East Fork /Smoky Creek Watershed Analysis

South Fork Trinity River

Shasta Trinity National Forest
Hayfork Ranger District

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United States
Department of
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Forest Service

South Fork
Coordinated
Resource
Management
Plan

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Chapter 1
INTRODUCTION

The Purpose of Watershed Analysis[1]

Watershed analysis is a procedure used to characterize the human, aquatic, riparian, and terrestrial features, conditions, processes, and interactions (collectively referred to as "ecosystem elements") within a watershed. It provides a systematic way to understand and organize ecosystem information. In so doing, watershed analysis enhances the ability to estimate direct, indirect, and cumulative effects of our management activities and guide the general type, location, and sequence of appropriate management activities within a watershed.

Watershed analysis is essentially *ecosystem analysis at the watershed scale.* As one of the principal analyses for implementing the Aquatic Conservation Strategy (ACS) set forth in the *Record of Decision for Amendments to Forest Service and Bureau of Land Management Planning Documents Within the Range of the Northern Spotted Owl* (USDA, USDI 1994) (Northwest ROD), it provides the watershed context for fishery protection, restoration, and enhancement efforts. The understanding gained through watershed analysis is critical to sustaining the health and productivity of natural resources. Healthy ecological functions are essential to maintain and create current and future social and economic opportunities.

Federal agencies are conducting watershed analyses to shift their focus from species and sites to the ecosystems that support them in order to understand the consequences of management actions *before* implementation. The watershed scale was selected because every watershed is a well-defined land area having a set of unique features, a system of recurring processes, and a collection of dependent plants and animals.

Watershed analyses are conducted by teams of journey-level specialists who follow a standard, interagency six-step process. The process is *issue driven.* Rather than attempting to identify and address everything in the ecosystem, teams focus on seven core analysis topics along with watershed-specific problems or concerns. These problems or concerns may be known or suspected before undertaking the analysis or may be discovered during the analysis. Analysis teams identify and describe ecological processes of greatest concern, establish how well or poorly those processes are functioning, and determine the conditions under which management activities, including restoration, should and should not take place. The process is also *incremental.* New information from surveys and inventories, monitoring reports, or other analyses can be added at any time.

Watershed analysis is not a decision making process. Rather it is a *stage-setting* process. The results of watershed analyses establish the context for subsequent

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1 This section is quoted from *Ecosystem Analysis at the Watershed Scale:-Federal Guide for Watershed Analysis - Version 2.2,* page 1).

decision making processes, including planning, project development, and regulatory compliance.

The results of watershed analysis can be used to:

- Assist in developing ecologically sustainable programs to produce water, timber, recreation, and other commodities.
- Facilitate program and budget development by identifying and setting priorities for social, economic, and ecological needs within and among watersheds.
- Establish a consistent, watershed-wide context for project-level National Environmental Policy Act (NEPA) analyses.
- Establish a watershed context for evaluating management activity and project consistency given existing plan objectives (e.g., ACS objectives).
- Establish a consistent, watershed-wide context for implementing the Endangered Species Act.
- Establish a consistent, watershed-wide context for local government water quality efforts and for the protection of beneficial uses identified by the states and tribes in their water quality standards under the Federal Clean Water Act.

Management Direction

The analysis area includes numerous land allocations as identified in the Shasta-Trinity National Forest Land and Resource Management Plan (LRMP) (USDA Forest Service 1993) (Map 1, Appendix E). About 3700 acres of administratively withdrawn areas and 1430 acres of congressionally withdrawn areas are present. Approximately 60% of the analysis area (29,844 acres) lies within Matrix lands, the majority of which is to be managed on a sustained yield basis for timber production. Approximately 20% of the analysis area (12,789 acres) lies within Late Successional Reserve (LSR) . The LSR, in combination with the other allocations and standards and guidelines in the Northwest ROD, is designed to maintain a functional, interactive, late-successional forest ecosystem.

