemed necessary by the USFWS. Barred owl monitoring will be conducted in coordination with protocol-level northern spotted owl surveys as described in the monitoring section of the HCP (Chapter 7). Within the 4-year interval, FGS will conduct a barred owl survey for two consecutive years to determine if barred owls are present. Survey results will be compiled and a status report provided to the USFWS every 4 years.
  - If a barred owl is detected in the Plan Area, FGS will locate and monitor the barred owl and notify the USFWS within 10 days of detection.
  - As part of the ITP issuance, FGS will apply for a Federal Depredation Permit for barred owls as needed. FGS will help to facilitate (e.g., through providing access to and across its ownership) implementation of barred owl control measures deemed appropriate by the USFWS.

- Consistent with its fuels management guidelines for the Plan Area, FGS will implement the following stocking control and fuel maintenance measures within the CSAs:
  - Plantation and naturally regenerated stands will be maintained at or below stocking levels considered "normal" as defined in standard yield tables where feasible.
  - Fine fuels (slash, brush, and trees less than 3 inches in diameter) will not be permitted to accumulate to levels greater than 10 tons/acre. Thinning of suitable habitat in CSAs would require pre-approval by USFWS.
- FGS will implement the following measures to prevent and/or control the spread of forest disease and insect outbreaks in the CSAs:
  - Salvage of trees that are weakened or killed by disease or insects, or that are damaged by wildfire or climatic events. Except where human safety is a factor, or in instances where snags have the potential to promote wildfires, salvage is not allowed in WLPZs or in designated suitable habitat within the CSAs. Salvage operations in CSAs would require pre-approval by USFWS.

5.3.2 Yreka Phlox

Approximately 887 acres of potential habitat (i.e., soils derived from ultramafic parent materials) are located within the areas of high and moderate likelihood for occurrence on FGS ownership (discussed in Chapters 3 and 4). Soils derived from ultramafic parent materials are also located on FGS lands outside of the areas identified as having a high or moderate likelihood for occurrence.

The following subsections describe the specific measures that are associated with each of the biological objectives for Yreka phlox.

5.3.2.1 Objective 1: Avoidance of Adverse Effects Objective

The following measures are associated with the avoidance of adverse effects objective:

- FGS will perform botanical surveys for undiscovered populations of Yreka phlox that may exist in the Plan Area. Botanical surveys will be conducted on any FGS lands with specific soil types derived from ultramafic parent material that are within the area of high to moderate likelihood of occurrence of Yreka phlox (i.e., within 8 miles of any point along a line drawn between Paradise Craggy, southwest through Yreka, to Etna) (see Figure 4-36 in Chapter 4).
  - Surveys will be conducted by a qualified botanist in accordance with standardized guidelines issued by USFWS (USFWS 1996), DFG (DFG 2000 and 2005b), and California Native Plant Society (CNPS 2001). Botanical surveys for undiscovered populations in the area of high to moderate likelihood of occurrence will be sufficient to (1) determine and document the presence or absence of Yreka phlox; (2) if present, map the location of Yreka phlox; (3) document the general population size; (4) identify and document habitat associations; (5) identify and document potential threats to the population, including those generally known for the species and applicable to the population and any additional threats that may exist for the

specific population; and (6) identify and map the appropriate EEZ boundaries to protect the identified population.

- Surveys will be conducted on Plan Area lands within the area of high to moderate likelihood of occurrence of Yreka phlox with soil type numbers 143 (Dubakella-Ipish Complex, 5 to 30 percent slopes), 144 (Dubakella-Ipish Complex, 30 to 50 percent slopes), 178 (Lithic Xerorthents-Rock Outcrop Complex, 0 to 65 percent slopes), 213 (Rock Outcrop-Dubakella Complex, 30 to 50 percent slopes), and 237 (Weitchpec Variant-Rock Outcrop Complex, 5 to 65 percent slopes).
- Surveys will be conducted during the optimal time for species identification. Flowering and identification of the species is dependent on elevation and climate conditions, however, flowering generally occurs between March and June. Accurate identification can often extend through August. Multiple visits to a site may be necessary to ensure that survey conditions are appropriate for identification.
- Field survey crews will include at least one member who has seen Yreka phlox growing in its natural habitat. Surveys for undiscovered populations will include a visit to known populations that occur in the area to determine if climate, precipitation, and timing for flowering are appropriate for species identification. If possible, visits to known populations will be to those that are similar in elevation, latitude, vegetation, and topography to the survey area.

- FGS will protect known and discovered occurrences on the FGS ownership through implementation of the following measures developed through coordination with the USFWS and DFG.
  - No operations will occur within occupied habitat, as determined by a boundary established at the outer perimeter of the group of Yreka phlox plants comprising the population.
  - An EEZ with a minimum width of 150 feet will be established around each known or discovered occurrence to reduce external influences and allow for expansion of populations.
  - EEZs established for plant protection will encompass the individuals or groups of plants and will be designated with appropriate flagging.
  - Except on existing roads, there will be no heavy equipment operations within the EEZ. Trees to be removed from within EEZs will be cut with a feller buncher and removed fully suspended above the ground or will be cut to lead away from protected plants within the buffer. Trees to be harvested near EEZs established to protect Yreka phlox will be directionally felled away from the EEZ.
  - Any mulch applied within or immediately adjacent to the EEZ around known or discovered populations will be certified weed free.
- FGS will perform detailed pre-activity surveys for Yreka phlox prior to Covered Activities that could directly (e.g. removal, destruction) or indirectly (e.g. changes in hydrology, introduction of invasive weeds) impact Yreka phlox. Covered activities that have the potential to impact Yreka phlox include, but are not limited to activities

associated with timber harvesting, road and landing construction and maintenance, silviculture, stand regeneration, harvest of minor forest products, fire prevention, construction or reconstruction of watercourse crossings, and site preparation. FGS would conduct pre-activity surveys for Yreka phlox at the THP-level as required under the State THP review process.

- FGS will avoid potential indirect impacts from road construction near known and discovered populations through placement/deposition of fill material and culverts in such a manner and in areas that will not adversely affect Yreka phlox populations. Road design and specifications will consider and avoid indirect impacts to known and discovered populations caused by compaction and alteration of slope drainage.

5.3.2.2 Objective 2: Sustainability Objective

The following measures are associated with the sustainability objective:

- FGS will monitor all known and discovered Yreka phlox occurrences on its ownership for the term of the Permits. The specific elements of the monitoring plan for Yreka phlox will be developed in consultation with the USFWS (as described in Chapter 7) but will include the following:
  - Current known locations of Yreka phlox on FGS lands.
  - Survey protocol to be followed.
  - Qualifications for monitoring personnel, which will include, at a minimum, familiarity with the species, the ecology of ultramafic habitats, and the threats to the species.

Monitoring will focus on habitat conditions and threats to the known populations within the occupied habitat and the EEZ established around each known or discovered occurrence. Invasive weeds such as Marlahan mustard (*Isatis tinctoria*) and yellow star-thistle (*Centaurea solstitialis*) have specifically been identified as threats to some Yreka phlox occurrences, and other weeds could be a threat. If invasive weeds with the potential to harm Yreka phlox are detected in the Yreka phlox monitoring areas, FGS will notify the USFWS within 10 days. FGS will help to facilitate (e.g., through providing access to and across its ownership) implementation of invasive weed control measures deemed appropriate by the USFWS at the time of detection.

Monitoring results will also help the USFWS determine the effects of global climate change on Yreka phlox. Should the USFWS determine, using the best available science, that global climate change has resulted in a reduction in the range of Yreka phlox, FGS will contribute to the federal recovery strategy for this species by allowing access to its ownership for the purposes of seed collection from known occurrences of Yreka phlox or reestablishment of populations on appropriate soil types.

CHAPTER 6

Effects of Covered Activities on Covered Species

This chapter describes the effects of Covered Activities, including implementation of this HCP, on specific ESA-protected and other species identified in Chapter 3 (Covered Species). Impacts are described for aquatic Covered Species and terrestrial Covered Species separately because the types of impacts are different for these two groups of species. Impacts of the Covered Activities on aquatic Covered Species are largely assessed through evaluation of the indirect effects of Covered Activities on watershed processes that can affect their habitats. Impacts on the terrestrial Covered Species are primarily the result of direct habitat modification, and incidental take can be estimated from the spatial and temporal distribution of habitat modification that will occur. Because of these differences, the structure of the discussion of impacts on aquatic species (Section 6.1) differs slightly from that used to describe impacts on terrestrial species (Section 6.2).

The subsection on aquatic Covered Species: (1) summarizes the biological requirements of the aquatic Covered Species; (2) describes (in general terms) how forest management activities can influence various watershed processes (e.g., hydrologic cycle), affecting habitat for the aquatic Covered Species; and (3) describes (specifically) how the Covered Activities, including HCP implementation, influence various watershed products (e.g., stream temperature), which can result in incidental take of aquatic Covered Species; and (4) evaluates the potential impact of the taking on the local and regional populations of aquatic Covered Species, including potential benefits of the conservation program.

The subsection on northern spotted owl (6.2.1): (1) summarizes the biological requirements of the northern spotted owl; (2) describes the types of impacts to the northern spotted owl that can result from the Covered Activities; and (3) quantifies the number of individual northern spotted owls that could be incidentally taken as a result of Covered Activities, and evaluates the potential impact of the taking on the local and regional owl populations, including potential benefits of the conservation program.

The subsection on Yreka phlox (6.2.2): (1) summarizes the biological requirements of the Yreka phlox; (2) describes the types of impacts to Yreka phlox that can result from the Covered Activities; and (3) describes how the conservation measures for Yreka phlox included in the Terrestrial Species Conservation Program avoid adverse effects to Yreka phlox.

In the following discussion, various terms used have specific meanings. These are:

- Covered Species—Species for which incidental take will be authorized in the Incidental Take Permits, identified in Chapter 1.
- Aquatic Covered Species—Covered Species that reside primarily in aquatic habitats; these species are fully described in Section 3.2.

- Terrestrial Covered Species—Covered Species that are primarily terrestrial; these species are fully described in Section 3.3.
- Covered Activities—Include specific activities related to FGS's forest and road management and activities relating to HCP implementation, identified in Chapter 2.
- Impacts—Direct or indirect effects on Covered Species or their habitats, both beneficial and adverse. The term "effects" has the same meaning for purposes of the following discussion.

6.1 Effects on Aquatic Covered Species

The aquatic species covered under this HCP ("aquatic Covered Species") are the Klamath and Upper Trinity Rivers Chinook salmon ESU, the Southern Oregon/Northern California Coasts coho salmon ESU, and the Klamath Mountains Province steelhead ESU, all of which belong to the broad group of fishes referred to commonly as "Pacific salmon." In recent years, the decline and extinction of Pacific salmon populations has been linked, in part, to habitat loss and degradation in their spawning and rearing streams (Nehlsen et al. 1991). Many of the proposed Covered Activities under this HCP have the potential to alter watershed processes and adversely affect aquatic habitat. Thus, the assessment of the effects from implementing the HCP is primarily habitat based.

Available information indicates that many populations of salmon and steelhead are limited by the existing condition of aquatic habitat, and this habitat was degraded, at least partially, due to past rangewide forestry practices. Increased regulation has led to changes in forest management activities, which has resulted in an improving trend in habitat conditions for aquatic species as these habitats recover in varying degrees from past management practices and naturally occurring events, such as flooding and wildfire. Implementation of current forest practice[1] regulations is expected to continue this trend as improvements in current forest practices result in reduced short and long-term adverse effects as compared to past practices. This HCP includes conservation measures equivalent to the highest level of protection afforded under the current California Forest Practice Rules and applies them over a large portion of the FGS ownership. With these measures, in combination with additional measures intended to minimize and mitigate the effects of Covered Activities, FGS expects this HCP will accelerate the rate of improvement in aquatic habitat conditions and achieve the HCP's biological goals and objectives over the Permit Term.

Under the HCP, the Covered Activities will occur over the entire FGS ownership over the 50-year term of the Permits. Because specific locations where timber harvest will occur on the FGS ownership over the 50-year term is uncertain and will depend on future forest stand and market conditions, it is assumed that all areas may be subject to timber harvest (with the exception of designated habitat management areas such as northern spotted owl Conservation Support Areas) at some point over the term of the HCP, and any effects of this harvesting will occur during this term. Because the biological requirements of the aquatic Covered Species are similar (see Chapter 3) and the Covered Activities will affect watershed

[1] For purposes of this analysis, current forest practices are defined as the 2008 California State Forest Practice Rules, which were the rules in place at the time the HCP was written

process and products that affect aquatic habitats for all the aquatic Covered Species, the effects are described for these species as a group, rather than individually.

The discussion of effects to aquatic Covered Species that follows includes:

1. A summary of the biological requirements of the aquatic Covered Species;
2. A general description of how forest management activities can influence various watershed processes (e.g., hydrologic cycle), affecting habitat for the aquatic Covered Species;
3. A description of how the Covered Activities, including HCP implementation, influence various watershed products (e.g., stream temperature) and can result in incidental take of aquatic Covered Species; and
4. An evaluation of the potential impact of the taking on the local and regional populations of aquatic Covered Species, including potential benefits of the conservation program.

6.1.1 Biological Requirements of the Aquatic Covered Species

The biological requirements of anadromous salmonids play an important role in evaluating the potential effects of Covered Activities and developing measures that avoid or minimize those impacts. Life history attributes of Chinook salmon, coho salmon, and steelhead—including their life history, range and distribution, and specific habitat preferences—are described in Chapter 3 of this HCP. The following discussion summarizes the biological requirements of these species that could be influenced by Covered Activities and implementation of the Aquatic Species Conservation Program. Due to the similarity among species, the biological requirements of the three aquatic Covered Species are discussed collectively.

In general, the size and steepness of streams used by anadromous salmonids depends on the species' size and swimming ability. Chinook salmon, the largest anadromous salmonid species in the Klamath River system, are strong swimmers. Conditions preferred by Chinook salmon are most commonly found in mainstem rivers and large tributaries. Steelhead spawn in tributary streams and will use channels with a gradient up to 20 percent and as little as 1 meter wide, provided sufficient space and substrate for redd construction is available. Coho salmon prefer small, gravel-bottomed tributaries for spawning, and generally do not use stream reaches with gradients greater than 3 percent. Coho salmon require considerably less space for redds than either Chinook salmon or steelhead, and may spawn in streams less than 1 meter wide if suitable gravels are available.

Anadromous salmonids are coldwater species. High water temperatures can reduce growth, result in egg loss, block upstream or downstream migration, or result in mortality. While all anadromous salmonids require cold water, preferred temperature ranges and thermal tolerances vary by species and life stage. Chapter 3 identifies the specific temperature ranges and thermal tolerances for each aquatic Covered Species.

The importance of LWD to aquatic complexity and fish abundance is well documented. LWD also plays an important role in non-fish-bearing (Class II and III) channels. These channels are generally smaller and steeper (higher gradient) and have the capacity to deliver sediment directly to Class I (fish-bearing) streams. While not providing habitat for fish in these channels, LWD functions to dissipate stream energy and store sediment that could affect habitat quality in downstream areas.

The amount of in-channel LWD necessary to maintain suitable habitat conditions for anadromous salmonids is not well understood and likely variable depending on factors such as forest type, watershed geology and topography, channel type, climate, and fish species. Juvenile coho salmon are strongly associated with woody debris during freshwater rearing, particularly during the winter, when they seek deeper pools and side channels with abundant cover. In contrast, juvenile Chinook salmon often move downstream to estuary areas shortly after emergence, and therefore are less likely to be influenced by LWD loadings than coho salmon.

Pool habitat is important to all species and life stages of anadromous salmonids. By providing shelter from predators and refugia during summer low flow periods, deep pools are beneficial to juvenile salmonids. Pools also provide areas of reduced velocity that are used by juveniles for winter rearing and by adults during migration and spawning. Different pool characteristics are preferred by the different salmonid age classes and species. Young coho salmon favor deep pools with abundant cover during their freshwater residence period. Young-of-the-year steelhead and salmon are common in dammed and plunge pools; older steelhead are more common in scour pools; and coho salmon are abundant in all pool types. While the importance of pools to fish is recognized, the relationship between the amount (surface area) and frequency (pool spacing) of pool habitat and the productivity and viability of fish populations in the various streams is unknown.

The size and quality of substrate influences where and how successfully salmonids spawn and fry develop. Channel substrate is a function of parent material, the rate of sediment delivery, and the transport capacity of the channel. The suitability of gravel substrate for spawning depends mostly on fish size; larger fish (such as Chinook salmon) can use larger substrate materials than can smaller fish (coho salmon and steelhead). However, while larger fish may be capable of spawning in steep channels with coarse sediment, they may choose to use smaller gravels in lower-gradient reaches instead. Substrate conditions can affect the survival to emergence of salmonids. In general, survival to emergence, which is expressed as a percentage, decreases as the amount of fine sediment in the substrate increases.

Anadromous salmonids require access to suitable spawning areas to reproduce. Access can be restricted naturally by factors such as stream gradient, depth, or geologic formations (such as waterfalls). Other potential barriers to salmonids include dams built without fish passage facilities, improperly constructed stream crossings, and stream sections that go dry due to diversion activities.

Based on the best scientific information available, the biological requirements of the aquatic Covered Species can be summarized as follows:

- Anadromous salmonids can utilize a wide variety of stream channels, but are generally restricted to spawning in lower gradient reaches.
- Anadromous salmonids require cool water temperatures during all of their life history stages.

- LWD is important for aquatic habitat complexity; LWD also plays an important role in non-fish-bearing (Class II and III) channels.
- Juvenile coho salmon are strongly associated with woody debris during freshwater rearing, particularly during the winter, when they seek deeper pools and side channels with abundant cover.
- Pool habitat is important to all species and life stages of anadromous salmonids.
- The suitability of gravel substrate for spawning depends mostly on fish size; increasing amounts of fine sediments can adversely affect survival to emergence.
- Anadromous salmonids require access to suitable spawning areas in order to reproduce.

6.1.2 General Effects of Forest Management Activities

In general, timber harvesting and associated activities have the potential to impact all of the aquatic Covered Species through alteration of the following watershed processes: the hydrologic cycle, LWD recruitment and distribution, thermal regimes, nutrient inputs, and sediment inputs and transport. In addition, the aquatic Covered Species can be affected by Covered Activities that are not necessarily habitat-based, such as activities that influence fish passage at stream crossings.

The effects of forest management operations (including timber harvest) on aquatic life depend on many factors, and studies often produce contradictory results (Spence et al. 1996). Factors that may influence responses include species' diversity and adaptability, physical and vegetative conditions, and harvest methods. Biotic interactions and wide-ranging migratory behaviors can act to reduce impacts of habitat alterations at the local level. Independent impacts can accumulate, or interact collectively, resulting in compensatory or synergistic responses. Large natural (catastrophic) events create variable baseline conditions that can be confused with other smaller scale sources of variability. Therefore, it is difficult to separate timber harvesting effects from natural disturbance regimes (Spence et al. 1996).

This subsection describes the potential effects of forest management activities on watershed processes and products that can affect the quality of aquatic habitats. The discussion of potential effects is organized by process (e.g., hydrologic cycle) or product (e.g., stream temperature) and includes:

- Hydrologic effects
- LWD recruitment
- Stream temperatures
- Nutrient inputs and stream productivity
- Sediment input
- Fish passage

Within each category, the potential effects of forest management activities on the process or product are briefly described. This discussion is not intended to represent an exhaustive description of the available literature. For more detailed discussions of the potential effects of timber management activities on salmonid habitats and the relationship between habitat variables and the status and trends of salmon populations, readers should refer to the work of FEMAT (1993), Hicks et al. (1991), Murphy (1995), National Research Council (1996), Nehlsen et al. (1991), Spence et al. (1996), Thomas et al. (1993), The Wilderness Society (1993), and any of the numerous references contained in this rich body of literature.

6.1.2.1 Hydrologic Effects

Forest management activities can affect hydrologic processes that determine stream flows. Alteration of snow pack, enhancement of runoff throughout timber harvest units or along roads, interception of groundwater flows by roads, and alteration of evapotranspiration through changes in forest structure all have the potential to affect hydrology in the Plan Area (Beschta et al. 1995; Ziemer 1998). The primary effects of timber management activities on hydrology pertain to peak flows, low (base) flows, water yield, and run-off timing (Spence et al. 1996). In rain-dominated systems in the Coast Range, increases in peak flows, water yield, and summer flows have been observed following timber harvesting activities.

Forest management activities, such as yarding, burning, or road and skid trail construction, may alter both surface and subsurface pathways that transport water to streams (Thomas et al. 1993; Murphy 1995; Keppeler and Brown 1998). Soil compaction caused by heavy equipment can decrease infiltration capabilities, increasing surface runoff. Ditches associated with roads collect run-off and intercept subsurface flows, and route them to streams more quickly. Roads can act as first order streams and channel more water directly into larger streams (Wemple 1994).

Timber harvest and road construction alter runoff by accelerating surface flows from hillsides to stream channels (Chamberlin et al. 1991; McIntosh et al. 1994). These accelerated flows can increase peak flows during rainstorms (Ziemer 1998). Increased peak flows can have direct effects on salmon because the resulting increased stream power can scour stream channels, killing incubating eggs and displacing juvenile salmon from winter cover (McNeil 1964; Tschaplinski and Hartman 1983). The effect of timber harvesting on peak flows generally diminishes with increasing watershed size and with increasing flow magnitude (Beschta et al. 2000; Ziemer 1998).

Removal of vegetation reduces evapotranspiration, which increases the amount of water that infiltrates the soil and ultimately reaches the stream. Increases in soil moisture can contribute to an increased risk of mass wasting (Sidle et al. 1985; Schmidt et al. 2001). The effect of any reduction in evapotranspiration is typically short lived (3-5 years), as regrowth of vegetation may consume more water than pre-timber harvest amounts (Harr 1977).

Streams draining recently logged areas may see increased summer flows (Keppeler 1998). Many paired watershed studies have found increases in summer base flow and total water yield (Bosch and Hewlett 1982). Increased summer flows can result in both positive and negative effects for fish and aquatic resources. Increases in summer flows generally diminish after a few years.

6.1.2.2 LWD Recruitment

In-stream woody debris is recognized as a fundamental habitat component for salmonids in forested settings. The physical processes associated with LWD include sediment sorting and storage, retention of organic debris, and modification of water quality (Bisson et al. 1987).

In-stream LWD provides important rearing habitats (pools), protective cover from predators, and elevated stream flow; helps sort and retain gravels used for spawning; and provides a substrate and source of organic material for the in-stream community of aquatic invertebrates (Murphy et al. 1986; Bisson et al. 1987). A decreased supply of LWD can result in increased vulnerability to predators, reduction in winter survival, reduction in carrying capacity, lower spawning habitat availability, reduction in food productivity and loss of species diversity (Spence et. al. 1996).

Timber harvest in riparian zones may remove trees that could otherwise contribute to in-channel LWD. Timber harvest and the presence or construction of roads in riparian areas may also result in a decline in the recruitment of LWD and a resulting reduction of in-channel LWD. Roads in riparian zones may reduce LWD recruitment from near the stream by removing their surface area from tree production, and also by intercepting trees that fall toward the channel. Upslope processes that may deliver LWD to streams include mass wasting and debris torrents (Spence et al. 1996). In general, upslope processes in the Plan Area are believed to contribute a small amount of LWD relative to riparian areas (see Appendix E *Computation of Potential LWD Contribution from Riparian Stands* and Benda et al. 2003). Removal of trees on areas prone to mass wasting or debris torrents could reduce this source of LWD and elevate the risk of these types of slope failures.

6.1.2.3 Stream Temperatures

Increases in summer water temperatures can have negative impacts on salmonids (Beschta et al. 1987). Potential impacts to salmonids are a reduction in growth efficiency, an increase in disease susceptibility, a change in age of smoltification, loss of rearing habitat, and shifts in the competitive advantage of salmonids relative to non-salmonid species (Hughes and Davis 1986; Reeves et al. 1987; Spence et. al. 1996). However, increased light levels and increased autotrophic production can also have a positive effect through an increase in food production and higher growth rates. Little is known regarding the potential impacts of greater daily fluctuations in temperature or colder nighttime and winter temperatures on streams with reduced canopy and aggraded channels. In the Plan Area, stream temperature monitoring suggest that water temperatures are not limiting to salmonids in many drainages.

Removal of the riparian canopy can result in elevated summer water temperatures, often in direct proportion to the increase in incident solar radiation that reaches the water surface (Chamberlin et al. 1991). High levels of canopy coverage are believed to contribute to stream shading and maintenance of cool stream temperatures. The influence of shading provided by riparian vegetation on stream temperature differs depending on a variety of factors, including stream size, position in the watershed, drainage orientation, and local climactic influences. Exposed channels will also radiate heat more rapidly at night.

6.1.2.4 Nutrient Inputs and Stream Productivity

In general, primary production in salmonid streams is driven by allochthonous inputs (derived from outside the aquatic system typically through detrital inputs). Where present, hardwoods are one of the most important sources of detrital inputs to lower order streams (Murphy and Meehan 1991). Hardwood leaves rapidly decompose in the stream, providing a source of nitrogen for primary production. Conifer needles take longer to decay and have far less nitrogen. Woody debris, even twigs and small branches, has limited nutritional value to streams because it decays so slowly and is very low in nitrogen (Murphy and Meehan 1991). Primary production in salmonid streams throughout the Pacific Northwest and Northern California is thought to be naturally limited due to low levels of nitrogen (Allan 1995; Triska et al. 1983). In addition, the productivity of lower order channels may also be limited by light (Triska et al. 1983).

Timber harvest in riparian areas can affect productivity of streams in several ways. Removal of canopy cover increases the amount of sunlight reaching the stream and can increase periphyton (algal) production (unless it is limited by nitrogen), which may increase the abundance of invertebrates and fish because algae is a higher quality food than leaf or needle litter. Increased algal production can increase the abundance of invertebrate collectors, which in turn can increase the abundance of predators, such as juvenile salmonids (Murphy and Meehan 1991). Studies indicate that nutrients increase in the first few years following logging (Hicks et al. 1991), but effects on overall salmonid production have not been documented (Hicks et al. 1991).

6.1.2.5 Sediment Input

Timber harvest and the construction and use of the associated road system have the potential to increase sediment inputs to area streams. Increased sediment inputs from such activities can reduce the quality of aquatic habitats for the aquatic Covered Species through reduced depth of pools, increased embeddedness and fining of gravel and cobble substrates, and the effects of chronic turbidity on the aquatic Covered Species.

Sediment of varying size from the smallest fines to large boulders can be generated from a variety of different sources involving different erosion processes, including surface erosion and mass soil movement. Surface erosion tends to generate smaller particles sizes, which are first detached and then transported downslope. The two hydrologic processes that transport surface erosion are channelized erosion by constricted flows (rilling and gullying), and sheet erosion in which soil movement is non-channelized (rolling and sliding) (Swanston 1991). Increases in channelized and non-channelized erosion occur when the infiltration capacities of soils are reduced by management activities, large storm events or fires. Chamberlin et al. (1991) reported that the potential for surface erosion is directly related to the amount of bare soil exposed to rainfall and runoff. Surface erosion by rainsplash and sheetwash processes from roads (including cut slopes), watercourse crossings, landings, skid trails, and ditches may all contribute to substantial increases in surface erosion and increased delivery of sediments into stream channels (Reid and Dunne 1984; Luce and Black 1999; Duan 2001). In general, surface erosion does not account for a large portion of the total sediment budget in a watershed (Hagans and Weaver 1987; Marron et al. 1995; Rice and Datzman 1981).

In steep mountainous terrain, mass soil movement is a major type of hillslope erosion and sediment source in watersheds (Sidle et al. 1985; Swanston 1991). The frequency and magnitude of mass soil movements depends on hillslope gradient, level of soil saturation, composition of dominant soil and rock types, degree of weathering, type and level of management activities, and occurrence of climatic or geologic events. Mass soil movements are usually episodic events, and tend to contribute significant quantities of sediment and organic debris to stream channels over time intervals ranging from minutes to decades (Swanston 1991). Forest management practices can affect slope stability by changing vegetative cover, hillslope shape, and water flow above and below the ground surface. Different forest management operations have distinct effects on the factors that control slope stability.

Timber harvest activities (falling and yarding) not directly associated with roads can increase direct sediment input to streams through surface erosion and mass wasting. Timber harvest may increase the amount of bare soil exposed to rainfall and runoff, leading to increased surface erosion. The occurrence of mass soil movement may also increase after timber harvesting, depending in part on the type and intensity of harvest methods (Rood 1984; Swanson et al. 1987). With respect to shallow landslide processes and slope stability, harvesting trees reduces effective soil cohesion by disrupting networks of interlocking roots from living trees, and increases soil moisture by reducing interception of precipitation and evapotranspiration of soil water. Deep-seated landslides may also be affected by the hydrologic changes associated with reduced evapotranspiration and reduced canopy interception during rainstorms (CDMG 1999).

Research has shown that road construction for timber harvesting can cause significant increases in erosion rates within a watershed (Haupt 1959; Gibbons and Salo 1973; Beschta 1978; Cederholm et al. 1980; Reid and Dunne 1984; Swanson et al. 1987; Furniss et al. 1991). Through creation of cut slopes and fill slopes too steep to be stable, deposition of sidecast material (spoils) that overburdens and/or oversteepens slopes, and diversion and/or concentration of both surface and subsurface runoff, road construction can lead to increases in the incidence of shallow mass soil movement. Deep-seated landslides (earthflows and rockslides) may be destabilized by undercutting of the landslide toe (e.g., by streambank erosion or excavation of road cuts), by adding significant mass to the landslide body (e.g., disposing of spoils from grading or excavation projects), or by significantly altering the groundwater conditions in a landslide (e.g., diversion of road drainage into head scarps or lateral scarps) (Transportation Research Board 1996, Chapter 16).

6.1.2.6 Fish Passage

Culverts improperly installed in fish bearing watercourses may be impassable to both adult migration and juvenile fish dispersal due to 1) high velocities at the inlet, outlet, or within the culvert; 2) a high entrance jump into the culvert outlet; 3) shallow water depths; or 4) lack of resting pools at the culvert inlet, outlet, or within the culvert. The potential effects of these barriers on adults of the fish species include delaying access to spawning habitat or blocking access to spawning habitat and rearing habitat to their offspring. The potential effects to juveniles include denying access to rearing habitat and velocity or temperature refugia.

6.1.2.7 Summary of General Effects

The general effects of forest management activities on watershed processes and products can be summarized as follows:

- Forest management activities, including timber harvest, can adversely affect aquatic species through alteration of various watershed processes and products.
- Increased runoff in timber harvest units or along roads, interception of groundwater flows by roads, and alteration of evapotranspiration through changes in forest structure

all have the potential to alter hydrology and affect aquatic Covered Species through changes in channel morphology, pool habitat, substrate deposition, and stream temperatures.

- Timber harvest and the presence or construction of roads in riparian areas can result in a decline in the recruitment of LWD and a resulting reduction of in-channel LWD. Removal of trees on areas prone to mass wasting or debris torrents can also reduce this source of LWD.
- Removal of the riparian canopy can result in elevated summer water temperatures, often in direct proportion to the increase in incident solar radiation that reaches the water surface.
- Timber harvest in riparian areas can affect nutrient inputs and productivity of streams, thus affecting aquatic Covered Species through changes in food availability.
- Timber harvest activities (falling and yarding) not directly associated with roads can increase direct sediment input to streams through surface erosion and mass wasting. Road construction for timber harvesting can cause significant increases in erosion rates within a watershed, altering aquatic habitats through increased deposition of fine sediment.
- Improperly installed culverts at stream crossings of fish bearing watercourses may be impassable to both adult and juvenile fish.

6.1.3 Potential Impacts of Covered Activities

This subsection analyzes the potential effects of Covered Activities, including implementation of the HCP conservation measures (Chapter 5), on aquatic Covered Species through changes in the watershed processes and products identified above. In general, only some of the Covered Activities will influence each of the watershed processes and products. Therefore, only the impacts of specific Covered Activities and conservation measures designed to minimize and mitigate these impacts are described below. The following discussion of potential impacts is organized by category of environmental effect.

6.1.3.1 Potential Impacts Due to Altered Hydrology

Timber harvest and related activities can affect the hydrologic cycle, resulting in altered flow patterns, through a reduction in both vegetative cover that intercepts rainfall and in the rate of evapotranspiration by living trees at the stand level. The Aquatic Species Conservation Program contains measures for riparian management, road management, and slope stability that will act to minimize and mitigate the effects of timber harvest and related activities on hydrology. The effects of these conservation measures on area hydrology are described following the description of effects due to timber harvest.

Timber Harvest. It is anticipated that increases in peak flows and summer low flows will occur in sub-watersheds that drain recently harvested areas. Effects of harvest on hydrologic processes will be greatest where harvest is concentrated in one watershed over a relatively short time period. Table 6-1 presents the estimated maximum amount of harvest (by decade) for the plan area by drainage. The purpose of Table 6-1 is to provide a qualitative measure of the potential for increases in peak flows due to harvesting. As indicated in Table 6-1, the maximum amount of harvest anticipated by FGS in individual drainages that support anadromous salmonids (Class A and Class B designated lands) rarely exceeds 15 percent of the total area in each of the first three decades, and never exceeds 50 percent of the total drainage area. Where the maximum harvest exceeds 15 percent, it is generally in smaller drainages where FGS is a major landowner. Given the resolution of the data and the many variables that affect hydrology, it is impossible to quantify the specific hydrologic responses to timber harvest. However, given that harvest rates are relatively low in most drainages, and that only a portion of the harvest would be even-aged regeneration, it is unlikely that timber harvest would have a substantial effect on peak flows or other hydrologic attributes.

TABLE 6-1
Maximum Harvest (percentage of total drainage area) Projected on the FGS Ownership

Drainage Name	Drainage Area (acres)	Decade				
		1	2	3	4	5
Class A Designated Lands						
Beaver	69,650	10.62	3.76	7.81	11.66	11.64
Big Ferry	6,270	14.46	2.76	2.41	3.22	12.58
Canyon	12,919	12.06	0.92	2.22	0.92	11.27
Cottonwood	63,540	14.06	7.25	3.80	7.32	10.21
Doggett	7,693	9.91	11.21	17.60	22.09	31.42
Dona	8,440	3.84	9.00	8.18	16.59	19.95
Dutch Creek	6,457	19.16	1.75	17.37	15.88	24.59
Empire Creek	6,038	32.48	3.39	2.09	19.00	16.80
Horse	38,969	4.08	7.93	11.60	14.26	16.69
Indian	13,851	13.49	3.66	6.54	12.61	18.72
Lumgrey Creek	5,475	28.30	0.25	6.52	22.06	21.24
Meamber	8,197	47.35	4.83	9.81	29.13	22.42
Middle Klamath	153,397	0.33	0.00	0.08	0.12	0.45
Mill	14,291	2.52	0.00	1.04	4.18	6.69
Moffett	93,843	3.02	3.25	6.13	2.33	9.21
Pat Ford	7,637	17.34	0.72	7.19	7.99	13.68
Patterson	4,027	49.27	1.34	14.86	16.58	20.38
Rattlesnake	11,444	7.28	1.79	0.21	5.10	6.22
Seiad	33,783	0.00	0.60	1.48	2.36	3.21
Class B Designated Lands						
Bogus Creek	34,557	1.11	2.28	1.84	0.12	3.07
Duzel	6,548	0.00	0.00	0.00	0.00	0.00
EF Scott	72,846	0.00	0.00	0.00	0.00	0.00
McConaughy	23,974	0.00	0.06	0.11	0.00	0.09
Willow Creek	25,025	0.42	0.24	0.89	1.58	2.31

TABLE 6-1
Maximum Harvest (percentage of total drainage area) Projected on the FGS Ownership

Drainage Name	Drainage Area (acres)	Decade				
		1	2	3	4	5
Class C Designated Lands						
Antelope Creek	19,215	0.76	0.60	0.28	0.44	1.25
Antelope Sink	28,314	0.78	1.19	0.96	1.39	1.74
Elliott Creek	21,305	10.37	8.01	6.08	14.87	10.60
Fourmile Hill	43,952	0.21	0.30	0.07	0.27	1.19
Garner Mtn	19,160	0.00	0.76	5.67	0.06	5.84
Glass Mtn	47,984	0.00	0.00	2.32	0.39	3.86
Grass Lake	55,095	2.34	3.59	9.00	6.84	11.55
Headwaters	21,043	4.08	6.75	9.76	7.84	12.01
Horsethief	58,536	0.14	0.49	3.16	2.75	5.57
Juanita Lake	28,102	0.14	0.60	1.73	2.10	2.79
Little Shasta	39,337	2.73	2.49	8.61	5.77	11.09
NW Mt Shasta	100,266	0.01	0.37	0.84	0.68	0.63
Shasta Valley	278,087	0.01	0.02	0.20	0.01	0.25
Shasta Woods	36,472	1.57	1.41	8.02	2.73	8.20

Silviculture. Silviculture is the practice of treating forests to manage tree and forest growth. The types of silvicultural methods commonly employed by FGS within the Plan Area are consistent with the methods defined and regulated in the CFPRs. As described in Chapter 2, silvicultural treatments range from thinning of young even-aged stands to timber harvest through uneven-aged and even-aged regeneration methods. FGS's silvicultural practices are designed to maintain and enhance the productivity of its timberlands by promoting prompt regeneration of harvested areas and rapid forest growth. Outside of WLPZs, timber harvest occurs under three general silvicultural regimes: (1) uneven-aged harvest, (2) even-aged thinning, and (3) even-aged regeneration. Each of the silvicultural regimes result in different harvest levels and post-harvest stand characteristics, with differing potential for impacts to aquatic Covered Species through alteration of hydrologic regimes as described in the following.

Uneven-aged Harvest. Uneven-age harvests are generally designed to maintain an inverse J-shaped distribution of tree sizes at what is considered a "normal" stocking level. Normal stocking levels are generally around 60 percent of the "full" stocking level and maximize board foot growth at the stand level. Harvests are conducted on a 10- to 20-year cycle in which stands are reduced to below normal stocking levels and allowed to regrow to normal stocking levels between harvests. Regrowth between harvests of stands at normal stocking levels averages 2 to 3 percent per year, such that harvest is targeted to remove from 20 to 30 percent of the stand volume on a 10-year harvest cycle. Where longer harvest rotations are used, a larger percentage of the stand may be harvested. Post harvest, uneven-aged stands generally have between 75 ft^2 and 120 ft^2 of basal area with an average diameter of at least 14 inches dbh, and provide at least 40 percent canopy cover. This level of retention is anticipated to provide sufficient rainfall interception and evapotranspiration to minimize the effects of uneven-aged harvest on hydrologic regimes.

Even-aged Thinning. Even-aged thinning units are intermediate treatments of mid-seral, even-aged stands designed to accelerate growth of trees. Trees over a wide diameter range are harvested, depending on the stand characteristics at the time of thinning, and whether the silvicultural method is biomass thinning or commercial thinning (see Chapter 2). In general, 20 to 30 percent of the basal area in a stand is removed during thinning activities. At least 60 percent of the overstory canopy is retained during thinning activities. Thinning of even-aged stands may occur 0 to 3 times during the term of the HCP, although some stands may be extended to higher ages through additional thinning. Retention of at least 60 percent of the overstory canopy over a broad range of diameters provides sufficient rainfall interception and evapotranspiration to minimize the effects of even-aged thinning on hydrologic regimes.

Even-aged Regeneration. Even-aged regeneration produces stands that will remain in young seral stages for up to 30 years depending on site potential and the level of stocking retained. These units are generally small, from 10 to 30 acres, and scattered on the landscape. In most cases, even-aged regeneration targets marginally stocked and/or deteriorating stands to improve their long-term productivity. Harvest methods include seed tree, shelterwood, and clearcutting. The effects of seed tree and shelterwood harvest methods are similar to those described for even-aged thinning. Clearcutting has a greater potential to alter rainfall interception and evapotranspiration through near complete removal of overstory vegetation, possibly leading to alteration of the hydrologic regime.

The potential for even-aged regeneration to alter hydrologic regimes is constrained by CFPRs that place strict limits on the size of even-aged regeneration harvest units, the distance between even-aged regeneration harvest units, and the timing of the harvest of contiguous even-aged regeneration units (14 CCR 913.1, 933.1, 953.1**)**. The net effect of these rules is that several years must elapse between initiation of timber harvesting operations on adjacent even-aged management units, depending on how long it takes to complete timber harvesting operations and reforestation efforts, and the growth rate of subsequent regeneration on the site. Even though intermediate treatments such as commercial thinning may result in transitory and minor changes in the hydrologic regime, constraints on rotation age are anticipated to provide decades of hydrologic recovery following even-aged timber regeneration utilizing clearcutting as a harvest method.

Riparian Management. Using the definitions of Class A, B, and C lands for this HCP, and the aquatic conservation measures that define WLPZ widths, approximately 1,225 acres (1.2 percent) of Class A and Class B designated land in the Plan Area is contained in Class I WLPZs. Class II WLPZs account for approximately 4,950 acres (4.8 percent) of Class A and B designated lands on the FGS ownership. ELZs along Class III watercourses make up approximately 2,485 acres (an additional 2.4 percent) of Class A and Class B designated lands in the Plan Area. Class I and II WLPZs make up approximately 1,350 acres (2.7 percent) of Class C designated lands within the Plan Area.

Class I WLPZs in Class A and Class B designated lands include inner zone areas in which an 85 percent canopy cover will be maintained with a minimum 65 percent post-harvest canopy retention in an outer zone. The same retention standards apply in Class II WLPZ inner and outer zone areas in Class A designated lands. Because the high canopy cover and tree retention standards within the inner zones along Class I and II watercourses in Class A designated lands severely limit harvest within the zone, only a small number of trees would be harvested within Class I and II WLPZs (primarily from the outer zone). In Class C lands, at least 50 percent of the overstory and 50 percent of the understory canopy will be left in a well distributed multi-storied stand. The net effect is that any hydrologic effect from "management" of this portion of the land base would likely be negligible or non-existent.

The riparian conservation measures were also designed to increase LWD recruitment through enhanced buffer widths and canopy retention standards in Class A and Class B lands. Over time, the riparian conservation measures will increase the amount of LWD in streams, which will ultimately increase overwintering habitat for juvenile salmonids. Increased LWD recruitment will mitigate the impacts of displacing juvenile salmonids that can result from altered hydrology by providing increased habitat diversity for juveniles displaced during a storm event.

Road Management. FGS expects that there will be a gradual reduction in road density on its ownership over the term of the HCP as roads are decommissioned. Road decommissioning and stabilization will result in a reduction in the amount of roads and ditches that deliver water to the channel network. Although altered peak flows still occur due to past and ongoing activities, any increase in peak flows from roads is anticipated to decline, due to the proposed road construction and upgrading guidelines that call for hydrologically disconnecting the road network, where feasible, over the term of the HCP. Since much of the road network across the FGS ownership has been constructed, the effects of road-related peak-flow increases will diminish over the term of the HCP as roads are upgraded to HCP standards.

Future road construction in the Plan Area is anticipated to consist primarily of short temporary spurs designed to locate landings at stable areas outside the wider WLPZs. These temporary roads will generally be utilized for one harvest season and then decommissioned. New road construction is expected to average less than 1 mile per year. At the same time, FGS plans to decommission many of its seasonal roads, such that there will be a gradual reduction in active road mileage on its ownership over the term of the HCP. The reduction in road mileage will contribute to improved hydrologic conditions anticipated over the Permit Term.

Hydrologic connectivity of roads was estimated during road inventories conducted in the Doggett and West Fork Cottonwood drainages. In West Fork Cottonwood, approximately 4 miles (13 percent) of the road network had a hydrologic connection. In the Doggett drainage, 7.6 miles (14 percent) of the road network was hydrologically connected. Much of the road mileage on the FGS ownership that is hydrologically connected consists of segments with inside ditches that are controlled by USFS through cooperative maintenance agreements. The remainder is made up of short road segments located at stream crossings. Because much of the road network exhibiting hydrologic connectivity is controlled by the USFS through cooperative maintenance agreements, FGS will be unable to hydrologically disconnect a large portion of the road network. Approximately 10 to 20 percent of hydrologically connected roads over which FGS has jurisdiction will be disconnected within the first 5 years. This is an average of 3 to 6 miles per year being disconnected with added road and ditch relief structures or road decommissioning. The reduction in hydrologic connectivity will contribute to improved hydrologic conditions anticipated over the Permit Term.

Through the use of decreased cross-drain and rolling dip spacing, and outsloping, as specified in the FGS Road Management Plan – Operations Guide (see Appendix B), the amount of concentrated surface runoff at any point will decrease. Ditch water will be dispersed onto the forest floor where it can infiltrate and reduce the effects of increased peak flow caused by the road network. The reduction in concentrated runoff will contribute to improved hydrologic conditions anticipated over the Permit Term.

Slope Stability Measures. The Aquatic Species Conservation Program includes measures designed to prevent management-related increases in sediment delivery from unstable landforms, such as inner gorges, headwall swales, and active landslide areas. While these conservation measures were developed to minimize mass wasting and sediment delivery to Plan Area streams, they will likely contribute to minimizing hydrologic effects due to timber harvest by limiting operations and retaining stands on unstable areas.

Other Covered Activities. The effects of minor forest product removal, fire prevention, and other activities (use of roads, landings, and log decks, and in-stream habitat restoration activities) on area hydrology would be minimal as these activities have little (if any) direct impact on water availability and use because they do not result in substantial vegetation removal or alteration of the pathways through which runoff reaches streams. Indirect effects on hydrology from silviculture and stand regeneration and improvement are anticipated to be beneficial as these activities maximize growth of stands and replace harvested trees providing soil surface cover and help to maintain evapotranspiration.

6.1.3.2 Potential Impacts Due to Changes in LWD Recruitment

Covered activities that can influence the supply of woody debris to streams include: (1) riparian management including delineation of WLPZs and harvest activities within WLPZs, (2) harvest on inner gorges and headwall swales, and (3) road construction and maintenance. Specific measures are included in the Aquatic Species Conservation Program to minimize the potential for these activities to impact recruitment of LWD.

Riparian Management. One of the objectives of riparian management is to ensure that an adequate number of appropriately sized trees are maintained in the stand at all times to maintain and enhance the potential contribution of functionally-sized LWD through time. The abundance and distribution of LWD in a stream is a function of several variables, including tree growth, tree mortality, bank erosion, mass wasting, stream transport, and decay. Since all of these factors will likely vary from one region to another—and some of the variables are difficult to estimate over large areas (e.g., relative contribution of LWD through tree mortality, windthrow, bank erosion and mass wasting)—it is impossible to define in-stream targets for LWD pieces or volumes, and impractical to manage riparian forests to meet such targets in the face of environmental variability. Instead, FGS has chosen to manage its riparian forests to provide the potential for in-stream LWD to be generated over time. Large woody debris “potential” refers to the number of trees in the adjacent riparian stand that have the potential to contribute wood to the stream of the appropriate size to be functional. These pieces may be recruited through a variety of methods as the stand ages. For example, bank erosion/undercutting, mortality, windthrow, and landslides (within the adjacent stand or that pass through the stand) can all result in LWD inputs to the stream from the adjacent stand.

The width of the WLPZ is critical in determining how much woody debris is available for recruitment. Many studies and modeling efforts have examined the role of buffer widths in providing woody debris to streams (Murphy and Koski 1989; McDade et al. 1990; Van Sickle and Gregory 1990; Reid and Hilton 1998). In general, these studies indicate that riparian buffer widths equal to one-site potential tree height are adequate to provide for nearly unimpaired wood recruitment from streamside stands. In developing a wood budget for tributaries of the Trinity River, probably the closest geographically to the Plan Area, Benda et al. (2003) found that in-stream LWD in this area is derived from a number of sources, including bank erosion (42 percent), mortality (39 percent), landslides (17 percent), and debris flows (1 percent). Where a source could be determined, 80 percent of the wood entered the channel from within 19 meters (62 feet) of the stream edge (Benda et al. 2003).

The simplest means to assess the effectiveness of streamside buffer widths is to assume that wood recruitment is derived only from tree mortality and windthrow. Using this approach, the potential future recruitment of LWD can be crudely estimated based on a source-distance curve for coarse woody debris. Recruitment may also occur from upslope areas; this process is discussed later in this subsection.

To develop an empirical LWD source-distance curve applicable to the Plan Area and FGS's silvicultural methods, a spreadsheet model was developed to calculate the potential contribution (volume) of LWD from any stand, given the diameter and height distribution of trees in the stand. The model utilizes standard geometric equations (see e.g., Van Sickle and Gregory 1990) to determine the potential contribution of any tree given its diameter and height and its distance (randomly generated) from the stream edge (see Appendix E for a complete description of the model). The modeled stand was developed from stand inventory data for an actual stand in the Cottonwood drainage, and is representative of approximately 60 percent of the stands currently found in the Plan Area. To determine the "site potential" of this stand, its growth was modeled using ORGANON for a period of 50 years with no management. In this way, the analysis accounts for tree growth through which trees become "recruitable" and provide more potential LWD volume as time passes. Thus, the modeled stand represents riparian stand conditions that would be present at the end of the Permit Term if no management (harvest) occurred, and gives an estimate of the "site-potential" recruitment potential of riparian stands in the Plan Area.

Class I Watercourses. In drainages with anadromous salmonids (Class A and B designated lands), the minimum WLPZ width along Class I (fish bearing) watercourses is 150 feet, with 85 percent overstory canopy retention in the inner zone (0 to 75 feet) and 65 percent overstory retention in the remaining outer zone (see Section 5.2.2). Because the high canopy cover and tree retention standards within the 75-foot inner zone severely limit harvest within the zone, it is likely that only a small number of trees would be harvested within Class I WLPZs (primarily from the outer zone). Occasionally, as adjacent stands are harvested, WLPZs will be lightly harvested to remove diseased trees or enhance riparian functions by encouraging growth on fewer trees. It is anticipated that harvest would result in the removal of 1 to 10 trees per acre on a 10- to 15-year cycle. Most of the WLPZs are likely to remain unharvested for many years as they grow to reach the canopy retention requirements.

Using the LWD model (see Appendix E) to predict the amount (volume) of LWD potentially recruited from the adjacent stand within 150 feet of the stream, the 75-foot wide inner zone—within which little harvest would occur—would provide approximately 95 percent of the site-potential LWD recruitment (see Figure 6-1). The remainder of the WLPZ (outer zone) also has the potential to contribute to LWD. These results indicate that the proposed riparian management measures will maintain a high level of LWD recruitment potential, and will provide for an increase in this potential through time relative to current conditions.

While the canopy retention standards are anticipated to retain a high level of LWD recruitment potential from the riparian stands, probably the most important measures relative to the potential recruitment of LWD are the tree retention and salvage standards. In Class A designated lands, FGS will retain the 10 largest conifers per 330 feet of stream (on each side of the stream) within 100 feet of the stream and trees that contribute to direct shading of pools. In Class B designated lands, at least 10 of the largest conifers within 50 feet of the stream (approximately five trees on each side) will be retained for each 330 feet of stream within the WLPZ. Retained trees will include trees that are most conducive to LWD recruitment. This will ensure that a high level of LWD recruitment potential is maintained.

Where clearcuts occur up to the edge of a riparian buffer (WLPZ), increased fall rates may exist for several years following harvest (Reid and Hilton 1998). The increased fall rate in stands adjacent to recent clearcuts may deliver woody debris at higher rates than would be expected under unharvested conditions. However, given that some trees in the WLPZ stands are currently smaller than their site potential, some of the wood may be of limited function in the channel. Further, premature recruitment of this smaller material would reduce the quantity of wood available in the future, when the trees would have been larger and more functional. Where even-aged regeneration methods and rehabilitation with the same effects as a clearcut are adjacent to a Class I WLPZ, a 25- to 50-foot special operating zone will be established where understory and mid-canopy conifers and hardwoods will be retained. The special operating zone will extend upslope from the WLPZ boundary and is expected to reduce the premature recruitment rates and contribute to retaining the LWD recruitment potential from the adjacent stand.

Overall, the riparian management measures along Class I watercourses are expected to maintain a high level of LWD recruitment potential, and will provide for an increase in this potential through time relative to current conditions. Increased LWD recruitment will enhance the quality of existing aquatic habitats and mitigate the impacts on juvenile salmonids that can result from altered hydrology by providing increased habitat diversity for juveniles displaced during a storm event.

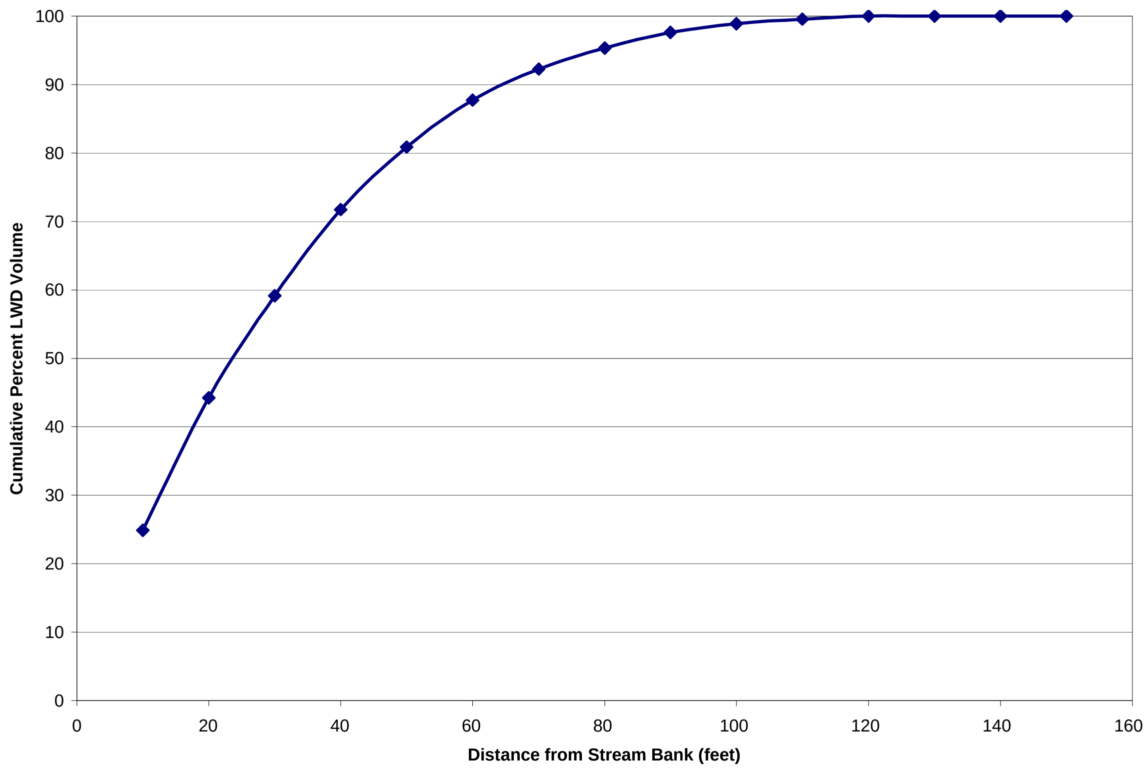

FIGURE 6-1
Relationship Between Distance from Stream Bank and Potential LWD Recruitment (volume) from Older Riparian Stand (50-year simulation) as Predicted by LWD Recruitment Model Using Random Tree Positions (see Appendix E).

Class II Watercourses. LWD provides functions similar to those provided in Class I watercourses, but it also has some unique functions, particularly in the smaller headwater streams. The piece size that is functional tends to decrease as the stream and associated hydraulic energy of the stream decreases. In addition, pool habitat is more likely to be formed by bedrock and boulders in small confined channels. As a result, LWD recruitment is less of a conservation priority in these streams and much of the benefit of the Class II WLPZs is thought to be for the maintenance of stream temperatures, sediment storage, and bank stability. Even so, it is still important that there are adequate sources of LWD for these channels into the future.

Class II watercourses in drainages with coho salmon (Class A designated lands) will have a WLPZ width of 100 feet. Canopy cover retention along Class II watercourses in Class A designated lands would average 85 percent within 50 feet of the stream and 65 percent outside of this inner zone. Similar to the Class I WLPZs in these drainages, the high retention standards in the inner zone of Class II WLPZs are anticipated to limit harvest to less than 10 trees per acre on a 10- to 15-year cycle. In addition, the measures in this HCP restrict salvage operations in Class II streams in drainages with anadromous salmonids (Class A and B designated lands). Modeling results indicate that this 50-foot inner zone can provide around 90 percent of the site-potential LWD recruitment from the adjacent stand. Retaining large dead, dying, or diseased trees will further contribute to the high level of

LWD recruitment potential from stands adjacent to these streams. Where even-aged regeneration methods and rehabilitation with the same effects as a clearcut are adjacent to a WLPZ, a 25- to 50-foot special operating zone will be established where understory and mid-canopy conifers and hardwoods will be retained. The special operating zone will extend upslope from the WLPZ boundary and is expected to reduce the premature recruitment rates and contribute to retaining the LWD recruitment potential from the adjacent stand.

Overall, the riparian management measures along Class II watercourses are expected to maintain a high level of LWD recruitment potential, and will provide for an increase in this potential through time relative to current conditions. Increased LWD recruitment will contribute to the maintenance of stream temperatures, sediment storage, and bank stability in Class II watercourse and ensure that they will continue to provide a source of LWD to Class I watercourses downstream.

Class III Watercourses. Riparian protection along Class III watercourses differs between Class A, Class B, and Class C designated lands. A WLPZ of 25 feet to 50 feet (depending on streamside slope) will be established in all Class lands. An ELZ of up to 50 feet, in which ground-based yarding will be limited to end-lining, will be established. In Class B and Class C lands, at least 50 percent of the understory vegetation present before timber operations shall be left living and well distributed within the WLPZ to maintain soil stability. In Class A and Class B lands, salvage operations are restricted and require retention of two dead, dying, or diseased conifer trees greater than 16 inches dbh and 50 feet tall per acre within 50 feet of Class III streams. In drainages with coho salmon (Class A designated lands), additional protection will be provided by retaining all trees within the channel zone, and trees that have boles that overlap the edge of the channel zone. The ELZ will be a minimum of 25 feet wide and up to 50 feet wide. Within the ELZ, at least 50 percent of the understory vegetation will be left post-harvest in an evenly distributed condition, and all snags, large woody debris, and countable trees 10 inches dbh or less will be retained, except where necessary to allow for cable yarding corridors, safety, or crossing construction.

In terms of wood supply to the stream network, it is anticipated that Class III watercourses will receive some fraction of the wood that would enter these watercourses under unmanaged conditions because outside of the ELZ, these areas are subject to harvest under current CFPRs. Some of this wood will be provided by the remaining snags, small diameter trees, and regrowth of stands between harvests. The retention of trees within the channel and overlapping the edge of the channel zone will contribute to in-channel LWD over the Permit Term. Maintaining or enhancing levels of in-channel LWD in Class III watercourses will contribute to maintaining habitat conditions in Class I reaches downstream by moderating streamflows and temperatures, storing sediment, and serving as a source of LWD during naturally occurring peak flow events that can trigger debris slides.

Harvest on Inner Gorges and Headwall Swales. Geologic processes can be important in providing LWD to streams, and in some situations, they may be the primary mechanism by which LWD reaches streams. In particular, shallow rapid landslides have the potential to deliver large amounts of LWD when they form on connected headwall swales or within inner gorges. In addition, debris torrents from small headwater Class II and III watercourses can be an important source of LWD when they empty directly into Class I or large Class II watercourses.

The Aquatic Species Conservation Program contains measures designed to reduce the incidence of management-related mass wasting. Two landforms are identified; they have a high likelihood of failure and can affect delivery of LWD to watercourses based on past observations. Specific measures are applied to: (a) inner gorges, and (b) headwall swales. Proposed protective measures on these landforms are discussed below in terms of their potential for influencing delivery of woody debris to watercourses. Other slope stability measures for shallow and deep-seated mass wasting hazard zones are designed to minimize the potential for management to influence the rate of failure and delivery of sediment to Plan Area streams, and would have little effect on the recruitment of LWD.

Inner Gorges. In drainages with anadromous salmonids (Class A and B designated lands), where an inner gorge extends beyond a Class I WLPZ and slopes are greater than 55 percent, a special management zone (SMZ) will be established where the use of even-aged regeneration methods is prohibited, and a minimum average overstory canopy of 60 percent will be retained. The SMZ shall extend upslope to the first major break-in-slope to less than 55 percent for a distance of 100 feet or more, or 300 feet as measured from the watercourse or lake transition line, whichever is less. On Class A designated lands, where an inner gorge extends beyond a Class II WLPZ, an SMZ will be established that extends upslope to the first major break-in-slope to less than 55 percent for a distance of 100 feet or more, or 200 feet as measured from the watercourse or lake transition line, whichever is less. All operations on slopes exceeding 65 percent within an inner gorge of a Class I or II watercourse shall be reviewed by a Professional Geologist prior to plan THP approval, regardless of whether they are proposed within a WLPZ or outside a WLPZ.

As described previously under Riparian Management, the WLPZs established along Class I and Class II watercourses will provide for a high level of LWD recruitment potential. Assuming that the canopy retention standard will result in retention of at least 60 percent of the existing trees (few, if any, stands in the Plan Area have 100 percent canopy cover), selective harvest within the SMZ will retain at least 60 percent of the potential LWD recruitment compared to unmanaged conditions in the SMZ and, in the event of a slope failure within the inner gorge, will deliver any wood within the failure area. Requiring geologic review of all operations on steep (greater than 65 percent) slopes within the inner gorge will ensure that proposed activities do not present a greater risk of slope failure and may require that harvest be restricted beyond the overstory canopy retention standards.

Headwall Swales. Headwall swale identification will be based primarily on field observations by trained and qualified personnel of slope qualities that are characteristic of the landform. A computer model, SHALSTAB, will be used to generate a map depicting areas of convergent topography to potentially be treated as headwall swales. This modeling will be used as a screening tool to identify areas of the landscape where headwall swales are likely to occur, but will not necessarily be used to delineate harvest boundaries.

Where harvesting is proposed on a connected headwall swale, it shall be reviewed by a Professional Geologist to ensure that proposed activities do not present a greater risk of sediment delivery from mass wasting. Only the selection regeneration method or commercial thinning intermediate treatment may be utilized on connected headwall swales, and a minimum average overstory canopy of 60 percent will be retained. Assuming that the canopy retention standard will result in retention of at least 60 percent of the existing trees (few, if any, stands in the Plan Area have 100 percent canopy cover), harvest within the SMZ will retain at least 60 percent of the potential LWD recruitment compared to unmanaged conditions in the SMZ and, in the event of a slope failure within the headwall swale, will deliver any wood within the failure area.

Road Construction and Maintenance. Many of the roads paralleling streams are key haul routes into the watershed and will be maintained for use over the 50-year term of the HCP. There are currently 84 miles of roads within Class I and Class II WLPZs, 19 miles of which are USFS Cooperative roads. Very little mileage of new streamside roads will be constructed over the term of the HCP. It is anticipated that less than 1,000 feet of new streamside road would be constructed per year during the term of the Permits, most new streamside roads would be for temporary use only. The presence of streamside roads has likely decreased the overall supply of wood available to be recruited to the stream. FGS does not expect an appreciable reduction in the effects that road construction and interception of upslope wood will have on recruitment patterns from riparian zones, as the area of roads is approximately 2 percent of the total area within Class I and II WLPZs. Salvage of trees that fall across existing or new roads will be limited to the portion of the tree bole upslope of the road. Generally this wood is not harvested unless it occurs in quantities large enough to make a load, requiring that several large trees are available in a small area. Trees within WLPZs that are felled to facilitate stream crossing upgrades, provide cable yarding corridors, or for safety reasons that are less than 50 percent merchantable will be left on site; others will be yarded unless prohibited by other provisions of this HCP. Daylighting within the WLPZ may occur for visibility purposes, not necessarily for drying out roads. Daylighting is limited to limb removal or occasional sapling removal, and is not anticipated to affect LWD recruitment.

Other Covered Activities. The effects of minor forest product removal, fire prevention, and other activities (use of roads, landings, and log decks; and in-stream habitat restoration activities) and other Covered Activities on LWD recruitment would be minimal, as these activities have little (if any) direct impact on LWD recruitment patterns. Indirect effects on LWD recruitment from these activities are also expected to be minimal.

6.1.3.3 Potential Impacts Due to Altered Stream Temperatures

One of the objectives of riparian management is to ensure that an adequate number of trees are maintained in the stand at all times to maintain and enhance stream shading, thus protecting stream temperatures through time. Although the relationship between canopy cover and stream shading likely varies on a site-specific basis, it is believed that a high level of canopy coverage will maintain a high level of stream shading provided by the adjacent riparian stand and protect stream temperatures during the Permit Term.

Riparian Management. The proposed conservation measures that may directly influence stream temperature are the riparian management measures establishing WLPZs along Class I and Class II watercourses. There would be little influence of the riparian measures along Class III watercourses because these watercourses are dry much of the year except during and immediately following rainfall when ambient air temperatures are cool and water temperatures are generally not a concern for salmonids.

In drainages with anadromous salmonids (Class A and B designated lands), the minimum width of WLPZs on Class I (fish bearing) watercourses is 150 feet with 85 percent overstory canopy retention in the inner zone (75 feet) and 65 percent overstory canopy retention in the remaining outer zone. In Class A designated lands, sufficient trees shall be retained within Class I WLPZs to maintain the pre-harvest level of direct shading to pools. In drainages with coho salmon (Class A designated lands), WLPZs will be established along Class II watercourses with a width of 100 feet. Canopy cover retention in these Class II WLPZs would average 85 percent within 50 feet of the stream and 65 percent outside of this inner zone. These retention standards will ensure that there will be almost no loss in canopy in the critical inner zone where stream shading would have the greatest potential to affect stream temperatures. There could be an immediate net reduction in canopy cover in the outer zones following timber harvest, which would be replaced within 5-10 years by recovery of the remaining tree crowns.

Effects on Canopy Coverage. Murphy and Hall (1981) visually estimated forest canopy to range from 40 to 95 percent in unmanaged forests in the western Cascade Mountains, Oregon. Brazier and Brown (1973) estimated that angular canopy density (ACD) within unmanaged stands of the southern Cascade Mountains and coast range of Oregon approximated 80 percent. Steinblums et al. (1984) found that ACD in the Cascade Mountains of western Oregon averaged 62 percent, while ACD for northern California private lands averaged 70 percent (Erman et al. 1977). Beschta et al. (1987) concluded that 80 to 90 percent shade canopy is representative of unmanaged forests in the Pacific Northwest. Retention of 85 percent canopy cover within the inner zones of WLPZs along both Class I and II watercourses in drainages with coho salmon (Class A designated lands) will provide canopy coverage similar to that observed in unmanaged stands.

Effects on Stream Shading. Based on review of numerous investigations, Johnson and Ryba (1992) concluded that forested buffer widths greater than 100 feet generally provide the same level of shading as that of an old-growth forest stand. Other authors (e.g., Beschta et al. 1987; Murphy 1995) have also concluded that buffers greater than 100 feet provide adequate shade to stream systems. The curves presented in FEMAT (1993) suggest that 100 percent effectiveness for shading is approached at a distance of approximately 0.75 tree heights from the stream channel. Assuming a tree height of 90 to 113 feet (100-year old Douglas-fir, site class 2 [Dunning and Reineke 1933]), a buffer width from 68 to 85 feet will provide 100 percent shading effectiveness. Class I and Class II WLPZ widths are likely to provide 100 percent shading effectiveness for protection of stream temperatures in the Plan Area. In addition, sufficient trees shall be retained within Class I WLPZs along coho streams (Class A designated lands) to maintain the pre-harvest level of direct shading to pools.

Effects on Stream Temperatures. The literature is not conclusive with respect to spatial and temporal stream temperature effects of vegetation shading (Sullivan et al. 1990; Dent and Walsh 1997; DEQ 1999). Many studies on small streams have documented the effects of removal of riparian vegetation on summer stream temperatures (Beschta et al. 1987; Brown and Krygier 1970). However, in one study stream, water temperature was unaffected except in the case of almost complete absence of trees, despite measured differences in total solar radiation related to buffer width (Brosofske et al. 1997). Even if water temperature is increased in harvested units, it may decrease within a relatively short distance (less than 300 meters) downstream when flowing through forested reaches (Zwieniecki and Newton 1999).

While high levels of canopy coverage are believed to contribute to stream shading and maintenance of cool stream temperatures, stream shading is only one of several factors that influence stream temperatures. Other factors that influence stream temperatures include season, elevation, aspect, local topography, groundwater input, tributary input, and air temperature. FGS has measured both air and stream temperatures at two locations on its ownership, allowing an analysis of the relationship between air temperature and stream temperatures.

In the Beaver drainage, air temperatures were measured adjacent to the water temperature recorder in lower West Fork Beaver Creek during a number of years. Comparing stream temperatures with air temperatures during the same time periods indicates that water temperatures exhibit the same trends observed in air temperatures (Figure 6-2). Although water temperatures at other locations in the drainage may be affected by factors other than air temperature (e.g., elevation, groundwater input), there is high correlation between water temperatures at all locations and air temperatures at the lower West Fork Beaver Creek location, and that variation in air temperature alone can explain up to 95 percent or more of the variation observed in water temperatures (Figure 6-3). Other years exhibit a similarly high correlation between water and air temperatures in the Beaver drainage (FGS unpublished data).

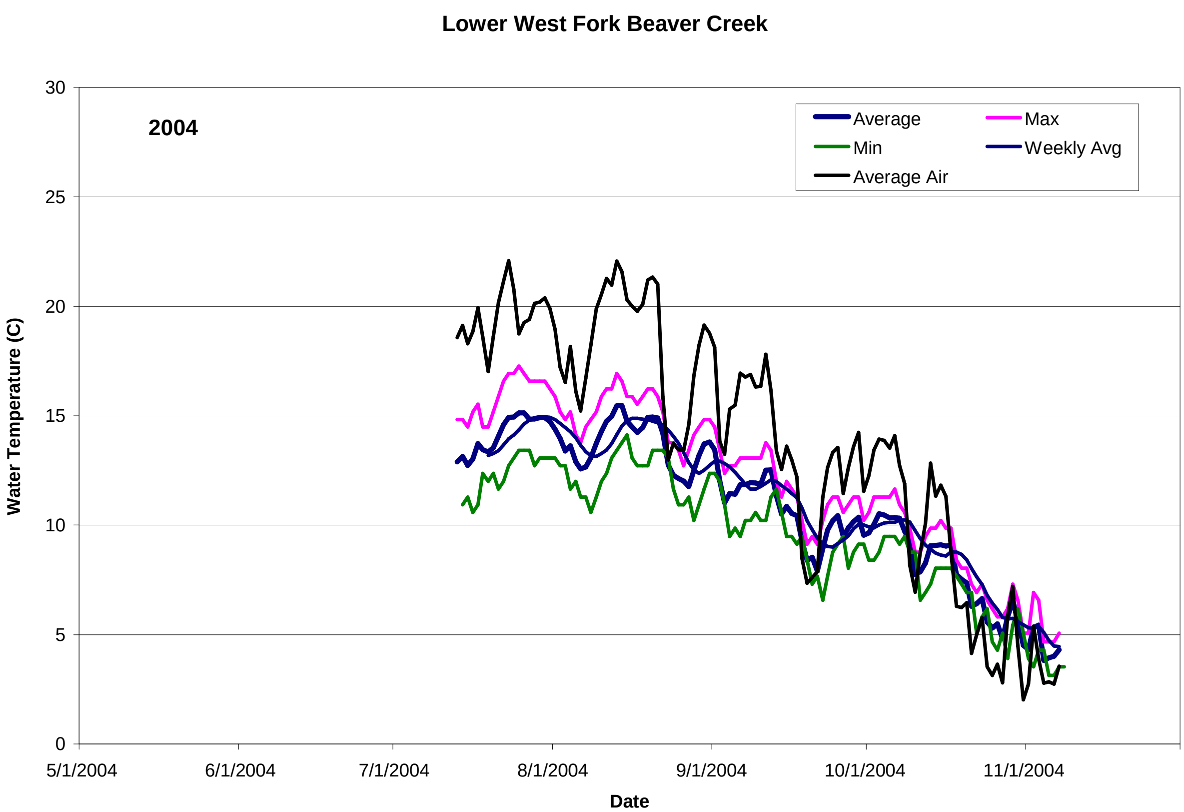

FIGURE 6-2
Air and Water Temperatures Observed in Lower West Fork Beaver Creek during 2004

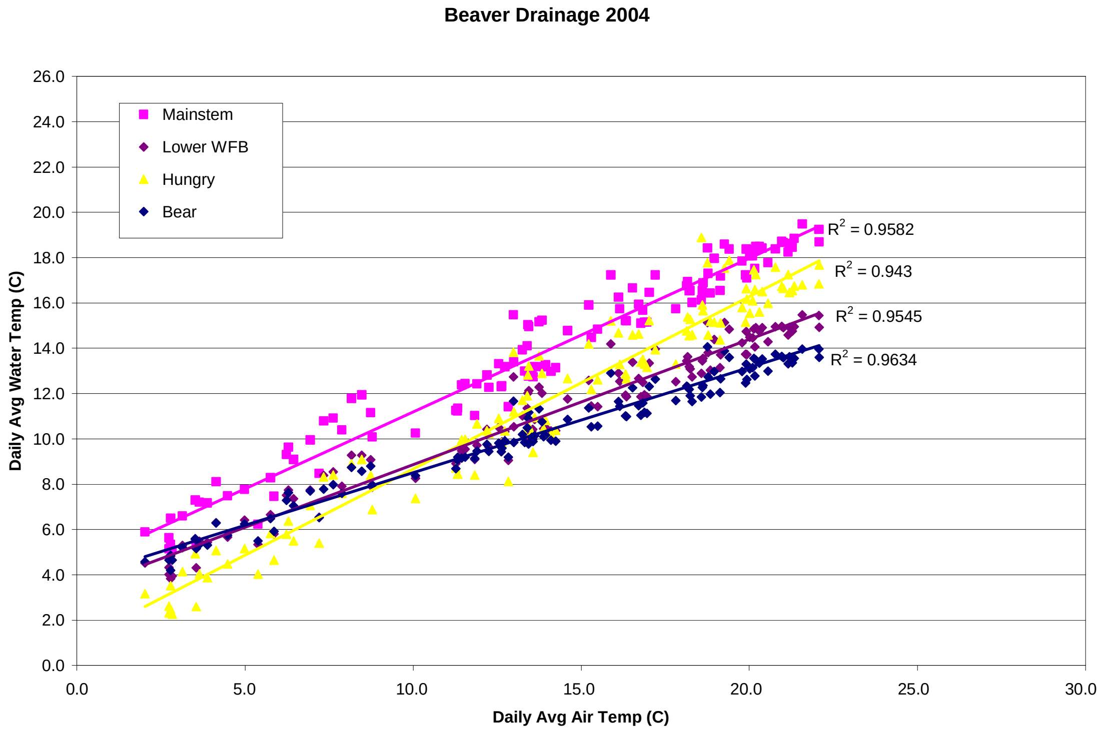

FIGURE 6-3
Relationship between Average Daily Air and Water Temperatures in the Beaver Drainage during 2004

In the Cottonwood drainage, air temperatures were measured adjacent to the water temperature recorder in West Fork Cottonwood Creek during a number of years. Similar to what was observed in the Beaver drainage, water temperatures generally exhibit the same trends observed in air temperatures (Figure 6-4). A simple linear regression analysis using air temperature as the independent variable indicates that there is a significant ($p<0.00001$) relationship between water temperature and air temperature, and that variation in air temperature alone can explain 81 to 97 percent of the variation observed in water temperatures (Figure 6-5). These results suggest that local air temperatures play a large role in determining water temperatures in area streams.

Considering the small amount of harvest that will occur in the important inner zone of Class I and II WLPZs, and the fact that riparian protection measures are going to be substantially increased under the HCP relative to baseline conditions, FGS anticipates that water temperatures will decrease over time in Class I and Class II watercourses. Water temperatures downstream of harvest units are not anticipated to change due to harvest upstream and there is a spatial limit to the influence of upstream reaches (i.e., harvest units) on the water temperature of downstream reaches. Downstream water temperature is essentially independent of upstream conditions as long as the stream has sufficient time to equilibrate (Sullivan and Adams 1990; Zwieniecki and Newton 1999). When streams become more exposed to solar radiation due to harvesting, water temperatures may tend toward a new equilibrium temperature determined by the new conditions. After the stream has had sufficient time to readjust to the undisturbed environmental conditions downstream, the effect of the upstream disturbed zone is essentially undetectable (Zwieniecki and Newton 1999).

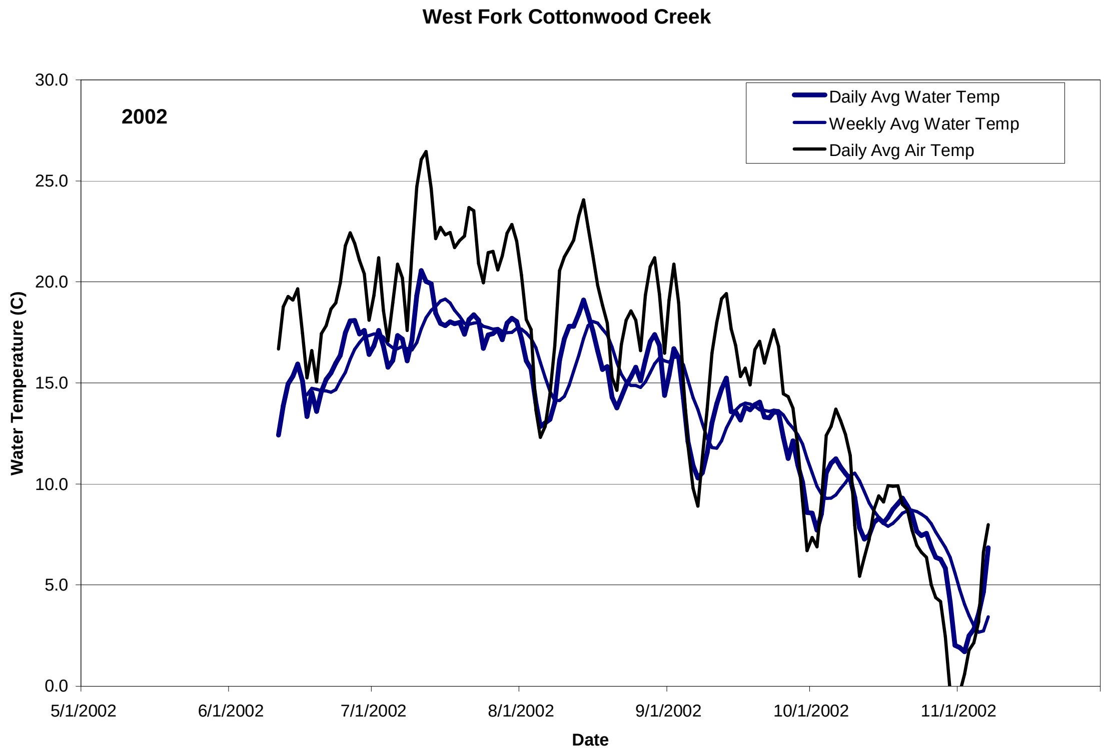

FIGURE 6-4
Air and Water Temperatures Observed in West Fork Cottonwood Creek during 2002

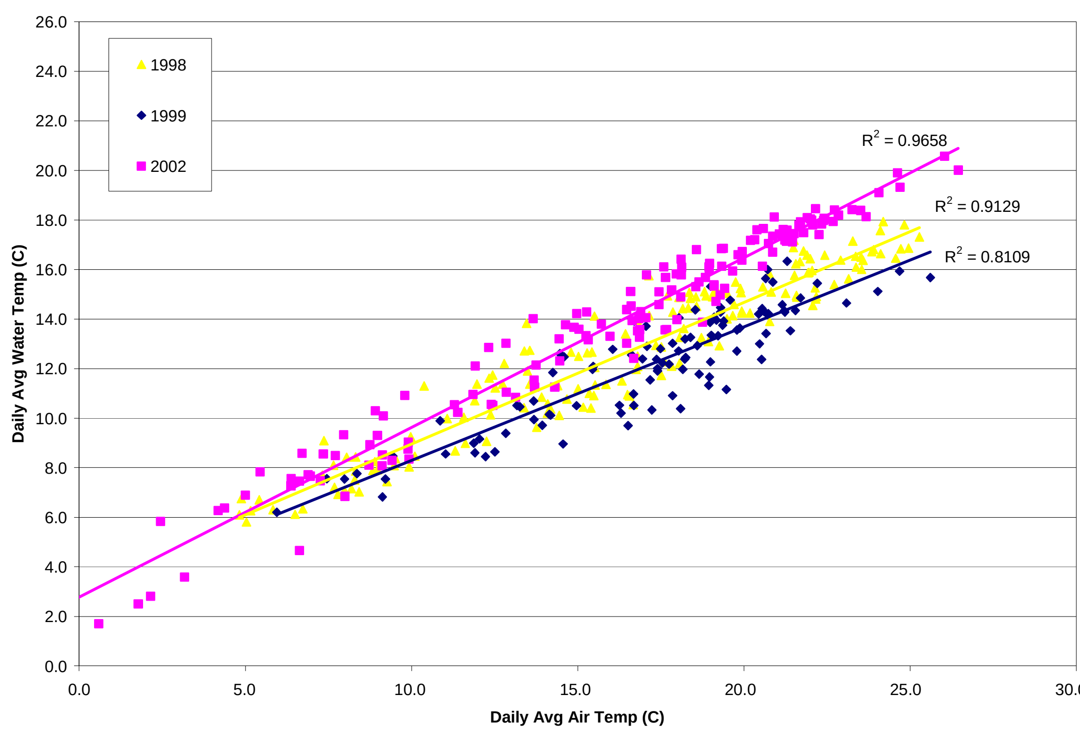

FIGURE 6-5
Relationship between Average Daily Air and Water Temperatures in West Fork Cottonwood Creek

Water temperature monitoring studies show that water temperatures may recover very rapidly. For 14 western Oregon streams, Zwieniecki and Newton (1999) found that water temperature increases associated with increased solar exposure due to harvest recovered to normal undisturbed levels within 150 meters (500 feet) below the cutting units. Similar results were reported by Caldwell et al. (1991) in eight Washington streams, where they found no effect on water temperature more than 500 feet downstream of harvest units.

Other Covered Activities. The effects of minor forest product removal, fire prevention, and other activities (use of roads, landings, and log decks; and in-stream habitat restoration activities) and other Covered Activities on stream temperatures would be minimal, as these activities have little (if any) influence on the conditions that affect stream temperatures.

6.1.3.4 Potential Impacts Due to Changes in Nutrient Input

Site-specific data on nutrient levels in streams within the Plan Area is not available, so the assessment of the conservation measures' impact on nutrient input is somewhat speculative and based on general aquatic ecological principles. The HCP conservation measures most likely to influence nutrient inputs are the riparian management measures establishing WLPZs.

As described previously for stream temperatures, the Class I and II WLPZs will provide 100 percent effective shading to streams in the Plan Area. As a result, measurable increases in the amount of sunlight reaching the streams are unlikely, and the level of primary productivity will remain essentially unchanged. Over the long-term, conifers may begin to out-compete streamside hardwoods and result in a gradual reduction in nutrient inputs to the stream. However, this will be a long process that will extend beyond the term of this HCP, and even then, would not result in the total elimination of hardwoods from the riparian areas. Any minor negative impact on salmonids from a loss in nutrient inputs due to an overall decrease in riparian hardwoods should be more than compensated for by the benefit of LWD from the increased retention of conifers.

The effects of minor forest product removal, fire prevention, and other activities (use of roads, landings, and log decks, and in-stream habitat restoration activities) and other Covered Activities on stream productivity would be minimal as these activities have little (if any) influence on the processes that affect nutrient inputs.

6.1.3.5 Potential Impacts Due to Changes in Sediment Inputs

FGS operations under the HCP will reduce management-related sediment input into the stream network, with the aim of reducing associated impacts on the aquatic Covered Species from increased sediment. The Aquatic Species Conservation Program contains measures for riparian management, road management, and slope stability that will contribute to a reduction in sediment input. The riparian management measures are designed to reduce potential harvest related sediment inputs into the stream network through tree retention within WLPZs. The slope stability measures are designed to minimize the potential for management to increase the rate of mass soil movement by identifying mass wasting hazard zones for shallow and deep-seated features and geologic review of unstable areas. The road management measures are designed to reduce potential road related sediment inputs into the stream network through road repairs and upgrades.

Much of the road work (inventories and sediment stabilization) will be "front-loaded" in that complete inventories in all Class A designated lands will be completed within 10 years of issuance of the Permits with the top five priority drainages completed in the first 5 years. Stabilization of sediment at the sites with the greatest potential for sediment delivery will be completed within 5 years of the inventory in each of these priority drainages. This is anticipated to result in stabilization of at least 50 percent of the potential sediment delivery volume identified during the inventories in the first 10 years following permit issuance. In addition, the road inventories will help to identify road segments that may be decommissioned during the early portion of the term of the Permits. Likewise, the riparian management measures will likely preclude harvest in many WLPZ areas until later in the term of the Permits, providing the maximum level of riparian function that the stand is capable of during the first few years.

Riparian Management. In drainages with anadromy (Class A and B designated lands), the minimum width of WLPZs on Class I (fish bearing) watercourses is 150 feet with 85 percent overstory canopy retention in the inner zone (75 feet) and 65 percent overstory canopy retention in the remaining outer zone. In Class A designated lands, sufficient trees shall be retained within Class I WLPZs to maintain the pre-harvest level of direct shading to pools. In drainages with coho salmon (Class A designated lands), WLPZs will be established along Class II watercourses in drainages with anadromy with a width of 100 feet. Canopy cover retention in these Class II WLPZs would average 85 percent within 50 feet of the stream and 65 percent outside of this inner zone. These retention standards, with the inherently associated understory retention, will likely result in almost no loss in total forest canopy in the inner zone along Class I and II watercourses.

Riparian buffers can reduce the amount of sediment delivered from riparian and upland areas by providing physical barriers to trap sediments moving overland, and interception and dissipation of raindrop impacts (Spence et al. 1996). Ketcheson and Megahan (1996) found that distance of hillslope sediment transport was inversely proportional to the amount of surface roughness found on the forest floor. A review prepared by Johnson and Ryba (1992) found that the available literature suggests buffer widths ranging from 50 to 151 feet are adequate to control overland transport of sediment, but noted that three of the five references they reviewed suggested 100 feet for this function. The ability of a given buffer width to control sediment inputs is a factor of soil type, slope, and ground cover (Spence et al. 1996). The WLPZs for Class I streams established in the HCP have variable widths, but generally fall within the cited literature values and are anticipated to trap most suspended sediment transported as overland sheet flow.

Specific Class I WLPZ conservation measures, such as retention of the 10 largest trees likely to contribute to in-stream LWD and restrictions on salvage logging, may also contribute to mitigating the effects of management related increased sediment loads on the aquatic Covered Species. The beneficial role of large woody debris in creating channel structure is widely known and well documented (Bisson et al. 1987; Lisle 1986). Tree retention will provide a potential source of LWD, and contribute to in-stream LWD levels to the extent that retained trees actually recruit to fish bearing watercourses. In addition to the riparian management measures previously described, general WLPZ conservation measures—such as the limitations on equipment, seeding and mulching of areas of ground disturbance larger than 100 square feet in WLPZs, and limitations on site preparation in WLPZs and

ELZs—will contribute to minimizing the effects of timber harvest on erosion processes on hillslopes that are adjacent to watercourses.

Slope Stability Measures. Slope stability measures focus on project-level identification of unstable (historically active) slopes/landslides and the application of specific management prescriptions to those areas described below as shallow or deep-seated MWHZs, inner gorges, and headwall swales. The purposes of the conservation measures applied in mass wasting hazard zones are to: (1) minimize and mitigate sediment delivery to aquatic habitat from management-related landslides, (2) minimize the erosion potential of identified mass wasting hazard zones, and (3) minimize the potential for activation from landslide-prone terrains. While the sediment delivery reduction expected by these measures cannot be accurately estimated, they are designed to eliminate the potential to the maximum extent practicable.

As discussed in Section 5.2.4, the slope stability conservation measures addressing shallow and deep-seated mass wasting are twofold. First, the HCP includes default prescriptions applied to all “slide areas,” “unstable areas,” and “unstable soils” as defined in 14 CCR 895.1 (collectively termed “unstable areas” for the purposes of this HCP). Second, the Aquatic Species Conservation Program includes terrain-specific conservation measures to address instability associated within explicit MWHZs. These terrain-specific default conservation measures are based on slope processes and geomorphic landforms associated with both shallow and deep-seated mass wasting hazards.