The Process: A Unique Interagency Team

This watershed analysis includes several aspects unique to the process. One significant way this project is different is that it is a joint undertaking of the United States Forest Service (USFS) and the South Fork Trinity River Coordinated Resource Management Planning Group, and it combines specialists from a diverse array of agencies and organizations who work together as an inter-disciplinary team. Team members are drawn from the USDA Natural Resources Conservation Service, the Trinity County Resource Conservation District, the US Fish and Wildlife Service, Humboldt State University, and Pacific Watershed Associates, as well as the USFS, which typically undertakes such projects alone. Several private consultants, including a Registered Professional Forester and an ethnobotanist, are also involved in the project.

The project is unusual also because it seeks to analyze past, present, and future desired conditions of *two* watersheds, instead of one. The interdisciplinary team decided that a watershed analysis of both these areas was feasible because the East Fork of the South Fork (East Fork) and Smoky Creek watersheds are adjacent and share many watershed geologic, climatalogical, vegetation, and land use characteristics.

In accordance with *Ecosystem Analysis at the Watershed Scale: Federal Guide for Watershed Analysis*, the analysis team undertook a six-step process to analyze the past, present, and future desired conditions of the watersheds. The following summary of this six-step process is from the *Federal Guide for Watershed Analysis*:

> 1. *Characterization of the watershed.* The purpose of step 1 is to identify the dominant physical, biological, and human processes or features of the watershed that affect ecosystem functions or conditions. The relationship between these ecosystem elements and those occurring in the river basin or province is established. When characterizing the watershed, teams identify the most important land allocations, plan objectives, and regulatory constraints that influence resource management in the watershed. The watershed context is used to identify the primary ecosystem elements needing more detailed analysis in subsequent steps.
>
> 2. *Identification of issues and key questions.* The purpose of step 2 is to focus the analysis on the key elements of the ecosystem that are most relevant to the management questions and objectives, human values, or resource conditions within the watershed. The applicability of the core questions and level of detail needed to address applicable core questions are determined. Rationale for determining that a core question is not applicable are documented. Additional topics and questions are identified based on issues relevant to the watershed. Key analysis questions are formulated from indicators commonly used to measure or interpret the key ecosystem elements.
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> 3. *Description of current conditions.* The purpose of this step is to develop information (more detailed than the characterization in step 1) relevant to the issues and key questions identified in step 2. The current range, distribution, and condition of the relevant ecosystem elements are documented.
>
> 4. *Description of reference conditions.* The purpose of step 4 is to explain how ecological conditions have changed over time as a result of human influence and natural disturbances. A reference is developed for later comparison with current conditions over the period that the system evolved and with key management plan objectives.
>
> 5. *Synthesis and interpretation of information.* The purpose of step 5 is to compare existing and reference conditions of specific ecosystem elements and to explain significant differences, similarities, or trends and their causes. The capability of the system to achieve key management plan objectives is also evaluated.
>
> 6. *Recommendations.* The purpose of this step is to bring the results of the previous steps to conclusion, focusing on management recommendations that are responsive to watershed processes identified in the analysis. By documenting

logical flow through the analysis, issues and key questions (from step 2) are linked with the step 5 synthesis and interpretation of ecosystem understandings (from steps 1, 3, and 4). Monitoring activities are identified that are responsive to the issues and key questions. Data gaps and limitations of the analysis are also documented.

Public Participation in Watershed Analysis

One component of watershed analysis is public input during the process. Several public meetings were held to discuss planning and in-progress work for the analysis. A mailing list of interested members of the public was developed, which included landowners within the analysis area and others, and these people were kept informed of the process as it unfolded. Several of the issues and key questions addressed in Chapter 2 were raised during discussions with concerned members of the public (these questions are noted in Chapter 2).

The public can provide valuable insights and information not readily available to the interdisciplinary team. Particularly valuable are first-hand accounts from landowners and long-term residents of the study area, which can provide information on the watersheds, particularly information related to human use of the area historically.

Organization of the East Fork/Smoky Creek Watershed Analysis Document

Although the analysis team undertook their investigation of the watersheds in the sequence of steps outlined above, the information contained in this document is not strictly presented in this order. It was decided that since the key issues and questions concerning the watersheds were the driving force behind the analysis, they would be presented first, in Chapter 2, followed by chapters that investigate these issues in detail. Chapter 3 provides an overview of the team's findings, presenting a broad characterization of the watersheds, including climate; geology, hydrology and aquatics; vegetation; wildlife; and human and public values of the watersheds. Chapter 4 traces past events and impacts on the key issues and questions under investigation. Chapter 5 discusses how these historical factors interact with current conditions in the watersheds. Chapter 6 provides a synthesis of the information presented in earlier chapters and points in the direction of management actions that could enhance the health and viability of the ecosystem and its valuable resources. Finally, Chapter 7 highlingts the highest priority recommendations outlined as part of the synthesis discussion in Chapter 6, recommendations for monitoring, and suggestions for closing data gaps the team identified during the course of the analysis. An Appendix at the back of the document includes cited references, a list of Abbreviations and Acronyms, a list of contributors, plantation history and treatments, maps that support the discussion in the first seven chapters of the document, and a copy of the watershed alalysis initiation letter.

Chapter 2
ISSUES AND KEY QUESTIONS

Overview of Issues and Key Questions

The issues and key questions in this chapter have been based on several parameters. The original direction given to the Watershed Analysis (WA) team is embodied in the Initiation Letter that began the WA process, in which the WA team was asked to place particular emphasis on "fisheries restoration, fuels reduction, late successional forest protection and enhancement and commercial wood products" (see Appendix F for the full text of the East Fork/Smoky Creek Watershed Analysis Initiation Letter).

In addition, The *Record of Decision for Amendments to Forest Service and Bureau of Land Management Planning Documents Within the Range of the Northern Spotted Owl* (USDA/ USDI 1994) (Northwest ROD) and the *Land and Resource Management Plan of the Shasta-Trinity National Forests* (LRMP) (USDA Forest Service 1993) formed the basic underpinning to these issues and questions outlined here, as these provide direction concerning the goals and objectives for the region in general and the Shasta-Trinity National Forest specifically.

The team also based these questions and issues on extant knowledge of the East Fork of the South Fork (East Fork) and Smoky Creek watersheds. In addition, interested members of the public were invited to provide input to the analysis team on issues and questions concerning them. Public meetings were announced and held, and mailings were sent to interested members of the public, to solicit input on the analysis and potential issues relevant to it. Questions and issues specifically raised by the public appear in this chapter and these are indicated by bullets (•) to the left of the question or issue.

The issues and key questions that follow fall into six broad categories based on the issues the team perceived as relevant to the watersheds: Late Successional Reserve protection and enhancement; threatened, endangered, and sensitive (TE&S) species; erosional processes, water quality, and TE&S fish species; human and public use values of the watersheds; catastrophic fire and fuels; and commodities production.

Issues and Key Questions

Issue 1: LSR Protection/Enhancement and Wildlife Corridors

1.1 *What is the condition of the Late Successional Reserve (LSR)?*

The purpose for addressing this question is to evaluate whether the LSR currently has the potential to function as it was intended. The primary criteria that will be used to evaluate this question are: functional connectivity to other LSR's, degree of fragmentation, and forest composition (amount of late successional forest).

1.2 *How do lands surrounding the LSR influence the integrity and functioning of the LSR?*

Geographically, LSR lands may be viewed as "islands." However, these islands interact with their surrounding landscapes (often Matrix lands). As such, these surrounding lands have the potential to influence how LSR's function. It is the intent of this analysis to identify ways to minimize threats/impacts to the LSR that exist outside of the LSR and to enhance the positive qualities that adjacent lands afford the LSR.