Shallow Mass Wasting Hazards. Deterministic slope stability modeling (SHALSTAB; see Appendix C) was used in combination with available landslide inventories and geomorphic mapping to identify potential shallow mass wasting hazards at the drainage level. Areas with a log q/T <-2.5 are considered to have a “moderate” potential for shallow mass wasting and areas with a log q/T <-2.8 are considered to have a “high” potential. Trained personnel (i.e., Certified Engineering Geologist, Professional Geologist, or trained Registered Professional Forester) will examine areas with a moderate or high potential for shallow mass wasting during THP layout, and identify MWHZs on all unstable shallow features that exhibit a preponderance of the physical hillslope characteristics consistent with active shallow landslides. Within areas of the identified shallow MWHZ that are field verified as unstable with reasonable potential to deliver sediment directly to a watercourse, FGS will apply the following measures in combination with the default measures for unstable areas (5.2.4):

- Limit new road or skid trail construction or major road reconstruction on toe slopes greater than 50 percent without field review and approval by a Professional Geologist or Certified Engineering Geologist.
- Minimize undercutting or removal of buttressed slide materials (i.e., slide deposits or colluvium).
- Apply bank stabilization measures in areas of management accelerated active bank erosion so as to not alter stream channel geomorphology.
- Prohibit heavy equipment operations under saturated soil conditions in the vicinity of shallow MWHZs without field review and approval from a Professional Geologist or Certified Engineering Geologist.

These measures will be implemented unless the Professional Geologist or Certified Engineering Geologist, based on geologic review of the MWHZ, recommends implementation of alternative conservation measures that are equally or more effective or more efficiently minimize the risk of sediment delivery and associated impacts to aquatic habitat.

Deep-Seated Mass Wasting Hazards. The compilations of landform mapping by Elder and Reichert (2006), used in combination with aerial photographic interpretation during the term of the HCP (see Monitoring Requirements in Chapter 7) will be used to identify potential deep-seated mass wasting hazards at the drainage level. Trained personnel (i.e., qualified Registered Professional Forester, Professional Geologist or Certified Engineering Geologist) will examine these potential deep-seated mass wasting hazards (i.e., earthflows, undifferentiated slides and headwall basins, rotational/translational slides) during THP layout and identify deep-seated MWHZs on all potentially unstable deep-seated features that exhibit a preponderance of the following physical hillslope characteristics consistent with active deep-seated landslides. Within areas of the identified deep-seated MWHZ that are field verified as unstable with reasonable potential to deliver sediment directly to a watercourse, FGS will apply the following measures in combination with the default measures for unstable areas (5.2.4):

- Retain uneven-aged stand structure within slide mass and toe slopes of deep-seated MWHZ boundaries.
- Establish an EEZ within deep-seated MWHZ boundaries, and extend the EEZ 30 feet upslope of the head scarp.
- Minimize undercutting or removal of buttressed slide materials, especially in toe slopes of any deep-seated MWHZ without field review and approval from a Professional Geologist or Certified Engineering Geologist.
- Prohibit loading slide material, slide mass margins, or toe slopes of unstable deep-seated MWHZ with excavation spoils, road fill, or surface runoff.

These measures will be implemented unless the Professional Geologist or Certified Engineering Geologist, based on geologic review of the MWHZ, recommends implementation of alternative conservation measures that are equally or more effective or more efficiently minimize the risk of sediment delivery and associated impacts to aquatic habitat

Inner Gorges. In drainages with anadromous salmonids (Class A and B designated lands), where an inner gorge extends beyond a Class I WLPZ and slopes are greater than 55 percent, an SMZ will be established where the use of even-aged regeneration methods is prohibited, and a minimum average overstory canopy of 60 percent will be retained. The SMZ shall extend upslope to the first major break-in-slope to less than 55% for a distance of 100 feet or more, or 300 feet as measured from the watercourse or lake transition line, whichever is less. On Class A designated lands where an inner gorge extends beyond a Class II WLPZ, an SMZ will be established that extends upslope to the first major break-in-slope to less than 55% for a distance of 100 feet or more, or 200 feet as measured from the watercourse or lake transition line, whichever is less. All operations on slopes exceeding 65% within an inner gorge of a Class I or II watercourse shall be reviewed by a Professional

Geologist prior to plan THP approval, regardless of whether they are proposed within a WLPZ or outside of a WLPZ.

Tree retention in the WLPZs, SMZs and inner gorges is expected to maintain a network of live roots that will preserve total soil cohesion and contribute to acceptable slope stability conditions in these areas. Another benefit of tree retention with regard to slope stability is the maintenance of forest canopy, contributing to the maintenance of rainfall interception and evapotranspiration. Maintenance of forest canopy is expected to contribute to acceptable slope stability conditions in some locations by partially mitigating high ground water ratios that may be management related. Geologic review of operations on inner gorges will ensure that proposed activities do not present a greater risk of sediment delivery from mass wasting.

Headwall Swales. As proposed in the HCP, headwall swale identification will be based primarily on field observations by trained and qualified personnel of slope qualities that are characteristic of the landform. A computer model, SHALSTAB, will be used to generate a map depicting areas of convergent topography to potentially be treated as headwall swales. This modeling will be used as a screening tool to identify areas of the landscape where headwall swales are likely to occur, but will not necessarily be used to delineate harvest boundaries.

Where harvesting is proposed on a connected headwall swale, it shall be reviewed by a Professional Geologist to ensure that proposed activities do not present a greater risk of sediment delivery from mass wasting. Only the selection regeneration method or commercial thinning intermediate treatment may be utilized on connected headwall swales, and a minimum average overstory canopy of 60 percent will be retained. Maintenance of forest canopy is expected to contribute to acceptable slope stability conditions in some locations by partially mitigating high ground water ratios that may be management related. Geologic review of operations on hydrologically connected headwall swales will ensure that proposed activities do not present a greater risk of sediment delivery from mass wasting.

Road Management. Mass wasting hazards and sediment delivery directly related to the road network in the Plan Area are addressed under the Road Management Measures (Section 5.2.3). FGS will use existing roads whenever feasible; strive to minimize total mileage; minimize disturbance to natural features; avoid wet areas and unstable areas; and minimize the number of watercourse crossings. Future road construction in the Plan Area is anticipated to consist primarily of short temporary spurs designed to locate landings at stable areas outside the wider WLPZs. These temporary roads will generally be utilized for one harvest season, and will then be decommissioned. New road construction is anticipated to average less than 1 mile per year. At the same time, FGS anticipates decommissioning many of their seasonal roads such that there will be a gradual reduction in active road mileage over the life of the HCP.

Road Maintenance. All roads on the FGS ownership will be subject to periodic and regular maintenance. There are a number of conservation measures described as “Measures for Roads and Landings in Class A Lands” in Section 5.2.2 that govern the construction, use, maintenance, and upgrading of roads on the FGS ownership. These measures are designed to minimize the potential for road-related sediment to reach area streams. FGS has developed a Road Management Plan - Operations Guide (Appendix B), which compiles road measures from the CFPRs, the long-term 1600 streambed alteration agreement, and BMPs currently used by FGS. Implementation of the conservation measures and other measures in the FGS Road Management Plan – Operations Guide will reduce the possibility of debris slides from road or water crossing failures, and minimize the generation of sediment from surface erosion from new, reconstructed, and upgraded roads.

Road Inventories and Treatment. Under the Road Management Plan (Section 5.2.3), drainage level road erosion inventories of roads owned and controlled by FGS will be conducted in all drainages within the Plan Area containing Class A designated lands. Inventories will also follow a schedule produced through a prioritization based on an assessment methodology that utilizes a landscape-level assessment of the risk of sediment delivery to streams from road-related erosion, the resources at risk, and proposed timber management operations. The road erosion inventory quantifies and maps individual sites for sediment delivery potential. FGS will prioritize road-related sediment sources for treatment based on the following factors: (1) volume of future sediment delivery, (2) treatment immediacy (risk to Covered Species), and (3) treatment cost-effectiveness.

Drainage level road erosion inventories in drainages with Class A designated lands will be complete within 10 years of issuance of the Incidental Take Permits with the top five priority drainages (see Table 5-2) completed in the first 5 years. Within these priority drainages, treatment of the sites with the greatest potential sediment delivery will be completed within 5 years of the inventory in conjunction with timber operations. Implementation will be carried out consistent with the Aquatic Protection Measures in Section 5.2.2 and to the standards and protocols set forth in the FGS Road Management Plan - Operations Guide (Appendix B). Treatment of the sites with the greatest potential sediment delivery will result in stabilization of at least 50 percent of the potential sediment delivery volume identified during the inventories. Based on recent road inventories on 122 miles of road within 22,173 acres on the FGS ownership the estimated future erosion that is deliverable to streams is 8,777 tons (72 tons/mile). There are approximately 1,140 miles of road under FGS jurisdiction in the Plan Area. Assuming that this figure represents the average potential sediment delivery to streams from roads on the FGS ownership, and that at least 50 percent of this potential would be stabilized during the first 10 years of the HCP, it is anticipated that the implementation of the HCP would stabilize approximately 50,000 tons of sediment over this time period.

Other Conservation Measures. In addition to the riparian, slope stability, and road management measures, the Aquatic Species Conservation Program contains restrictions that will minimize the generation and delivery of fine sediments from harvest units to stream channels. In general, these measures focus on tractor, skidder and forwarder operating restrictions, prescribed fire objectives, equipment limitations, and bare soil exposure measures. Collectively, and in combination with the conservation measures previously described, these actions will reduce management related surface erosion and contribute to decreased sediment loads, which will help to minimize and mitigate the possible effects of management related sediment input on the aquatic Covered Species.

Other Covered Activities. Other than the effects previously described, effects of minor forest product removal, fire prevention, and other activities (use of roads, landings, and log decks, and in-stream habitat restoration activities) on sediment inputs would be minimal, as these activities have little (if any) influence on the processes that affect sediment inputs.

6.1.3.6 Potential Impacts on Fish Passage

The DFG Passage Assessment Database (September 2006) identifies a total of 27 known potential barriers on the FGS ownership. During the road inventory process, potential fish passage problems at existing watercourse crossings will be documented using methods specified in Chapter IX of the California Salmonid Stream Habitat Restoration Manual, 1998, 3rd edition (DFG 1998). Stream crossings that are impeding fish passage will be prioritized for upgrading or replacement with a "fish friendly" structure. As the Road Management Measures are implemented over time, fish passage problems at watercourse crossings in the Plan Area will be eliminated.

6.1.3.7 Summary of Impacts

The conservation measures identified in Chapter 5 are designed to avoid or minimize impacts to aquatic Covered Species through changes in watershed processes and products to the maximum extent practicable. The potential impacts of the Covered Activities, including implementation of the avoidance and minimization measures included in the HCP, on watershed processes and products are summarized in the following:

- Impacts due to altered hydrology will be avoided or minimized through riparian management, road management, and slope stability measures.
- Impacts due to changes in LWD recruitment will be avoided or minimized through riparian management measures, harvest restrictions on inner gorges and headwall swales, road maintenance practices, and salvage restrictions.
- Impacts due to altered stream temperatures will be avoided or minimized through riparian management measures that minimize effects on canopy coverage and stream shading.
- Impacts due to changes in nutrient inputs will be avoided or minimized through riparian management measures that retain streamside trees that provide nutrient inputs.
- Impacts due to changes in sediment inputs will be avoided or minimized through riparian management measures; slope stability measures that provide protection in mass wasting hazard zones, inner gorges and headwall swales; and road management measures, including maintenance, inventories, and treatment.
- Impacts due to the blockage of fish passage will be avoided or minimized by the proper culvert installation at stream crossings or replacement with fish-friendly structures.

6.1.4 Incidental Take and Impacts of the Taking

The purpose of this subsection is to identify the potential for incidental take of aquatic Covered Species that could occur as a result of Covered Activities, and evaluate the potential impact of the taking on the local and regional populations (ESUs). This analysis relies on the description of the potential for changes in watershed processes to influence the habitat conditions in area streams presented in Section 6.1.3 and the amount of habitat for the aquatic Covered Species in the Plan Area relative to the amount of habitat for these species in their respective ESUs.

While the watershed processes that influence stream conditions (e.g., substrate composition, canopy coverage, water temperature) in the Plan Area and the surrounding region have been affected by decades of timber harvest and associated activities, recent regulations on forest practices have reduced these effects and stream conditions are anticipated to improve in the future. Implementation of this HCP with its additional conservation measures is expected to contribute to this improving trend over the term of the Permits with a corresponding improvement in habitat for the aquatic Covered Species.

As described in Chapter 4, the current Plan Area contains very little of the known or suspected habitat for the aquatic Covered Species in the drainages where FGS has ownership. For example, the threatened coho salmon is known or suspected to be present in only 3.7 miles of stream in FGS's Klamath River Management Unit compared to a total of nearly 120 miles of stream known or presumed to support coho salmon in these same drainages (see Table 4-13 in Chapter 4). Coho salmon are not known or suspected to use any streams on the FGS ownership in the Scott Valley and Grass Lake Management Units even though 54.8 miles and 58.4 miles, respectively, are presumed to support coho salmon in drainages that include these management units. Chinook salmon are even more limited in the Plan Area, with only 3.4 miles of stream supporting this species on the FGS ownership compared to a total of over 230 miles in drainages with FGS ownership (see Table 4-17 in Chapter 4). While steelhead are more broadly distributed, the entire FGS ownership contains only 14.3 miles of stream presumed to support steelhead compared to a total of over 370 miles in drainages with FGS ownership (see Table 4-15 in Chapter 4). Much of the habitat for these species on the FGS ownership is thought to support juvenile rearing, with little spawning of adults occurring in stream reaches on the ownership.

Like the description of potential effects provided in Section 6.1.3, the following discussion of incidental take and impacts of the taking is organized by category of environmental effect on the aquatic Covered Species and their habitats: altered hydrology, LWD recruitment, stream temperature, nutrient input, sediment input, and fish passage. In addition the potential for incidental take directly through operation of heavy machinery in streams, drafting of water from streams, and spills of hazardous materials and the impacts of such taking are discussed.

6.1.4.1 Altered Hydrology

The hydrology of a watershed is controlled by many complex interacting factors. Increases in runoff and peak flows can result from harvesting activity and road construction (either from individual harvesting activities or from the combined effects of multiple harvesting operations in a drainage that are temporally or spatially related). Such increases in runoff and peak flows could in turn result in incidental take of Covered Species. The effects of temporary changes in watershed hydrology on the aquatic Covered Species and their habitats are difficult to assess. Salmonids have adapted to temporal variations in flow conditions by timing the phases of their life cycles to take advantage of seasonal discharges characteristics (Sullivan et. al. 1987).

Increased runoff in the early part of the rainy season could provide marginal benefits to the Covered Species by reducing water temperatures and providing more flow for migrating adults and dispersing or emigrating juveniles. However, a harvesting-related increase in peak flow could increase the frequency that storm events mobilize channel substrates and damage developing eggs and alevins in redds. Increased peak flows could also affect the survival of over-wintering juvenile salmonids by displacing them out of preferred habitats. Displacement of juveniles could result in incidental take if the displacement results in killing or injuring individuals. Short-term increases in summer baseflows may improve survival of juveniles (Hicks et al. 1991) and increase the amount of aquatic habitat. However, these effects are proportional to harvested area and diminish with regrowth of forest vegetation.

In summary, the extent to which watershed hydrology is altered by timber harvesting activities is a function of the amount and timing of those activities in a sub-basin or watershed. Given the cumulative relationship among those activities and this type of environmental effect, it is difficult to assess the potential for these activities to cause altered hydrology itself, and even more difficult, in turn, to evaluate the potential for altered hydrology to result in incidental take of the Covered Species. Management-altered hydrology has the potential to harm both the early stages of development (eggs and alevins) as well as over-wintering juvenile salmonids. However, the effects of altered hydrology may be beneficial for adults returning to spawn in the fall and for summer juvenile populations. Therefore, depending on which factor(s) are actually limiting for salmonid production in a given drainage, some levels of altered hydrology may be beneficial.

The potential impacts of altered hydrology are highly complex, and although changes in hydrology have the potential to cause take that could lead to local declines in populations of the aquatic Covered Species, the actual impact of various levels of altered hydrology remain unknown. This HCP contains measures to minimize the potential for management in the Plan Area to result in altered hydrology (see Chapter 5) and, therefore it is anticipated that the potential for incidental take of the aquatic Covered Species that could result from altered hydrology is low. Changes in channel morphology as an indicator of the effects of altered hydrology will be assessed during the monitoring program (Chapter 7).

6.1.4.2 LWD Recruitment

Long-term reductions in LWD can result in less stream complexity and reduce the amount of high quality rearing habitat for salmonids and other fish species. LWD in a watercourse provides for sediment storage and sorting that benefits both fish and amphibian species. A decline in pool density, pool depth, in-stream cover, and gravel retention are likely to result from LWD losses. Harvesting practices that result in low levels of LWD may, accordingly, impact the growth, survival, and total production of the aquatic Covered Species. Over the long term, much of the LWD that creates and maintains aquatic habitat elements is likely derived from catastrophic events such as major floods and landslides. However, LWD is also recruited when individual trees fall into the stream channel from adjacent forest stands.

Harvest in areas adjacent to streams that results in a failure to allow long-term natural recruitment of wood for future habitat may result in take of anadromous salmonids as such habitat alterations may constitute significant habitat modification or degradation. However, harvest in riparian areas that promotes long-term recruitment of wood for future recruitment by promoting faster diameter growth and/or improvement in species composition (i.e., hardwood replacement with conifers) may constitute significant habitat improvement. Therefore, this HCP contains measures that minimize the potential for management in the Plan Area to result in a long-term reduction in LWD potential (see Chapter 5).

As a result of the riparian management measures implemented under the HCP, an increase in LWD potential is expected over the term of the Permits. In addition, the slope stability measures will ensure that upslope LWD source areas on unstable slopes and inner gorges will continue to contribute LWD to Plan Area streams. The effectiveness of these measures will be evaluated as part of the monitoring program (Chapter 7). It is anticipated that adverse effects on the aquatic Covered Species that could result from loss of LWD will be avoided, or minimized, such that the potential for incidental take of individuals in the Plan Area will be low. Given the minimal potential for incidental take of individuals in the Plan Area due to reductions in LWD recruitment and the limited amount of habitat for the aquatic Covered Species in the Plan Area relative to areas outside of the Plan Area that support these species, the impacts of any incidental taking on the local and regional (ESU) populations of aquatic Covered Species would be minimal.

6.1.4.3 Altered Stream Temperatures

Increases in water temperatures during summer can have negative impacts on salmonids (Beschta et al. 1987) and other species. Potential impacts to the aquatic Covered Species are a reduction in growth efficiency, increase in disease susceptibility, change in age of smoltification, loss of rearing habitat, and shifts in their competitive advantage over non-salmonid species (Hughes and Davis 1986; Reeves et al. 1987; Spence et al. 1996). In some situations, increased light levels and increased autotrophic production can be beneficial due to an increase in food production and higher growth rates. Little is known of the potential impacts of colder nighttime and winter temperatures on streams with reduced canopy and aggraded channels. However, it seems likely that this is relatively unimportant compared to increases in temperature.

Although elevated water temperatures can be a relatively localized phenomenon, this factor generally functions in a cumulative manner throughout a sub-basin or watershed. The impact of elevated water temperature also tends to be cumulative on a temporal scale, such that short-term increases are less likely to be harmful compared to more chronic increases in water temperature. The potential harm or death associated with this factor would primarily influence juvenile coho salmon and steelhead rearing during summer and early fall. Take of aquatic Covered Species could occur as the result of temperature increases causing the impairment of essential functions and injury or mortality. The potential impacts of such taking include potential reductions in the local or regional populations of the listed aquatic Covered Species and could affect a possible need to list currently unlisted aquatic Covered Species under the ESA in the future.

This HCP contains measures to minimize the potential for management in the Plan Area to result in long-term increases in stream temperatures (see Chapter 5). Any increase in stream temperature over the term of the Permits is expected to be minimal, and temporary, due to the riparian management measures implemented under the HCP. The slope stability measures will contribute to decreased sediment input from unstable slopes and inner gorges to area streams and minimize the potential for temperature increases due to channel aggradation. The effectiveness of these measures will be evaluated as part of the monitoring program (Chapter 7). It is anticipated that adverse effects on the aquatic Covered Species that could result from altered stream temperatures will be avoided or minimized, such that the potential for incidental take of individuals in the Plan Area will be low.

6.1.4.4 Nutrient Inputs

Timber harvest in riparian areas can affect productivity of streams in several ways. Removal of canopy cover increases the amount of sunlight reaching the stream and can increase periphyton (algal) production (unless it is limited by nitrogen), which may increase the abundance of invertebrates and fish because algae is a higher quality food than leaf or needle litter. However, a beneficial effect on salmonids would only be realized if the alteration of the riparian vegetation did not also lead to adversely high water temperatures. An increase in stream productivity may also not ultimately result in increased production of salmonids, because it will primarily benefit summer rearing populations when the "bottleneck" (i.e., limiting factor) for many salmonid streams is winter rearing habitat (Murphy and Meehan 1991). Site-specific data on nutrient levels in streams within the Plan Area is not available, so it is unknown whether nutrient levels in area streams are a limiting factor.

As described previously for stream temperatures, riparian management will provide 100 percent effective shading to streams in the Plan Area. As a result, measurable increases in the amount of sunlight reaching the streams are unlikely, and the level of primary productivity will remain essentially unchanged. Over the long-term, conifers may begin to out-compete streamside hardwoods and result in a gradual reduction in nutrient inputs to the stream. However, this will be a long process that will extend beyond the term of this HCP, and even then, would not result in the total elimination of hardwoods from the riparian areas.

The impacts of altered nutrient inputs would likely be subtle and difficult to predict. The greatest potential impact would be to juvenile salmonids that need to reach some threshold in size before successful smoltification and out-migration can occur. Decreases in nutrient inputs would not likely result in direct harm, but they may reduce survival during the freshwater rearing period. In addition, ocean survival would likely be decreased if smolts out-migrate at smaller sizes. However, it would be difficult to determine that any management activities were responsible for take as the result of altered nutrient inputs. Any minor negative impact on salmonids from a loss in nutrient inputs due to FGS's management activities should be more than compensated for by the benefit of LWD from the increased retention of conifers. Therefore, the potential for incidental take of individuals in the Plan Area is anticipated to be low.

6.1.4.5 Sediment Inputs

Timber harvest and the construction and use of the associated road system have the potential to increase sediment inputs to area streams. Increased sediment inputs from such activities can reduce the quality of aquatic habitats for the aquatic Covered Species through reduced depth of pools, increased embeddedness and fining of gravel and cobble substrates. The aquatic Covered Species may also be affected by chronic turbidity through gill irritation and inability to locate and capture food organisms.

The Aquatic Species Conservation Program contains measures for riparian management, road management, and slope stability that will contribute to a reduction in sediment input (see Chapter 5). The riparian management measures are designed to reduce potential harvest related sediment inputs into the stream network through tree retention within WLPZs. The slope stability measures are designed to minimize the potential for management to increase the rate of mass soil movement by identifying mass wasting hazard zones for shallow and deep-seated features and geologic review of unstable areas. The road management measures are designed to reduce potential road related sediment inputs into the stream network through road repairs and upgrades. Many of the road repairs and upgrades will occur during the first 10 to 15 years after issuance of the Permits with an anticipated 50 percent reduction in sediment delivery during this time frame.

Changes in channel morphology, residual pool volume with fine sediment (V*), and surface fines in pool tails as indicators of the amount of sediment input will be assessed during the monitoring program (Chapter 7). It is anticipated that adverse effects on the aquatic Covered Species that could result from increased sediment input will be avoided or minimized, such that the potential for incidental take of individuals in the Plan Area will be low.

6.1.4.6 Fish Passage

When culverts are improperly installed in fish bearing watercourses, they may be impassable to both adult migration and juvenile fish dispersal. Over the term of the Permits, impacts due fish passage problems on the FGS ownership will be avoided or minimized by proper culvert installation at all stream crossings or replacement with fish-friendly structures. Identification and elimination of fish passage problems will likely occur during the first 10 to 15 years following issuance of the Permits as the drainage-level road inventories are completed. Therefore, therefore it is anticipated that the potential for incidental take of the aquatic Covered Species that could result from poor fish passage conditions is low.

6.1.4.7 Direct Impacts

In addition to the potential indirect effects on aquatic Covered Species through changes in watershed processes and products previously described, there are forest management activities that can have direct effects on the aquatic Covered Species, resulting in incidental take. Activities with the potential to harm single individuals or small groups of individuals include operation of heavy machinery in streams, such as construction of watercourse crossings or stream enhancement work (potentially injuring or killing adults, juveniles, larvae, and/or eggs of the species). Other activities—such as drafting of water from streams for dust abatement (potentially injuring or killing individuals suctioned up with the water and potentially damaging or destroying the incubating eggs of such species)—have the potential to harm larger groups of individuals. The use of petroleum products as fuel and lubricants in machinery and equipment (potentially injuring or killing individuals and incubating eggs in the event of incidental or accidental drips and leaks) could also harm large groups of individuals or entire stream segments.

The potential for incidental take of individuals through operation of heavy machinery in streams during Covered Activities is anticipated to be minimal. Equipment is expected to operate in the wetted channel at pre-approved designated skid crossings from 5 to 10 crossings per THP, with up to 12 uses of the crossings on each of perhaps five THPs per year. This equates to a total of 30 to 60 uses of THP stream crossings per year. Skid crossings are not located on Class I (fishbearing) streams. Road construction and maintenance activities may require in-channel work up to 40 times per year. The FGS Road Management Plan – Operations Guide (see Appendix B) includes specifications for design and maintenance of stream crossings, work windows, and erosion control, including Best Management Practices for construction and maintenance of stream crossings in accordance with the long-term streambed alteration permit being developed in conjunction with DFG. Given the minimal potential for incidental take of individuals in the Plan Area through operation of heavy machinery in streams and the limited amount of habitat for the aquatic Covered Species in the Plan Area relative to areas outside of the Plan Area that support these species, the impacts of any incidental taking on the local and regional (ESU) populations of aquatic Covered Species would be minimal.

Water drafting is conducted under strict guidelines (see 14 CCR 936.9.1 in Section 5.2.2) to ensure that no aquatic Covered Species are accidentally suctioned up with the water or harmed by dewatering of the stream in which they reside. Thus, the potential for incidental take of individuals during water drafting operations will be minimal. Equipment exclusions around Class I, II, and III watercourses specified in the Aquatic Species Conservation Program will minimize the potential for hazardous materials due to leaks or drips from heavy equipment reaching a stream. Preventative measures are incorporated into the FGS Road Management Plan – Operations Guide (Appendix B) and long-term streambed alteration (1600) permit to preclude possible degradation of water quality due to accidental spillage of hazardous materials. Therefore the potential for incidental take of individuals in the Plan Area due to hazardous materials will be low.

6.1.4.8 Summary of Incidental Take and Impacts of the Taking

- Timber harvest is not anticipated to have an adverse effect on the aquatic Covered Species due to minor effects on peak flows and other hydrologic attributes.
- Riparian management is not anticipated to have an adverse effect on the aquatic Covered Species because a high level of canopy cover and tree retention will protect against adverse impacts due to increased stream temperatures, reduced nutrient input, and a reduction in LWD recruitment.
- Road management is anticipated to have a beneficial effect on the aquatic Covered Species because the road network will decrease in extent and largely be disconnected hydrologically from area streams over the term of the Permits.
- The slope stability measures are anticipated to contribute to minimizing hydrologic effects due to timber harvest; therefore, impacts to aquatic Covered Species due to altered hydrology as a result of sediment input are anticipated to be minimal.
- Increased LWD recruitment will function to mitigate the impacts on juvenile salmonids that can result from altered hydrology by providing increased habitat diversity for juveniles displaced during a storm event.

- Fish passage problems will be corrected over the term of the Permits and benefit local and regional populations of the aquatic Covered Species.
- Restrictions on the use of heavy equipment in streams, water drafting guidelines, and preventative measures regarding spillage of hazardous materials are anticipated to avoid or minimize the potential for take of aquatic Covered Species or adverse effects to critical habitat for coho salmon.
- Overall, the Covered Activities, including implementation of the aquatic conservation measures in the HCP are anticipated to contribute to the expected improving trend in aquatic habitat conditions in area streams. Incidental take of the aquatic Covered Species is anticipated to be minimal and localized, and impacts of the taking will be temporary in nature and affect only a small portion of the available habitat for the aquatic Covered Species. Therefore, it is anticipated that FGS' forest management activities will not have a significant adverse impact on the local or regional (ESU) populations of aquatic Covered Species.

6.2 Effects on Terrestrial Covered Species

Terrestrial Covered Species are the northern spotted owl and the Yreka phlox. The northern spotted owl is widespread throughout the Plan Area and is associated with many forest types. The Yreka phlox is generally found in limited locations associated with particular soil types.

6.2.1 Northern Spotted Owl

The northern spotted owl is found from southwestern British Columbia, western Washington and Oregon, into northwestern California south to Marin County (Forsman 1976; Forsman et al. 1984; Gutiérrez et al. 1995; American Ornithologists' Union 1998). The range of the northern spotted owl contacts the range of the California spotted owl (*S. o. occidentalis*) in northern California near the southern end of the Cascade Range (Thomas et al. 1990; USFWS 1992; Barrowclough et al. 1999; Haig et al. 2001).

The regional population in the Plan Area is divided by two Ecological Provinces: the California Klamath Province and the California Cascades Province (a characterization of conditions within the two provinces is provided in Chapter 4). The effects analysis is conducted separately for the Area of Analysis within the California Klamath and California Cascades Provinces because each province is distinct in terms of population demographics and trends, threats, and quantity and quality of northern spotted owl habitat. The Area of Analysis is intended to represent the area within the ecological provinces where FGS's operations may reasonably affect dispersal and long-term distribution of owls (within approximately 20 miles of the FGS ownership). The local population is defined by the area, referred to as the Area of Impact, within which individual northern spotted owls could be directly affected by FGS's operations. It encompasses the known northern spotted owl activity centers within 1.3 miles of FGS ownership, which is the average radius of northern spotted owl home ranges within the California Klamath Province (Irwin et al. 2004).

Forest management is the primary activity in the Plan Area, occurring on approximately 152,000 acres. Not all forest management activities and their effects have the potential to cause "take" of northern spotted owls. The modification of forest stand conditions through timber harvest has the greatest potential to affect (adversely or beneficially) northern spotted owls because of the immediate and long-term effects it has on habitat conditions and prey availability. Silvicultural treatments such as thinning may benefit northern spotted owls by accelerating the development of northern spotted owl habitat and dense prey populations, and reducing the risk of catastrophic wildfire. Silvicultural activities associated with stand regeneration are unlikely to affect habitat conditions for northern spotted owls, but have the potential to adversely affect northern spotted owls by increasing noise and activity levels. Other Covered Activities related to timber harvesting, harvesting minor forest products, fire prevention, and watershed management could result in varying levels of habitat modification and disturbance.

The discussion of effects to northern spotted owls that follows includes:

1. A summary of the biological requirements of the northern spotted owl;
2. A description of the types of impacts to northern spotted owls resulting from the Covered Activities; and
3. A quantification of the number of individual northern spotted owls that could be taken as a result of Covered Activities and an evaluation of the potential impact of the taking on the local and regional owl populations, including potential benefits of the conservation program.

6.2.1.1 Biological Requirements of the Northern Spotted Owl

The biological requirements of northern spotted owls play an important role in evaluating the potential effects of Covered Activities and developing measures that minimize and mitigate those impacts. Life history attributes of the northern spotted owl, including their life cycle and reproduction, survivorship and mortality, diet, and home range size are described in Chapter 3 of this HCP. The following discussion focuses on the biological requirements of northern spotted owls that are influenced by Covered Activities and that serve as the basis for the compensatory mitigation.

Northern spotted owls require a range of forest characteristics for nesting, roosting, foraging, and dispersal activities, and for shelter and support of a prey base. Northern spotted owls have been observed in a number of forest types (Forsman et al. 1984) including: Douglas-fir (*Pseudotsuga menziesii*), western hemlock (*Tsuga heterophylla*), grand fir (*Abies grandis*), white fir (*Abies concolor*), ponderosa pine (*Pinus ponderosa*), Shasta red fir (*Abies magnifica shastensis*), mixed evergreen, mixed conifer hardwood (Klamath montane), and redwood (*Sequoia sempervirens*). The upper elevation limit at which northern spotted owls occur corresponds with the transition to subalpine forest, which is characterized by relatively simple structure and severe winter weather (Forsman 1976; Forsman et al. 1984). In the Plan Area, northern spotted owls are typically observed in Klamath mixed conifer and Douglas-fir forest types, particularly in areas where hardwoods provide a multilayered structure at an early age, and are rarely located in white fir or ponderosa pine types.

Northern spotted owls generally rely on older forested habitats because such forests contain the structures and characteristics required for nesting, roosting, and foraging. Features that support nesting and roosting typically include a moderate to high canopy closure (60 to

90 percent); a multi-layered, multi-species canopy with large overstory trees (with dbh of greater than 30 inches); a high incidence of large trees with various deformities (large cavities, broken tops, mistletoe infections, and other evidence of decadence); large snags; large accumulations of fallen trees and other woody debris on the ground; and sufficient open space below the canopy for northern spotted owls to fly (Thomas et al. 1990). Forested stands with high canopy closure also provide thermal cover (Weathers et al. 2001) and protection from predators.

Foraging habitat generally has attributes similar to those of nesting and roosting habitat, but such habitat may not always support successfully nesting pairs (USFWS 1992). Dispersal habitat consists of stands with adequate tree size and canopy closure to provide protection from avian predators and at least minimal foraging opportunities (USFWS 1992). Forsman et al. (2002) found that northern spotted owls could disperse through highly fragmented forest landscapes. There is little evidence that small openings in forest habitat influence the dispersal of northern spotted owls, but large, non-forested valleys such as the Willamette Valley apparently are barriers to both natal and breeding dispersal (Forsman et al. 2002). This observation likely applies to the Shasta, Scott, and Rogue Valleys in the Plan Area.

Recent landscape-level analyses in portions of the Oregon Coast and California Klamath provinces suggest that a mosaic of late-successional habitat interspersed with other seral conditions may benefit northern spotted owls more than large, homogeneous expanses of older forests (Meyer et al. 1998; Franklin et al. 2000; Zabel et al. 2003). In the Oregon Klamath and Western Oregon Cascade provinces, Dugger et al. (2005) found that apparent survival and reproduction was positively associated with the proportion of older forest near the territory center (within 730 meters [2,395 feet]). Survival decreased dramatically when the amount of non-habitat (non-forest areas, sapling stands, etc.) exceeded approximately 50 percent of the home range (Dugger et al. 2005). Olson et al. (2004) found that reproductive rates fluctuated biennially and were positively related to the amount of edge between late-seral and mid-seral forests, and other habitat classes in the central Oregon Coast Range. Olson et al. (2004) concluded that while mid-seral and late-seral forests are important to northern spotted owls, a mixture of these forest types with younger forest and non-forest may be best for northern spotted owl survival and reproduction in their study area. This represents the best available information for the ecological provinces that are close to the Plan Area.

Franklin et al. (2000) examined the effects of climate and landscape characteristics on the temporal and spatial variation of owl life history traits in the California Klamath Province. Northern spotted owl survival was positively and non-linearly associated with the amount of interior older forest greater than 328 feet from an edge and the amount of edge between older forest and other vegetation types. Reproductive output was negatively and non-linearly associated with the amount of interior older forest, had a quadratic (concave) relationship to the number of older forest patches, and was positively associated with the amount of edge between older forest and other vegetation types. These results suggest a trade-off between interior older forest benefiting survival, while posing a cost to reproduction.

Northern spotted owls may be found in younger forest stands that have the structural characteristics of older forests or retained structural elements from the previous forest. In redwood forests and mixed conifer-hardwood forests along the coast of northwestern

California, where growth rates of trees are significantly faster than within the drier Klamath Province, considerable numbers of northern spotted owls also occur in younger forest stands, particularly in areas where hardwoods provide a multilayered structure at an early age (Thomas et al. 1990; Diller and Thome 1999). In mixed conifer forests in the eastern Cascades in Washington, 27 percent of nest sites were in old-growth forests, 57 percent were in the understory reinitiation phase of stand development, and 17 percent were in the stem exclusion phase (Buchanan et al. 1995). In the western Cascades of Oregon, 50 percent of northern spotted owl nests were in late-seral/old-growth stands (greater than 80 years old), and none were found in stands of less than 40 years old (Irwin et al. 2000). Although many of these studies were conducted in more mesic climates where larger tree sizes associated with northern spotted owl take less time to develop, retention of legacy structures and hardwoods is also an extremely valuable management tool to promote occupancy by northern spotted owls in the Plan Area.

Habitat use also is influenced by prey availability. Ward (1990) found that northern spotted owls foraged in areas with lower variance in prey densities within older forests, and near ecotones of old forest and brush seral stages. Zabel et al. (1995) suggested that because dusky-footed woodrats (*Neotoma fuscipes*) occur at higher densities and are larger than flying squirrels, owls may not need to travel as far to fulfill their energy requirements. Consequently, in areas where woodrats are the principal prey (such as the Plan Area), owls are expected to have smaller home ranges than in areas where flying squirrels are the principal prey.

Summary of Biological Requirements. Based on the best scientific information available, the biological requirements of northern spotted owls can be summarized as follows:

- Northern spotted owls require a range of forest characteristics for nesting, roosting, foraging, and dispersal activities.
- Northern spotted owls generally rely on older forested habitats because such forests contain the structures and characteristics required for nesting, roosting, and foraging.
- Northern spotted owls may be found in younger forest stands that have the structural characteristics of older forests or retained structural elements from the previous forest.
- A mosaic of late-successional habitat interspersed with other seral conditions may benefit northern spotted owls more than large, homogeneous expanses of older forests.
- Habitat use is influenced by prey availability.
- Dusky-footed woodrats are a major part of the diet in the Oregon Klamath, California Klamath, and California Coastal provinces, and contribute to the smaller home range sizes observed.

6.2.1.2 Potential Impacts of Covered Activities on Northern Spotted Owls

The Covered Activities identified in Chapter 2 have the potential to alter forest characteristics, and influence the availability and quality of habitat for northern spotted owls, resulting in the incidental take of individual owls. These activities vary in their level of impact to northern spotted owls. The modification of forest stand conditions through timber harvest has the greatest potential to affect (adversely or beneficially) northern spotted owls because of the immediate and long-term effects it has on habitat conditions and prey availability. Silvicultural treatments such as thinning may benefit northern spotted owls by accelerating the development of northern spotted owl habitat and dense prey populations and reducing the risk of catastrophic wildfire. Silvicultural activities associated with stand regeneration are unlikely to affect habitat conditions for northern spotted owls, but have the potential to adversely affect northern spotted owls by increasing noise and activity levels. Other Covered Activities related to timber harvesting, such as road construction, maintenance, and use; harvest of minor forest products; fire prevention; and watershed management, could result in varying levels of habitat modification and disturbance. The potential impacts of timber harvest and other Covered Activities on northern spotted owls are addressed in this subsection.

Timber Harvesting. Potential adverse effects of timber harvest activities (falling, bucking, and yarding) associated with uneven-aged and even-aged regeneration methods are exhibited primarily through a reduction in stand density, average tree size, and canopy closure. Timber harvest can affect northern spotted owl habitat by reducing the canopy below levels preferred by northern spotted owls, reducing stand density to the extent that northern spotted owls cannot find adequate thermal cover or protection from adverse weather conditions or predation, reducing prey habitat, and eliminating features such as mistletoe brooms and decadent trees that support nesting sites. Activities associated with timber harvest may disturb nearby northern spotted owls. However, these activities will not occur during breeding, nesting, or rearing periods within 0.25 mile of any active northern spotted owl nest site, as specified by the conservation measures.

Timber harvest, depending on the silvicultural treatment, can be beneficial through maintaining forest health and productivity, and promoting the development of a heterogeneous forest structure consisting of a full range of forest habitats. Providing a full range of forest habitats may benefit northern spotted owls more than providing large, homogeneous expanses of older forests (Meyer et al. 1998; Franklin et al. 2000; Zabel et al. 2003). For example, some prey species, such as flying squirrels and red-backed voles, are associated with forest structural complexity. Other prey species, notably the dusky-footed woodrat, are associated with both young, second-growth forest stands and old-growth stands (Carey et al. 1992; Sakai and Noon 1993). Studies of home ranges conducted within the California Klamath and California Cascades provinces have concluded that woodrats are the principal prey species of owls in the Plan Area (Solis and Gutierrez 1990; Carey et al. 1992; Helppi 1995; Zabel et al. 1995; Bingham and Noon 1997). Forest management may restrict or enhance prey abundance and availability to northern spotted owls at the stand level. At the landscape scale, heterogeneous forests may yield a more diverse prey base than homogenous forests. Silvicultural treatments can reduce the potential for fire, especially large, stand replacing events that can significantly affect northern spotted owl habitat. Therefore, timber harvest has both negative and positive effects on northern spotted owls that, through this HCP, are balanced using a management approach that minimizes the detrimental effects and emphasizes the benefits of timber harvest.

Silviculture. Silviculture is the practice of treating forests to manage tree and forest growth. The types of silvicultural methods commonly employed by FGS within the Plan Area are consistent with the methods defined and regulated in the California FPRs. As described in Chapter 2, silvicultural treatments range from thinning of young even-aged stands, which may or may not result in a harvest of forest products, to timber harvest through uneven-aged and even-aged regeneration methods. FGS's silvicultural practices are designed to maintain and enhance the productivity of its timberlands by promoting prompt regeneration of harvested areas and rapid forest growth. Silvicultural treatments vary by stand age, stand condition, site class, and species composition, resulting in a heterogeneous forest structure at both the stand and landscape scales within the Plan Area.

Thinning is an important silvicultural tool for maintaining and enhancing forest health and growth. Overstocked, un-thinned stands typically become stagnant with limited site resources shared by too many trees. The result is a cessation of diameter growth and a marked increase in tree mortality. This is especially critical in the seedling and sapling stages of growth, but is significant throughout the life of the forest. Other silvicultural activities associated with stand regeneration and improvement include site preparation, prescribed burning, slash treatment, tree planting, and vegetation management.

Silvicultural treatments associated with uneven-aged management (especially thinning) can reduce the adverse effects of timber harvest. Different types of thinning can have varying consequences on the ecosystem, including effects on northern spotted owl prey species, the plants and fungi that provide them with food and cover, and the health and resilience of the forest (Carey et al. 1996; Colgan et al. 1999; Graham et al. 1999; Carey 2000a, 2001; Thysell and Carey 2000, 2001; Wilson and Carey 2000; Carey and Wilson 2001).

Conventional thinning in the Mixed Conifer/Mixed Evergreen Zone may benefit woodrats and deer mice in the mid-term. Overall, however, conventional thinning may be detrimental to flying squirrels because this species is associated with higher canopy closure and a more complex forest structure. Variable-density thinning holds promise for acceleration of the development of northern spotted owl habitat and dense prey populations (Carey et al. 1999; Carey 2001, 2003.; Carey and Wilson 2001) especially when appropriate attention is paid to decadence characteristics, such as snags, cavity trees, and coarse woody debris (Bunnell et al. 1999; Carey et al. 1999; Carey 2002). Variable-density thinning, used to promote multispecies management, provides the positive effects of conventional thinning, such as increased growth of trees, crown differentiation, development of understory, and increased flowering and fruiting of understory plants (Carey 2001), with lower levels of negative mechanical impact, and loss of canopy connectivity, spatial heterogeneity, and woody plant diversity.

Thinning also can reduce the potential for catastrophic fires. Fires play different roles in different ecosystems (Franklin et al. 2002). Some forests and their fauna are well adapted to fire, with an understory that may be highly flammable but quick to recover, and overstory trees that may be quite fire resistant. This is true of the mixed conifer forest of southwestern Oregon and northern California, where the old-growth is even more patchy than the forests to the north. These forests incorporate various evergreen hardwoods and hard-leaved shrubs that support dense woodrat populations. Thinning in these forest types could help restore a fire regime that benefits northern spotted owls by preventing stand replacement fires, and promoting the regeneration of forest floor vegetation and the accessibility of prey.

Spatial heterogeneity (patchiness) resulting from the Covered Activities and the mixed ownership landscape with federal lands may prove to be the key to restoring forest health and low intensity fire regimes while retaining patches of complex forests that benefit owls and their prey. This is supported by Olson et al. (2004) who concluded that their results from the central Oregon Coast Range indicated that while mid-seral and late-seral forests are important to northern spotted owls, a mixture of these forest types with younger forest and non-forest may be best for northern spotted owl survival and reproduction. The mosaic of forest types created by the Covered Activities across the landscape within the Plan Area is expected to provide the mid- and early-seral forest stages that supplement the late-seral forests located on adjacent federal lands. This is expected to improve the survival and reproduction of the local and regional populations of northern spotted owls by fulfilling the need for a range of habitat types over the landscape.

Stand regeneration activities such as site preparation, prescribed burning, slash treatment, tree planting, and vegetation management would not result in adverse effects on northern spotted owls through habitat modification, as these activities are generally confined to early seral stage forests not considered owl habitat. The potential for disturbance is also expected to be low, as owls typically nest away from early seral stage forests, and forage on the edge at night when forest management activities are rare. However, stand regeneration activities may displace prey, making them more available for northern spotted owls.

Other Covered Activities. Covered activities such as road construction, maintenance, and use; rock quarrying; harvest of minor forest products; fire prevention; and watershed management can have adverse effects on northern spotted owls through habitat modification. However, because these activities generally occur in small, localized areas, owls could be adversely affected primarily through increased noise and activity level (i.e., disturbance). The potential adverse effects resulting from these other Covered Activities are described in the following.

Road use, construction, and maintenance carried out by FGS on its ownership could result in adverse effects to northern spotted owls through habitat modification or disturbance. Adverse effects due to habitat modification are anticipated to be minor as road use, construction, and maintenance activities rarely result in substantial alteration of forest stand conditions, but could result in increased noise and activity levels. Seasonal restrictions on activities within 0.25 mile of active nest sites during the breeding season (see Chapter 5) would minimize any disturbance associated with these activities. Road closure and abandonment, on the other hand, could lead to reduced disturbance as vehicular traffic is removed from areas around active nest sites.

Rock quarrying on the FGS ownership has the potential to adversely affect northern spotted owls through habitat modification and disturbance. Because of the quarries’ small size (usually 2 acres or less in size), the potential effect of habitat modification at the quarry on nearby northern spotted owls is expected to be minor. The potential for disturbance is expected to be low due to the small number of quarry sites operating in any particular area or time period, and because quarrying activities within 0.25 mile of an active nest site would be subject to the seasonal restrictions identified in the Terrestrial Species Conservation Strategy (Chapter 5).

Harvest of minor forest products, such as Christmas trees and bows, firewood, fence posts, poles, yew bark, stumps, root wads, and mushrooms, occasionally occurs on the FGS ownership. These are relatively minor components of FGS’s operations, are typically small-scale, and are regulated by contract. This activity may result in adverse effects to northern spotted owls through disturbance. The potential for disturbance is expected to be low because the areas where these products are grown and harvested are typically not considered owl habitat.

Prevention of wildfire involves vegetation management and construction of fuel breaks strategically located throughout the Plan Area. Suppression efforts are the responsibility of government agencies, but occasionally FGS will be involved in initial suppression activities, which include the construction of fuel breaks by hand or bulldozer, falling of trees or snags, and collecting and applying water on the wildfires. These activities could result in disturbance of active nest sites. Although fire prevention activities could result in disturbance of nearby northern spotted owls, these activities may benefit the local and regional northern spotted owl population by minimizing the forest area consumed by catastrophic wildfire. Seasonal restrictions on activities within 0.25 mile of active nest sites during the breeding season (see Chapter 5) would minimize any disturbance associated with these activities.

Watershed management activities include habitat enhancement, site restoration, riparian exclusion, and activities associated with HCP implementation, such as fish passage improvements, road and crossing upgrades, and hydrologic disconnection of roads. Depending on the nature of the specific activity, watershed management activities are expected to result in a long-term net benefit to Covered Species. They could, however, adversely affect northern spotted owls in the short term through habitat modification or disturbance.

Habitat modification as a result of these activities would not result in impacts to owls beyond those identified for timber harvest. Disturbance of nesting northern spotted owls may occur wherever heavy equipment is used in conducting management activities within 0.25 mile of an active northern spotted owl nest during the breeding season. Seasonal restrictions identified in the Terrestrial Species Conservation Strategy (Chapter 5) would minimize any disturbance associated with these Covered Activities. Watershed management activities occur in localized areas over a short time frame, and as a consequence, are not expected to have a substantial adverse effect on northern spotted owls over the Permit Term. Furthermore, because these activities are undertaken to improve ecological conditions, northern spotted owls would likely benefit from such management.

Summary of Potential Impacts. The potential impact of Covered Activities on northern spotted owls can be summarized as follows:

- The modification of forest stand conditions through timber harvest has the greatest potential to affect northern spotted owls because of the immediate and long-term effects it has on habitat conditions and prey availability.
- Potential adverse effects of timber harvest are exhibited primarily through a reduction in stand density, average tree size, and canopy closure.
- Timber harvest, depending on the silvicultural treatment, can be beneficial to northern spotted owls by promoting the development of a heterogeneous forest structure consisting of a full range of forest habitats.

- Silvicultural activities (especially thinning) can reduce the adverse effects of timber harvest, accelerate the development of northern spotted owl habitat and dense prey populations, and reduce the potential for catastrophic fires.
- The potential adverse effects resulting from habitat modification and disturbance associated with Covered Activities other than timber harvest would not be greater than or incrementally increase the impacts associated with timber harvest.
- The potential adverse effects resulting from Covered Activities other than timber harvest are anticipated to be low as these activities generally occur in small, localized areas and are generally of short duration.
- Seasonal restrictions on activities within 0.25 mile of active nest sites will minimize any direct disturbance associated with the Covered Activities.

6.2.1.3 Incidental Take and Impacts of the Taking

The purpose of this subsection is to quantify the amount of incidental take of northern spotted owls that could occur as a result of Covered Activities, and evaluate the potential impact of the taking on the local and regional populations of northern spotted owls. This analysis consists of the following steps:

A. Establishing a northern spotted owl population and habitat baseline;

B. Evaluating the likelihood of incidental take at each known activity center;

C. Determining the level of incidental take in terms of individual owls;

D. Objectively evaluating and ranking the relative conservation value of each activity center;

E. Evaluating the potential impact of the taking at the local population scale in terms of relative conservation value of activity centers where incidental take could occur;

F. Evaluating the potential impact of the taking at the regional population scale in terms of short-term habitat loss, incidental take of individuals, and demographic support of federally designated CHUs; and

G. Evaluating the potential positive impacts of the Covered Activities on the local and regional populations.

A) Establishment of a Population and Habitat Baseline. To assess the potential effects of the Covered Activities on northern spotted owls, activity centers in the DFG northern spotted owl database[2] were evaluated for occupancy to establish a current baseline northern spotted owl population within a 1.3-mile radius of FGS's ownership (the Area of Impact). The DFG northern spotted owl database for 1987 to 2007 contains records of 97 activity centers within the Area of Impact. Of these, 15 activity centers have been determined by the USFWS as unlikely to be occupied based on a thorough review of habitat conditions and survey data. Therefore, 82 valid activity centers supporting an estimated total of 158 individual northern

[2] available via subscription from the biogeographic data branch of the California Department of Fish and Game [http://www.dfg.ca.gov/biogeodata/]. The database is continuously updated as new information becomes available and represents the most current compilation of northern spotted owl activity centers available.

spotted owls are believed to occur, or have occurred, within the Area of Impact. Of these 82 activity centers in the Area of Impact, 74 are located in the California Klamath Province and 8 are located in the California Cascades Province. Based on the distribution of the current population and habitat available, there is a very low probability of additional activity centers within the Area of Impact.

Baseline habitat mapping was jointly compiled by USFWS and FGS for the Area of Analysis (within 20 miles of the FGS ownership). The baseline habitat mapping is a compilation of the Klamath National Forest habitat mapping for national forest lands, FGS forest inventory mapping for FGS lands, CalVeg vegetation mapping for other lands in California, and Geographic Resource Solutions' Applegate Digital Vegetation mapping and Western Oregon Digital Image Project mapping for other lands in Oregon. The initial mapping was thoroughly reviewed by USFWS personnel and subsequently updated to represent habitat conditions as of 2005. This represents the best source of information currently available on potential habitat for northern spotted owls in the Plan Area of Analysis. Data sources used in the development of the baseline habitat mapping are described in Appendix A.

According to the baseline habitat mapping, there are approximately 741,000 acres of suitable northern spotted owl habitat (nesting, roosting, and foraging) within the 3,304,843-acre Area of Analysis (22 percent). Approximately 43,300 acres of the FGS ownership (1.3 percent of the total Area of Analysis) are mapped as habitat currently suitable for northern spotted owls, of which approximately 30,785 (20 percent of the Plan Area) acres are located within 1.3 miles of currently known northern spotted owl activity centers.

B) Evaluating the Likelihood of Incidental Take at Each Activity Center. Each activity center in the Area of Impact was evaluated based on expected changes in forest characteristics and composition within a 1.3-mile radius (the home range) and a 0.5-mile radius (core) circle around the activity center over the Permit Term. Changes in forest characteristics due to the Covered Activities were predicted based on FGS's anticipated harvest schedule. A series of standards were applied to determine if incidental take of northern spotted owls occupying the activity center is likely or unlikely. The following standards were collaboratively developed by FGS and USFWS using the USFWS's timber harvest plan guidelines:

Conditions in which incidental take of northern spotted owls occupying an activity center is likely:

- The activity center is on the FGS ownership, or
- Greater than 50 percent of the activity center's home range (1.3-mile radius) is on the FGS ownership, or
- The activity center has more than 15 percent but less than 50 percent of its home range on the FGS ownership, and:
    a. The activity center's home range contains less than 40 percent nesting/roosting and foraging habitat (greater than 60 percent of the home range is dispersal habitat or non-habitat), or
    b. At least 10 percent of the nesting/roosting habitat in the activity center's core (0.5-mile radius) is on the FGS ownership.

Conditions in which incidental take of northern spotted owls occupying an activity center is unlikely:

- Less than 15 percent of the activity center's home range is on the FGS ownership, or
- The activity center has more than 15 percent but less than 50 percent of its home range on the FGS ownership, and:
    a. The activity center's home range contains more than 40 percent nesting/roosting and foraging habitat (less than 60 percent of the home range is dispersal habitat or non-habitat),
    b. less than 10 percent of the nesting/roosting habitat within the activity center's core is on the FGS ownership

C) Determining the Level of Incidental Take in Terms of Individual Owls. Based on the evaluation of the likelihood of incidental take at each activity center, incidental take as a result of habitat modification due to Covered Activities will be authorized at 43 currently known activity centers in the California Klamath Province. If the activity center in which timber operations occurred is occupied, the resident northern spotted owls may abandon the site (be displaced). This displacement could result in the death or injury of individual northern spotted owls or disruption of their reproductive activities. Displaced owls may relocate to unoccupied suitable habitat and continue to nest and reproduce; however, they may also become more vulnerable to predation or adverse weather conditions, subject to poorer foraging conditions, or experience increased stress. Habitat modification could also adversely affect northern spotted owls if habitat conditions become more favorable to competitors (i.e., barred owls).

Once the suitable habitat within the home range of these activity centers has been modified due to timber harvest, it is unlikely that it will reach "suitable" status within the term of the HCP. Therefore, the activity center's potential contribution to the local population is permanently reduced. Mitigation requirements for this incidental take were developed based on the permanent loss of owls at activity centers where incidental take is considered likely (43 activity centers). However, many of these activity centers have not been recently surveyed and it is unknown whether they currently provide sufficient suitable habitat or support owls.

The 43 activity centers where take is authorized represent 83 individual northern spotted owls. This estimate of the potential for incidental take represents a worst-case scenario because it assumes that each of the activity centers supports northern spotted owls at their highest historical reproductive status (see Table 6-2) and that the modification of habitat would lead to the incidental take of all individual northern spotted owls occupying those activity centers. In this way, the estimated level of incidental take is the maximum that is expected to occur.

No northern spotted owls in the Area of Impact within the California Cascades Province are likely to be incidentally taken as a result of habitat modification as a result of Covered Activities over the Permit Term; this is because the CSAs established under this HCP will provide demographic support to all known activity centers within 1.3 miles of the FGS ownership in which FGS has greater than 10 percent ownership within the home range. All

Covered Activities would be conducted in a manner that complies with the terms and conditions of this HCP, including the Terrestrial Species Conservation Strategy. Habitat commitments in the CSAs preclude adverse modification of habitat for northern spotted owls in these areas.

D) Objectively Evaluating and Ranking the Conservation Value of Each Activity Center. Key to understanding the impacts of incidental take is that while "take" is quantified at the individual owl level, the impacts of the taking are assessed at the local and regional population levels, because each incidental take can affect the species population and its conservation in varying degrees. In other words, the location of an activity center and the northern spotted owls that occupy it can be more critical than the number of individuals taken when determining the value of the activity center and individuals for conservation and recovery of the species. The "conservation value" of each activity center within the Area of Impact was assessed using an evaluation matrix developed by FGS and the USFWS. The matrix allows for:

1. An assessment of the relative value of each activity center in the Area of Impact to conservation and recovery of the species using an objective, quantitative, and repeatable approach; and
2. Identification of high value activity centers for which demographic support will be provided (through establishment of CSAs) as mitigation for incidental take of lower value activity centers.

"Conservation value" is a concept that is intended to account for the range of impacts of taking individual owls within the context of the local population. It is an objective approach that scores a set of factors that represent the biological productivity and sustainability of each activity center in terms of its potential contribution and importance to the federal conservation strategy. The process for defining and quantifying "conservation value" was collaboratively developed by USFWS staff and FGS, and subsequently reviewed by researchers with northern spotted owl expertise[3]. The following factors were used to rank the relative conservation value of each activity center within the Area of Impact:

- Proximity of the activity center to a federally designated CHU
- The reproductive status and history of the activity center
- Proportion of private land in the core (0.5-mile radius) and home range (1.3-mile radius) of the activity center
- The predicted probability of occupancy by a nesting northern spotted owl pair using the habitat model developed by Zabel et al. (2003)

[3] The process for defining and quantifying "conservation value" was reviewed by Jeffrey Dunk (Humboldt State University) and Brian Woodbridge (USFWS Yreka Office)

TABLE 6-2
Impacts Evaluation Matrix. Individual Factor Scores and Conservation Value of Each Activity Center

Activity Centers within the Area of Impact	Proximity to Critical Habitat Unit	Private Land within Core	Private Land within Home Range	Predicted Probability of Occupancy (Po)	Reproductive Status	Conservation Value	Take Category*
SK379	4	4	4	3.93	4	111	N
SK238	4	4	4	3.89	4	111	M
SK097	4	4	4	3.19	4	102	M
SK378	4	4	4	4.00	3	100	M
SK099	4	4	3	3.97	4	100	M
SK530	4	4	4	2.87	4	98	M
SK237	4	4	4	3.37	3	94	N
SK044	4	4	3	3.30	4	94	M
SK194	4	4	4	2.44	4	93	N
SK048	4	3	3	3.58	4	88	N
SK012	4	4	2	3.51	4	85	N
SK063	4	3	2	3.73	4	81	M
SK352	4	4	3	2.37	3	80	M
SK512	4	4	3	2.36	3	80	M
SK291	4	4	3	2.31	3	80	M
SK051	4	3	2	3.11	4	78	N
SK002	4	3	2	3.60	3	76	M
SK153	4	3	2	3.57	3	76	M
SK531	4	3	2	3.38	3	75	M
SK526	4	3	2	2.99	3	74	N
SK262b	4	3	2	1.03	4	69	M
SK040	3	4	3	3.61	4	68	M
SK153B	4	4	3	0.31	3	66	N
SK284	4	2	1	0.44	4	65	M
SK462	4	3	2	0.05	4	64	M
SK446	2	4	3	3.77	4	50	M
SK061	3	2	2	3.64	3	44	M
SK262	3	1	2	3.06	4	41	T
SK028	3	3	3	0.33	4	38	M

TABLE 6-2
Impacts Evaluation Matrix. Individual Factor Scores and Conservation Value of Each Activity Center

Activity Centers within the Area of Impact	Proximity to Critical Habitat Unit	Private Land within Core	Private Land within Home Range	Predicted Probability of Occupancy (Po)	Reproductive Status	Conservation Value	Take Category*
SK100	2	3	3	3.12	4	37	M
SK542	3	2	1	0.51	4	37	N
SK310	2	4	2	3.22	4	35	T
SK239	2	3	3	2.72	4	34	T
SK380	2	2	3	3.98	4	34	T
SK503	2	4	2	2.75	4	32	M
SK131	0	4	4	3.47	3	31	N
SK500	2	3	2	2.53	4	27	T
SK204	2	3	3	3.21	2	27	N
SK065	2	2	2	3.02	4	25	T
SK382	1	3	3	2.95	4	24	N
SK318	0	4	3	2.54	4	23	T
SK359	1	4	2	2.96	4	22	T
SK472	0	4	2	3.56	4	21	T
SK020	0	4	2	3.53	4	21	T
SK477	0	4	2	3.16	4	19	T
SK387	0	3	3	2.59	4	17	T
SK469	1	2	3	2.97	4	17	T
SK130	1	3	3	3.70	2	16	T
SK428	1	4	2	2.01	4	16	M
SK334	0	4	2	2.50	4	15	T
SK548	0	2	3	3.60	3	12	M
SK370	1	3	1	3.23	4	11	T
SK322	0	4	2	2.37	3	11	T
SK335	0	3	2	3.13	3	11	T
SK321	1	3	2	1.44	4	10	T
SK336	0	2	2	3.44	4	10	T
SK473	1	2	3	2.78	2	10	T
SK533	0	3	3	1.46	4	10	T

TABLE 6-2
Impacts Evaluation Matrix. Individual Factor Scores and Conservation Value of Each Activity Center

Activity Centers within the Area of Impact	Proximity to Critical Habitat Unit	Private Land within Core	Private Land within Home Range	Predicted Probability of Occupancy (Po)	Reproductive Status	Conservation Value	Take Category*
SK388	1	2	2	1.83	4	9	T
SK389	0	2	2	3.05	4	9	T
SK474	0	3	2	2.59	3	9	T
SK454	0	3	2	1.82	4	8	T
SK205	1	1	1	3.17	4	6	T
SK309	0	1	3	2.63	4	6	T
SK391	0	1	2	3.25	4	5	T
SK365	0	2	2	3.08	2	5	T
SK450	0	2	1	3.71	3	4	T
SK046	0	1	1	3.54	4	3	T
SK442	0	4	4	0.43	2	3	N
SK534	0	1	1	3.33	4	2	T
SK363	0	1	1	3.12	4	2	T
SK386	0	1	2	2.93	2	2	N
SK475	0	1	1	2.89	4	2	T
SK361	0	1	1	3.75	3	2	T
SK368	0	1	1	2.78	4	2	T
SK360	0	1	1	3.50	3	2	T
SK364	0	1	1	3.49	3	2	T
SK358	0	1	1	2.25	4	2	T
SK467	0	1	1	1.74	4	1	T
SK369	0	1	2	0.40	4	1	T
SK333	0	2	2	0.07	4	0	T
SK537	0	1	1	0.37	3	0	N
				Total Conservation Value		2,991	

*Take Categories: M = Mitigation site where CSA is established; T = Activity center where take is authorized; N = Activity center where take is not likely

Scores for each factor were derived for each activity center, and a weighting process was used to determine an overall conservation value for each activity center. Individual factor scores were adjusted to a comparable scale, and then weighted according to their potential contribution to the federal conservation strategy. A further description of each factor is provided in the text below. The conservation value of each activity center in the Area of Impact was determined using the following formula:

> *Conservation Value of an Activity Center =[(0.75* percent private land in core)* (0.25* percent private land in home range)*Po* (Reproductive Status)] + (2* proximity to CHU)*[2]

Proximity to CHU. This factor was given relatively more weight than the other three factors in recognition of the HCP's objective to provide demographic support to owl populations on nearby federal lands, especially those owls critical to the federal conservation strategy. Activity centers were assigned a numerical ranking of "0" through "4" based on the following distance criteria:

> 0: The activity center is more than 2 miles from a CHU
> 1: The activity center is between 1.3 and 2.0 miles of a CHU
> 2: The activity center is between 0.5 and 1.3 miles of a CHU
> 3: The activity center is less than 0.5 mile from a CHU
> 4: The activity center is in a CHU

Reproductive Status and History of the Activity Center. For each activity center, the reproductive status factor was based on the highest historically recorded reproductive status from 1987 through 2007. This, in effect, establishes the maximum level of reproductive capacity observed for each activity center. This factor recognizes the importance of reproductive capacity of each activity center toward the long-term sustainability of the local population. This factor was given the same relative weight as three of the four factors. Activity centers were assigned a ranking of "0" through "4" based on the following reproductive criteria:

> 0: The activity center is abandoned
> 1: The reproductive status of the activity center is undetermined
> 2: The activity center consists of a territorial single
> 3: The activity center consists of a non-reproductive pair
> 4: The activity center consists of a reproductive pair

Proportion of Private Land in the Core and Home Range of the Activity Center. In the context of the federal conservation strategy for northern spotted owls, private lands are assigned a lower conservation value than federal lands. Although the ESA prohibits the take of listed wildlife species by private landowners, it does not require private landowners to implement conservation actions for listed species. Therefore, it would be problematic to implement habitat protection measures specific to the HCP for sites containing significant amounts of private land under the jurisdiction of multiple landowners other than FGS, particularly when that private land is in an activity center's core. Consequently, the federal conservation strategy for the northern spotted owl relies primarily on the retention and management of large blocks of northern spotted owl habitat on federal forest lands (USDA and USDI 1994; USFWS 2008).

As reflected in the scores below, this factor recognizes that private land in the core and home range of an activity center has a negative effect on its conservation value. The home range and core of each activity center is evaluated separately and combined to form a single factor with greater weight placed on an activity center's core. Activity centers were assigned a ranking of "1" through "4" based on the percent of private land within the activity center's core and home range as follows:

Core:
1: The core contains more than 75 percent private land
2: The core contains between 51 percent and 75 percent private land
3: The core contains between 26 percent and 50 percent private land
4: The core contains less than 26 percent private land

Home Range:
1: The home range contains more than 75 percent private land
2: The home range contains between 51 percent and 75 percent private land
3: The home range contains between 26 percent and 50 percent private land
4: The home range contains less than 26 percent private land

Predicted Probability of Occupancy (Po) of a Nesting Owl Pair. Each activity center within the Area of Impact was evaluated using the habitat-based model developed by Zabel et al. (2003). This model predicts the probability of potential occupancy of a nesting owl pair based on the total amount and proportion of nesting/roosting and foraging habitat available within a 0.5-mile radius of the activity center. This factor recognizes the value of current suitable habitat as a determinant of activity center occupancy. This factor was assessed on a continuum from "0" through "4" as a direct function of Po rather than being lumped in classes. This provided a discrete value for each activity center ranging from a low of 0.05 to 4.0.

Results of the evaluation, including individual factor scores, conservation values for each activity center, and take category for each activity center are presented in Table 6-2.

E) Evaluating Potential Impacts of the Taking at the Local Population Scale in the Area of Impact. The following section describes and evaluates the impacts of incidental take that could occur with implementation of the HCP, including implementation of the Terrestrial Species Conservation Program, on the local population of owls within the Area of Impact. As previously described, the conservation value of each activity center within the Area of Impact was assessed using an evaluation matrix developed by FGS and the USFWS. The sum of the conservation values for all activity centers within the Area of Impact is 2,991. The conservation value of individual activity centers ranges from 0 to 111 (see Table 6-2). Higher numbers represent higher conservation value within the context of the local population.

Under the HCP, FGS would establish CSAs focusing primarily on activity centers with the highest conservation value to provide demographic support to the federal conservation strategy. The process used to determine conservation value is described in Section 6.2.1.3 (D) above, but in summary, the activity centers with the highest conservation value are activity centers representing breeding pairs in close proximity to CHUs with a low percentage of private land in the home range and core area (i.e., high proportion of federal land), and that have a high probability of occupancy by northern spotted owls.

As shown by the bars in Figure 6-6, the activity centers with some of the highest conservation values will be protected through establishment of CSAs on the FGS ownership (identified as "Mitigation" [M] sites on the graph). These activity centers generally have a conservation value of greater than 40 on a scale of 0 to 111. Activity centers where Covered Activities are not likely to result in take (N on the graph) due to limited FGS ownership in the home range likewise have relatively high conservation values (>60). In contrast, the activity centers where take would be authorized under the ITP (T on the graph) generally have conservation values less than 40, with the majority having values less than 20; over half of the "take" sites have conservation values less than 10 on a scale of 0 to 111. In terms of raw conservation value, the highest ranked "take" site is SK262 which ranks 27th out of 82 activity centers and provides a conservation value of 41 on a scale of 0 to 111.

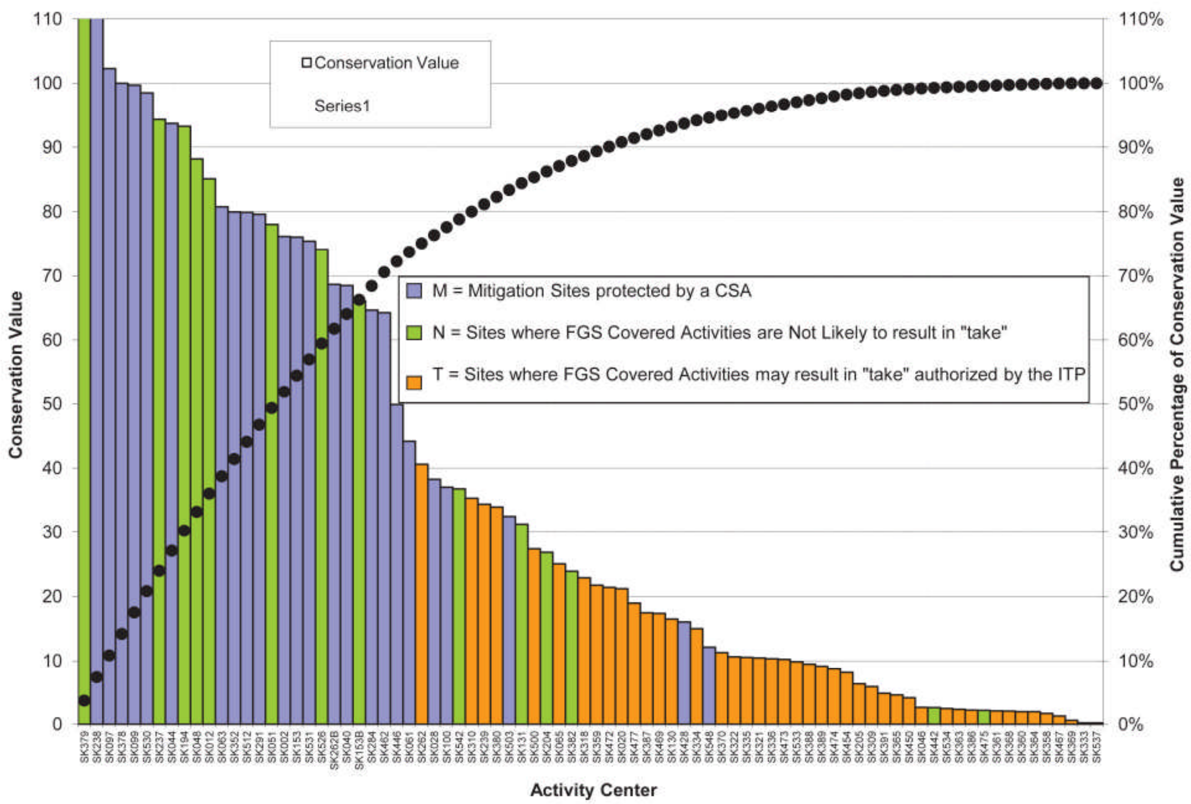

FIGURE 6-6
Conservation Value of Activity Centers in the Area of Impact (within 1.3 miles of the FGS ownership)

The majority of the northern spotted owls that could be taken over the Permit Term are from activity centers that:

- Are not in close proximity to a CHU;
- Contain high amounts of private land in the core and home range;
- Have inconsistent occupancy and productivity;
- Contain relatively poor quality habitat; or
- Are surrounded by extensive tracts of low quality habitat, thereby providing minimal connectivity value.

Thus, the majority of activity centers where incidental take is authorized have relatively low conservation value as determined using the impacts evaluation matrix for activity centers in the Area of Impact (see Table 6-2 and Figure 6-6). If take occurred at all 43 activity centers where take is authorized, there would be a corresponding reduction of 18 percent of the total conservation value of activity centers in the Area of Impact. The 24 CSAs established under the HCP as mitigation contribute approximately 55 percent of the total conservation value in the Area of Impact (a mitigation ratio of 3:1). Incidental take of northern spotted owls associated with activity centers supported by the CSAs would not be authorized. Activity centers in which incidental take of northern spotted owls is unlikely because of low overlap with the FGS ownership account for an additional 27 percent of the total conservation value of activity centers in the Area of Impact. Overall, 82 percent of the total conservation value of activity centers in the Area of Impact would be retained and conserved by the HCP's conservation, mitigation, and take avoidance measures (Figure 6-7).

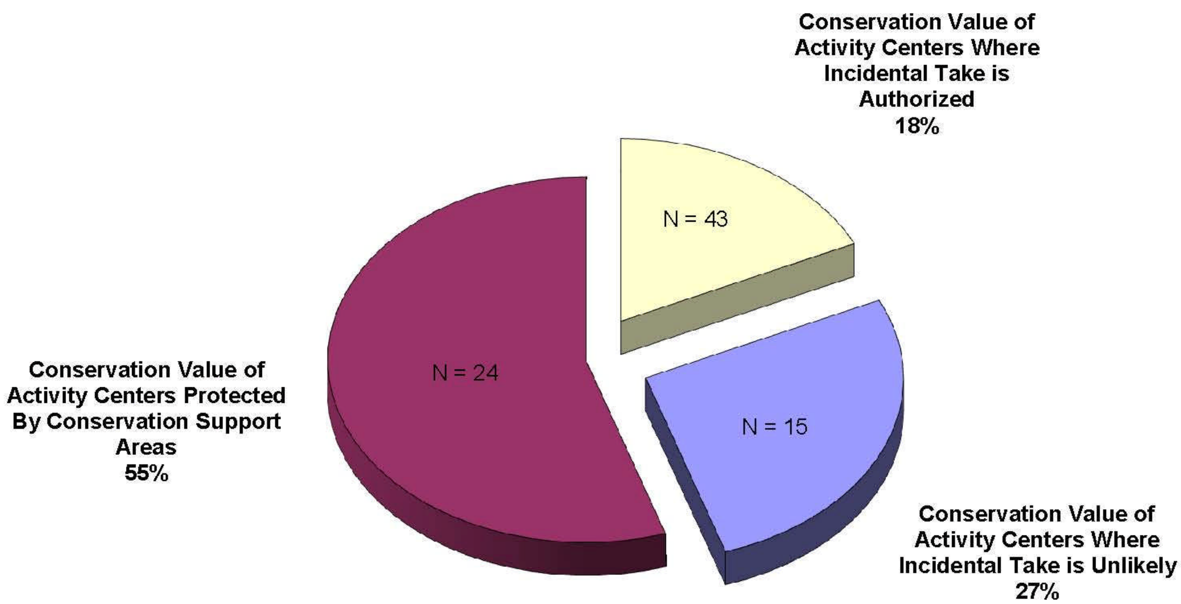

FIGURE 6-7
Percentage of the Total Conservation Value Contributed by Each Category of Known Activity Center in the Area of Impact.
(N = number of activity centers in each category)

F) Evaluating Impacts of the Taking at the Regional Population Scale in the Area of Analysis. The following section describes and evaluates the impacts of implementing the HCP, including the Terrestrial Species Conservation Program, on the regional population of owls within the Area of Analysis. The regional population within the Area of Analysis consists of activity centers and individual owls located within 20 miles of the FGS ownership. The regional population includes northern spotted owls in both the California Klamath Province and the California Cascades Province. The California Klamath Province encompasses the area west of I-5 and the California Cascades Province is east of I-5. A description of the characteristics and conditions within the two provinces is provided in Chapter 4. Impacts of the taking on the regional population are analyzed separately for each Ecological Province and for the critical habitat for northern spotted owl within them because each province is distinct in terms of population demographics and trends, threats, and quantity and quality of northern spotted owl habitat.

The potential impact of incidental take as a result of Covered Activities in the California Cascades Province was not evaluated because incidental take of northern spotted owls associated with known activity centers in this portion of the Plan Area will not be authorized under this HCP. The local population in this province is considered essential to the regional population. Under this HCP, CSAs will be established around known activity centers in which FGS has greater than 10 percent ownership within the home range. The same harvest restrictions in CSAs established in the California Klamath Province will apply in this province and any harvest in the CSAs will require approval by the USFWS (see Chapter 5). In this way, FGS lands in the California Cascades Province will be managed to provide demographic support to the federal conservation strategy and FGS's Covered Activities in this province will not result in the incidental take of northern spotted owls through habitat modification.

California Klamath Province. As previously described for the local population in the Area of Impact, habitat modification due to timber harvest could result in incidental take of owls at 43 activity centers in the California Klamath Province over the term of the Permits. The 43 activity centers where take is authorized represent a maximum of 83 individual northern spotted owls. Based on the 2005 owl habitat layer and the probability of occupancy model (Zabel et al. 2003), a total of 186 activity centers, or 372 spotted owls, were estimated to occur within the California Klamath Province Area of Analysis. Under the HCP, the 83 owls that could be incidentally taken over the Permit Term represent 22 percent of the estimated number of northern spotted owls within the Area of Analysis. This estimate of the potential for incidental take represents a worst-case scenario because it assumes that each of the activity centers supports northern spotted owls at their highest historical reproductive status (see Table 6-2) and that the modification of habitat would lead to the incidental take of all individual northern spotted owls occupying those activity centers. However, not all activity centers may be currently occupied, some activity centers may not be occupied at their highest historic reproductive status, and some displaced owls may be able to disperse and continue to reproduce. Therefore, the estimated level of incidental take is the maximum that is expected to occur over the term of the Permits.

The potential impact of incidental take as a result of Covered Activities on the regional owl population in the California Klamath Province was assessed using the following criteria:

1. Comparison of the amount of suitable northern spotted owl habitat likely to be affected by FGS's Covered Activities with the total amount of suitable habitat within the Area of Analysis;

2. The number of activity centers within 1.3 miles of federally designated critical habitat where the home range overlaps with the Area of Impact, such that FGS's Covered Activities could result in incidental take of northern spotted owl.

Suitable Owl Habitat Likely to be Affected

The amount of suitable habitat in the Area of Analysis likely to be affected by FGS's activities was based on the projected harvest schedule under the HCP and the 2005 USFWS/FGS northern spotted owl baseline habitat layer (see Appendix A). The baseline population for the Area of Analysis was estimated using the baseline habitat layer and the probability of occupancy model (Zabel et al. 2003). See Chapter 4 for a full description of the process by which habitat polygons were converted to potential owl numbers. The potential for incidental take at activity centers within federally designated critical habitat was based on the Revised Designation of Critical Habitat for the Northern Spotted Owl; Final Rule (FR 73 47326, August 13, 2008).

The Area of Analysis for this HCP (the FGS ownership plus an approximate 20-mile radius around the ownership) within the California Klamath Province contains 2,157,945 acres, of which FGS manages 111,195 acres (approximately 5 percent). Currently, 35 percent (746,650 acres) of the total Area of Analysis in this province is managed by other private landowners; 60 percent (1,295,000 acres) is administered by federal agencies. Approximately 291,000 acres (22 percent) of the federal lands are in federally designated CHUs for the northern spotted owl. Approximately 27 percent of the Area of Analysis (572,460 acres) in this province is considered suitable northern spotted owl habitat. Currently, about 40,000 acres of the suitable northern spotted owl habitat (7 percent) is located on the FGS ownership.

Over the term of the Permits, nearly all of the currently available habitat for northern spotted owl in the Plan Area could be harvested, with the exception of approximately 7,100 acres which are protected in CSAs. It is anticipated that the majority of timber harvest in the Plan Area will occur in the first 10 years of the HCP. During this first decade, the amount of northern spotted owl habitat modified due to FGS's harvest activities is estimated to be 20,700 acres, representing only 3.6 percent of the current northern spotted owl habitat in the Area of Analysis (as determined using the 2005 USFWS/FGS northern spotted owl habitat layer) within the California Klamath Province. Since much of the habitat loss due to timber harvest will occur in the first decade of the HCP, other habitat will be permitted to grow and the general quality of habitat on the FGS ownership will improve over time. The initial short-term loss of habitat will be mitigated by long-term habitat commitments (i.e., establishing CSAs) leading to an increasing amount of northern spotted owl habitat in the HCP Area over the term of the Permits (Figure 6-8).

Activity Centers Within 1.3 Miles of Designated Critical Habitat
There are seven federally designated CHUs within the Area of Analysis in the California Klamath Province, but only three CHUs overlap with the Area of Impact. This suggests that FGS's Covered Activities under this HCP have the potential to adversely impact northern spotted owls occupying activity centers only within three designated CHUs in this province through habitat modification. The designated CHUs within the California Klamath Province Area of Impact where FGS activities have the potential to adversely impact northern spotted owls through habitat modification are the Klamath Intra-Province (CHU 16), the Scott and Salmon Mountains (CHU 25), and the Southern Cascades (CHU 17). The following is an evaluation of potential effects on northern spotted owls occupying activity centers within 1.3 miles of CHUs that overlap the Area of Impact.

<u>Klamath Intra-Province, CHU 16</u>: The total area of this CHU is 97,572 acres, of which 51,653 acres are within the Area of Analysis (4,211 acres in the Area of Impact), primarily in the Oregon portion of the CHU. Only one activity center where FGS owns greater than 10 percent of the acreage in the home range (SK291) is within this CHU. FGS will establish a CSA around this activity center and will restrict harvest in the CSA until the conditions for harvest have been met. All other known activity centers in this CHU are outside of the Area of Impact; no northern spotted owl habitat within the home ranges surrounding these

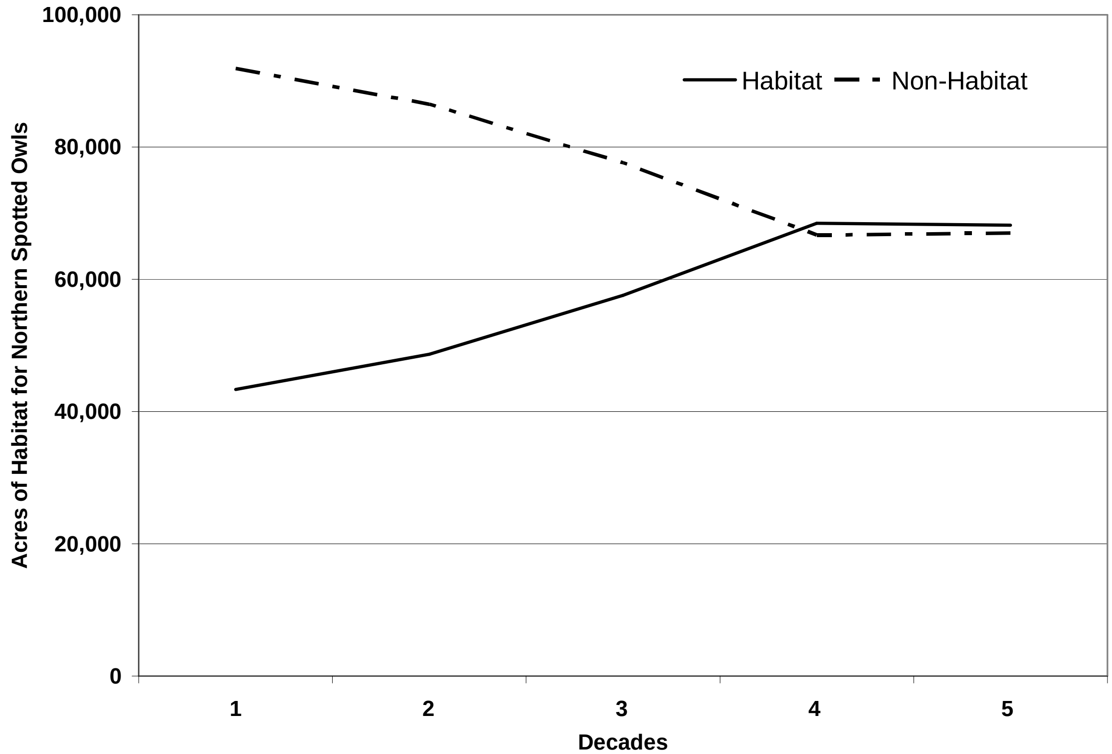

FIGURE 6-8
Projections of Northern Spotted Owl Habitat in the Plan Area by Decade

activity centers is likely to be modified by FGS to the extent that results in the incidental take of northern spotted owls over the Permit Term. Therefore, no incidental take of northern spotted owls as a result of habitat modification during FGS's operations is anticipated in this CHU and their operations will not have a significant adverse impact on the local or regional population of northern spotted owls that may use this CHU.

Scott and Salmon Mountains CHU 25: The total area of this CHU is 242,450 acres, 167,520 acres of which are within the Area of Analysis (24,695 acres in the Area of Impact). Of the 13 known northern spotted owl activity centers in this CHU with home ranges that overlap the Area of Impact, 12 will be protected by establishment of CSAs that encompass their home ranges. Only one activity center (SK262) is located within 0.5 mile of CHU 25 and has habitat within its home range that is likely to be modified to the extent that incidental take could occur. This activity center is characterized as supporting a reproductive pair. The entire core area of this activity center is private land, and 57 percent of the home range is private land. Owls in SK262 are dependent on habitat located on the FGS ownership. The current probability of occupancy is estimated to be 68 percent. Based on the impacts evaluation matrix, SK262 has a conservation value of 41 on a scale of 0 to 111. Incidental take of northern spotted owls associated with this activity center is mitigated by establishment of CSAs that directly support the other known activity centers in this CHU (SK002, SK044, SK063, SK097, SK099, SK238, SK262b, SK352, SK378, SK512, SK530, SK531), such that incidental take at one activity center (SK262) will not have a significant adverse impact on the local or regional population of northern spotted owls.

Southern Cascades CHU 17: The total area of this CHU is 226,430 acres, 47,355 acres of which are in the California Klamath Province Area of Analysis and 46,108 acres are in the California Cascades Province Area of Analysis (described below). Of the acreage in the California Klamath Province Area of Analysis, 727 acres are within the Area of Impact. No northern spotted owl habitat within the home ranges surrounding activity centers within 1.3 miles of the Klamath portion of this CHU is likely to be modified to the extent that results in the incidental take of northern spotted owls because FGS does not own greater than 10 percent of the home range acreage. Therefore, Covered Activities that occur on the FGS ownership over the term of the Permits will not have a significant adverse impact on the local or regional population of northern spotted owls that may use this CHU.

Summary of Impacts of the Taking at the Regional Population Scale in the California Klamath Province Area of Analysis

In summary, habitat modification due to timber harvest could result in incidental take of owls at 43 activity centers in the California Klamath Province over the term of the Permits. The 43 activity centers where take is authorized represent a maximum of 83 individual northern spotted owls. The estimated 83 owls (22% of the regional population) that could be incidentally taken is the maximum level of incidental take that could occur and is not likely to be this high because: 1) some activity centers may not be currently occupied, 2) some activity centers may not be currently occupied at their highest historic reproductive status, and 3) habitat removal may not result in incidental take at some of the activity centers because some owls may be able to disperse and continue to reproduce.

The potential impact of incidental take as a result of Covered Activities on the regional owl population in the California Klamath Province is not anticipated to be significant for the following reasons:

- The amount of suitable habitat for northern spotted owls on the FGS ownership (approximately 40,000 acres) is small relative to the large amount of suitable owl habitat currently available in the Area of Analysis (572,460 acres).
- A relatively small percentage of currently suitable habitat for northern spotted owl in the Area of Analysis is likely to be downgraded or converted to unsuitable habitat by FGS's Covered Activities (6.1% over the Permit Term, with 3.6% within the first decade). This loss of habitat would be mitigated by an overall increase in the amount of suitable habitat over the term of the Permits.
- Only one activity center within 1.3 miles of federally designated critical habitat for northern spotted owl has habitat within its home range that is likely to be modified to the extent that incidental take could occur, and this take would be mitigated through establishment of CSAs that directly support the other 12 known activity centers in this CHU.