The Northwest ROD requires that in fifth-field watersheds where late-successional stands currently comprise less than 15 percent of the Federal lands (including all allocations), effort will be made to identify additional stands that display old-growth characteristics in order to ensure that 15% of the watershed consists of areas in late successional stages of development. In the East Fork and Smoky Creek watersheds such areas could contribute to the integrity and functioning of the LSR, as well as provide connectivity to other old-growth areas for species dependent on this habitat. In addition, the band of unroaded area north of the LSR in Happy Camp watershed provides an additional measure of protection to the LSR, as the Northwest ROD also provides for the retention of late successional forest stands in areas allocated to unroaded, non-motorized recreation.

1.3 *Can management and/or restoration activities help the LSR attain old-growth characteristics?*

Because the only management actions allowed in LSR's are those that will enhance their quality, in this analysis we will identify opportunities for such enhancement, if they exist.

1.4 *What are the fuels conditions in the LSR?*

Fuels occur as both standing and dead/down biomass. Because LSR's were designated to protect late-successional forest species, large-scale threats to the quantity and quality of LSR habitat must be assessed. This analysis recognizes catastrophic fire as potentially the largest natural threat to the quantity of old growth forest habitat within the LSR. Thus, comparison of current fire regimes with historic conditions and evaluation of the potential threat of fire in these watershed units are warranted.

Issue 2: Threatened, Endangered, and Sensitive Species

2.1 *What ecological factors limit the distribution and abundance of Threatened, Endangered and Sensitive (TE&S) species that occur within the watersheds?*

Through identifying the ecological factors that limit these species' abundance, it is the intent of this analysis to determine whether management/restoration efforts in the watersheds could contribute to species enhancement. It is possible that factors outside the watersheds are overwhelmingly contributing to species decline; thus, management within the East Fork and Smoky Creek watersheds would have minimal or no influence.

2.2 *What is the importance of the watersheds to TE&S species in the larger geographic (e.g., forest-, or region-wide) area?*

Identifying the relative importance of habitats and other factors (e.g. predators/competitors, human activities) within these watersheds to TE&S species will influence the overall analysis recommendations. If, for example, it is determined that habitats within these watersheds are source habitats for a species (i.e. those that produce excess offspring that subsequently colonize other habitats), greater protection for them might be appropriate.

2.3 *Can the watersheds contribute to keeping sensitive species from becoming Federally Listed species?*

Federal or state listing of a species as Threatened or Endangered is generally the culmination of a history of population decline; once a species is "listed," it is almost always more expensive and difficult to deal with than it would have been to keep the species from reaching the thresholds for listing. In this analysis we will seek to identify species in the watersheds that appear to be headed toward listing, including Survey and Manage species, and identify important elements in the watersheds for them.

Issue 3: Erosional Processes, Water Quality, and TE&S Fish Species

3.1 *What is the relative importance of the quality and quantity of fish habitat within the watersheds to fish populations, including TE&S fish species, in the South Fork Trinity River basin?*

The analysis area lies within Tier I Key Watershed and contains sub-basins which are currently thought to provide refugia habitat for TE&S fish stocks within the South Fork Trinity River (South Fork). The purpose of this question is to characterize habitats within the analysis area and consider their importance and significance in the restoration, recovery, and management of the South Fork.

3.2 *What are the dominant ecological processes that shape fish habitat conditions within the watersheds, for example hillslope and channel erosion, as well as the transport, storage, and routing of large wood and sediment?*

Much attention has been focused on the decline of South Fork fish populations. Identification and an enhanced understanding of the dominant ecological processes which shape fish habitat conditions are basic to informed, sound management decisions and restoration efforts.

3.3 *Do natural or management-related conditions exist which have the potential to alter and degrade the high value fish habitat or "refugia" found within the analysis area?*

Recognizing that refugia habitats are the cornerstone for maintenance and recovery of threatened or declining fish stocks, identification of activities or conditions which have the potential to alter or degrade fish habitats is of utmost importance.