- The majority of the spotted owls that could be incidentally taken over the term of the Permits are from activity centers that have relatively low conservation value and the loss of conservation value at these activity centers is mitigated at a 3:1 ratio by establishment of the CSAs (see Subsection 6.2.1.3 [E] above).
- As described by Anthony et al. (2006), demographic data for study populations in the California Klamath Province show that overall, northern spotted owl populations have been relatively stable (see Subsection 4.9.1.2 in Chapter 4 of this HCP).

California Cascades Province. The Area of Analysis for this HCP within the California Cascades Province covers 1,146,898 acres, of which FGS manages 48,500 acres (approximately 4 percent). Currently, about 47 percent (540,000 acres) of the total Area of Analysis in this province is managed by other private landowners. Approximately 49 percent (563,000 acres) is administered by federal agencies. Approximately 15 percent of the federal lands (85,948 acres) are in federally designated CHUs for the northern spotted owl. Suitable habitat in this province within the Area of Analysis is currently limited to 15 percent of the landscape. Suitable habitat on the FGS ownership in this province (about 4,800 acres) currently constitutes less than 1 percent of the total landscape and about 2.8 percent of the suitable habitat for northern spotted owls within the Area of Analysis.

Incidental take of northern spotted owls on the FGS ownership in this province will not be authorized by the ITPs. FGS lands within 1.3 miles of currently known activity centers in this province that have the potential to be affected by FGS operations will be managed to provide demographic support to the federal conservation strategy by establishment of CSAs. Harvest in the CSAs will be restricted and subject to USFWS approval. Establishment of the CSAs will contribute to minimizing and mitigating the impact of incidental take of owls in other areas of the FGS ownership on the northern spotted owl population.

The USFWS has also identified the regional population in this province as directly threatened by displacement from barred owls. As part of this HCP, FGS has agreed to manage northern spotted owl habitat on its ownership in a manner that supports known activity centers, as well as assist in the management of barred owls in this province.

There are three federally designated CHUs within the California Cascades Province Area of Analysis, but only one overlaps with the Area of Impact (Southern Cascades Unit 17). This suggests that Covered Activities under this HCP have the potential to adversely impact activity centers only within one designated CHU in this province through habitat modification. The potential effects on northern spotted owls occupying activity centers within 1.3 miles of the designated CHU that overlaps the Area of Impact are described in the following.

Southern Cascades CHU 17: The total area of this CHU is 226,430 acres, of which 46,108 acres are in the California Cascades Province Area of Analysis and 47,355 acres are in the California Klamath Province Area of Analysis. Of the acreage in the California Cascades Province Area of Analysis, 13,054 acres are within the Area of Impact. Three activity centers where FGS owns greater than 10 percent of the acreage in the home range are within this CHU (SK153, SK284, and SK462). FGS will establish CSAs around each of these activity centers and will restrict harvest in the CSAs until the conditions for harvest have been met. Incidental take of owls in these activity centers will not be authorized. All other known activity centers in this CHU are outside of the Area of Impact; no northern spotted owl habitat within the home ranges surrounding these activity centers is likely to be modified by FGS to the extent that results in the incidental take of northern spotted owls. Therefore, FGS's operations will not have a significant adverse impact on the local or regional population of northern spotted owls in the California Cascades Province.

G) Evaluating Potential Positive Impacts of Covered Activities on Local and Regional Populations. Many of the specific measures identified to minimize and mitigate the impact of incidental take on the local and regional populations focus on actions within and near known activity centers. These actions help reduce the negative effects of Covered Activities. However, the general forest management associated with Covered Activities could have a positive, long-term influence on local and regional northern spotted owl populations. The basic premise of this HCP is that by allowing timber harvest within selected areas currently encumbered by the ESA, the majority of FGS timberlands will be allowed to grow to a more mature condition than is currently possible. At the landscape scale, this will yield a heterogeneous forest condition that is managed on a sustainable basis for high quality forest products and provides diverse wildlife habitats. The heterogeneous forest structure resulting from silvicultural practices employed by FGS in the Plan Area will tend to increase edge between the various seral stages of forest stands. These ecotone areas are typically rich in resources used by northern spotted owl prey, such as dusky-footed woodrats.

Other Covered Activities will occur locally, but could have beneficial impacts beyond the operation area. Road abandonment will eliminate vehicular traffic, reducing disturbance to northern spotted owls. Stand regeneration and improvement is intended to restore forest stands to full productivity, hence increasing the potential for long-term sustainability of northern spotted owl habitat. Although fire prevention and suppression activities could result in disturbance to northern spotted owls, these activities will likely benefit local and regional northern spotted owl populations by minimizing the forest area consumed by catastrophic wildfire. Depending on the nature of the specific activity, various watershed management and fish and wildlife habitat enhancement activities are expected to result in benefits to northern spotted owls.

Summary of Incidental Take and Impacts of the Taking. The level of incidental take of northern spotted owls and the impacts of the taking at the local and regional level can be summarized as follows:

- As a result of habitat modification that will occur in 43 currently known activity centers in the Area of Impact within the California Klamath Province, incidental take of up to 83 individual northern spotted owls could occur over the 50-year Permit Term.
- Incidental take of northern spotted owls in the California Cascades Province will not be authorized in the Permits.
- The estimated 83 owls that could be incidentally taken is the maximum level of incidental take that could occur and is not likely to be this high because: 1) some activity centers may not be currently occupied, 2) some activity centers may not be currently occupied at their highest historic reproductive status, and 3) habitat removal may not result in incidental take at some of the activity centers because some owls may be able to disperse and continue to reproduce.

- Incidental take of northern spotted owls occupying the 43 activity centers where take is authorized would result in an 18 percent reduction in the total conservation value of the northern spotted owl population in the Area of Impact.
- The impact of the taking that may occur at the 43 activity centers where take is authorized (18% reduction in conservation value) is mitigated at a 3:1 ratio by the establishment of 24 CSAs which provide and protect 55 percent of the total conservation value in the Area of Impact.
- There are 15 activity centers in the Area of Impact in which FGS activities are not likely to result in incidental take because of FGS's limited ownership in the home ranges. These activity centers contribute 27 percent of the total conservation value in the Area of Impact.
- The majority of harvest is anticipated to occur during the first decade and is expected to result in habitat modification of approximately 3.6 percent of the current northern spotted owl habitat in the Area of Analysis.
- The initial short-term loss of habitat will be mitigated by long-term habitat commitments that will result in an increasing amount of northern spotted owl habitat in the Plan Area over the term of the Permits.
- Although general forest management and other Covered Activities may result in incidental take in the short-term, they have the potential to benefit northern spotted owls through maintaining forest health and productivity, and promoting the development of a heterogeneous forest structure consisting of a full range of forest habitats in the long-term.
- Silvicultural treatments can reduce the potential for fire, especially large, stand replacing events that can significantly affect habitat for northern spotted owls.
- Based on the potential for incidental take and the impacts of such taking, it is anticipated that FGS' forest management activities will not have a significant adverse impact on the local or regional populations of northern spotted owls in the California Klamath and California Cascades Provinces.

6.2.2 Yreka Phlox

Yreka phlox is a narrow endemic known only from the vicinity of Yreka, California. The plant occurs on lands owned and managed by industrial timber companies, other private landowners, the USFS, California Department of Transportation, and the City of Yreka. It is currently known to occur at five locations, none of which are found on the FGS ownership. Detailed descriptions of these known locations are provided in Chapter 4.

Under the HCP, the Covered Activities will occur over the entire FGS ownership over the 50-year term of the HCP. The specific locations of timber harvest cannot be projected over the Permit Term; therefore, it is assumed that all areas may be subject to timber harvest (with the exception of designated habitat management areas such as northern spotted owl CSAs) at some point over the term of the HCP, and any effects of this harvesting will occur during the Permit Term. Because Yreka phlox has a limited distribution and specific habitat requirements, potential effects of Covered Activities are restricted to a relatively small portion of the FGS ownership with the potential to support Yreka phlox.

The discussion of effects to Yreka phlox includes:

1. A summary of the biological requirements of Yreka phlox;
2. A description of how the Covered Activities, including HCP implementation, can impact Yreka phlox; and
3. A description of how the conservation measures for Yreka phlox included in the Terrestrial Species Conservation Program will avoid adverse effects to the Yreka phlox.

6.2.2.1 Biological Requirements of Yreka Phlox

Yreka phlox grows on serpentine soils at elevations from 880 to 1,340 meters (2,800 to 4,400 feet) in association with other plants tolerant of serpentine soils (USFWS 2006). As a serpentine endemic, Yreka phlox is found only on soils derived from ultramafic parent rocks, including serpentinite and peridotite. Based on the characteristics of known and reported Yreka phlox occurrences, areas with soils derived from ultramafic rock that occur within roughly 13 kilometers (8 miles) of any point along a line drawn from Paradise Craggy southwest through Yreka to Etna are considered to have high to moderate potential to support Yreka phlox (USFWS 2006).

6.2.2.2 Potential Impacts of Covered Activities on Yreka Phlox

Covered activities that result in ground disturbance or vegetation removal could adversely affect Yreka phlox. The primary activities that could result in adverse effects to Yreka phlox (if they occur within the limited range of the phlox) are new road, landing, and skid trail construction and introduction of competitive invasive weeds through seed transport and soil disturbance associated with timber harvest and other silvicultural activities. Little new road construction is anticipated over the term of the Permits, and landing and skid trail construction are generally associated with timber harvest or other silvicultural activities. Because the serpentine soils where Yreka phlox is found are generally not suited for timber production, few landings and skid trails are anticipated to be constructed in these areas, and the potential for introduction of invasive weeds as a result of timber harvest in these areas is also low; therefore, the potential for adverse impacts is low.

6.2.2.3 Avoidance of Adverse Effects

The Terrestrial Species Conservation Program (Chapter 5) includes conservation measures designed to avoid adverse effects to the Yreka phlox and provide information on species status and distribution in the Plan Area. Collectively, these measures will avoid adverse effects to the Yreka phlox due to Covered Activities and contribute to the federal conservation strategy for this species by:

- Surveying for and documenting currently unknown occurrences of Yreka phlox in areas on FGS lands with suitable soils and in areas identified by USFWS as having a high or moderate likelihood to support the species;
- Conducting detailed pre-activity surveys for Yreka phlox prior to Covered Activities that could directly (e.g., removal, destruction) or indirectly (e.g., changes in hydrology,

introduction of invasive weeds) impact Yreka phlox. FGS would conduct pre-activity surveys for phlox at the THP-level as required under the State THP review process.

- Protecting known and discovered occurrences on the FGS ownership by establishing EEZs around each known or discovered occurrence to reduce external influences and allow for expansion of populations.
- Monitoring known and discovered occurrences on the FGS ownership will provide information on species status, distribution, and threats, and contribute to development of local information that will aid in federal conservation efforts.
- Facilitating (e.g., through providing access to and across its ownership) implementation of invasive weed control measures, as necessary if invasive weeds are identified as a threat to known Yreka phlox populations in the Plan Area.
- Facilitating (e.g., through providing access to and across its ownership) efforts to reestablish Yreka phlox populations in the event that global climate change results in a range reduction of this species.

In summary, implementation of the HCP is anticipated to result in protection of Yreka phlox and its habitat over the term of the Permits, and implementation of the HCP is not anticipated to result in direct or indirect adverse effects to this species. The measures for Yreka phlox included in the Terrestrial Species Conservation Program effectively avoid adverse impacts to the species and contribute to the federal conservation strategy for this species.

CHAPTER 7

Monitoring and Reporting

This HCP uses a combination of habitat-based and species-specific approaches for ensuring that impacts to Covered Species are avoided, minimized, or mitigated to the maximum extent practicable. The conservation measures developed and presented in Chapter 5 are based on the best information available at the time the measures were developed. The monitoring strategy described in this chapter provides the framework and process for evaluating compliance with the requirements of this HCP and the ITPs, the effectiveness of the conservation measures, and for adjusting management actions if needed to respond to changed conditions. This chapter describes the monitoring and reporting activities associated with the aquatic and terrestrial components of the HCP.

7.1 Regulatory Requirements

Monitoring the effectiveness of conservation measures and ensuring compliance with the terms of the conservation program are mandatory elements of HCPs. The Services elaborated on monitoring requirements for HCPs in its Five Points Policy Guidance (64 FR 11485), and identified two types of required monitoring: (1) compliance monitoring and (2) effectiveness monitoring. Compliance monitoring verifies that the permittee is carrying out the terms and conditions of the HCP, and the accompanying ITPs and IA. Effectiveness monitoring entails collecting data that can be used to evaluate the conservation program's effectiveness in achieving the HCP's biological goals and objectives and ensuring that levels of incidental take are within the range anticipated with the HCP's implementation. Key information to be obtained through monitoring includes both the level of incidental take, as inferred through changes in habitat conditions resulting from the Covered Activities, and the biological conditions generated through land and resource management under the conservation program.

7.2 Monitoring

The following sections summarize the elements of compliance and effectiveness monitoring associated with the Aquatic Species Conservation Program and the Terrestrial Species Conservation Program. An overview of the aquatic compliance and effectiveness monitoring elements is provided in Section 7.2.1. The northern spotted owl compliance and effectiveness monitoring elements are described in Section 7.2.2, and the Yreka phlox compliance and effectiveness monitoring elements are described in Section 7.2.3. Details of each monitoring component—including site selection, field data collection, and data analysis—are provided in HCP Appendix F.

7.2.1 Aquatic Species

This section describes the type and frequency of compliance and effectiveness monitoring associated with the Aquatic Species Conservation Program.

7.2.1.1 Compliance Monitoring for Aquatic Covered Species

Compliance monitoring for the Aquatic Species Conservation Strategy consists of: documenting compliance with the riparian, slope stability, road management, and other conservation measures (e.g., measures intended to avoid direct take of fish) set forth in the Aquatic Habitat Conservation Strategy. Compliance with these measures will be documented largely through the reporting requirements outlined in Section 7.3 and through the following monitoring activity.

Compliance Monitoring Associated with Riparian Management. Take avoidance and minimization associated with riparian management will be accomplished through a combination of measures specifying WLPZ widths and restrictions on harvest (canopy coverage, tree retention) and activities (road building, soil disturbance) within WLPZs. Compliance with these measures will be documented through annual post-harvest WLPZ inspections conducted by FGS personnel or contractors of approximately 10 percent of WLPZs where harvest has occurred in that year.

Post-harvest WLPZ Inspection. FGS will document compliance with specific WLPZ management measures through post-harvest inspections of selected Class I and Class II WLPZs where harvest has occurred. Results of the inspections will be compiled annually and provided to the Services in the annual report.

Monitoring Type:	Compliance monitoring.
Sites:	Randomly selected WLPZs where harvest has occurred.
Sampling Frequency:	Once, immediately following harvest (within 1 year) in approximately 10 percent of the WLPZs where harvest has occurred in that year.
Objective:	Demonstrate that the WLPZ Management Measures (e.g., WLPZ width, canopy coverage, tree retention, soil disturbance) have been fully complied with.
Methods:	Compatible with CALFIRE's protocols in the Forest Practices Implementation and Effectiveness Monitoring Program protocols (e.g., FORPRIEM).
Reporting:	Annual monitoring report; trend analysis at 5-year intervals.

7.2.1.2 Effectiveness Monitoring

Monitoring the effectiveness of the aquatic conservation measures is necessary to evaluate whether the biological goals and objectives established in the HCP for the aquatic species are being met, and whether the effects of HCP implementation on physical and biological processes affecting the aquatic Covered Species and their habitats are exceeding the levels anticipated by NMFS in their Biological Opinion. FGS's monitoring program for aquatic species consists of several elements that evaluate the effectiveness of the aquatic conservation measures by measuring changes in specific variables ("watershed products") that affect the quantity and quality of habitats for the aquatic Covered Species (Table 7-1).

The primary "watershed products" that influence the quality and quantity of aquatic habitats in the Plan Area include:

- Water temperature
- LWD recruitment
- Fine sediments
- Channel morphology and conditions

The monitoring program focuses on these watershed products because they can be directly affected by the Covered Activities and can be monitored at a reasonable cost. To determine the effects that Covered Activities have on these products, the monitoring program uses a process-based approach that produces a current condition baseline for each of the primary watershed products and can be repeated to determine changes over time.

Measuring changes over time following forest practices is particularly useful when natural systems are unavailable for comparison, and desired conditions are not well established. In this instance, the Aquatic Species Conservation Strategy will be considered effective if it results in improvement in resource conditions or input processes over time. Since FGS's lands are intermingled with multiple landowners across the regional landscape, the monitoring program for aquatic species is designed to identify changes in watershed products that can affect aquatic Covered Species and their habitats resulting from Covered Activities occurring specifically on FGS's ownership. Monitoring efforts for aquatic species and the effectiveness of aquatic conservation measures will occur across varying scales (i.e., across the ownership, at the drainage or basin-scale, and at the project level), depending on the attributes to be measured and the necessary level of measurement to obtain the desired monitoring objectives. Each monitoring objective is based on a causal linkage between Covered Activities and changes in watershed processes and products that affect habitats for the aquatic Covered Species.

Impacts to aquatic Covered Species and their habitats may be separated in space and time from the activity that initiated them, and may be integrated with effects of other activities and natural events, making monitoring and interpretation of effects problematic. Consistent (i.e., in time and space) monitoring of watershed products that have a causal linkage to Covered Activities: (1) provides information on the effects of Covered Activities quickly and cost effectively; (2) identifies when and where the Aquatic Species Conservation Program may not be effective; and (3) provides information on the changes in the condition of habitat for aquatic Covered Species to help evaluate cumulative effects.

TABLE 7-1
Effectiveness Monitoring

Physical/Biological Processes Assessed ("Watershed Products")	Biological Goal	Monitoring Program Element	Time Frame for Results	Sampling Frequency	Sample Locations	Methods	Objectives
Stream temperature	Maintain a high level of stream shading to provide cool water temperature regimes that are consistent with the requirements of the individual Covered Species.	Property-wide Summer Water Temperature Monitoring	> 5 years	Annually for up to 10 years and then at least 5 years each decade	10-15 Sites within Cottonwood, Horse, Beaver, Moffett, Doggett, Dona, and Meamber drainages	Temperature data logger during summer/fall time period	(1) Provide a long-term record of water and air temperatures in key drainages. (2) Provide a reference water temperature database that can be used, if needed, as the baseline in project level analyses. (3) Evaluate observed water temperatures in relation to standards for suitability for salmonids (MWAT and MWMT). (4) Allow for an analysis of water temperature changes across the ownership in relation to FGS's management activities.
Stream temperature	Maintain a high level of stream shading to provide cool water temperature regimes that are consistent with the requirements of the individual Covered Species.	Harvest Unit-level Water Temperature Monitoring	> 5 years	Annually, at least 2 years prior to harvest and up to five years post harvest	Approximately five sites in selected Class I and II reaches (10 total) with proposed timber harvest	Temperature data loggers at paired sites upstream and downstream of harvest units	(1) Demonstrate that stream temperatures do not change by more than 2°C relative to pre-harvest conditions as the stream moves through the treatment (harvest) unit. (2) Demonstrate that any increases in stream temperatures within harvest units return to pre-harvest levels within 5 years of harvest.
Large Woody Debris	Provide for the recruitment of LWD into streams so as to maintain and allow the development of functional stream habitat conditions.	Riparian Stand Inventory	> 5 years	Once, immediately following harvest; repeated surveys at 5-year intervals	Up to 40 (10 annually) selected Class I and II reaches with WLPZ harvest	Inventory of permanent survey plots coupled with LWD modeling	(1) Demonstrate that harvest within Class I and Class II WLPZs does not reduce the potential volume of recruitment (immediately post-harvest) by greater than 10 percent compared to pre-harvest conditions. (2) Demonstrate that harvest within Class I and II WLPZs does not reduce the potential volume of recruitment over the long term (i.e., 50 years) by greater than 10 percent compared to modeled "unmanaged" conditions.
Fine Sediments	Minimize and mitigate human-caused sediment inputs.	Channel substrate monitoring	> 5 years	Annually	Index reaches in Beaver, Horse, Moffett, and Cottonwood drainages	Grid sampling / rapid V*	Verify that fine sediment deposition (surficial and volume) does not increase over 5 or more years within channels influenced by Covered Activities.

TABLE 7-1
Effectiveness Monitoring

Physical/Biological Processes Assessed ("Watershed Products")	Biological Goal	Monitoring Program Element	Time Frame for Results	Sampling Frequency	Sample Locations	Methods	Objectives
Fine Sediments	Minimize and mitigate human-caused sediment inputs.	Road inventories	> 10 years	Initial inventories followed by repeat inventories at 10 year intervals	All drainages with Class A and B designated lands	Inventory protocols developed by Pacific Watershed Associates and/or the California Department of Fish and Game	(1) Demonstrate that FGS's road inventories, prioritization, and treatment activities have resulted in a 50 percent reduction in the potential sediment delivery volume identified during the inventories over the first 20 years of the Permit Term. (2) Demonstrate a reduction in hydrologic connectivity, and an increase in rocked surfacing on FGS controlled roads.
Fine Sediments	Minimize and mitigate human-caused sediment inputs.	Road-related Improvements	1 year	Update of database as road improvements occur	Road improvement sites not directly linked to the road inventory and prioritization for treatment.	Maintain a GIS database that includes the description of the type of improvements made, methods used, and reductions in potential sediment delivery	Demonstrate that FGS's regular road maintenance, upgrading, and decommissioning activities have resulted in a reduction in hydrologic connectivity and potential sediment delivery volume.
Fine Sediments	Minimize and mitigate human-caused sediment inputs.	Mass wasting assessment	>15 years	15 years, or event-driven	Sub-basins in the Horse, Beaver, and Cottonwood drainages	Aerial photo mapping with ground-based field verification	Verify that landslide frequency on areas/landforms subject to Covered Activities has not increased above similar, reference areas/landforms.
Channel Morphology and Conditions	Protect hydrologic and riparian processes that influence water quality, aquatic habitat, and riparian functions.	Channel condition assessment	5 years	Initial assessment, repeated assessments at 5-year intervals	Index reaches in Beaver, Horse, Moffett, and Cottonwood drainages	Channel cross sections, sediment grain size, bank stability, LWD survey, channel morphology, aquatic habitat survey	Verify that geomorphic conditions and channel morphology in index reaches show a stable or improving trend indicating the overall effectiveness of the aquatic species conservation program.

Effectiveness Monitoring for Water Temperatures

Property-Wide Summer Temperature Monitoring. To verify that Covered Activities are not contributing to elevated stream temperatures, FGS will monitor water temperatures in selected channel reaches in the Plan Area. FGS will monitor water temperatures annually at sites in Class I and Class II watercourses across the Plan Area using the methods identified in Appendix F, Section 2. The Beaver, Horse, Cottonwood, Moffett, Doggett, Dona, and Meamber drainages have been selected for water temperature monitoring based on: (1) the availability of prior monitoring data; (2) the extent of FGS ownership within the drainage; (3) the extent of anticipated harvest over the term of the permits; (4) the likelihood of water temperatures being harmful to aquatic Covered Species; and (5) the presence of anadromous salmonids on the ownership or in reaches downstream within the drainage. Monitoring will document the MWMT, MWAT, and daily and seasonal (summer/fall) water temperature fluctuations for each monitoring site. Within the Beaver, Cottonwood, and Doggett drainages, air temperatures will be monitored adjacent to one of the water temperature monitoring sites. This is largely a continuation of FGS's current long term temperature monitoring, which has been ongoing since 1997.

Although the riparian measures to be implemented under the HCP are expected to minimize the potential for water temperature increases in downstream reaches where salmonids are present, natural disturbance, climate change and activities on other ownerships could lead to increases. Should increases in water temperature be observed, linking these increases to FGS's management would require further assessment, including an assessment of temperature differences between upstream and downstream monitoring sites, air temperature regimes, natural disturbances, and other anthropogenic influences.

Additional investigations would utilize the most cost-effective, established technology at the time (e.g., additional temperature probes, infrared imagery, solar radiation monitoring, etc.) and could include project-level analysis. Any additional assessment would be focused on streams supporting anadromous salmonids where average MWAT values exceed 16°C on a regular basis and where changes have been observed in the relationship between water temperatures at the upstream and downstream monitoring locations.

Monitoring Type:	Effectiveness monitoring.
Sites:	Water temperature data will be collected in the Cottonwood, Horse, Beaver, Moffett, Doggett, Dona, and Meamber drainages, generally near the downstream boundaries of the FGS ownership. In the Cottonwood, Beaver, and Doggett drainages, where FGS ownership represents a significant portion of the drainage area, water temperature data will also be collected near the upstream boundary, and air temperature data will be collected adjacent to one of the water temperature monitoring sites.
Sampling Frequency:	Annually, for at least 5 years from issuance of the ITPs or until at least 10 years of data have been collected (including data collected up to 5 years prior to development of this HCP). Continued monitoring for at least 5 years in each decade over the term of the Permits.

Objectives:	(1) Provide a long-term record of water and air temperatures in key drainages so that trends in water temperatures and the relationship between water and air temperatures can be evaluated; (2) Provide a reference water temperature database that can be used, if needed, as the baseline in project level analyses; (3) Evaluate observed water temperatures in relation to standards for suitability for salmonids (MWAT and MWMT); and (4) Allow for an analysis of water temperature changes across the ownership to demonstrate that temperatures in Plan Area streams do not increase substantially over the long-term due to FGS's management activities.
Methods:	Water and air temperature data will be collected from at least May through October provided that flows and weather allow access to the monitoring sites. FGS will have flexibility in the timing of logger deployment, but will ensure that monitoring period will be sufficient to capture the MWAT and MWMT and characterize the daily and seasonal (summer/fall) temperature fluctuations at each site. Data loggers will be initially calibrated for accuracy and precision and deployed to record temperatures on a maximum 2-hour sampling interval.
Reporting:	Annual monitoring report; trend analysis at 5-year intervals.

Harvest Unit-level Water Temperature Monitoring. FGS will monitor water temperatures before and after timber harvesting in WLPZs adjacent to selected reaches of Class I and Class II watercourses in conjunction with adjacent riparian zone canopy closures using the protocol described in Appendix F, Section 3. The goal is to assess potential effects of harvesting and the effectiveness of the riparian conservation measures in minimizing water temperature effects. Monitoring will be focused on Class I streams supporting anadromous salmonids and Class II streams tributary to anadromous streams. During THP preparation, FGS is able to identify stands where harvest may occur over a period of 3 to 5 years. Riparian stands identified for harvest will be candidates for harvest unit-level temperature monitoring such that monitoring can generally begin at least 2 years prior to harvest.

Harvest unit-level monitoring will utilize the most cost-effective, established technology, and study design available at the time. It is anticipated that some form of a before/after/control/impact (BACI) approach would be used, but other designs could be utilized if they are determined to be more applicable. FGS will consult with NMFS regarding monitoring locations and the most appropriate and cost-effective methods to use for the project-level analysis. Where possible, monitoring sites used during the property-wide temperature monitoring will be used as one of the harvest unit-level monitoring sites to maximize sampling efficiency.

Monitoring Type:	Effectiveness monitoring.
Sites:	Selected sites in drainages supporting anadromous salmonids and where timber harvest is anticipated within the riparian zone under this HCP. Up to five harvest units along Class I and Class II watercourses (10 total) will be selected for monitoring over the first 10 years of the HCP.
Sampling Frequency:	Annually, for at least 2 years prior to and 5 years after harvesting, or until monitoring indicates that conditions have returned to pre-harvest conditions.
Objectives:	(1) Demonstrate that stream temperatures do not change by more than 2°C relative to pre-harvest conditions as the stream moves through the treatment (harvest) unit; and (2) Demonstrate that any increases in stream temperatures within harvest units return to pre-harvest levels within 5 years of harvest.
Methods:	Water and air temperature data will be collected from at least May through October provided that flows and weather allow access to the monitoring sites. FGS will have flexibility in the timing of logger deployment, but will ensure that the monitoring period will be sufficient to capture the MWAT and the MWMT, and characterize the daily and seasonal (summer/fall) temperature fluctuations at each site. Data loggers will be initially calibrated for accuracy and precision and deployed to record temperatures on a maximum 2-hour sampling interval. Riparian canopy data will be collected pre-harvest and in the post-harvest WLPZ inspection described below.
Reporting:	Annual monitoring report for each year that monitoring is conducted; trend analysis after 5 years of post-harvest monitoring for each monitoring site.

Effectiveness Monitoring for LWD Recruitment Potential. FGS will monitor the effectiveness of the WLPZ retention measures in providing for potential long-term woody debris recruitment. This element is intended to provide a means of evaluating the long-term changes in recruitment potential. This element does not directly monitor in-stream accumulation of wood, although monitoring conducted under the "Channel Condition Assessment" element will document LWD levels in area streams. It is likely that some of the riparian stand inventories described below will be conducted along index reaches for the "Channel Condition Assessment" (see Appendix F, section 7 and below). Riparian stand inventories will be conducted during the post-harvest WLPZ inspections (see Compliance Monitoring, Appendix F, Section 1) to characterize riparian stands within WLPZs (Appendix F, Section 4).

Riparian Stand Inventory. A transect-based inventory, at permanent plots, of trees greater than 10 cm (4 inches) dbh within the WLPZ will be coupled with a tree fall model to estimate the potential LWD recruitment volume present within the WLPZ stand (see Appendix E). An applicable tree growth model (e.g., ORGANON or CACTOS) will be used to model "unmanaged" conditions in the stand over time and estimate the LWD recruitment potential (volume) of the unmanaged stand each decade as described in Appendix E. The differences in recruitment potential, both before and after harvesting and between the harvested and unmanaged conditions, will be quantified over a modeling period of at least 20 years.

The HCP measures for protection of Class I and II WLPZs are expected to retain at least 90 percent of the pre-harvest LWD potential and to provide at least 90 percent of the potential LWD volume, over the long-term, anticipated from the same stand if it remained unmanaged (refer to Biological Goals and Objectives section). Should a decrease of greater than 10 percent in the volume of potential LWD be observed over the 20-year monitoring period, linking this decrease to FGS harvest would require further assessment. Additional assessment could include an assessment of compliance with the HCP measures in harvested WLPZs, windfall rates, natural disturbances, and other anthropogenic influences.

Monitoring Type:	Effectiveness monitoring.
Sites:	Randomly selected subset of post-harvest WLPZ inspection sites within Class I and Class II WLPZ stands; at least three Class I and two Class II sites (up to 10 plots per year) for the first 4 years of the Permit Term.
Sampling Frequency:	Once, immediately following harvest (within 1 year); repeated surveys at 5-year intervals for 20 years using permanent plots.
Objectives:	(1) Demonstrate that harvest within Class I and Class II WLPZs does not reduce the potential volume of recruitment (immediately post-harvest) by greater than 10 percent compared to pre-harvest conditions; (2) Demonstrate that harvest within Class I and II WLPZs does not reduce the potential volume of recruitment over the long term (i.e., 50 years) by greater than 10 percent compared to modeled "unmanaged" conditions; and (3) Provide site-specific stand growth data that can be used to refine the growth model used to predict future "unmanaged" potential LWD recruitment.
Methods:	Transect-based riparian stand inventories that provide information on tree size (dbh and height) and distance from the stream.
Reporting:	Annual monitoring report for the first 4 years of the Permit Term (until all permanent plots have been established); repeated analysis at 5-year intervals.

Effectiveness Monitoring for Fine Sediments. Fine sediments generated as a result of FGS operations can impact aquatic Covered Species located in Class I and Class II watercourses downstream of and adjacent to Covered Activities. The primary sources of these sediments are mass wasting inputs, roads (including construction and maintenance), and sediment derived from channel and bank instability. The monitoring activities described below allow for an analysis of the cumulative effectiveness of HCP measures designed to reduce the amount of fine sediments entering Class I and Class II watercourses. Sediment monitoring activities address the aquatic species conservation program goal of minimizing sediment inputs from the Covered Activities.

Channel Substrate Monitoring. To verify that the Covered Activities do not result in increased deposition of fine sediments in pools throughout the stream network, FGS will measure the volume of fine sediments in pools using the rapid v* protocol (see Appendix A9 of Stillwater Sciences and Dietrich 2002) and surface fines using grid sampling in pool tails. The Beaver, Horse, Cottonwood, and Moffett drainages have been selected for monitoring based on: (1) the availability of prior monitoring data, (2) the extent of FGS ownership within the drainage, and (3) the presence of anadromous salmonids within the drainage. To capture the influence of FGS activities on fine sediment deposition in pools, an index reach approach will be adopted. Index reaches will be selected based on: (1) their ability to show a response in streambed characteristics to changes in sediment supply (i.e. low gradient, gravel-bedded reaches) and (2) the extent of Covered Activities anticipated upstream of the reach.

Monitoring Type:	Effectiveness monitoring.
Sites:	At least one index reach in each of the Beaver, Horse, Moffett, and Cottonwood drainages.
Sampling Frequency:	Annually, for at least 5 years from issuance of the ITPs. Monitoring will occur at a consistent time coinciding with the lowest stable flow period during the late summer or early fall.
Objective:	Verify that fine sediment deposition (surficial and volume) does not increase over 5 or more years within channels influenced by Covered Activities.
Methods:	a) Rapid v*; measure fine sediment volume in 6 to 12 pools in each 500-meter to 1,000-meter-long index reach using the rapid v* protocol (see Appendix F, Section 8). b) Grid samples; measure percentage of surface area covered in fine (<2 mm) sediment in pool tail areas of pools selected for rapid v* and an additional random sample of at least 10 pools in each 500 meter to 1000 meter long index reach using a 0.5-meter-square grid with 100 points (see Appendix F, Section 8).
Reporting:	Annual monitoring report; trend analysis after 5 years of monitoring.

Road Inventories. FGS will monitor the effectiveness of the road upgrading and decommissioning measures in reducing the frequency and severity of sediment inputs from road-related sources. FGS has committed to initial drainage-level road inventories in all drainages in the Plan Area containing Class A designated lands within 10 years of issuance of the ITPs, following a priority based on: (1) miles of high and very high erosion risk road segments, and (2) miles of coho salmon habitat on and downstream of the FGS ownership. In addition, drainage level inventories in drainages with Class B lands will be completed within 15 years of ITP issuance. Effectiveness monitoring will consist of repeated road inventories in all drainages on a 10-year cycle.

Established methods for road inventories will be utilized. Current methods include those used by Pacific Watershed Associates (unpublished) and the DFG in Part X of the California Salmonid Stream Habitat Restoration Manual (DFG 2006). The inventory will assess, at a minimum: (1) the occurrence of hydrologically connected road segments; (2) the location of high, moderate and low treatment priority sites; (3) the amount of sediment potentially delivered from these sites; and (4) the distribution of road surface types. Results of the inventories will be integrated with results of the Channel Substrate Monitoring to aid in assessing the effects of reduced sediment input as a result of road-related processes.

Monitoring Type:	Effectiveness monitoring.
Sites:	All drainages with Class A and B designated lands.
Sampling Frequency:	Road inventories will be conducted every 10 years during the permit period based on the original inventory date (priority).
Objectives:	(1) Demonstrate that FGS's road inventories, prioritization, and treatment of sites with the greatest potential sediment delivery have resulted in a 50 percent reduction in the potential sediment delivery volume identified during the inventories over the first 20 years of the Permit Term. (2) Demonstrate a reduction in hydrologic connectivity, and an increase in rocked surfacing on FGS controlled roads.
Methods:	Inventory protocols developed by Pacific Watershed Associates (unpublished), the California Department of Fish and Game (DFG, 2006), or through consultation with NMFS (see Appendix F, Section 5).
Reporting:	Periodic road inventory reports for each drainage, following inventories at approximately 10-year intervals will be included in the annual report for that year (see "Reporting" below).

Road-related Improvements. In addition to the road inventories, prioritization, and treatment of sites with the greatest potential sediment delivery described above, FGS conducts regular road maintenance, upgrading, and decommissioning activities that reduce hydrologic connectivity of road segments and sediment delivery from road surfaces and stream crossings. FGS will track all road-related improvements to reduce sediment delivery potential throughout the Plan Area, and submit an annual report to document the effectiveness of road maintenance, upgrading, and decommissioning activities, collectively referred to as "Road Improvements." Road improvements include: (1) application of best management practices (BMPs) to reduce sediment delivery from stream crossings and other potential sediment sources identified in THPs; (2) road-related construction activities, including the improvement of existing roads; and (3) road-related upgrading and decommissioning activities, including reshaping, resurfacing, or hydrologic disconnection of existing roads. Documentation of road-related improvements will include maintenance of a GIS-based database that includes a description of the type of improvements made, methods used, reductions in potential sediment delivery, the date(s) of activities, photographs, and personnel involved.

Contents of the database will be integrated with results of the road inventories and results of the Channel Substrate Monitoring to aid in assessing the effects of reduced sediment input as a result of road-related processes.

Monitoring Type:	Effectiveness monitoring.
Sites:	Road improvement sites not directly linked to the road inventory and prioritization for treatment.
Sampling Frequency:	Update of database as road improvements occur.
Objective:	Demonstrate that FGS's regular road maintenance, upgrading, and decommissioning activities have resulted in a reduction in hydrologic connectivity and potential sediment delivery volume.
Methods:	Maintain a GIS database that includes the description of the type of improvements made, methods used, reductions in potential sediment delivery, the date(s) of activities, photographs, and personnel involved following Erosion Control Plan (NCRWQCB) protocols for THPs.
Reporting:	Annual summary of road improvements and erosion control.

Mass Wasting Assessment. FGS will conduct a mass wasting assessment to examine the relationships between mass wasting processes and forest management practices. The purpose is to ensure that timber harvesting and other Covered Activities do not increase hillslope mass wasting rates above regional background rates. FGS will conduct landslide surveys in the Horse, Beaver, and Cottonwood drainages using aerial photography in conjunction with ground-based field verification. These drainages were selected based on: (1) the proportion of sample areas with active operations, and areas without active operations; (2) the presence of anadromous salmonids; (3) similar lithology; and (4) concurrent data collection efforts.

The landslide information will be compiled along with information on timber harvest and associated silvicultural methods, potentially unstable landforms (i.e., deep-seated slides, headwall swales, and inner gorges), and other landforms as described by hillslope gradient, shape, and parent lithology. The assessment will compare the frequency of landslides, for various landforms, between areas harvested over the previous 15 years (study sites) and unharvested areas (reference sites). To achieve an adequate sample size, FGS may obtain landslide data from non-FGS lands.

Protocols for the mass wasting assessment will generally follow the procedures described in Pacific Watershed Associates (PWA) (1998), Reid (1998), or other applicable procedures.

Monitoring Type:	Effectiveness monitoring.
Sites:	Sub-basins in the Horse, Beaver, and Cottonwood drainages.
Sampling Frequency:	The mass wasting assessment will be conducted in year 15 of the permit term and again in year 30 if the results of the initial assessment indicate that FGS management is linked to an increase in landslide frequency.
Objective:	Verify that landslide frequency on areas/landforms subject to Covered Activities has not increased above similar, reference areas/landforms.
Methods:	Aerial photo mapping with ground-based field verification.
Reporting:	Results of monitoring will be tabulated and reported in year 15 and year 30 of the permit period.

Effectiveness Monitoring for Channel Morphology and Conditions. The combined effects of altered hydrology, changes in sediment delivery to a stream, and LWD recruitment within a stream channel can affect the overall condition of a stream channel, and impact the quantity and quality of aquatic habitat. The monitoring activities described below allow for an assessment of conditions in stream channels that may be affected by the Covered Activities. Channel monitoring activities address the aquatic species conservation program goal of protecting hydrologic and riparian processes that influence water quality, aquatic habitat, and riparian functions.

Channel Condition Assessment. FGS will conduct periodic monitoring to assess channel conditions to evaluate channel responses to Covered Activities on its ownership. Within selected index reaches, FGS will use a variety of sampling techniques to identify changes in channel morphology and conditions, including cross-sectional area and shape, sediment grain size, bank stability, LWD, channel characteristics, and aquatic habitat quality. Channel monitoring will occur in the Beaver, Horse, Cottonwood, and Moffett drainages. These drainages were selected for monitoring based on: (1) the availability of prior monitoring data, (2) the extent of FGS ownership within the drainage, and (3) the presence of anadromous salmonids within the drainage. To capture the influence of FGS activities on geomorphic conditions in a given channel, an index reach approach will be adopted. Index reaches will be selected based on: (1) their ability to show a response in channel characteristics to changes in input processes (i.e. low gradient, gravel-bedded reaches), and (2) the extent of Covered Activities anticipated upstream of the reach.

The USFS SCI methodology for the Pacific Southwest Region (Frazier et al. 2005) in combination with the California Department of Fish and Game Aquatic Habitat methodology (DFG, 1998) was used in development of the data collection protocols (Appendix F, Section 7).

Monitoring Type:	Effectiveness monitoring.
Sites:	Selected index reaches in Beaver, Horse, Moffett, and Cottonwood drainages.
Sampling Frequency:	Index reaches will be established and initial monitoring conducted within 2 years of ITP issuance, followed by monitoring at 5-year intervals for the Permit Term. Monitoring will occur at a consistent time coinciding with the lowest stable flow period during the late summer or early fall.
Objective:	Verify that geomorphic conditions and channel morphology in index reaches show a stable or improving trend indicating the overall effectiveness of the aquatic species conservation program.
Methods:	a) Channel cross-sections: Measure two to four permanently established cross-sections in each index reach. b) Sediment grain size: Perform pebble counts at locations of permanently established cross sections in each index reach. c) Bank stability: Evaluate bank stability at 100 points along each index reach. d) In-channel LWD distribution, type, and function: Enumerate, measure, and identify functional LWD within each index reach. e) Channel characteristics: Identify and measure the characteristics (length, width) of each riffle, pool, and run within the index reaches, and estimate average and maximum pool depth and depth at the riffle crest for each pool. f) Aquatic Habitat Quality: Assess shelter, embeddedness, and canopy cover of each habitat unit.
Reporting:	Results of monitoring will be tabulated and reported following establishment of index reaches (within 2 years of ITP issuance); trend analysis at 5-year intervals included in the annual report for that year.

7.2.1.3 Aquatic Species Monitoring Adaptability

The aquatic species monitoring outlined in the previous sections utilizes monitoring protocols that represent current, peer-reviewed, and accepted methods at the time of HCP development. It is possible that other monitoring or sampling methods may be developed during the term of the HCP that would provide more accurate measurements or increase the efficiency of data gathering efforts for different monitoring parameters. FGS and the Services may mutually agree to modify the monitoring protocols listed in this HCP to better monitor the effectiveness of the conservation measures and ensure compliance with the terms of the conservation program at any time.

7.2.2 Northern Spotted Owl

This section describes the type and frequency of compliance and effectiveness monitoring for the northern spotted owl associated with the Terrestrial Species Conservation Program.

7.2.2.1 Compliance Monitoring for the Northern Spotted Owl

Compliance monitoring for the northern spotted owl consists of documenting compliance with the measures set forth in the Terrestrial Species Habitat Conservation Strategy. Compliance monitoring for measures associated with each biological objective are described below.

Compliance Monitoring Associated with Objective 1 – Demographic Support. Compensatory mitigation for incidental take of owls over the Permit Term will be provided through establishment of CSAs on FGS's ownership to provide demographic support to activity centers with high conservation priority. FGS may harvest in CSAs only if general habitat conditions within the home range and core area of the activity center(s) set forth in Section 5.3.1 are met, and specific habitat targets within the CSA (see Table 5-3) will be maintained post-harvest. Harvest within a CSA will require written approval from the USFWS. Compliance monitoring for this objective consists of: 1) documenting that FGS has not conducted harvest activities within the CSAs unless the required general habitat conditions are met; and 2) if FGS conducts timber operations in the CSAs, verifying that the specific habitat targets are met following these activities.

To verify that no timber operations have occurred in CSAs without prior approval from USFWS, FGS will provide USFWS with a list of the locations of active THPs on an annual basis (see "Reporting" below).

If FGS proposes to conduct timber operations in a CSA, prior to conducting these activities, FGS will provide map(s) of the CSA showing suitable northern spotted owl habitat in the home range and core areas of the supported activity center to the USFWS. As part of the THP process, FGS will inventory areas proposed for harvest to verify that the specific targets for northern spotted owl habitat within the CSA pre-harvest can be met following harvest. FGS will provide the USFWS with a copy of the proposed THP encompassing the CSA, and obtain written approval for harvest in the CSA. Following completion of timber operations in a CSA, FGS will inventory harvested stands to document post-harvest stand conditions and submit a post-harvest report to the USFWS. The post-harvest report will quantify the amount of nesting, roosting, and foraging habitat in the harvested area, and characterize stand conditions in sufficient detail to verify compliance with the minimum habitat requirements for the CSA. FGS will submit the post-harvest report to USFWS within 6 months of completing timber operations.

Monitoring Type:	Compliance monitoring.
Sites:	CSAs with proposed timber operations.
Objective:	Demonstrate compliance with habitat commitments for the CSA within the core and home range of the activity center.

Methods:	Forest stand inventories documenting stand basal area, canopy cover, qmd, and number of large trees to identify suitable habitat for northern spotted owls.
Reporting:	Within 6 months following completion of timber operations in a CSA.

Compliance Monitoring Associated with Objective 2 – Riparian Management. The Aquatic Species Habitat Conservation Strategy provides for protection of riparian zones through establishment of WLPZs with restrictions on harvest and other activities within the WLPZ. No additional riparian management measures for northern spotted owls are included in the Terrestrial Species Habitat Conservation Strategy. Compliance with the WLPZ measures will be documented through reporting and post-harvest WLPZ inspections as previously described in Section 7.2.1.

Compliance Monitoring Associated with Objective 3 – Dispersal Habitat. Dispersal habitat consists of stands with adequate tree size and canopy closure to provide protection from avian predators and at least minimal foraging opportunities (USFWS, 1992). Forsman et al. (2002) found that northern spotted owls could disperse through highly fragmented forest landscapes, yet the stand-level and landscape-level attributes of forests needed to facilitate successful dispersal have not been thoroughly evaluated (Buchanan, 2004). Because FGS will maintain a forested landscape on its ownership, the biological objective for dispersal habitat will be met. No compliance monitoring or additional reporting is required to document compliance with this measure. However, at 10-year intervals throughout the term of the Permits, FGS will provide a summary of acres in each CWHR diameter and canopy cover class in the Plan Area as part of the annual report for that year.

Compliance Monitoring Associated with Objective 4 – Incidental Take Avoidance and Minimization. Incidental take avoidance and minimization will be accomplished through a combination of pre-harvest surveys and seasonal timing restrictions. In addition, FGS will provide formal training on owl identification and signs of northern spotted owl presence to field personnel that will be conducting THP preparation and timber operations. As described in Section 5.3.1, FGS will conduct up to three protocol surveys each year of operation at known activity centers if necessary to determine site occupancy and reproductive status and survey suitable habitat within 0.25-mile of Covered Activities planned for operations during the active breeding season. Survey results must be reviewed and approved by the USFWS prior to operations. Compliance monitoring for this objective consists of documenting that pre-harvest surveys have been conducted, seasonal restrictions have been implemented as necessary, and personnel have been trained.

To demonstrate compliance with the incidental take avoidance and minimization measures, FGS will submit an annual report to the USFWS. The report will include the locations, dates, and results of the surveys conducted in association with THPs. Upon request, FGS will provide copies of the THPs in which take avoidance and minimization measures were implemented. FGS will document which employees have undergone northern spotted owl training and, upon request, provide the materials used in training employees to the USFWS.

Compliance Monitoring Associated with Objective 5 – Threat Management. Threat management focuses on the CSAs and includes surveys for barred owl, measures for wildfire prevention in CSAs, and measures to control disease and insect outbreaks in CSAs. To demonstrate compliance with the barred owl control measures, FGS will submit an annual report to the USFWS of the results of any barred owl surveys conducted. The report will include the protocol followed, locations, dates, and results of the surveys. As described in Section 5.3.1, FGS will locate and monitor any barred owl detection in a CSA and notify the USFWS within 10 days of detection. FGS will work closely with the USFWS to implement barred owl control measures deemed appropriate by the USFWS at the time of detection. The annual report will also describe any control measures for barred owls that are implemented and the results of the control actions.

FGS may conduct fuel management or salvage in CSAs only if general habitat conditions within the home range and core area of the supported activity center(s) set forth in Section 5.3.1 are met and specific habitat commitments within the CSA (see Table 5-3) will be maintained post-harvest. Fuels management and salvage in CSAs will require prior written approval by the USFWS. If FGS proposes to conduct fuel management or salvage in a CSA, prior to conducting these activities, FGS will provide USFWS with a copy of the proposed fuels management or salvage plan for the CSA and provide the agency an opportunity for pre-activity review of the proposed management activity. Following completion of management or salvage operations in a CSA, FGS will inventory harvested stands to document post-harvest stand conditions and submit the results of the post-harvest inventory to the USFWS. The post-harvest inventory will quantify the amount of nesting, roosting, and foraging habitat in the harvested area and characterize stand conditions in sufficient detail to verify compliance with the minimum habitat requirements for the CSA. FGS will submit the results of the post-harvest inventory to the USFWS as part of the annual report prepared for the year in which the inventory is completed.

7.2.2.2 Effectiveness Monitoring

Monitoring the effectiveness of the northern spotted owl conservation measures is necessary to evaluate whether the biological goals and objectives established in the HCP for the species are being met, and whether the effects of HCP implementation on northern spotted owls and their habitats are exceeding the levels anticipated by the Service in their Biological Opinion.

FGS's effectiveness monitoring program for northern spotted owls focuses on monitoring habitat conditions and northern spotted owl occupancy of the CSAs.

Effectiveness Monitoring of Northern Spotted Owl Habitat in CSAs. Under the HCP, timber harvest will be restricted in CSAs unless general habitat conditions within the home range and core areas of the supported activity center(s) are present and specific habitat targets within the CSA will be maintained post-harvest. Thus, the amount and quality of northern spotted owl habitat in the CSAs is expected to be maintained or to increase over the Permit Term. To assess the effectiveness of the HCP in maintaining or improving habitat in the CSAs, habitat conditions for northern spotted owl within the core and home range of each activity center supported by a CSA on the FGS ownership will be monitored and compared to the habitat standards described in Chapter 5.

Monitoring Type: Effectiveness monitoring.

Sites: All CSAs established on the FGS ownership.

Sampling Frequency:	Stand inventories within all CSAs will be completed within 2 years of issuance of the incidental take permits and repeated every 10 years during the permit period.
Objectives:	Demonstrate that FGS's management activities in CSAs promote development of stand conditions that provide suitable owl habitat within the CSAs over the Permit Term.
Methods:	Stand level inventories of areas in the CSAs identified as suitable northern spotted owl habitat or potential northern spotted owl habitat (see Appendix D – Maps of CSA habitat areas).
Reporting:	Baseline report following initial inventory of CSAs and periodic reports following repeat inventories at 10-year intervals.

Monitoring for Northern Spotted Owl Use in CSAs. The biological goal of establishing the CSAs and specifying habitat requirements within the CSAs is to enhance the likelihood that activity centers supported by CSAs will remain or become occupied by northern spotted owls, and thereby provide demographic support to the federal conservation strategy. Occupancy of an area by northern spotted owls is influenced by many factors, of which habitat condition is only one. Also, home ranges for owls supported by CSAs encompass land managed by many different entities (e.g., USFS, other private timber companies) in addition to FGS. As a result of these circumstances, habitat conditions on FGS lands is only one factor affecting the presence or absence of northern spotted owls in these activity centers, and the absence of owls in an activity center cannot be used as a definitive measure of the HCP's effectiveness. Nonetheless, it is desirable to monitor occupancy of the activity centers supported by CSAs on the FGS ownership as one component for assessing the effectiveness of the HCP.

FGS will conduct protocol surveys to detect the presence of northern spotted owls in activity centers supported by CSAs. Survey results will be reviewed and approved by the USFWS to ensure compliance with the "Protocol for surveying proposed management activities that may impact northern spotted owls" (USFWS, 1991) or current northern spotted owl survey protocols approved by the USFWS.

Surveys conducted for two consecutive years are considered more reliable for assessing occupancy of activity centers than a single survey every 4 years. For this reason, FGS will conduct protocol surveys during two consecutive years, unless an owl is detected during the first year. If an owl is detected during the first year of surveys, this will indicate occupancy of the activity center, and no follow-up survey is required the second year. The surveys will be repeated at 4-year intervals for the duration of the permit to document and identify trends in occupancy and reproductive status of activity centers supported by CSAs on the FGS ownership. If there are no detections for two consecutive years at more than 40 percent of the CSAs (nine CSAs) within a 4-year period, then FGS will notify the Service and DFG, and enter into a discussion about why the sites are unoccupied and whether any alternative actions within the HCP commitments could promote occupancy. Alternatives such as delayed harvest in nearby activity centers where take is authorized, or establishment of an alternative CSA with similar conservation value could be proposed. If an alternative CSA is identified and approved through written concurrence by the USFWS, then FGS may conduct timber harvest operations within the unoccupied CSA without further restriction, other than as specified in other sections of this HCP (i.e., the CSA will no longer be considered a conservation or mitigation area).

Monitoring Type:	Effectiveness monitoring.
Sites:	All CSAs established on the FGS ownership.
Sampling Frequency:	Protocol surveys during breeding period for two consecutive years at 4-year intervals.
Objectives:	Determine northern spotted owl occupancy at activity centers supported by CSAs on the FGS ownership.
Methods:	Three-visit protocol surveys during the breeding period for northern spotted owl.
Reporting:	Annual reporting of results of any surveys conducted in the preceding year.

Monitoring for Barred Owls in CSAs. The objective of threat management measures for barred owls is to prevent barred owls from displacing northern spotted owls and becoming established. Detections of barred owls could reflect a range expansion and increased risk of barred owls becoming established. Under the HCP, FGS will survey activity centers supported by the CSAs for barred owls. If barred owls are detected, FGS will work closely with the USFWS to implement appropriate barred owl control measures as necessary. Following implementation of any control measures, another individual could quickly move into the area. To monitor the effectiveness of the control strategy and minimize the potential for additional barred owls to become established following control actions FGS will, upon request by USFWS, conduct annual surveys for barred owls within 1 mile of the detection site. Annual surveys will continue until no barred owls are detected for 3 consecutive years, or until the USFWS no longer requests additional surveys, after which the survey frequency will revert to the standard protocol of 2 consecutive years every 4 years.

Monitoring Type:	Effectiveness monitoring.
Sites:	Activity centers supported by CSAs on the FGS ownership in which barred owls have been detected and control measures have been implemented.
Sampling Frequency:	Annual protocol surveys during breeding period until no detections for 3 consecutive years or the USFWS determines that surveys are no longer necessary.
Objectives:	(1) Determine occurrence of barred owls in CSAs.
	(2) Demonstrate effectiveness of any barred owl control actions.
Methods:	USFWS-approved protocol surveys for barred owls.

Reporting: Annual reporting of results of any surveys conducted in the preceding year.

7.2.2.3 Northern Spotted Owl Monitoring Adaptability

The monitoring outlined in the previous sections uses monitoring protocols that represent current, peer-reviewed, and accepted methods at the time of HCP development. It is possible that other monitoring methods may be developed during the term of the HCP, which would provide for better or more cost-effective assessment of compliance with and effectiveness of the conservation measures. FGS and the USFWS may mutually agree to modify the monitoring protocols listed in this HCP to better monitor the effectiveness of the conservation measures and ensure compliance with the terms of the conservation program at any time.

7.2.3 Yreka Phlox

This section describes the type and frequency of compliance and effects monitoring for Yreka phlox associated with the Terrestrial Species Conservation Program.

7.2.3.1 Compliance Monitoring for Yreka Phlox

Adverse effects to Yreka phlox will be avoided through a combination of botanical surveys to identify undiscovered populations, establishing EEZs around known and discovered populations, and pre-activity surveys prior to Covered Activities that could affect this species. Threat management and sustainability of the species will be accomplished by the use of the EEZs, as well as implementation of a monitoring program at all known or discovered populations on the FGS ownership. To verify compliance with these measures, FGS will submit an annual report to the USFWS containing the following information:

- The location, dates, and results of botanical and pre-activity surveys for Yreka phlox; and
- The location of THPs in which avoidance and minimization measures for Yreka phlox were implemented.

In addition to implementing measures to avoid adverse impacts to Yreka phlox, under the HCP, FGS will monitor known and discovered sites on its ownership. To verify compliance with this measure, FGS will submit an annual report of the results of monitoring occupied sites to the USFWS.

7.2.3.2 Effectiveness Monitoring

Monitoring the effectiveness of the Yreka phlox conservation measures is necessary to evaluate whether the biological goals and objectives established in the HCP for the species are being met. As described in Section 5.3.2, FGS will develop and implement a monitoring plan for all known and discovered sites on its ownership. Although FGS is committing to monitoring of Yreka phlox populations on its land as a conservation measure, the monitoring plan will also serve as effectiveness monitoring. The objective of the avoidance measures is to avoid adverse impacts to Yreka phlox from timber operations, and thereby maintain populations of this plant on FGS land. By monitoring population status, habitat conditions, and threats at known locations, the effectiveness of the avoidance measures can be assessed.

The specific elements of the monitoring plan for Yreka phlox will be developed in consultation with the USFWS but will include the following.

- Current known locations of Yreka phlox on FGS lands.
- Survey protocol to be followed. Monitoring will focus on habitat conditions, threats, and gross population response to these factors. The need to include detailed population size and demographic assessment will be determined by FGS, USFWS, and DFG on a site/occurrence specific basis. If assessments of population size will be included in the monitoring plan, a pilot study may be conducted to guide the development of a final sampling design that will permit efficient detection of long-term population changes.
- Qualifications for monitoring personnel, which will include, at a minimum, familiarity with the species, the ecology of ultramafic habitats, and threats to the species.

Monitoring Type:	Effectiveness monitoring.
Sites:	All known and discovered populations/occurrences of Yreka phlox on the FGS ownership.
Sampling Frequency:	To be determined through development of the monitoring plan and coordination with DFG and USFWS.
Objectives:	Identify habitat conditions, threats, and gross population response to these factors by Yreka phlox populations on the FGS ownership.
Methods:	To be determined through development of the monitoring plan and coordination with DFG and USFWS.
Reporting:	Annual reporting of results of any monitoring activities conducted in the preceding year for each population/occurrence.

7.3 Reporting

7.3.1 Aquatic Species Conservation Strategy Reporting Requirements

FGS will regularly submit reports to NMFS and DFG to document its compliance with the terms of the HCP and report the results of effectiveness monitoring. FGS's obligations can be separated into three categories:

1. Annual reports
2. Periodic analyses
3. Event-driven analyses

Reporting requirements are described below for each of these categories.

7.3.1.1 Annual Reports

FGS will submit an annual report to NMFS and DFG on HCP activities occurring in the preceding year. At a minimum, the annual report will include:

- Any incidental take of coho salmon, Chinook salmon or steelhead;
- List of the active THPs and their locations, and identifying THPs in which take minimization and avoidance measures for aquatic Covered Species were implemented;
- Dates, locations, and results of post-harvest WLPZ inspections conducted under the compliance monitoring requirements for aquatic species (see Section 7.2.1.1);
- Dates, locations, and results of water temperature monitoring activities conducted in that year and preceding years;
- Dates, locations, and results of riparian stand inventories and LWD modeling in that year and preceding years;
- Dates, locations, and results of channel substrate monitoring activities in that year and preceding years;
- Summary of road improvements and erosion control measures completed in that year; and
- Dates, locations, and results of channel condition assessments conducted in that year.

FGS will submit each year's annual report by March 31 of the following year.

7.3.1.2 Periodic Analyses

FGS will periodically conduct trend analyses associated with several monitoring activities conducted on an annual basis. These analyses will occur at defined intervals (e.g., 5 years) throughout the Permit Term, but time of analysis will differ depending on the time interval and starting year of the monitoring activity. The trend analysis will include:

- A summary of annual monitoring results leading to and included in the cumulative analysis;
- Cumulative analysis of the annual monitoring results, including a statistical analysis of any trends or changes, if feasible; and
- An assessment of the effectiveness of the conservation program in meeting the goals and objectives of the HCP based on the cumulative analysis.

Details of the annual monitoring will be included in the annual reports (see above), while the analysis of trends will be included in the annual report for the year in which the analysis is completed.

7.3.1.3 Event-driven Analyses

FGS will conduct a mass wasting analysis using aerial photographs in year 15 and potentially year 30 following issuance of the ITPs (see Section 7.2.1). FGS will conduct landslide surveys in the Horse, Beaver, and Cottonwood drainages using aerial photography in conjunction with ground-based field verification. The assessment will compare the frequency of landslides, for various landforms, between areas harvested over the previous 15 years (study sites) and unharvested stands (reference sites). The mass wasting assessment report will include:

- Methods used to compare the frequency of landslides between areas harvested over the previous 15 years (study sites) and unharvested stands (reference sites);
- Dates, times, and location of aerial photos used in the analysis;
- Dates, times, and locations of ground-based verification;
- Summary of timber harvest and associated silvicultural methods on harvested areas for each landform over the previous 15 or more years;
- Estimates of landslide frequency for each landform in study and reference sites; and
- An assessment of the effectiveness of the conservation program in meeting the HCP's goals and objectives.

Results of the mass wasting assessment will be included in the annual report prepared for the year in which the ground-based portion of the assessment is completed.

7.3.2 Terrestrial Species Conservation Strategy Reporting Requirements

FGS will regularly submit reports to the USFWS and DFG to document its compliance with the terms of the HCP and report the results of effectiveness monitoring. FGS reporting obligations can be separated into three categories:

1. Annual reports
2. Periodic analyses
3. Event-driven analyses

Reporting requirements are described below for each of these categories.

7.3.2.1 Annual Reports

FGS will submit an annual report to the USFWS and DFG on HCP activities occurring in the preceding year. At a minimum, the annual report will include

- Any incidental take of northern spotted owls;
- List of the active THPs and their locations, and identification of THPs in which take minimization and avoidance measures for northern spotted owls or avoidance measures for Yreka phlox were implemented;
- The amount of suitable habitat within the core area and home range of each activity center on the "take" list that has been harvested or otherwise converted to nonhabitat;
- Dates, locations, and results of northern spotted owl surveys conducted in association with THPs;
- Dates, locations, and results of northern spotted owl surveys in CSAs in that year and preceding years;

- Dates, locations, and results of barred owl surveys in that year and preceding years;
- Dates, locations, and results of botanical and pre-activity surveys for Yreka phlox; and
- Dates, locations, and results of monitoring activities for Yreka phlox conducted under the population monitoring requirement for this species.

FGS will submit each year's annual report by March 31 of the following year.

7.3.2.2 Periodic Analyses

FGS will periodically analyze northern spotted owl habitat in the CSAs. As part of the effectiveness monitoring program, FGS will conduct a baseline stand inventory of its lands within CSAs within 2 years of permit issuance and every 10 years thereafter. The inventory results will include:

- Maps of locations of stands that were inventoried;
- For each CSA, the amount and location of suitable northern spotted owl habitat in accordance with the definitions used in this HCP; and
- Estimates of snag, downed woody debris, and hardwood densities.

Results of the inventories and analysis of habitat for northern spotted owl will be included in the annual report for the year in which the inventories are completed.

7.3.2.3 Event-driven Analyses

During the term of the ITP, FGS will not conduct timber operations on its lands in CSAs unless specific habitat requirements are met. If FGS proposes to conduct timber operations in a CSA, including wildfire management and salvage operations, FGS will inventory areas proposed for harvest to document pre-harvest stand conditions (including amount of hardwoods, downed woody debris, and snags) during THP preparation and obtain USFWS approval prior to operations in the CSA. Following completion of timber operations in a CSA, FGS will analyze habitat conditions for northern spotted owl in CSAs where timber operations have occurred. The post-harvest analysis will include:

- The amount and location of nesting, roosting and foraging habitat within the CSA prior to timber operations;
- The amount and location of nesting, roosting and foraging habitat within the CSA following timber operations;
- Results of stand level inventories of harvested stands in CSAs before and after timber operations; and
- Densities of snags, downed woody debris, and hardwoods in harvested CSAs before and after timber operations.

Results of the post-harvest analyses will be included in the annual report for the year in which the analyses are completed.

CHAPTER 8

Plan Implementation

8.1 Plan Implementation

The primary administrator for implementation of this HCP is FGS. FGS will be responsible for the conduct of all conservation, mitigation, monitoring, and reporting activities specified in Chapters 5 and 7 of this HCP; however, some of the activities may be delegated to and carried out by contractors, partners, or volunteers.

Although significant technical expertise and local knowledge of Covered Species and their habitats are held by the agency staff that advised FGS personnel and consultants that prepared this plan, FGS may seek to consult with outside scientists and other technical experts who can provide technical advice on implementation of the conservation and monitoring programs. In developing the conservation program for northern spotted owls, FGS, in consultation with USFWS, consulted with noted authorities on northern spotted owl biology and behavior. These experts provided input on the analysis of impacts to northern spotted owls and development of the matrix used to establish the relative conservation value of northern spotted owl activity centers. In the event of changed or unforeseen circumstances (described below) that substantially alter habitat for northern spotted owls in the CSAs established on the FGS ownership, outside experts may be consulted to provide input on actions needed to ensure that FGS is meeting its mitigation obligations for take of northern spotted owl.

8.2 Changed and Unforeseen Circumstances

Section 10 regulations (as codified in [50 CFR, Sections 17.22(b)(2) and 17.32(b)(2)]) require that an HCP specify the procedures to be used for dealing with changed and unforeseen circumstances that may arise during the implementation of the HCP. In addition, the No Surprises Rule ([63 Federal Register 8859, February 23, 1998 as codified in 50 CFR 17.22 (b)(5), 17.32 (b)(5), and 222.307(g)]) describes the obligations of the permittee and the Services. The purpose of the No Surprises Rule is to provide assurance to the non-federal landowners participating in habitat conservation planning under the ESA that no additional land restrictions or financial compensation will be required for species adequately covered by a properly implemented HCP, in light of unforeseen circumstances, without the consent of the permittee.

8.2.1 Changed Circumstances

Changed circumstances are defined in 50 CFR 17.3 and 222.102 as changes in circumstances affecting a species or geographic area covered by an HCP that can reasonably be anticipated by plan developers and the Services, and for which contingency plans can be prepared (e.g., the new listing of species, a fire, or other natural catastrophic event in areas prone to such event). If additional conservation and mitigation measures are deemed necessary to respond to changed circumstances, and these additional measures were already provided for in the plan's operating conservation program (e.g., the conservation management activities or mitigation measures expressly agreed to in the HCP or IA), then the permittee will implement those measures as specified in the plan. However, if such measures were not provided for in the plan's operating conservation program, the Services will not require these additional measures without the consent of the permittee, provided that the HCP is being "properly implemented" (properly implemented means the commitments and the provisions of the HCP and the IA have been or are being fully implemented). At no time does the ITP authorize Covered Activities to put a species in jeopardy.

For the purposes of this HCP, changed circumstances are those changes affecting a species or geographic area covered by the HCP that can reasonably be anticipated and planned for by FGS, NMFS, and the USFWS at the time of the HCP's preparation. In discussions with USFWS, NMFS, and DFG, FGS identified several reasonably foreseeable circumstances under which changes could occur during the Permit Term that could result in a substantial and adverse change in the status of a species covered by the HCP. Foreseeable conditions that could result in "changed circumstances" as defined in applicable federal regulations and policies are identified below.

- Global climate change, resulting in increased fire risk, flooding, drought, incidence of pests or pathogens, increase in the number or density of invasive species, or restriction in the range of Covered Species at a regional or local scale. These issues are individually addressed in the sections below as they would pertain to changed circumstances in the Plan Area.
- Listing of Covered or Non-Covered Species or Designation of Critical Habitat for a Covered or Non-Covered Species that may be affected by a Covered Activity.
- A change in the listing status (including de-listing) of a Covered or Non-Covered Species through a formal status review by the Services.
- Designation or revision of critical habitat for a Covered or Non-Covered species that may be affected by a Covered Activity.
- Stand replacing fires that (alone or in combination with other events such as blow-down) affect greater than 150 feet, measured along the length of the stream, of previously standing timber within a Class I WLPZ or SMZ along streams supporting any of the aquatic Covered Species in a given year.
- Stand replacing fire that (alone or in combination with other events such as blow-down) downgrades suitable habitat within the core area or home range of an activity center supported by a CSA on the FGS ownership to non-habitat, such that the CSA no longer provides demographic support to the federal conservation strategy or meets the biological objectives of the HCP.
- Complete blow-down that (alone or in combination with other events such as fire) affects greater than 150 feet, measured along the length of the stream, of previously standing timber within a Class I WLPZ or SMZ along streams supporting any of the aquatic Covered Species.

- Blow-down that (alone or in combination with other events such as fire) downgrades suitable habitat within the core area or home range of an activity center supported by a CSA on the FGS ownership to non-habitat, such that the CSA no longer provides demographic support to the federal conservation strategy or meets the biological objectives of the HCP.
- Stand modification (e.g., changes in average diameter or canopy coverage) due to pests or pathogens, or their control, that (alone or in combination with other events such as fire and blow-down) downgrades suitable habitat within the core area or home range of an activity center supported by a CSA on the FGS ownership to non-habitat, such that the CSA no longer provides demographic support to the federal conservation strategy or meets the biological objectives of the HCP.
- Landslides that deliver greater than 1,000 cubic yards of sediment to a channel.
- Introduction or invasion by exotic plant or animal species (e.g., barred owl) that affect Covered Species or their habitat.

The potential for each of these circumstances is reasonably foreseeable. As described in this subsection, FGS also has considered the potential for floods and earthquakes to have effects that could constitute "changed circumstances." FGS's strategy for addressing each of these changed circumstances is described in the following. If changed circumstances occur, FGS will implement the supplemental prescriptions set forth in this subsection.

8.2.1.1 Global Climate Change

According to the USFWS (2008), the potential effects of increasing atmospheric concentrations of carbon dioxide and other "greenhouse gases," and the observed increase in the average temperature of the Earth's atmosphere and oceans, have been the subject of considerable technical analysis and political debate. There is growing consensus that climate change is occurring and additional change is predicted. Global climate change has the potential to influence fire risk and the incidence of exotic species, flooding, drought, and disease at a regional and local scale. The impacts of these proximal events (e.g., fire, flood) due to global climate change are addressed in the following subsections as they would pertain to changed circumstances in the Plan Area.

There is considerable uncertainty associated with projecting future climate changes. This uncertainty is partly due to uncertainties about future emissions of greenhouse gases and to differences among climate models and simulations (Stainforth et al., 2005; Duffy et al., 2006). There are no known climate change simulations for the Klamath-Siskiyou region, but the results of numerous climate change simulations for California and the Pacific Northwest have been published (see below). Together, these simulations describe a range of plausible outcomes from increased emissions of greenhouse gases.

The projected effects of climate change on local and regional temperatures, precipitation, vegetation, and fire are described below. Much of the following discussion was taken from the 12-Month Finding on a Petition to List the Siskiyou Mountains Salamander (*Plethodon stormi*) and Scott Bar Salamander (*Plethodon asupak*) as Threatened or Endangered (73 FR 4380; January 24, 2008). The 12-month finding on this petition is particularly relevant because the range of both of these species overlaps the Plan Area and because this analysis represents the best available information on the effects of global climate change in the Plan Area.

All of the studies that were reviewed predicted continued increases in average surface temperatures in California and the Pacific Northwest in response to increased emissions of greenhouse gases (Leung and Ghan, 1999; Snyder et al., 2002; Electric Power Research Institute [EPRI], 2003; Hayhoe et al., 2004; Cayan et al., 2006; Duffy et al., 2006; Maurer, 2007; Salathé et al., 2008). The magnitude of projected increases in annual average temperature varied widely among studies, depending on the models and emissions scenarios used, from 3 to 10.4°F (1.5 to 5.8°C), by the year 2100 (EPRI, 2003; Hayhoe et al., 2004; Cayan et al., 2006; Maurer, 2007). Simulations consistently project more pronounced temperature increases in California during the summer months than during other times of the year, 3.9 to 14.9 °F (2.2 to 8.3°C) by 2100 (Hayhoe et al., 2004; Cayan et al., 2006; Maurer, 2007). Some simulations projected more rapid temperature increases at higher elevations than at lower ones (Leung and Ghan, 1999; Salathé et al., 2008). Most researchers attributed this difference to a snow-albedo feedback effect; this occurs when increased surface temperatures cause earlier and faster snow melt, which, in turn, allows more absorption of heat by the ground and further increases in surface temperatures.

Reviews of a large number and variety of climate change simulations found that projected changes to precipitation in California were highly variable but clustered around no change or a slight increase in annual precipitation (Cayan et al., 2006; Maurer, 2007). Warming temperatures are consistently projected to increase the proportion of precipitation that falls as rain rather than as snow in California and the Pacific Northwest (Leung and Ghan, 1999; Snyder et al., 2002; Hayhoe et al., 2004; Cayan et al., 2006; Maurer, 2007). Earlier and more rapid snowmelt and decreases in the proportion of precipitation that falls as snow are expected to cause declines in spring snowpacks (Hayhoe et al., 2004; Cayan et al., 2006; Maurer, 2007). Declines in spring snowpacks have already occurred in some areas and are correlated with global warming trends (Mote, 2003). However, despite regional warming over the past half century, the glaciers of Mount Shasta have continued to expand following a contraction during a prolonged drought in the early twentieth century (Howat et al., 2007). Some areas will experience increased cloud cover as surface temperatures continue to increase (Croke et al., 1999).

Vegetation modeling by Lenihan et al. (2003a, 2003b) projected that increased emissions of greenhouse gases will cause large-scale replacement of evergreen conifer forest (e.g., Douglas fir-white fir) with mixed evergreen forest (e.g., Douglas-fir-tanoak) in the Klamath-Siskiyou region. This redistribution of vegetation types is predicted to occur under conditions created by two contrasting climate change models (Lenihan et al. 2003a).

Loarie et al. (2008) projected that up to 66 percent of California's endemic flora would experience >80 percent reductions in range size as a result of anticipated climate changes. While this is a worst-case scenario based on high levels of CO_2 emissions in the future, a global climate model with high sensitivity to atmospheric greenhouse gas levels, and no dispersal component, the models ignore several factors that would exacerbate the projected impacts of climate change, including specialization to restricted soil types and the spread of invasive species. Because Yreka phlox is restricted to ultramafic soil types and has limited dispersal capabilities, global climate change could result in a reduction in the range of this species. However, it is difficult to speculate as to the extent of range reduction that could occur within the Plan Area and the complete loss of local populations is not anticipated. The conservation strategy for Yreka phlox (subsection 5.3.2) addresses this potential for a range reduction by allowing seeds to be collected on FGS lands for long-term storage and development of techniques to reestablish populations, consistent with the federal recovery strategy.

Despite variability in climate change simulations, consistent projections for warmer summers, reduced spring snowpacks, and earlier and more rapid snowmelt suggest that forests in California and the Pacific Northwest will experience longer fire seasons and more frequent, extensive, and severe fires in the future (Flannigan et al., 2000; Lenihan et al., 2003a; Whitlock et al., 2003; McKenzie et al., 2004). Whether or not these fire predictions will occur is unknown due to inconsistent predictions for precipitation, including increased cloud cover and rainfall. However, the planned response to changed circumstances related to wildfire is described in subsection 8.2.1.5 below.

8.2.1.2 Listing of Species That Are Currently Unlisted

Listing of a Covered Species. The preamble to the No Surprises rule states that the listing of a species as endangered or threatened could constitute a changed circumstance. It is conceivable that the currently unlisted Covered Species (steelhead, Chinook salmon) could again be proposed for listing or become listed in the future. Because conservation measures for these species are included in this HCP and these species are “Covered” by the ITP being issued, listing of these species would not be considered a changed circumstance and will not have the effect of causing additional land, mitigation, restrictions, or compensation to be required of FGS as long as the HCP is being implemented in compliance with the take authorization conditions for that Covered Species. Notwithstanding the above, the ITPs may be suspended or revoked if continuation of the Permits would result in jeopardy to a listed Covered Species.

Listing of a Non-Covered Species. If a species that is not a Covered Species under the HCP (“Non-Covered Species”) is listed under the federal ESA subsequent to the effective date of the ITPs, and the Non-Covered Species is affected by the Covered Activities, such listing will constitute a changed circumstance. If a Non-Covered Species that may be affected by a Covered Activity is listed under the federal ESA during the Permit Term, the Section 10 Permits will be reevaluated by the Services. The HCP Covered Activities may be modified, as necessary, to ensure that the activities covered under the HCP are not likely to jeopardize or result in the take of Non-Covered Species. FGS shall implement the modifications to the HCP Covered Activities determined by the Service in consultation with FGS to avoid the likelihood of jeopardy to or take of the Non-Covered Species. FGS shall continue to implement such modifications until such time as they apply for and the Services approve an Amendment of the Section 10 Permits, in accordance with applicable statutory and regulatory requirements, to cover the Non-Covered Species or until the Services notify FGS in writing that the modifications to the HCP Covered Activities are no longer required to avoid the likelihood of jeopardy of Non-Covered Species or take of a Non-Covered Species.

8.2.1.3 Change in the Listing Status of Covered Species

It is conceivable that the listing status of a Covered Species could be changed (i.e., from Threatened to Endangered) through a formal status review during the Permit Term. Because conservation measures for these species are included in this HCP and these species are "Covered" by the ITP being issued, a change in the listing status of these species would not be considered a changed circumstance and will not have the effect of causing additional land, mitigation, restrictions, or compensation to be required of FGS if this HCP is being implemented in compliance with the take authorization conditions for that species. Notwithstanding the above, the ITPs may be suspended or revoked if continuation of the Permits would result in jeopardy.

If a Covered Species is delisted during the Permit Term through a formal status review, then the HCP may be modified, as appropriate, to reduce or eliminate required measures for that species, if the applicable Service concludes that such measures did not contribute, in whole or in part, to the decision to de-list the species and that modification of such measures is not likely to lead to or contribute to re-listing of the species. FGS will continue to implement the HCP in accordance with all applicable provisions until such time they apply for and the Services approve an Amendment of the Section 10 Permits.

8.2.1.4 Designation or Revision of Critical Habitat for a Covered or Non-Covered Species

Critical habitat has been designated for some of the federally listed species covered by this HCP. If in the future, critical habitat that is currently designated for a Covered Species is revised, or critical habitat is newly designated for a Covered Species, and such designated or revised critical habitat may be affected by one or more Covered Activities, or if critical habitat is designated or revised for a Non-covered species and such designated or revised critical habitat may be affected by one or more Covered Activities, such revision or designation of critical habitat would constitute a changed circumstance, and the Section 10 permit will be reevaluated by the affected Service in consultation with FGS. If the affected Service concludes that one or more Covered Activities would adversely modify designated or revised critical habitat, the Covered Activit(ies) shall be modified to the extent necessary to avoid adverse modification. The affected Service shall work with FGS and with the other Service to limit any modifications to the Covered Activities to those that necessary to avoid adverse modification of critical habitat and are the least disruptive to FGS's on-going timber operations. FGS shall either implement the modifications to the Covered Activities identified by affected Service until the affected Service notifies FGS in writing that the modifications to the Covered Activities are no longer required to avoid adverse modification of critical habitat, or FGS may relinquish the Permits in accordance with applicable Service regulations. Notwithstanding the above, the ITPs may be suspended or revoked if continuation of the Permits would result in adverse modification of any newly designated or revised critical habitat.

8.2.1.5 Fire and Wind

Fire frequency, intensity, and size within the Plan Area have changed since the fire-suppression era (1950 to present) (Fry and Stephens, 2006). Prior to the fire-suppression era, fires occurred frequently; and in most of the vegetation assemblages covering large portions of the Klamath Mountains, they were of generally low to moderate and mixed severity (Skinner et al., 2006). Fires occurring in the fire-suppression era are less frequent and have greater intensity, resulting in a more homogeneous effect on the habitat by damaging and removing all vegetation (Fry and Stephens, 2006). These are often considered "stand-replacing" fires. Stand-replacing fires can cause immediate long-term changes that affect watershed processes, terrestrial and aquatic species and their habitats, and timber. Fire suppression is not a covered activity. The strategy for responding to and suppressing forest fires is generally established by CAL FIRE and USFS. FGS has little ability to influence such strategy.

Small-scale blow-down of trees in riparian areas is not expected to have a long-term significant adverse impact on stream shading or water temperatures. Moreover, limited blow-down within the riparian zones could have the beneficial effect of introducing large woody debris into streams that currently lack this habitat-forming element. A blow-down event in a CSA that downgrades suitable habitat for northern spotted owls to non-habitat could have adverse effects on this species, although, in some cases, trees blown down by wind can benefit northern spotted owls by providing habitat for their prey base.

Fire and wind can (alone or in combination with other factors such as pest damage) alter forest stands and affect watershed processes that create and maintain aquatic habitat quality. In addition, alteration of forest stands in the CSAs due to any or all of these factors can adversely affect habitat quantity and quality for northern spotted owls, reducing the effectiveness of the CSAs in meeting the biological objectives of the HCP. Because fire and wind have similar effects (i.e., tree removal and subsequent alteration of aquatic and terrestrial habitats), they are considered as a group in terms of defining what may constitute a changed circumstance.

Two different criteria for changed circumstances due to fire and wind are applied because of the differing levels of effect on the aquatic and terrestrial Covered Species. When a stand replacing fire or blow-down due to wind affects riparian zones along Class I streams that support any of the aquatic Covered Species or a significant portion of the Plan Area, the risk of adverse effects on the aquatic Covered Species through altered hydrology, increased water temperatures, and increased sediment delivery is magnified. For this reason, fire or wind damage at the stream level is used to identify when changed circumstances for the aquatic Covered Species may have occurred.

For owls, it is important that enough suitable habitat is maintained within the CSAs to provide demographic support to the federal conservation strategy and meet the objectives of the HCP. For this reason, the conditions for allowable harvest in a CSA (see subsection 5.3.1.1) are used to identify when the CSA may no longer provide demographic support of the federal conservation strategy and could constitute a changed circumstance.

Changed Circumstances with Respect to Aquatic Species Protection. Fires are a natural part of the forest ecology in the Plan Area and it is reasonably foreseeable that fires of variable size and intensity will occur in the Plan Area over the Permit Term. Stand-replacing fires (fires that kill most of the trees) have the greatest potential to alter forest conditions to the extent that represents a changed circumstance. These fires occur at a lower frequency than low to moderate severity fires. Based on the fire history database maintained by the USFS, stand-replacing fires that burned any portion of the Plan Area supporting the aquatic Covered Species have occurred 17 times since 1915, six of which occurred in FGS's Grass Lake Management Unit which does not support the aquatic Covered Species. In FGS's Klamath River and Scott Valley Management Units, where the aquatic Covered Species are found, these stand-replacing fires are rare and generally do not affect a substantial portion of the Plan Area, although one fire affected 67 percent of FGS's ownership in a single drainage. It is reasonably foreseeable that this frequency of stand-replacing fires would continue during the Permit Term. Blow-down of trees due to wind is also a naturally occurring event in the Plan Area. Based on historic experience in the Plan Area by FGS foresters, complete blow-down of trees in riparian areas is rare, and has never affected more than 1,000 feet along any stream.

A stand-replacing fire or complete blow-down event (alone or in combination) that affects less than 150 feet, measured along the stream in a Class I WLPZ, is unlikely to have significant adverse effects on the aquatic Covered Species because of its limited ability to influence water temperature or sediment input. FGS will respond to events of this magnitude or lower as part of normal operations and, where appropriate, implement reforestation practices that promote recovery of riparian stands consistent with the Aquatic Species Conservation Strategy. Fire and/or wind events that affect more than 150 linear feet, measured along the stream, of previously standing timber in a Class I WLPZ could have an adverse effect on the aquatic Covered Species and may constitute a changed circumstance. Stand-replacing fires and/or blow-down events that affect large portions of the Plan Area in drainages that support aquatic Covered Species also could adversely affect these species to the extent that it represents a changed circumstance.

In the event that a stand-replacing fire affects the FGS ownership in drainages that support the aquatic Covered Species, or there is complete blow-down along greater than 150 feet of stream in a Class I WLPZ, FGS will provide NMFS with information regarding the damage within 30 days of detection and will identify areas where damage due to fire or wind in a Class I WLPZ exceeds 150 feet of WLPZ along a stream. FGS, in consultation with NMFS, will determine if a changed circumstance for aquatic Covered Species has occurred, based on the quantity of habitat for aquatic Covered Species that has been altered and the potential for the event to adversely affect these species. If a changed circumstance affecting aquatic Covered Species due to damage from fire or wind events occurs, FGS will apply the following supplemental prescriptions within the affected area of the drainage.

1. Trees damaged or killed outright by fire or wind, including those in WLPZs and Special Management Zones (SMZs), will be considered by FGS for salvage.

2. Salvage of trees downed or dead by fire or wind must comply with state law and other terms of this HCP (e.g., on unstable areas). Salvage operations within a WLPZ or SMZ must be approved by NMFS. No trees within the channel zone of a WLPZ may be removed. In addition, the conduct of any salvage operations within a WLPZ or SMZ will be done with reasonable care to minimize soil erosion, to retain structural features that contribute to bank or slope stability, and to retain standing dead trees that will contribute to the recruitment of LWD to watercourses within the area affected by the fire.

3. Reforestation of any WLPZ or SMZ affected by the fire or wind will be implemented as soon as reasonably possible. Equipment Exclusion Zones established for protection of Yreka phlox will be avoided during any reforestation activities associated with fire or wind.

Changed Circumstances with Respect to Protection of the Northern Spotted Owl. The terrestrial species conservation program for northern spotted owl (see subsection 5.3.1) includes specific conditions under which harvest activities can be conducted in CSAs. The harvest restrictions are based on habitat targets for the CSA as a whole (regardless of ownership, established to promote a high probability of occupancy by spotted owl nesting pairs at these known activity centers with high conservation value to the federal conservation strategy. If a stand replacing fire or damage due to wind results in a downgrade of suitable habitat within the core area or home range of an activity center supported by a CSA on the FGS ownership to non-habitat, such that the conditions for allowable harvest in the CSA (see subsection 5.3.1.1) can no longer be met over the Permit Term, this will indicate that the CSA may no longer meet the objectives of the HCP and may constitute a changed circumstance. In the event that fire or wind affects a CSA by alteration of suitable northern spotted owl habitat, FGS will provide the USFWS with information regarding the habitat alteration due to fire or wind within 30 days of detection. FGS, in consultation with USFWS, will determine if a changed circumstance has occurred, based on the quantity and quality of habitat for northern spotted owls that remains in the CSA or could develop over the Permit Term. Based on the fire history database maintained by the USFS, it is reasonably foreseeable that up to four CSAs could be adversely affected by stand-replacing fires during the Permit Term, potentially resulting in a changed circumstance. The frequency of adverse effects due to wind cannot be estimated, but is anticipated to be less than the incidence of stand-replacing fires. If a changed circumstance affecting a CSA due to fire or wind occurs, FGS will apply the following supplemental prescriptions within affected CSAs.

1. Trees damaged or killed outright by fire or wind, including those in WLPZs or SMZs, will be considered by FGS for salvage.

2. Salvage of trees downed or dead by fire or wind within CSAs must comply with state law, other terms of this HCP (i.e., on unstable areas), and be approved by the USFWS prior to removal. In addition, the conduct of any salvage operations within a CSA will be done with reasonable care to minimize soil erosion, to retain structural features that contribute to bank or slope stability, and to retain standing dead trees that will contribute to the recruitment of LWD to watercourses within the area affected by the fire.

3. Reforestation of any CSA affected by the fire or wind will be implemented as soon as reasonably possible. Equipment Exclusion Zones established for protection of Yreka phlox will be avoided during any reforestation activities associated with fire or wind.

4. FGS will enter into discussions with the USFWS regarding alternatives that would maintain the approximate conservation value provided by the affected CSA(s) under the original conservation strategy. Alternatives could include, but are not limited to, delayed harvest around nearby activity centers where take is authorized, or establishment of an alternative CSA with similar conservation value. If an alternative CSA is identified and approved through written concurrence by the USFWS, then FGS may conduct timber harvest operations within the fire or wind damaged CSA without further restriction, other than as specified in other sections of this HCP (i.e., the CSA will no longer be considered a conservation or mitigation area).