3.4 *What restoration opportunities are available to minimize or reduce the risk of chronic or catastrophic degradation of high-value habitats within the analysis area?*

This question builds upon the previous question. If conditions or activities which threaten the refugia quality of habitats within the watersheds are identified, we hope to explore and recommend actions which will address those conditions and activities and secure existing high-value aquatic habitats for the long term.

3.5 *How will this analysis assist the North Coast Regional Water Quality Control Board in establishing standards and recommending actions which restore water quality in the South Fork?*

Under the Clean Water Act, the North State Water Quality Board listed the South Fork as an "impaired water body." A process, spearheaded by the U. S. Environmental Protection Agency (EPA), was initiated to identify standards and recommend actions to restore water quality in the South Fork. Clearly, this effort has tremendous implications for management of the South Fork. A basic understanding of current and historic water quality conditions and the ecological and management activities which have and are affecting water quality is needed to establish standards and recommend actions. We originally included this question hoping to provide this basic understanding within the watersheds.

The East Fork/Smoky Creek watershed analysis began shortly after the EPA began to involve local agencies and interest groups in the process for identifying standards and recommending actions for restoring water quality in the South Fork. Since that time there has been much debate over the merits of in-stream quantitative standards versus a "target- driven" approach focusing on management practices in the basin. Now, at the conclusion of our analysis it is unclear what type of standards and/or recommended actions will be established. Therefore it is difficult to address our original key question on this issue. Through this analysis, we have identified the dominant ecological processes and management activities which have and are affecting water quality within the watersheds. We have made management recommendations to reduce risks to aquatic resources, including water quality, and emphasized the importance of habitats within the watersheds to the South Fork as a whole. We hope that the information provided within this analysis will be considered a part of the ongoing process for establishing a final set of water quality standards and management requirements in the South Fork watershed as developed and approved by the EPA.

Issue 4: Human and Public Use Values

- 4.1 *What is the most significant human use within the analysis area and how does it affect the watershed?*

Timber harvesting is the dominant human use within the watersheds. Public opinion regarding the appropriate degree of harvesting ranges from those who want continued harvesting within the watersheds, those who want only moderate thinning, to those who want harvesting stopped completely or curtailed significantly. The effects of timber harvesting on the watersheds are discussed at length in later chapters.

4.2 *Is this area currently used by Native Americans and what land management practices are compatible with Native American needs?*

Historically, Native Americans inhabited the study area, gathering foods and medicines and seeking spiritual sustenance. The demographics of this area have been altered since contact time: European settlers replaced Native Americans then migrated out as well, leaving only a scattered few non-native, year-round residents. Currently, native people continue to use this land, though the use is greatly diminished from pre-contact times. Archaeological surveys have assessed many traditional procurement and habitation sites, but little is known about currently used spiritual sites.
Sites of spiritual significance, however, have not been revealed by the tribes, and specific recommendations for protection of these sites cannot yet be made. However, practices that ultimately improve the health of the watershed are believed to be compatible with Native American needs.

4.3 *What non-timber forest products (NTFP's) have been and will be harvested in the watersheds? Will harvesting NTFP's adversely affect the watersheds and LSR objectives, and will harvesting maintain special status species?*

Currently, very little harvesting of NTFP's takes place within the watersheds. This is due to several factors: the remoteness of the watersheds, the current low level of interest in harvesting NTFP's, and the lack of a proliferation of high market value species within the analysis area. Because of the minimal level of NTFP harvesting, it is not considered a significant issue of concern at present.

4.4 *What role does recreation play in the analysis area.*

The analysis area supports a diverse array of recreational activities. Hiking, mountain biking, hunting, and horse packing are common and increasing in popularity. An extensive road system supports four-wheel driving, motorcycling, and hunting. Off-road vehicle use occurs as well but is minimal.