8.2.1.6 Pest or Pathogen Infestation

Insects and diseases can usually be kept under control through careful forest management and proper treatments. Natural control of insects can take place through climatic conditions, parasites, or predators via biological control. Defoliators, borers, bark beetles, and various terminal and root feeders, along with sucking insects, are common types of insects in California forests. However, large outbreaks of insects or pathogens are uncommon in the Plan Area.

Introduced pathogens can also lead to the decline of native tree species. One example is Sudden Oak Death (SOD) caused by *Phytophthora ramorum*. In 14 coastal California counties and Curry County, Oregon, *P. ramorum* has caused outbreaks of SOD, killing more than 1 million native oak and tanoak trees (California Oak Mortality Task Force [COMTF], 2008). Under a worst case circumstance, as infected trees die, the niche they occupied becomes colonized by other forest tree species. Because there are no known incidences of SOD within the Plan Area, and the Plan Area is in an area considered to have a very low risk of establishment and spread of SOD (COMTF, 2008), the disease is not expected to have a measurable adverse effect on the Covered Species or on the functional attributes of the HCP.

Site quality and nutrient availability play a key role in forest health and vigor and susceptibility to insect or pathogen damage. Since much of the Plan Area is of moderate site quality, infestations are less likely to occur within the healthy forests that occupy these sites. In addition, riparian areas (e.g., WLPZs) tend to be high quality sites, and as such, are less likely to be affected by pests and pathogens. For this reason, criteria for changed circumstances apply only to pest and pathogen damage that occurs in CSAs established around northern spotted owl activity centers.

The conservation measures identified in Chapter 5 provide protection against most pest or pathogen invasions by promoting forest health. However, prolonged drought as a result of global climate change could alter the resistance of native forests to various pests or pathogens. If stand modification due to pests or pathogens, or their control, (alone or in combination with other factors such as fire and wind) downgrades suitable habitat within the core area or home range of an activity center supported by a CSA on the FGS ownership to non-habitat, such that the conditions for allowable harvest in the CSA can no longer be met over the Permit Term, this will indicate that the CSA may no longer meet the objectives of the HCP and may constitute a changed circumstance. FGS will provide the USFWS with information regarding the damage within 30 days of detection and, in consultation with USFWS, will determine if a changed circumstance has occurred, based on the quantity and quality of habitat for northern spotted owls that remains in the CSA or could develop over the term of the Permits. If a changed circumstance affecting a CSA due to pests or pathogens occurs, FGS will apply the following supplemental prescriptions within affected CSAs.

1. Trees damaged or killed outright by pests or pathogens in a CSA, including those in WLPZs and SMZs, will be considered by FGS for salvage.

2. Salvage of trees damaged or killed by pests or pathogens within CSAs must comply with state law and be approved by the USFWS prior to removal. Salvage operations within a WLPZ or SMZ must be approved by NMFS. In addition, the conduct of any salvage operations will be done with reasonable care to minimize soil erosion, to retain structural features that contribute to bank or slope stability, and to retain standing dead

trees that will contribute to the recruitment of LWD to watercourses within the area affected by pests or pathogens.

3. Reforestation of any CSA affected by pests or pathogens, or their control, will be implemented as soon as reasonably possible. Equipment Exclusion Zones established for protection of Yreka phlox will be avoided during any reforestation activities associated with pests or pathogens.

4. FGS will enter into discussions with the USFWS regarding alternatives that would maintain the approximate conservation value provided by the affected CSA(s) under the original conservation strategy. Alternatives could include, but are not limited to, delayed harvest around nearby activity centers where take is authorized, or establishment of an alternative CSA with similar conservation value. If an alternative CSA is identified and approved through written concurrence by the USFWS, then FGS may conduct timber harvest operations within the pest or pathogen damaged CSA without further restriction, other than as specified in other sections of this HCP (i.e., the CSA will no longer be considered a conservation or mitigation area).

8.2.1.7 Landslides

Landslides are known to have local and often significant impacts on the physical character of stream habitat and their biological communities. However, landslides and earthflows of many dimensions and driving processes are a natural part of the forested landscape in the Pacific Northwest, replenishing channels with gravel and wood derived from valley slopes and tributary systems. Without the catastrophic transfer and replenishment of these materials, the habitat of streams in this region ultimately simplifies, supporting fewer species and a less diverse fish community (Reeves et. al., 1995). Thus, while the short-term effects of landslides can devastate local populations of aquatic vertebrates, landslides and their legacies can actually serve to preserve and perpetuate the habitat that they require and support long term persistence of metapopulations. This HCP is expected to reduce management related landslides and develop forest conditions that enable natural landslides to deliver sufficient quantities of wood for the creation of productive stream habitat.

Landslide rates and processes differ in the various geologic settings across the Plan Area. In the Klamath and Scott River Management units, shallow rapid landslides are the most common kinds of landslides, but some portions are underlain by deep-seated landslides and earthflows. The Grass Lake Management Unit is volcanic and relatively stable. Based on historic experience within the Plan Area, a landslide that results in the delivery of more than 1,000 cubic yards of sediment to a stream channel is unusual, but could occur over the Permit Term.

Generally, landslides that cause alteration of the instream habitat condition in any watershed are part of the ordinary ecology of the forested landscape. Conservation measures within this Plan were designed to address sediment and other habitat effects from past landslides—and through a combination of stream buffer prescriptions, land management restrictions, slope stability analyses, and geologic review of mass wasting hazard areas—to avoid significant adverse impacts from management related landslides and mass wasting events in the future. Therefore, effects on instream habitat due to small landslides are adequately addressed by the existing conservation and mitigation measures.

However, delivery of more than 1,000 cubic yards of sediment to a channel could adversely affect habitat for the aquatic Covered Species beyond what it anticipated in the HCP and may constitute a changed circumstance.

If a landslide on the FGS ownership results in the delivery of more than 1,000 cubic yards of sediment to a channel (from either a source area, or from combined source area and propagated volumes), FGS will provide both Services with information regarding the landslide (e.g., location, size, potential to adversely affect Covered Species) within 10 days of its discovery. FGS and the Services will confer to determine from the available information if it is reasonably possible that FGS's management activities on or adjacent to the area of the landslide could have materially contributed to causing such landslide. If the Services and FGS conclude that it is reasonably possible that FGS's management activities materially contributed to the occurrence of such a landslide, they will jointly review the default measures to determine if changes are necessary. Where appropriate, the review may form the basis for changes to the default measures specified in this HCP.

8.2.1.8 Invasive Species

The USFWS anticipates that barred owls will colonize suitable habitat within the Plan Area within the Permit Term. Because barred owls select habitat similar to that occupied by northern spotted owls, it is likely that newly established barred owl territories will overlap and may displace northern spotted owls within some of the known activity centers. The function of CSAs in providing conservation support to high value activity centers will be compromised in direct proportion to the number of barred owls that colonize the CSAs. Displacement of northern spotted owls from a CSA is considered a changed circumstance and may require implementation of barred owl control measures. This low threshold for triggering barred owl management is necessary because offspring produced at established barred owl territories, regardless of location within CSAs or not, will increase the threat to northern spotted owl territories supported by CSAs.

To maintain the functionality of the Terrestrial Species Conservation Program, FGS will monitor the CSAs and other activity centers on its ownership for barred owl presence (see Chapter 7, Monitoring and Reporting). If barred owls are detected in any CSA or activity center on the FGS ownership, FGS will notify the USFWS within 10 days of detection. FGS will enter into discussions with the USFWS regarding alternative management actions for barred owls. Such actions could include, but are not limited to, control of barred owls through removal and study of barred owl/northern spotted owl interactions. As part of the ITP issuance, FGS will apply for a Federal Depredation Permit for barred owls as needed. FGS will help to facilitate (e.g., through providing access to and across its ownership) implementation of barred owl control measures deemed appropriate by the USFWS at the time of detection.

The locations of the Yreka phlox in Siskiyou County are the only known locations of this plant species in the world. Competition with invasive weeds, such as Marlahan mustard (*Isatis tinctoria*) and yellow star thistle (*Centaurea solstitialis*) specifically have been identified as significant and chronic threats to Yreka phlox, and other species of weeds could become a threat. If invasive weeds with the potential to harm Yreka phlox are detected in the Yreka phlox monitoring areas, FGS will notify the USFWS within 10 days of detection. FGS will help to facilitate (e.g., through providing access to and across its ownership) implementation of invasive weed control measures deemed appropriate by the USFWS at the time of detection.

8.2.1.9 Flooding

Floods are a natural and necessary component of aquatic and riparian ecosystems. For example, floods transport and sort sediment; deposit fine sediments, organic materials and chemical nutrients onto flood surfaces; recruit large woody debris; and scour pools and create other beneficial aquatic habitats. Changing river courses periodically also provides opportunities for the establishment of new riparian stands. Alluvial terraces along river valleys provide ideal growing conditions for hardwood and conifer stands, and are one of the most dynamic vegetative mosaics in the forested landscape.

Floods can cause damage to forest transportation systems (e.g., watercourse crossings, bridges, roads). Floods can also cause damage to forest stands by undermining trees, washing out soil from around the roots, or softening the soil and causing trees to fall. Likewise, floods also suffocate roots by reducing available oxygen in the rooting zone.

The frequency with which floods occur and their relative magnitude are inversely related. Large floods are infrequent while smaller floods can go unnoticed and may recur as often as once every year. Severe floods are often associated with rain-on-snow events. Existing gauging station records provide evidence of historic floods in 1861 and 1955 that were equal in magnitude but less damaging than that of December 1964, which is noted as the most severe flood ever recorded in California history. Two other floods, possibly similar in magnitude to that of 1964, occurred around 1600 and 1750. The latest intense flood occurred in 1997, and was the result of a large rainstorm preceded by a heavy snowpack (i.e., a rain-on-snow event).

A flood that is of lesser magnitude than a 100-year recurrence interval event (i.e., less than a 100-year flood) is part of the expected normal ecology of the forest. A flood of such magnitude (greater than a 100-year recurrence interval) that may substantially alter habitat status or require additional conservation or mitigation measures in excess of those already included in the Plan is not reasonably foreseeable during the life of the Plan, and would be considered an "unforeseen circumstance."

8.2.1.10 Earthquakes

The Plan Area is located in an area that is not known for earthquakes. Earthquakes are quite uncommon and are generally of a relatively insignificant magnitude, typically 2 to 3 on the Richter scale. Occasionally, greater magnitude events occur, but they are impossible to predict. In the forest environment, earthquakes of magnitude 6 or less on the Richter scale produce little, if any, visible change, and apparently have little impact on wildlife or fishery habitat.

While it may be speculated that localized landslides or other earth movements resulted from these earthquakes, there are no data to document that this occurred within the Plan Area. Landslides caused by earthquakes are addressed separately in this "Changed Circumstances" subsection.

An earthquake of such magnitude (greater than magnitude 6 on the Richter scale) that may substantially alter habitat status or require additional conservation or mitigation measures in excess of those already included in the Plan is not reasonably foreseeable during the life of the Plan, and would be considered an "unforeseen circumstance."

8.2.2 Unforeseen Circumstances

Unforeseen circumstances are changes in circumstances affecting a species or geographic area covered by the HCP that could not reasonably have been anticipated by FGS, NMFS, and USFWS at the time the HCP was developed and negotiated, and that result in a substantial and adverse change in the status of a Covered Species (50 CFR 17.3 and 222.102). The Services bear the burden of demonstrating that unforeseen circumstances exist, using the best scientific and commercial data available. All changes not described above as "changed circumstances" that would result in a substantial and adverse change in the status of a Covered Species are considered unforeseen circumstances.

In case of an unforeseen event, FGS will immediately notify the Services. In determining whether such an event constitutes an unforeseen circumstance, the Services shall consider, but not be limited to, the following factors: size of the current range of the affected species; percentage of range adversely affected by the HCP; percentage of range conserved by the HCP; ecological significance of that portion of the range affected by the HCP; level of knowledge about the affected species and the degree of specificity of the species' conservation program under the HCP; and whether failure to adopt additional conservation measures would appreciably reduce the likelihood of survival and recovery of the affected species in the wild.

If the Service(s) determine that additional conservation and mitigation measures are necessary to respond to the unforeseen circumstances, and the HCP is being properly implemented, the additional measures required will be, to the maximum extent practicable, as close as possible to the terms of the original HCP, and must be limited to modifications within any conserved habitat area or to adjustments within lands or waters that already are set-aside in the HCP's operating conservation program. Additional conservation and mitigation measures shall not involve the commitment of additional land or financial compensation, or restrictions on the use of land or other natural resources otherwise available for development or use under the original terms of the HCP without the consent of the permit holder.

8.3 Funding

FGS has been a business entity since 1907. Throughout its history, FGS has been a profitable and sustainable provider of forest products to meet domestic and international softwood lumber demands. Sustainable management approaches relating to the lands covered under the HCP have been in place over this period as part of the company's regulated forest practices, and related land management activities. The combination of FGS's stability within the forest products and agricultural communities, together with its established reputation as a reliable supplier of lumber products, provide evidence of adequate and continuing financial resources to implement the plan.

In general, FGS will finance the HCP with revenues from its ongoing operations. Accordingly, as harvesting is planned and carried out, it will provide the funds needed to carry out the HCP's measures to mitigate the impacts of take. Insofar activities such as road management inventories and Yreka phlox surveys are conducted independently of timber operations, these activities will be funded through the revenues generated by timber harvest activities. FGS has already completed a number of road inventories, showing a commitment to complete this activity, and demonstrating its ability to budget for and fund this activity through timber harvest revenues. Funding for road inventories will be included in the Yearly Expenditure Report provided to the Services.

As described throughout the HCP, and as warranted in the Implementation Agreement, FGS is committed to expend the necessary funds to fulfill its obligations under the plan. After the issuance of the incidental take permits by the USFWS and NMFS, FGS will post a security deposit as an additional form of assurance that adequate funding will be provided for the HCP. The sum of the security deposit shall be determined annually based on: (1) a list of Timber Harvest Plans (THPs) (as per California Public Resource Code Sections 4581-4592) located in HCP Class A drainages (Table 5-1 of this HCP) to be operated on during the calendar year; and (2) any additional material out-of-pocket cost related to implementation of the HCP, as determined on a yearly basis based on the Yearly Expenditure Report described below.

The security deposit shall include a road component and an area component. The road component shall be calculated according to the following schedule for all roads appurtenant to the proposed THP or Notice of Timber Operations, which lie within a HCP Class A drainage: (a) $5,000/mile for all road segments within Class I Watercourse and Lake Protection Zones (WLPZs); (b) $2,500/mile for all road segments within Class II WLPZs; (c) $1,000/mile for all road segments within Equipment Exclusion Zones (EEZs) and Equipment Limitation Zones (ELZs) which are established for Class III Watercourses, inner gorges and connected headwall swales; (d) for each new, reconstructed or temporary Class I watercourse crossings additional security in the amount of $2,000/crossing shall be required. Where an existing Class I watercourse crossing will be used without modification, additional security in the amount of $500/crossing shall be required; (e) for each new, reconstructed or temporary Class II watercourse crossing, additional security in the amount of $1,000/crossing shall be required. Where an existing Class II watercourse crossing will be used without modification, additional security in the amount of $500/crossing shall be required; (f) for each new, reconstructed or temporary Class III watercourse crossings additional security in the amount of $500/crossing shall be required. Where an existing Class III watercourse crossing will be used but not reconstructed, additional security in the amount of $250/crossing shall be required. The area component shall be calculated at the rate of $500/acre for all proposed WLPZs and those EEZs or ELZs which are established for Class III Watercourses, inner gorges and connected headwall swales.

Further, by January 1st of each calendar year during the Permit Term, and following the adoption of FGS company budget by its Board of Directors (which normally occurs by the end of November of the prior year), FGS will provide the Services with a Yearly Expenditure Report (YER). The YER will, when appropriate, identify the HCP tasks undertaken the prior year, and the funds expended to implement those tasks. The YER will also identify: (1) HCP tasks FGS intends to implement in the upcoming calendar year (e.g., monitoring, surveying), (2) out-of-pocket expenditures related to those tasks (e.g., hiring of outside specialists), (3) funds budgeted for those purposes, and (4) whether the budgeted funds are THP-related or not. FGS must provide this information to the Services for their review and concurrence before any activity authorized by the HCP may commence.

Finally, FGS further understands that any failure to implement all of its duties under this HCP for any reason, funding considerations or otherwise, could result in violation of the ITP, enforcement action, including penalties under ESA Section 9 and Section 11, and suspension or revocation of the ITP. To ensure that the obligations under the HCP are being met, FGS and the Services will meet on an annual basis, or as needed, to confirm that the conservation measures are being properly implemented, review monitoring and survey data presented in the annual reports (see Chapter 7, Monitoring and Reporting), and confirm that the conservation programs are meeting the biological objectives of the HCP.

8.4 Modifications and Amendments

There are two types of changes that may be made to the HCP and/or the HCP Permits and/or its associated documents:

- Minor Modifications
- Amendments

Minor Modifications and Amendments shall be processed in accordance with the provisions of the IA and all applicable legal requirements, including but not limited to the ESA, NEPA, and any applicable federal regulations.

8.4.1 Minor Modifications

Minor Modifications to the HCP are changes provided for under the operating conservation program. Minor Modifications do not (1) modify the scope or nature of activities or actions covered by the Section 10(a)(1)(B) permit; (2) result in operations under the HCP that are significantly different from those contemplated or analyzed in connection with the Plan as approved; (3) result in adverse impacts on the environment that are new or significantly different from those analyzed in connection with the Plan as approved; or (4) result in additional take not analyzed in connection with the HCP as approved. As noted above, Minor Modifications shall be processed in accordance with the provisions of the IA and all applicable legal requirements, including but not limited to the ESA, NEPA, and any applicable federal regulations.

Minor Modifications to the HCP may include, but are not limited to, the following:

1. Correcting any maps or exhibits to correct errors in mapping or boundary lines.
2. Modifying existing or establishing new avoidance or minimization measures that incorporate new nomenclature or technology. Any new or modified measures will not be substantially different in nature from existing measures and will achieve equivalent or greater protection for Covered Species.
3. Making minor changes to monitoring or reporting protocols.
4. Revising mitigation area enhancement and management techniques.

5. Making minor modifications to the HCP that are consistent with the biological goals and objectives of the HCP, and that the Services have analyzed and agreed to.

It is anticipated that FGS may, over the term of the Permits, sell or acquire additional timberlands in drainages where they currently have ownership. Sales and acquisitions of lands to be covered by the HCP shall be subject to the provisions of the IA and all applicable legal requirements, including but not limited to the ESA, NEPA, and any applicable federal regulations.

8.4.2 Amendments to the HCP

Amendments to the HCP include, but are not limited to changes that affect the scope of the HCP and conservation strategy, increase the amount of take, add new species, or change significantly the boundaries of the HCP. Amendments to the HCP require an amendment to the Section 10(a)(1)(B) permits and to the Services' decision documents, including NEPA documents, biological opinions, and findings and recommendations documents. Amendments will also require additional public review and comment. As noted above, Amendments shall be processed in accordance with the provisions of the IA and all applicable legal requirements, including but not limited to the ESA, NEPA, and any applicable federal regulations.

The following describes several types of changes that would require an Amendment to the HCP.

1. The listing under the ESA of a new species within the Plan Area that is not an HCP Covered Species but may be affected by HCP Covered Activities, and for which the permittee seeks coverage under the HCP and Section 10(a)(1)(B) permit.
2. Significant changes to the HCP including, but not limited to the following:
    a. Changes to the method for calculating compensation for incidental take, which would increase the levels of incidental take permitted for the HCP.
    b. A material change in the level of funding except as otherwise provided for in the HCP to account for all adjustments for inflation and changed circumstances.
3. Changes to the Covered Activities that were not addressed in the HCP as originally adopted, and which otherwise do not meet the provisions for Minor Modifications above.
4. Extending the term of the HCP Permits past the 50-year term.
5. Changes in the Plan Area through acquisition of properties that exceed the limit of 10 percent of the Initial Plan Area (15,218 acres).
6. Changes in the Plan Area through the sale of properties that provide suitable habitat for any of the Covered Species or mitigation for impacts to these species on the remaining ownership and the new owner(s) do not wish to assume the obligations of the Permits through the process identified in subsection 8.4.6 below.

8.4.3 Amendments to the Section 10(a)(1)(B) Permits

Amendments to the HCP will require an amendment to the Section 10(a)(1)(B) permits. Amendments to the Section 10(a)(1)(B) permits shall be processed in accordance with the provisions of the IA and all applicable legal requirements, including but not limited to the ESA, NEPA, and any applicable federal regulations.

8.4.4 Suspension/Revocation

NMFS and/or the USFWS may suspend or revoke their respective permits, in whole or in part, for cause. Suspension or revocation of the Section 10(a)(1)(B) permits, in whole or in part, by the Services shall be processed in accordance with the provisions of the IA and all applicable legal requirements, including but not limited to the ESA, NEPA, and any applicable federal regulations.

8.4.5 Extension of the Section 10(a)(1)(B) Permit

FGS intends to receive authorization for incidental take from the Services for a period of 50 years. Unless incidental take authorization has been extended through a Permit Amendment or issuance of a new permit, the Section 10(a)(1)(B) permits will no longer be in effect, and FGS will need to comply with the prevailing regulations regarding listed species. Extension of the Section 10(a)(1)(B) permits shall be processed in accordance with the provisions of the IA and all applicable legal requirements, including but not limited to the ESA, NEPA, and any applicable federal regulations.

8.4.6 Permit Transfer

All or a portion of the ITPs may be transferred to a third party in accordance with the current statutory and regulatory requirements governing such transfers. Currently, regulations governing ITP transfers are codified at 50 C.F.R. 13.25(b). If the sale or transfer of a single or multiple parcels over the Permit Term cumulatively involves more than 10 percent of the Initial Plan Area (15,218 acres) and the new owner(s) do not wish to accept transfer of the Permits, then FGS must apply for an Amendment to the HCP and Permits (see Section 8.4.3). For the "No Surprises" assurances for Yreka phlox to be extended to the new owner(s), the new owner(s) must continue to implement the conservation measures specified in the HCP.

If the sale or transfer involves land committed as mitigation under the HCP (i.e., CSAs) and the new owner(s) do not wish to transfer the Permits, then FGS must provide mitigation on the remainder of its ownership that is equivalent in value to the mitigation areas being sold or transferred. In consultation with the Service, FGS will select and maintain CSAs around activity centers that provide an equivalent level of mitigation based on total conservation value. FGS will adhere to the Plan measures (meeting the biological goals and objectives) on the remaining Plan Area for the original term of the Permits (50 years from issuance).

If the sale or transfer involves land where incidental take of owls is authorized under the HCP (i.e., "take" sites) and the new owner(s) do not wish to transfer the Permits, then FGS must provide mitigation for the take of owls at the 3:1 mitigation ratio provided for in the Terrestrial Species Conservation Strategy (see Chapters 5 and 6). In consultation with the Service, FGS will select and maintain CSAs around activity centers on the remaining ownership that meet the 3:1 mitigation ratio based on total conservation value. FGS's mitigation commitment does not relieve the new owner's obligation under the federal ESA.

FGS, however, will not be required to establish additional CSAs for mitigation on its ownership if the new owner(s) apply for and receive authorization for transfer of the Permits or if the land sold or transferred is mitigation for the take sites (i.e., at a 3:1 ratio based on conservation value). FGS will adhere to the Plan measures (meeting the biological goals and objectives) on the remaining Plan Area for the original term of the Permits (50 years from issuance).

8.4.7 Early Termination

In the event of early termination of the HCP and Permits, FGS will commit to the following based on the level of take of northern spotted owl and the mitigation ratio provided for in the Plan:

- FGS will mitigate any incidental take that has occurred as a result of habitat modification by maintaining one or more CSAs that provide an overall conservation value equal to at least three (3) times the conservation value of the activity centers where take has occurred for the original term of the Permits.

Under the HCP, incidental take through habitat modification is authorized at 43 known activity centers that provide 18 percent of the total conservation value of known activity centers in the Area of Impact. The impacts of this taking are mitigated by the development, protection, and enhancement of suitable northern spotted owl habitat on the FGS ownership within 24 CSAs that provide 55 percent of the total conservation value of known activity centers in the Area of Impact (a 3:1 ratio). This same mitigation ratio (3:1) will be used in the event of early termination to identify the appropriate level of mitigation for incidental take that has occurred prior to termination of the Plan and Permits.

The level of incidental take that has occurred prior to termination of the HCP will be based on the amount (acreage) and location of suitable northern spotted owl habitat within the core and home range of known activity centers within the Area of Impact that are rendered unsuitable. In the event of early termination of the Plan and Permits, FGS will field verify the extent of habitat conversion for activity centers where incidental take is authorized to determine, in consultation with the USFWS, the level of take that has occurred prior to termination of the HCP and Permits. The sum of the conservation value of those activity centers where incidental take due to habitat modification has occurred is the level of impact that must be mitigated at a 3:1 ratio. In consultation with the USFWS, FGS will select an adequate number of CSAs from those established in the Plan to meet the 3:1 mitigation ratio based on total conservation value. FGS will adhere to the Plan measures (harvest restrictions and habitat commitments) (see Table 5-3) in the selected CSAs for the original term of the Permits (50 years from issuance).

For the aquatic Covered Species, much of the conservation effort that serves as mitigation for potential take of these species occurs during the first 10 to 15 years of implementation through comprehensive drainage-level road inventories in high priority drainages and stabilization of at least 50 percent of the identified road-related sediment that could be delivered to area streams. The slope stability measures and take avoidance measures (e.g., for water drafting) are expected to provide real-time, site-specific take avoidance and mitigation when applied according to the terms and conditions of the HCP. The benefits of these avoidance and mitigation measures applied during harvest activities, such as provided by the slope stability measures, are anticipated to remain until the next harvest cycle (approximately 40-50 years). It is therefore anticipated that no additional mitigation would be required for the aquatic Covered Species in the event of early termination of the HCP and Permits.

CHAPTER 9

Criteria for Issuance of the Incidental Take Permits

9.1 Contents of a Habitat Conservation Plan

Section 10(a)(1)(B) of the Endangered Species Act allows the Secretary to permit taking of listed species if such taking is incidental to, and not the purpose of, the carrying out of an otherwise lawful activity. Section 10(a)(2)(A) further specifies that no permit may be issued by the Secretary authorizing any taking referred to in paragraph (1)(B) unless the applicant submits to the Secretary a conservation plan that specifies:

- The impact which will likely result from such taking;
- What steps the applicant will take to minimize and mitigate such impacts, and the funding that will be available to implement such steps;
- What alternative actions to such taking the applicant considered and the reasons why such alternatives are not being utilized; and
- Such other measures that the Secretary may require as being necessary or appropriate for the purposes of the plan.

The manner in which this HCP meets those requirements is described below with reference to sections in the document where additional information is presented.

9.1.1 Impact of the Taking

9.1.1.1 Aquatic Covered Species

The Covered Activities described in Chapter 2 of this HCP may result in incidental take of Chinook salmon, coho salmon, and steelhead. The life history and habitat requirements of these species are described separately in Chapter 3 of this HCP and environmental baseline conditions in the Plan Area for each species are described in Chapter 4. The potential effects of the Covered Activities with implementation of the HCP, including the potential for incidental take, the impact of the taking, and mitigation of the impact are described in Chapter 6 of this HCP.

In general, habitat conditions in the Plan Area for aquatic Covered Species are improving relative to the conditions that existed historically as a result of early timber harvest and other anthropogenic activities. This improvement is the result of more stringent regulations and refinement and implementation of management practices that reduce environmental impacts. This HCP will continue the trajectory of improving conditions in streams in the Plan Area and minimize the potential for take. As described in Chapter 6 of this HCP, the Covered Activities are not expected to alter the important watershed processes and products to the extent that they result in substantial adverse impacts to the aquatic Covered

Species in the Plan Area. As a consequence, the impact of the taking would be minimized at the local level, with virtually no anticipated impact at the regional or ESU level to aquatic Covered Species.

9.1.1.2 Northern Spotted Owl

As described in Chapter 6, management under this HCP anticipates the modification of habitat for northern spotted owls to the extent that incidental take at 43 activity centers in the California Klamath Province could occur. Incidental take of northern spotted owls is not authorized in the California Cascades Province (FGS's Grass Lake management unit). If the activity center in which management occurs is occupied, the resident northern spotted owls may abandon the site (be displaced). This displacement could result in the death or injury of individual owls or disruption of their reproductive activities. Displaced owls may relocate to unoccupied suitable habitat and continue their nesting activities and successfully reproduce; however, they may also become more vulnerable to predation or adverse weather conditions, subject to poorer foraging conditions, and experience increased stress. Disturbance during the breeding season is minimized by establishment of a 0.25-mile buffer around known active nest sites. Habitat modification could also adversely affect northern spotted owls if habitat conditions became more favorable to competitors (i.e., barred owls). The potential threat to northern spotted owls from barred owls is addressed through monitoring and implementation of barred owl control measures.

Habitat modification within the home range around the 43 activity centers where take is authorized under the HCP could result in the incidental take of up to an estimated 83 individual spotted owls over the 50-year term of the Permits. Based on the 2005 owl habitat layer and the probability of occupancy model (Zabel et al. 2003), a total of 186 activity centers, or 372 spotted owls, were estimated to occur within the California Klamath Province Area of Analysis. Under the HCP, the 83 owls that could be incidentally taken over the Permit Term represent 22 percent of the estimated number of northern spotted owls within the Area of Analysis for this Province. This estimate of the potential for incidental take represents a worst-case scenario because it assumes that each of the activity centers supports and is occupied by spotted owls at the highest historical reproductive status and that the modification of habitat within the home ranges around these activity centers would lead to the incidental take of the individual spotted owls occupying those activity centers. However, not all activity centers may be occupied at historic levels and some owls may be able to disperse and continue to reproduce. The estimate also assumes that conditions on the ownership remain static, and does not account for the improving trend in the quantity and quality of habitat for the northern spotted owl over the Permit Term. While unlikely, this estimated level of incidental take represents the maximum that could occur.

The majority of northern spotted owls that could be incidentally taken over the term of the Permits are from activity centers that have relatively low conservation value, as determined using the impacts evaluation matrix (see Chapter 6). Incidental take of owls at the 43 activity centers where take is authorized could result in an 18 percent reduction of the total conservation value of activity centers in the Area of Impact. To mitigate this impact, FGS will establish 24 CSAs, focusing primarily on activity centers with the highest conservation value, to provide demographic support to the federal conservation strategy. Incidental take of northern spotted owls associated with activity centers supported by CSAs would not be authorized. The activity centers protected by CSAs contribute approximately 55 percent of the total conservation value in the Area of Impact, thus mitigating the incidental take of owls at activity centers where take is authorized at a 3:1 ratio. Activity centers in which incidental take of northern spotted owls is unlikely because of low overlap with the FGS ownership account for an additional 27 percent of the total conservation value of activity centers in the Area of Impact. Overall, 82 percent of the total conservation value of activity centers in the Area of Impact would be retained and conserved by the HCP's conservation, mitigation, and take avoidance measures.

As described in Chapter 6, FGS's anticipated timber harvest would result in a 3.6 percent reduction in the amount of suitable habitat for northern spotted owl in the California Klamath Province Area of Analysis during the first decade. This short-term loss of habitat will be mitigated by long-term habitat commitments leading to an increasing amount of northern spotted owl habitat in the Plan Area over the term of the Permits. In addition, nearly all activity centers with home ranges that overlap with federally designated critical habitat for northern spotted owl and where FGS's Covered Activities could result in incidental take of owls will be protected by CSAs under the HCP for the term of the Permits. Silvicultural treatments anticipated under the HCP will reduce the potential for fire, especially large, stand replacing events that can have substantial adverse effects on habitat for northern spotted owls. FGS's forest management and other Covered Activities also have the potential to benefit northern spotted owls and other species through maintaining forest health and productivity, and promoting the development of a heterogeneous forest structure.

The potential impact of incidental take as a result of Covered Activities on the regional owl population in the California Klamath Province is not anticipated to be significant for the following reasons:

- The amount of suitable habitat for northern spotted owls on the FGS ownership (approximately 40,000 acres) is small relative to the large amount of suitable owl habitat available in the Area of Analysis (nearly 600,000 acres).
- A relatively small percentage of currently suitable habitat for northern spotted owl in the Area of Analysis is likely to be downgraded or converted to unsuitable habitat by FGS's Covered Activities and this loss of habitat would be mitigated by an overall increase in the amount of suitable habitat over the term of the Permits.
- Only one activity center within 1.3 miles of federally designated critical habitat for northern spotted owl has habitat within its home range that is likely to be modified to the extent that incidental take could occur, and this take would be mitigated through establishment of CSAs that directly support the other 12 known activity centers in this CHU.
- The majority of the spotted owls that could be incidentally taken over the term of the Permits are from activity centers that have relatively low conservation value and the loss of conservation value at these activity centers is mitigated at a 3:1 ratio (in conservation value) by establishment of the CSAs.

- As described by Anthony et al. (2006), demographic data for study populations in the California Klamath Province show that overall, northern spotted owl populations have been relatively stable (see Subsection 4.9.1.2 in Chapter 4 of this HCP).
- FGS's forest management and other Covered Activities have the potential to benefit northern spotted owls through maintaining forest health and productivity, and promoting the development of a heterogeneous forest structure.

9.1.1.3 Yreka Phlox

Yreka phlox is listed as endangered under the federal ESA. USFWS would include Yreka phlox on the list of Covered Species for the ITP authorizing incidental take of northern spotted owl in order to provide FGS assurances under the "No Surprises" policy. To gain these assurances under the ITP, this HCP includes conservation measures designed to avoid adverse effects to Yreka phlox and additional measures to protect known and discovered populations on the FGS ownership through monitoring of each protected population. Collectively, these measures will avoid adverse effects to Yreka phlox resulting from Covered Activities and contribute to the federal conservation strategy for this species.

9.1.2 Minimization and Mitigation of Impacts and Funding

9.1.2.1 Minimization and Mitigation of Impacts

The conservation measures that will be implemented to avoid or minimize incidental take of aquatic Covered Species (the Aquatic Species Conservation Program) and measures designed to avoid or minimize take of northern spotted owl and avoid adverse effects to Yreka phlox (the Terrestrial Species Conservation Program) are described separately in Chapter 5 of this HCP. Chapter 6 of this HCP describes the impacts of the Covered Activities on both aquatic and terrestrial Covered Species and how the conservation and mitigation measures minimize and mitigate the impacts of the taking on these species. Section 9.2.2 describes how the Aquatic and Terrestrial Species Conservation Programs mitigate the impacts of the taking to the maximum extent practicable.

9.1.2.2 Funding

FGS will finance the HCP with revenues from its timber harvesting operations. The anticipated costs of implementing these measures and the mechanisms by which funding will be provided and assured are described in the Implementing Agreement for this HCP. See Section 9.2.3 for further discussion of funding.

9.1.3 Alternatives

In accordance with the requirements for issuance of the ITPs, FGS considered several alternatives to the proposed taking of Covered Species in the HCP. The primary alternatives considered by FGS were:

- No Permits/No Plan
- Landscape-level Conservation Strategy
- Reduced Permit Area

9.1.3.1 No Permits/No Plan

Under this alternative, FGS would continue to be subject to existing legal and regulatory requirements, including the ESA take prohibition which would apply to all listed species in the Plan Area. Under the No Permits/No Plan Alternative:

- FGS would not seek authorization for take of the listed or unlisted Covered Species;
- The proposed Incidental Take Permits would not be issued;
- This HCP would not be implemented; and
- Timber operations and related activities would occur in the Plan Area in accordance with existing state and federal regulations, the approved sustained yield plan for the Plan Area, and FGS's operational policies and plans.

As currently occurs, FGS foresters would develop and design site-specific measures to address potentially significant environmental effects that otherwise might not be adequately addressed by application of the prescriptive measures contained in the CFPRs. A multi-disciplinary team composed of representatives from North Coast RWQCB, DFG, the California Geological Survey, and other resource agencies such as NMFS and USFWS would review each proposed THP and, where necessary, would identify additional site-specific measures to avoid or mitigate potentially significant environmental impacts.

Some measures benefiting the Covered Species would be implemented in the Plan Area (a) in compliance with existing laws and regulations that apply to watershed impacts, sensitive species, cumulative impacts, and the prohibition on take; and (b) as a result of FGS's continued participation in monitoring and habitat enhancement projects within the region.

Fruit Growers considered but rejected the No Permits/No Plan Alternative because it does not offer a long-term solution for reconciling its operations with ESA requirements that apply to the listed Covered Species. Current regulatory restrictions, in conjunction with the large number of owl territories that are located on or overlap FGS lands, have substantially restricted FGS's management and operational flexibility since the owl was listed in 1990. These restrictions are forcing FGS to operate more intensively in other portions of its ownership in order to generate the timber volume necessary to remain economically viable. Continued operation under these management restrictions would jeopardize FGS's long-term ability to economically produce timber. Further, as discussed in Chapter 6, FGS believes that the HCP as proposed will have beneficial effects for Covered Species that the No Permit/No Plan strategy cannot provide.

9.1.3.2 Landscape-level Conservation

This alternative provides a different approach to northern spotted owl conservation by providing moderate quality foraging and dispersal habitat across the FGS ownership as compensation for incidental take of owls. In this manner, conservation would be achieved by landscape-level actions rather than by preserving specific owl habitat within home ranges (e.g., the CSAs designated under the HCP). Covered Activities would remain the same as described for the HCP (Chapter 2) but the conservation strategies for the Covered Species would differ as described in the following sections. Under the Landscape-level Conservation Strategy Alternative, FGS would not seek authorization for take of the listed or unlisted aquatic Covered Species and the proposed Incidental Take Permit for the aquatic Covered Species would not be issued.

Aquatic Covered Species. Under this alternative, management for coho salmon and other salmonid species would be similar to current operations and as described above for the "No Permits/No Plan" Alternative. Current CFPR regulations would apply, including application of additional measures for protection of these species in selected "watersheds with threatened and impaired values" (T&I Watersheds). T&I Watersheds are defined as any planning watershed where populations of anadromous salmonids that are listed as threatened, endangered, or candidate under the state or federal ESA are currently present or can be restored. For coho salmon, the new "Protection Measures in Watersheds with Coho Salmon" [14 CCR 936.9.1] regarding forest management would apply in watersheds where coho salmon have been documented by DFG to be present during or after 1990. These special requirements apply in addition to all other district CFPRs within qualifying planning watersheds.

Northern Spotted Owl. Under the Landscape-level Conservation Strategy Alternative, FGS would implement a modified conservation program with different biological objectives for demographic support and dispersal habitat. This landscape-based approach would be expected to increase foraging opportunities for owls nesting on adjacent ownerships, and provide for dispersal of northern spotted owls across the ownership. The primary objective of this alternative conservation program would be to provide foraging habitat at twice the existing level. The increase in foraging habitat would be expected to result in a landscape that supports foraging by northern spotted owls.

FGS would conduct forest management activities consistent with landscape-level goals developed for each management unit. Habitat management objectives would be based on the California Wildlife Habitat Relationships (CWHR) system. CWHR habitat types 4M, 4D, 5M, 5D, and 6, which consist of stands with a mean diameter of 11 inches or greater with 40 percent or greater canopy cover, are considered to provide foraging and dispersal habitat for northern spotted owls. With the exception of 4M, these habitat types may also provide nesting and roosting habitat.

The following measures describe how the demographic support and dispersal habitat objectives would be met for each management unit:

- Manage the Klamath River management unit in such a manner as to allow an increase in the representation of CWHR habitat types 4M, 4D, 5M, 5D, or 6 over the term of the permit with a goal of providing these stand structures on at least 35 percent of the Klamath River management unit by the end of the permit term.

- Manage the Klamath River management unit to allow the maintenance of CWHR habitat types 4M, 4D, 5M, 5D, or 6 on at least 15 percent of the Klamath River management unit in any decade of the permit. These habitat types are considered to provide foraging and, with the exception of 4M, may also provide nesting/roosting habitat.

- Manage the Klamath River management unit to allow the maintenance of CWHR habitat types 3M, 3D, 4P, or 5P on at least 15 percent of the Klamath River management unit in any decade of the permit. These habitat types are considered to provide dispersal habitat.

- Manage the Scott Valley management unit to allow an increase in the representation of CWHR habitat types 4M, 4D, 5M, 5D, or 6 over the term of the permit with a goal of providing these stand structures on at least 25 percent of the Scott Valley management unit by the end of the permit term.
- Manage the Grass Lake management unit to allow an increase in the representation of CWHR habitat types 4M, 4D, 5M, 5D, or 6 over the term of the permit with a goal of providing these stand structures on at least 20 percent of the Grass Lake management unit by the end of the permit term.

In addition to the CWHR-based habitat management measures described above, this alternative also includes the take avoidance measures included in the HCP that would minimize disturbance to nesting and roosting owls. This alternative also contains measures that would defer harvest in some areas:

- Conversion of suitable habitat to low quality foraging, dispersal, or unsuitable habitat within 1.3 miles of at least eight currently occupied activity centers located on CHUs would be deferred for up to 15 years.
- Harvest would be allowed in areas of deferred harvest before the end of the 15-year deferral period if either: (1) based on habitat typing from aerial photographs, the area within 1.3 miles of the activity center contains 40 percent or more suitable habitat, or (2) surveys have demonstrated that the activity center is abandoned.
- Conversion of suitable habitat to low quality foraging, dispersal, or unsuitable habitat in the Grass Lake management unit within 1.3 miles of at least one activity center located on a CHU would be deferred for at least 5 years and up to 15 years.

Yreka Phlox. Under this alternative FGS would comply with all current regulations for protection of listed plant species, including Yreka phlox. FGS would incorporate site-specific measures into THPs as necessary for the purpose of avoiding adverse impacts to Yreka phlox.

FGS considered the Landscape-level Conservation approach during the preparation of the HCP and rejected it in favor of the habitat-based conservation approach used in the proposed HCP because this alternative does not address incidental take of all of the listed species found in the Plan Area (i.e., coho salmon are excluded), does not provide protection under the "No Surprises" rule should steelhead or Chinook salmon become listed in the future, and does not provide as much support to the federal conservation strategy for northern spotted owl as is anticipated under the proposed HCP. By establishing CSAs that protect and enhance habitat for northern spotted owl in areas that contribute the most "conservation value" to the federal conservation strategy, the proposed HCP provides a higher level of demographic support than the Landscape-level Conservation Strategy under this alternative.

9.1.3.3 Reduced Permit Area

Under this alternative, USFWS would issue an ITP for northern spotted owl and NMFS would issue an ITP for Chinook salmon, coho salmon, and steelhead. However, the ITPs would only apply to the applicant's Klamath River and Scott Valley management units; its

Grass Lake management unit would be excluded from ITP coverage. All the terms and conditions of the proposed HCP would apply to the reduced area. No incidental take of the ITP species would be authorized in the Grass Lake management unit.

The Grass Lake management unit lies within the California Cascades Province for the northern spotted owl. The FGS ownership in this area represents approximately 4 percent of this province. Suitable habitat on FGS ownership in this area is limited to 15 percent of the landscape. Similar to the proposed HCP, no incidental take would be authorized in the Grass Lake management unit under this alternative. FGS considered this approach during the preparation of the HCP and rejected it in favor of including the Grass Lake management unit in the Plan Area because this would help support a comprehensive approach to habitat management in the region and would provide additional demographic support to the federal conservation strategy through establishment of CSAs around several activity centers.

9.1.4 Other Measures

The conservation strategies described in Chapter 5 were developed in coordination with NMFS and DFG (Aquatic Covered Species) and the USFWS (Terrestrial Covered Species) to avoid or minimize incidental take and mitigate the impacts of any taking to the maximum extent practicable (see below). Both of these agencies provided substantial input during development of the HCP. Therefore, no additional measures are anticipated as being necessary or appropriate for purposes of the plan.

9.2 Findings Based on the Habitat Conservation Plan

Section 10(a)(2)(B) of the ESA identifies the criteria an applicant must meet before the USFWS or NMFS may issue an incidental take permit. Specifically, in addition to a permit application and related conservation plan, the Services must make findings that:

- The taking will be incidental;
- The applicant will, to the maximum extent practicable, minimize and mitigate the impacts of such taking;
- The applicant will ensure that adequate funding for the plan will be provided;
- The taking will not appreciably reduce the likelihood of the survival and recovery of the species in the wild; and
- The measures, if any, required under subparagraph (A)(iv)[1] will be met; and
- [The issuing agency] has received other required assurances that the plan will be implemented.[2]

The permit shall contain such terms and conditions as the Secretary deems necessary or appropriate to carry out the purposes of this paragraph, including, but not limited to, such

[1] Referencing to “such other measures that the Secretary may require as being necessary or appropriate for purposes of the plan.” ESA Sec. 10(a)(2)(A)(iv).

[2] ESA Sec. 10 (a)(2)(B) (i-v).

reporting requirements as the Secretary deems necessary for determining whether such terms and conditions are being complied with [Sec. 10(2)(B)(v)]. If these criteria are met and the HCP and supporting information are statutorily complete, the Services will issue the permits.

The following subsections describe how this HCP, including the conservation program described in Chapter 5, will facilitate making these findings and meets the criteria for issuance of an ITP.

9.2.1 Incidental Take

FGS maintains the land within the Plan Area for the primary purpose of timber production and harvest. The Covered Activities described in Chapter 2 of this HCP are conducted for these purposes in compliance with the CFPRs, other State regulations governing timber harvest activities and other applicable laws. Therefore, any take of individuals of the Covered Species would be incidental to otherwise lawful activities.

9.2.2 Maximum Extent Practicable

As noted above, the ESA authorizes the issuance of an incidental take permit if measures can be implemented to minimize and mitigate the impacts of incidental take to the “maximum extent practicable.” The term “maximum extent practicable” is not defined in the statute or in any formal agency regulations. However, guidance is provided in the HCP Handbook, which explains that a finding of “maximum extent practicable“ typically requires consideration of two factors: (1) adequacy of the minimization and mitigation program, and (2) whether it is the maximum that can be practically implemented by the applicant (HCP Handbook, Section 7). “This criterion inherently requires a discussion of the minimization and mitigation efforts and their relationship to the project impact and the desired outcome of the HCP” (Addendum to the HCP Handbook). In National Wildlife Federation v. Norton, 2005 U.S. Dist. LEXIS 33768, at *46 (E.D. Cal. 2005), the district court instructed that “these two factors are evaluated on a sliding scale, such that a stronger showing on one factor may compensate for a weaker showing on the other. [citation omitted] For instance, where the habitat lost is of minimal or no value to the Covered Species and the mitigation plan more than compensates for the level of injury, the applicant need not do more, even if it would be financially feasible.” See also, National Wildlife Federation v. Norton, 306 F.Supp2d 920, 928 (E.D. Cal. 2004) (“The level of mitigation must be ‘rationally related to the level of take under the plan.’”)

In this context, practicability should also include consideration of the benefit to Covered Species that would be provided by additional economic investment (i.e., the biological value of the next increment of mitigation) if an impact cannot be fully mitigated. For example, riparian zones influence the level of shading on the stream, recruitment of LWD, and overland transport of sediment. The benefits of the riparian zone, however, are greatest nearest the stream, and they diminish as the distance from the stream increases. Because the timber value of trees does not change, the biological benefit associated with each additional increment of riparian zone width that is managed for conservation purposes becomes more expensive. This is because wider riparian buffers would remove volume from FGS’s harvestable inventory, and add substantially to production costs associated with the maintenance and possible re-construction of its road system. Roads inside WLPZs have much higher maintenance standards which add substantially to the company's costs of operation, with only minimal gains in biological benefit. Simply stated, economic expenditures to achieve minimal gains in biological benefits are too costly to be practicable for an operation that has to produce income in order to stay in business, and would render the plan economically and operationally infeasible.

The following describes how the Aquatic Species and Terrestrial Species conservation programs contained in this HCP will minimize and mitigate the impact of any take of Covered Species to the maximum extent practicable based on the concepts described above.

9.2.2.1 Aquatic Species Conservation Program

The Aquatic Species Conservation Program within this HCP has been designed to avoid or minimize the impacts of the Covered Activities on watershed processes and products that affect the aquatic Covered Species indirectly through habitat alteration, and by minimizing the potential for direct harm to these species through injury or death. The adequacy of these measures is demonstrated by how well they meet the biological objectives. The conservation measures described in Chapter 5 were designed to address the specific biological requirements of the aquatic Covered Species by meeting several biological objectives, and to be manageable and enforceable. The following describes the adequacy of the conservation measures and why the conservation program represents the maximum that can be practicably implemented.

Meeting the Biological Objectives

Objective 1: Riparian Shading. The HCP will promote growth of stands in the WLPZs towards a more mature state with a high level of overstory canopy coverage and stream shading through riparian management. A high level of canopy coverage will be maintained in the "inner zone" of WLPZs where stream shading would have the greatest potential to affect stream temperatures. In Class A designated lands, sufficient trees will be retained within Class I WLPZs to maintain the pre-harvest level of direct shading to pools. Through these measures, FGS will minimize the potential for harvest-related impacts on water temperature and the potential for indirect take of aquatic Covered Species. These measures are expected to maintain or increase shading, and improve (reduce) water temperatures in Class I and Class II streams over the Permit Term. Because these measures will ultimately maintain riparian shading at levels comparable to un-managed conditions, they will effectively avoid or minimize the potential for take of aquatic Covered Species from this source. Furthermore, the populations of the aquatic Covered Species that use the sections of streams that FGS manages represent a small fraction of the total species populations. Given the adequacy of the measures to avoid or minimize take, the low potential for impact at the species level, and the target level of shading (85 percent) is likely near the maximum possible given forest growth characteristics and natural levels of disturbance, it is not practicable for FGS to attempt to further increase shading.

Objective 2: LWD Recruitment. The HCP increases the potential for recruitment of in-channel LWD on the FGS ownership through riparian management measures that retain trees and snags with the greatest likelihood to contribute to in-channel LWD and slope stability measures that ensure that LWD delivery from upslope areas such as inner gorges and headwall swales will not be compromised. These measures will contribute to improving LWD conditions for Covered Species in FGS streams. Retaining trees with a low probability of recruitment would be economically burdensome and would not significantly contribute to LWD in the stream channels or benefits to aquatic Covered Species. Thus, increasing retention of trees in riparian areas beyond that prescribed in the HCP would not be practicable.

Objective 3: Sediment Control. The HCP will minimize soil delivery to area watercourses through implementation of riparian management measures that minimize soil disturbance in WLPZs, a road management plan, slope stability measures that reduce sediment production and delivery to stream channels from mass wasting due to Covered Activities, and stream crossing BMPs that minimize sediment production and delivery to stream channels from stream crossings due to Covered Activities.

FGS's sediment control measures address all major potential sources of sediment to the streams that are influenced by FGS's activities. As described above, the biological benefit associated with each additional increment of riparian zone width or inner gorge width where activities are restricted becomes more expensive. The prescribed road management measures are expected to reduce sediment delivery from this source by 50 percent in the first ten years of the Permit. Increasing the number or frequency of road inventories would not appreciably reduce the amount of sediment potentially reaching Plan Area streams and would be economically burdensome for FGS. Geologic review is required prior to any activities on field verified unstable areas such that additional review by a Professional Geologist or Certified Engineering Geologist would be economically burdensome and would not contribute substantially to a reduction in sediment production and delivery. The conservation measures in the HCP adequately address the sediment sources with the greatest potential to affect aquatic Covered Species. The cost of implementing measures beyond those identified in the HCP increases substantially. Therefore, given the cost of implementing additional measures, the marginal benefit that would be afforded to Covered Species, and the low potential for impact at the species level, implementing additional measures would not be practicable.

Maximum that can be Practicably Implemented

In drainages containing Class A and B designated lands, WLPZs established along Class I (fishbearing) and Class II (aquatic habitat) watercourses will restrict operations on nearly 6,200 acres of the Plan Area. ELZs along Class III watercourses will restrict operations on an additional approximately 2,485 acres of Class A and Class B designated lands in the Plan Area. These lands are some of the most productive lands on the ownership because of their proximity to water in an otherwise dry region. As described above, restricting operations on additional riparian acreage (e.g., establishing wider WLPZs or ELZs) would limit FGS's ability to profitably manage its ownership over the long term. Similarly, the road management plan entails a substantial monetary commitment by FGS on an annual basis and over the Permit Term. Geologic review of field-verified unstable areas and aerial photo mapping of landslides included as part of the monitoring plan (see Chapter 7 of this HCP), likewise represent a substantial monetary commitment by FGS.

As described above and in Chapter 6 of this HCP, the Covered Activities are not expected to alter the important watershed processes and products to the extent that they result in substantial adverse impacts to the aquatic Covered Species at the local or regional (ESU) level. Implementation of the conservation measures in the Aquatic Species Conservation Program will avoid or minimize these potential impacts and mitigate the impacts of any incidental take by providing beneficial effects on water temperatures, LWD recruitment, and sediment delivery over the term of the Permits. Additional investment or even more restrictive measures would provide only a marginal increase in the level of protection and could compromise FGS's ability to sustainably manage the forest stands on its ownership. Thus the Aquatic Species Conservation Program represents the maximum extent practicable for FGS to implement on its ownership.

9.2.2.2 Terrestrial Species Conservation Program (Northern Spotted Owl)

The northern spotted owl mitigation strategy proposed in this HCP differs from other HCPs for northern spotted owls in northern California. Some HCPs, such as those on the northern California coast (e.g., PALCO, Green Diamond), are based on northern spotted owl reproductive performance, while the mitigation strategy in this HCP is based on strategic habitat retention. The primary reason for the differences in approach is that northern spotted owls in the California's North Coast Region depend heavily on private lands for nesting habitat due to a lack of federal reserve land in the region. The interior Klamath Region where the FGS ownership is located, in contrast, has a relatively large amount of federal land. The FGS ownership is surrounded and intermixed with federal lands that are mandated to be managed for the northern spotted owl as part of the Northwest Forest Plan (i.e., in Late-Successional Reserves). Therefore, there is less reliance on private lands for nesting habitat in the federal conservation strategy in the interior Klamath Region. Within the Plan Area, FGS lands in CSAs will provide demographic support to northern spotted owls nesting on federal lands by providing suitable (primarily foraging) habitat around activity centers with high conservation value.

The Terrestrial Species Conservation Program within this HCP includes measures for northern spotted owls that are designed to avoid or minimize the impacts of the Covered Activities on northern spotted owls. The conservation measures described in Chapter 5 are designed to address the specific biological requirements of northern spotted owls by meeting several biological objectives, and to be manageable and enforceable. The following describes the adequacy of the conservation measures and why the conservation program represents the maximum that can be practicably implemented.

Meeting the Biological Objectives

Objective 1: Demographic Support. Consistent with the Revised Recovery Plan for Northern Spotted Owl (USFWS 2011), the HCP will contribute to northern spotted owl conservation in the region by providing demographic support to owls on nearby federal lands through the establishment of 24 CSAs on the FGS ownership. The CSAs correspond to activity centers with high potential for contribution to owl conservation in the region, and provide foraging opportunities for owls nesting in CHUs and other federal lands adjacent to the FGS ownership. Suitable habitat on the FGS ownership around these activity centers is necessary for the continued viability of the activity centers. Of the 24 CSAs, 18 are located on or within 0.5 mile of a designated CHU. The remaining five are not within 0.5 mile of a CHU, but have a high conservation value because they provide, or have the potential to provide, strategic connectivity to other activity centers across the landscape.

In general, the CSAs will be established around activity centers that provide the highest level of demographic support (i.e., "conservation value") to the federal conservation strategy. A description of how the conservation value was calculated and derived is provided in Chapter 6 of this HCP. In summary, activity centers with the highest conservation value represent breeding pairs in close proximity to CHUs for northern spotted owl with a low percentage of private land in the home range and core area (i.e., high proportion of federal land), and a high probability of occupancy by northern spotted owls. These CSAs will protect habitat and provide support to activity centers that provide 55 percent of the total conservation value of all activity centers within the Area of Impact to mitigate the 18 percent reduction in conservation value of activity centers where incidental take is authorized under the HCP.

Objective 2: Riparian Management. Under the Aquatic Species Conservation Program, FGS will establish WLPZs to maintain and enhance riparian functions along Class I and II watercourses, retain snags and woody debris, and maintain stands in a mature state with high canopy coverage. The WLPZ measures will apply to nearly 6,200 acres of the Plan Area and result in an increase in the quality of foraging and dispersal habitat within riparian corridors as these stands age and grow over the term of the Permits. This aspect of the HCP will benefit northern spotted owls by providing moderate- to high-quality foraging habitat within and dispersal opportunities through riparian corridors (WLPZs) across the FGS ownership. The WLPZs, in combination with the CSAs, provide foraging and dispersal opportunities for owls between watersheds, and promote connectivity among the local population of northern spotted owls.

Objective 3: Dispersal Habitat. Dispersal habitat consists of stands with adequate tree size and canopy closure to provide protection from avian predators and at least minimal foraging opportunities (USFWS 1992). Forsman et al. (2002) found that northern spotted owls could disperse through highly fragmented forest landscapes, yet the stand-level and landscape-level attributes of forests needed to facilitate successful dispersal have not been thoroughly evaluated (Buchanan 2004). The HCP will promote forest management practices that will increase the acres of suitable nesting, roosting and foraging habitat on the FGS ownership from around 40,000 acres currently (2005) to nearly 70,000 acres as stands age and grow over the Permit Term (see Figure 6-8 in Chapter 6). Specifically, this HCP will promote a heterogeneous forest landscape consisting of structure, edge, and diversity with minimal fragmentation. Because FGS will maintain a forested landscape on its ownership, the biological objective for dispersal habitat will be met and further action would not be necessary.

Objective 4: Incidental Take Minimization. Throughout the Permit Term, FGS will minimize the potential for disturbance-related incidental take of nesting northern spotted owls by restricting timber operations within 0.25 mile of active northern spotted owl nest sites during the breeding season (February 1 through August 31). These measures, which are consistent with the CFPRs, will adequately minimize the potential for disturbance of nesting northern spotted owls in the vicinity of the operations. By implementing measures that: (1) help ensure that owls actively nesting on or within 0.25 mile of FGS's proposed harvest activities are located prior to harvest; and (2) restrict timber harvest within 0.25 mile of the nest site until after the breeding season, potential disturbance of nesting birds would be minimized, thereby minimizing potential impacts to the reproductive contribution of these birds to the local population.

Objective 5: Threat Management. The threat of high severity wildfire (i.e., fire that substantially alters stand structure) that results in loss of habitat for northern spotted owl on federal lands continues to be a concern in the Area of Impact. The Terrestrial Species Conservation Program addresses this threat by providing habitat on FGS ownership within CSAs that correspond to activity centers on federal lands with a high conservation value. The majority of the CSAs established on the FGS ownership are within 0.5 mile of a CHU. Northern spotted owls are known to forage most heavily within proximity to the nest (0.5 mile or less). In the event of wildfire within a CHU, northern spotted owls on federal lands may rely more heavily on habitat on the nearby FGS ownership.

Under the HCP, FGS will manage against catastrophic wildfire on its ownership within the CSAs by implementing stocking control and fuels management. The objective of fuels management in a forest setting is to control potential flame length and spread rate of ground fires, and to control ladder fuels. This is accomplished through practicable silvicultural treatments to control stocking and, more important, fuelbed characteristics, in particular fine fuels loading from slash and vegetation.

It is in FGS's best interest to reduce the threat of wildfire on its land. The fire reduction practices it performs serve to protect its investment, while at the same time help ensure the long-term viability of habitat for northern spotted owls. Additional measures to reduce the threat of wildfire would not be necessary and additional fuel management activities could impair the quality of habitat for northern spotted owls.

In addition, displacement of northern spotted owls by barred owls is an increasing concern in the Area of Impact. Under the HCP, FGS will support federal efforts to manage this threat by monitoring for barred owls in the CSAs. If detected, FGS will work with the USFWS to implement barred owl control measures on the FGS ownership as deemed necessary by the USFWS.

Maximum that can be Practicably Implemented

As described above, the term "maximum extent practicable" typically requires consideration of two factors: (1) adequacy of the minimization and mitigation program, and (2) whether it is the maximum that can be practically implemented by the applicant (HCP Handbook, Section 7). The adequacy of the minimization and mitigation program included in the Terrestrial Species Conservation Program in meeting the biological objectives of the HCP is described above. In addition, the level of incidental take anticipated under this HCP is the result of habitat modification within the home ranges around 43 activity centers that, in total, provide 18 percent of the total conservation value provided by all of the activity centers within 1.3 miles of the FGS ownership (Area of Impact). This loss of habitat is offset by protection and maintenance of northern spotted owl habitat in 24 CSAs that contribute 55 percent of the total conservation value (three times the conservation value that may be lost). Therefore, the level of mitigation is rationally related to the level of anticipated take. In combination, the conservation measures for northern spotted owl and the level of mitigation provided by the CSAs in the Terrestrial Species Conservation Strategy adequately minimize and mitigate the impact of the take of any individual owls on the overall northern spotted owl population at the local, regional, and range-wide scales.

Practicability also should include consideration of the benefit to Covered Species that would be provided by additional economic investment (i.e., the biological value of the next increment of mitigation relative to the economic cost of implementation). The marginal value of additional mitigation sites is evaluated below by comparing the "benefit-cost" ratio, which is the ratio of conservation value to FGS acreage where activities would be restricted (i.e., in the home range) for each activity center. As shown in Figure 9-1, the mitigation sites generally provide the highest benefit-cost ratio (high conservation value per FGS acre in the home range) and that the ratio decreases rapidly once the highest value activity centers are protected. Only the "Mitigation" (M) and "Take" (T) sites are included in this analysis because the activity centers where take is "Not Likely" (N) would not be significantly altered by FGS activities (see Chapter 6). The benefit-cost ratio of the take sites is substantially lower than most of the mitigation sites and decreases rapidly, approaching zero for the 10 lowest ranking activity centers. Results of this benefit-cost analysis indicate that protecting additional activity centers by establishing more CSAs would provide little additional biological value and would entail progressively higher costs to FGS.

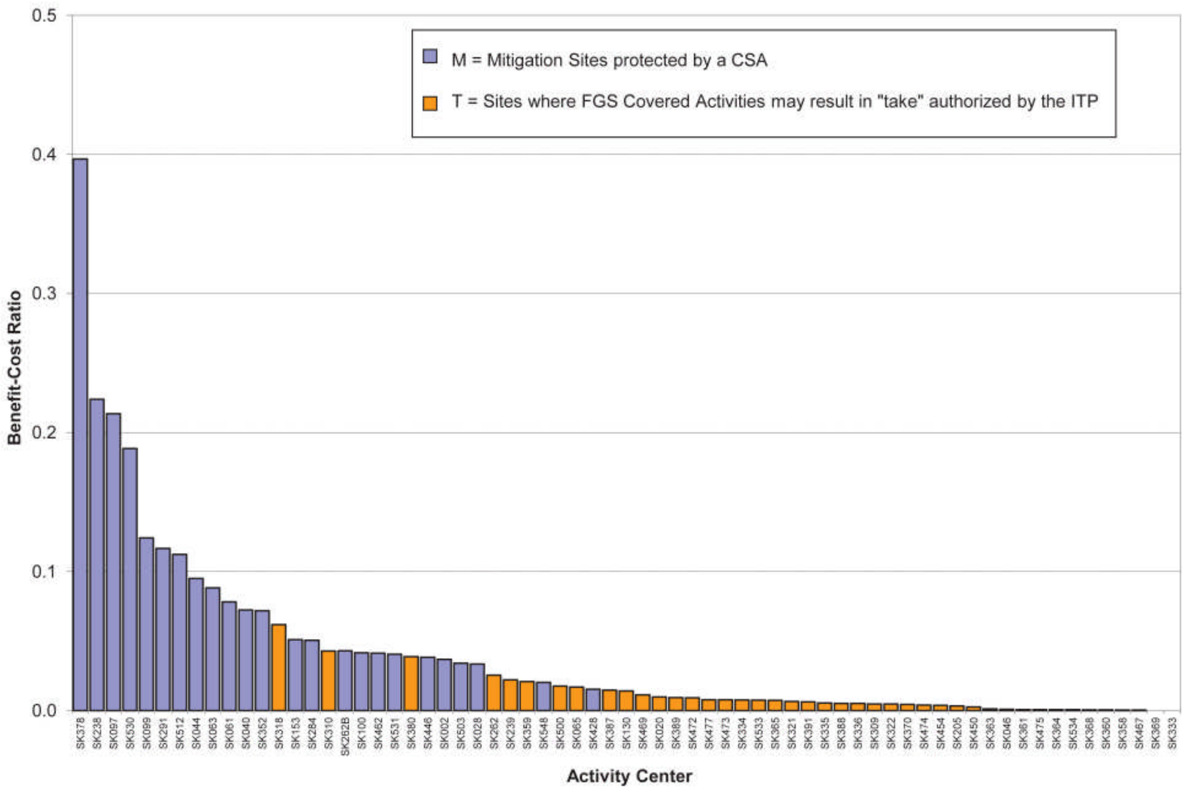

FIGURE 9-1
Benefit-Cost Ratio for Activity Centers on the Mitigation and Take Lists

The level of mitigation (24 CSAs) under the HCP represents the maximum that is practicable for FGS to implement because any additional acreage managed as CSAs around other activity centers would add little to the overall conservation value of mitigation sites and would add substantially to the economic cost of mitigation (i.e., amount of the ownership encumbered in CSA home ranges). In addition, providing additional CSAs could compromise the long-term sustainability of forest management in the Plan Area by unnecessarily restricting timber harvest in these areas. By restricting the volume that is currently scheduled for harvest, FGS would be forced to harvest elsewhere in the Plan Area to generate the needed timber volume. This would disrupt the planned harvest schedule and would reduce the sustainable harvest level by effectively reducing the size-class of the harvested stands. As the average tree size decreases, the volume per tree and per acre also decreases such that FGS would be forced to harvest more acres to reach a volume that yields a financially viable level of return.

In addition, nearly 10,000 acres within WLPZs and ELZs will be maintained in a vegetative condition that provides suitable foraging habitat for northern spotted owls. Timber harvest and other related activities will be severely restricted within the CSAs and WLPZs over the 50-year term of the Permits. This acreage collectively encumbers roughly 6 percent of the FGS ownership in long-term habitat commitments. Additional WLPZ or CSA acreage with restricted harvest would not result in substantial additional benefits to northern spotted owls and would place a substantial economic burden on FGS.

9.2.2.3 Terrestrial Species Conservation Program (Yreka Phlox)

The Terrestrial Species Conservation Program (Chapter 5) includes conservation measures designed to avoid adverse effects to Yreka phlox and additional measures to protect known and discovered populations of Yreka phlox on the FGS ownership through monitoring and development of management plans for each protected population. Collectively, these measures will effectively avoid adverse impacts to Yreka phlox resulting from Covered Activities and additional measures are not necessary.

9.2.3 Funding

FGS is committed to expend the necessary funds to fulfill its obligations under the plan. HCP Section 8.3 describes the various financial and reporting commitments required from FGS by the Services to provide the ESA-mandated assurances that adequate funding for the plan will be provided. These commitments will be implemented in accordance with the terms outlined in the IA.

FGS understands that failure to implement all of the actions required under this HCP for any reason, funding considerations or otherwise, could result in violation of the terms of the ITPs, and enforcement action, including penalties under ESA Section 9 and Section 11, and suspension or revocation of the ITPs.

9.2.4 Likelihood of Survival and Recovery

9.2.4.1 Aquatic Covered Species

The Aquatic Species Conservation Program within this HCP has been designed to avoid or minimize the impacts of the Covered Activities on watershed processes and products that affect the aquatic Covered Species indirectly through habitat alteration and by minimizing the potential for direct harm to these species during equipment operation at stream crossings and water drafting (see Chapter 5). Implementation of the HCP is anticipated to contribute to an improving trend in the quality of aquatic habitats over the term of the Permits. As described above and in Chapter 6, the measures included in the Aquatic Species Conservation Program effectively avoid or minimize adverse impacts on the aquatic Covered Species and contribute to meeting the biological objectives. The impacts of any incidental taking on the local and regional (ESU) populations of aquatic Covered Species are anticipated to be minimal. Therefore, FGS believes that its forest management activities, including implementation of the HCP, will not appreciably reduce the likelihood of the survival and recovery of these species in the wild.

9.2.4.2 Northern Spotted Owl

The conservation and mitigation measures for northern spotted owls included in the Terrestrial Species Conservation Program (described in Chapter 5) have been designed to avoid or minimize and mitigate the impacts of the Covered Activities on northern spotted owls. The conservation program does this, in part, by contributing to and supporting the federal conservation efforts for northern spotted owls. The contribution to federal conservation efforts is a significant element of this HCP, as over half of the lands within the Area of Analysis are administered by federal agencies, and much of the federal land is adjacent to the FGS ownership.

There are approximately 142,000 acres of suitable northern spotted owl nesting/roosting and foraging habitat currently mapped in the California Klamath Province Area of Impact and approximately 572,000 acres of currently suitable habitat for northern spotted owl in the California Klamath Province Area of Analysis. The FGS ownership includes about 40,000 acres of the currently suitable habitat for northern spotted owl in the California Klamath Province. Over the term of the Permits, nearly all of the currently available habitat for northern spotted owl in the Plan Area could be harvested, with the exception of approximately 7,100 acres which are protected in CSAs. It is anticipated that the majority of timber harvest in the Plan Area that may affect currently suitable northern spotted owl habitat will occur in the first 10 years of the HCP. During this first decade, the amount of northern spotted owl habitat that would be modified as a result of FGS's harvest activities is estimated to be 20,700 acres, representing 14.6 percent of the currently suitable northern spotted owl habitat in the Area of Impact and 3.6 percent of the currently suitable northern spotted owl habitat in the Area of Analysis (as determined using the 2005 USFWS/FGS northern spotted owl habitat layer) within the California Klamath Province. As described in Chapter 6, this short-term reduction in suitable habitat could result in the incidental take of individual northern spotted owls.

Incidental take of northern spotted owl at the local population level will be mitigated by establishing CSAs around northern spotted owl activity centers with high potential to contribute to the federal conservation strategy for northern spotted owl. The majority of northern spotted owls likely to be incidentally taken over the term of the Permits are from activity centers that have relatively low conservation value. The Terrestrial Species Conservation Program mitigates the impact of the take with long-term commitments by FGS to manage for suitable northern spotted owl habitat in 24 CSAs that provide approximately three times the conservation value that would be lost due to habitat modification within the home ranges around the 43 activity centers where incidental take is authorized (see Chapter 6).

Within the Area of Impact, there are several federally designated CHUs (and subunits) for the northern spotted owl. The proximity of these CHUs to the FGS ownership presents an opportunity for FGS, through the HCP, to contribute directly to the federal conservation strategy for northern spotted owl. Utilizing the impact evaluation matrix (see Chapter 6, subsection 6.2.1.3 D), individual activity centers were selected to maximize the conservation potential of FGS timberlands in supporting the federal conservation strategy. This approach not only minimizes the impacts of the incidental taking on the species, but contributes to the conservation and recovery of the species by providing demographic support to those activity centers with the highest conservation value.

In addition, implementation of the HCP is anticipated to result in an increasing trend in the amount of suitable habitat for the northern spotted owl in the Plan Area over the term of the Permits (see Figure 6-8 in Chapter 6). This increase in the amount of potentially suitable habitat is expected to be accompanied by an increase in habitat quality as stands grow and mature. Together, the increase in habitat quantity and quality for northern spotted owls will contribute to demographic support of the federal conservation strategy for northern spotted owl.

Implementation of the HCP will avoid or minimize the potential for incidental take of northern spotted owls, mitigate the impacts of incidental take at the local population level, provide for an increase in the amount and quality of suitable habitat for northern spotted owls, and contribute demographic support to the federal conservation strategy. Therefore, FGS believes that its forest management activities under the HCP will not appreciably reduce the likelihood of the survival and recovery of this species in the wild.

9.2.4.3 Yreka Phlox

The Terrestrial Species Conservation Program (Chapter 5) includes conservation measures designed to avoid adverse effects to Yreka phlox and additional measures to protect known and discovered populations of Yreka phlox on the FGS ownership through monitoring and development of management plans for each protected population. Collectively, these measures will avoid adverse impacts to Yreka phlox resulting from Covered Activities and contribute to the federal conservation strategy for this species by:

- Surveying for and documenting currently unknown occurrences of Yreka phlox in areas on FGS lands with suitable soils and in areas identified by USFWS as having a high or moderate likelihood to support the species;
- Protecting known and discovered occurrences on the FGS ownership by establishing EEZs around each known or discovered occurrence to reduce external influences and allow for expansion of populations;
- Monitoring of known and discovered occurrences on the FGS ownership to provide information on species status, distribution, and threats, and contribute to development of local information that will aid in federal conservation efforts.
- Facilitating (e.g., through providing access to and across its ownership) implementation of invasive weed control measures, as necessary if invasive weeds are identified as a threat to known Yreka phlox populations in the Plan Area.
- Facilitating (e.g., through providing access to and across its ownership) efforts to reestablish Yreka phlox populations in the event that global climate change results in a range reduction of this species.

In summary, implementation of the HCP is anticipated to result in protection of Yreka phlox and its habitat over the term of the Permits and FGS's forest management activities are not anticipated to result in adverse effects to this species. Therefore, FGS's forest management activities, including implementation of the HCP, will not appreciably reduce the likelihood of the survival and recovery of Yreka phlox in the wild.

9.2.5 Other Measures and Assurances

As described above in Section 9.1, the conservation strategies described in Chapter 5 were developed in coordination with NMFS (Aquatic Covered Species) and the USFWS (Terrestrial Covered Species) to avoid or minimize incidental take and mitigate the impacts of any taking to the maximum extent practicable. As such, no additional measures are anticipated as being necessary or appropriate for purposes of the plan.

CHAPTER 10

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APPENDIX A

Methodology for the Development of the Northern Spotted Owl Habitat Base Layer

METHODOLOGY FOR THE DEVELOPMENT OF THE NORTHERN SPOTTED OWL HABITAT BASE LAYER FOR FRUIT GROWERS SUPPLY COMPANY'S HILT-SISKIYOU FOREST AND REGIONAL LANDSCAPES

Methods Report
November 2005

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METHODOLOGY FOR THE DEVELOPMENT OF THE NORTHERN SPOTTED OWL HABITAT BASE LAYER FOR FRUIT GROWERS SUPPLY COMPANY'S HILT-SISKIYOU FOREST AND REGIONAL LANDSCAPES

I. INTRODUCTION

A. Scope of the Project

The development of a current northern spotted owl (NSO) habitat layer is part of a series of steps in creating a habitat conservation plan (HCP) for the Fruit Growers Supply Company's (FGS) Hilt-Siskiyou Forest. This project is a cooperative effort between FGS and the U.S. Fish and Wildlife Service (FWS) to produce an accurate Geographic Information System (GIS) layer that correctly represents current NSO habitat for FGS's ownership and the regional area. Using a combination of local data sources and models, a habitat data layer has been derived for the HCP analysis area, which encompasses portions of Siskiyou, Shasta, and Trinity counties in California and Jackson, Josephine, and Klamath counties in Oregon. This derived data layer represents the most current and accurate NSO data layer for the project area.

This report describes the methodology and data sources used to develop the NSO data layer. Additional details can be obtained by contacting FGS.

B. Objectives

The need to locate, characterize, and quantify NSO habitat is a critical part of FGS's current and future forest management activities. Development of a reliable NSO habitat layer is a necessary element of the HCP in order to: 1) Characterize existing habitat conditions within the local area (termed the area of impact) and regional landscape (termed the area of analysis); 2) assess and quantify the effects of FGS's proposed actions over the life of the incidental take permit; and 3) develop conservations measures for NSO that will serve to mitigate the impacts of any taking. For the FGS HCP, the area of analysis has been defined as the area within a 20-mile radius of FGS's ownership.

Project objectives were designed to develop an accurate NSO base layer at a landscape level by using six existing data sources:

1.) FGS NSO habitat layer

2.) Klamath National Forest NSO habitat layer

3.) The United States Department of Agriculture (USDA) Forest Service data layer (Classification and Assessment with Landsat of Visible Ecological Groupings [CALVEG])

4.) Geographic Resource Solutions (GRS) Applegate digital vegetation layer

5.) Western Oregon Digital Image Project (WODIP) vegetation layer

6.) United States Geological Survey (USGS) 10-meter Digital Elevation Model (DEM)

C. Location of the Area of Analysis

The area of analysis was defined as the area within a 20-mile radius of FGS's ownership. Figure 1a in the appendix provides a map of the project area. The project area is approximately 4.1 million acres in size, and contains 98 percent of the FGS Hilt-Siskiyou Forest. The area elevation ranges from approximately 1,000 to 14,000 feet above mean sea level, and encompasses approximately three ecological zones (Klamath Mountains, Western Cascades, and Southern Cascades).

Due to distinct differences in ecological characteristics, the area of analysis was divided into two processing zones: Eastern Klamath and Western Cascade. The Eastern Klamath encompasses approximately 2.9 million acres and the Western Cascade approximately 1.2 million. Figure 1b in the appendix provides a map of the two processing zones.

II. DATA SOURCES

A. Data Search

The first step consisted of locating accurate information that would cover the entire area of analysis. The data layers currently available include:

1. FGS NSO habitat layer
2. Klamath National Forest NSO habitat layer
3. USDA Forest Service CVEG data layer (CALVEG)
4. GRS Applegate digital vegetation layer
5. WODIP vegetation layer
6. USGS 10-meter DEM

FGS NSO habitat layer

FGS and FWS personnel agreed that the best habitat data available for FGS ownership would be the FGS NSO habitat layer. These data are derived from the FGS inventory and cover the entire Hilt-Siskiyou forest. The data have been field verified for accuracy and are current through post-harvest 2005. The layer provides Wildlife Habitat Relationship (WHR) attributes that are derived from forest stand characteristics, such as species, basal area, and quadratic mean diameter. The WHR attributes are then ascribed value as non-habitat, foraging habitat, or nesting/roosting habitat. The WHR attributes associated with each of the three NSO habitat classes are presented below:

- Nesting/Roosting 4M, 4D, 5M, 5D, 6
- Foraging 4P, 4M, 5P
- Non-Habitat All remaining WHR

That 4M is identified as both foraging and nesting/roosting habitat reflects the range of variability in canopy cover in size class 4 and the resolution of the FGS inventory; 4M is not generally considered nesting/roosting habitat because canopy cover is <60 percent. However, many class 4M stands in the forest inventory may have areas of higher canopy cover and, based on field verification and photo interpretation of areas within 1.3 miles of timber harvest plans (THP) and adjacent NSO activity centers, are used as nesting/roosting habitat by owls. Likewise, stands mapped as WHR classes 4M and 4D in the forest inventory may include small patches of classes 5M, 5D, and 6.

This data layer was inspected by FWS and refined based on field verification and photo-interpretation for areas within 1.3 miles of timber harvest plans (THP) and adjacent NSO activity centers. Updates were made to areas that were mistyped to ensure that current conditions were accurately reflected. A sample of the FGS NSO habitat layer is presented in Metadata 2a in the appendix.

Klamath National Forest NSO habitat layer

This data source is forest-wide coverage of NSO habitat with the most recent update completed in 2003. Habitat classes include nesting/roosting, foraging, dispersal, and non-suitable habitat. The habitat layer is derived from the Klamath National Forest vegetation layer, which includes data on elevation, aspect, tree species, size, and density. Information pertaining to this data layer is presented in Metadata 2b in the appendix.

After comparison with FGS 2001 aerial photography of the landscape at a scale of 1 inch equals 1,000 feet (1:12,000), and working knowledge of the data layer, FWS concluded that the data layer is suitable for use on lands not covered by FGS in the Eastern Klamath ecological zone. FWS concluded, however, that the layer's accuracy is not sufficient to adequately characterize the Western Cascade ecological zone and, therefore, should not be used and would be excluded from this zone.

USDA Forest Service CVEG data layer (CALVEG)

The CALVEG classification system is a California-wide system developed by the USDA Forest Service, Region 5, to serve as a standard for existing vegetation maps. CALVEG is a regional project used for planning and assessment and other natural resource applications. This data source is a seamless vegetation layer, which means the extent encompasses the entire landscape including all ownerships. CALVEG was derived from 1994 Landsat Thematic Mapper (TM) satellite imagery. It was most recently updated in 1998. The layer includes species, size, and density information that can be used to derive NSO habitat. The vegetation information from this layer was grouped to the species, size, and density parameters of the USDA Forest Service Timber Type classifications in order to derive NSO habitat through the Zabel crosswalk. Further details of these procedures will be discussed in the methods section. Source information for these metadata is presented in Metadata 2c in the appendix.

GRS Applegate Digital Vegetation Layer

This was a cooperative mapping effort between the USDA Forest Service and Bureau of Land Management for the Applegate River watershed in Southern Oregon. Geographic Resource Solutions of Arcata, California, produced the layer. The data layer was derived from Landsat TM satellite imagery, DEMs, and measured field data. The final database has estimated vegetation attributes (species, size, and canopy closure) that were used to group into USDA Forest Timber Type classifications in order to derive NSO habitat through the Zabel crosswalk. Further details of these procedures will be discussed in the methods section. Contact information regarding this dataset is provided in the appendix.

WODIP Vegetation Layer

This Bureau of Land Management mapping project was derived from 1993 Landsat TM satellite imagery. The data provides vegetation for Western Oregon and is being used for resource analysis by the Bureau of Land Management and USDA Forest Service. This project was developed by AverStar Inc., and was produced in two phases. Phase I was to produce a general landcover map of water, urban/agriculture, non-forest vegetation, barren, and forest vegetation. Phase II further refined the forest vegetation into specific tree information classes. The WODIP tree species, tree size, and tree crown closure were grouped into USDA Forest Timber Type classifications in order to derive NSO habitat through the Zabel crosswalk. The information for the WODIP zones that intersect the HCP area of interest are cascade, Illinois river drainage, Upper Klamath river drainage, and the Middle Rogue river drainage. Further details of these procedures will be discussed in the methods section. Contact information pertaining to this data layer is provided in the appendix.

USGS 10-meter DEM

Elevation and aspect variables are part of the inputs required for the Zabel habitat model. FGS compiled 75, 7.5-minute USGS 10-meter DEM quadrangles to cover the extent of this surface requirement. Additional elevation and aspect information (90-meter) was used to cover the entire area of interest. Klamath National Forest provided this information.

III. METHODS

A. CALVEG NSO Habitat Modeling

The objective of this step was to produce a seamless NSO habitat layer of the area of analysis and area of impact. As previously mentioned in the data source section, the FGS and Klamath National Forest NSO habitat data sources were completed prior to this project. CALVEG does not include NSO habitat, but does have the vegetation information to classify these NSO categories (non, foraging, and nesting/roosting). CALVEG NSO habitat was modeled within various ecological zones using the methods described in Zabel 2003a and Zabel 2003b. Parameter descriptions associated with foraging habitat within each ecological zone are presented in Model 3a in the appendix, while parameters associated with nesting/roosting habitat within each ecological zone are presented in Model 3b in the appendix. The steps involved in NSO habitat modeling include data preparation, classifying NSO habitat, data review, and data refinement. These steps are described in the following paragraphs.

1. CALVEG Data Preparation

The CALVEG data layer is a vegetation layer with information including species, size, and density. These vegetation attributes are three of the five inputs required by the Zabel foraging and nest/roosting models. The Zabel model's species, size, and density inputs are based on the USDA Forest Service Timber Type classification. CALVEG vegetation categories differ from the Forest Service classification system, which required that FGS convert the CALVEG species, size, and density to Forest Service timber type classification. (Refer to Metadata 2c). Elevation and aspect information (derived from USGS DEM) was also added to the dataset to meet the requirements of the Zabel foraging and nesting/roosting models. Once these additions and conversions were added to the CALVEG dataset, the Zabel NSO habitat model was preformed.

2. Initial NSO Habitat Model Outputs

Initial Zabel NSO habitat model results were then compared to Klamath National Forest NSO habitat results on intersecting areas within the area of analysis in order to assess differences and similarities of the two layers. This comparison was used to verify if the initial Zabel model results adequately represented NSO habitat at a site-specific level, and if any adjustments would have to be made to the CALVEG data layer. The Klamath National Forest layer has been well tested and is a good landscape data source available for the area of interest; for this reason, the layer was considered as the reference layer. Table 3a in the appendix contains the results of this comparison. Two additional assessments were preformed on the Eastern Klamath and Western Cascade ecological zones. These results are presented in Table 3b and 3c in the appendix.

FWS personnel also reviewed the initial NSO habitat output for site-specific areas using 2001 1:12,000 aerial photography. They concluded that CALVEG, with a few site specific adjustments, accurately characterized forest conditions within the Eastern Klamath ecological zone. The review showed that the accuracy was lower in the Western Cascades, but still considered acceptable.

3. CALVEG Data Refinements

To improve the accuracy of the NSO habitat layer, FGS and FWS agreed to make four global adjustments to the CALVEG dataset:

a.) A CALVEG size class of 4 with a CALVEG density class of 6 or 7 is considered NSO foraging habitat.

b.) A CALVEG size class of 3 with a CALVEG density class of 4 or 5 is not considered NSO habitat.

c.) A CALVEG size class of 3 with a CALVEG density class of 8 or 9 located on a south-facing aspect is not considered NSO habitat.

d.) A CALVEG size class of 3 with a CALVEG density class of 8 or 9 and located on any aspect other than south-facing is considered NSO foraging habitat.

FGS personnel applied these CALVEG refinements to the Zabel NSO habitat model to produce new output. FGS and FWS then performed a validation process in which the NSO habitat layer was reviewed against FGS aerial photography for several areas through the area of analysis. FWS and FGS staff agreed that this output preformed well in characterizing existing conditions and could be combined with the other data sources to produce a seamless NSO habitat layer.

B. Southern Oregon Habitat Modeling

GRS Applegate digital vegetation layer and WODIP vegetation layer were used to cover the remaining gaps located in Southern Oregon within the entire 20-mile impact area. The process to model habitat emulates the same methods used for the CALVEG dataset.

1. GRS Applegate Digital Vegetation Layer

The extent of the GRS dataset is the Applegate river drainage and was used to fill the majority of the drainage that is outside of the Klamath National Forest. The GRS dataset species information lacks the refinement of the CALVEG but is the best landscape level layer available for this region. The first step in producing NSO habitat from this vegetation dataset was to crosswalk the required vegetation categories into the USDA Forest Service classification (see table below).

GRS –Species	USDA Forest Service –Species
MC -Mixed Conifer	Mixed Conifer
TF-True Fir	White Fir
GRS –Size (dbh*)-	**USDA Forest Service –Size (dbh*)**
3 (9”-12.9”)	2 (9.8”-11.4”)
4 (13”-16.9”)	3 (11.5”-16.9”)
5 (17”-20.9”)	4 (17.0”-23.5”)
6 (21”-25.9”)	4 (17.0”23.5”)
7 (26”-31.9”)	5 (23.6”-35.4”)
8 (32”+)	6 (35.5”+)
GRS -Crown Closure	**USDA Forest Service –Canopy Cover**
4 (40-49%)	P
5 (50-59%)	P
6 (60-69%)	N
7 (70-79%)	N
8 (80-89%)	G
9 (90-100%)	G

* dbh=diameter at breast height

The above groupings were developed by FGS and FWS and used to model NSO habitat. The recoded vegetation classes were used in combination with elevation and aspect information to delineate NSO habitat with the Zabel model (Eastern Klamath model).

To improve the accuracy of the derived NSO habitat classes, FGS and FWS agreed to make four global data refinements to the GRS dataset:

a.) GRS size class of 5 or 6 with a GRS crown closure class of 6 or 7 is considered NSO foraging habitat.

b.) GRS size class of 4 with a GRS crown closure class of 4 or 5 is not considered NSO habitat.

c.) GRS size class of 4 with a GRS crown closure class of 8 or 9 located on south-facing aspect is not considered NSO habitat.

d.) GRS size class of 4 with a GRS crown closure class of 8 or 9 located on any aspect other than south-facing is considered NSO foraging habitat.

FGS personnel applied these GRS data refinements to the Zabel NSO habitat model to produce new outputs. FGS and FWS examined the results with Bureau of Land Management aerial photographs and USDA Forest Service NSO point locations. The resulting review showed that the GRS Applegate vegetation is suitable for defining NSO habitat for the 20-mile impact area.

2. WODIP Vegetation Layer

The remaining gaps located in the Southern Oregon portion of the 20-mile impact area were filled with the WODIP vegetation dataset. The WODIP dataset species and size information is coarse and has lower refinement than the CALVEG and GRS vegetation layers, but again, this dataset offered the most complete coverage of the remaining portions of the 20 mile impact area. The first step in producing NSO habitat from this vegetation dataset was to crosswalk the required vegetation categories into the USDA Forest Service classification (see table below).

WODIP –Species	**USDA Forest Service –Species**
Conifer	Mixed Conifer
WODIP –Size (dbh*)	**USDA Forest Service –Size (dbh*)**
2 (10”-19”)	3 (11.5”-16.9”)
3 (20”-29”)	4 (17.0”-23.5”)
4 (30”+)	5 (23.6”-35.4”)
WODIP –Crown Closure	**USDA Forest Service –Canopy Cover**
45% (40-49%)	P
55% (50-59%)	P
65% (60-69%)	N
75% (70-79%)	N
85% (80-89%)	G
95% (90-100%)	G

* dbh=diameter at breast height

The above groupings were developed by FGS and FWS and used to model NSO habitat. The recoded vegetation classes were used in combination with elevation and aspect information, and divided by ecological region to delineate NSO habitat with the Zabel model.

To improve the accuracy of the derived NSO habitat classes, FGS and FWS agreed to make four global data refinements to the WODIP dataset:

a) WODIP size class of 3 with a WODIP crown closure class of 65 percent or 75 percent is considered NSO foraging habitat.

b.) WODIP size class of 2 with a WODIP crown closure class of 45 percent or 55 percent is not considered NSO habitat.

c.) WODIP size class of 2 with a WODIP crown closure class of 85 percent or 95 percent located on south-facing aspect is not considered NSO habitat.

d.) WODIP size class of 2 with a WODIP crown closure class of 85 percent or 95 percent located on any aspect other than south-facing is considered NSO foraging habitat.

FGS personnel applied these WODIP data refinements to the Zabel NSO habitat model to produce new outputs. The NSO habitat layer was reviewed with Bureau of Land Management photographs for approximately five locations. These locations showed the NSO habitat delineation to be accurate.

C. Development of Seamless NSO Habitat Layer

The area of analysis includes five distinct datasets all having NSO habitat types. The data layers needed to be combined to produce a seamless dataset. An order of priority (see table below) was established in which the FGS data layer was used first for both ecological zones. For the Eastern Klamath ecological zone, the Klamath National Forest data layer was then applied to remaining areas not covered by the FGS layer, and then the CALVEG NSO habitat layer was applied to areas not covered by the Klamath National Forest layer. FGS and FWS staff determined this prioritization after the validation step of evaluating the accuracy of each layer using field data and recent aerial photography. The FGS NSO habitat layer is the most current and is tied to field verified inventory data. For this reason, the FGS dataset was given the highest priority in both ecological zones. The Klamath National Forest NSO habitat layer is derived from the USDA Forest Service vegetation dataset, and was most recently updated in 2003. The FWS assessment of the Klamath National Forest layer is that it is more accurate than the CALVEG layer in describing conditions in the Eastern Klamath ecological zone, but the Klamath National Forest layer does not accurately describe conditions in the Western Cascade ecological zone. As such, the CALVEG layer was used to describe the Western Cascade zone outside of FGS lands.

The remaining gaps in the dataset for both ecological zones were filled with the GRS NSO habitat layer and WODIP NSO habitat layer. The GRS digital vegetation layer has much more information available and was much more accurately crosswalk into the Zabel classification than WODIP. As a result the GRS NSO layer will have higher prior than the WODIP NSO layer. Figure 2 in the appendix shows the data layer priority for the area of interest.

Eastern Klamath Ecological Zone	Western Cascades Ecological Zone
1. FGS NSO habitat	1. FGS NSO habitat
2. Klamath National Forest NSO habitat	2. CALVEG NSO habitat
3. CALVEG NSO habitat	3. WODIP NSO habitat
4. GRS NSO habitat	
5. WODIP NSO habitat	

D. Layer Updates

Timber Products is the one of the largest industrial landowner in the area of analysis. Vegetation layer updates to Timber Products lands were applied to both the Klamath National Forest and CALVEG layers to ensure that recent changes in vegetation were captured in the dataset. The updates included THPs within the Eastern Klamath ecological zone for years 1994 to 2005. The 1994 through 2000 harvest information was downloaded digitally through the California Department of Forestry’s website.

Additional THPs covering years 2001 through 2005 were gathered from the California Department of Forestry Siskiyou Unit Office in Yreka, California. The THPs were obtained in hardcopy and digitized by FGS into a GIS format.

E. Current Status of Seamless NSO Habitat Layer

The NSO layer was completed December 2005 and is currently used as the "baseline" for current habitat conditions. The layer's foraging and nesting/roosting is a major input for predicting NSO percent occupancy, which is an important part for the analysis in development of the HCP.

APPENDIX

Figure 1a. Project area vicinity map

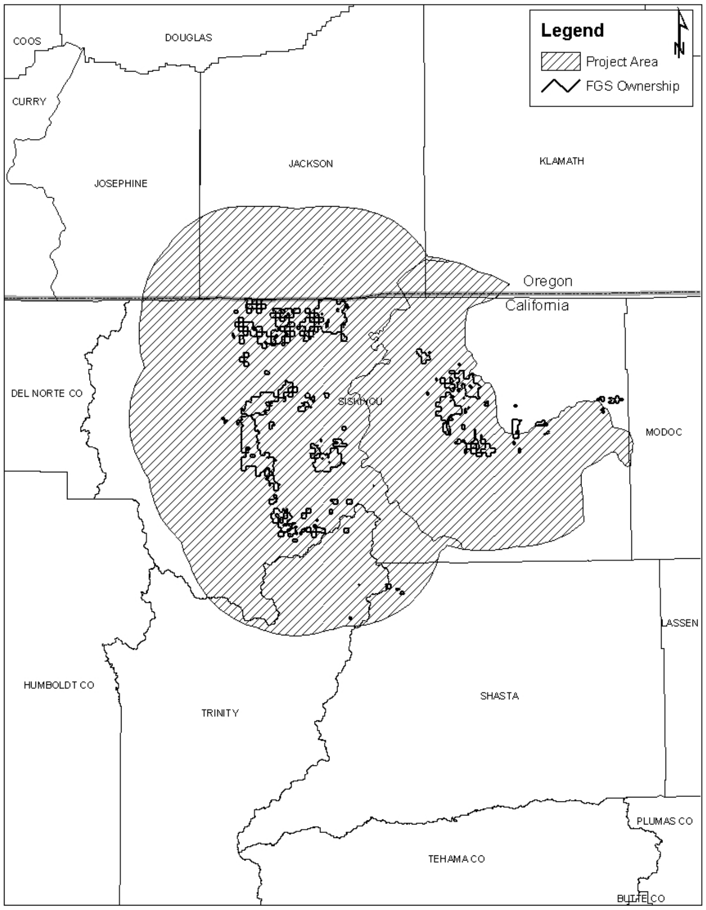

Figure 1b. Ecological zone map

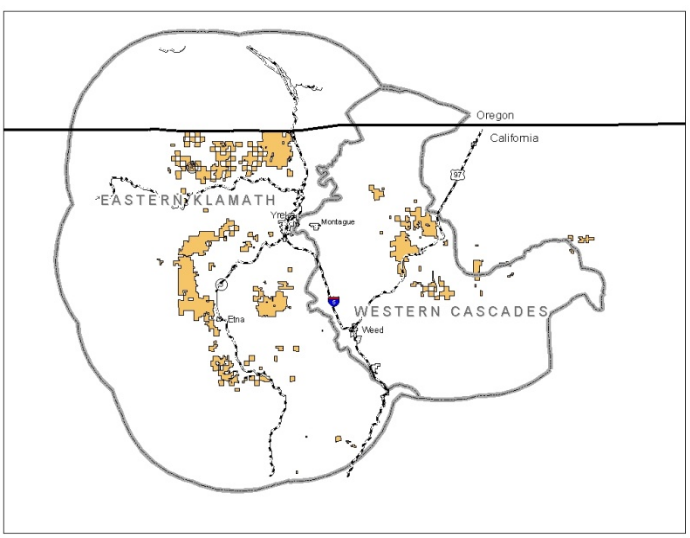

Figure 2. Data Priority Order

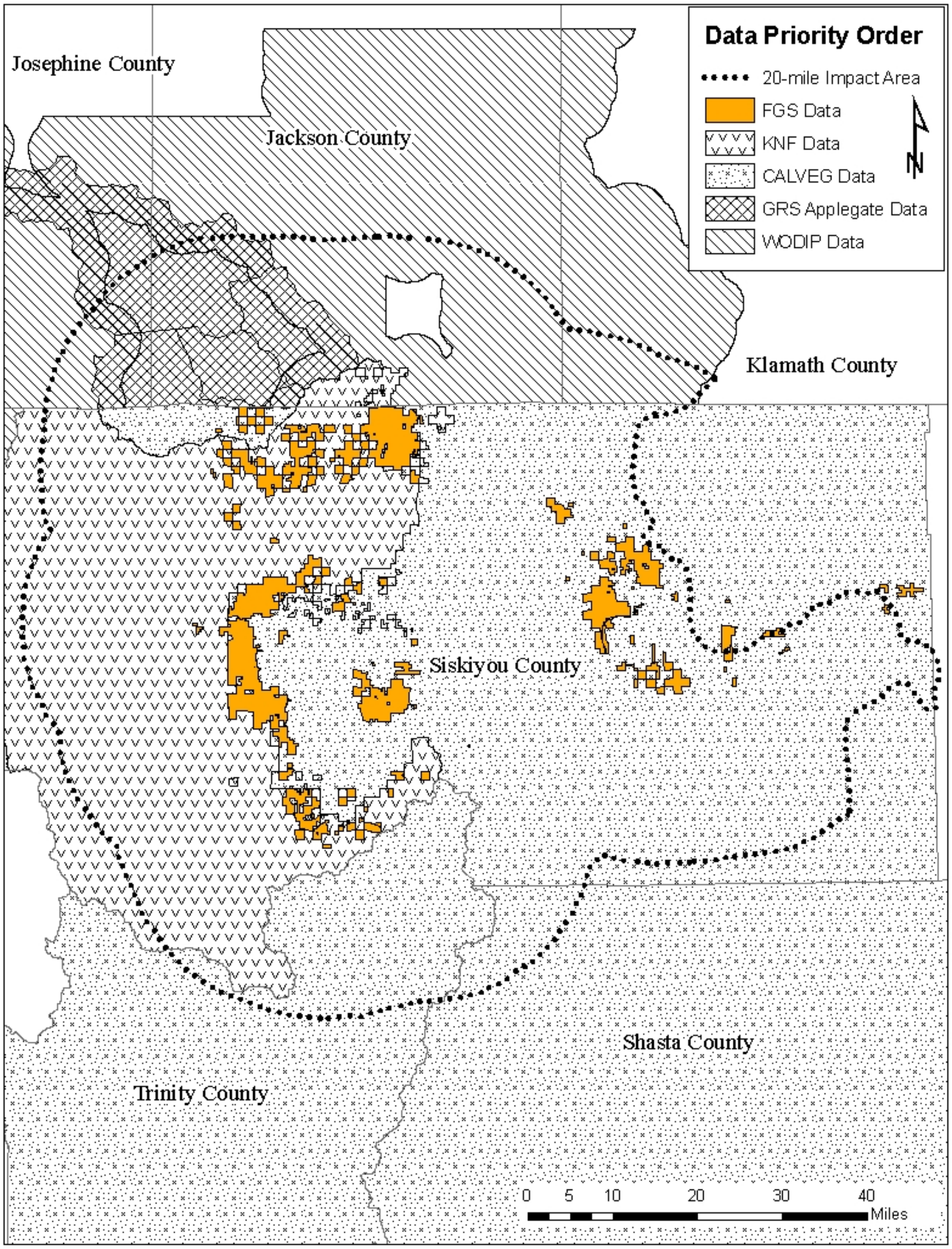

Table 3a. Accuracy assessment for project area

NSO Habitat	Non	Forage	Nest/Roost	Total Acres	Producer's Accuracy
Non	510624	58205	62752	631582	81%
Forage	53468	28035	35414	116917	24%
Nest/Roost	25047	13122	43388	81558	53%
Total Acres	589139	99363	141554	830057	
User's Accuracy	87%	28%	31%		**Overall Accuracy 70%**

Table 3b. Accuracy assessment for Eastern Klamath ecological zone

NSO Habitat	Non	Forage	Nest/Roost	Total Acres	Producer's Accuracy
Non	274465	28508	51055	354028	78%
Forage	42924	22479	32670	98073	23%
Nest/Roost	23669	12307	42343	78319	54%
Total Acres	341058	63307	126069	530420	
User's Accuracy	80%	36%	34%		**Overall Accuracy 64%**

Table 3c. Accuracy assessment for Western Cascade ecological zone

NSO Habitat	Non	Forage	Nest/Roost	Total Acres	Producer's Accuracy
Non	236144	29697	277536	277536	85%
Forage	10544	5556	18843	18843	29%
Nest/Roost	1378	816	3239	3239	32%
Total Acres	248066	15484	299618	299618	
User's Accuracy	95%	15%	7%		**Overall Accuracy 81%**

Model 3a. Zabel foraging habitat model

Ecological Archives A013-017-A2
Cynthia Z. Zabel, Jeffrey R. Dunk, Howard B. Stauffer, Lynn M. Roberts, Barry S. Mulder, and Adrienne Wright. 2003. Northern Spotted Owl habitat models for research and management application in California (USA). Ecological Applications 13:1027–1040.

Appendix B. New description of Northern Spotted Owl "foraging" (F) habitat by ecological zone in northern California (USA) developed for the USDA Forest Service Land Management Planning vegetation database.

Dbh class[‡]	**Canopy coverage class (%)**[‡]	**Ecological zone**[†]				
		Western Klamath	**Eastern Klamath**	**Western Cascades**	**Modoc**	**Interior Coast**
Habitat type[‡]						
Douglas-fir						
5	P	<4500': SR [‖] 4500–6000': ST, K[‖]	<4500': K[‖]			SR[§] 4500–6000': ST[‖]
4	P	0–4500': SR[‖] 4500–6000': ST, K[‖]	<4500': K[‖] <6000': ST[¶]			SR[§] 4500–6000': ST[‖]
3	G	<6000': SR, K				SR[§]
3	N	<4500': ALL 4500–6000': ALL[‖]	<4500': K 4500–6000': K[‖] <6000': ST[¶]			SR[§] <4500': ST 4500–6000': ST[‖]
3	P	<4500': ALL[‖]	<4500': ALL[‖]			SR[§] <4500': ST[‖]
2	G	<6000': ST, K[‖]	<4500': K[‖]			<6000': ST[‖]
Mixed conifer						
5	N			<6000': ALL	<6500': ALL	
5	P	<4500': SR[‖] 4500–6000': ST, K[‖]	<4500': K[‖]			SR[§] 4500–6000': ST[‖]
4	N			<6000': ALL	<6500': ALL	
4	P	<4500': SR[‖] 4500–6000': ST, K[‖]	<4500': K[‖] <6000': ST[¶]			4500–6000': ST[‖] M, SR[§]
3	G	<6000': SR, K		6000–7000': ALL	0-6500': ALL	SR[§]
3	N	<4500': ALL 4500–6000': ALL[‖]	<4500': K 4500–6000': K[‖] <6000': ST[¶]	<6000': ALL	<6500':ALL	SR[§] <4500': ST 4500–6000': ST[‖]
3	P	<4500': ALL[‖]	<4500': K[‖] <6000: ST[¶]			SR[§] <4500': ST[‖]
2	G	<6000': ST, K[‖]	<4500': K[‖]			<6000': ST[‖]
Ponderosa pine						
5	N			<6000': ALL	<6500': ALL	
5	P	4500–6000':	<4500': K[‖]			4500–6000':

		ST, K[‖]				ST[‖]
4	N			<6000': ALL	<6500': ALL	
4	P	4500–6000': ST, K[‖]	<4500': K[‖] <6000': ST[¶]			4500–6000': ST[‖]
3	G	4500–6000': SR, K		6000–7000': ALL	<6500': ALL	4500–6000': ST
3	N	4500–6000': ALL[‖]	<4500': K <6000': ST[¶]	<6000': ALL	<6500': ALL	4500–6000': ST[‖]
3	P		<4500': K [‖] <6000': ST[¶]			
2	G	4500–6000': ALL[‖]	<4500': K[‖]			<4500': ST 4500–6000': ST[‖]
White fir						
5	N			<6000': ALL	<6500': ALL	
4	N			<6000': ALL	<6500': ALL	
4	P		<6000': ST[¶]			
3	G			6000–7000': ALL	<6500': ALL	
3	N		<6000': ST[¶]	<6000': ALL	<6500': ALL	
3	P		<6000': ST[¶]			
Red fir						
5	N			<6000': ALL	<6500': ALL	
4	N			<6000': ALL	<6500': ALL	
4	P		<6000': ST[¶]			
4	X					M[§]
3	G			6000–7000': ALL	<6500': ALL	
3	N		4500–6000': K[‖] <6000': ST[¶]	<6000': ALL	<6500': ALL	
3	P		<6000': ST[¶]			
Conifer/Hardwood						
4	X					M[§]

Note: Elevations are shown in feet since it is the more prevalent unit used by federal and private land managers.

[†]Abbreviations are: SR = Six Rivers National Forest; ST = Shasta-Trinity National Forest; K = Klamath National Forest; M = Mendocino National Forest; ALL = all national forests within the ecological zone.

[‡]Habitat types are from 1980 USDA Forest Service Regional Timber Type classifications, updated with 1990–1995 Forest Inventory and Analysis plot data. Numbers represent tree diameters at breast height (dbh), and letters represent percent canopy cover. Tree size and canopy coverage classes were derived from U.S. Forest Service Regional Timber Type classification, but differ from those due to consideration of forest growth since the 1980 inventory, hardwood contribution to stand density and canopy coverage, and influence of stand origination type on current stand structure. Dbh classes are: 2 = 24.9 to 29.2 cm, 3 = 29.3 to 43.1 cm, 4 = 43.2 to 59.9 cm, 5 = 60.0 to 90.2 cm, 6 = >90.2 cm. Canopy coverage classes are: P = 40–59 percent, N = 60–79 percent, and G = 80–100 percent.

[§]All elevations.

[‖]Excluding all southerly aspects.
[¶]Dunning site class 3 on Shasta-Trinity National Forest only.

Model 3b. Zabel nesting/roosting habitat model

Ecological Archives A013-017-A1
Cynthia J. Zabel, Jeffrey R. Dunk, Howard B. Stauffer, Lynn M. Roberts, Barry S. Mulder, and Adrienne Wright. 2003. Northern Spotted Owl habitat models for research and management application in California (USA). Ecological Applications 13:1027–1040.

Appendix A. New descriptions of Northern Spotted Owl "nesting and roosting" (NR) habitat by ecological zone in northern California (USA) developed for the USDA Forest Service Land Management Planning vegetation database.

Dbh class[‡]	**Canopy coverage class (%)**[‡]	**Ecological zone**[†]				
		Western Klamath	**Eastern Klamath**	**Western Cascades**	**Modoc**	**Interior Coast**
Habitat type[‡]						
Douglas-fir						
6		<6000': ALL	<6000': ALL			SR[§]
5	G	<6000': ALL	<6000': ALL			SR[§]
5	N	<6000': ALL	<6000': ALL			SR[§]
5	P	<4500': ST, K, M[‖]				
4	G	<6000': ALl	<6000': ALL			SR[§]
4	N	<6000': ALL	<6000': ALL			SR[§]
4	P	<4500':ST, K, M[‖]				
3	G	<6000': ST	<6000': ALL			
Mixed conifer						
6		<6000': ALL	<6000': ALL	<6000': ALL	<6500': ALL	ALL[§]
5	G	<6000': ALL	<6000': ALL	<7000': ALL	<6500': ALL	ALL[§]
5	N	<6000': ALL	<6000': ALL			ALL[§]
5	P	<4500': ST, K, M[‖]				
4	G	<6000': ALL	<6000': ALL	<7000': ALL	<6500': ALL	ALL[§]
4	N	<6000': ALL	<6000': ALL			ALL[§]
4	P	<4500': ST, K, M[‖]				
3	G	<6000': ST	<6000': ALL	<6000': ALL		M[§]
Ponderosa pine						
6		<6000': ALL		<6000': ALL	<6500': ALL	
5	G	<6000': ALL		<7000': ALL	<6500': ALL	
5	N	<6000': ALL				
5	P	<4500': ST, K, M[‖]				
4	G	<6000': ALL		<7000': ALL	<6500': ALL	
4	N	<6000': ALL				
4	P	<4500': ST, K, M[‖]				
3	G	<6000': ST		<6000': ALL		
White fir						
6			<6000': ALL	<6000': ALL	<6500': ALL	

5	G		<6000': ALL	<7000': ALL	<6500': ALL	
5	N		<6000': ALL			
4	G		<6000': ALL	<7000': ALL	<6500': ALL	
4	N		<6000': ALL			
3	G		<6000': ALL	<6000': ALL		
Red fir						
6				<6000': ALL	<6500': ALL	
5	G			<7000': ALL	<6500': ALL	
4	G			<7000': ALL	<6500': ALL	
3	G			<6000': ALL		
Redwood						
5	G	<4500': SR				

Note: Elevations are shown in feet since it is the more prevalent unit used by federal and private land managers.

[†]Abbreviations are: SR = Six Rivers National Forest; ST = Shasta-Trinity National Forest; K = Klamath National Forest; M = Mendocino National Forest; ALL = all national forests within the ecological zone.

[‡]Habitat types are from 1980 USDA Forest Service Regional Timber Type classifications, updated with 1990–1995 Forest Inventory and Analysis plot data. Numbers represent tree diameters at breast height (dbh), and letters represent percent canopy cover. Tree size and canopy coverage classes were derived from U.S. Forest Service Regional Timber Type classification, but differ from those due to consideration of forest growth since the 1980 inventory, hardwood contribution to stand density and canopy coverage, and influence of stand origination type on current stand structure. Dbh classes are: 2 = 24.9 to 29.2 cm, 3 = 29.3 to 43.1 cm, 4 = 43.2 to 59.9 cm, 5 = 60.0 to 90.2 cm, 6 = >90.2 cm. Canopy coverage classes are: P = 40–59 percent, N = 60–79 percent, and G = 80–100 percent.

[§]All elevations.

[‖]Excluding all southerly aspects

Metadata 2a. FGS NSO habitat layer

Theme:	FGS NSO Habitat
Coverage Extent:	FGS Hilt-Siskiyou Forest
Source:	Derived layer
Last Update:	September 2005
Primary Feature Type:	Polygon
Data Resolution:	1:12,000
Projection:	UTM Zone 10
Comments:	Derived from FGS stand inventory and x-walked into Northern Spotted Owl habitat classification system.

Contact: Fruit Growers Supply Company
Resource Contact: Kelly Conner, and Jay Powell
Phone: 530-475-3453
Address: Fruit Growers Supply Company
1216 Fruit Growers Road
Hilt, CA 96044

System Software: Arc/Info

Table Name: .PAT

Item Name: owlhab Item Type: char Item Length: 5

Item Value	Description
Nest/Roost	Nesting/Roosting Habitat
Forage	Foraging Habitat
Non-Habitat	Non-Suitable Habitat

FGS NSO habitat (owlhab) is derived from the FGS forest inventory WHR. Wildlife-habitat relationships are produced by extracting inventoried forest stand information. The annually produced WHR field is then converted to NSO habitat.

Nesting/Roosting:	4M,4D,5M,5D,6
Foraging:	4P,5P,
Non-Habitat:	All remaining WHR

Revised 9/20/05

Metadata 2b. Klamath National Forest NSO habitat layer

Klamath National Forest
Geographic Information System
Theme Documentation

Revision Date:	July 2003
Theme:	Suitable Habitat for the Northern Spotted Owl
File Pathname:	/fsfiles/ref/library/gis/klamath/wildlife/owl_habitat
Disclaimer:	** The Klamath National Forest cannot assure the reliability or suitability of this information for a particular purpose. Original data was compiled from various sources. Spatial information may not meet National Map Accuracy Standards. This information may be updated without notification. **
Project Name:	KNF Base Layer

IDENTIFICATION INFORMATION

Coverage Extent:	Forest-wide
Source:	Derived layer
Last Update:	July 2003
Primary Feature Type:	Polygon
Other Feature Types:	
Distribution Limitations:	None
Data Resolution:	1:24000
Projection:	UTM Zone 10
Comments:	Derived from veg0495 using elevation, aspect, and size and density. See documentation at the end of this document.

SOURCE INFORMATION

Source System: LIDES/DWRIS (USFS Region 5 GIS)
Source Scale: 1:24000
Source Projection: UTM Zone 10
Capture Method: scanned and digitized

CUSTODIAN INFORMATION

Contact Organization: Klamath National Forest Supervisor's Office
Resource Contact: Julie Perrochet, T&E Species Coordinator
Phone: 530-842-6131 **Email:** jperrochet@fs.fed.us
Address: 1312 Fairlane Road
Yreka, CA 96097

GIS Contact: Dianne Torpin,
Klamath National Forest Supervisor's Office
GIS Staff

Phone: 530-842-6131 **Email:** dtorpin@fs.fed.us
Address: 1312 Fairlane Road
Yreka, CA 96097

PROCESSING INFORMATION

Theme Generation: See the macro */fsfiles/ref/gis/library/wildlife/aml/create_owl_hab.aml for detailed information on the creation of this layer.

Lineage: See */fsfiles/ref/gis/library/wildlife/aml for other layers associated with this coverage.

ATTRIBUTE INFORMATION

==

System Software: Arc/Info

Table Name: .PAT

==

Item Name: owl_habitat **Item Type:** char **Item Length:** 12

<u>**Item Value**</u>	<u>**Description**</u>
Nest/Roost	Nesting/Roosting Habitat
Forage	Foraging Habitat
Dispersal	Dispersal Habitat
Non-Habitat	Non-Suitable Habitat

The following are the rules used for inclusion of vegetation polygons as suitable nesting/roosting/foraging (NRF) habitat for NSO on the Klamath National Forest. The Forest has been divided into 4 general habitat zones, based on elevation, physiographic conditions, and dominant forest communities. The most important variable across these zones is the relative contribution of hardwood species in forest structure.

Douglas-fir Zone (Douglas-fir/Hardwood) (west-side HC UK SR):

Elevation:

>6000'	clip out all polygons	
4500-6000'	3G,4N,4G,5N,5G,6	3N,4P,5P,2G on azimuth 247.6-157.5
<4500'	3N,3G,4N,4G,5N,5G,6	3P,4P,5P,2G on azimuth 247.6-157.5

Rationale: This is the Klamath National Forest's lower-elevation habitats, dominated by DF-HDWD.

At low elevation, hardwoods form an important component of stand suitability, allowing stands with scattered conifer overstory to be suitable for NRF habitat. Below 4,500 feet, stands on south-southwest exposures tend to be hotter, drier and more open, therefore 3N, 4-5P, and 2G stands are only considered suitable on N-E slopes. Above 4,500 feet, hardwoods are less prevalent, and conifer density is a better indicator of stand suitability; therefore, 3N and 4P stands are suitable only on north slopes where hardwoods may still add to stand structure. Above 6,000 feet, stands are typically composed of true firs, with little or no hardwood structure. These stands are typically unsuitable for long-term NRF, but may be used by dispersers or short-term territorial floaters.

Douglas-fir/pine (Mixed Conifer) Zone (OK & SC)

Elevation:
>6000' clip out all polygons
4500-6000' 3G,4N,4G,5N,5G,6 3N,on azimuth 247.6-157.5
<4500' 3N,3G,4N,4G,5N,5G,6 3P,4P,5P,2G on azimuth 247.6-157.5

Rationale: Same as above for west-side, except that many habitats tend to be drier and more open, limiting available habitat particularly on S-W slopes. Many S-W slopes are brushfields with scattered pine or DF. Open stands 'P' are typically not suitable above 4,500 feet. Although some occupied territories have been located as high as 5,500 feet, they typically are in habitats similar to lower elevation (DF-WF), and likely utilize foraging habitat at or below the elevation of the nest stand (5,000 – 5,600 feet). Red fir/white fir stands above 6,000 feet are still considered unsuitable for long-term NRF.

Eastside Mixed Conifer (GNST)

Elevation:
>7000' clip out
6000-7000' 3G,4G,5G no PP, LPP, JP (except PPWF,PPDF,PPRF)
<6000' 3G,3N,4N,4G,5N,5G,6

Rationale: The Goosenest Ranger District lies in the California Cascades, and supports forest communities dramatically different from the west side of the Klamath National Forest.

Minimum elevation is about 4,500 feet, and slopes are typically gentle, reducing the effects of aspect. Forest communities typically do not support any hardwoods (some oak at extreme NW), therefore stand structure is conifer only. Eastside MC consists of Douglas-fir/WF/Incense cedar and ponderosa pine and is highly suitable for NRF, true fir habitats are typically suitable only at lower elevations (< 6,000 feet).

Eastside True Fir/Pine (GNST)

Elevation:
>6500' clip out
<6500' 3N,3G,4N,4G,5N,5G,6 no PP, LPP, JP (except PPWF,PPDF,PPRF)

Rationale: The eastern half of the Goosenest Ranger District is (was) dominated by ponderosa pine, grading into true fir communities at higher elevations. Douglas-fir is rarely found east of Hwy 97. Early railroad logging and fire suppression has resulted in a dramatic increase of white fir as a stand dominant, creating habitats used to some extent by owls for dispersing, and foraging by rarely-territorial floaters. Nesting attempts and long-term (>2 years) territorial singles are rare, and occurred in dense red fir/white fir OG. Definition of suitable NRF habitat in this area is problematic, and must include some aspect of proximity to dense late-successional habitat. Above 6,500 feet, late snowpack and low understory diversity limit habitat suitability of NRF habitat.

Edit Log

07/22/2003 -RAV

The original layer contained only polygons representing suitable nesting/roosting and forage habitat. Another layer (“NSO_dispersal”) contained dispersal habitat. Neither layer explicitly contained “non-habitat”. This update combined nesting/roosting, forage, dispersal, and non-habitat into a single layer to facilitate analysis procedures.

07/23/2003 – BLA

Updated by adding a Nest/Roost polygon in the tamarack timber sale area as field mapped by Christy Cheyne.

Metadata 2c. USDA Forest Service CVEG data layer (CALVEG)

Existing Vegetation
The existing vegetation map layer is the source for CALVEG types. The CALVEG Classification System is a statewide system developed by the USDA Forest Service in Region 5 to serve as a standard for existing vegetation maps. (USDA Forest Service. 1981. CALVEG: A Classification of California Vegetation. Pacific Southwest Region, Regional Ecology Group, San Francisco CA. 168 pp.). The following are the general mapping and classification rules for the existing vegetation layer.

Vegetation Mapping Criteria:

Minimum Mapping Size
2.5 acres for contrasting vegetation conditions based on vegetation type, tree canopy closure, and overstory tree size (see tables 38, 40, and 39) No minimum mapping unit for lakes and conifer plantations

Life Forms are initially generated from classification of Landsat Thematic Mapper imagery into the following hierarchical classes:
Conifer - greater than 10 percent conifer cover as the dominant type
Mix - greater than 10 percent tree cover and 20 to 90 percent hardwood cover
Hardwood - greater than 10 percent hardwood cover as the dominant type
Shrub - greater than 10 percent shrub cover as the dominant type
Grass - greater than 10 percent grass cover as the dominant type
Barren - less than 10 percent cover of any natural vegetation
Agriculture
Urban
Ice/snow
Water

Subsequently, the following items are mapped within Life Form classes: Vegetation Type (CALVEG). Rules have been developed by Vegetation Zone for setting parameters for CALVEG mapping. Complete CALVEG mapping keys can be obtained from the Remote Sensing Lab. Contact Hazel Gordon (916-454-0812) for specific Zone keys for the CALVEG classification system.

Tree Density: Conifer and hardwood tree density is mapped as a function of canopy closure in ten- percent classes. In conifer/hardwood mixtures, relative density of each is mapped as well as total tree canopy closure, with conifer tree density stored in item DENSITY, hardwood tree density stored in DENSITY2, and total tree density stored in DEN_TOTAL.

Overstory Tree Size: Overstory tree size is mapped as a function of crown diameters of overstory trees as interpreted from aerial photography and satellite imagery. The plurality size condition of the predominant, dominant, and co-dominant trees in a stand is assigned a Regional size class (tables 39A and 39B).

Additional Coverage Items:
Ecological Tile: The basic units used to store existing vegetation layers within a statewide existing vegetation library. Source is from

Goudey and Smith (1994), Ecological Units of California-Subsections (map), USDA Forest Service, Pacific Southwest Region, San Francisco CA. Scale 1:1,000,000. WHR Type, Size, Density, and Range: Corresponding parameters from the California Wildlife Habitat Relationships classification system. Northwest Size, Northwest Structure: Size and structural attributes specific to monitoring requirements for the Northwest Forest Plan and not present in Forest vegetation layers outside the Klamath Province.

FieldItem NameColumn WidthTypeValid Codes
Vegetation ZoneVEGZONE1NumericTable 36A
Ecological TileECOTILE3AlphaTable 36B
Vegetation Cover TypeCOVERTYPE3AlphaTable 37
Primary CALVEGVEGTYPE2 AlphaTable 38
Tree Size ClassSIZE1 AlphaTable 39A, 39B
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Tree Size ClassSIZE21Alpha39B
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Northwest SizeNWSIZE2AlphaTable 39C
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Table 38 - CALVEG Type
Fields in this table refer to the CALVEG classification system map classes. Vegtype (Regional Dominance Type) is a two-letter code designating primary (dominant) and secondary (understory hardwood in MIX cover types only) vegetation alliances. Vegtype codes apply to both the VEGTYPE and VEGTYPE2 themes in the CALVEG map products. Description is a short phrase that lists either the common vegetation name of the dominant vegetation alliance or the land-use category. Cover type is a three-letter code equivalent to cover types described in Table 37. Prod assigns a commercial productivity code to each mapped vegetation type. Timberland productivity for these codes is further described in Table 43.
Size = 3; Type = alpha

X-WALK TO USDA FOREST SERVICE SPECIES GROUPS

CALVEG VEGTYPE	DESCRIPTION	USFS SPECIES TYPE
DF	Douglas-Fir	Douglas-Fir
DP	Douglas-Fir – Pine	Douglas-Fir
DW	Douglas-Fir – White Fir	Douglas-Fir
EP	Eastside Pine	Ponderosa Pine
JP	Jeffery Pine	Ponderosa Pine
KP	Knobcone Pine	Ponderosa Pine
MF	Mixed Conifer – Fir	Mixed Conifer
MH	Mountain Hemlock	Red Fir
MK	Klamath Mixed Conifer	Mixed Conifer
MP	Mixed Pine	Mixed Conifer
MU	Ultramafic Mix Conifer	Mixed Conifer
PP	Ponderosa Pine	Ponderosa Pine
PW	Ponderosa Pine – WF	Ponderosa Pine
RF	Red Fir	Red Fir
SA	Subapline Conifer	Red Fir
WF	White Fir	White Fir

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Table 39A - Tree Size Class - Conifer Types
Size = 1; Type = alpha-numeric

Code	Tree Size	Description Average Visible Crown Dbh	FS SIZE TYPE
	Non-Stocked	(Areas Not Reforested)	0
0	Seedlings	(Derived From Plantation Age)	0
1	Saplings	(Derived From Plantation Age)	0
2	Poles	Crown Diameter Less Than 12 Feet	2
3	Small	Crown Diameter From 12 To 24 Feet	3
4	Medium	Crown Diameter From 24 To 40 Feet	4
5	Large	Crown Diameter Greater Than 40 Feet	5
X	Not Determined		0

Table 40 - Tree Density Class
Size = 1; Type = alpha-numeric

Code	Crown Closure	FS SIZE TYPE
0	0 - 9 % Cover	0
1	10 - 19 % Cover	0
2	20 - 29 % Cover	0
3	30 - 39 % Cover	0
4	40 - 49 % Cover	P
5	50 - 59 % Cover	P
6	60 - 69 % Cover	N
7	70 - 79 % Cover	N
8	80 - 89 % Cover	G
9	90 - 100 % Cover	G
X	Not Determined	

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APPENDIX B

Road Management Plan—Operations Guide

APPENDIX B

Road Management Plan – Operations Guide

Road Management Plan

All logging roads and landings on the ownership or under the control of Fruit Growers Supply (FGS) within the Plan Area shall be planned, located, constructed, reconstructed, used, and maintained in a manner which is consistent with long-term enhancement and maintenance of the forest resource; best accommodates appropriate yarding systems, and economic feasibility; minimizes damage to soil resources and fish and wildlife habitat; and prevents degradation of the quality and beneficial uses of water.

To this end, FGS will utilize existing roads whenever feasible; strive to minimize total mileage; minimize disturbance to natural features; avoid wet areas and unstable areas; and minimize the number of watercourse crossings.

Utilizing the road classes of the California Forest Practice Rules (CFPRs), the following road management measures have been developed to assess the existing transportation system for treatment prioritization; establish best management practices to prevent and control erosion production; and to systematically improve the transportation system and related infrastructure.

This document provides the definitions and standards necessary for consistent road construction, maintenance, decommissioning, and utilization. For implementation purposes the Best Management Practices of the Long-term Streambed Alteration Agreement between FGS and DFG are included, and where appropriate the CFPR code is cited.

Definitions

"Average active channel width" means the channel width obtained from measuring at least five widths of different habitat units outside the influence of the crossing. The active channel margin is that area that is normally scoured by flows every year, as evidenced by scoured substrate or predominantly terrestrial vegetation.

"Bankfull stage or zone" means the area where the stream fills the entire channel cross section without significant inundation of the adjacent floodplain, and generally has a recurrence interval of 1.5 to 2.0 years.

"Chance of rain" means National Weather Service forecast of 30% or more probability of precipitation within the next 24 hours.

"Class I, II and III" means the same as defined in the 2005 California Forest Practice Rules, Title 14, California Code of Regulations.

"Corduroy crossing" means de-limbed logs laid parallel to support the tractor or skidder on wet and soft ground.

"Edge of the facility" means the culvert inlet or outlet, the edge of the traveled road surface on a ford or bridge, or the end of the logs or culvert in a temporary crossing, whichever is further from the crossing centerline.

"Qualified individual" means a person that has had training in the target special status plant habitat and/or species identification, and possess sufficient knowledge such that the presence or absence of the target habitat and/or species can be determined with confidence.

"Spittler crossing" means a temporary stream crossing that uses chokered logs for fill (with or without a culvert), an 8-inch minimum straw layer, and local topfill for the running surface.

"Temporary crossing" means a stream crossing used during timber operations, removed subject to the timeframes specified above, and that are designed to pass the expected flows during the period of use (i.e., activated and deactivated seasonally).

"Vented ford" means a permanent ford armored to withstand 100-year flows with a culvert sized to pass summer low flows. Vented fords include heavy armoring over the crossing surface and outfall or predominantly rock fill, and may include a grate on the culvert inlet for ease of clearing.

"Stream" means any defined channel with distinguishable bed and bank showing evidence of having contained flowing water indicated by deposit of rock, sand, gravel, or soil, and that supports onsite or downstream aquatic life at some time, including but not limited to, streams as defined in PRC 4528(f). Stream also includes manmade streams.

"Wet area" means an area which is moist on the surface throughout most of the year and/or support aquatic vegetation, grasses, and forbs as their principal vegetative cover.

Protection of Special-status Species

A current version of the California Natural Diversity Database shall be queried as well as FGS environmental/wildlife files for the presence of special-status species prior to conducting activities. FGS will adhere to applicable DFG protocols for special status species.

Implementation Regions

For the purposes of implementation, the Plan Area has been divided at the drainage level into three "Implementation Classes" based primarily on the range and distribution of anadromous salmonid populations and the proximity of FGS lands to known or potential habitat for coho salmon: Class A, B, and C lands. These "Implementation Classes" were developed in coordination with NMFS and DFG and indicate where various classes of conservation measures will be implemented under this HCP; they are not intended to describe the current, historic, or potential distribution of coho salmon within the regional landscape. Table 5-1 of the HCP identifies drainages in each Implementation Class.

Class A lands (83,288 acres) include all fee-owned land, or lands in which FGS has timber rights within their Klamath River and Scott Valley Management Units that are located west of Interstate 5 and north of State Highway 3. Class A lands generally include stream reaches that are directly tributary to the Klamath or Scott rivers that support (or historically supported coho salmon or that are directly upstream of these coho salmon reaches.

Class B lands (18,767 acres) include all fee-owned lands, or lands in which FGS has timber rights in the Bogus Creek and Willow Creek drainages, and that portion of the Moffett Creek drainage that lies south of State Highway 3. These lands are located in drainages that are within the range of anadromy, but currently do not support coho salmon and have no real potential to do so in the future.

Class C lands (50,123 acres) include all fee-owned lands, or lands in which FGS has timber rights located in the Elliott Creek drainage and those in drainages east of Interstate 5 (Grass Lake Management Unit), except the in the Bogus Creek and Willow Creek drainages (described above as Class B lands). These lands are located above long-standing barriers to anadromous fish or have no direct connection to streams supporting anadromous salmonids.

Time of Operation

1. The operator shall conduct activities during the periods specified below. The Operator shall conduct the activities at such time that adverse impacts to fish and wildlife resources are avoided or minimized.

2. Class I Streams. The operator shall conduct the following activities only during periods of low or no water flow between June 15 and October 15: vegetation removal, bank stabilization, and maintenance, replacement and installation of stream crossings. Temporary crossings installed during this time may be removed after October 15, but in such event shall be removed prior to the first chance of rain (i.e. 30 percent or more) within the next 24 hours as forecast by the National Weather Service, but in no case past November 15. Variations to these time schedules may be requested by FGS with NMFS and/or DFG consultation and approval.

3. Class II and Class III Streams. The Operator will conduct crossing construction, replacement, and decommissioning activities only during periods of low to no water flow between May 1 and October 15. Temporary crossings installed during this time may be removed after October 15, but in such event shall be removed prior to the first chance of rain (i.e. 30 percent or more) within the next 24 hours as forecast by the National Weather Service, but in no case past November 15. Variations to these time schedules may be requested by FGS with NMFS and/or DFG consultation and approval.

4. Obstruction and Sediment Removal. The Operator shall remove obstructions and sediment during time periods specified above if a substantial threat to the facility does not exist. The Operator may remove obstructions and sediment at any time if the obstructions and sediment would reasonably be expected to cause substantial damage to resources or cause the facility to fail outside the periods specified above.

5. Water Drafting. The Operator may draft water into water trucks at any time provided that the access site is sufficiently armored to prevent sediment discharge. Detailed protection measures are described below.

6. Waterhole Maintenance. The Operator shall maintain waterholes only between May 1 and October 15 during periods of low flow, unless the water hole or associated stream is dry or the waterhole is an off-channel facility.

Road Assessment

FGS will identify road-related sediment sources in accordance with the prioritization process set forth in subsection 5.2.3.2 of the HCP for the Plan Area. Drainage level road erosion inventories of roads owned and controlled by FGS will be conducted in all drainages within the Plan Area containing Class A and Class B designated lands. Inventories will follow a schedule produced through prioritization based on methodology that uses a landscape-level assessment of risk of sediment delivery to streams from road-related erosion, an assessment of resources at risk, and proposed timber management operations.

An assessment of road surface and drainage conditions for all road segments within a THP area and appurtenant to proposed operations shall be included in the THP.

[14 CCR 943.9.2(c)]

(1) The assessment shall contain a list of site-specific, field inventory information including proposed treatment of existing or potential sediment sources for all crossings, ditch relief culverts, road surfaces, road cuts, road fills, landings, turnouts, and inboard ditches.

(A) Field inventory information shall be obtained by a Registered Professional Forester (RPF) or supervised designee while traversing the road segments.

(B) All roads within watercourse and lake protection zones (WLPZ) will be evaluated for impacts to the watercourse.

(2) The assessment shall be subject to approval by the Director of the California Department of Forestry and Fire Protection (CAL FIRE) with written concurrence by the California Department of Fish and Game (DFG). Additional field inventory, work sites, and/or alternative treatments may be required.

The results of the road assessment shall be used to construct, reconstruct, or decommission road segments prior to filing a work completion report. Maintenance needs identified during and after the road assessment shall be addressed as soon as is feasible.

FGS will document any potential fish passage problems, including culverts that are impeding fish passage, during the field inventory. Methods used to evaluate fish passage will include those specified in the latest version of the California Salmonid Stream Habitat Restoration Manual or its equivalent document, throughout the life of the HCP.

Road Standards

FGS will classify new roads designed for a single use in a Timber Harvesting Plan (THP) as temporary, and decommission the roads upon completion of operations. Permanent roads are designed and surfaced for all-season use. Seasonal roads are part of the permanent transportation network, but will be surfaced for use in extended dry periods or hard frozen conditions. **[14 CCR 895.1]**

Routine use of logging roads, tractor roads, or landings shall not take place at any location where saturated soil conditions exist, where a stable logging road or landing operating surface does not exist, or when visibly turbid water from the road, landing, or skid trail surface or inside ditch may reach a watercourse or lake. Operations may take place when roads and landings are generally firm and easily passable or during hard frozen conditions. Isolated wet spots on these roads or landings shall be rocked or otherwise treated to permit passage. However, operations and maintenance shall not occur when sediment discharged from landings or roads will reach watercourses or lakes in amounts deleterious to the quality and beneficial uses of water. This section shall not be construed to prohibit activities undertaken to protect the road or to reduce erosion. **[14 CCR 943.6]**

In Class A lands, use of unpaved roads shall cease when: precipitation is sufficient to generate overland flow off the road surface, use of any portion of the road results in rutting of the road surface, or a stable operating surface cannot be maintained. **[14 CCR 943.9.2(j)]**

Resumption of road use shall only occur when there is a stable operating surface. Resumption of road or landing construction or reconstruction shall not occur until the soil conditions allow a stable operating surface to be developed. **[14 CCR 943.9.2(k)]**

No road or landing construction, reconstruction, or decommissioning will be undertaken from October 15 to May 1, unless explained, justified, and accepted by NMFS and/or DFG, or at any time outside this period when saturated soil conditions exist. Access will be allowed to correct emergency, road-related problems demanding immediate action (as defined in Public Resources Code section 21060.3). Where new roads are constructed, they will be subject to the restrictions and standards set forth in the 2008 CFPRs for new construction and re-construction of roads, and are summarized below. Drainage structures within class I watercourses shall allow for unrestricted passage of fish during any life stage. **[14 CCR 943.3(c)]**

Unless specified, the following standards shall apply to all logging roads and landings on the ownership or under the control of Fruit Growers Supply (FGS) within the Plan Area.

Road Design

FGS will avoid locating roads on steep slopes, inner gorge or steep toe slopes, connected headwall swales or debris slide slopes, and deep-seated landslides. All proposed road construction or reconstruction in these locations shall be reviewed by a Professional Geologist (PG) to ensure that proposed activities do not present a greater risk of sediment delivery from mass wasting. In addition, FGS will submit to the U.S. Fish and Wildlife Service (USFWS) and the National Marine Fisheries Service (NMFS) collectively (the Services) an explanation, justification, and a map of the proposed exception as part of the informational copy of the THP notice of filing. **[14 CCR 943]**

Wherever feasible, roads will be located on or close to ridge tops or on benches where the road prism can be built with the least soil displacement. FGS will not construct new roads within WLPZs, with the exception of watercourse crossings or spur roads off of existing roads within WLPZs which would be designed to extend outside the WLPZ. **[14 CCR 943.1(h)]**

To the extent feasible, new roads will be constructed so the road network will not drain directly into watercourses (i.e., will be hydrologically disconnected). **[14 CCR 943.2(h)]**

The number of crossings shall be kept to a feasible minimum. **[14 CCR 943.3(b)]**

Exposed, erodible fill along new road construction that drains towards a stream shall be stabilized with slash or mulch.

Road Width

FGS will construct management roads to have a running surface width of less than 18 feet (mainline roads) and less than 16 feet (secondary roads). **[14 CCR 943.1(g)]**

Unless prohibited by existing contracts with the United States Department of Agriculture (USDA), the United States Forest Service (USFS), or other federal agency, new and reconstructed logging roads shall be no wider than a single lane, compatible with the largest type of equipment specified for use on the road, with adequate turnouts provided as required for safety. The maximum width of these roads shall be specified in any associated THP. These roads shall be outsloped where feasible and drained with water breaks or rolling dips (where the road grade is inclined at 7 percent or less), in conformance with other applicable CFPRs. **[14 CCR 943.9.1(b), 943.1(g)(1)]**

Temporary roads will have a width of less than 16 feet, will typically be outsloped with rolling dips, will be planned and designed for a single harvest entry, and will be decommissioned upon completion of harvest operations.

Exceptions to the road width specifications will be made where necessary considering topographic constraints, landing locations, turnouts, engineered berms, and curve widening, as measured in 200-foot lineal segments. Greater widths will be allowed to satisfy requirements of alignment, safety, and equipment. Curves will be widened to an additional width based on the following:

Radius	Additional Width
100+ feet radius	+ 3 feet
75-100 feet radius	+ 5 feet
50-74 feet radius	+ 8 feet

Road Grade

FGS will ensure that final grades of new roads do not exceed a grade of 15 percent, except that pitches of up to 20 percent shall be allowed, not to exceed 500 continuous feet, to avoid unstable slopes, steep slopes, inner gorges, inner gorge crossings, or to access a suitable watercourse crossing location. **[14CCR 943.1(e)]**

Roads shall be constructed so that no break in grade, other than that needed to drain the fill, shall occur on through fill; breaks in grade shall be above or below the through fill, as appropriate. Where conditions do not allow the grade to break as required, through fills must be adequately protected by additional drainage structures or facilities. **[14 CCR 943.2(d)]**

In Class A and B Lands, all permanent or seasonal logging roads with a grade of 15% or greater that extends 500 continuous feet or more that are appurtenant to a THP or to be constructed or reconstructed shall have specific erosion control measures stated in the plan any associated THP.

Road Surface Drainage

FGS will reshape the existing roadbed to assure proper surface drainage where necessary and feasible. **[14 CCR 943.1(f)]**

FGS will use a combination of outsloped and crowned roads with inboard ditches where appropriate on reshaped roads that are to be rocked.

FGS will generally use an outsloped road prism for reshaped native surface roads.

All existing, new and reconstructed roads in WLPZs that will be used for hauling in wet weather conditions will be surfaced with competent rock to a minimum compacted depth of 6 inches or paving, and the road surface maintained to avoid rutting or pumping of fines during use.

Inboard ditches will be maintained to allow free flow of water and minimize soil erosion, and eliminated where feasible or breached with culverts or rolling dips at strategic locations to reduce concentrated runoff. **[14 CCR 943.4(j)]**

Inboard ditches will be breached with culverts or rolling dips uphill of watercourse locations to eliminate direct discharge into watercourses. Where this is not feasible, ditches will be rocked, armored, or otherwise treated to control erosion.

Inboard ditches may be maintained at seep and spring locations for short distances to protect road fill from saturation provided that they are breached sufficiently to eliminate ditch erosion.

The following design features shall be included in the maintenance, construction, reconstruction, or decommissioning of roads, except where site-specific alternatives are explained, justified, and approved by the Director of CAL FIRE, with written concurrence by DFG. The Director of CAL FIRE may only approve alternatives where the consequences for aquatic habitat are no greater than would result from the standard measures. Except for maintenance needs that arise from October 15 to June 1, all work described below shall be completed before October 15 in the year that work begins. **[14 CCR 943.9.2(f)]**

(1) Road surfaces shall be outsloped with rolling dips, wherever feasible.

(2) All road segments shall be hydrologically disconnected, to the extent feasible, from watercourses and lakes by site specific application of the following: outsloping, rocking, installation of rolling dips, cross drains, and/or waterbars, except where site specific alternatives are explained and justified in the THP, and approved by the Director of CAL FIRE, with written concurrence by DFG. All of these features shall drain to stable sediment filter strips.

(3) Crossings and associated fills shall be removed or reconstructed where there is evidence of failure potential or sediment delivery to Class I, II, or III watercourses and lakes.

(4) Culverts shall be replaced or removed if they are crushed, perforated, piping, separated, not adequate to carry water from the fifty-year flood level, located in unstable fill, or causing erosion that may be expected to deliver sediment to Class I, II, or III watercourses and lakes. Replaced culverts shall be installed at or as close to the original stream grade and slope as feasible.

(5) In Class A lands, each road approach to a watercourse crossing shall be treated to create and maintain a stable operating surface, and to avoid the generation of fines during use, in accordance with subsection (A) through (F) below. The road approach encompasses either of the following areas, whichever is less: (i) the area from the watercourse channel to the nearest drainage facility, but not less than 50 feet; or (ii) the area from the watercourse channel to the first high point on the road where road drainage flows away from the watercourse.

(A) Road surfaces on the following shall consist of high-quality, durable, compacted rock or paving: **(i)** permanent roads, **(ii)** seasonal roads crossing Class I watercourses, and **(iii)** roads used for hauling (logs, rock, heavy equipment) from October 15 to June 1.

(B) Road surfaces on the following shall be treated with either: rock, slash, seed and straw mulch, seed and stabilized straw, or seed and slash: **(i)** all seasonal roads used for hauling in the current year, and **(ii)** all seasonal roads used from October 15 to June 1 for purposes other than hauling

(C) Approaches to temporary crossings shall be rocked as needed after crossing removal to avoid rutting or pumping fines during use.

(D) Ditches exhibiting downcutting along the following shall be lined with high-quality, durable rock: **(i)** permanent roads, **(ii)** seasonal roads crossing Class I watercourses, and **(iii)** roads used for hauling from October 15 to June 1.

(E) Ditches along the following shall be treated to prevent scour: **(i)** seasonal roads used for hauling in the current year, and **(ii)** seasonal roads used from October 15 to June 1 for purposes other than hauling.

(F) Bare soil on associated fill slopes, shoulders and cuts shall be treated to minimize erosion.

(6) Sediment discharge from unstable or eroding cutbanks, fillslopes, and landing fills will be prevented by pulling, buttressing, or other means, and by installing and maintaining effective erosion control materials.

(7) Bridges (including associated fill, rip rap, and abutments) and bridge approaches showing evidence of failure potential or sediment delivery to Class I, II, or III watercourses and lakes shall be repaired, replaced, or removed.

All road approaches associated with a crossing that will be used during wet weather and drain into a watercourse will be surfaced with durable competent rock of sufficient depth, chip-seal or pavement to prevent the deformation and/or erosion of the road surface to the nearest water bar or point where road drainage does not drain into the watercourse crossing.

Road approaches to Class I or II permanent crossings will be surfaced with durable competent rock of sufficient depth, chip-seal or pavement to prevent the deformation and/or erosion of the road surface to the nearest water bar or point where road drainage does not drain into the watercourse crossing, or a minimum of 50 feet.

Road approaches and truck pads at water drafting locations will be treated as necessary to prevent sediment production and delivery to a watercourse or waterhole. Road approaches will be armored as necessary from the end of the road approach nearest the watercourse for a minimum of 50 feet, and to the nearest water bar, dip or point where road drainage does not drain toward the watercourse, with durable compacted rock, compacted grindings, pavement, or chip-seal.

Exposed, erodible fill along the new road that drains towards the stream shall be stabilized with mulch.

Approaches to temporary crossings shall be rocked as needed after crossing removal to avoid rutting or pumping fines during use by light vehicles/ATVs.

Ditches exhibiting downcutting along 1) permanent roads, 2) seasonal roads crossing Class I watercourses, and 3) roads used for hauling from October 15 to May 1 shall be lined with high-quality, durable rock.

Ditch Relief Structures

FGS will install ditch relief structures (culverts or rolling dips) to meet the following maximum spacing specifications:

Maximum Spacing (feet) by Erosion Hazard Rating			
Road Grade	**Extreme**	**High**	**Moderate/Low**
2%	600	—	—
4%	530	600	—
6%	355	585	600
8%	265	425	525
10%	210	340	420
12%	180	285	350
14%	155	245	300
16%	135	215	270
18%	115	190	240

FGS will install additional ditch relief culverts or rolling dips where appropriate to adequately disconnect the roads from watercourses and to minimize ditch water accumulation on slide prone landforms such as inner gorges.

Road Stream Crossings

Logging road watercourse crossing drainage structures on watercourses that support fish shall allow for unrestricted passage of all life stages of fish that may be present; and shall be fully described in any associated THP in sufficient clarity and detail to allow evaluation by the review team and the public, provide direction to FGS for implementation, and provide enforceable standards for the inspector. **[14 CCR 943.3(c)]**

Any new permanent culverts installed within Class I watercourses shall allow upstream and downstream passage of fish or listed aquatic species during any life stage and for the natural movement of bedload to form a continuous bed through the culvert and shall require an analysis and specifications demonstrating conformance with the intent of this section and subsection. **[14 CCR 943.3(g)]**

In Class A and B lands where situations exist that elevate risks to the values set forth in 14 CCR 936.2(a) (e.g., road networks are remote, the landscape is unstable, water conveyance features historically have a high failure rate, culvert fills are large) drainage structures and erosion control features shall be oversized, low maintenance, or reinforced, or they shall be removed before the completion of the timber operation. The method of analysis and the design for crossing protection shall be included in the THP. **[14 CCR 943.9.1(g)]**

In Class A lands within WLPZs, any new road or landing construction, reconstruction, new watercourse crossings, use of Class I fords or opening of old roads (except for the purpose of decommissioning) will be subject to approval by the Director of CAL FIRE, with written concurrence by DFG. The Director of CAL FIRE will only approve such practices where protection for aquatic habitat provided by proposed practices is at least equal to the protection provided by the use of alternate routes or locations outside of the WLPZ. **[14 CCR 943.9.2(d)]**

FGS will follow stream crossing standards established in conjunction with the California Department of Fish and Game (DFG) as part of an ownership-wide Streambed Alteration Agreement, described in the following.

Crossing Types

The type of crossing will be appropriate for the season, stream class, and type of use as described in the following table and guidance:

Watercourse Classification	Permanent Roads	Temporary/Skid Roads
Class I	bridge, plate arch, culvert, rocked ford	bridge, Spittler with rock surface, culvert with rock fill, rocked ford
Class II wet	bridge, culvert, vented ford	bridge, Spittler, culvert with rock fill
Class II dry	culvert, rocked ford	Spittler, rocked ford, culvert
Class III wet	culvert, vented ford	culvert, vented ford, Spittler
Class III dry	rocked ford, rocked dip	rocked ford, Spittler, Humboldt, rocked dip
Seep/wet area	French drain, burrito, vented ford, culvert	vented ford, corduroy

- **Rocked Fords and Dips** are used in intermittent or ephemeral streams that are typically dry during hauling. Rocked Fords have rock for fill and are generally used in Class II streams to prevent stream flows from altering the channel. Fords shall not be used where listed species are present on site or substantial sedimentation or turbidity would be created from use unless approved by DFG. A temporary crossing will be installed for hauling in fords with stream flows (Spittler or CMP with rock fill). Fords will be the preferred crossing type on shallow, poorly incised, smooth bottom channels that do not require substantial excavation of the bank and that are usually dry during the normal work period. If use of the ford would result in substantial downstream turbidity or sedimentation, another crossing type will be utilized, or a temporary crossing will be installed over the ford for hauling.
- **Temporary crossings** with soil fill (Humboldt, dipped, CMP with soil fill, etc.) shall not be used in streams that support aquatic life or where transport of sediment may impact downstream aquatic resources (excludes crossings with a soil cap for running surface separated from the fill by a straw and/or geotextile fabric layer). Temporary crossings on dry Class II and III watercourses that have poorly incised, shallow, or smooth channels that require little or no bank excavation will usually be fords. Temporary crossings on Class II and III watercourses that have incised, deep, rough, or steep channels will usually be a bridge or Spittler crossing to minimize bank disturbance. Spittler crossings are preferred for incised channels that support aquatic life and/or are flowing during hauling. Temporary culvert crossings with rock fill is preferred in shallow channels that need minimal fill.
- **Vented fords** are designed to pass low flows through the culvert and high flows over the crossing. Vented fords are used where there are low flows during hauling.
- **Corduroy crossings** are generally used to skid over a wet area and consist of a layer of logs laid perpendicular to the skid trail.

Permanent Bridges

Bridges are the preferred crossing type for fish-bearing Class I watercourses. Where bridges are used, they will be constructed as clear span bridges without abutment fills below the ordinary bankfull stage unless engineered and with approval of NMFS and/or DFG. Bridges will be set high enough to pass the entire 100-year peak flow and floating debris beneath the deck. Log stringer bridges may be used, but all surfacing material will be clean rock if the surface material is not otherwise planked, plated, or paved.

Stream banks will be excavated to the minimum extent necessary to install bridge abutments. Cast–in-place, pre-cast concrete, I-beams, or another engineer approved material shall be used for the abutments.

All bridge approach fill shall be stabilized with large angular rock rip-rap or properly installed gabion baskets filled with clean rock, “Hilfiker” walls properly installed to the manufacturer’s specifications, concrete footings, abutments, and headwalls, or a combination thereof. The revetments shall be installed with sound footings placed below grade of original ground. Uncured concrete shall not be allowed to pass into State waters. Forms for cast-in-place concrete construction shall be mortar-tight.

An excavator or winch-tractor shall be used to winch or suspend the flat cars or other bridge structure across the stream. Both the leading and trailing ends of the flat cars shall be lifted to prevent the gouging of the stream bed.

Road approaches to bridges shall be rocked with pit run 6 inch minus material to prevent erosion. Application of pit run rock will be adequate to form a hardened running surface and applied in a manner that will prevent runoff of fine sediments to adjacent watercourses in quantities deleterious to aquatic organisms.

A site specific description, project sediment control plan, and work plan shall be submitted to NMFS and DFG with any notifications for permanent bridge construction.

All bridge locations will be evaluated for the presence of a floodplain. At bridge locations with a floodplain, site specific plans will be developed to ensure that either the floodplain function is maintained by providing water passage or that no significant effects will occur from the placement of road approaches and bridge abutments.

Temporary Bridges

Temporary bridges can be flatcars, log stringers, plate, or other clear-span designs, which shall be removed by the end of the work period in each year. Bridge abutments below the high water mark shall be rock, pre-cast concrete or logs. Log stringer bridges shall be surfaced with planking or straw under a road surface layer of rock, to prevent surface material from entering channel during use.

Stream banks will be excavated to the minimum extent necessary to install bridge abutments. Any fill placed for bridge ramps shall be contained and stabilized with rock armor.

Temporary bridges shall be installed with a deck super-structure elevation sufficient to allow flows for the season of use to pass unobstructed beneath the deck.

An excavator or winch-tractor shall be used to winch the flat cars or other bridge structure across the stream. Both the leading and trailing ends of the flat cars shall be lifted to prevent the gouging of the stream bed.

Approach fills shall be adequately contained and stabilized to prevent sloughing and/or eroding into the stream channels.

Upon completion of use, bridge ramp fill, and rail car or other bridge structure shall be removed. Abutments may be left in place if they are constructed to the standards of permanent bridges. Bridge ramp fill shall be disposed of where it will not result in sedimentation of the stream. All disturbed areas resulting from the project that lead to the stream shall be stabilized immediately after the bridge has been removed. Stabilization may involve seeding and mulching as specified under "Erosion Control" or rocking.

Permanent Culvert Crossings - Class I Watercourses

Any new permanent structure or culvert placed on fish bearing Class I watercourses will be designed, constructed, and maintained such that it does not constitute a barrier to upstream or downstream movements of all life stages of fish. **[14 CCR 943.3(c)]**

Boulder weirs may be installed downstream of the crossing to maintain grade. Weirs shall be constructed in a U-shape with the bottom of the U facing upstream per DFG's California Salmonid Stream Habitat Restoration Manual (Flosi, et. al. 2003). Footer boulders may be used to increase stability in medium to large streams. These shall be placed in a footing trench slightly downstream of the surface boulders. Boulder weirs shall be constructed to create a maximum water elevation change of one foot. Boulder weir design and construction must be approved by NMFS and/or DFG prior to installation.

Fish passage shall be maintained where existing and restored where there is available habitat upstream from the crossing. Culverts on fish-bearing streams shall ensure fish passage using methods supported by the best available current research[1]. Methods shall be acceptable to both FGS and DFG. In the event mutual agreement cannot be reached regarding the crossing design, then the following measures shall be used:

- The culvert diameter shall generally be 1.5 times the average active channel width.
- The culvert inlet will be installed/embedded below stream grade less than 40 percent of the culvert diameter and the outlet between 20 and 40 percent of the culvert diameter. Where there is evidence that soil and other debris is likely to significantly reduce culvert capacity below design flow, oversize culverts, trash racks, or similar devices shall be installed in a manner that minimizes culvert blockage. Trash racks will only be used with DFG or NMFS approval. **[14 CCR 943.2(i)]**
- The culvert shall be set at 0 percent slope.
- The following equation shall be used as a test prior to installation:

Minimum culvert diameter = S x L/0.2
(where S = channel slope, and L = culvert length)[2]

Permanent Culvert Crossings - Class II and III Watercourses

Any permanent culvert at new Class II and III watercourse crossings will be sized to accommodate 100-year peak flows and debris and sediment loads. The size will be calculated by using the appropriate size as determined from at least two acceptable methods (one calculated/desk method and one field method). These may be methods identified in Cafferata et al. (2004). Culvert diameters will be equal or greater than the average active channel width.

Where there is evidence that soil and other debris is likely to significantly reduce culvert capacity below design flow, oversize culverts, trash racks, or similar devices shall be installed in a manner that minimizes culvert blockage. Trash racks will only be used with DFG or NMFS approval. **[14 CCR 943.2(i)]**

Culvert inlets may be bevel-cut at 45 degrees to increase capacity.

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[1] Some examples include, but not limited to: California Salmonid Stream Habitat Restoration Manual – 1998 (3rd Ed); Oregon Road/Stream Crossing Restoration Guide – Spring 1999.

[2] Example - If the average channel width is 10 feet and gradient 5%, then the first cut culvert diameter is 15 feet (1.5 times the channel width), and the upstream end embedded 6 ft. maximum (40% x 15 ft.) and downstream end 3 feet

New or replaced culverts will be installed at or as close to the original stream grade and slope as feasible.

Fill placed in the channels shall not exceed the minimum necessary to construct the crossings. The exposed fill material placed within the channels at culvert inlets and outlets shall be armored with rock sufficiently sized and properly installed to resist wash-out by high seasonal flows. The rock armoring shall be keyed well into proper footing trenches and into stream banks. As a minimum, rock armoring shall extend from the stream channel to the top of the culvert. Any exposed fill material above this level will either be rock armored as well, or mulched as described under "Erosion Control." All overflow "fail-safe" dips shall be rock armored.

Armoring of culvert crossings will be commensurate with the risk of overtopping and guided by the following table:

Risk	Indicators	Armoring
Low	Sized for 100-year flows; HW/d ratio < 0.7 @ Q100; receives yearly maintenance	Inlet and outlet to top of culvert.
Medium	HW/d ratio = 1 @ Q100, does not receive yearly maintenance; steep gradient stream	Armor critical/overflow dip over entire fill.
High	Not sized for 100-year flows (i.e. HW/d >1); excessive fill; not aligned; not accessible in winter; steep gradient stream	Armor all fill underlain with geotextile fabric.

Inlets and fill will be designed and configured as wingwalls and not as a headwall, as much as feasible.

Armoring will consist of rock rip-rap or other non-erodible material (e.g., concrete head wall). Rock rip-rap will be of sufficient size and depth to remain in place during 100-year peak flows (generally 6 to 12 inch or greater diameter, or equal to the largest size that naturally exists in the channel). Channel armoring will be set below grade so as to allow the natural accumulation of bedload at watercourse grade.

Culverts will be aligned with the watercourse channel. Culverts will extend beyond the road fill and will not be perched (suspended). On Class II and III watercourses they will be installed at watercourse gradient or have downspouts or energy dissipaters (rock rip-rap or boulders) at the outfall to prevent erosion.

If setting to grade is physically limited by bedrock or large boulders, culverts shall have down-flumes or culverts extended down the entire fill. If half-round down-flumes are used, they will be of sufficient size to accommodate the entire anticipated flow from the attached culvert. Down-flumes will be securely attached to the culvert and durably anchored to the fill slope using methods or materials designed to operate through the life of the crossing (i.e., using deadman posts or cable-anchor assemblies).

All permanent culvert crossings will include an overflow dip/critical dip (low point in the road near the crossing to carry water overflow) or other feature designed to minimize watercourse diversion potential.

Basins will not be constructed and channels will not be widened at culvert inlets unless designed and approved as part of a waterhole facility.

Multiple-pipe crossings will not be constructed or reconstructed within the bankfull channel, unless approved by NMFS or DFG.

Large rocks and woody debris will be removed from the crossing fill area. Both the culvert foundation and the trench walls will be free of logs, stumps, limbs, and rocks that could damage the pipe, or subsequently cause seepage of flow around the outside of the culvert pipe.

The culvert bed will consist of either compacted, rock-free soil or gravel. If gravel is used for the bed, geotextile filter fabric should be placed to separate the gravel from the soil, to minimize the potential for soil piping. A slight hump (camber) in the center of the culvert alignment is recommended (1.5 to 3 inches per 10 feet of culvert pipe length) to compensate for settling of the culvert bed. Backfill soil material will be layer-placed and machine compacted in 1-foot lifts.

Backfill material will be free of large rocks, limbs, or other debris that could damage the pipe or allow water to seep around the pipe. Culvert ends should be covered first. Backfill material will be compacted in layers at frequent intervals. Finer material will be placed along the pipe on permanent culverts to create a better seal.

Newly installed culvert ends will extend beyond the toe of the fill.

Fill placed in the channel will not exceed the minimum necessary to construct the crossing. The exposed fill material placed within the channel will be armored with clean rock from the toe of the fill to the top of the culvert to prevent erosion of the fill (see Table above). Soil fill within the channel above the top of the culvert will be stabilized and will not exceed a slope of 1.5H:1V (67%), unless stabilized with rock or rip-rap.

If erosion of the streambed exists at any of the existing culvert outlets, indicating elevated out fall velocities due to compression of flow, competent rock galleries shall be installed in the stream bed at the culvert outlets to resist such erosion.

Temporary Road Crossings on Class I and II Watercourses

Fill materials for temporary crossings on Class I or II watercourses will include 2- to 6-inch pit run rock; screened river gravels; clean, washed 2-inch plus rock or gravel; and/or logs. Materials and methods used will avoid any visible increase in surface erosion or turbidity. Bridge abutments below the high water mark will be rock or logs. When fill material is removed from the crossing, the channel shape and gradient will be returned to pre-project condition to the extent feasible, and any adjacent bare soil will be stabilized by mulching or other effective method.

Spittler and modified-Spittler type crossings include logs to fill the channel that are chokered to facilitate removal, a culvert if necessary to carry flows, a 4-8-inch straw layer capping the logs, and a temporary running surface of local topfill or rock. Culverts shall be of sufficient size to accommodate the expected flow during the use period. Spittler crossings used on fish-bearing streams shall utilize rock for the running surface and no straw layer. Rock fill used for a running surface shall be free of soil. Spittler crossings shall be constructed by laying choker cables or similar cables across stream channel, then placing pipe and/or sound logs in the channel bottom, or lowering pre-chokered logs into the channel. The logs will then be covered with the straw layer, and rock or a local topfill for road surfacing. The straw layer will extend beyond the road fill surface to prevent fill from entering the logs and stream (i.e., the straw layer should be visible on the crossing edges after installation). If whole bales are used, the twine will be cut after installation of the bales to create a continuous straw layer. For removal, the topfill is scraped off without sidecasting, the logs removed as a unit by pulling the chokers, and any excess loose soil removed from the crossing using mechanized equipment and/or hand tools, as necessary.

Channel rocks and debris may be moved only for the temporary culvert installation, while leaving the remainder in the channel for interstitial spaces for water flow and fish habitat beneath the temporary crossing.

When fill material used in the crossing is removed, the channel shape and gradient will be returned to pre-project condition to the extent feasible. Habitat structures removed during temporary crossing installation will be restored or replaced in equal quantities after removing the crossing.

Temporary bridges can be flatcars, log stringers, plate, or other clear-span designs, which will be removed by the end of the work period in each year. Fills for abutments below bankfull stage will be log and/or rock. Log stringer bridges will be surfaced with planking or straw under a road surface layer of rock to prevent surface material from entering channel during use.

Upon completion of use, temporary crossings on “temporary roads” as defined in the CFPRs will be removed and temporary roads shall be blocked to prevent standard 4-wheel drive vehicles prior to October 15 of the year of use.

Rocked Fords

Fords shall be the preferred crossing type on shallow, poorly incised, smooth bottom channels that do not require substantial excavation of the bank and that are usually dry during the normal work period. For Class I watercourses, fords will be sparingly used on smooth bottom channels and only if constructing another type of crossing (e.g., ramping up approaches to install a culvert or bridge) would likely cause more environmental harm than good within the watercourse. If using the ford would result in a visible increase in surface erosion or turbidity, another crossing type shall be utilized or a temporary crossing shall be installed over the ford for hauling. Rocked fords will be designed to accommodate 100-year peak flows.

Any ford of Class I watercourses will allow unimpeded movement of adult and juvenile fish. Fords will not be used on Class I watercourses if the crossing gradient will be different from the natural watercourse gradient, or if a barrier would be created at the outlet. Fords will be constructed to maintain surface flow and prevent watercourse flows from sieving through the crossing.

Fords will be constructed using rock that will withstand erosion by expected flow velocities, placed in a U-shaped channel to create a drivable crossing. Fords will be buttressed on the downstream side as necessary to maintain the crossing grade.

Concrete fords will not be constructed or reconstructed.

No native soil may be pushed into the watercourse high flow channel. If grading of the road surface is required, all material will be graded away from the watercourse.

Constructed or re-constructed fords will have road approaches treated to minimize sediment production and prevent tracking of soil into the crossing. Road approaches will be armored from the edge of the watercourse for a minimum of 50 feet, or to the nearest water bar, dip, or point where road drainage does not drain toward the crossing, with durable compacted rock.

Boulder weirs may be installed downstream of the ford to maintain grade. Weirs shall be constructed in a U-shape with the bottom of the U facing upstream per the Department's California Salmonid Stream Habitat Restoration Manual (Flosi, et. al. 2003). Footer boulders may be used to increase stability in medium to large streams. These shall be placed in a footing trench slightly downstream of the surface boulders. Boulder weirs shall be constructed to create a maximum water elevation change of one foot. Boulder weir design and construction must be approved by NMFS and/or DFG prior to installation.

Vented Fords

Culvert installations associated with a vented ford shall be installed per the construction standards detailed under "Permanent Culvert Crossings." These culverts are sized to pass normal operating period flows, and are designed to allow high winter flows to pass over the ford. To protect the culverts during installation, a soil pad shall be placed over the culvert prior to the placement of filter fabric and large rock. The entire fill shall be protected with barrier cloth prior to the placement of large rock armoring. Stream banks shall be contoured to produce a wide relatively flat u-shaped crossing when the ford is complete to allow water to sheet over the ford rather than to concentrate, which could produce erosion. The table on page B-10 indicates when vented fords may be used at watercourse crossings. As indicated, vented fords will not be installed at Class I watercourse crossings.

The ford base shall be constructed of large angular rock and boulder material capable of withstanding 100-year flows. The road running surface shall be placed on top of the large rock/boulder base. It shall consist of clean 6-inch minus rock. Ford maintenance will involve the cleaning of inlet and outlet locations to maintain the fords proper function, and where needed, the replacement of protective rock armoring, and/or road running surface. Vented fords will not be used at Class I stream crossings.

Rocked Dips

The road prism and stream banks shall be contoured to produce a relatively flat U-shaped crossing when the rocked dip is complete.

The road running surface shall be lined with 6-inch minus rock. Fines may be included in amounts sufficient to bind the road running surface.

Dip inlet and outlet locations, and any exposed fill at the outlet, shall be armored with angular rock sufficiently sized to withstand erosion from high winter water flows.

Stream Crossing Approaches

Road approaches to new or re-constructed permanent crossings on Class I and II watercourses will be treated to minimize erosion and sediment delivery to the watercourse. Any road surface that drains toward a watercourse will feature rolling dips that drain onto stable or stabilized areas. Road approaches will be armored sufficiently with durable rock, compacted grindings, pavement, or chip-seal to prevent road surface fines from entering the watercourse. **[14 CCR 943.3(f)]**

In Class A lands, each road approach to a watercourse crossing shall be treated to create and maintain a stable operating surface, and to avoid the generation of fines during use, in accordance with subsection (1) through (6) below. The road approach encompasses either of the following areas, whichever is less: (i) the area from the watercourse channel to the nearest drainage facility, but not less than 50 feet; or (ii) the area from the watercourse channel to the first high point on the road where road drainage flows away from the watercourse. **[14 CCR 943.9.2(f)]**

(1) Road surfaces on the following shall consist of high-quality, durable, compacted rock or paving: **(i)** permanent roads, **(ii)** seasonal roads crossing Class I watercourses, and **(iii)** roads used for hauling (logs, rock, heavy equipment) from October 15 to June 1.

(2) Road surfaces on the following shall be treated with either: rock, slash, seed and straw mulch, seed and stabilized straw, or seed and slash: **(i)** all seasonal roads used for hauling in the current year, and **(ii)** all seasonal roads used from October 15 to June 1 for purposes other than hauling

(3) Approaches to temporary crossings shall be rocked as needed after crossing removal to avoid rutting or pumping fines during use.

(4) Ditches exhibiting downcutting along the following shall be lined with high-quality, durable rock: **(i)** permanent roads, **(ii)** seasonal roads crossing Class I watercourses, and **(iii)** roads used for hauling from October 15 to June 1.

(5) Ditches along the following shall be treated to prevent scour: **(i)** seasonal roads used for hauling in the current year, and **(ii)** seasonal roads used from October 15 to June 1 for purposes other than hauling.

(6) Bare soil on associated fill slopes, shoulders, and cuts shall be treated to minimize and/or prevent erosion.

Channel De-watering

During instream work, if surface flow is present and prolonged turbidity may be transported downstream, the flow will be diverted around the work area by temporary pipe, diversion channel, or pumping. Flow shall be bypassed for the entire time that instream work is conducted (i.e., 24 hrs a day for multiple day projects). Bypass is not required for installation of temporary crossings or culverts that do not need channel preparation prior to installation, and assuming low flows.

Any temporary dam, berm, road, or other obstruction that is required will be built only from materials such as sandbags, gabions, screened and washed gravel, plastic impervious barrier, stream gravel from the dry, exposed bars in the vicinity of the project or other materials or means that will cause minimal turbidity or siltation. Water routed around the work site will re-enter the channel below the annual high-water mark.

Construction of the diversion will normally begin in the downstream area and continue in an upstream direction, and the flow will be diverted only when construction of the diversion is completed. Channel bank or barrier construction will be adequate to prevent seepage into or from the work area. Channel banks or barriers will not be made of earth or other erodible supportive materials unless first enclosed by sheet piling, rock rip-rap, geo-synthetic materials, or other protective materials. The enclosure and supportive material will be removed when the work is completed and removal will normally proceed from downstream in an upstream direction.

Temporary channels will be constructed in the following manner:

(a) Begin excavation for the temporary channel at the downstream end of the diversion but do not connect with flowing stream at this time. Leave three- to five-foot "plug" between flowing stream and beginning of excavation.

(b) Build the temporary channel with new banks approximately 3 to 1 slope from top of bank to streambed to avoid collapse. Stop the diversion channel approximately three to five feet from upstream edge of flowing stream where channel will connect with the live stream.

(c) Place and maintain a sediment barrier in the stream at a location within 150 feet below the downstream end of the temporary channel. The sediment barrier will be in place prior to opening the temporary channel. The sediment barrier will be maintained until all flows are clear of sediment after the opening of the new low flow channel. When the water is clear of sediment, remove the sediment barrier.

(d) Open plugs downstream end first-this. This should be done by hand or small equipment to cause the least disturbance.

(e) Place a diversion barrier of gravel across the stream on an angle to divert flow into the new channel. Upon project completion, notch the gravel barrier down to stream grade and allow heavy winter flows to wash out the remaining gravel barrier.

Road Construction

New logging roads and landings shall be planned, located, constructed, reconstructed, used, and maintained in a manner which is consistent with long-term enhancement and maintenance of the forest resource; best accommodates appropriate yarding systems, and economic feasibility; minimizes damage to soil resources and fish and wildlife habitat; and prevents degradation of the quality and beneficial uses of water.

Factors that shall be considered when selecting alternatives shall include the following:

(a) Use of existing roads whenever feasible.

(b) Use of systematic road layout patterns to minimize total mileage.

(c) Planned to fit topography to minimize disturbance to the natural features of the site.

(d) Avoidance of routes near the bottoms of steep and narrow canyons, through marshes and wet meadows, on unstable areas, and near watercourses or near nesting sites of threatened or endangered bird species.

(e) Minimization of the number of watercourse crossings.

(f) Location of roads on natural benches, flatter slopes and areas of stable soils to minimize effects on watercourses.

(g) Use of logging systems which will reduce excavation or placement of fills on unstable areas. **[14 CCR 943]**

FGS will not carry out road construction during the winter, except that road upgrading may take place when dry, rainless, or hard frozen conditions exist and soils are not saturated as described below. Spot rocking with 6 inches minus competent, fractured rock may be utilized to stabilize or repair isolated rutted or soft road segments to continue operations.

FGS may conduct road upgrading during the winter period if soils are not saturated. In addition to observations of increasing soil saturation during rain events by personnel, saturated soil conditions may be evidenced by:

- Reduced traction by equipment as indicated by spinning or churning of wheels or tracks in excess of normal performance;
- Inadequate traction without blading wet soil;
- Soil displacement in amounts that cause a visible increase in turbidity in an adjacent Class I, II, III watercourse, except that construction may occur on isolated wet spots arising from localized groundwater such as seeps or springs;
- Pumping of road surface fine sediments by road use; or
- Creation of ruts greater than would be created by traffic following normal road watering, which transports surface material to a drainage facility that discharges directly into a watercourse.

Subject to the above restriction regarding saturated soil conditions, FGS may conduct road upgrading during the winter period if dry, rainless conditions (no measurable rainfall has occurred within the last 5 days and no rain is forecast by the National Weather Service for the next 5 days), or when ground conditions satisfy the "hard frozen" definition in 14 CCR 895.1 (frozen soil conditions where loaded or unloaded vehicles can travel without sinking into the road surfaces to a depth of more than 6 inches over a distance of more than 25 feet) and the following restrictions are followed:

- Each project site is completed, with erosion control measures installed, prior to any day for which a chance of rain of 30 percent or greater is forecast by the National Weather Service or within 10 days, whichever is earlier;
- Class I watercourse crossings will not be installed or replaced; any other watercourse crossings where significant surface flows could prevent effective diversion of flow around the work site will not be installed or replaced; and
- Erosion control supplies are retained on site and applied to each completed site by the end of that operational day.

- Sites that require more than 10 days for completion will not be started during the winter period unless there is an emergency situation. See definition of "Emergency Road Repair" below.

New logging roads shall not exceed a grade of 15% except that pitches of up to 20% shall be allowed not to exceed 500 continuous feet, unless such a gradient will serve to reduce soil disturbance. **[14 CCR 943.1(e)]**

FGS will avoid the use of through-cuts where feasible in new road construction. In areas where through-cuts cannot be avoided (e.g., to avoid steep slopes, unstable slopes) permanent ditch-outs will be installed at the beginning and end of the through cut.

Except for certain soil types or site conditions that require vertical cut slopes (e.g., rock outcrops), cuts slopes will be designed and constructed to minimize the risk of slope failure, soil disturbance, and excessive excavation.

Logging roads shall be constructed without overhanging banks. **[14 CCR 943.2(k)]**

For new road construction in areas where existing road cut slopes have exhibited failures, FGS will evaluate site specific situations and apply measures as appropriate, such as mulching, grass seeding, buttressing, and erosion mats to ensure cut bank stability and to minimize erosion.

On side slopes greater than 50 percent, where the length of the road section is greater than 100 feet and the width is greater than 15 feet, FGS will construct fills greater than 4 feet in vertical height at the outside shoulder of the road on a bench that is excavated at the proposed toe of the fill, and is wide enough to compact the first lift and subsequent lifts in approximately 1-foot intervals from the toe to the finished grade. **[14 CCR 943.2(c)]**

Where a road section that is greater than 100 feet in length crosses slopes greater than 65 percent, placement of fill is prohibited and placement of sidecast shall be minimized to the degree feasible. **[14 CCR 943.2(b)]**

For areas requiring "end-haul" or some degree of "waste management," FGS will deposit excess material in a stable location where sediment will not deliver to any watercourses. **[14 CCR 943.2(g)]**

FGS will place turnouts at reasonable intervals along the new road alignment that will be located where a minimum of excavation will be necessary to increase the road width. Turnouts will not be constructed if fill is required on side slopes for their construction. **[14 CCR 943.1(g)]**

FGS will clear a width that is based on the slope of the ground to adequately displace organic material so that organics are not incorporated in the fill, and to avoid having fill material butt up against green trees. [**14 CCR 943.2(u)]**

FGS will clear all trees more than 12 inches diameter at breast height (dbh) within 5 feet of the top of the cut slope. Trees greater than 12 inches dbh within 5 feet of the top of the cut slope may be retained if they will not be susceptible to windthrow or of being undercut. **[14 CCR 943.2(l)]**

FGS will not incorporate slash and other debris from road construction into the road prism, fills, or sidecast material. When feasible, slash and debris will be placed parallel to the toe of road fill slopes as a filter windrow. Slash will not be bunched against residual trees or placed in locations where it may gain entry into Class I, II, or III watercourses.

[14 CCR 943.2(u)]

On slopes greater than 35 percent, FGS will substantially remove the organic layer of the soil prior to fill placement. **[14 CCR 943.2(f)]**

In Class A and B lands, in addition to the provisions listed under 14 CCR 943.1(e), all permanent or seasonal logging roads with a grade of 15 percent or greater that extend 500 continuous feet or more—that are appurtenant to a THP or to be constructed or reconstructed—shall have specific erosion control measures stated in any associated THP.

[14 CCR 943.9.1(f)]

In Class A and B lands, where logging road or landing construction or reconstruction is proposed, the THP shall state the locations of and specifications for road or landing abandonment or other mitigation measures to minimize the adverse effects of long-term site occupancy of the transportation system within the watershed. **[14 CCR 943.9.1(a)]**

In Class A and B lands, the following shall apply on slopes greater than 50 percent:

(1) Specific provisions of construction shall be identified and described for all new roads.

(2) Where cutbank stability is not an issue, roads may be constructed as a full-benched cut (no fill). Spoils not utilized in road construction shall be disposed of in stable areas with less than 30 percent slope and outside of any WLPZ, equipment exclusion zone (EEZ), or equipment limitation zone (ELZ).

(3) Alternatively, roads may be constructed with balanced cuts and fills if properly engineered, or fills may be removed with the slopes recontoured prior to the winter period. **[14 CCR 943.9.1(e)]**

In Class A and B lands construction or reconstruction of logging roads, tractor roads, or landings shall not take place during the winter period unless the approved THP incorporates a complete winter period operating plan pursuant to 14 § CCR 934.7(a) that specifically address such road construction. Use of logging roads, tractor roads, or landings shall not take place at any location where saturated soil conditions exist, where a stable logging road or landing operating surface does not exist, or when visibly turbid water from the road, landing, or skid trail surface or inside ditch may reach a watercourse or lake. Grading to obtain a drier running surface more than one time before reincorporation of any resulting berms back into the road surface is prohibited. **[14 CCR 936.9(l)]**

In Class A lands, all roads in Class I WLPZs shall exhibit a rocked or paved stable operating surface. The surface shall consist of high quality, durable, compacted rock or paving. The road surface and base shall be maintained to avoid generation of fines during use.

[14 CCR 943.9.2(h)]

The following measures will be implemented in Class I WLPZs in Class A designated lands:

(1) No road or landing construction, reconstruction, or decommissioning shall be undertaken from October 15th to May 15th, or at any time outside this period when saturated soil conditions exist, except as provided below. **[14 CCR 943.9.2(i)]**

(2) The RPF may propose site-specific exceptions that are explained and justified in the THP, and approved by the Director of CAL FIRE, with written concurrence by DFG. The Director of CAL FIRE will only approve exceptions where the protection provided for aquatic habitat by the proposed practices is at least equal to the protection provided by the above time period or conditions. Access without specific approval by the Director of CAL FIRE is allowed to correct emergency, road-related problems demanding immediate action. **[14 CCR 943.9.2(i)]**

Road Maintenance

All logging roads and landings under the control of Fruit Growers Supply (FGS) within the Plan Area shall be maintained in a manner which is consistent with long-term enhancement of the forest resource, minimizes damage to soil resources and fish and wildlife habitat, and prevents degradation of the quality and beneficial uses of water.

In addition to routine maintenance such as road surface and drainage maintenance, FGS will prioritize upgrades through a drainage level road erosion inventory process within Class A and Class B designated lands. This process is scheduled to prioritize inventories based on risk of sediment delivery to streams from road-related erosion, resources at risk, and proposed timber management operations. Upgrades identified in the inventories are scheduled to coincide with routine maintenance or other operations.

It is not FGS's intent to operate throughout the winter period, but rather to take advantage of dry rainless or hard frozen conditions to expedite the completion of road maintenance operations.

FGS may carry out patch (spot) rocking, brushing, cleaning inlets and outlets of culverts, cleaning ditches where poor drainage is occurring, repairing or maintaining existing waterbars, replacement of a failed or imminently failing culvert along a needed access road, and site specific road surface grading for maintaining the integrity of the road surface year-round, including during the winter period.

Grading will not be used to blade off wet soil to provide conditions for extended periods of operation on a deteriorated road surface. Grading of road surfaces shall occur only when necessary to achieve a uniform, stable, and well-drained operating surface. Inboard ditches shall be graded only when they are blocked or lack adequate inside ditch hydraulic capacity, or driver safety is a concern. Where feasible, blading the segment of ditch between the watercourse and first drainage facility shall be avoided.

Side casting of soils will not occur on road approaches to crossings where an adequate filter strip is not present.

The installation of waterbars, rolling dips and critical dips; general project grading for shaping the road surface; road outsloping; road rocking; resurface rocking; cleaning ditch lines; and general culvert replacements may occur only during the period when road upgrading may occur, including during the winter period.

Disturbance or removal of vegetation shall not exceed the minimum necessary to complete operations. If vegetation removal is needed away from where excavation (cleaning catch basins) will take place, the vegetation will be pruned at ground level and not grubbed out to promote rapid re-vegetation. Vegetation removal will be limited to within 30 feet upstream and downstream from crossings. All cleared vegetation and debris will be removed from the watercourse corridor and placed or secured where they cannot re-enter a watercourse.

Restoration shall include the re-vegetation of areas stripped or exposed by project activities.

Rock, riprap, or other erosion protection shall be placed in areas where vegetation cannot reasonably be expected to become reestablished.

Culvert inlets and outlets shall be cleaned of excess sediment, vegetation, woody debris, rocks, etc., which may hinder stream flows through the culvert or that may pose plugging potential.

Spoils from culvert cleaning will be deposited in a location away from streams where the material cannot re-enter the stream.

If there is evidence of erosion at culvert outlets from accelerated flow through the pipe, a rock gallery of sufficient dimension to dissipate flow velocity shall be installed immediately downstream of the culvert pipe outlet.

If there is evidence of fill erosion at the culvert crossing, the exposed fill will be protected with angular rock sufficiently sized to withstand high seasonal flows and anticipated road runoff.

If there is diversion potential at the culvert crossing, an overflow dip shall be placed in the road as close to where original ground downslope meets the crossing fill to provide for a "fail-safe" drainage design.

Existing overflow dips shall be re-dipped where needed to restore proper function.

FGS will use the same installation standards for new roads when replacing washed out culverts, upgrading existing culverts, or replacing culverts on previously decommissioned roads.

During road inspection and maintenance, measures shall be employed to ensure the following: waterbars fully capture run-off from road surfaces and discharge it without gully formation or sediment delivery to waters; culverts (including crossdrains) are not occluded by debris; inboard ditches are not downcutting or scouring; cutbank erosion is minimized, and the fine sediment present on road surfaces is prevented from delivery to Class I, II, or III watercourses and lakes.

Inlet and outlet structures, additional drainage structures (including ditch drains), and other features to provide adequate capacity and to minimize erosion of road and landing fill and sidecast to minimize soil erosion and to minimize slope instability shall be repaired, replaced, or installed wherever such maintenance is needed to protect the quality and beneficial uses of water. **[14 CCR 943.4(m)]**

In Class A lands, routine corrective work that prevents diversion of water from a watercourse or ditch or helps maintain a stable operating surface (e.g., repairing inboard ditches, cross drains, water bars, road surface and fill, unblocking of culverts) shall be performed as soon as possible, regardless of the time of year. Vehicle access for routine corrective work shall only be permitted in accordance with 14 CCR § 943.9.2(k). Other maintenance needs of lower priority shall be undertaken between June 1st and October 15th. **[14 CCR 943.9.2(o)]**

In Class A lands, forest floor discharge sites below the outlets of drainage facilities on all roads within the THP area and appurtenant to proposed operations shall be inspected by FGS for evidence of sediment delivery to Class I, II, or III watercourses and lakes at least twice annually: once between June 1 and October 15, and at least once after October 15, following the first storm event producing bankfull stage discharges prior to filing the notice of completion report. If evidence of sediment delivery is present, additional cross drains, waterbars, or rolling dips shall be installed to reduce the discharge volume to the site. **[14 CCR 943.9.2(p)]**

In Class A lands, grading of road surfaces shall occur only when necessary to achieve a uniform, stable, and well-drained operating surface. Inboard ditches shall be graded only when they are blocked or lack adequate inside ditch hydraulic capacity, or driver safety is a concern. Where feasible, blading the segment of ditch between the watercourse and first drainage facility shall be avoided.

Maintenance Schedules

Routine maintenance is scheduled on a 3-5 year cycle according to the table below.

Maintenance	Hilt/Klamath River	Elliott Creek	Scott Bar	Moffett Creek	Soap Creek	Grass Lake
General/Routine Repairs	3 Yr	3 Yr	3 Yr	5 Yr	5 Yr	5 Yr
Minor	Year of discovery	Year of discovery	Year of discovery	Year of discovery	Year of discovery	Year of discovery
Major	Scheduled with Routine Maintenance	Scheduled with Routine Maintenance	Scheduled with Routine Maintenance	Scheduled with Routine Maintenance	Scheduled with Routine Maintenance	Scheduled with Routine Maintenance
Emergency	ASAP	ASAP	ASAP	ASAP	ASAP	ASAP

ASAP means As Soon As Practicable

Road Inspection

FGS will inspect all permanent roads owned and controlled by FGS for needed maintenance each year. Permanent crossings will be monitored every two years and minor maintenance (i.e., cleaning out inlet, clearing waterbar outlets) performed at the time or that season. Major maintenance issues will be documented in a company database, prioritized and scheduled for maintenance.

Other roads that are appurtenant to THPs will be inspected at least through the prescribed maintenance period for erosion controls specified in the THP.

The inspections will assess the effectiveness and condition of all erosion control and drainage structures.

In Class A lands, all roads within the THP area and appurtenant to proposed operations shall be inspected by FGS at least twice annually: once between June 1st and October 15th, and at least once after October 15th following the first storm event producing bankfull stage, prior to completion of operations. The inspection shall be started as soon as conditions permit access (in accordance with 14 CCR § 923.9.2 [943.9.2](k)) to ensure that drainage structures and facilities are functioning to hydrologically disconnect the road prism from waters. Inspection results and follow up corrective measures shall be documented and shall be provided to CAL FIRE and DFG. **[14 CCR 943.9.2(l)]**

In Class A lands, decommissioned roads shall be inspected following the first storm event producing bankfull stage after decommissioning, and again prior to filing the completion report. The purpose of the inspection will be to verify the effectiveness of treatments in preventing sediment discharges to waters and to ensure treatments are functioning to restore natural drainage and hillslope stability. If treatments are found to be ineffective prior to the end of the prescribed maintenance period, further treatments shall be applied if the volume of sediment prevented from entering a channel by additional treatments is greater than that incurred by re-entering the site. **[14 CCR 943.9.2(m)]**

Inspection Schedules

All permanent roads owned and controlled by FGS will be inspected annually for adequate drainage. Permanent crossings will be inspected on a two year cycle for functionality and risk of failure. Storm-related inspections will be conducted in areas that have received 2 inches or more of precipitation in a 24-hour period during or immediately after such an event. Decommissioned roads will be inspected following the first bankfull storm event and again prior to filing the completion report. Needed repairs identified during inspections or as part of a THP are scheduled for completion according to the table below.

Inspection	Hilt/Klamath River	Elliott Creek	Scott Bar	Moffett Creek	Soap Creek	Grass Lake
Permanent Roads: Surface/Drainage	Annual	Annual	Annual	Annual	Annual	Annual
Permanent Crossings: Functionality	2 Year	2 Year	2 Year	2 Year	2 Year	2 Year
Storm-related: road damage	During or Immediately after event	During or Immediately after event	During or Immediately after event	During or Immediately after event	During or Immediately after event	During or Immediately after event
Decommissioned: effectiveness	Following bankfull storm and again prior to completion report	Prior to completion report	Following bankfull storm and again prior to completion report	Prior to completion report	Following bankfull storm and again prior to completion report	Prior to completion report
THP: Erosion Control Sites	2x/Year	1x/Year	2x/Year	1x/Year	2x/Year	1x/Year

Inspection Content

FGS will conduct inspections on roads that are accessible. Problems identified during the inspections will be documented, and recommendations for their repair will be provided. The inspections will assess whether:

(1) There is adequate waterbar spacing, depth, interception of the ditch line, and complete diversion of water flow onto undisturbed soil.

(2) There are areas having poorly drained low spots or inadequately breached outside berms.

(3) Ditches are open, properly functioning, and free of debris that could plug the ditch or a culvert and cause a diversion of water onto the road surface.

(4) Culverts are functioning properly (i.e., the culvert is not rusted out or separated at a joint; water is flowing through the pipe and not underneath; sediment and debris is not reducing the pipe capacity).

(5) Fish passage is provided.

FGS will prioritize maintenance or repairs that are needed based on treatment immediacy (a subjective combination of event probability and potential sediment delivery evaluated as either low, moderate, or high). FGS's goal will be to complete all the priority tasks prior to the winter period. If the priority workload exceeds that which can be accomplished in the current maintenance year, lower priority sites will be held over until the following maintenance year.

Storm-related Road Inspections

If a storm occurs that produces 2 inches of precipitation or more in a 24-hour period at a gauge location identified below, then FGS's timberlands staff will conduct storm-related inspections of all accessible rocked roads in the corresponding region, to the extent the roads can be traveled without causing road damage during or immediately after such event.

Gauge Location	Associated Inspection Area
Yreka	Grass Lake Management Unit
Fort Jones Ranger Station	Scott Valley Management Unit
Oak Knoll Ranger Station	Klamath River Management Unit

FGS will make repairs during the storm-related inspections if hand labor can correct the problem.

Any problems observed during storm-related inspections that would require the use of heavy equipment for repair will be reported to a designated "storm response coordinator." The coordinator will prioritize and schedule repairs so they are accomplished as soon as possible. If access is prohibited because of adverse conditions, these sites will receive priority for treatment during the following summer's road maintenance schedule.

Emergency Road Repair

If there is an imminent threat to life, property, or public safety, or a potential for a massive sediment input with catastrophic environmental consequences, and the appropriate emergency response action is otherwise prohibited by this section of this Plan, FGS will notify the Services' designated contacts, but a formal notification will not be required prior to response actions being taken.

Road Decommissioning Standards

Abandonment of roads, watercourse crossings and landings shall be planned and conducted in a manner which provides for permanent maintenance-free drainage, minimizes concentration of runoff, soil erosion and slope instability, prevents unnecessary damage to soil resources, promotes regeneration, and protects the quality and beneficial uses of water. **[14 CCR 943.8]**

Road entrances shall be blocked so that standard production four wheel-drive highway vehicles cannot pass the point of closure at the time of abandonment. **[14 CCR 943.8(a)]**

The Director of CAL FIRE may approve an exception to these requirements when such exceptions are explained and justified in the THP, and the exception would provide for the protection of the beneficial uses of water or control erosion to a standard at least equal to that which would result from the application of the standard rule.

FGS will follow the guidelines and performance standards for road decommissioning methods described in the latest version of the California Salmonid Stream Habitat Restoration Manual, or its equivalent document, throughout the life of the HCP.

Watercourse Crossings

Where feasible FGS will remove watercourse crossings, other drainage structures, and associated fills in accordance with 14 CCR 943.3(d). Fills shall be excavated to form a channel that is as close as feasible to the natural watercourse grade and orientation, and that is wider than the natural channel. Where it is not feasible to remove drainage structures and associated fills, and with NMFS and/or DFG approval, the fill shall be excavated to provide an overflow channel that will minimize erosion of fill and prevent diversion of overflow along the road should the drainage structure become plugged. **[14 CCR 943.8(e)]**

The natural channel grade will be determined by approximating a straight line through the crossing between the natural channel bottom upstream and downstream of the crossing.

Large woody debris resulting from the crossing abandonment (e.g., log stringers) will be left within the floodplain or channel.

The banks of the channel will be laid back to a stable repose, generally at an angle less than that of adjacent, non-roadbed affected banks. Such slopes will not be steeper than 1.5 to 1 (67%) unless armored with rip-rap or other effective means.

The excavated material and any resulting cut bank shall be sloped back from the channel and stabilized to prevent slumping and to minimize soil erosion. Where needed, this material shall be stabilized by seeding, mulching, rock armoring, or other suitable treatment. **[14 CCR 943.3(d)]**

Appropriate erosion control measures—such as mulching for continuous cover for a distance of 20 feet on each side of stream centerline, or to the first water bar, whichever is closest—will be utilized to prevent surface erosion at excavated crossings.

Rolling dips or water bars shall be installed as necessary to prevent road runoff from reaching abandoned crossings.

Road Surface Drainage

Localized outsloping will be utilized as necessary to adequately drain the road surface.

Road segments with inside ditches shall either have the ditch eliminated and the road outsloped or large cross drain waterbars installed. Cross drain waterbars should be deeper than standard waterbars and extend from the cutbank to the outside edge of the road. On steep road segments >10%, cross drain waterbars should be skewed at 45% to the road alignment. Discharge from the ditches will not be directed onto unstable areas.

Permanently decommissioned road surfaces shall be ripped, except if directly adjacent to a stream, and cross drained to minimize surface erosion and to eliminate soil compaction and planted with commercial tree species where appropriate to re-establish timber production.

FGS will establish maintenance-free surface drainage for temporarily and permanently decommissioned roads that are hydrologically disconnected from watercourses by applying general abandonment procedures which include the following: **[14 CCR 943.8]**

- Stabilization of exposed soils on cuts, fills, or sidecast where deleterious quantities of eroded surface soils may be transported in a watercourse. **[14 CCR 943.8(b)]**
- Grading or shaping of road and landing surfaces to provide dispersal of water flow. **[14 CCR 943.8(c)]**
- Pulling or shaping of fills or sidecast where necessary to prevent discharge of materials into watercourses due to failure of cuts, fills, or sidecast. **[14 CCR 943.8(d)]**

Water bars or rolling dips shall be installed on the road surface at intervals of no greater than the 2008 CFPR Standards (see Table below) or 200 feet, whichever is shorter.

2008 Forest Practice Rule Standards for Maximum Distance Between Waterbreaks

	Slope			
EHR	**< 10%**	**11 - 25%**	**26 - 50%**	**>50%**
Low	300’	200’	150’	100’
Moderate	200’	150’	100’	75’
High	150’	100’	75’	50’
Extreme	100	75	50	50

14 CCR 934.6(c)

Road-related Unstable Areas

FGS will pull back unstable or potentially unstable road or landing fill identified during the road assessment process and deposit spoil material in a stable location.

Appropriate erosion control measures such as grass seeding and mulching will be utilized to prevent surface erosion at excavated unstable areas.

Erosion Control

FGS will perform mulching, grass seeding, planting, and/or installation of energy dissipation (rock armor or woody debris) when determined necessary by qualified and trained personnel for additional erosion control to minimize erosion and prevent sediment from entering watercourses.

Vehicular access to abandoned and decommissioned roads will be controlled by blocking entrances with large berm "tank-traps," large boulders, large logs, gates, or large slash piles.

Erosion control materials will be applied in sufficient quantity prior to the onset of measurable precipitation and before October 15 with re-application throughout the maintenance period to minimize, to the maximum extent feasible, any visible increase in turbidity in Class I, II or III receiving waters.

One hundred percent of disturbed, bare mineral soil that is exposed in conjunction with crossing construction, maintenance, repair, or removal that may be delivered to a watercourse will be treated for erosion control immediately upon completion of work on the crossing or prior if the National Weather Service forecast is a “chance” of rain (i.e., 30% or more). For projects that require more than one day to complete, all materials will be protected from erosion at the end of each workday if the National Weather Service forecast is a “chance” of rain (i.e., 30% or more).

The project shall at all times feature adequate erosion and sediment control devices to prevent the degradation of water quality. Operator shall prevent the discharge of sediment, and/or muddy, turbid, or silt-laden waters, resulting from the project, into the stream channel. Where necessary to prevent any such discharge, Operator shall properly install and maintain sediment barriers (such as clean, uncrushed gravel or filter fabric fencing) capable of preventing downstream sedimentation/turbidity. Said devices shall be cleaned of all trapped sediment as necessary to maintain proper function. Recovered sediment shall be disposed of where it shall not return to the waters of this State. Said devices shall be completely removed from the channel, along with all temporary fills, upon completion of operations.

Fill material will be deposited in a stable location or treated to prevent erosion and subsequent delivery to a watercourse.

Prior to the onset of any storm event that may impact the project site, a sediment barrier (straw bales, silt filter fabric fencing, or other effective method), will be installed where necessary to prevent silt laden water from the project site from entering the stream or lake.

Straw bale barriers will consist of whole bales set on a cut end in a four-inch deep trench. Bales will be butted together and staked in place with metal stakes, rebar, or other effective means.

Silt filter fabric fencing deployed in streams will be limited to use in streams during low flows. Where necessary to resist collapsing, such filter fabric fencing will be supported by metal t-posts and rabbit wire or other effective means. Filter fabric will be placed with the entire bottom in a minimum two-inch deep trench.

Sediment barriers will be maintained in good operating condition throughout the period of construction of the project. This includes, but is not limited to, removal of accumulated silt and/or replacement of damaged bales and fabric fencing.

All remnants of any such dam or barrier will be completely removed upon completion of work.

Mulches shall be certified weed-free. Mulches or its equivalent (e.g., compacted slash) shall be applied so that not less than 90% of the disturbed areas are covered. All mulches (except hydro-mulch) shall be applied in a layer not less than two inches deep. In areas susceptible to high winds and/or cattle grazing, all straw mulches shall be kneaded or tracked-in with track marks parallel to the contour. Seeding will not be utilized if possible. In the event it is deemed necessary, seed shall consist of a mix of dry land orchard grass and tetrapoid rye, or other "native" grass seed mix found to be effective for soil or project conditions applied at a rate of not less than 25 pounds per acre.

Stream Channel Reconstruction

Stream channel reconstruction will occur under the review of CDFG and NMFS. Such reconstruction activities may be proposed under THPs or non-THP road management activity and will be subject to applicable state law (e.g., CDFG 1600 agreements). Vegetation disturbance shall be kept to the minimum necessary. If vegetation removal is needed away from where excavation will take place, the vegetation will be pruned at ground level and not grubbed out to promote rapid re-vegetation.

Reconstructed channels shall be returned to their natural width and grade. The new channel should not cause a sluice or flume-like condition that increases the speed of water flows above that of the existing channel.

If needed to protect downstream conditions, large rock or boulder weirs shall be placed in the reconstructed channel near its downstream end to help dissipate stream flow energy. Rock protection on stream banks immediately below the reconstructed channel may be installed when necessary to prevent erosion.

Bank Stabilization

FGS will stabilize eroded stream banks that are contiguous with and within 30 feet of a watercourse crossing. Banks will be sloped to a stable repose. Equivalent methods and materials will be used for the repair, improvement, or maintenance.

Bank stabilization methods may utilize those designs contained within the most recent edition of the Department of Fish and Game's California Salmonid Habitat Restoration Manual, or other generally accepted methods.

If the watercourse channel has been altered during the operations, the channel and bank configuration of the disturbed areas will be stabilized and restored to as near its natural condition as practicable, including its shape and gradient.

Rock rip-rap shall be sized to provide stable slope protection. Rock rip-rap and energy dissipater materials shall consist of clean rock, competent for the application, sized and properly installed to resist washout. Rock rip-rap slopes shall be supported with competent boulders keyed into a footing trench with a depth sufficient to properly seat the footing course boulders and prevent instability (typically at least 1/3 diameter of footing course boulders). Rock rip-rap slopes and footing trenches shall feature an underlayment of appropriate grade geo-textile fabric to protect fill from erosion. Smaller rocks may be used to fill voids after placement of the bearing rocks.

Rocks may be removed from the stream channel of Class II and III watercourses provided they can be plucked from the bed surface without excavation into the streambed.

Obstruction and Sediment Removal

Obstruction or sediment removal will be limited to within 30 feet upstream and downstream from the edge of the facility. The natural channel grade will be maintained.

Structures and associated materials that are not designed to withstand high seasonal flows will be removed to areas above bank-full stage before such flows occur, except large woody debris, which may be replaced or left in the watercourse channel.

Deposit and Disposal of Material

Fill, debris, soil, silt, sand, bark, slash, rubbish, cement or concrete or washings thereof, oil or petroleum products or other organic or earthen material will not be allowed to enter into or placed where it may be washed by rainfall or runoff into a watercourse. Non-biodegradable refuse, litter, trash, and debris resulting from operations and other activity in connection with these operations will be disposed of concurrently with the conduct of these operations.

Equipment Use, Petroleum and other Pollution Control

Heavy equipment operation within the wetted channel will be minimized. If operations require moving equipment across a flowing watercourse, equipment crossing will be minimized and restricted to armored locations that will cause a minimum amount of channel disturbance and without causing a prolonged visible increase in turbidity. If heavy equipment must be operated within the wetted channel, operations will only occur at low flows. For repeated crossings, a bridge, culvert, or rock-lined crossing will be installed.

Any equipment or vehicles driven and/or operated within or adjacent to the stream will be checked and maintained daily to prevent leaks of materials that, if introduced to water, could be deleterious to aquatic life, wildlife, or riparian habitat. Stationary equipment such as motors, pumps, generators, and welders located within or adjacent to the stream will be positioned over drip pans to contain any existing petroleum leaks. Drip pans will be sufficient in size to capture at least 2 to 3 gallons of leaking fluids. Absorbent blankets, sheet barriers and/or thick straw beds will be placed on gravel bars and beneath parked equipment that have several small but chronic leaks. The clean-up of all petroleum and/or chemical spills will begin immediately. The Department will be notified immediately by FGS of any spills and will be consulted regarding clean-up procedures.

Staging, storage, and re-fueling areas for machinery, equipment, and materials shall be located outside of the stream. No equipment shall be operated within the flowing stream, except as provided in this agreement. Any equipment or vehicles driven and/or operated within or adjacent to the stream shall be checked and maintained daily to prevent leaks of materials that, if introduced to water, could be deleterious to aquatic life, wildlife, or riparian habitat. Stationary equipment such as motors, pumps, generators, and welders located within or adjacent to the stream shall be positioned over drip pans. The clean-up of all petroleum and/or chemical spills shall begin immediately. The Department shall be notified immediately by FGS of any spills and shall be consulted regarding clean-up procedures.

No equipment maintenance or refueling will be conducted within 100 feet any watercourse channel or lake margin.

Water Drafting

Road approaches and truck pads will be treated as necessary to prevent sediment production and delivery to a watercourse or waterhole. Road approaches will be armored as necessary from the end of the road approach nearest the watercourse for a minimum of 50 feet, or to the nearest water bar, dip or point where road drainage does not drain toward the watercourse, with durable compacted rock, compacted grindings, pavement, or chip-seal. Brow logs, straw bales or other blockages will be placed at the end of the truck pad where needed to prevent overland flow into the water source and to limit truck access.

Class I watercourses shall not be temporarily or permanently dammed to create a drafting pool.

Minimum water depth at the deepest part of the riffle crest for Class I watercourses will be at least 0.2 feet deep.

When diverting water from any Class I or II watercourse, bypass flows will be maintained that ensure continuous surface flow in downstream reaches, and keep fish (as defined in Fish and Game Code § 45: "Fish means wild fish, mollusks, crustaceans, invertebrates, or amphibians, including any part, spawn, or ova thereof.") in downstream reaches in good condition.

Small dams may be installed at Class II diversion sites by using sandbags, wood at the head of a culvert, or river run gravel and sheet plastic (cofferdam) barriers. The sandbags will be filled with clean sand or river gravel and then placed into the stream by hand. Once dammed, bypass water will be routed downstream of the infiltration via gravity in order to maintain flow downstream of the diversion site. Upon completion, or prior to the winter operating period, the sandbags will be removed entirely from the channel by hand and sand will not be deposited into the channel. River gravel may remain in the channel.

All water drafting vehicles should be checked daily and shall be repaired as necessary to prevent leaks of deleterious materials from entering the stream and Watercourse and Lake Protection Zone (WLPZ).

In Class A and B lands, water drafting for timber operations from within a channel zone of a natural watercourse or from a lake shall conform with NMFS water drafting guidelines:

(1) The RPF shall incorporate into the THP:

(A) a description and map of proposed water drafting locations,

(B) the watercourse or lake classification, and

(C) the general drafting location use parameters (i.e., yearly timing, estimated total volume needed, estimated total uptake rate and filling time, and associated water drafting activities from other THPs).

(2) On Class I and Class II streams where FGS has estimated that:

(A) bypass flows are less than 2 cubic feet per second, or

(B) pool volume at the water drafting site would be reduced by 10%, or

(C) diversion rate exceeds 350 gallons per minute, or

(D) diversion rate exceeds 10% of the above surface flow;

No water drafting shall occur unless FGS prepares a water drafting plan to be reviewed and, if necessary a stream bed alteration agreement issued, by DFG and approved by the Director of CAL FIRE. The Director of CAL FIRE may accept the project description and conditions portion of an approved "Streambed Alteration Agreement" issued under the Fish and Game Code (F&GC 1600 et seq.) which is submitted instead of the water drafting plan described in 14 CCR § 916.9.1 [936.9.1] (r)(2)(D)(1-5).

The water drafting plan shall include, but not be limited to:

(1) disclosure of estimated percent streamflow reduction and duration of reduction,

(2) discussion of the effects of single pumping operations, or multiple pumping operations at the same location,

(3) proposed alternatives and discussion to prevent adverse effects (e.g., reduction in hose diameter, reduction in total intake at one location, described allowances for recharge time, and alternative water drafting locations),

(4) conditions for operators to include an operations log kept on the water truck containing the following information: Date, Time, Pump Rate, Filling Time, Screen Cleaned, Screen Conditions, and Bypass flow observations,

(5) a statement by the RPF for a pre-operations field review with the operator to discuss the conditions in the water drafting plan.

(3) Intakes shall be screened in Class I and Class II waters. Screens shall be designed to prevent the entrainment or impingement of all life stages of fish or amphibians. Screen specifications shall be included in the THP.

Drafting from gravity fed storage tanks shall conform to the following:

(a) Water storage tanks shall be fitted with properly sized pipes designed to cleanly return the tank overflow to the source stream.

(b) Outflow pipes shall be sized to fully contain the tank overflow and prevent it from overflowing onto the drafting pad or road surface.

(c) Water storage tank return pipes at the water outfall area shall be armored or designed to prevent erosion of the streambed, bank or channel and sediment delivery to the stream.

(d) Intakes shall be screened with openings <1/8 inch diameter (horizontal for slotted or square openings) for Class II gravity intakes or 3/32 inch for round openings or 1/16 inch diameter (horizontal for slotted or square openings) for Class I gravity intakes.

(e) Water storage tanks shall be screened or closed to effectively prevent wildlife entrapment.

At the end of drafting operations, intake screens shall be removed and drafting pipes plugged, capped, or otherwise blocked (i.e. with a valve shut-off) or removed from the active channel to terminate water drafting during the winter period.

For Class I waters in which coho salmon are present, all water drafting shall be conducted in accordance with the following:

(1) FGS shall measure flow using standard accepted methods during the following times: within two weeks prior to the start of operations, every two weeks after startup. Water Drafting in Class I watercourses with coho shall cease when the bypass flow drops below 1.5 cubic feet per second (cfs).

(2) Minimum bypass conditions shall be maintained at all times during water drafting. Minimum bypass conditions shall be determined in the field with DFG using the following methods and criteria. The operator shall furnish four survey pins, two 24-inch minimum length stream gauges marked in 1/10-foot increments, and tools and materials for installing the gauges into the streambed (e.g., rebar stakes, C-posts, wooden stakes). Minimum water depth at the deepest part of the riffle crest for Class I watercourses will be at least 0.2 feet deep.

(3) Water truck operators shall maintain a water-drafting log book that contains the following information, and is kept current during operations: date, time, pump rate, filling time, and staff gauge height at riffle crest (deepest point) prior to intake drafting and at completion. Drafting logs shall be submitted on request to NMFS or DFG.

(4) Drafting operations for the season may not commence until a pre-operational meeting has taken place between a FGS forestry department representative (RPF) and the licensed timber operator (LTO) responsible for field operations. The meeting shall take place at a representative sample of drafting sites (e.g., Class I watercourse, Class II watercourse, Class I and II ponds, and gravity fed storage tanks) and any other drafting sites with unique, site specific conditions. The LTO shall fully inform all water truck operators of their responsibilities stipulated within this plan.

(5) Water drafting by more than one truck shall not occur simultaneously at the same site.

(6) Where overflow run-off from water trucks or storage tanks may enter the watercourse; effective erosion control devices shall be installed such as water bars, gravel berms, brow logs, or hay bales.

(7) At the end of drafting operations, intake screens shall be removed and drafting pipes plugged, capped, or otherwise blocked (i.e. with a valve shut-off) or removed from the active channel to terminate water drafting during the winter period.

(8) Herbicide mix trucks shall not directly draft water from any watercourse or pond. Herbicide mixing activities shall not occur where runoff may enter a watercourse or hydrologically connected drainage facility.

Waterhole Maintenance

Waterhole maintenance includes stabilizing banks and removing fill material to maintain or increase capacity. Fill removed shall be placed in a stable location that will not erode and deposit in a steam.

During waterhole maintenance, silty/turbid water shall not be discharged into the stream. Silty/turbid water shall be settled in a settling basin, filtered or otherwise treated prior to discharge back into the stream channel.

Vegetation disturbance shall be kept to the minimum necessary to clean the water hole of excess sediment. If vegetation removal is needed away from where excavation will take place, the vegetation will be pruned at ground level and not grubbed out to promote rapid re-vegetation.

Waterhole outlets and overflow channels will be inspected for proper function and will be repaired or replaced as necessary. Replacement of any overflow channels will involve re-excavating the channel, lining it with barrier cloth, and placing angular rock of sufficient size to withstand high seasonal flows over the barrier cloth.

Habitat Restoration

Habitat restoration projects shall follow the standards and designs contained within the most recent edition of the Department of Fish and Game's California Salmonid Habitat Restoration Manual.

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APPENDIX C

Mass Wasting Component

2 MASS WASTING HAZARDS

Mass wasting hazards are identified at the watershed scale by compiling existing mapping and inventory information, identifying potential shallow landslide instability based on deterministic modeling, and identifying potentially deep-seated instability based on landform mapping by the USFS. As part of the HCP mass wasting conservation approach, air photo mapping and field assessment of unstable and potentially unstable slopes will be conducted by qualified personnel (i.e., trained RPF, PG, or CEG) on a project-specific basis.

2.1 Sources of Mass Wasting Information

The primary information sources for mass wasting and other erosion processes in the HCP area include past and ongoing landslide and road erosion inventories, riparian and stream bank protection projects, and related efforts to control sediment sources and improve water quality by Fruit Growers and other private as well as federal, state, and local government stakeholders. These projects informed Fruit Growers effort to identify unstable and potentially unstable landforms and develop appropriate conservation measures to reduce management-related sediment production and delivery to stream channels.

The Siskiyou Resource Conservation District, Scott River Watershed Council (SRWC; formerly the CRMP), and French Creek Watershed Advisory Group have independently or jointly implemented numerous watershed improvement projects on private land in the Scott River basin, including riparian and streambank improvement projects, salmonid habitat improvement projects, erosion and sediment reduction projects, flow-related studies, and educational projects. As a result, the SRWC published a Strategic Action Plan (SWRC 2004) as a common guide for watershed restoration and management efforts in the Scott River watershed by identifying and prioritizing resource objectives and setting implementation practices and procedures.

The Klamath National Forest has conducted numerous planning and assessment projects in and near the HCP area that provide critical information about geological and biological resources, erosion processes, and land management practices. These include the Beaver Creek Ecosystem Analysis (USFS 1996), Callahan Ecosystem Analysis (USFS 1997), Lower Scott Ecosystem Analysis (USFS 2000), Horse Creek Watershed Analysis (USFS 2002), phase I and phase II final reports following the flood of 1997, and Lower Scott River Roads Analysis. USDA Forest Service inventories of erosion processes in different geologic terrains were especially useful during development of the mass wasting strategy, especially landslide inventories (1992, 1994, post-1997) used in testing the results of potential shallow landslide instability models. In July 2006, USFS Region 5 released a region-wide bedrock and geomorphology geodatabase (Elder and Reichert 2006). Landforms developed in this digital compilation provided the basis for defining unstable and potentially unstable terrains at the watershed scale.

The State of California has identified the Scott and Klamath River basins as impaired water bodies because water quality standards are not being met and/or current conditions are not supporting designated beneficial uses of the waterbody due to elevated sediment loads, elevated water temperatures, or nutrient imbalances (http://www.swrcb.ca.gov/rwqcb1/programs/tmdl/Status.html). In cooperation with private landowners and other government resource agencies, the State has initiated efforts to recover beneficial uses of water and improve habitat for species of concern through the Total Maximum Daily Load (TMDL) process. A sediment source assessment, conducted as part of the TMDL process, identified sediment delivery processes and sources in the Scott River watershed and estimated delivery from these sources. The Scott River TMDL reports that the total contribution from natural and anthropogenic sediment sources is 72% above that of background sediment delivery (NCRWQCB 2005). Natural sediment sources are primarily from streamside landslides, bank erosion, and gullying. The largest anthropogenic sediment sources include road-related landslides and stream crossing failures. The Scott River TMDL identifies the need to reduce sediment loading from road-related landsliding by 42% and from failed stream crossings by 71%. Load allocations established in the Scott River TMDL intend to reduce current anthropogenic sediment delivery by a total of 63%. The Action Plan for the Scott River Watershed Sediment and Temperature TMDLs includes, among other components, strategies for implementation and monitoring (implementation monitoring, upslope and instream effectiveness monitoring, and compliance and trend monitoring). A draft of the Klamath River TMDL and Implementation Plan is scheduled for approval by US EPA Region 9 by August 2007.

County Public Works Departments are responsible for management of county roads and bridges. The five counties in northern California – Siskiyou, Del Norte, Humboldt, Trinity, and Mendocino – have joined together in the Five Counties Salmonid Conservation Program (Harris 2002). The program has developed “A Water Quality and Stream Habitat Protection Manual for County Road Maintenance in Northwestern California Watersheds.” County roads, however, represent a very small portion of the total road network and are rare within Fruit Grower’s ownership

2.2 Potential Shallow Instability

Deterministic slope stability modeling was used in combination with available landslide inventories and geomorphic mapping to identify potential shallow mass wasting hazards at the watershed scale. The validity of the modeling results was tested using regional shallow landslide mapping information. Additional air photo mapping and field assessment will be conducted by qualified personnel (i.e., trained RPF, PG, or CEG) to verify unstable and potentially unstable mass wasting hazards at the project scale.

2.2.1 Methods of predicting potential shallow instability

The deterministic shallow landslide model SHALSTAB was used to delineate potential shallow landslide hazards within Fruit Growers’ HCP area. SHALSTAB combines an infinite slope stability model and a steady-state hydrologic model to predict the potential for shallow landsliding controlled by topography and pore water pressure (Montgomery and Dietrich 1994). The model does not predict the location of deep-seated instability nor instability associated with steep, planar slopes forming inner gorges. The SHALSTAB equation relates the pattern of soil saturation (h/z) for a given storm to a hydrologic ratio (q/T) and a topographic ratio (a/b sinθ). The hydrologic ratio q/T captures the magnitude of the precipitation event (represented by q) relative to the subsurface downslope transmissivity (represented by T). The larger q is relative to T, the more likely the ground is to saturate and the greater the potential instability. The topographic ratio a/b sinθ captures the effects of convergent topography on concentrating runoff and elevating pore water pressure. Slope angle and drainage area are determined from a 10-m DEM. The friction angle parameter is set to a constant high value of 45° to compensate for the lack of a total cohesion term. A constant wet soil bulk density of 1700 kg/m^3 (2,865 lb/yd^3) approximates the typical soil bulk density in the HCP area.

A validation test was used to evaluate SHALSTAB performance using the methods of Dietrich et al. (2001). The test compares predicted instability (defined by log q/T values) within mapped shallow landslides and randomly-placed landslide shapes. The model performs well if for unstable log q/T classes, the frequency and cumulative percent of mapped landslides is significantly greater than the frequency and cumulative percent of randomly-placed landslide shapes. Landslides typically encompass more than 100 m^2 (1,076 ft^2) (i.e., one 10 m grid cell) and therefore, more than one log q/T value. The lowest (i.e., most unstable) log q/T value in contact with the landslide polygon is assumed to be the q/T controlling instability. Validation tests encompassed three watershed areas: the Scott River basin (1,895 km^2 [732 mi^2]), portions of the Klamath River basin (1,614 km^2 [623 mi^2]), and portions of the Salmon River basin (212 km^2 [82 mi^2]). The model was not applied to or tested in the Grass Lake Management Unit because shallow landslides are rare and SHALSTAB is generally a poor predictor of potential shallow instability in volcanic terrain typical of that area.

Validation tests were based on landslide data from two primary sources, (1) active landslides mapped by the Klamath National Forest (USFS 2003a) and (2) a landslide inventory of the Scott River basin by the North Coast Regional Water Quality Control Board (NCRWQCB 2005). Landslide attributes include (among other characteristics) year of occurrence, initiation site, geologic and geomorphic setting at the initiation site, slide geometry (length, width, depth, area, and volume), slope steepness and aspect, percent delivery, and land use interpreted as the probable cause of the slide. Due to differences in the methods and resolution of available landslide mapping, SHALSTAB was independently tested using each of the two landslide data sources. In addition to the basin-specific validation tests, tests were also conducted in unique geologic terrains (refer to Section 1.4.1 for a description of geologic terrains). Where a landslide encompasses more than one geologic terrain, the geologic terrain encompassing the largest percentage of the total landslide area was attributed to the landslide.

The following factors may also influence SHALSTAB performance:

- resolution of 10-m DEM data limit characterization of slope;
- where Klamath National Forest landslide data have no attribute for slide type, active landslides were assumed to be shallow debris slides and were included in the validation tests;
- a 36-m (118 ft) radius was used to obtain a 0.4 ha (1-ac) buffer around Klamath National Forest landslide point data, an area approximately equal to the average area of debris slide polygons mapped in the Scott River basin by the Regional Water Board; and
- the resolution of available geologic mapping simplifies complex geologic and geomorphic controls on landslide initiation, size, and delivery.

2.2.2 Potential shallow instability

2.2.2.1 General distribution of predicted instability in the HCP area

Table 2 summarizes the distribution of potential shallow landslide instability predicted by SHALSTAB on Fruit Growers ownership within the Klamath River and Scott Valley Management units. These results, shown with active landslides mapped by the USFS (2003a), are illustrated in Figure 9. High potential instability is represented by areas where log q/T $\leq$ -2.8, and moderately high potential instability is represented by areas where log q/T $\leq$ -2.5. These results provide a means of identifying potentially unstable area on Fruit Growers ownership and the proportion of each planning watershed represented by this potential instability (Table 3,

Figure 10). Approximately 12% of the total Fruit Growers ownership is characterized as potentially highly unstable, and approximately 25% is characterized as moderately highly unstable. Areas with relatively high potential for shallow instability generally occur on steep convergent slopes in metamorphic, granitic, and mafic–ultramafic geologic terrains (Figure 11, Figure 12), while sedimentary and volcanic terrains are comparatively stable.

Table 2. SHALSTAB results by planning watershed.

Management unit	Planning watershed	Total area, km2	Area of FGS ownership, km2	Area, km^2, of potential instability on FGS ownership						
				Chronic Instability						Stable
				<-9.9	-9.9 to -3.1	-3.1 to -2.8	-2.8 to -2.5	-2.5 to -2.2	-2.2 to 9.9	>9.9
Klamath River	Beaver	281.9	68.5	0.1	3.0	3.5	6.3	6.3	2.7	46.6
	Cottonwood	257.1	65.9	0.3	2.7	3.1	7.2	10.3	6.4	35.5
	Doggett	31.1	16.1	0.0	0.6	0.7	0.9	0.7	0.2	13.0
	Dona	34.2	10.1	0.0	0.3	0.3	0.6	0.4	0.1	8.5
	Dutch Creek	26.1	12.0	0.1	1.1	1.2	2.3	2.9	1.8	2.6
	Elliott Creek	86.2	18.2	0.2	2.0	2.1	3.0	1.8	0.6	7.7
	Empire Creek	24.4	10.8	0.1	0.6	0.8	1.6	2.4	1.5	3.8
	Horse	157.7	39.1	0.0	2.6	2.8	3.3	1.5	0.5	28.2
	Lumgrey Creek	22.2	10.2	0.0	0.2	0.4	1.2	1.6	0.9	5.8
	Middle Klamath	620.8	7.1	0.0	0.6	0.9	1.4	1.4	0.6	2.1
	Seiad	136.7	5.8	0.0	0.5	0.5	0.9	1.1	0.9	1.9
	Klamath River Total	**1678.5**	**263.7**	**0.9**	**14.4**	**16.2**	**28.8**	**30.3**	**16.2**	**155.6**
Scott Valley	Big Ferry	25.4	5.2	0.04	0.5	0.5	0.7	0.5	0.2	2.7
	Canyon	52.3	8.0	0.02	0.4	0.4	0.9	0.9	0.5	4.8
	Duzel	26.5	0.05	-	-	-	0.00	0.01	0.01	0.0
	EF Scott	294.8	0.7	-	0.1	0.2	0.2	0.1	0.01	0.3
	Indian	56.1	16.1	0.03	0.8	1.0	2.3	2.9	1.7	7.3
	McConaughy	97.0	0.5	-	0.02	0.1	0.1	0.0	0.0	0.2
	Meamber	33.2	20.4	0.04	0.8	0.9	2.2	2.9	1.4	12.1
	Mill	57.8	5.8	0.02	0.3	0.4	0.9	0.8	0.3	3.0
	Moffett	379.8	79.2	0.1	4.0	6.2	14.7	14.1	4.9	35.2
	Pat Ford	30.9	8.7	0.02	0.2	0.1	0.4	0.6	0.2	7.1
	Patterson	16.3	8.5	0.04	0.6	0.6	1.6	1.8	0.6	3.2
	Rattlesnake	46.3	4.4	0.03	0.3	0.3	0.8	1.0	0.4	1.6
	Yreka	65.4	0.6	-	0.01	0.01	0.05	0.1	0.04	0.4
	Scott Valley Total	**1181.8**	**158.0**	**0.3**	**8.0**	**10.7**	**25.0**	**25.7**	**10.3**	**77.9**

Table 3. Summary of potential shallow landslide instability on FGS ownership relative to total SHALSTAB validation area.

Management Unit	Planning watershed	Total area, km^2	Area of FGS ownership, km^2	FGS as % of Total	Area with HIGH potential instability (log q/t <= -2.8)		Area with MODERATELY HIGH potential instability (log q/t <= -2.5)	
					FGS, km^2	FGS as % of Total	FGS, km^2	FGS as % of Total
Klamath River	Beaver	281.9	68.5	24%	6.5	2%	12.8	5%
	Cottonwood	257.1	65.9	26%	6.1	2%	13.4	5%
	Doggett	31.1	16.1	52%	1.3	4%	2.2	7%
	Dona	34.2	10.1	30%	0.6	2%	1.1	3%
	Dutch Creek	26.1	12.0	46%	2.4	9%	4.7	18%
	Elliott Creek	86.2	18.2	21%	4.4	5%	7.3	9%
	Empire Creek	24.4	10.8	44%	1.5	6%	3.1	13%
	Horse	157.7	39.1	25%	5.5	3%	8.8	6%
	Lumgrey Creek	22.2	10.2	46%	0.7	3%	1.9	9%
	Middle Klamath	620.8	7.1	1%	1.5	0%	2.9	0%
	Seiad	136.7	5.8	4%	1.1	1%	2.0	1%
	Klamath River Total	**1678.5**	**263.7**	**16%**	**31.5**	**2%**	**60.3**	**4%**
Scott Valley	Big Ferry	25.4	5.2	20%	1.0	4%	1.8	7%
	Canyon	52.3	8.0	15%	0.8	2%	1.7	3%
	Duzel	26.5	0.0	0%	0.0	0%	0.0	0%
	EF Scott	294.8	0.7	0%	0.2	0%	0.4	0%
	Indian	56.1	16.1	29%	1.8	3%	4.2	7%
	McConaughy	97.0	0	1%	0.1	0%	0.2	0%
	Meamber	33.2	20.4	61%	1.8	5%	4.0	12%
	Mill	57.8	5.8	10%	0.8	1%	1.7	3%
	Moffett	379.8	79.2	21%	10.3	3%	25.0	7%
	Pat Ford	30.9	8.7	28%	0.3	1%	0.8	2%
	Patterson	16.3	8.5	52%	1.2	8%	2.9	18%
	Rattlesnake	46.3	4.4	10%	0.6	1%	1.4	3%

Management Unit	Planning watershed	Total area, km^2	Area of FGS ownership, km^2	FGS as % of Total	Area with HIGH potential instability (log q/t <= -2.8)		Area with MODERATELY HIGH potential instability (log q/t <= -2.5)	
					FGS, km^2	FGS as % of Total	FGS, km^2	FGS as % of Total
	Yreka	65.4	0.6	1%	0.0	0%	0.1	0%
	Scott Valley Total	**1181.8**	**158.0**	**13%**	**19.0**	**2%**	**44.0**	**4%**
Grand Total		**2860.2**	**421.8**	**15%**	**50.5**	**12%**	**104.3**	**25%**

In the Klamath River Management Unit, Beaver and Cottonwood Creeks have the largest amount of highly unstable area (each with ~6.5 km^2 [2.5 mi^2]), but that area represents only 2% of each planning watershed and when combined, represents 2% of Fruit Grower's ownership. Elliot and Dutch creeks have less unstable area (4.4 km^2 [1.7 mi^2]) and 2.5 km^2 [1.0 mi^2]), respectively), representing 5% and 9% of each planning watershed. In the Scott Valley Management Unit, Moffet Creek has the largest amount of highly unstable area (10.3 km^2 [4.0 mi^2]), representing 3% of the planning watershed. Meamber, Indian, and Patterson creeks have less highly unstable area (1.8 km^2, 1.8 km^2, and 1.3 km^2 [0.7 mi^2, 0.7 mi^2, and 0.5 mi^2]), representing 5%, 3%, and 8% of each planning watershed.

2.2.2.2 Validation results

A total of 341 active slides mapped by the USDA Forest Service (USFS 2003a) in the Klamath, Scott, and Salmon River basins (Table B-1, Figure B-1) were used to test the SHALSTAB results and relate potential instability to geologic terrains. Mapped slides were initially separated into those with road association and no road association, except for the Salmon River basin, where no road data were available. Validation tests were then conducted with all slides and with only the non-road-related slides. Results from the validation tests indicate that 78% of the slides in the Klamath basin and more than 86% of the slides in the Salmon and Scott river basins occurred in areas where log q/T was ≤ -2.8; while 90% of the slides in the Klamath basin and more than 95% of the slides in the Salmon and Scott river basins occurred in areas where log q/T was ≤ -2.5 (Figure 13a). In all three basins, observed landslide density increased sharply at a log q/T of -2.8 (Figure 13b). These results did not change significantly when using only non-road-related slides. SHALSTAB performed similarly well in granitic, mafic/ultramafic, and metamorphic terrains; but not as well in sedimentary terrain (Figure 14), possibly due to the local influence of bedding and dip orientation on shallow landslide instability in sedimentary rocks.

A total of 190 active slides mapped by the North Coast Regional Water Quality Control Board (NCWQCB 2005) was used to test the SHALSTAB results and relate potential instability to geologic terrains in the Scott River basin (Table B-2, Figure B-2). Mapped slides were separated into those mapped as points (n=91) and polygons (n=99). Separate validation tests were then conducted for slides with and without road association for both polygon and point landslide data. Results from the validation tests indicate that 95% of the slides mapped as polygons in the Scott River basin occurred in areas where log q/T was ≤ -2.8, and 96% of the slides occurred in areas where log q/T was ≤ -2.5 (Figure 15a). Validation results were not as good using slides areas created from point data, as would be expected since the areas created from landslides points may be a poor approximation of the actual landslide area. In all cases observed landslide density increases sharply at log q/T of -2.8 (Figure 15b). These results did not change significantly when using only non-road-related slides. SHALSTAB performed similarly well in granitic and metamorphic terrains, but not as well in mafic/ultramafic terrain, possibly due to the interaction between shallow and deep-seated mass wasting processes (Figure 16a and 16b).

The results from the validation tests demonstrate that (1) the majority of mapped landslides occur in areas predicted to be unstable, and (2) a threshold exists at a log (q/T) value of -2.8 where the density of mapped landslides increases sharply. The significant deviation in both the cumulative percent of landslides and landslide density between mapped landslides and randomly placed "landslide" polygons indicates that the model is unbiased and effective at predicting areas with greater potential for shallow instability. Similar patterns in the cumulative percent of landslides and landslide density curves occur when the validation is conducted by geologic terrain, indicating generally good model performance in various geologic terrains. The good model performance is consistent with previous validation tests in the northern California Coast Range (Dietrich et al. 2001), Oregon Coast Range (Montgomery and Dietrich 1994), and western Washington (Shaw and Vaugeois 1999).

2.3 Potential Deep-seated Instability

Reactivation of existing deep-seated features is more common than initiation of mass movement in areas without evidence of prior movement. Slopes prone to deep-seated reactivation commonly occur in (1) convergent headwall basins filled with thick colluvium, where concentrated surface runoff from roads, skid trails, and landings may be directed; and (2) toe slopes susceptible to removal of lateral support by road construction, timber harvest, or active channel erosion.

Recognition of deep-seated landslide terrain and complex landslide-prone terrain is a critical first step to predicting and avoiding potential deep-seated landslide instability. Active and dormant deep-seated and complex landslide-prone terrain in the HCP area are compiled by Elder and Reichert (2006) as part of an effort by the USFS to map landforms in the Klamath National Forest and surrounding areas (Figures 17a and 17b). Active deep-seated landslides and complex landslide-prone terrain is uncommon in the HCP area and concentrated in or near the Klamath River Management Unit. Dormant complex-landslide-prone terrain, primarily consisting of features mapped as undifferentiated slides and headwall basins, is common in both the Klamath River and Scott Valley Management Unit. Deep-seated landslides, mapped mostly as rotational/translational slides, extend throughout most of Beaver Creek and to a lesser extent in portions of Horse Creek. The compilations of landform mapping by Elder and Reichert (2006), used in combination with aerial photographic interpretation and field mapping on a project basis to verify landslide boundaries, classification, and activity state provides the basis for conservation measures designed to avoid accelerated movement or reactivation of deep-seated landslides and complex landslide-prone terrain.

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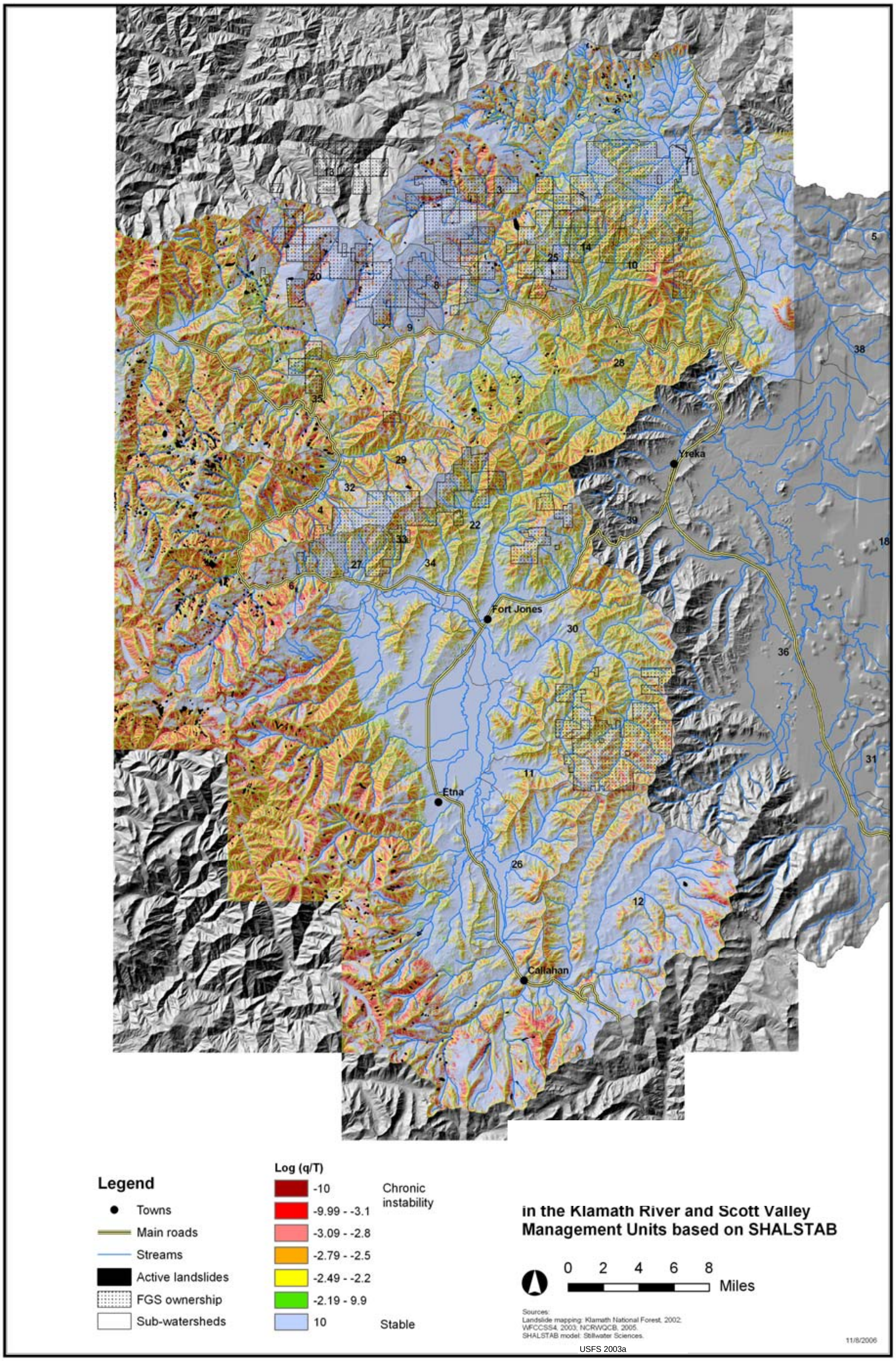


Figure 9. Potential shallow landslide instability in the Klamath River and Scott Valley Management Units based on SHALSTAB.

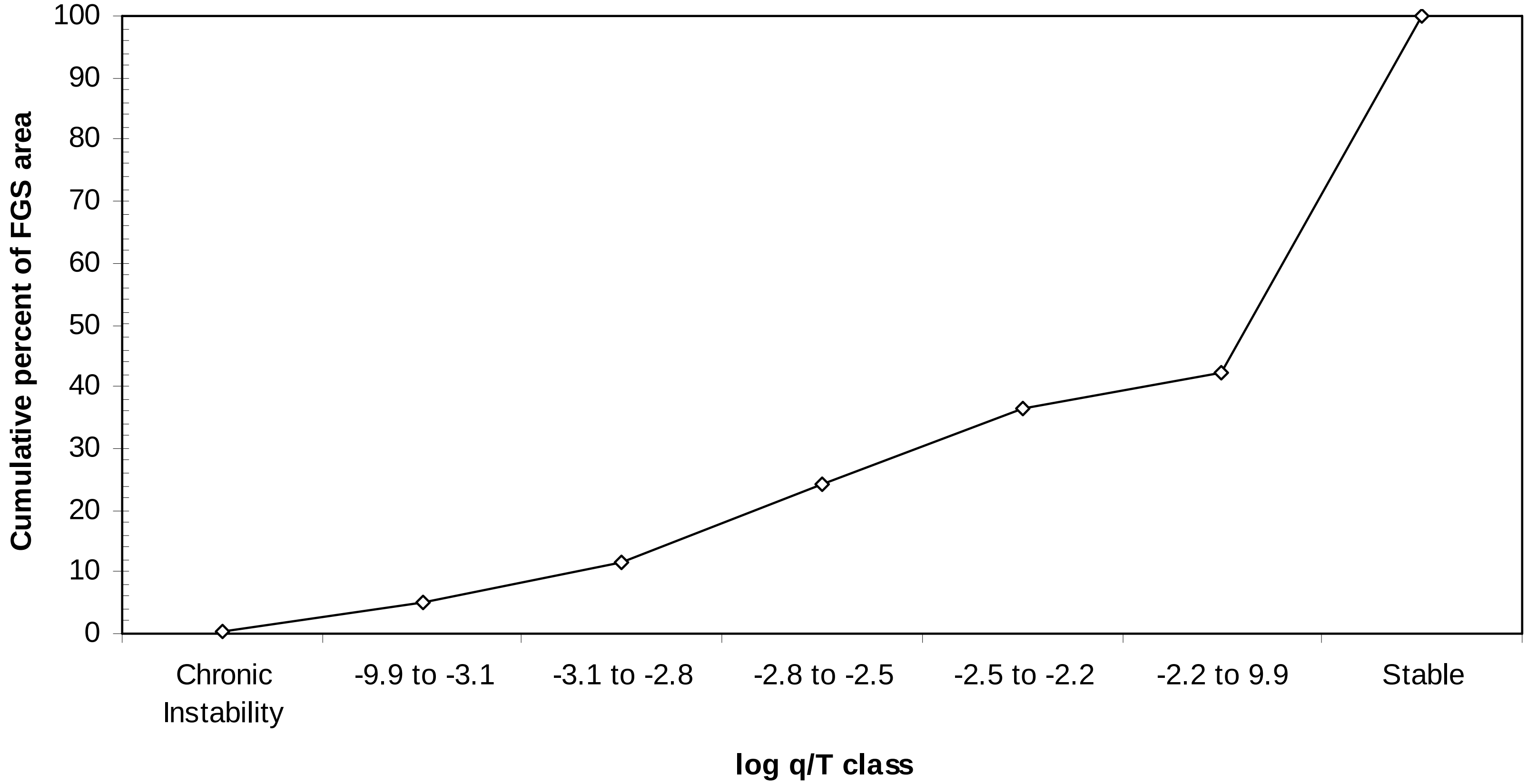


Figure 10. Potential shallow landslide instability on FGS ownership.

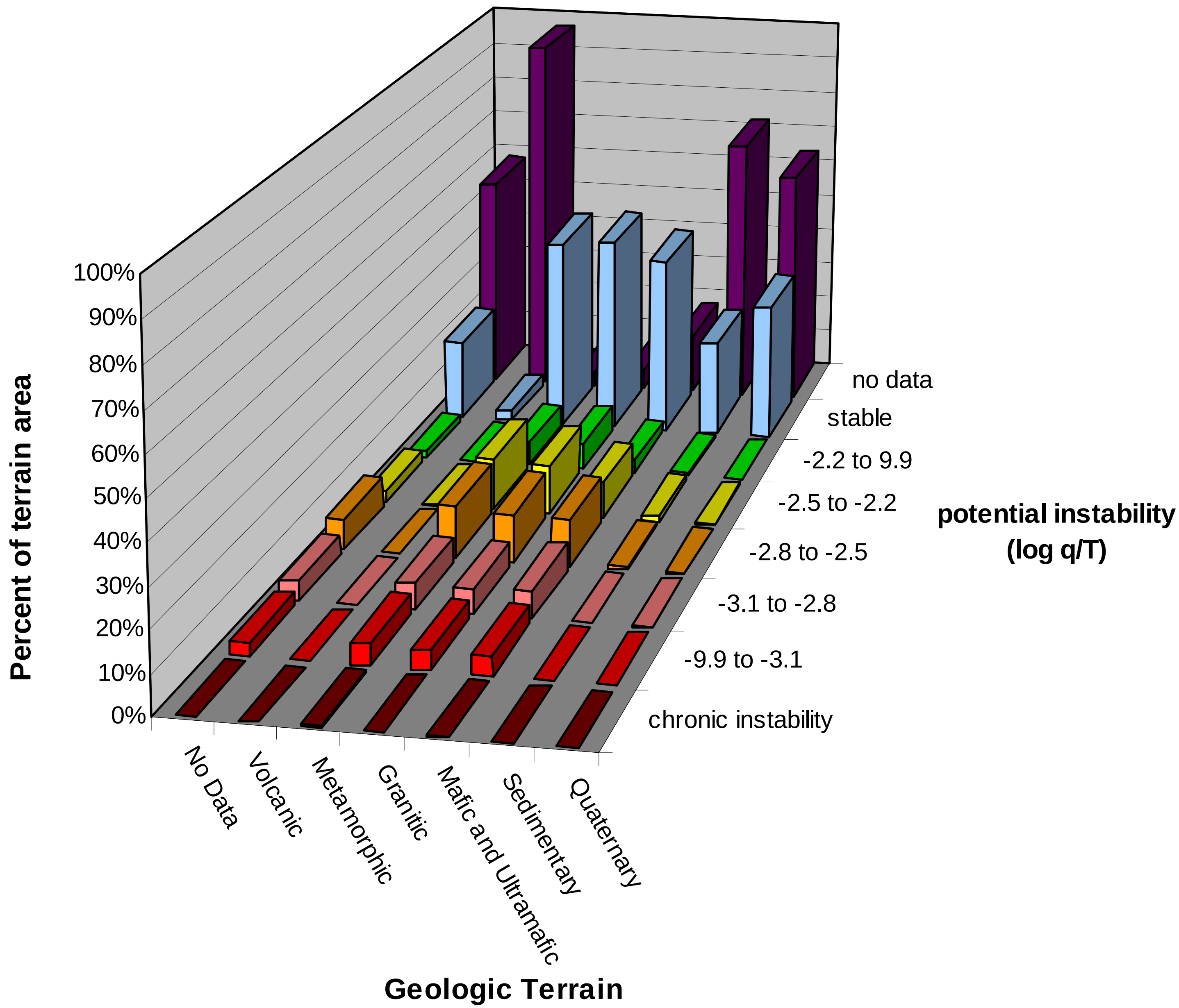


Figure 11. Percent of geologic terrain area in SHALSTAB log (q/T) classes within the Klamath River and Scott Valley Management Units of the HCP area.

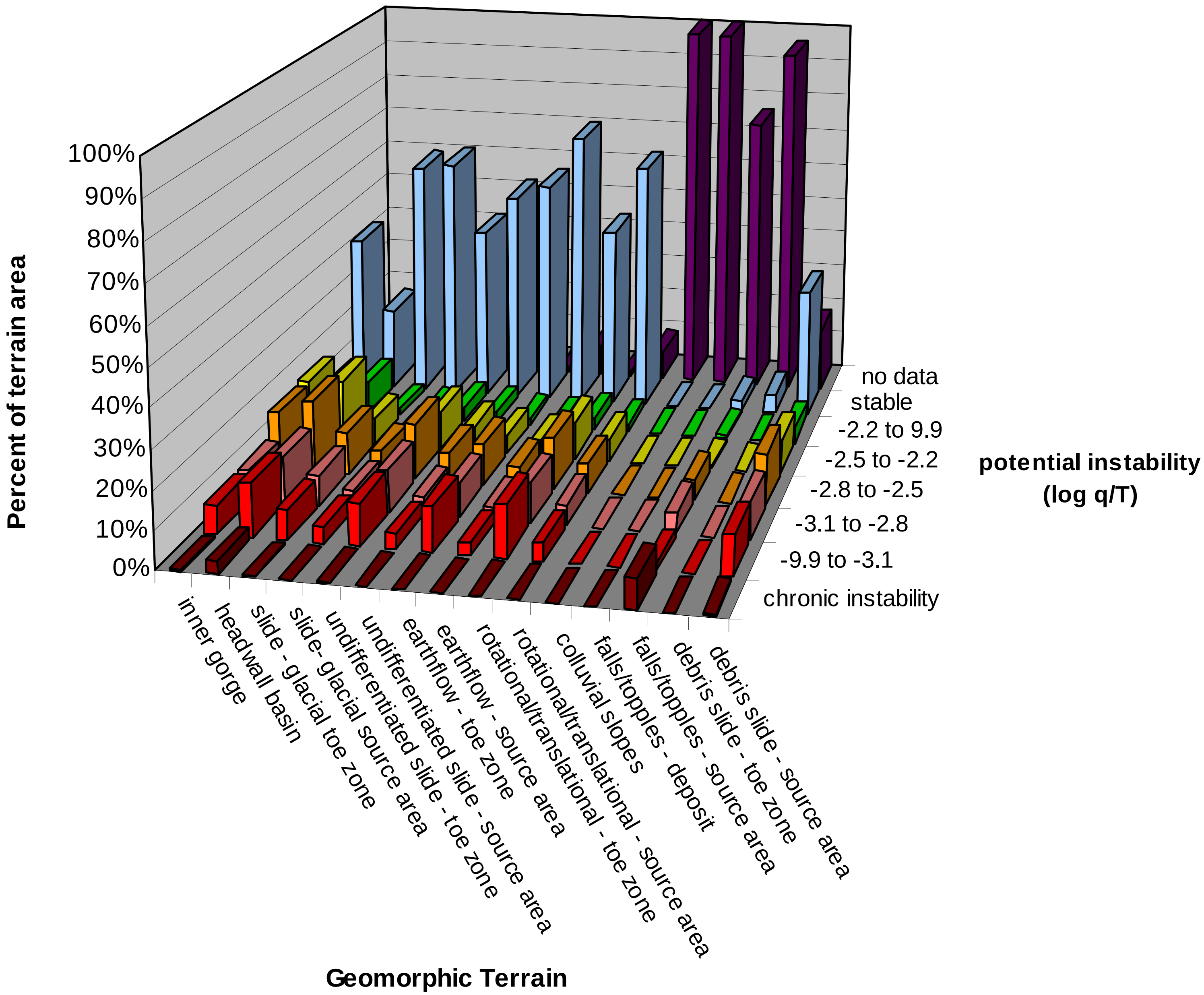


Figure 12. Percent of geomorphic terrain area in SHALSTAB log (q/T) classes within the Klamath River and Scott Valley Management Units Of the HCP area.

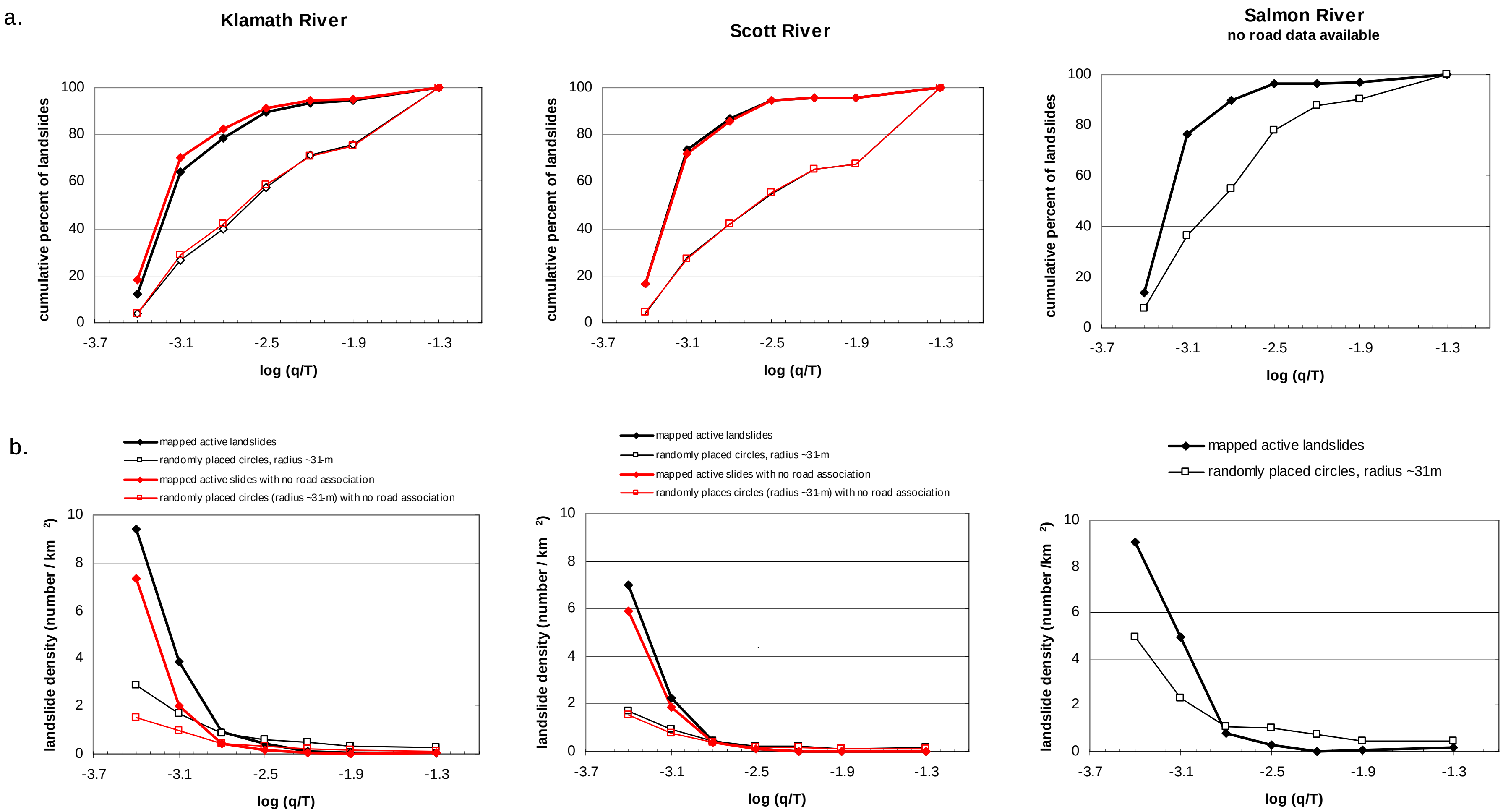


Figure 13. SHALSTAB validation results in the Klamath River, Scott River, and Salmon River validation areas. Active landslides mapped by Klamath National Forest (KNF 2002). (a) Cumulative percent of all active landslides, landslides with no road association, and of randomly placed circles (radius ~31-m) as a function of log (q/T) class. (b) Landslide density (number of landslides per total validation area) for all active slides, landslides with no road association, and randomly placed circles.

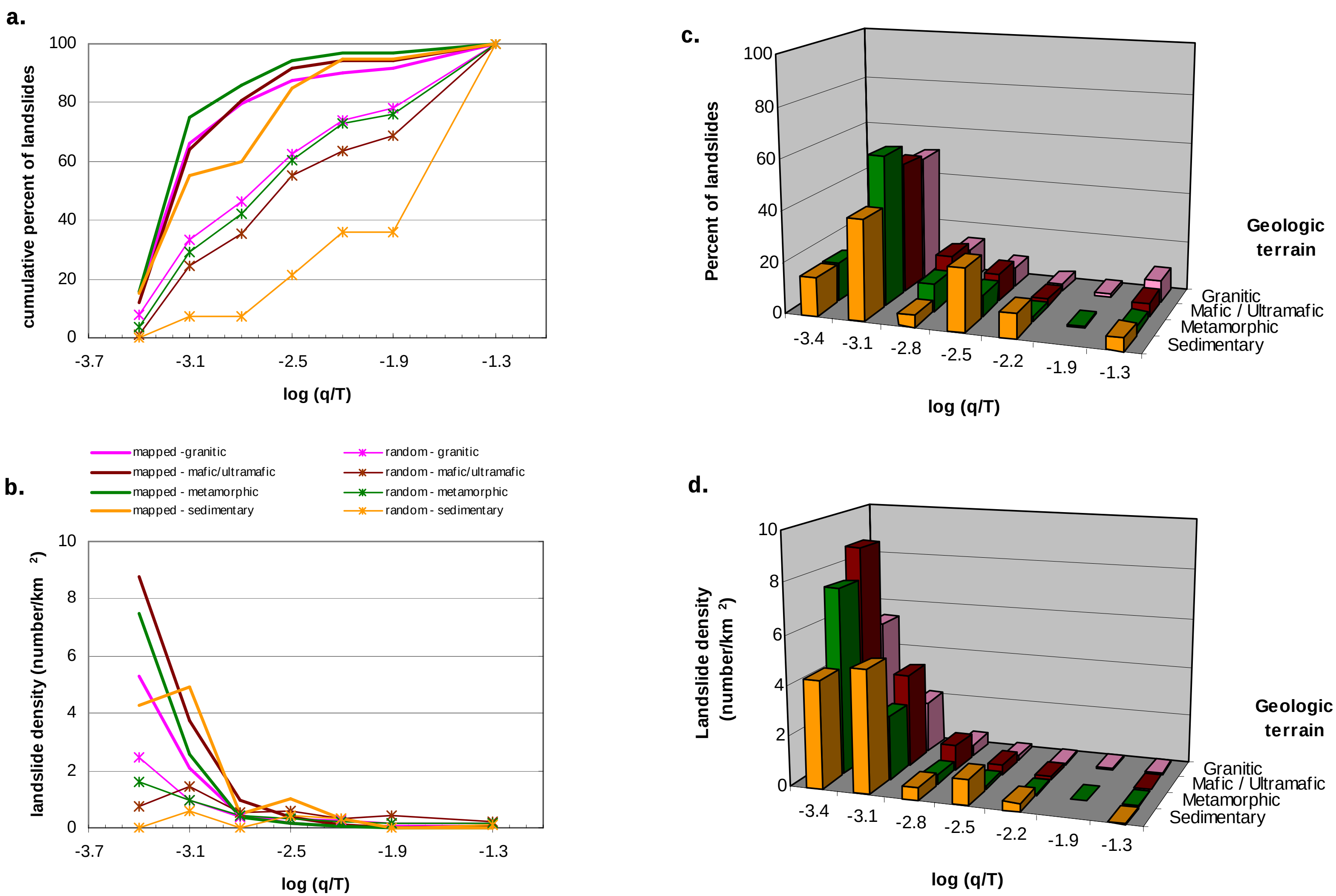


Figure 14. SHALSTAB validation results by geologic terrain in the Klamath River, Scott River, and Salmon River validation areas. Active landslides mapped by Klamath National Forest (KNF 2002). (a) Cumulative percent of mapped active landslides with no road association and of randomly placed circles (radius ~31-m) as a function of log (q/T) class. (b) Landslide density (number of landslides per total validation area for mapped active slides and randomly placed slides. (c) Percentage of active landslides by geologic terrain and log (q/T) class. (d) Landslide density by geologic terrain and log (q/T) class.

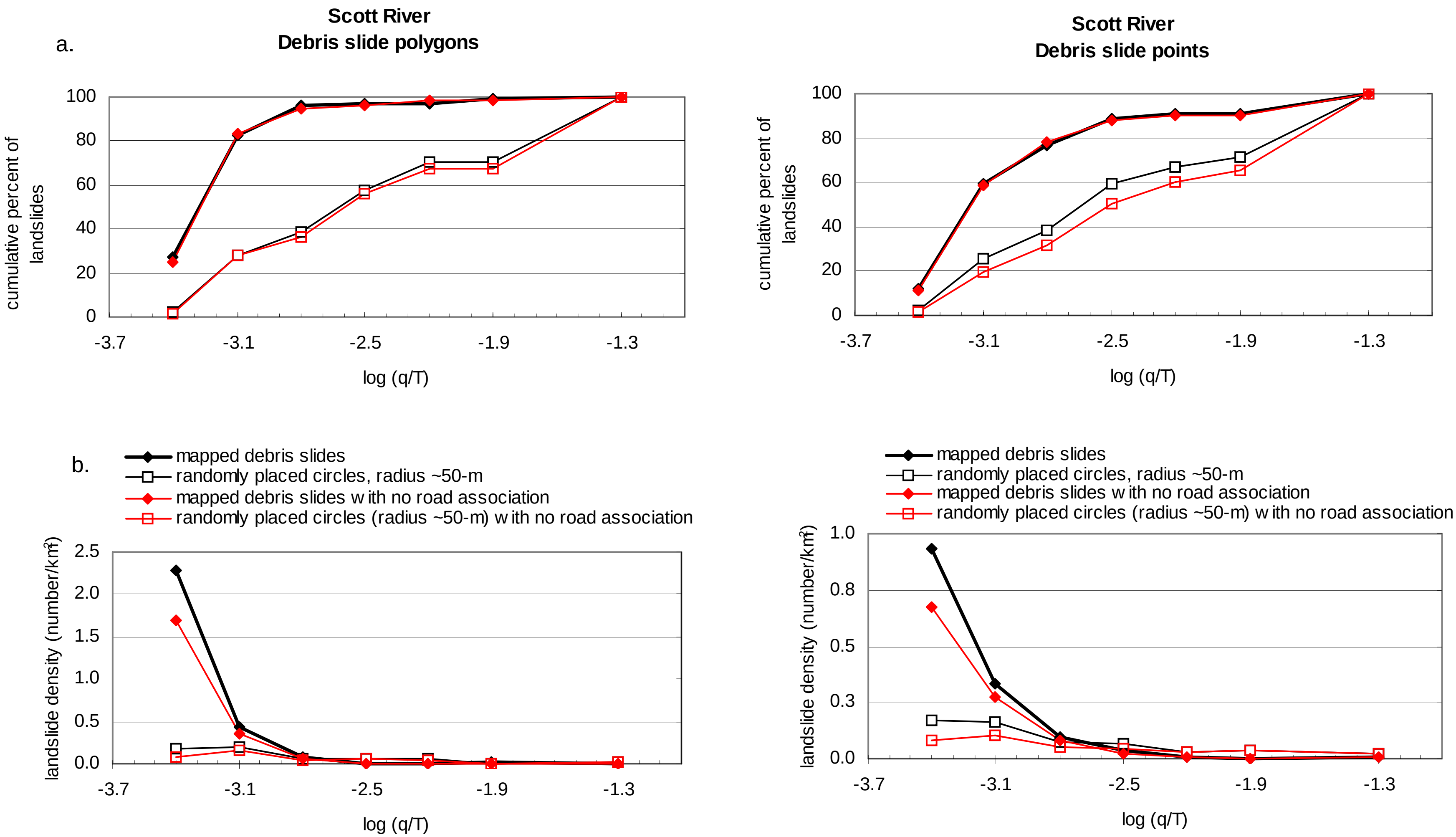


Figure 15. SHALSTAB validation results in the Scott River validation area. Landslides mapped VESTRA (NCWQCB 2005). (a) Cumulative percent of all debris slides, debris slides with no road association, and of randomly placed circles (radius ~50-m) as a function of log (q/T) class. (b) Landslide density (number of landslides per total validation area) for all debris slides, debris slides with no road association, and randomly placed circles.

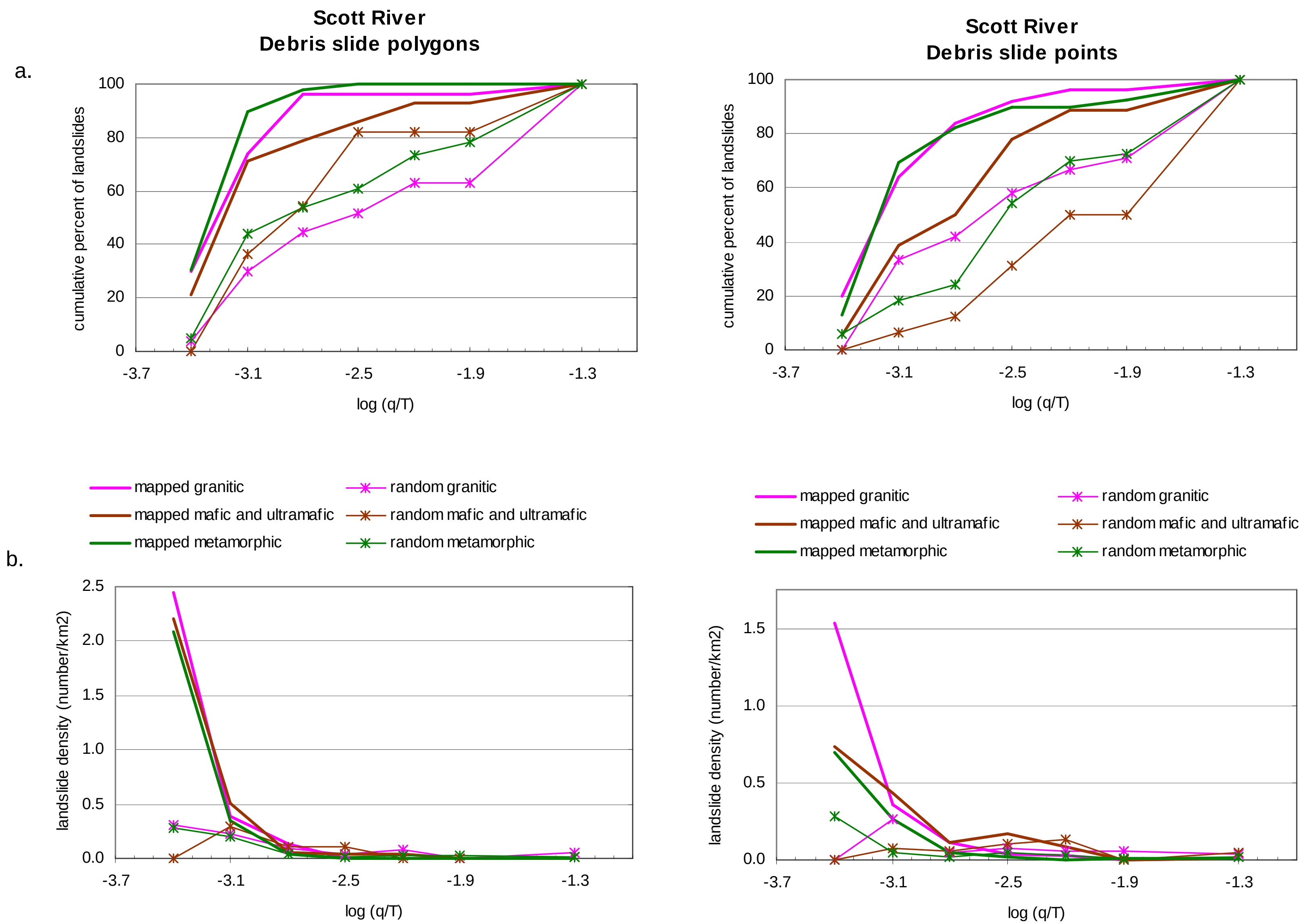


Figure 16. SHALSTAB validation results by geologic terrain in the Scott River validation.
Debris slides mapped by VESTRA (NCWQCB 2005). (a) Cumulative percent of debris slides with no road association and of randomly placed circles (radius ~50-m) as a function of log (q/T) class. (b) Landslide density (number of landslides per total validation area For mapped active slides and randomly placed circles.

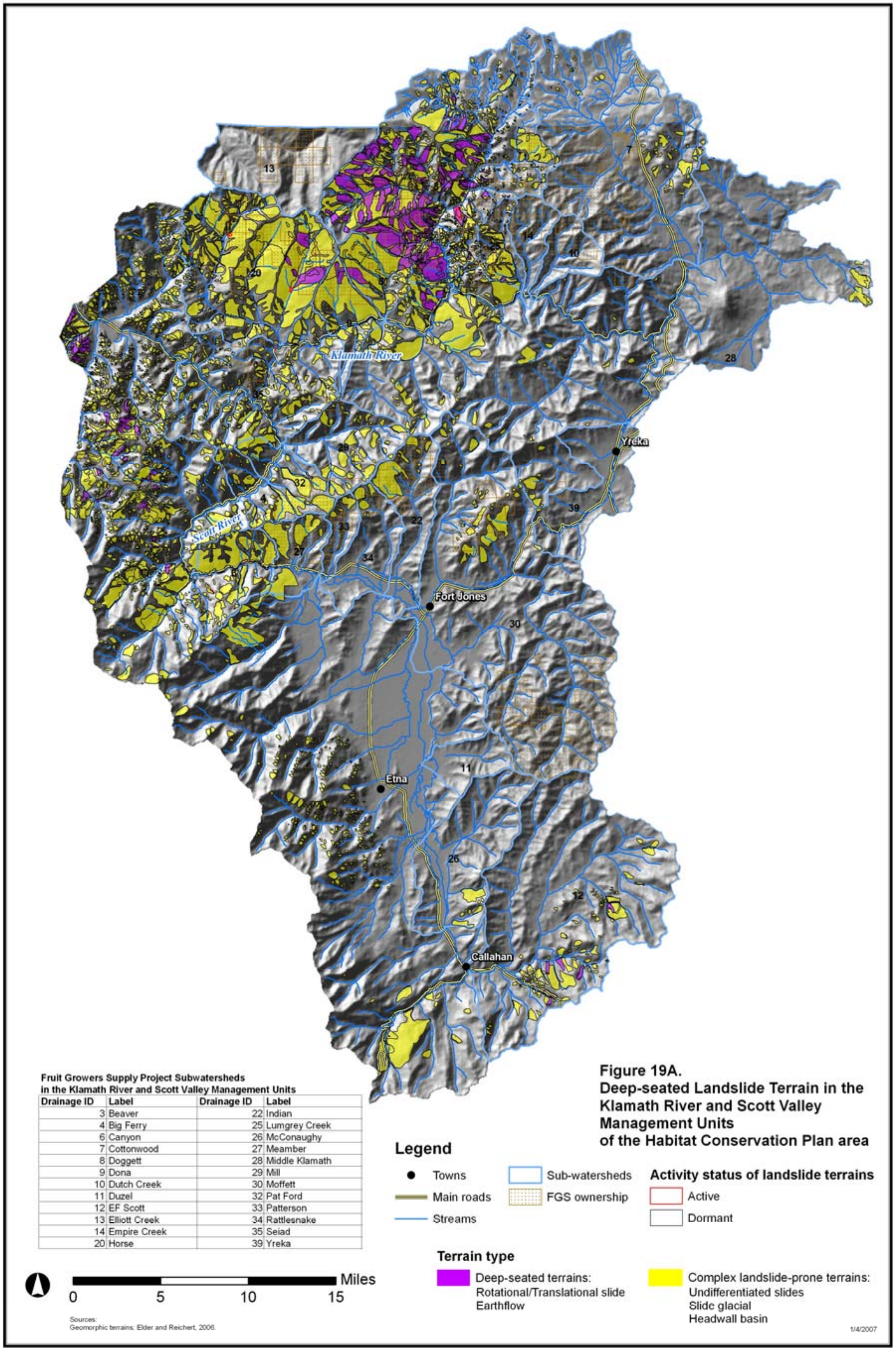
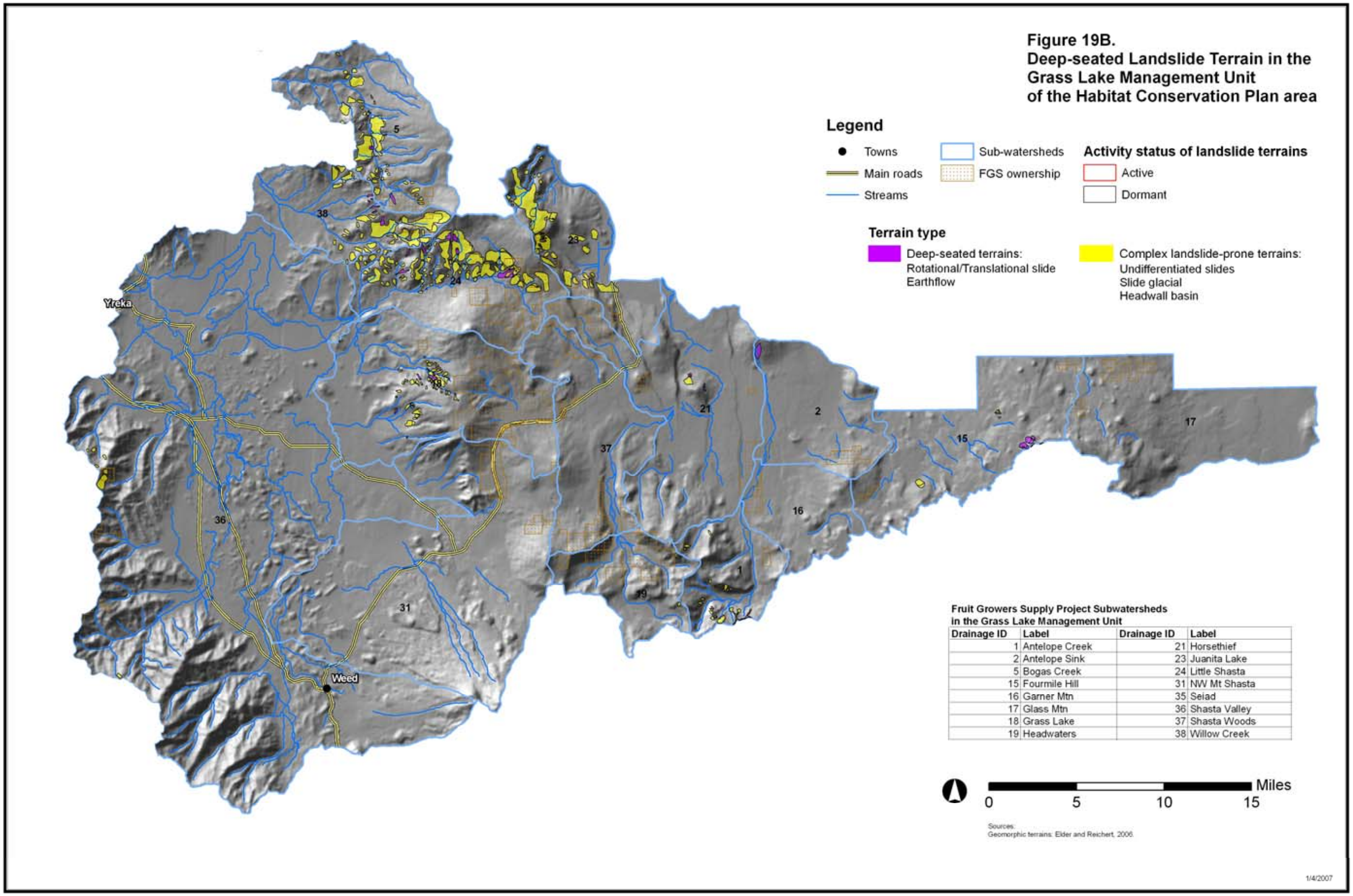


Figure 17a. Deep-seated landslide terrain in the Klamath River and Scott Valley Management Units of the Habitat Conservation Plan area.



Drainage ID	Label	Drainage ID	Label
1	Antelope Creek	21	Horsethief
2	Antelope Sink	23	Juanita Lake
5	Bogas Creek	24	Little Shasta
15	Fourmile Hill	31	NW Mt Shasta
16	Garner Mtn	35	Seiad
17	Glass Mtn	36	Shasta Valley
18	Grass Lake	37	Shasta Woods
19	Headwaters	38	Willow Creek

Figure 17B. Deep-seated landslide terrain in the Grass Lake Management Unit of the Habitat Conservation Plan area.

Appendices

Appendix B

Landslide data used in SHALSTAB validation tests

Table B-1. Summary of active landslides (AS) in the Klamath River, Scott River, and Salmon Rivers validation areas.[1]

Basin	Granitic terrain				Mafic and Ultramafic terrain				Metamorphic terrain				Sedimentary terrain				Total			
	Area, km^2	**Total number of AS[2]**	**Number of AS with no road association[3]**	**Total slide area[4], hectare (ha)**	**Area, km^2**	**Total number of AS**	**Number of AS with no road association**	**Total slide area, ha**	**Area, km^2**	**Total number of AS**	**Number of AS with no road association**	**Total slide area, ha**	**Area, km^2**	**Total number of AS**	**Number of AS with no road association**	**Total slide area, ha**	**Area, km^2**	**Total number of AS**	**Number of AS with no road association**	**Total slide area, ha**
Klamath	336	181	73	74	155	126	98	76	1,032	538	267	362	91	17	13	4	1,614	862	451	515
Scott	355	103	89	108	255	64	53	78	1,286	338	280	261	0	0	0	0	1,895	505	422	447
Salmon[5]	43	57	57	23	12	20	20	25	153	145	145	85	2	1	1	0	212	223	223	133
Total	**734**	**341**	**219**	**204**	**422**	**210**	**171**	**179**	**2,471**	**1,021**	**692**	**708**	**93**	**18**	**14**	**4**	**3,720**	**1,590**	**1,096**	**1,095**

[1] Active landslide data compiled by the Klamath National Forest from three mapping projects: LMP geologic mapping (1992), Salmon Sub-basin Sediment Analysis (1994), and 1997 Flood Assessment (1998). Data resolution is 1:24,000.
[2] Active slides include features interpreted as showing movement within the last 400 years.
[3] A 5-m road buffer was applied to a GIS road coverage to identify landslides that have potential association with a mapped roadway.
[4] Area estimates of active landslides are derived from the percentage of mapped landslide within each geologic terrain.
[5] No road information was available for the Salmon River watershed.

Table B-2. Summary of debris slides (DS) data in the Scott River basin.[1]

GIS coverage type	Granitic terrain			Mafic and Ultramafic terrain			Metamorphic terrain			Total		
	Total number of DS	Number of DS with no road association[2]	Total slide area[3], ha	Total number of DS	Number of DS with no road association	Total slide area, ha	Total number of DS	Number of DS with no road association	Total slide area, ha	Total number of DS	Number of DS with no road association	Total slide area, ha
polygon[4]	32	27	55.1	11	11	11.0	56	41	79.0	99	79	145.2
point[5]	26	24	10.5	19	16	7.6	46	33	18.5	91	73	36.6

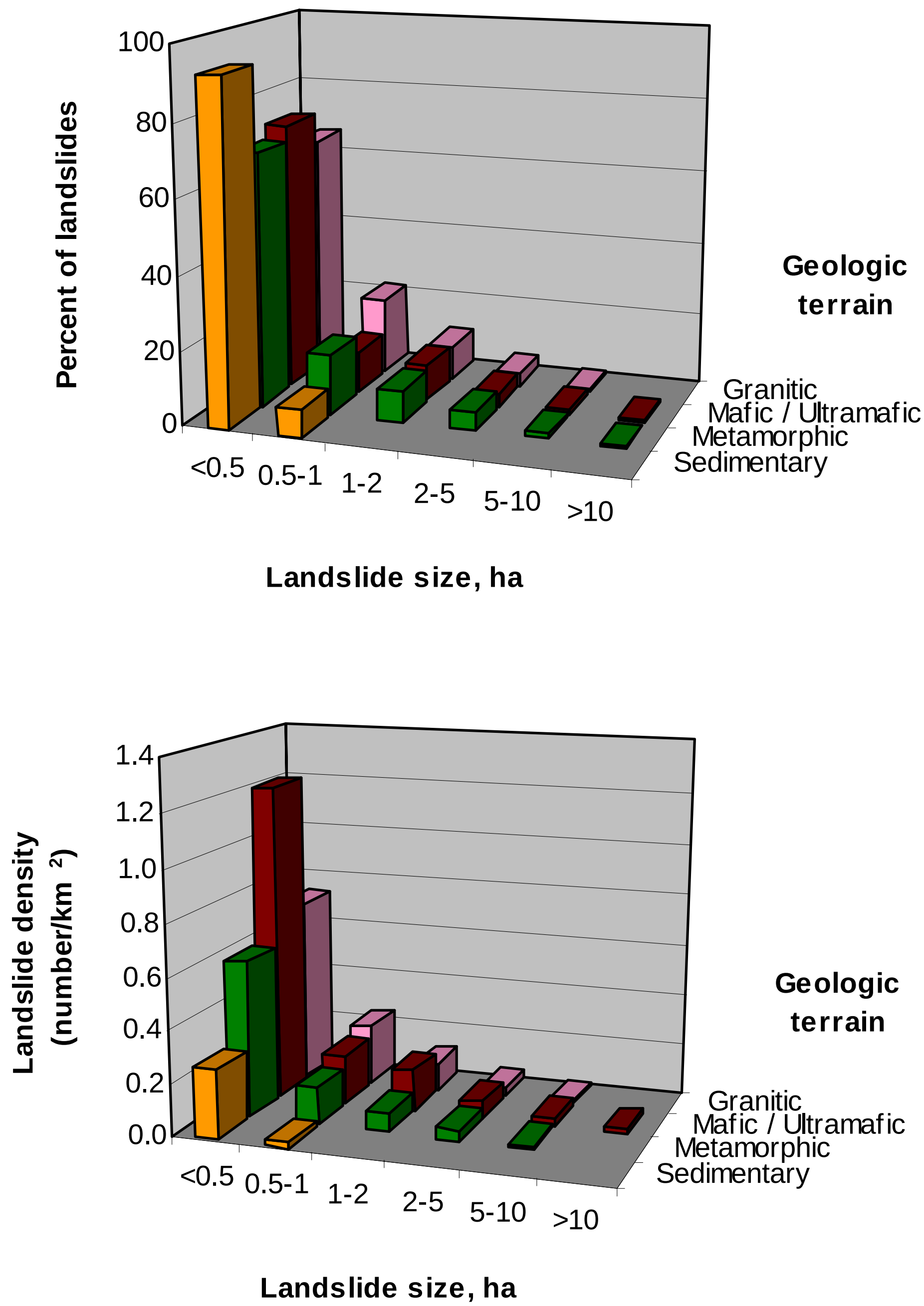


Figure B-1. Summary of active landslides by size and geologic terrain in the Klamath River, Scott River, and Salmon River validation areas.

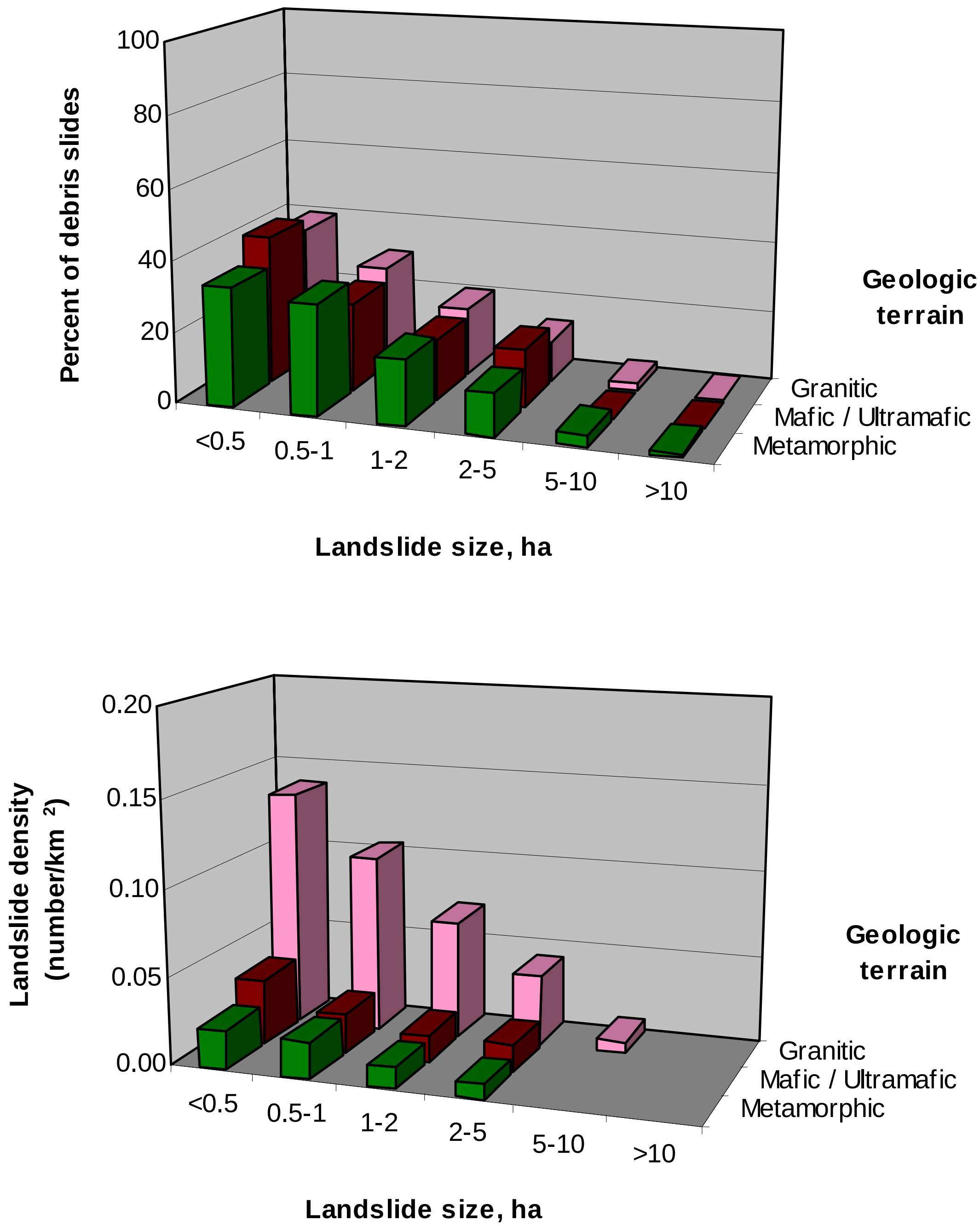
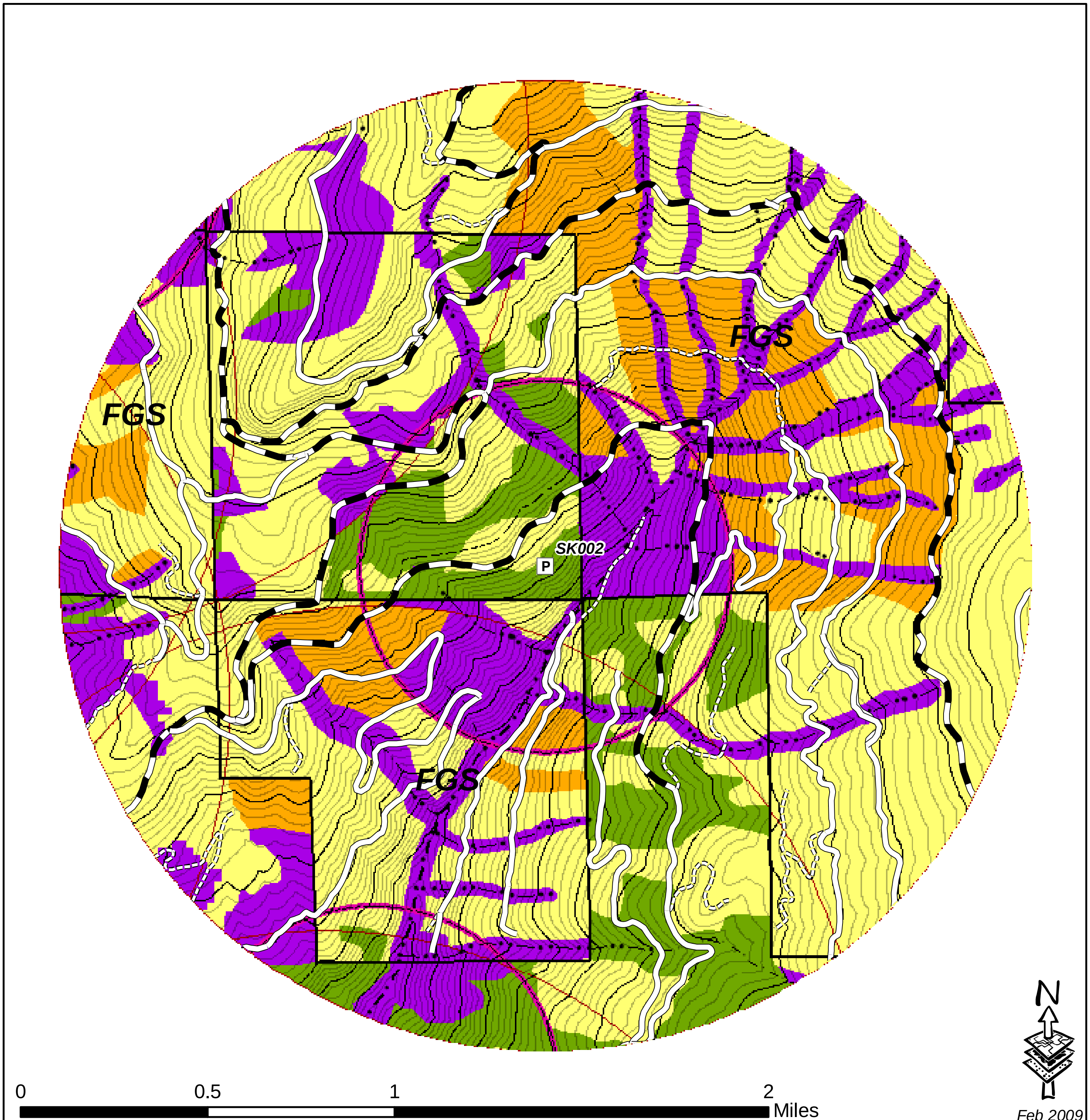


Figure B-2. Summary of debris slides (polygon data) by size and geologic terrain in the Scott River validation areas.

APPENDIX D

Conservation Support Area Maps



NSO Home Range and Core

Target Habitat Distribution

Current Status
- R Reproductive Pair
- P Nesting Pair
- T Territorial Single
- ⊗ Abandoned

NSO Habitat
- Unsuitable
- Low Foraging
- High Foraging
- Nesting/Roosting

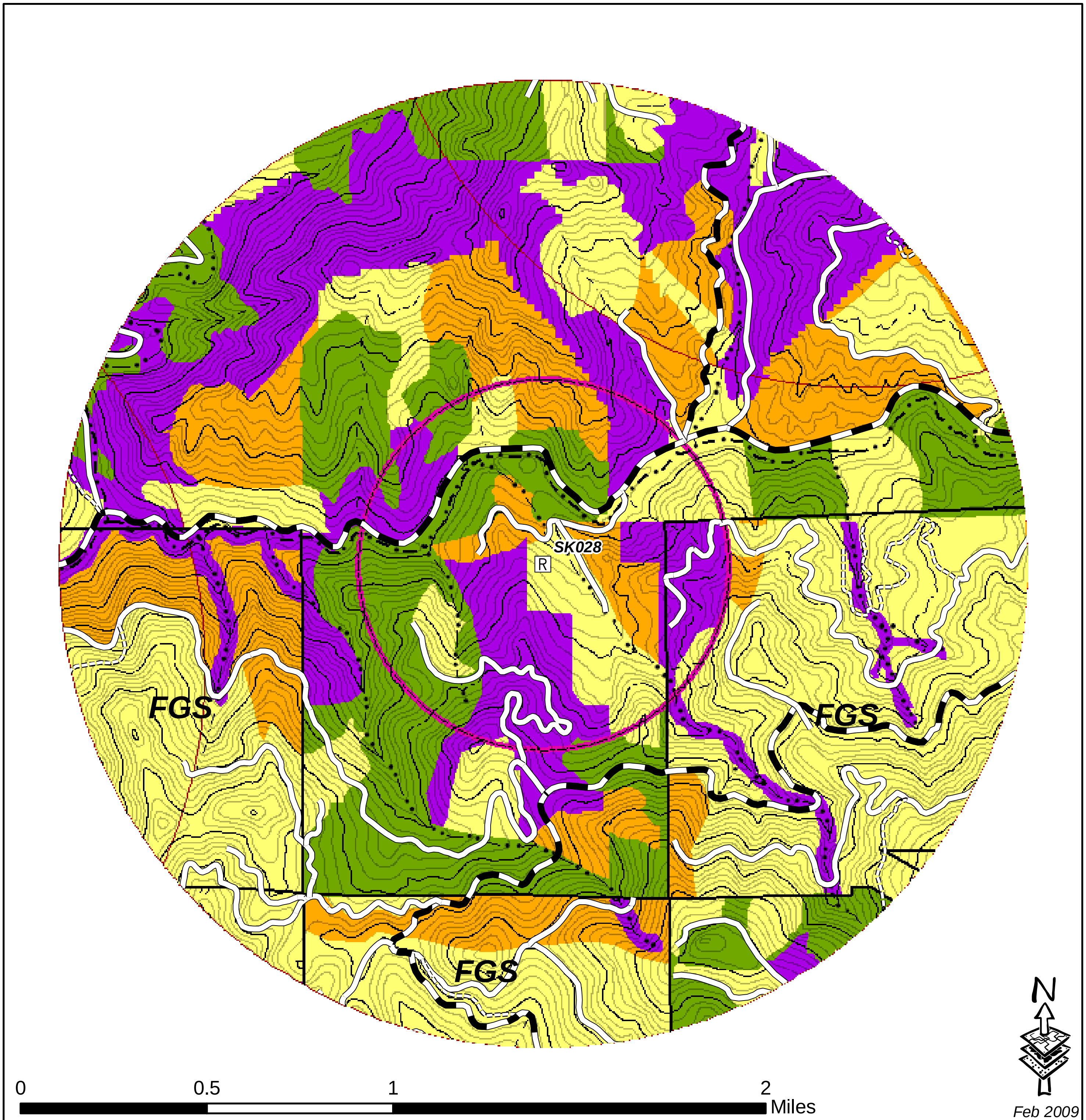
Streams
- Fish
- Non-Fish
- Intermittent

Roads
- Primary
- Secondary
- Local

- FGS Ownership
- NSO 0.5 mile Core

SK002

Map Prepared by FGS - lxpht002953\NSO CSA editing



NSO Home Range and Core

Target Habitat Distribution

Current Status
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NSO Habitat
- Unsuitable
- Low Foraging
- High Foraging
- Nesting/Roosting

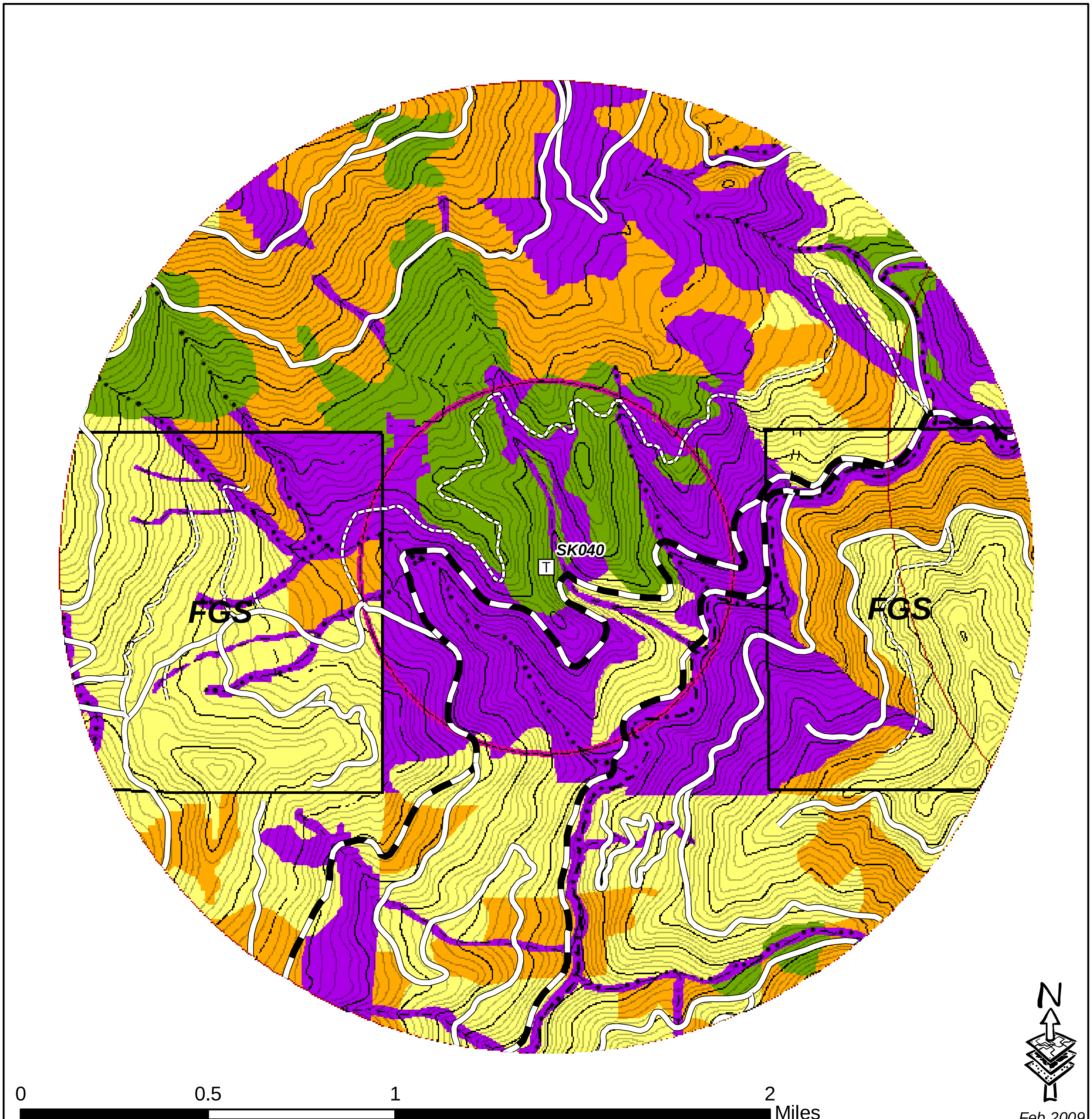
Streams
- Fish
- Non-Fish
- Intermittent

Roads
- Primary
- Secondary
- Local

- FGS Ownership
- NSO 0.5 mile Core

SK028

Map Prepared by FGS - lxpht002953\NSO CSA editing



NSO Home Range and Core

Target Habitat Distribution

Current Status
- R Reproductive Pair
- P Nesting Pair
- T Territorial Single
- ⊗ Abandoned

NSO Habitat
- Unsuitable
- Low Foraging
- High Foraging
- Nesting/Roosting

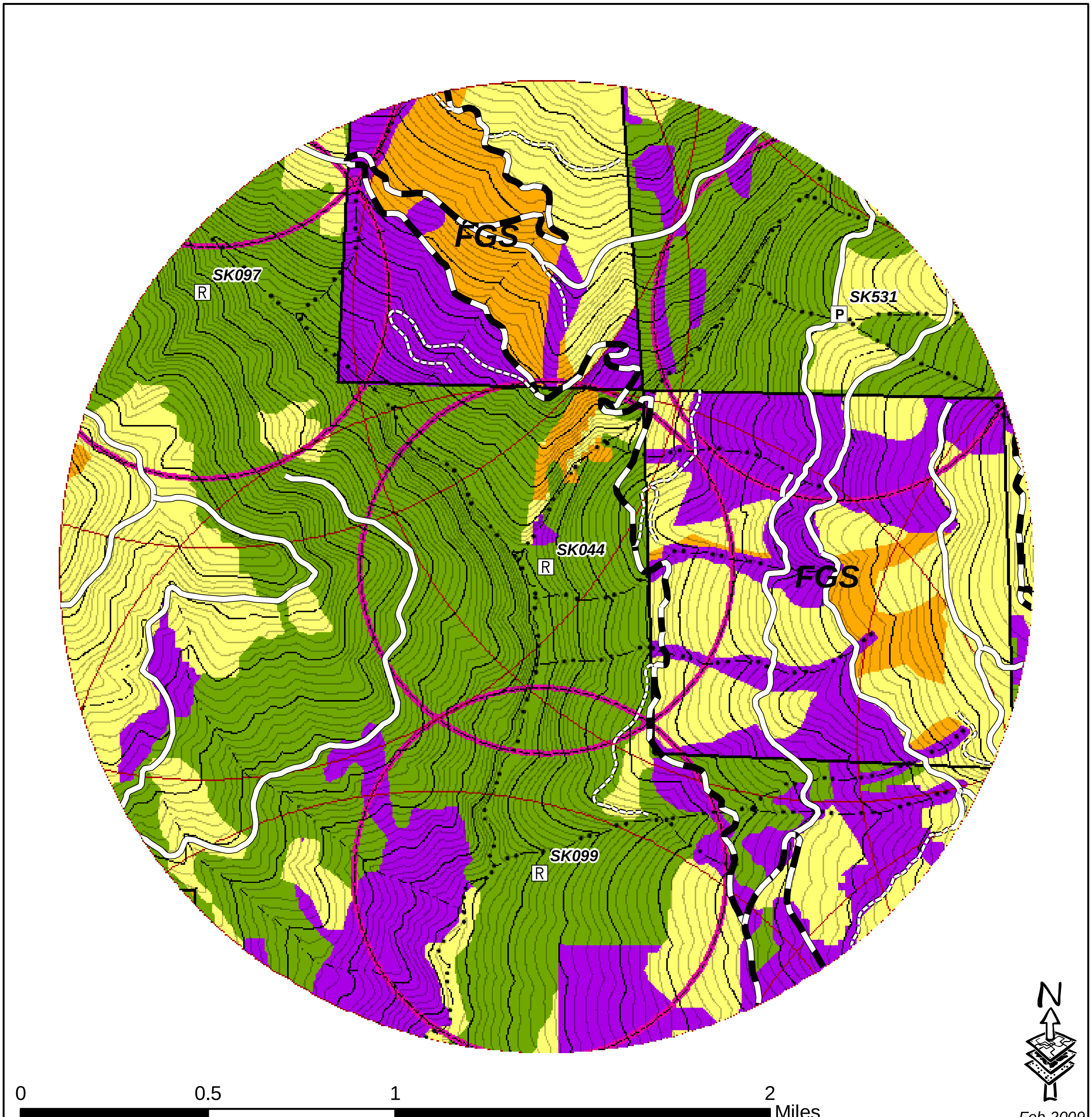
Streams
- Fish
- Non-Fish
- Intermittent

Roads
- Primary
- Secondary
- Local

- FGS Ownership
- NSO 0.5 mile Core

SK040

Map Prepared by FGS - lxpht002953\NSO CSA editing



NSO Home Range and Core

Target Habitat Distribution

Current Status
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- P Nesting Pair
- T Territorial Single
- ⊗ Abandoned

NSO Habitat
- Unsuitable
- Low Foraging
- High Foraging
- Nesting/Roosting

Streams
- Fish
- Non-Fish
- Intermittent

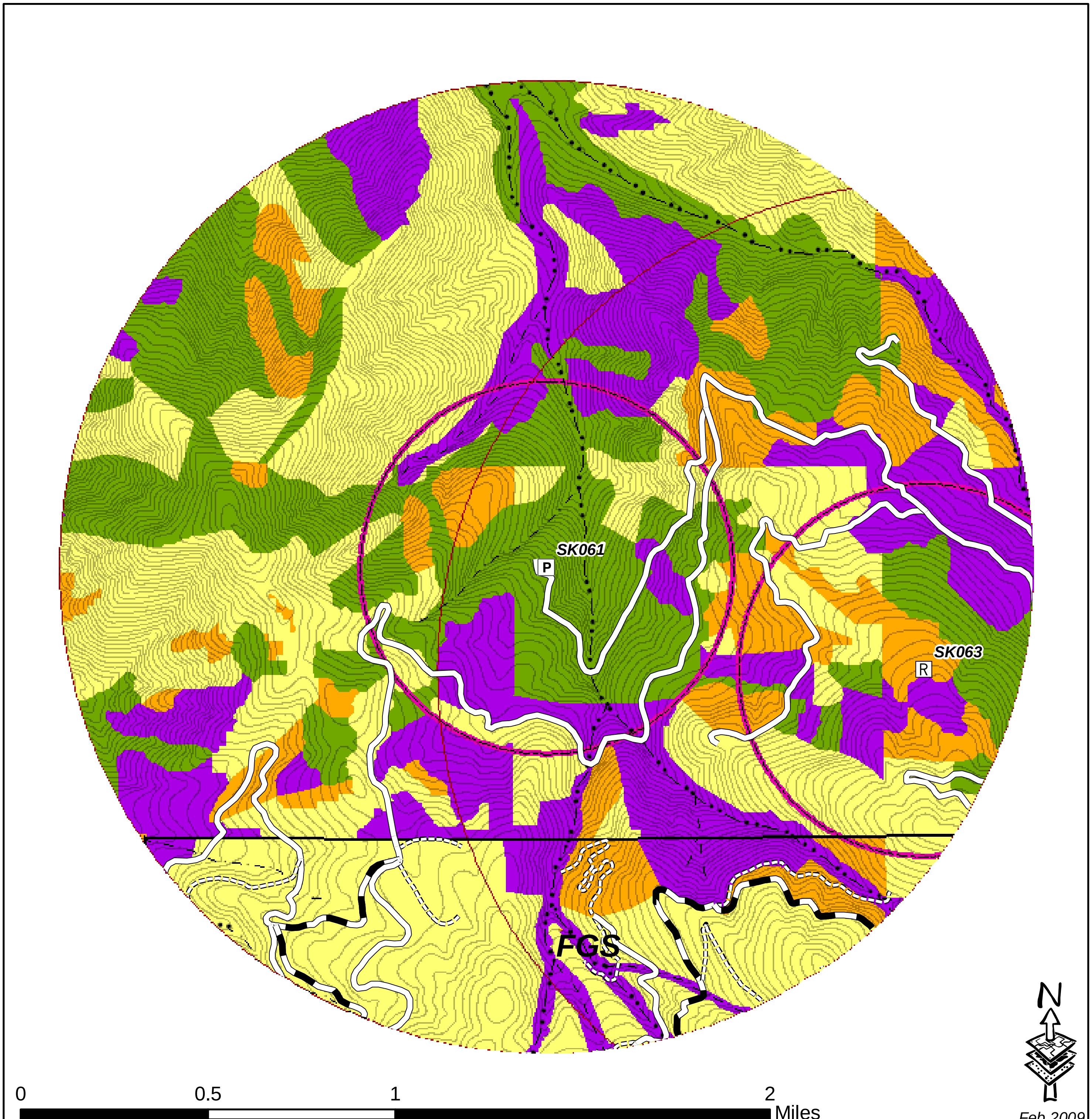
Roads
- Primary
- Secondary
- Local

- FGS Ownership
- NSO 0.5 mile Core

FGS

SK044

Map Prepared by FGS - lxpht002953\NSO CSA editing



NSO Home Range and Core

Target Habitat Distribution

Current Status
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NSO Habitat
- Unsuitable
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- High Foraging
- Nesting/Roosting

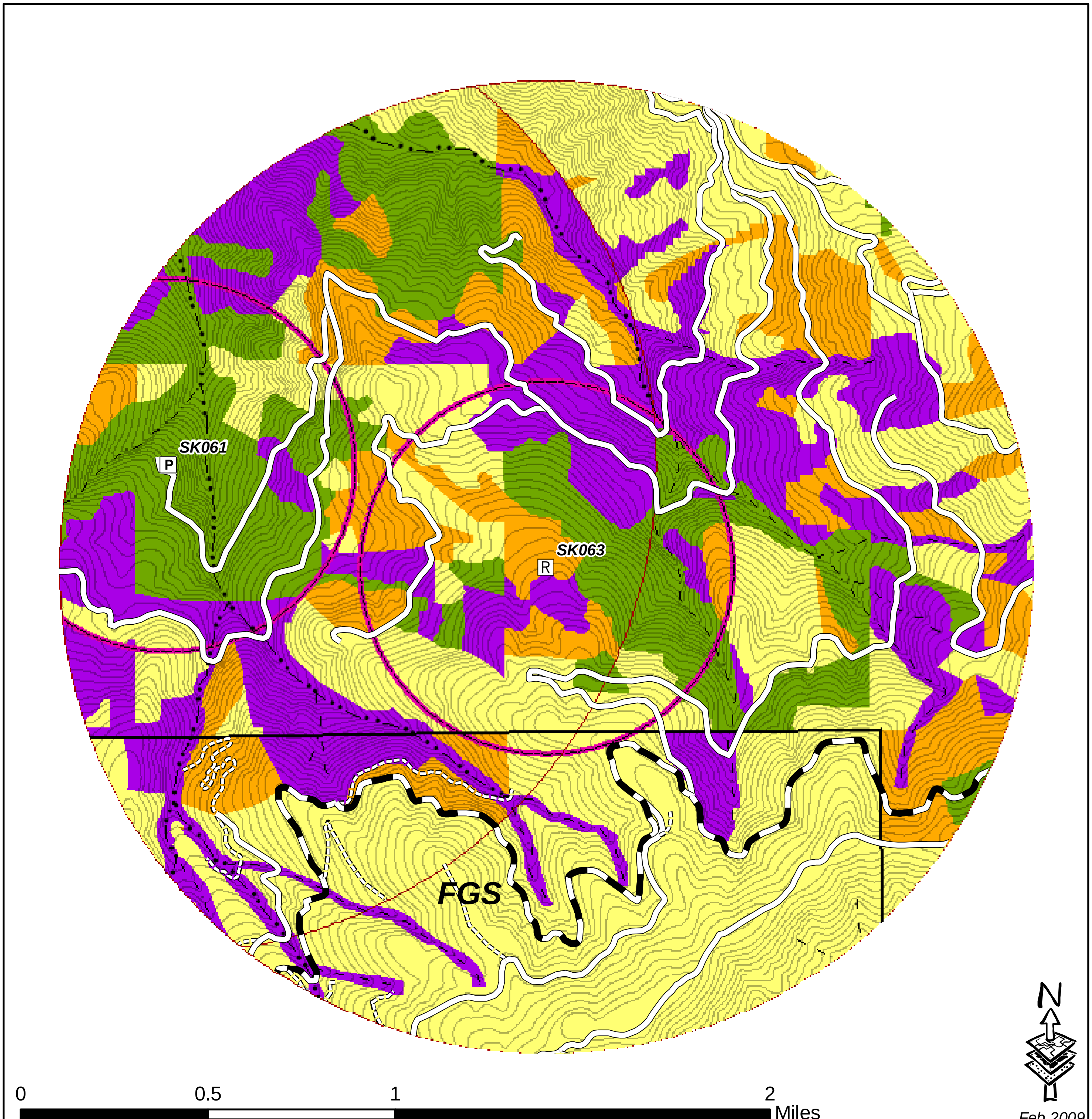
Streams
- Fish
- Non-Fish
- Intermittent

Roads
- Primary
- Secondary
- Local

- FGS Ownership
- NSO 0.5 mile Core

SK061

Map Prepared by FGS - lxpht002953\NSO CSA editing



NSO Home Range and Core

Target Habitat Distribution

Current Status
- R Reproductive Pair
- P Nesting Pair
- T Territorial Single
- ⊗ Abandoned

NSO Habitat
- Unsuitable
- Low Foraging
- High Foraging
- Nesting/Roosting

Streams
- Fish
- Non-Fish
- Intermittent

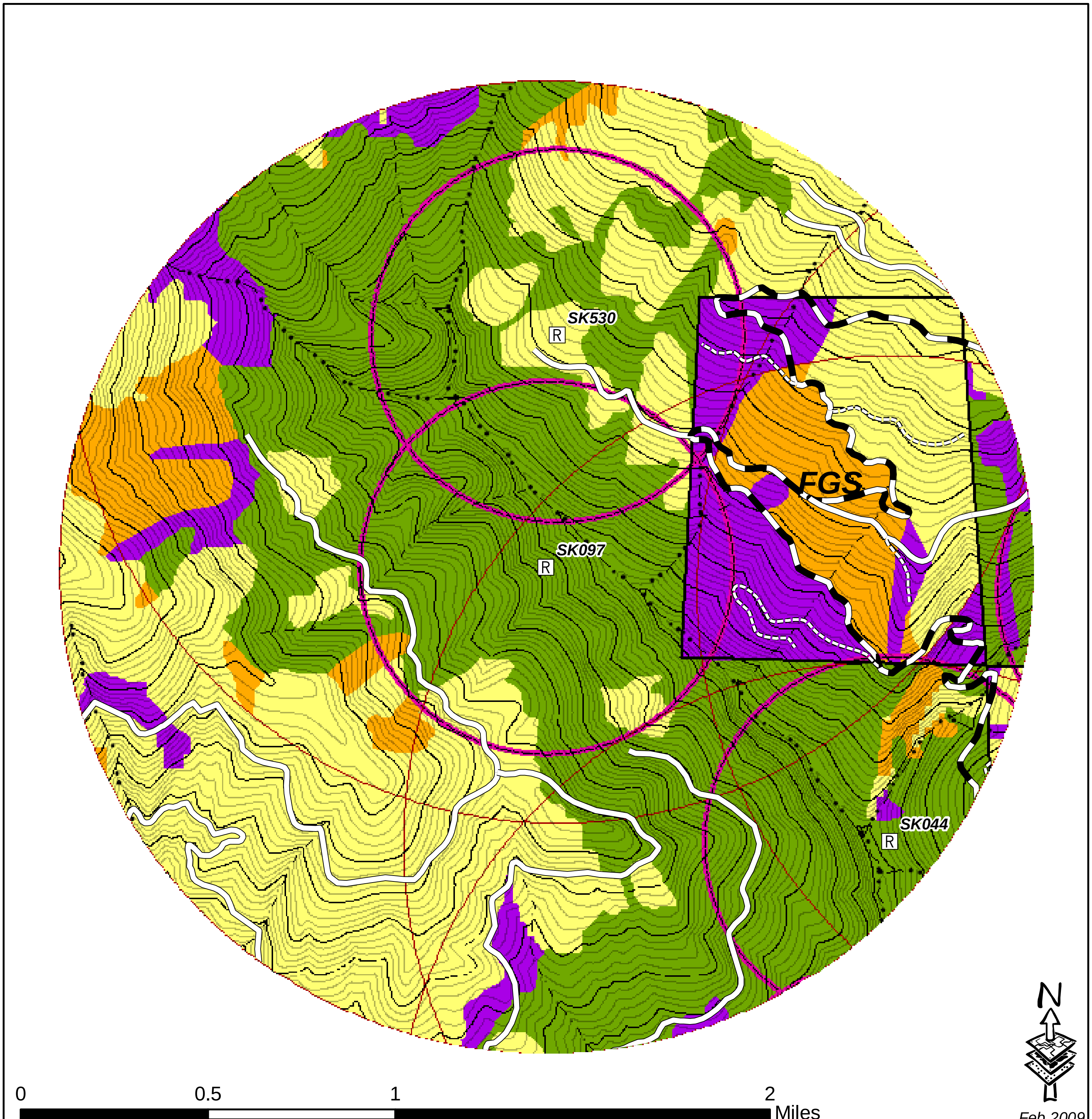
Roads
- Primary
- Secondary
- Local

FGS Ownership

NSO 0.5 mile Core

SK063

Map Prepared by FGS - lxpht002953\NSO CSA editing



NSO Home Range and Core

Target Habitat Distribution

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NSO Habitat
- Unsuitable
- Low Foraging
- High Foraging
- Nesting/Roosting

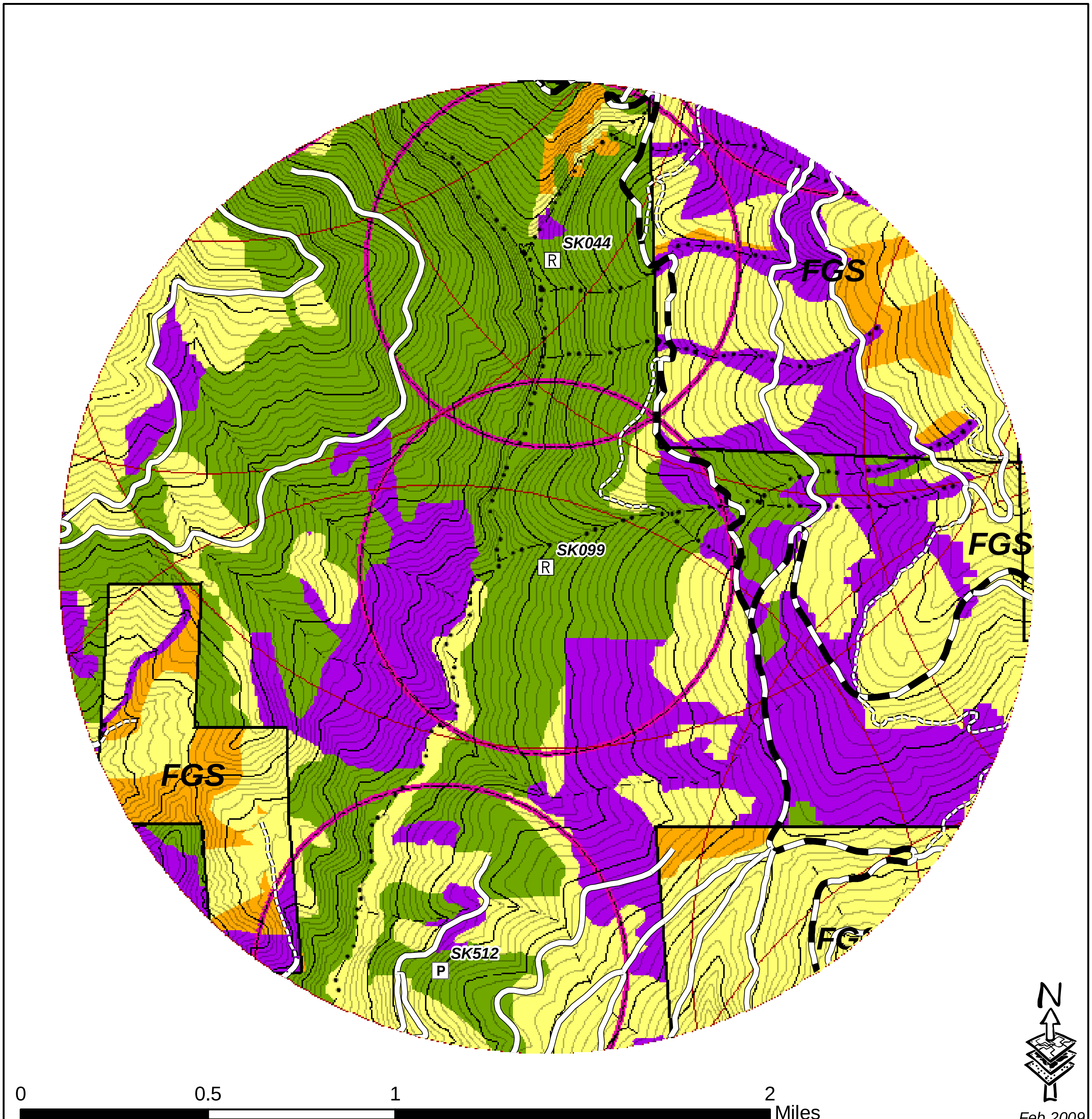
Streams
- Fish
- Non-Fish
- Intermittent

Roads
- Primary
- Secondary
- Local

- FGS Ownership
- NSO 0.5 mile Core

SK097

Map Prepared by FGS - lxpht002953\NSO CSA editing



NSO Home Range and Core

Target Habitat Distribution

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- P Nesting Pair
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NSO Habitat
- Unsuitable
- Low Foraging
- High Foraging
- Nesting/Roosting

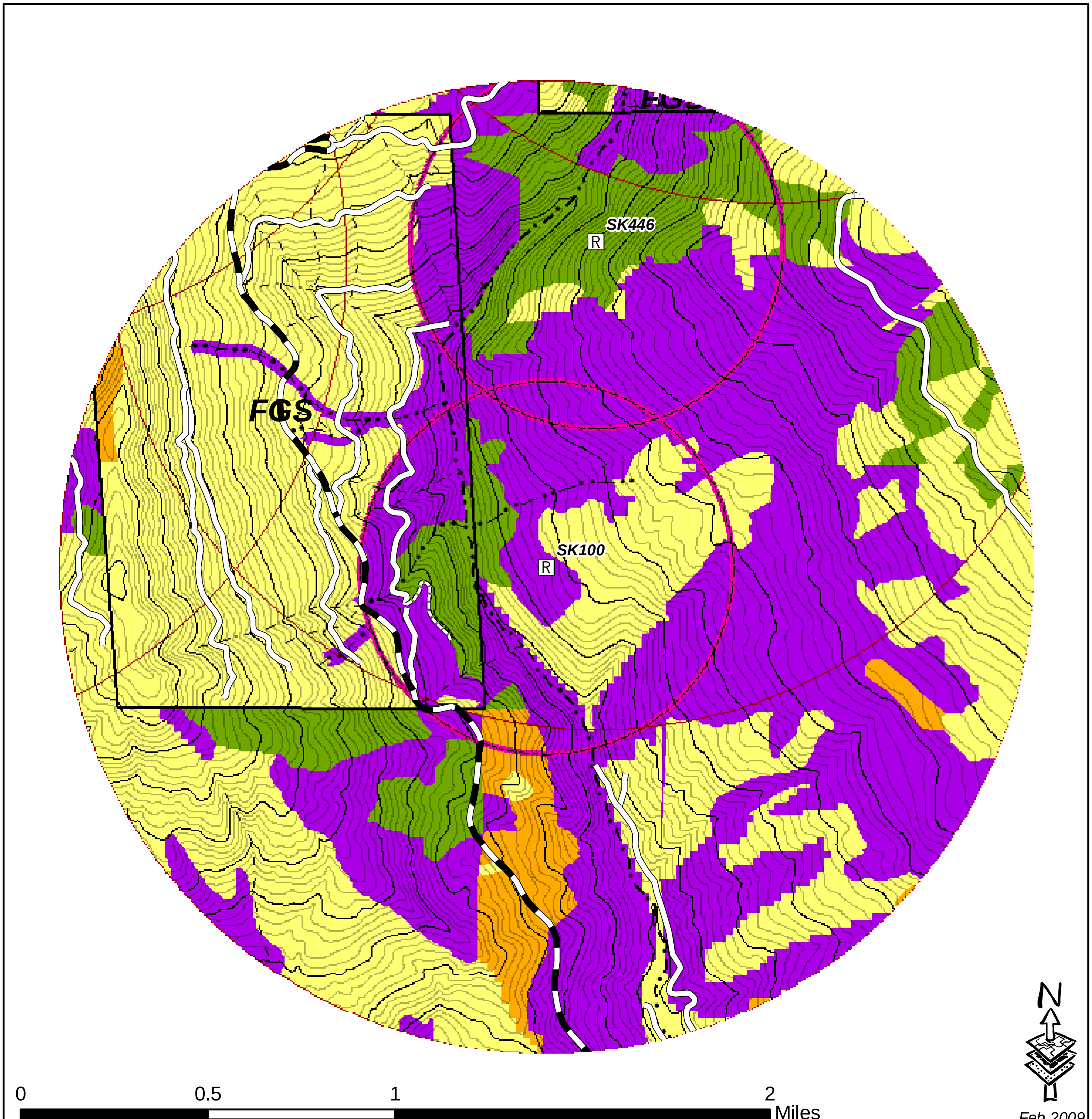
Streams
- Fish
- Non-Fish
- Intermittent

Roads
- Primary
- Secondary
- Local

- FGS Ownership
- NSO 0.5 mile Core

SK099

Map Prepared by FGS - lxpht002953\NSO CSA editing



NSO Home Range and Core

Target Habitat Distribution

Current Status

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- P Nesting Pair
- T Territorial Single
- ⊗ Abandoned

NSO Habitat

- Unsuitable
- Low Foraging
- High Foraging
- Nesting/Roosting

Streams

- Fish
- Non-Fish
- Intermittent

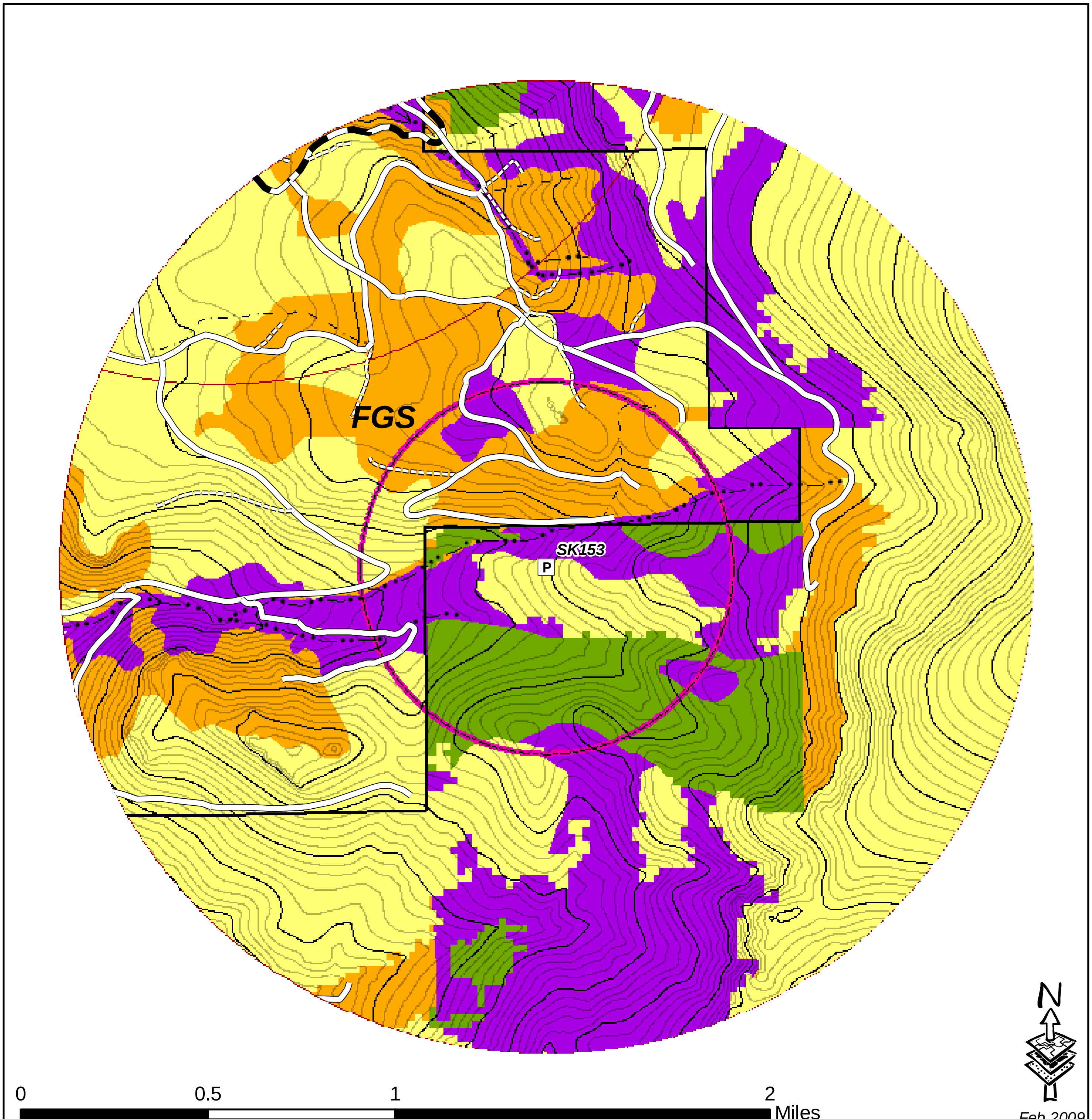
Roads

- Primary
- Secondary
- Local

- FGS Ownership
- NSO 0.5 mile Core

SK100

Map Prepared by FGS - lxpht002953\NSO CSA editing



NSO Home Range and Core

Target Habitat Distribution

Current Status
- R Reproductive Pair
- P Nesting Pair
- T Territorial Single
- ⊗ Abandoned

NSO Habitat
- Unsuitable
- Low Foraging
- High Foraging
- Nesting/Roosting

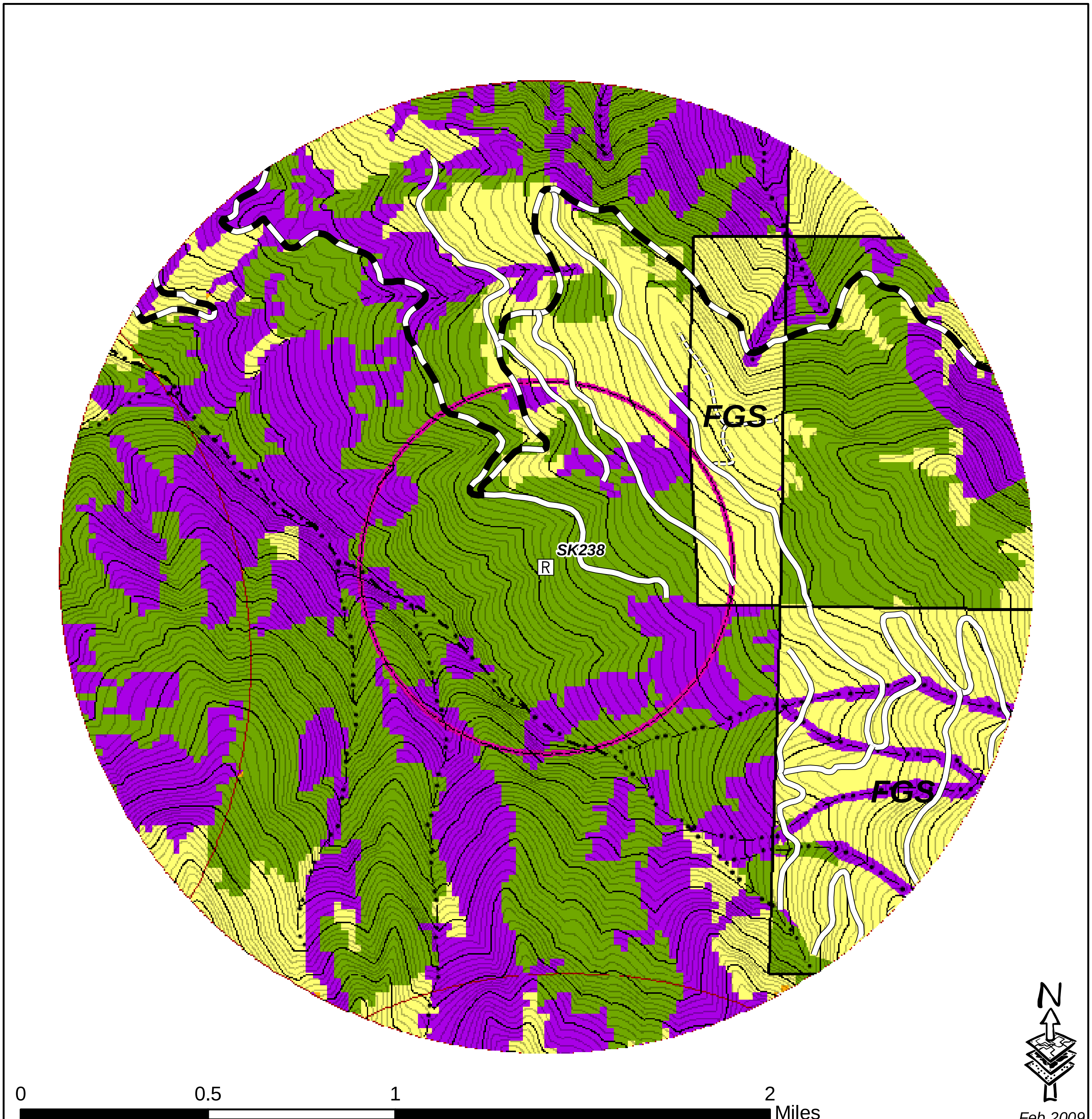
Streams
- Fish
- Non-Fish
- Intermittent

Roads
- Primary
- Secondary
- Local

- FGS Ownership
- NSO 0.5 mile Core

SK153

Map Prepared by FGS - lxpht002953\NSO CSA editing



NSO Home Range and Core

Target Habitat Distribution

Current Status
- R Reproductive Pair
- P Nesting Pair
- T Territorial Single
- ⊗ Abandoned

NSO Habitat
- Unsuitable
- Low Foraging
- High Foraging
- Nesting/Roosting

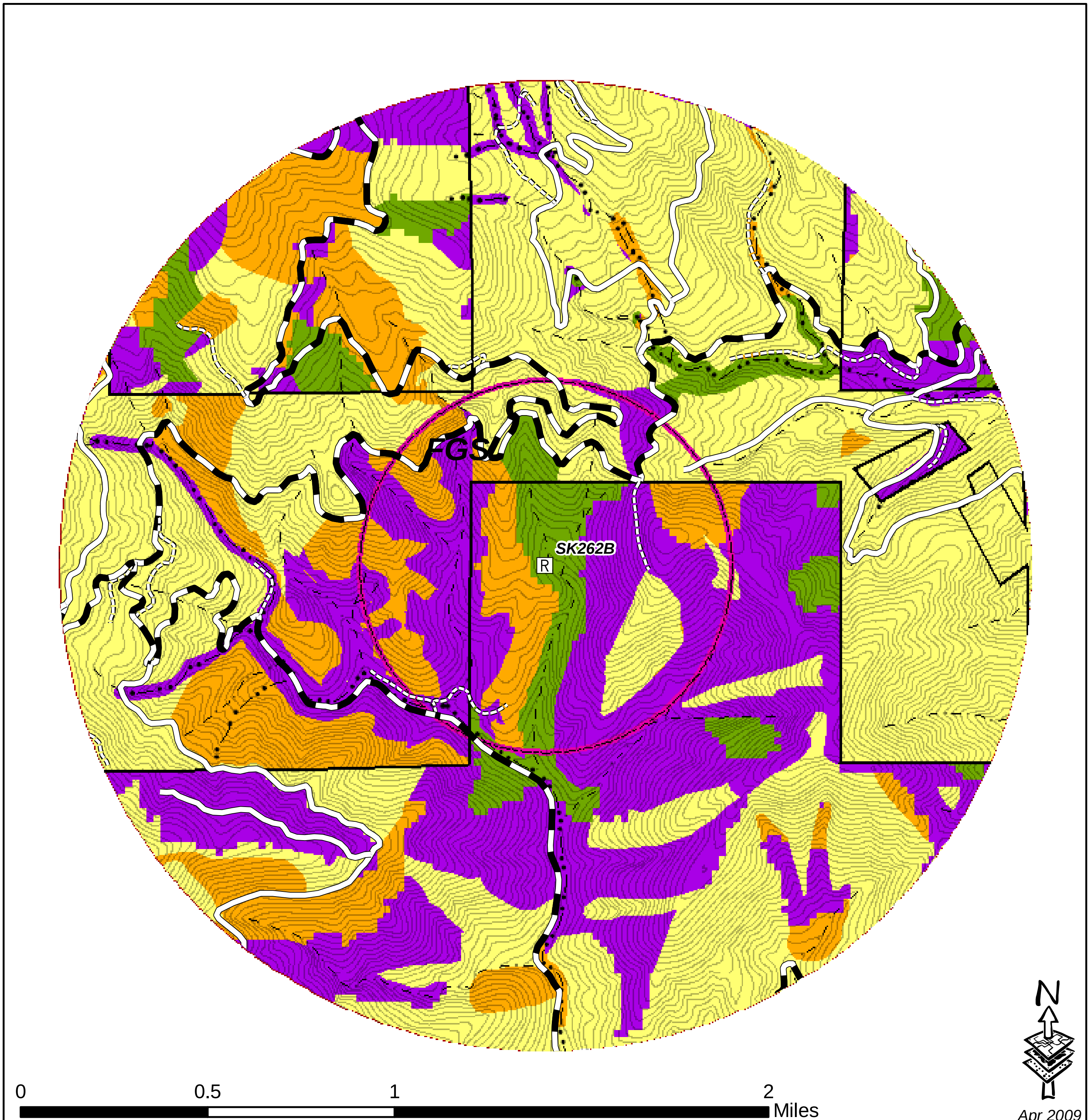
Streams
- Fish
- Non-Fish
- Intermittent

Roads
- Primary
- Secondary
- Local

- FGS Ownership
- NSO 0.5 mile Core

SK238

Map Prepared by FGS - lxpht002953\NSO CSA editing



NSO Home Range and Core

Target Habitat Distribution

Current Status
- R Reproductive Pair
- P Nesting Pair
- T Territorial Single
- ⊗ Abandoned

NSO Habitat
- Unsuitable
- Low Foraging
- High Foraging
- Nesting/Roosting

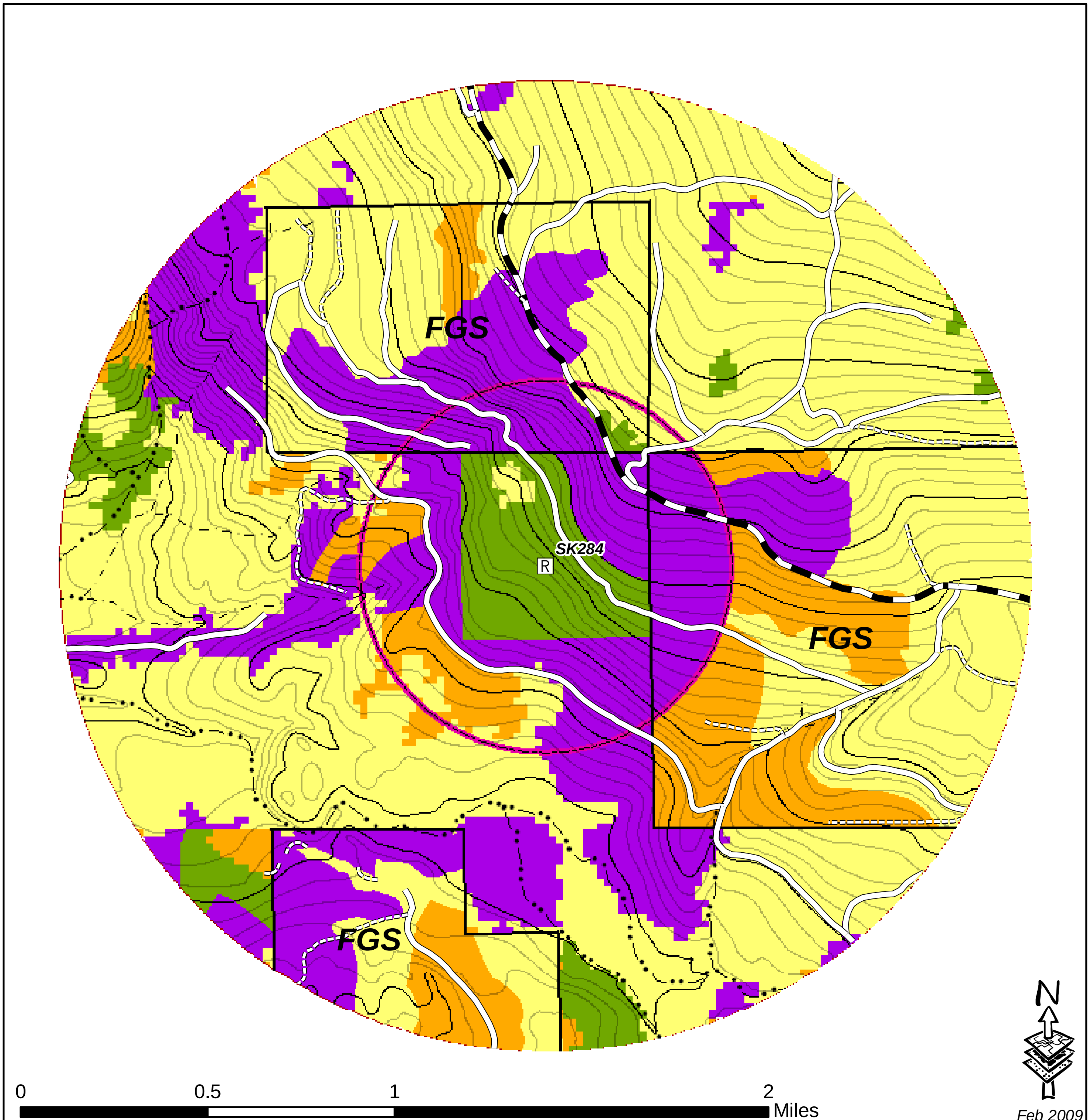
Streams
- Fish
- Non-Fish
- Intermittent

Roads
- Primary
- Secondary
- Local

FGS Ownership
NSO 0.5 mile Core

SK262B

Map Prepared by FGS - lxpht002953\NSO CSA editing



NSO Home Range and Core

Target Habitat Distribution

Current Status
- R Reproductive Pair
- P Nesting Pair
- T Territorial Single
- ⊗ Abandoned

NSO Habitat
- Unsuitable
- Low Foraging
- High Foraging
- Nesting/Roosting

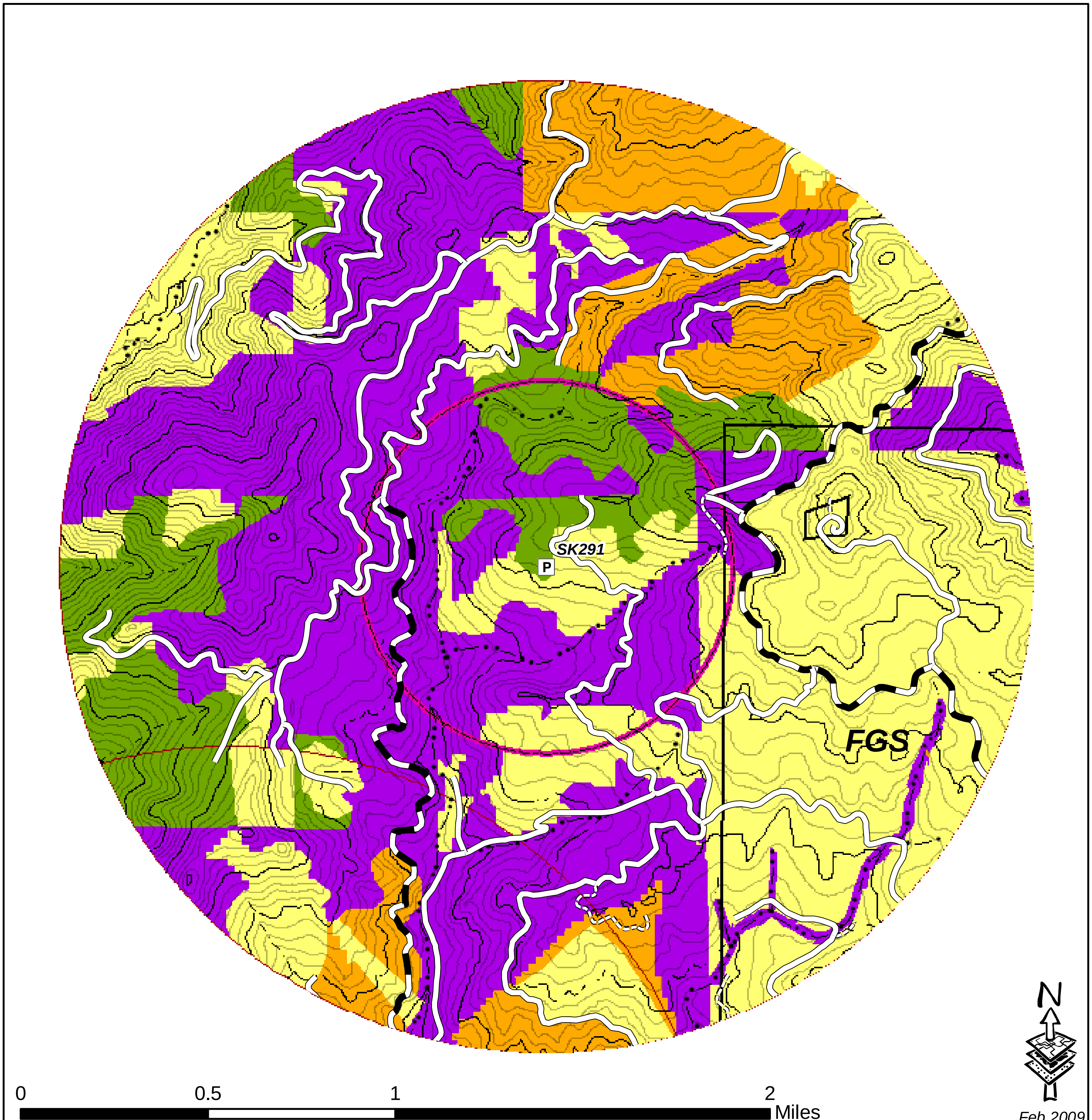
Streams
- Fish
- Non-Fish
- Intermittent

Roads
- Primary
- Secondary
- Local

- FGS Ownership
- NSO 0.5 mile Core

SK284

Map Prepared by FGS - lxpht002953\NSO CSA editing



NSO Home Range and Core

Target Habitat Distribution

Current Status
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- P Nesting Pair
- T Territorial Single
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NSO Habitat
- Unsuitable
- Low Foraging
- High Foraging
- Nesting/Roosting

Streams
- Fish
- Non-Fish
- Intermittent

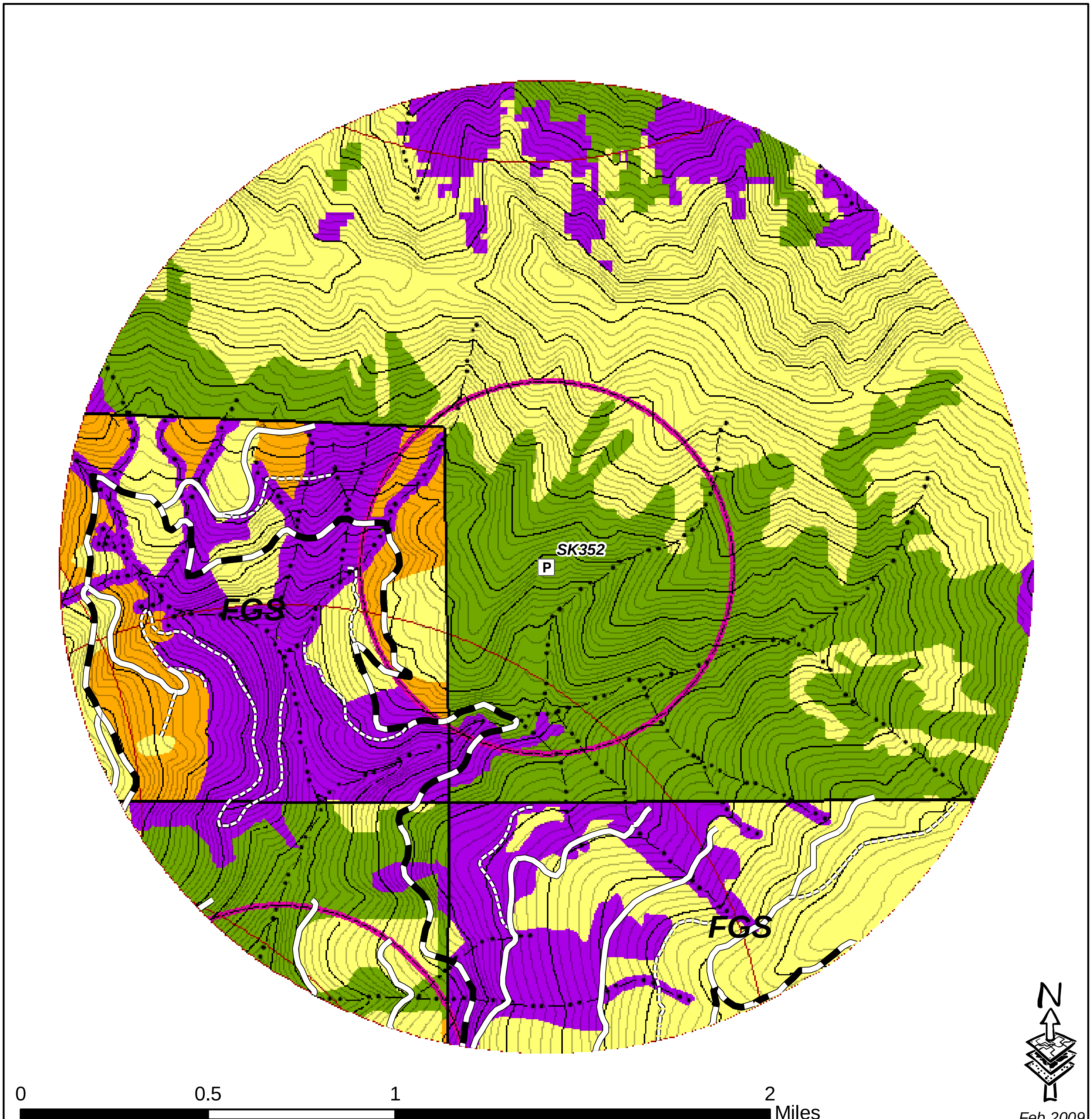
Roads
- Primary
- Secondary
- Local

- FGS Ownership
- NSO 0.5 mile Core

FGS

SK291

Map Prepared by FGS - lxpht002953\NSO CSA editing



NSO Home Range and Core

Target Habitat Distribution

Current Status
- R Reproductive Pair
- P Nesting Pair
- T Territorial Single
- ⊗ Abandoned

NSO Habitat
- Unsuitable
- Low Foraging
- High Foraging
- Nesting/Roosting

Streams
- Fish
- Non-Fish
- Intermittent

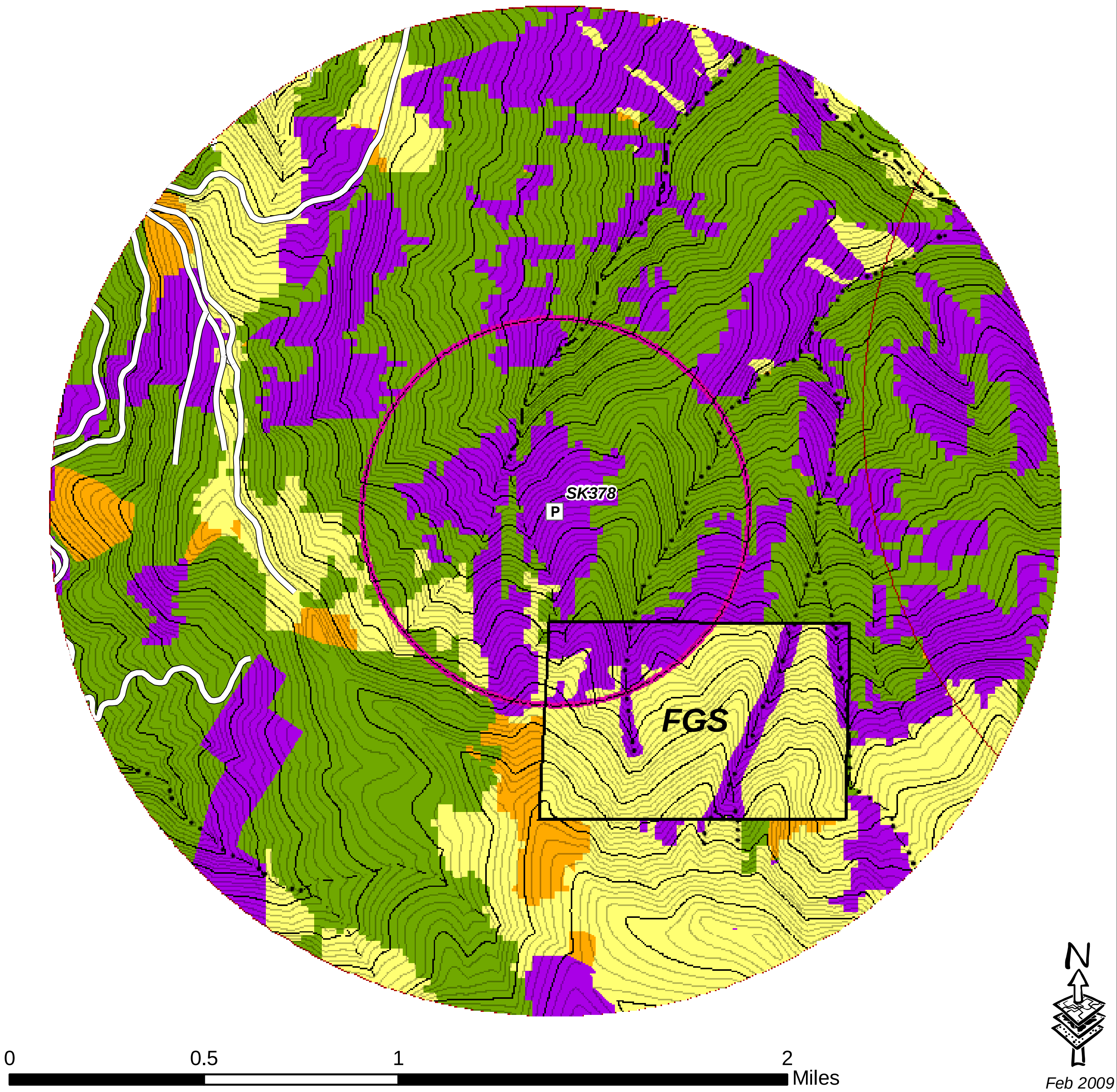
Roads
- Primary
- Secondary
- Local

FGS Ownership

NSO 0.5 mile Core

SK352

Map Prepared by FGS - lxpht002953\NSO CSA editing



NSO Home Range and Core

Target Habitat Distribution

Current Status
- R Reproductive Pair
- P Nesting Pair
- T Territorial Single
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NSO Habitat
- Unsuitable
- Low Foraging
- High Foraging
- Nesting/Roosting

Streams
- Fish
- Non-Fish
- Intermittent

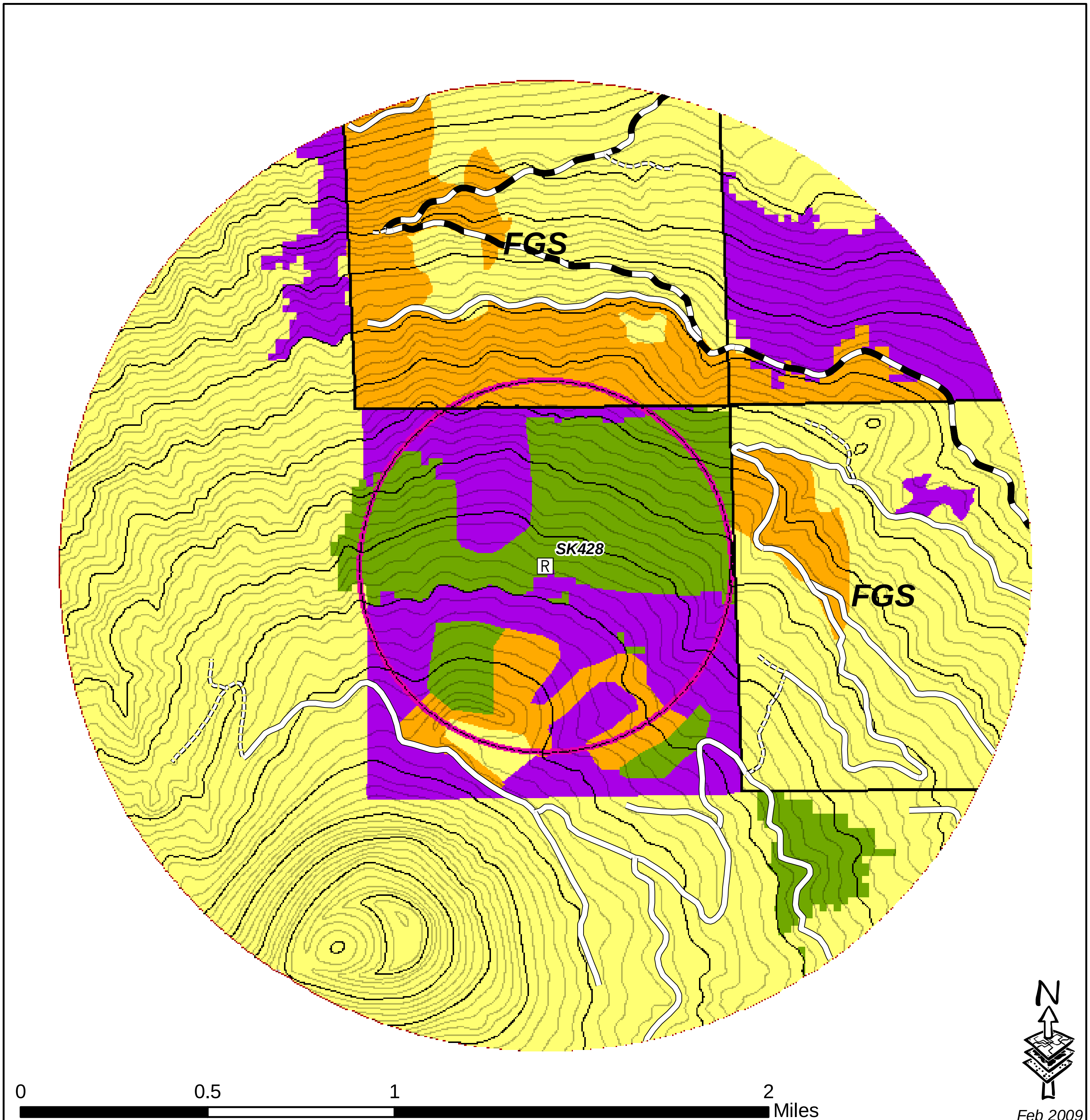
Roads
- Primary
- Secondary
- Local

- FGS Ownership
- NSO 0.5 mile Core

FGS

SK378

Map Prepared by FGS - lxpht002953\NSO CSA editing



NSO Home Range and Core

Target Habitat Distribution

Current Status
- R Reproductive Pair
- P Nesting Pair
- T Territorial Single
- ⊗ Abandoned

NSO Habitat
- Unsuitable
- Low Foraging
- High Foraging
- Nesting/Roosting

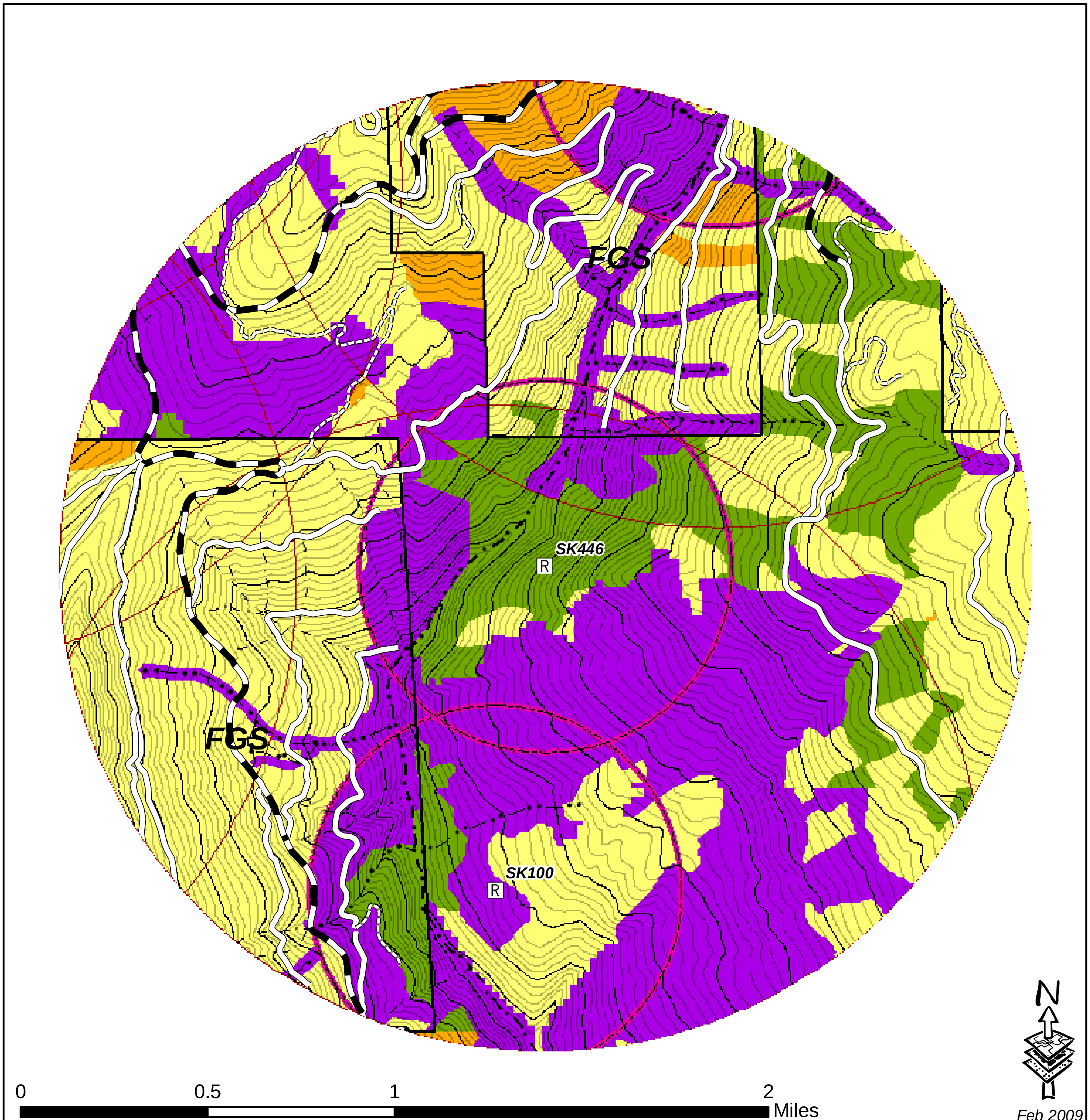
Streams
- Fish
- Non-Fish
- Intermittent

Roads
- Primary
- Secondary
- Local

- FGS Ownership
- NSO 0.5 mile Core

SK428

Map Prepared by FGS - lxpht002953\NSO CSA editing



NSO Home Range and Core

Target Habitat Distribution

Current Status
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- P Nesting Pair
- T Territorial Single
- ⊗ Abandoned

NSO Habitat
- Unsuitable
- Low Foraging
- High Foraging
- Nesting/Roosting

Streams
- Fish
- Non-Fish
- Intermittent

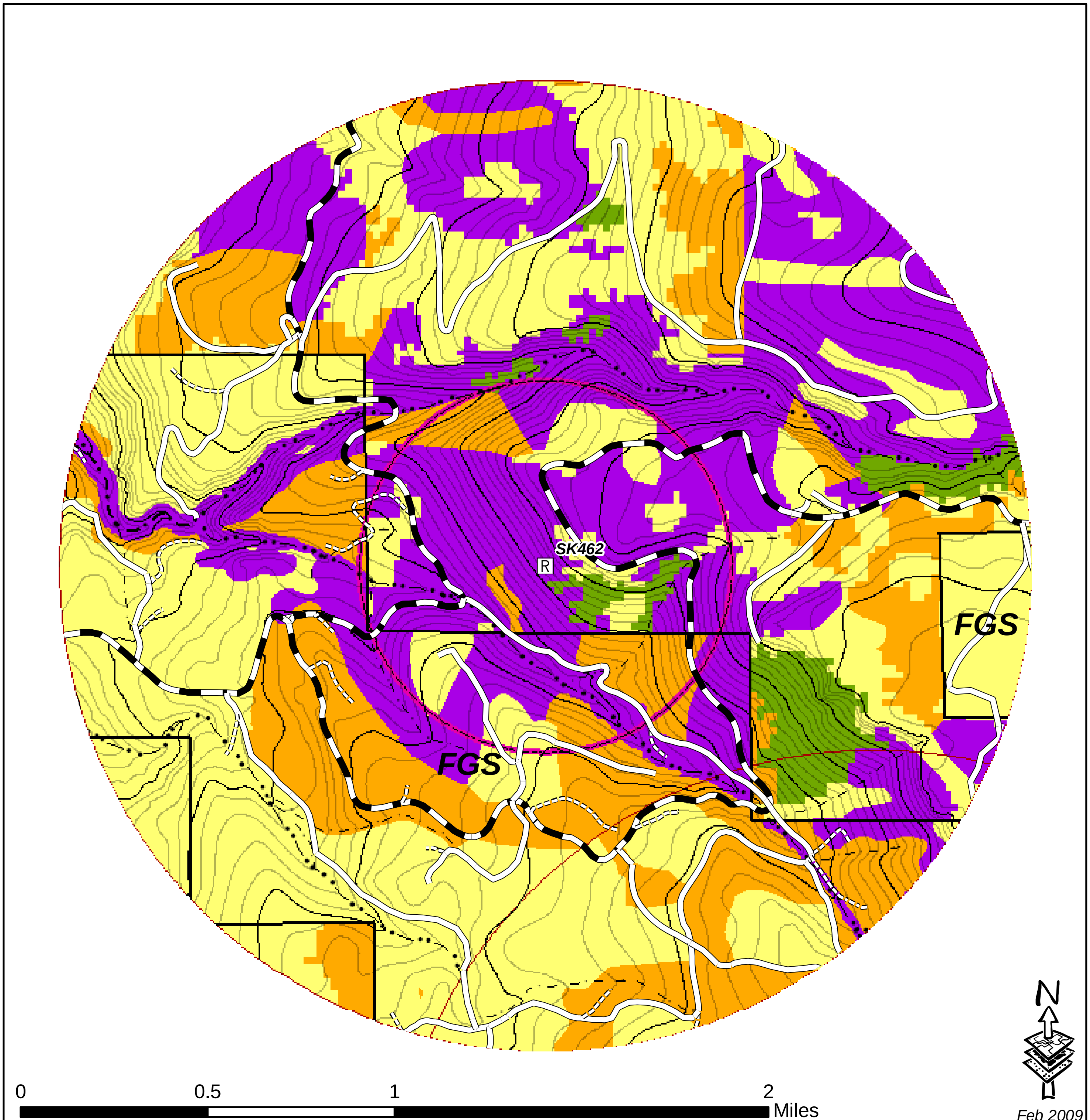
Roads
- Primary
- Secondary
- Local

- FGS Ownership
- NSO 0.5 mile Core

fGS

SK446

Map Prepared by FGS - lxpht002953\NSO CSA editing



NSO Home Range and Core

Target Habitat Distribution

Current Status
- R Reproductive Pair
- P Nesting Pair
- T Territorial Single
- ⊗ Abandoned

NSO Habitat
- Unsuitable
- Low Foraging
- High Foraging
- Nesting/Roosting

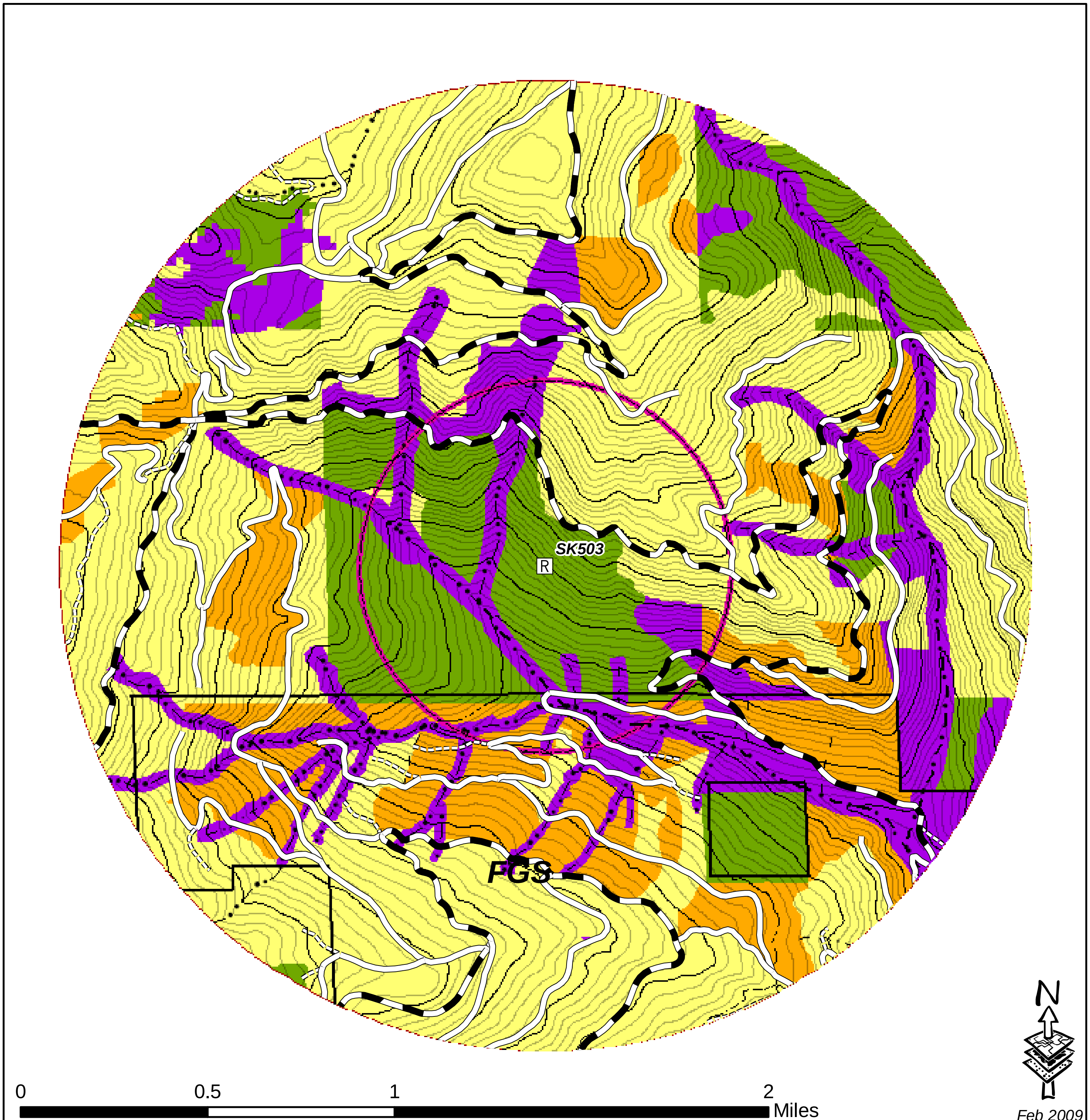
Streams
- Fish
- Non-Fish
- Intermittent

Roads
- Primary
- Secondary
- Local

- FGS Ownership
- NSO 0.5 mile Core

SK462

Map Prepared by FGS - lxpht002953\NSO CSA editing



NSO Home Range and Core

Target Habitat Distribution

Current Status
- R Reproductive Pair
- P Nesting Pair
- T Territorial Single
- ⊗ Abandoned

NSO Habitat
- Unsuitable
- Low Foraging
- High Foraging
- Nesting/Roosting

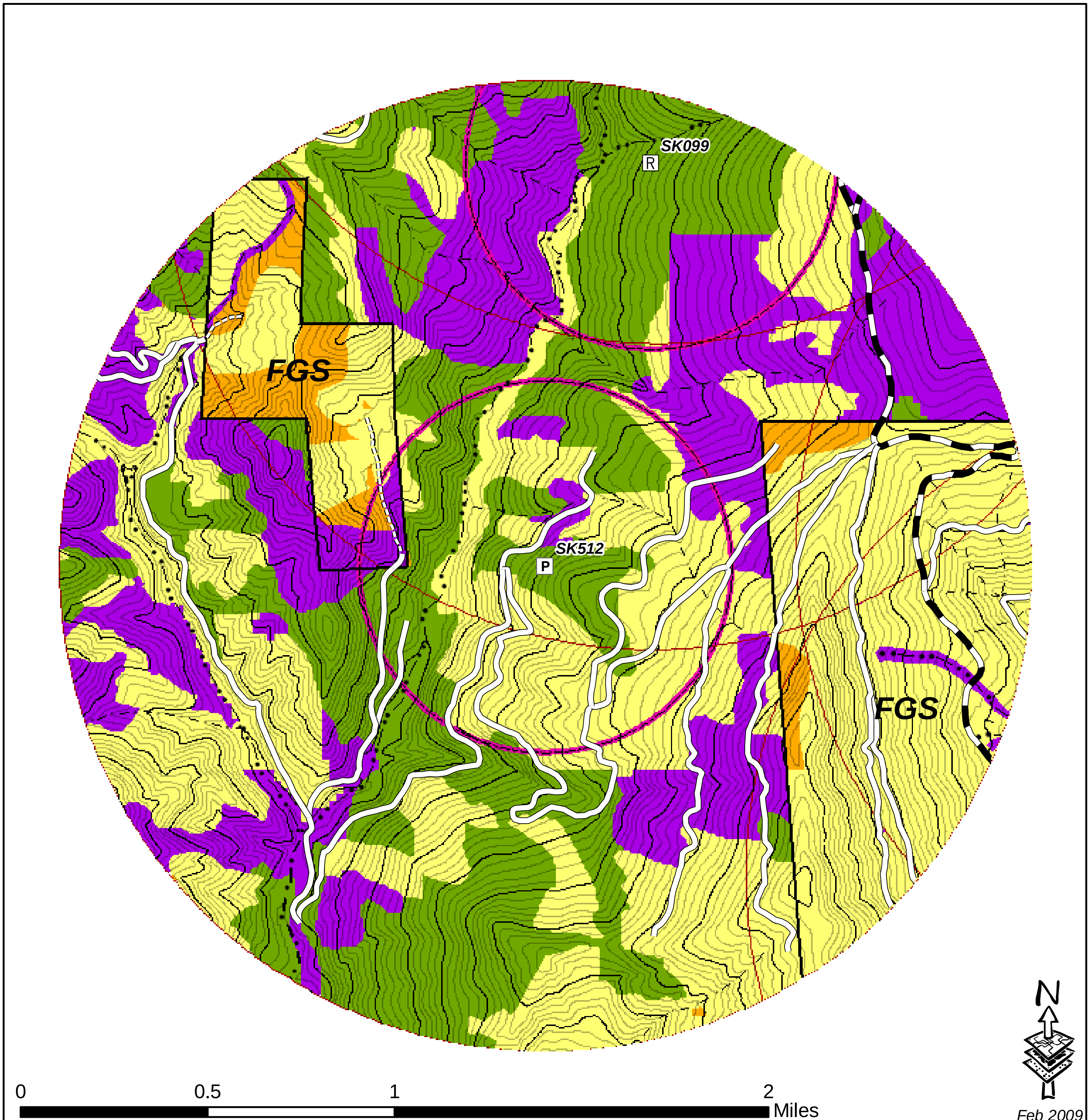
Streams
- Fish
- Non-Fish
- Intermittent

Roads
- Primary
- Secondary
- Local

- FGS Ownership
- NSO 0.5 mile Core

SK503

Map Prepared by FGS - lxpht002953\NSO CSA editing



NSO Home Range and Core

Target Habitat Distribution

Current Status
- R Reproductive Pair
- P Nesting Pair
- T Territorial Single
- ⊗ Abandoned

NSO Habitat
- Unsuitable
- Low Foraging
- High Foraging
- Nesting/Roosting

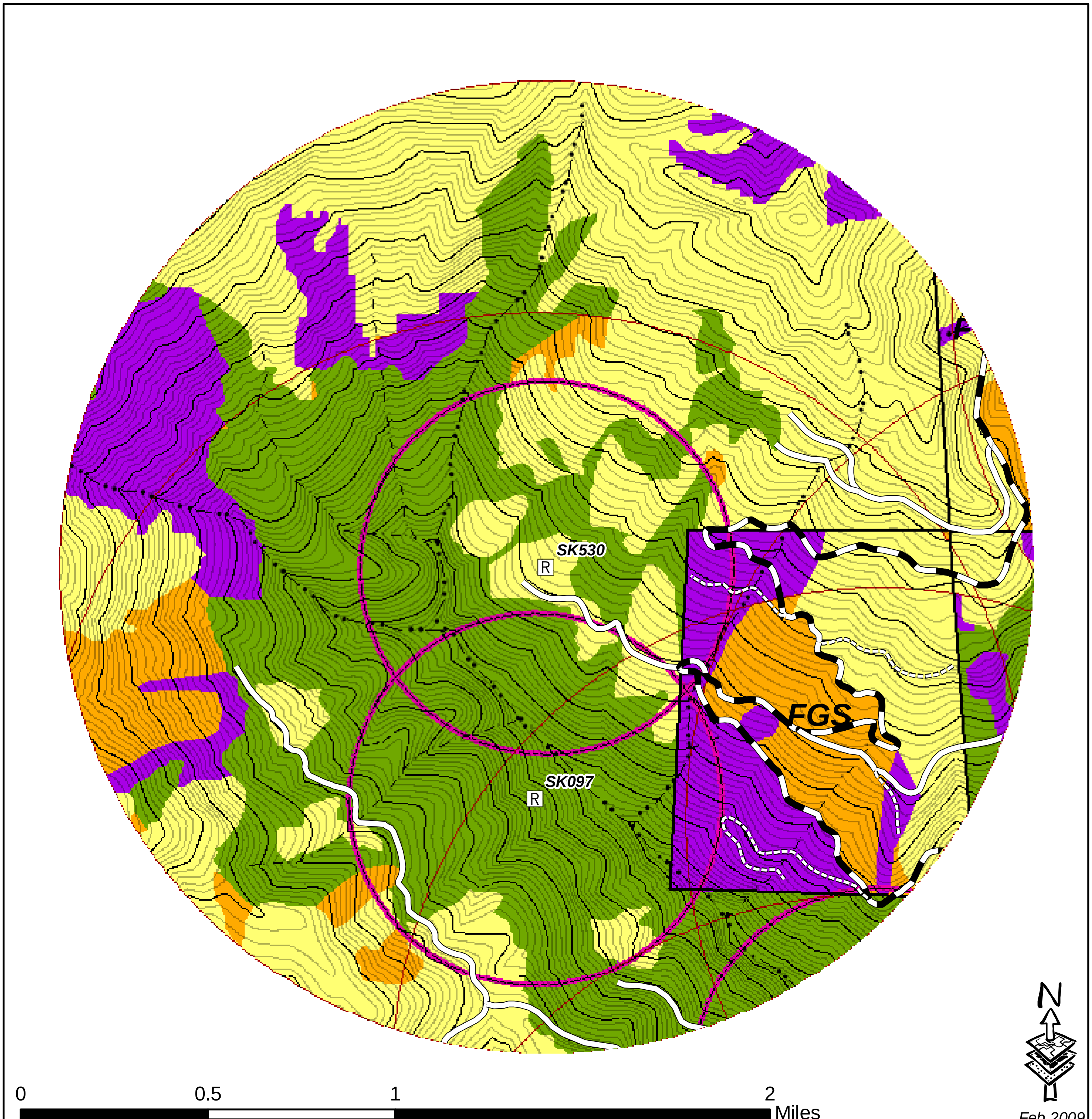
Streams
- Fish
- Non-Fish
- Intermittent

Roads
- Primary
- Secondary
- Local

- FGS Ownership
- NSO 0.5 mile Core

SK512

Map Prepared by FGS - lxpht002953\NSO CSA editing



NSO Home Range and Core

Target Habitat Distribution

Current Status
- R Reproductive Pair
- P Nesting Pair
- T Territorial Single
- ⊗ Abandoned

NSO Habitat
- Unsuitable
- Low Foraging
- High Foraging
- Nesting/Roosting

Streams
- Fish
- Non-Fish
- Intermittent

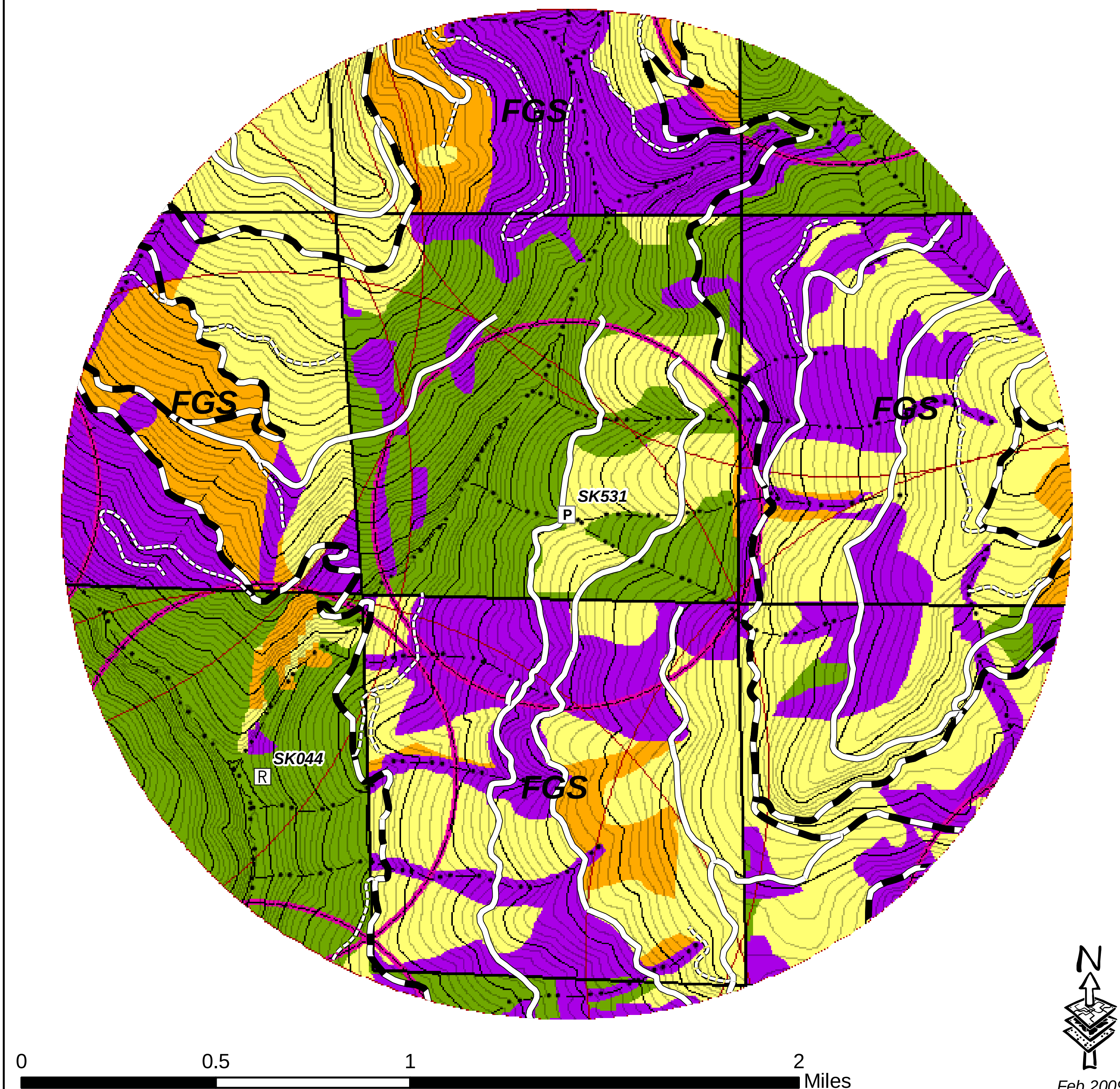
Roads
- Primary
- Secondary
- Local

- FGS Ownership
- NSO 0.5 mile Core

FGS

SK530

Map Prepared by FGS - lxpht002953\NSO CSA editing



NSO Home Range and Core

Target Habitat Distribution

Current Status
- R Reproductive Pair
- P Nesting Pair
- T Territorial Single
- ⊗ Abandoned

NSO Habitat
- Unsuitable
- Low Foraging
- High Foraging
- Nesting/Roosting

Streams
- Fish
- Non-Fish
- Intermittent

Roads
- Primary
- Secondary
- Local

- FGS Ownership
- NSO 0.5 mile Core

fGS

SK531

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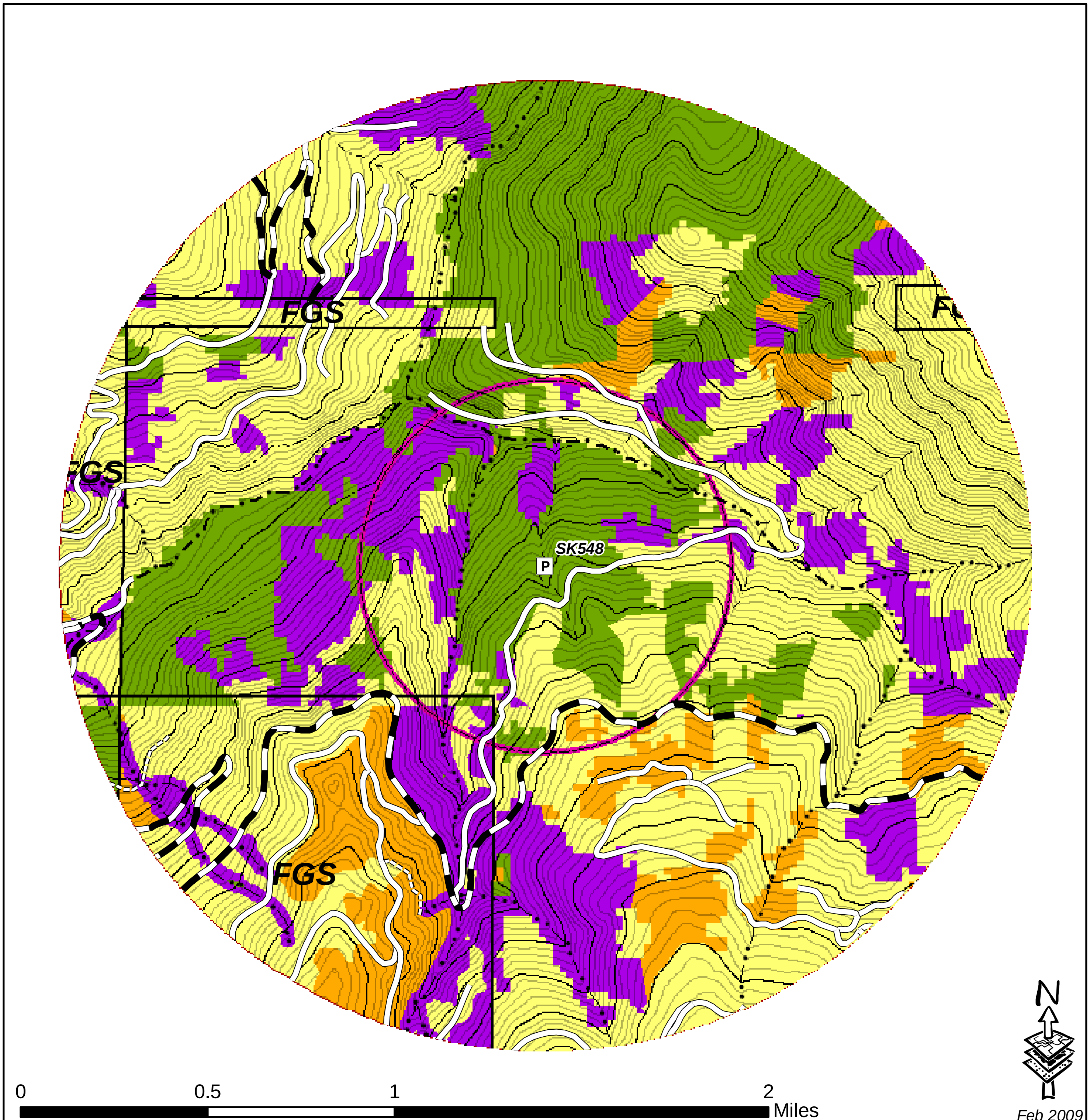

NSO Home Range and Core

Target Habitat Distribution

Current Status
- R Reproductive Pair
- P Nesting Pair
- T Territorial Single
- ⊗ Abandoned

NSO Habitat
- Unsuitable
- Low Foraging
- High Foraging
- Nesting/Roosting

Streams
- Fish
- Non-Fish
- Intermittent

Roads
- Primary
- Secondary
- Local

- FGS Ownership
- NSO 0.5 mile Core

SK548

Map Prepared by FGS - lxpht002953\NSO CSA editing

APPENDIX E

Computation of Large Woody Debris Potential

Computation of Potential Large Woody Debris Contribution from Riparian Stands

PREPARED FOR: Fruit Growers Supply Company

PREPARED BY: Neil Nikirk

DATE: August 2008

Introduction

The presence of large woody debris (LWD) influences the structure and function of stream ecosystems in forested basins. Woody debris provides cover for fish and substrate for colonization by macroinvertebrates. LWD also influences channel morphology by forming pools, dissipating stream energy, stabilizing bars and banks, and storing sediment. The primary role of LWD is different within different types of channels (Montgomery and Buffington, 1993). For example, LWD in channels with high stream gradients functions primarily to store sediment and dissipate stream energy. In contrast, in low-gradient channels, the primary functions of LWD are pool formation, provision of cover, and protection of erodible stream banks.

The importance of LWD to aquatic complexity and fish abundance is well documented (Andrus et al., 1988; Bilby and Ward, 1989; Robison and Beschta, 1990; Hicks et al., 1991; Ralph et al., 1994). LWD also plays an important role in non fish-bearing (Class II and III) channels. These channels are generally smaller and steeper (higher-gradient) and have the capacity to deliver sediment directly to Class I (fish-bearing) streams. While not providing habitat for fish in these channels, LWD functions to dissipate stream energy and store sediment that could affect habitat quality in downstream areas.

Functioning aquatic habitat reflects the interaction of a number of watershed and in-channel processes. The presence of in-channel LWD strongly influences many of these processes and is known to be important for maintaining quality fish habitat. Over the long term, much of the LWD that creates and maintains aquatic habitat elements is likely derived from catastrophic events such as major floods and landslides (Murphy, 1995). However, LWD is also recruited when individual trees fall into the stream channel from adjacent forest stands. Benda et al. (2003) developed a wood budget for tributaries of the Trinity River in the Klamath Mountains of northern California; their findings suggest that instream LWD in this area is derived from a number of sources including bank erosion (42 percent), mortality (39 percent), landslides (17 percent), and debris flows (1 percent). Where a source could be determined, 80 percent of the wood entered the channel from within 19 meters (62 feet) of the stream edge (Benda et al., 2003).

FGS's Riparian Goals and Objectives

The primary biological goal of the aquatic plan is to manage Fruit Growers Supply Companies (FGS) forestlands in a manner that does not adversely influence the persistence or preclude the recovery of salmon and steelhead inhabiting drainages containing FGS ownership. The specific goal of riparian management is to manage riparian areas in a manner that maintains riparian functions that contribute to the persistence of salmon and steelhead in the Habitat Conservation Plan (HCP) Area.

FGS recognizes the value of dead wood in large fishbearing channels. FGS wishes to manage riparian stands along Class I watercourses to maintain and improve the ability or adjacent riparian stands to provide adequate amounts of LWD to HCP Area streams to maintain or enhance aquatic habitat conditions for salmonids. Furthermore, the value of woody debris in smaller Class II and Class III watercourses is recognized, and riparian stands along these watercourses will be managed to maintain or enhance the ability of adjacent stands to provide adequate amounts of LWD.

How Much Wood is Enough?

One of the characteristics of wood in stream channels is its variability in terms of supply, longevity, and function. There is no established protocol for determining the amount of wood that should be retained in streams (or adjacent stands) to adequately fulfill ecosystem functions. Although it is helpful to understand the ecologic functions of wood in streams, this approach to determining the amount needed fails because the complexities of sizes, shapes, and arrangements of wood in streams preclude any scientific specification of target loadings (Lisle, 2002). The amount of wood in unaltered systems (i.e., reference loadings) cannot be used to define a threshold amount because wood volumes are highly variable (up to order of magnitude), even within pristine channels in similar settings and the distributions for managed and pristine channels overlap (Lisle, 2002; Harmon et al., 1986; Berg et al., 1998; Keller and Tally, 1979). One of the shortcomings of these approaches is that even if the appropriate wood loading was known, we would also have to know how to manage riparian forests to achieve that loading.

A more recent approach to determining how much wood is enough is the formulation of wood budgets (Martin and Benda, 2001; Benda and Sias, 2003). Wood in streams is evaluated in the context of the potential of the adjacent forest to furnish adequate amounts of wood to the channel, given historical inputs and outputs that have led to the present level of wood loading. Historic values for the gain and loss of wood usually cannot be determined precisely. This method is site-specific and data intensive and does not answer the question of how much wood is enough. It does, however, attempt to account for historic (and future) management in evaluating the trend in wood loading, given the present and future potential of the riparian forest to contribute wood to the stream.

Potential LWD from Adjacent Riparian Stands

Because it is impossible to define instream targets for LWD pieces or volumes, and impractical to manage riparian forests to meet such targets in the face of environmental variability, FGS has chosen to manage their riparian forests to provide the potential for instream LWD to be generated over time. LWD potential refers to the trees in the adjacent riparian stand that have the potential to contribute pieces of wood to the stream of the appropriate size to be functional. These pieces may be recruited through a variety of methods as the stand ages (e.g., bank erosion/undercutting, mortality, windthrow, and landslides).

The objective of riparian management is to ensure that an adequate number of appropriately sized trees are maintained in the stand at all times to maintain and enhance the potential contribution of functionally-sized LWD through time. To quantify to potential contribution of LWD from adjacent stands, a simple spreadsheet model was developed to calculate the potential contribution of LWD from any stand, given the diameter and height distribution of trees in the stand. The model utilizes standard geometric equations (Van Sickle and Gregory, 1990) to determine the potential contribution of any tree given its diameter, height, and distance from the stream edge.

LWD Model

The LWD model assumes that LWD inputs consist of whole trees falling into the stream channel from an adjacent riparian stand. It does not attempt to account for LWD inputs that originate upstream or upslope from the specified stand (greater than 150 feet from the stream margin). Tree fall is assumed to be random and uniformly distributed within a complete circle around the point of fall. It is also assumed that LWD must have a diameter of at least 6 inches to be included in the overall potential contribution. This is consistent with the findings of LWD surveys conducted on FGS lands that indicate that 6-inch woody debris can be functional in stream channels on the ownership (FGS unpublished data).

Probability of Entering the Stream

The probability that a tree will enter the stream upon falling is a function of the distance from the stream channel and the height of the tree (see Figure 1). The height of the tree is specified in the tree list, which also gives the diameter at breast height (dbh). The probability that a falling tree will contribute LWD to the stream (P_s) is defined by the arc in which the tree bole can intersect the stream bank with a diameter of at least 6 inches. This arc is defined by the angles ‘a’ and (180- a) where a = arcsin (z/h_e). In this equation, the height (h_e) is the “effective height,” which is further defined as the distance along the tree bole at which the diameter is 6 inches (see below). The probability of contributing LWD to the stream channel (P_s) is then calculated by the following equation:

(1) $$Ps = \int_{a}^{180-a} f(a)da$$

In the case of random tree fall direction, the integral evaluates (Robison and Beschta, 1990; McDade et al., 1990; Van Sickle and Gregory, 1990) to:

(2) Ps = arcos (z/h_e)/180

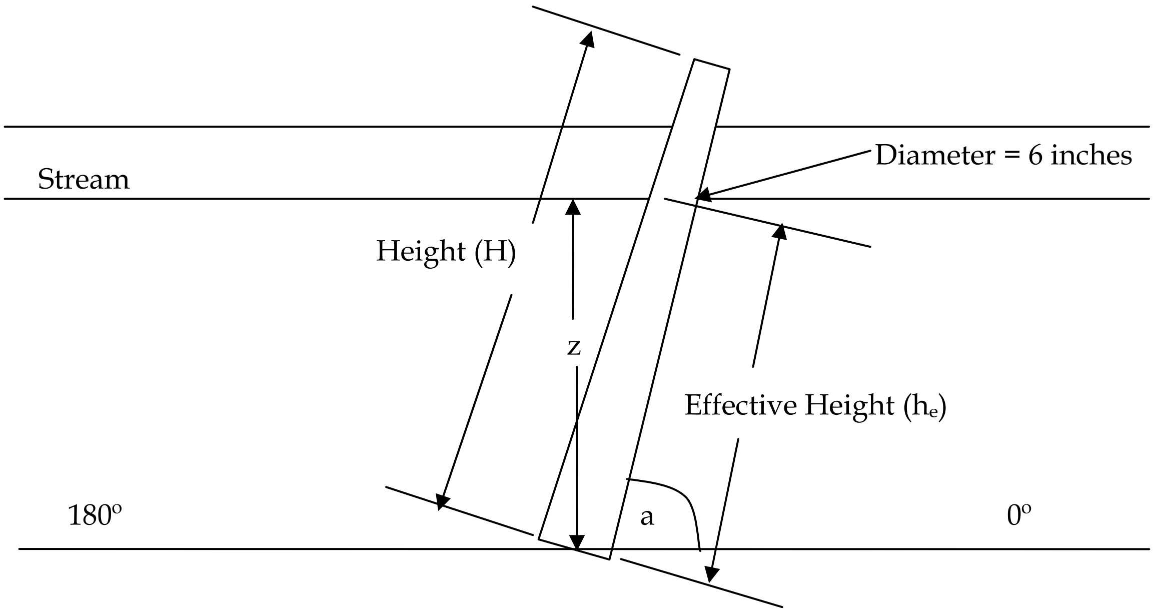

Figure 1: Model Tree Fall

Effective Tree Height

The model assumes that tree boles are long, thin cones. The effective tree height (h_e) in the above equation is calculated from a similar-triangle argument (Figure 2). The ratio of the diameter at any height along the bole (d) to the dbh is equal to the ratio of the distance from the tip (h_d) to the overall tree height (H)(adjusted for breast height):

(3) $d/dbh = h_d/(H-4.5)$

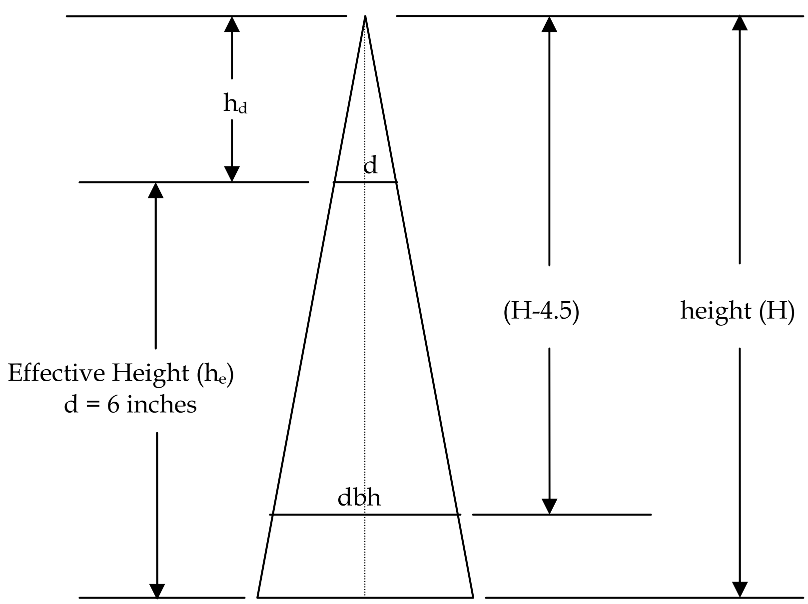

Figure 2: Effective Height

With an effective diameter (d) of 6 inches, the above equation evaluates to an effective height (h_e) of:

(4) $h_e = H - h_d$ where $h_d = (6/dbh)*(H-4.5)$

Volume of LWD Contributed by Individual Trees

To compute the volume of wood that could be contributed by a single tree, the model assumes that tree boles are conical in shape, such that the conical volume contributed to the stream is calculated by the simple volume equation:

(5) $Vol = \pi r^2 /3 * L$ where:

r = the radius of the bole at the stream margin

L = the length of the bole beyond the stream margin

For computational simplicity, the bole volume is calculated for a tree that falls perpendicular to the stream (a = 90 degrees). To account for the width of the stream, only the volume of the bole within a specified stream width is included in the overall volume estimate. A stream width of 20 feet was used to approximate the bank-full width of Class I streams on the FGS ownership. Because the perpendicular distance (z) is the shortest possible, this is the maximum bole volume that can be contributed. While this may overestimate the actual volume that would be contributed by any individual tree falling, calculating the overall potential contribution for the stand as the average across all distances (see below) will be more realistic and differences between stands will reflect the relative potential contribution without bias.

LWD Potential from Adjacent Stand

The overall potential for contribution of LWD from the entire stand is calculated as the average potential for each tree, summed across all trees in the stand. Each tree has a known diameter and height (from the stand's tree list), and is assigned a distance from the stream. The volume contributed by each tree is summed to provide the stand potential volume.

(6) $LWD_{pot} = \sum(TPA_{dbh,\ ht} * Prob_{dbh,\ ht,\ z} * Vol_{dbh,\ ht,\ z})$ where:

TPA = trees per acre of each dbh/height class in the stand

Prob = probability of contributing >6-inch LWD based on distance from stream (z), dbh, and height

Vol = volume contributed based on diameter at stream margin and stream width

For the computation of average probability of contribution, trees are assumed to be uniformly distributed with respect to distance from the stream margin (z) and a random fall direction. Distance from the stream (z) is assigned using a uniform random number generator (0 to 150 feet). The probability of contribution from each tree is computed individually based on distance (z) and effective height (h_e), and then summed to provide the overall volume contributed and the number of pieces for the entire stand.

Use of a random number generator allows for a "monte-carlo" style of gaming to be employed by creating a number of trials (distributions) and averaging across all trials. This results in an "expected value" of the volume potentially contributed by a given stand with multiple distributions of trees with respect to distance from the stream.

Comparison of Alternative Stands and Management

Given a tree list for an individual stand detailing the trees per acre (TPA) in each diameter/height class, the potential contribution of LWD (volume and pieces) can be calculated for that stand using the LWD model described previously. Stands will vary in the number of trees and the diameter and height distributions of those trees. Alternative stands (tree lists) may represent different site conditions or the result of different management prescriptions applied to a given stand. By specifying tree lists resulting from different management prescriptions, the model can be used to evaluate the effect of management on LWD potential.

To simulate the effect of management using the harvest prescription detailed in the HCP, a harvest algorithm was developed to identify which trees would be harvested based on their size (dbh), distance from the stream (z), and tree retention standards, namely:

- The 10 largest trees (>16 inches dbh) within 50 feet of the stream are retained
- At least 200 square feet of basal area (per acre) within 50 feet of the stream is retained (approximating the requirement for 85 percent canopy coverage)
- At least 100 square feet of basal area (per acre) between 50 and 150 feet of the stream is retained (approximating the requirement for 65 percent canopy coverage)
- Only those trees in excess of the theoretical J-curve for 200 square feet of basal area are harvested within 50 feet of the stream
- Only those trees in excess of the theoretical J-curve for 100 square feet of basal area are harvested between 50 and 150 feet of the stream
- Trees farthest from the stream are harvested preferentially over those closest to the stream

Using a random number generator to assign individual trees a distance from the stream, an infinite number of alternative "stands" can be simulated for a given tree list. The potential LWD contribution from each stand can then be compared under the managed scenario and the unmanaged scenario. In the managed scenario, trees will be harvested if they meet the above criteria for harvest, while in the unmanaged scenario, no trees are harvested. This allows a comparison of managed versus unmanaged conditions for a variety of tree distributions (with respect to distance from the stream) using a tree list that is representative of riparian stands in the HCP Area.

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APPENDIX F

Monitoring Protocols

APPENDIX F

Monitoring Protocols

This HCP uses a combination of habitat-based and species-specific approaches for ensuring that impacts to covered species are avoided, minimized, or mitigated to the maximum extent practicable. FGS will conduct various monitoring activities to document compliance with the requirements of this HCP and the ITPs and evaluate the effectiveness of the conservation measures.

An overview of the compliance and effectiveness monitoring elements, including monitoring objectives, parameters, methods, analyses, and quality control measures, is provided in subsection 7.2 of this HCP. The following sections describe the protocols to be used for each monitoring component.

Aquatic Species Monitoring

This section describes the protocols for compliance and effectiveness monitoring activities associated with the Aquatic Species Conservation Program.

Compliance Monitoring Associated with Riparian Management.

Take avoidance and minimization associated with riparian management will be accomplished through a combination of measures specifying WLPZ widths and restrictions on harvest (canopy coverage, tree retention) and activities (road building, soil disturbance) within WLPZs. Compliance with these measures will be documented through annual post-harvest WLPZ inspections of Class I and Class II WLPZs where harvest has occurred in THPs for that year.

F-1 Post Harvest WLPZ Inspections

Post-harvest inspections of randomly selected WLPZs where harvest has occurred will be conducted within one year following harvest in approximately 10 percent of the WLPZs within active THPs for that year. These inspections will demonstrate that the WLPZ Management Measures (e.g., WLPZ width, canopy coverage, tree retention, soil disturbance) have been fully complied with. The protocols described below are compatible with CalFire's protocols in the Forest Practice Rules Implementation & Effectiveness Monitoring (FORPRIEM) procedures and methods.

Site Selection

1. Divide Class I and II stream courses in each THP into 200 foot segments by using GIS. Estimate the total length (feet) of the stream courses and divide by 200. Number the segments and use a random number table to determine which segments to survey yielding a 10% sample size.

2. Make sure there are no roads, stream-course crossings, or yarding corridors with permitted large openings in the canopy in the WLPZ sample segment. If so, choose another random WLPZ segment.

3. Highlight the randomly selected segments on a copy of the THP map for reference.

Field Data Collection

1. Record UTM coordinates of the end points of each WLPZ sample segment.

2. Calculate the distance between measuring points (D), based on the width of the WLPZ specified in the THP ($D = 2\sqrt{width}$). Using this formula for standard WLPZ widths of 100 and 150 feet, D = 20 and 25 feet, respectively. Use the calculated D even if the WLPZ is flagged different than specified in the THP. Do not take any canopy measurements outside of the flagged WLPZ.

3. Survey only one side of the stream course. Use a "flip-of-a-coin" method for determining what side of the stream course to survey if necessary.

4. Starting in the downstream corner of the WLPZ segment at the watercourse transition line, establish the distance to the first measurement point (D_1) by choosing a random number between 0 and 1 and multiplying this by D to get the distance of the first point from the watercourse transition line. Measure D_1 perpendicular from the stream course to the first measurement point.

5. Starting at the first measurement point, use a densitometer (vertical sighting tube) to determine canopy closure. After the first measurement point, the distance to the next point will always be D. Move away from point 1 perpendicular from the stream course a distance of D. Continue to collect canopy closure measurements along the line until the next point would exit the WLPZ, then turn at a right angle and move a distance D to begin a new line in the opposite direction. Continue with another line toward the stream course. Repeat this pattern until canopy closure has been measured at 50 points. Record each point as a "hit" or "miss" on the WLPZ Compliance Sampling Form. If deciduous trees are encountered in winter without leaves, assume that leaf cover would be present during the summer and record this point as a "hit."

6. Record all field data on the WLPZ Compliance Sampling Form and answer questions requiring ocular estimates as indicated on the sampling form.

7. While measuring canopy closure, visually survey for compliance with other HCP Aquatic Measures. Indicate if harvest has occurred in the WLPZ within the previous year, and if standards have been met for tree retention, groundcover, treatment of bare soil, channel zone operations, and Special Operating Zone compliance.

Data Analysis

Canopy closure will be calculated by multiplying the number of "hits" by 2 and reported as a percentage. Ocular estimates will allow assessment of compliance with other HCP conservation measures.

Effectiveness Monitoring

Monitoring the effectiveness of the aquatic conservation measures is necessary to evaluate whether the biological goals and objectives established in the HCP for the aquatic species are being met, and whether the effects of HCP implementation on physical and biological processes affecting the aquatic covered species and their habitats are exceeding the levels anticipated by NMFS in their Biological Opinion. FGS's effectiveness monitoring activities for aquatic species include several elements that evaluate the effectiveness of the aquatic conservation measures by measuring changes in specific variables ("watershed products") that affect the quantity and quality of habitats for the aquatic covered species.

Monitoring elements concentrate on the primary "watershed products" that influence the quality and quantity of aquatic habitats in the Plan Area including:

- Water temperature
- LWD recruitment
- Fine sediments
- Channel morphology and conditions

F-2 Monitoring of Water Temperatures (Property-Wide)

To verify that covered activities are not contributing to elevated stream temperatures, FGS will monitor water temperatures in selected drainages in the Plan Area. The Beaver, Horse, Cottonwood, Moffett, Doggett, Dona, and Meamber drainages have been selected for water temperature monitoring based on: (1) the availability of prior monitoring data; (2) the extent of FGS ownership within the drainage; (3) the extent of anticipated harvest over the term of the permits; (4) the likelihood of water temperatures being stressful; and (5) the presence of anadromous salmonids on the ownership or in reaches downstream within the drainage.

FGS will monitor water temperatures at sites in Class I and Class II watercourses across the Plan Area using the methods detailed below. Monitoring will document the MWMT, MWAT, and daily and seasonal (summer/fall) water temperature fluctuations for each monitoring site. Within the Beaver, Cottonwood, and Doggett drainages, air temperatures will be monitored adjacent to one of the water temperature monitoring sites.

Property-wide water temperature monitoring will be conducted annually, for at least 5 years from issuance of the ITP or until at least 10 years of data have been collected (including data collected up to 5 years prior to development of this HCP). Monitoring will continue over the term of the Permits such that water and air temperatures will be monitored for at least five years each decade. Water and air temperature data will be collected from at least May through October provided that flows and weather allow access to the monitoring sites. FGS will have flexibility in the timing of logger deployment, but will ensure that monitoring period will be sufficient to capture the MWAT and MWMT and characterize the daily and seasonal (summer/fall) temperature fluctuations at each site.

Site Selection

1. Water temperature data loggers will be deployed in the Cottonwood, Horse, Beaver, Moffett, Doggett, Dona, and Meamber drainages, near the downstream boundaries of the FGS ownership. In the Cottonwood, Beaver, and Doggett drainages, where FGS ownership represents a significant portion of the drainage area, data loggers will also be deployed near the upstream boundary. Air temperature data will be collected adjacent to one of the water temperature monitoring sites using additional data loggers. These locations may be modified with approval from NMFS and CDFG.

2. Water temperature data loggers will be located in runs or riffles, where the flow is mixed (versus in a pool where stratification might occur) out of direct exposure to the sun. Data loggers will be placed to remain fully submerged, even at the lowest baseflow

conditions. Air temperature data loggers will be located adjacent to the stream (within 50-feet of the stream bank) in an area that is shaded during the mid-day time period.

Equipment Calibration and Deployment

1. Each year prior to deployment, data loggers will be calibrated for accuracy and precision by placement in a water-bath at temperatures of 10 to 20°C for at least 4 hours, with water bath temperature measured at least hourly using a National Institute of Standards and Technology (NIST)-certified thermometer. Because calibration adjustments are not possible on the data logger, any adjustments will be applied to the data during post-processing and analysis.

2. Data loggers will be set to record temperatures on a maximum two-hour sampling interval. The preferred sampling interval is 60 minutes.

3. Data loggers will be housed in a protective housing clearly identified as "Water Temperature Monitoring Device - Do Not Disturb" and securely tethered by steel chain to the stream bank at the specified locations. Logger placement will be checked before the typical week of MWAT (late July) to be sure logger is fully submerged and operating properly. Data loggers will be retrieved prior to the first snowfall (typically late October).

4. Site data will be recorded, including UTM coordinates, channel depth and width, canopy cover, and base-flow.

Data Analysis

Data will be downloaded and processed into standard reports for each monitoring site. Standard reports include graphical displays of daily and weekly average temperatures; cumulative distribution curves of temperature; and daily and weekly minimum, mean, maximum, and temperature fluctuation. Any calibration factors determined from the calibration test will be applied prior to data analysis.

F-3 Monitoring of Water Temperatures (Harvest Unit-Level)

FGS will monitor water temperatures before and after timber harvesting in selected reaches of Class I and Class II watercourses in conjunction with adjacent riparian zone canopy closures using the protocol described below. The goal is to assess potential effects of harvesting and the effectiveness of the riparian conservation measures in minimizing water temperature effects. Monitoring will be focused Class I streams supporting anadromous salmonids and Class II streams tributary to anadromous streams. FGS will consult with NMFS regarding monitoring locations and the most appropriate and cost-effective methods to use for the project-level analysis.

Harvest unit-level water temperature monitoring will be conducted annually, for at least 2 years prior to and 5 years after harvesting, or until monitoring indicates that conditions have returned to pre-harvest conditions. Water and air temperature data will be collected from at least May through October provided that flows and weather allow access to the monitoring sites. FGS will have flexibility in the timing of logger deployment, but will ensure that monitoring period will be sufficient to capture the MWAT and MWMT and characterize the daily and seasonal (summer/fall) temperature fluctuations at each site.

Site Selection

1. Water temperature data loggers will be deployed in Class I watercourses supporting anadromous salmonids (on or downstream of the FGS ownership) and Class II watercourses tributary to anadromous streams where timber harvest is anticipated within the riparian zone under this HCP. Up to 10 harvest units (five Class I and five Class II) will be selected for monitoring. Where possible, monitoring sites used during the property-wide temperature monitoring will be used as one of the harvest unit-level monitoring sites to maximize sampling efficiency. Monitoring locations will be determined in coordination with NMFS and CDFG.

2. Water temperature data loggers will be located in runs or riffles, where the flow is mixed (versus in a pool where stratification might occur) out of direct exposure to the sun. Data loggers will be placed to remain fully submerged, even at the lowest baseflow conditions.

Equipment Calibration and Deployment

Data loggers will be initiated and deployed as in the Property-Wide Temperature Monitoring above.

Data Processing and Analysis

Data will be downloaded and processed into standard reports for each monitoring site. Standard reports include graphical displays of daily and weekly average temperatures; cumulative distribution curves of temperature; and daily and weekly minimum, mean, maximum, and temperature fluctuation. It is anticipated that some form of a before/after/control/impact (BACI) approach comparing response (harvested) reaches with control (unharvested) reaches would be used for analysis. However, other designs could be utilized if they are determined to be more applicable.

F-4 Monitoring of LWD Recruitment Potential

FGS will monitor the effectiveness of the WLPZ retention measures in providing for potential long-term woody debris recruitment. This element is intended to provide a means of evaluating the long-term changes in recruitment potential. This element does not directly monitor in-stream accumulation of wood, although monitoring conducted under the "Channel Stability" element will document LWD levels in area streams. Riparian stand inventories will be conducted during the post-harvest WLPZ inspections (see subsection F-1 above) to characterize riparian stands within WLPZs.

A transect-based inventory, at permanent plots, of trees greater than 10 cm (4 inches) dbh within the WLPZ will be coupled with a tree fall model to estimate the potential LWD recruitment volume present within the WLPZ stand (see Appendix E). The riparian stand inventories will be conducted once, within 1 year following harvest, and repeated at 5 year intervals for 20 years at selected permanent plots using the protocols described below.

Site Selection

Riparian stand inventories will be conducted in a randomly selected subset of post-harvest WLPZ inspection sites (see above) within Class I and Class II WLPZ stands. At least three Class I and two Class II sites (up to 10 plots per year) will be selected during each of the first 4 years of the Permit Term, for a total of up to 40 permanent inventory plots.

Field Data Collection

1. Transect-based riparian stand inventories will provide information on tree size (dbh and height) and distance from the stream.
2. Transect center-lines will be permanently established using metal tags clearly labeled with Transect ID. To help locate this point in subsequent measurements yellow tree-marking paint will be used liberally and coordinates will be obtained by GPS. Starting points will be located at the watercourse transition line as close to the center of the 200-foot Post Harvest WLPZ Inspection stream segment as possible.
3. Riparian Stand Inventory plots will be 0.20 acres in size. For Class I WLPZs this equates to a 150' x 58' transect, and for Class II WLPZs a 100' x 87' transect.
4. All trees and snags greater than 10 cm (4 in) within these transects will be measured for dbh (nearest inch), total height (nearest 10 foot) and categorized for distance from the stream transition line (ten-foot intervals).
5. All measurements will be recorded on the Riparian Stand Inventory Form.

Data Analysis

LWD potential in the stand based on tree sizes and distances from the stream will be estimated using a LWD model (see Appendix E). An applicable tree growth model (e.g., ORGANON or CACTOS) will be used to model "unmanaged" conditions in the stand over time and estimate the LWD recruitment potential (volume) of the unmanaged stand each decade as described in Appendix E. The differences in recruitment potential, both before and after harvesting and between the harvested and unmanaged conditions, will be quantified over a modeling period of at least 20 years.

F-5 Monitoring of Road Measures Effectiveness

Road Inventories. FGS will monitor the effectiveness of the road upgrading and decommissioning measures in reducing the frequency and severity of sediment inputs from road-related sources. FGS has committed to initial drainage-level road inventories in all drainages in the Plan Area containing Class A designated lands within 10 years of issuance of the ITPs, following a priority based on: (1) miles of high and very high erosion risk road segments, and (2) miles of coho salmon habitat on and downstream of the FGS ownership. In addition, drainage level inventories in drainages with Class B lands will be completed within 15 years of ITP issuance. Effectiveness monitoring will consist of repeated road inventories in all drainages on a 10-year cycle.

Established methods for road inventories will be utilized. Current methods include those used by Pacific Watershed Associates (unpublished) and the CDFG in Part X of the California Salmonid Stream Habitat Restoration Manual (CDFG 2006). The inventory will assess, at a minimum: (1) the occurrence of hydrologically connected road segments; (2) the location of high, moderate and low treatment priority sites; (3) the amount of sediment potentially delivered from these sites; and (4) the distribution of road surface types. Results of the inventories will be integrated with results of the Channel Substrate Monitoring to aid in assessing the effects of reduced sediment input as a result of road-related processes.

Road-related Improvements. In addition to the road inventories, prioritization, and treatment of sites with the greatest potential sediment delivery described above, FGS conducts regular road maintenance, upgrading, and decommissioning activities that reduce hydrologic connectivity of road segments and sediment delivery from road surfaces and stream crossings. FGS will track road-related improvements that are conducted outside of the inventory and prioritization process to reduce sediment delivery potential throughout the Plan Area, and submit an annual report to document the effectiveness of road maintenance, upgrading, and decommissioning activities, collectively referred to as "Road Improvements." Road improvements include: (1) application of best management practices (BMPs) to reduce sediment delivery from stream crossings and other potential sediment sources identified in THPs; (2) road-related construction activities, including the improvement of existing roads; and (3) road-related upgrading and decommissioning activities, including reshaping, resurfacing, or hydrologic disconnection of existing roads. Documentation of road-related improvements will include maintenance of a GIS-based database that includes a description of the type of improvements made, methods used, reductions in potential sediment delivery, the date(s) of activities, photographs, and personnel involved.

Contents of the database will be integrated with results of the road inventories and results of the Channel Substrate Monitoring to aid in assessing the effects of reduced sediment input as a result of road-related processes.

F-6 Monitoring of Slope Stability Measure Effectiveness

FGS will conduct a mass wasting assessment to examine the relationships between mass wasting processes and forest management practices. The purpose is to ensure that timber harvesting and other covered activities do not increase hillslope mass wasting rates above regional background rates. FGS will conduct landslide surveys in the Horse, Beaver, and Cottonwood drainages using aerial photography in conjunction with ground-based field verification. These drainages were selected based on: (1) the proportion of sample areas with active operations, and areas without active operations; (2) the presence of anadromous salmonids; (3) similar lithology; and (4) concurrent data collection efforts. Protocols for the mass wasting assessment generally follow the procedures described in Pacific Watershed Associates (PWA) (1998) and Reid (1998).

The landslide information will be compiled along with information on timber harvest and associated silvicultural methods, potentially unstable landforms (i.e., deep-seated slides, headwall swales, and inner gorges), and other landforms as described by hillslope gradient, shape, and parent lithology. The assessment will compare the frequency of landslides, for various landforms, between areas harvested over the previous 15 years (study sites) and unharvested areas (reference sites). To achieve an adequate sample size, FGS may obtain landslide data from non-FGS lands.

F-7 Monitoring of Channel Morphology and Conditions

FGS will conduct periodic monitoring to assess channel conditions to evaluate channel responses to covered activities on their ownership. Within selected index reaches, FGS will use a variety of sampling techniques to identify changes in channel morphology and conditions, including cross-sectional area and shape, sediment grain size, bank stability, LWD, channel characteristics, and aquatic habitat quality. Channel monitoring will occur in the Beaver, Horse, Moffett, and Cottonwood drainages. These drainages were selected for monitoring based on: (1) the availability of prior monitoring data, (2) the extent of FGS ownership within the drainage, and (3) the presence of anadromous salmonids within the drainage.

To capture the influence of FGS activities on geomorphic conditions in a given channel, an index reach approach will be adopted. Monitoring will occur at a consistent time coinciding with the lowest stable flow period during the late summer or early fall. Monitoring of geomorphic conditions in the index reaches will be conducted initially within 2 years of issuance of the ITP and then repeated at 5-year intervals for the duration of the Permit Term.

Site Selection

At least one permanent index reach in each of the Beaver, Horse, Moffett, and Cottonwood drainages will be identified. Index reaches will be selected based on: (1) their ability to show a response in streambed characteristics to changes in management (i.e. low gradient, gravel-bedded reaches) and (2) the extent of covered activities anticipated upstream of the reach. Selected reaches should be uniform in terms of geomorphic characteristics (for example, gradient, flow, channel morphology and valley form). Index reaches will encompass a length of at least 10 bank-full widths and be a minimum of 500 feet of linear stream channel and should contain at least 20 pool/riffle sequences. These locations may be modified with approval from NMFS and CDFG.

Field Data Collection

The methods described in the California Department of Fish and Game Salmonid Stream Habitat Restoration Manual, Third Edition (CDFG 1998) and the USFS Region 5 Stream Condition Inventory protocols (Frazier et al. 2005) were used in development of the following data collection protocols.

1. Record UTM coordinates of the end points of each index reach.

2. Beginning at the downstream boundary of the index reach, walk upstream and identify aquatic habitat units to Level II (pool, riffle, flatwater). Characterize each unit to at least Level III which differentiates riffle types on the basis of water surface gradient (riffle or cascade), and pool types according to their location in the stream channel (main channel, lateral scour, or backwater).

    a. Identify and measure the characteristics (length, width) of each riffle, pool, and run within the index reaches, and estimate average and maximum pool depth and depth at the riffle crest for each pool.

    b. Assess shelter, dominant substrate (visual), embeddedness, canopy cover, and composition of bank vegetation in each habitat unit.

    c. Record all data on the FGS Aquatic Habitat Form.

3. Establish two to four permanent locations for measurement of channel geometry along cross sections spanning the active channel and extending to the elevation corresponding to the Flood-Prone Area (CDFG 1998).

    a. Identify candidate sites during the first pass along the index reach. Flag and number each candidate site and record its distance from the start of the sensitive reach. Candidate sites are fast water habitat units (riffles) in straight sections typical of the reach. Candidate sites must have clear bankfull stage indicators. Do not use pools as candidate sites. If there are less than three candidate sites in the reach, measure them all.

b. Measure the bankfull channel width (W_{bqf})of the stream at bankfull discharge (Q_{bkf}). Is measured by stretching a level tape from one bank to the other, perpendicular to the stream and at the Q_{bkf} line of demarcation on each bank. Q_{bkf} is determined by changes in substrate composition, bank slope, and perennial vegetation caused by frequent scouring flows.

c. Record depths and substrate composition from 20 stations equally spaced along a fiberglass measuring tape stretched across the channel at bankfull width. Measurements are taken along the tape line, starting at zero, at each predetermined distance point. Depths are the distance from the tape to the channel substrate below.

d. Draw a detailed sketch of the channel cross-section, showing the location of depth measurements, maximum depth, bankfull width, and flood-prone area (see Figure III-7 in CDFG 1998).

e. Determine channel entrenchment, width/depth ratio, sinuosity, and water surface slope using the methods described in CDFG (1998) or other appropriate methods.

f. Record all data on the Stream Channel Type Form.

4. Use pebble count method (e.g. Wolman 1954; Kondolf 1997) to determine particle size distribution of surface sediments in riffles at locations of permanently established cross sections.

5. Assess streambank stability at 50 evenly spaced intervals within the index reach using visual indicators (Frazier et al. 2005). Banks on both sides of the stream channel will be assessed for a total of 100 indicator points per reach.

a. Streambank stability is assessed by observing cover and other stability indicators within a plot on the surface of the streambank. The plot is 12 inches (30 cm) wide, perpendicular to flow and extends the length of the streambank from bankfull stage to the crest of the first convex slope above bankfull stage or twice the maximum bankfull depth, whichever occurs first.

b. Assess the condition of the streambank at each location as “Stable,” “Vulnerable,” or “Unstable” based on the following visual indicators:

Stable streambank plots have 75% or more cover of living plants and/or other stability components that are not easily eroded, and have no indicator of instability. Cover components indicating stability include: (1) perennial herbaceous species, such as grass-sedge-rush; (2) woody shrubs (willows, etc.); (3) broadleaf trees (cottonwood, aspen, alder, etc.); (4) conifer trees, (5) plant roots that are on or near the surface of the streambank and provide substantial binding strength to the substrate beneath; (6) boulders (>256 mm), bedrock, and cobble/boulder aggregates when combined as a stabilizing mass; (7) logs that are firmly embedded into stream banks; and (8) erosion resistant streambank soil (hardened conglomerate or highly cohesive clay/silt stream banks).

Vulnerable streambank plots have 75% or more cover but have one or more instability indicators (see below).

Unstable streambank plots have less than 75% cover and have instability indicators. Unstable streambanks are often bare or nearly bare banks composed of particle sizes too small or uncohesive to resist erosion at high flows. Indicators of instability include: (1) fracturing, blocking, or slumping including cracks near the top of the streambank, slumping banks without cracks, and blocks of soil/plant material which have fallen off or have been pushed down the bank; (2) mass movement including stream bank failure from deep-seated landslides and gravity erosion of oversteepened slopes adjacent to the channel.

c. Record all data on the Streambank Stability Form

6. Assess LWD distribution, type, and function within the "bankfull channel" of the index reach.

    a. At the beginning of each day, prior to categorizing and recording LWD, field personnel should select several pieces of LWD for sight calibration. Diameter and length ranges should be estimated and then verified by measuring with a diameter and measuring tape.

    b. Identify all LWD pieces or live trees within the bankfull channel with diameters > 4 inches (small end) and lengths > 6 feet and record the number of pieces in each diameter (2 inch) and length (2 feet) class. Record position (distance from reach boundary), type (hardwood or conifer), and function (e.g. sediment storage) of each piece of LWD. Note presence of root wads and debris jams.

    c. Record all data on LWD Inventory Form.

Data Analysis

Maintain all data collected in a database for review on a 5-year cycle by a qualified geomorphologist/hydrologist to assess trends in channel characteristics and aquatic habitat quality.

F-8 Monitoring of Fine Sediments (Pool Substrates)

Fine sediments generated as a result of FGS operations can impact aquatic covered species located in Class I and Class II watercourses downstream of and adjacent to covered activities. The primary sources of these sediments are mass wasting inputs, roads (including construction and maintenance), and sediment derived from channel and bank instability. The monitoring activities described below allow for an analysis of the cumulative effectiveness of HCP measures designed to reduce the amount of fine sediments entering Class I and Class II watercourses. Sediment monitoring activities address the aquatic species conservation program goal of minimizing sediment inputs from the covered activities.

To verify that the covered activities do not result in increased deposition of fine sediments in pools, FGS will measure the volume of fine sediments in pools and the percent of pool tail surface area covered with fine sediments in selected drainages. The Beaver, Horse, Cottonwood, and Moffett drainages have been selected for monitoring based on: (1) the availability of prior monitoring data, (2) the extent of FGS ownership within the drainage, and (3) the presence of anadromous salmonids within the drainage.

To capture the influence of FGS activities on fine sediment deposition in pools, an index reach approach will be adopted. Monitoring will occur at a consistent time coinciding with the lowest stable flow period during the late summer or early fall. Monitoring of fine sediment deposition in pools and pool tails will be conducted annually for at least 5 years from issuance of the ITP.

Site Selection

At least one permanent index reach in each of the Beaver, Horse, Moffett, and Cottonwood drainages will be identified. These will be the same index reaches identified for monitoring of channel morphology and conditions (see subsection F-7 above).

Field Data Collection

1. Beginning at the first pool to be sampled, estimate the volume of fine sediment using the Rapid V* protocol described below and in Stillwater Sciences and Dietrich (2002). The number of pools may vary depending on the size of the pools and other factors that limit the number of pools that can be sampled in a single field day, but at least six pools will be measured in each reach. When the V* values are highly variable (>20% of the mean), at least 10 pools will be measured, if available.

2. Pools to be measured are defined by their characteristics: (a) slow or no velocity during summer base flows; (b) hydraulic control at pool tail, usually a concave longitudinal profile; (c) length is greater than wetted width; (d) have significant residual depths (i.e., the deepest part of the pools is greater than two times the depth of water flowing out of the pools), and (e) the dominant feature occupies most of stream width and includes thalweg (backwater and side channel pools are not measured).

    a. Record the UTM coordinates of each pool to be sampled.

    b. Estimate the volume of the residual pool by measuring the length, average width and maximum depth of water to determine the volume of water in the pool. This will entail measurements at several points, locations, or transects within the pool.

    c. Probe the bottom of the pool extensively to identify the locations and surface areas of all patches of fine sediment within the residual pool.

    d. Measure the depth of each patch of fine sediment in five locations (per patch) to calculate the average depth of the deposit.

    e. Draw a detailed sketch of the pool, showing the outline of the residual pool, location of fine sediment deposits, location of pool depth measurements, and any significant landmarks (e.g., riprap or large trees) that would be useful for locating the pool in the future.

    f. Record all field data on the Rapid V* Data Form.

3. Assess the percent of pool tail surface area covered by fine sediments using the grid-based protocol described below and in Frazier et al. (2005) in all pools not selected for Rapid V* measurement.

    a. Record the UTM coordinates of each pool tail selected for monitoring.

    b. Three grid samples are collected at the downstream 10% of each pool length within the wetted stream width. Samples are taken at the thalweg and midway between the thalweg and each edge.

    c. The grid is a 12-inch frame with cross wire mesh which forms 49 intersections and a marked corner for the 50th point. Count and record the number of intersections above substrate that is 2 mm or less. A viewing tube, dive mask, or a piece of plexiglass can aid in viewing the grid by breaking the water surface turbulence.

    d. Record all field data on the Grid Sample Data Sheet.

Data Analysis

*Rapid V**

Pool volume occupied by fine sediments is calculated by dividing the estimated volume of fine sediments in each pool by the sum of the water volume and fine sediment volume.

$$\text{Pool filling (PF)} = \frac{\sum_{i=1}^{n} A_i d_i}{\sum_{i=1}^{n} A_i d_i + V} \qquad \text{(Equation 1)}$$

where A_i is the surface area, d_i is the depth of the *i*th sediment patch in the pool, and V is the total pool water volume.

A volume weighted mean (Equation 2) will be the statistic used to characterize pool filling by fine sediment at the reach level.

$$\text{Volume Weighted, Reach Averaged Pool Filling} = \frac{\sum_{i=1}^{n} PF_i \text{ x } PV_i}{\sum All\ Pool\ Volumes} \qquad \text{(Equation 2)}$$

Where PF_i is the pool filling calculated from equation 1 above and PV_i is the volume of the *i*th pool.

Grid Sampling

Percent surface area occupied by fine sediments is calculated by multiplying the total number of intersections over fine sediments per sample by 2. The average for the pool tail is the average of the three samples per pool tail area. The reach average is the average of all pool tail areas sampled.

Aquatic Species Monitoring Adaptability

The aquatic species monitoring outlined in the previous sections utilizes monitoring protocols that represent current, peer-reviwed, and accepted methods at the time of HCP development. It is possible that other monitoring or sampling methods may be developed during the term of the HCP that would provide more accurate measurement of or increase the efficiency of data gathering efforts for different monitoring parameters. FGS and the Services may mutually agree to modify the monitoring protocols listed in this HCP to better monitor the effectiveness of the conservation measures and ensure compliance with the terms of the conservation program at any time.

Northern Spotted Owl

This section describes the type and frequency of compliance and effectiveness monitoring for northern spotted owls associated with the Terrestrial Species Conservation Program.

Compliance Monitoring

Compliance monitoring for northern spotted owls consists of documenting compliance with the measures set forth in the Terrestrial Species Habitat Conservation Strategy for the northern spotted owl. Compliance monitoring for measures associated with each biological objective are described below.

F-9 Compliance Monitoring Associated with Objective 1 – Demographic Support

Compensatory mitigation for incidental take of owls over the Permit Term will be provided through establishment of CSAs on FGS's ownership to provide demographic support to activity centers with high conservation priority. FGS may harvest in CSAs only if general habitat conditions within the home range and core area of the activity center(s) set forth in subsection 5.3.1 are met, and specific habitat targets within the CSA (see Table 5-3) will be maintained post-harvest. Harvest within a CSA will require written approval from the USFWS. Compliance monitoring has the following objectives: 1) document that FGS has not conducted harvest activities within the CSAs unless the required general habitat conditions are met; and 2) verify that the specific habitat targets within harvested CSAs are met following harvest activities.

If FGS proposes to conduct timber operations in a CSA, prior to conducting these activities, FGS will provide map(s) of the CSA showing suitable northern spotted owl habitat in the home range and core areas of the supported activity center to the USFWS. As part of the THP process, FGS will inventory areas proposed for harvest to verify that the specific targets for northern spotted owl habitat within the CSA can be met following harvest. FGS will provide the USFWS with a copy of the proposed THP encompassing the CSA, and obtain written approval for harvest in the CSA. Following completion of timber operations in a CSA, FGS will inventory harvested stands to document post-harvest stand conditions and submit the results of the post-harvest inventory to the USFWS. The post-harvest inventory will quantify the amount of nesting, roosting, and foraging habitat in the harvested area, and characterize stand conditions in sufficient detail to verify compliance with the minimum habitat requirements for the CSA. FGS will submit the results of the post-harvest inventory to the USFWS as part of the annual report prepared for the year in which the inventory is completed.

Site Selection

Forest stand inventories to identify suitable habitat for northern spotted owls will be conducted in CSAs proposed for harvest both prior to and following harvest activities.

Field Data Collection

1. Standard forest stand inventories documenting stand basal area, canopy cover, qmd, and number of large trees will be conducted within the core and home range areas around activity centers supported by CSAs.
2. All data will be recorded on the Stand Inventory Form.

Data Analysis

Areas of suitable northern spotted owl habitat within the core area and home range will be mapped and quantified prior to and following harvest activities in the CSA.

F-10 Compliance Monitoring Associated with Objective 2 – Riparian Management

The Aquatic Species Habitat Conservation Strategy provides for protection of riparian zones through establishment of WLPZs with restrictions on harvest and other activities within the WLPZ. No additional riparian management measures for spotted owls are included in the Terrestrial Species Habitat Conservation Strategy. Compliance with the WLPZ measures will be documented through reporting and post-harvest WLPZ inspections as previously described in subsection 7.2.1.

F-11 Compliance Monitoring Associated with Objective 3 – Dispersal Habitat

Dispersal habitat consists of stands with adequate tree size and canopy closure to provide protection from avian predators and at least minimal foraging opportunities (USFWS 1992). Forsman et al. (2002) found that spotted owls could disperse through highly fragmented forest landscapes, yet the stand-level and landscape-level attributes of forests needed to facilitate successful dispersal have not been thoroughly evaluated (Buchanan 2004). Because FGS will maintain a forested landscape on their ownership, the biological objective for dispersal habitat will be met. No compliance monitoring or additional reporting is required to document compliance with this measure. At 10-year intervals following issuance of the ITPs, FGS will provide a summary of acres in each CWHR diameter and canopy cover class in the Plan Area as part of the annual report for that year.

F-12 Compliance Monitoring Associated with Objective 4 – Incidental Take Avoidance and Minimization

Incidental take avoidance and minimization will be accomplished through a combination of pre-harvest surveys and seasonal timing restrictions. In addition, FGS will provide formal training on owl identification and signs of spotted owl presence to field personnel that will be conducting THP preparation and timber operations. Compliance monitoring for this objective consists of documenting that pre-harvest surveys have been conducted, seasonal restrictions have been implemented as necessary, and personnel have been trained.

To demonstrate compliance with the Incidental Take Avoidance and Minimization measures, FGS will submit an annual report to the USFWS prior to timber operations of the results of spotted owl surveys conducted in association with THPs. The report will include the location, dates, and results of the surveys. Upon request, FGS will provide copies of proposed THPs in which take avoidance and minimization measures are to be implemented. FGS will document which employees have undergone spotted owl training and, upon request, provide the materials used in training employees to the USFWS.

Site Selection

All known NSO activity centers within 1.3-miles of the FGS ownership that are not supported by CSAs (i.e., “take” sites) will be surveyed to assess occupancy and reproductive status by spotted owls in order to initiate measures to minimize or avoid incidental take of northern spotted owls during the breeding season. Surveys will be scheduled to occur 1 to 2 years in advance of anticipated harvest activities.

Field Data Collection

1. FGS will develop and maintain a GIS database of known northern spotted owl locations and a property wide spotted owl call-point map (approved by the USFWS).
2. FGS will conduct stand searches of historic and known NSO activity centers to determine site occupancy and reproductive status prior to timber operations.
3. If a spotted owl (or barred owl) is located, occupancy and reproductive status will be determined.
4. If spotted owls cannot be located by means of a walk-through stand search, and for areas with operations scheduled during the breeding season, three protocol owl surveys will be conducted each year prior to operations, covering the suitable habitat within 0.25-mile of the proposed operations. If the owl is located during protocol surveys, a day time walk-in survey will be conducted to determine site occupancy and reproductive status. If a new spotted owl is located, a new activity center will be identified.
5. When a northern spotted owl is located, FGS will establish a 0.25-mile disturbance buffer, restricting activities around occupied activity centers, for the duration of the breeding season as described in the timing restrictions on activities around occupied activity centers (see Subsection 5.3.1 of the HCP).
6. In the event of a barred owl detection, FGS will notify USFWS within 10 days and help to facilitate (e.g., through providing access to and across their ownership) implementation of barred owl control measures deemed appropriate by the USFWS at the time of detection. Any control measures will be monitored for effectiveness.

Data Analysis

These protocols will be implemented to assure that the biological goals of the FGS HCP are met. The data and reports obtained will be compiled and evaluated to determine the effectiveness of the HCP and used to help determine the best course of action if the biological goals are not met.

F-13 Compliance Monitoring Associated with Objective 5 – Threat Management

Threat management focuses on the CSAs and includes surveys for barred owl, measures for wildfire prevention in CSAs, and measures to control disease and insect outbreaks in CSAs. To verify compliance with the barred owl control measures, FGS will submit an annual report of the results of any barred owl surveys to the USFWS. As described above for Monitoring Activity F-12, FGS will notify the USFWS within 10 days if a barred owl is detected during barred owl surveys in the CSAs. FGS will help to facilitate (e.g., through providing access to and across their ownership) implementation of barred owl control measures deemed appropriate by the USFWS at the time of detection. The report will include the protocol followed, locations, dates, and results of the surveys. The annual report will also describe any control measures for barred owls that are implemented and the results of the control actions.

FGS may conduct fuels management or salvage in CSAs only if general habitat conditions within the home range and core area of the supported activity center(s) set forth in subsection 5.3.1 are met and specific habitat targets within the CSA (see Table 5-3) will be maintained. Fuels management and salvage in CSAs will require prior written approval by the USFWS. If FGS proposes to conduct fuels management or salvage in a CSA, prior to conducting these activities, FGS will provide USFWS with a copy of the proposed fuels management or salvage plan for the CSA and provide the agency an opportunity for pre-activity review of the proposed management activity. Following completion of management or salvage operations in a CSA, FGS will inventory harvested stands to document post-harvest stand conditions and submit a post-harvest report to the USFWS. The post-harvest report will quantify the amount of nesting, roosting, and foraging habitat in the harvested area and characterize stand conditions in sufficient detail to verify compliance with the minimum habitat requirements for the CSA. FGS will submit a post-harvest report to USFWS within 6 months of completing fuels management or salvage activities.

Effectiveness Monitoring

Monitoring the effectiveness of the spotted owl conservation measures is necessary to evaluate whether the biological goals and objectives established in the HCP for the species are being met, and whether the effects of HCP implementation on northern spotted owls and their habitats are exceeding the levels anticipated by the USFWS in their Biological Opinion.

FGS's effectiveness monitoring program for northern spotted owls focuses on monitoring habitat conditions and spotted owl occupancy of the CSAs.

F-14 Monitoring of Northern Spotted Owl Habitat in CSAs

Under the HCP, timber harvest will be restricted in CSAs unless general habitat conditions within the home range and core areas of the supported activity center(s) set forth in subsection 5.3.1 of the HCP are present and specific habitat targets within the CSA (see Table 5-3) will be maintained post-harvest. Thus, the amount and quality of spotted owl habitat in the CSAs is expected to be maintained or to increase over the Permit Term. To assess the effectiveness of the HCP in maintaining or improving habitat in the CSAs, habitat conditions for northern spotted owls within the core and home range of each activity center supported by a CSA will be monitored and compared to the habitat standards described in Chapter 5 of the HCP.

To demonstrate that FGS's management activities in CSAs promote development of stand conditions that provide suitable owl habitat within the CSAs over the Permit Term, FGS will conduct stand level inventories of areas in the CSAs identified as suitable spotted owl habitat or potential spotted owl habitat (see Appendix D – Maps of CSA habitat areas). Stand inventories within all CSAs will be completed within 2 years of issuance of the incidental take permits and repeated every 10 years during the permit period.

F-15 Monitoring for Northern Spotted Owl Use in CSAs

The biological goal of establishing the CSAs and specifying habitat requirements within the CSAs is to enhance the likelihood that activity centers supported by CSAs will remain or become occupied by spotted owls, and thereby provide demographic support to the federal conservation strategy. Occupancy of an area by spotted owls is influenced by many factors, of which habitat condition is only one. Also, home ranges for owls supported by CSAs encompass land managed by many different entities (e.g., USFS, other private timber companies) in addition to FGS. As a result of these circumstances, habitat conditions on FGS lands is only one factor affecting the presence or absence of spotted owls in these activity centers, and the absence of owls in an activity center cannot be used as a definitive measure of the HCP's effectiveness. Nonetheless, it is desirable to monitor occupancy of the activity centers supported by CSAs as one component for assessing the effectiveness of the HCP.

FGS will conduct protocol surveys to determine NSO occupancy in activity centers supported by CSAs. Survey protocols and results will be reviewed by the USFWS to ensure compliance with the "Protocol for surveying proposed management activities that may impact northern spotted owls" (USFWS 1991) or currently accepted northern spotted owl survey protocols.

Surveys conducted for two consecutive years are considered more reliable for assessing occupancy of activity centers than a single survey every 4 years. For this reason, FGS will conduct protocol surveys during two consecutive years, unless an owl is detected during the first year. If an owl is detected during the first year of surveys, this will indicate occupancy of the activity center, and no follow-up survey is required the second year. The surveys will be repeated at 4-year intervals for the duration of the permit to document and identify trends in occupancy and reproductive status of activity centers supported by CSAs. If there are no detections for two consecutive years at more than 40 percent of the CSAs (9 CSAs) within a 4 year period, then FGS will notify USFWS and DFG, and enter into a discussion about why the sites are unoccupied and whether any actions within the HCP commitments could promote occupancy.

Site Selection

Monitoring for the presence of northern spotted owls will be conducted in all CSAs on a 4-year cycle.

Field Data Collection

1. A walk-in stand search of historic activity centers will be conducted to locate and determine the status of any owls occupying the activity center.

2. If a northern spotted owl (or barred owl) is located, occupancy and reproductive status will be determined.

3. If a northern spotted owl cannot be located through a stand search, call-points (pre-approved by USFWS) in close proximity to the activity center in high quality nesting/roosting habitat will be surveyed to locate owls using night surveying protocols that limit potential response from neighboring activity centers.

4. If no owls are located in the high quality nesting/roosting habitat, a pre-approved set of call-points throughout the CSA and home range will be utilized.

5. Upon locating an owl using night surveying techniques, a day time follow-up survey to determine reproduction and nesting status will be conducted.

6. Activity centers in remote areas where no vehicular access is available will be subject to only a day time stand search to locate the owls due to safety concerns.

7. To determine and manage threats to northern spotted owls, surveys for barred owls will be conducted using current USFWS-approved survey protocols. The same call points used for spotted owl monitoring will be used, but the barred owl's natural history will be taken into consideration and their distinct vocalization will be used.

8. In the event of a barred owl detection, FGS will notify USFWS and work closely with the USFWS to implement barred owl control measures deemed appropriate by the USFWS at the time of detection. Any control measures will be monitored for effectiveness.

Data Analysis

These protocols will be implemented to assure that the biological goals of the FGS HCP are met. The data and reports obtained will be compiled and evaluated to determine the effectiveness of the HCP and used to help determine the best course of action if the biological goals are not met.

F-16 Monitoring for Barred Owls in CSAs

The objective of threat management measures for barred owls is to prevent barred owls from displacing spotted owls and becoming established. Detections of barred owls could reflect a range expansion and increased risk of barred owls becoming established. Under the HCP, FGS will survey activity centers supported by the CSAs for barred owls as described above. If barred owls are detected, FGS will work closely with the USFWS to facilitate implementation of appropriate barred owl control measures. Following implementation of any control measures, another individual could quickly move into the area. To monitor the effectiveness of the control strategy and minimize the potential for additional barred owls to become established following control actions, FGS will, upon request by USFWS, conduct annual surveys for barred owls within 1 mile of the detection site. Annual surveys will continue until no barred owls are detected for 3 consecutive years, or until the USFWS no longer requests additional surveys, after which the survey frequency will revert to the standard protocol of 2 consecutive years every 4 years.

Northern Spotted Owl Monitoring Adaptability

The monitoring outlined in the previous sections uses monitoring protocols that represent current, peer-reviewed, and accepted methods at the time of HCP development. It is possible that other monitoring methods may be developed during the term of the HCP that provide for better or more cost-effective assessment of compliance with and effectiveness of the conservation measures. FGS and the USFWS may mutually agree to modify the monitoring protocols listed in this HCP to better monitor the effectiveness of the conservation measures and ensure compliance with the terms of the conservation program at any time.

Yreka Phlox

This section describes the type and frequency of compliance and effects monitoring for Yreka phlox associated with the Terrestrial Species Conservation Program.

Compliance Monitoring

Avoidance of adverse effects to Yreka phlox will be accomplished through a combination of botanical surveys to identify undiscovered populations, establishing EEZs around known and discovered populations, and pre-activity surveys prior to Covered Activities that could directly (e.g. removal, destruction) or indirectly (e.g. changes in hydrology) impact Yreka phlox. Threat management and sustainability of the species will be accomplished by establishing EEZs, as well as implementation of monitoring and management plans. To verify compliance with these measures, FGS will submit an annual report to the USFWS containing the following information:

- the location, dates, and results of botanical and pre-activity surveys for Yreka phlox; and
- the location of THPs in which avoidance and minimization measures for Yreka phlox were implemented.

In addition to implementing measures to minimize adverse impacts to Yreka phlox, under the HCP, FGS will monitor known and discovered Yreka phlox occurrences on its ownership. To verify compliance with this measure, FGS will submit an annual report of the results of monitoring activities conducted during the previous year to the USFWS.

Effectiveness Monitoring

Monitoring the effectiveness of the Yreka phlox conservation measures is necessary to evaluate whether the biological goals and objectives established in the HCP for the species are being met. As described in Section 5.3.2, FGS will develop and implement a monitoring plan for all known and discovered sites on their ownership. Although FGS is committing to monitoring Yreka phlox populations on its land as a conservation measure, the monitoring plan will also serve as effectiveness monitoring. The objective of the minimization and avoidance measures is to avoid impacts to Yreka phlox from timber operations, and thereby maintain populations of this plant on FGS land. By monitoring population status, habitat conditions, and threats at known locations, the effectiveness of the avoidance measures can be assessed.

F-17 Monitoring Yreka Phlox Populations

The specific elements of the monitoring plan for Yreka phlox will be developed in consultation with the USFWS but will include the following.

- Current known locations of Yreka phlox on FGS lands.
- Survey protocol to be followed. Monitoring will focus on habitat conditions, threats, and gross population response to these factors. The need to include detailed population size and demography assessment will be determined by FGS, USFWS, and DFG on a site/occurrence specific basis. If assessments of population size will be included, a pilot study will be conducted to guide the development of a final sampling design that will permit efficient detection of long-term population changes.
- Qualifications for monitoring personnel, which will include, at a minimum, familiarity with the species, the ecology of ultramafic habitats, and the threats to the species.

Site Selection

All known and discovered populations/occurrences of Yreka phlox on the FGS ownership will be monitored.

Field Data Collection

Specific monitoring protocols will be determined through development of the monitoring plan and coordination with DFG and USFWS.

Data Analysis

Specific data analysis methods and reporting requirements will be determined through development of the monitoring plan and coordination with DFG and USFWS.

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