- 4.5 *Within the East Fork area are 5,000 acres of Roadless Area and Evaluation (RARE II) lands that lie adjacent to the Yolla Bolla Wilderness. Will* *there be recommendations in the watershed analysis to designate this land as Wilderness in order to protect it?*

Wilderness designations and proposed changes to existing wilderness areas lie outside the scope of watershed analysis. However, there are numerous references and protections provided within the LRMP pertaining to RARE II lands. In addition, much of these lands currently reside in LSR land allocations and Tier I Key Watershed.

- 4.6 *Will the lower portion of Smoky Creek, which lies within the Chinquapin roadless area, and which is also RARE II land, continue to be managed as roadless? Will recommendations be made in the watershed analysis to designate this land as Wilderness in order to protect it?*

Wilderness designations and proposed changes to existing wilderness areas lie outside the scope of watershed analysis. However, there are numerous references and protections provided within the LRMP pertaining to RARE II lands. In addition, much of these lands currently reside in LSR land allocations and Tier I Key Watershed.

- 4.7 *How will survival of sugar pine be considered?*

The public has expressed concern about sugar pine survival in the watersheds. This topic will be addressed in conjunction with Issue 6 Commodities Production, and Issue 2 TE&S Species.

- 4.8 *To what extent does grazing occur in the analysis area and what are its impacts?*

Grazing within the analysis area is minimal. Impacts from grazing practices are not believed to be significant, except for some isolated areas. Ongoing Biological Assessment and consultation between US Forest Service (USFS) and National Marine Fisheries Service are evaluating these impacts in depth. Therefore, we do not anticipate this to be a significant issue addressed in this analysis.

4.9 *Has a monitoring program been initiated that will assess whether biological diversity and old growth habitats are being maintained?*

The USFS must follow the dictates in a multitude of management documents, all of which require monitoring programs be initiated. This analysis will seek to discover the extent to which monitoring activities are occurring within the analysis area and make recommendations based on perceived needs for monitoring ecosystem elements in the watersheds.

4.10 *How does the proposed Wild and Scenic River recommendation for the SFTR above Forest Glen affect management decisions?*

The LRMP provides extensive guidance regarding this question (pp. 3-22 and 3-23). Since lands around Wild and Scenic portions in the watersheds are not allocated to

Matrix, or commodities production, impact to Wild and Scenic portions of the South Fork is not anticipated.

Issue 5: Catastrophic Fire and Fuels

5.1 *What and where are the critical and unique resources at risk from catastrophic fire in these watersheds?*

Fire, in and of itself, is value neutral. When viewed in the context of human values, it becomes either neutral, desirable, or undesirable depending upon its effect on these values. Given the LRMP and Northwest ROD management directions for these watersheds, which prioritize goals and objectives, it is necessary to identify and locate the resources which are critical to attaining these goals and objectives that would be damaged by catastrophic fire.

5.2. *What are the fire risks (chances of fire ignition), weather patterns, and fuel hazards (fuel types, amounts, and conditions) in different areas of these watersheds?*

Assuming that catastrophic fires can adversely effect resources of value to humans, it is desirable to know what is the likelihood of these fires (i.e. fire danger). The danger of catastrophic fires is comprised of three elements: the risks of fires starting, weather patterns which affect their spread, and the condition of fuels. In order to develop strategies for minimizing catastrophic fires, it is necessary to identify the history and nature of fire starts and fire spread in these watersheds, what are the various weather patterns which contribute to these fires, and what are the conditions and locations of the fuels.

Issue 6: Commodities Production

6.1 *Given the LRMP and Northwest ROD management directions, what and where are the timber harvest opportunities within the watersheds?*

Matrix lands allocated to Prescription VIII, Commercial Wood Products Emphasis, comprise a large proportion of these watersheds. At the same time, these watersheds lie within Tier I Key Watershed, where water quality protection is a priority. There are also significant areas allocated to protection of late-successional forests and the wildlife which they support, especially the Northern Spotted Owl (NSO). Other priorities are protection of fisheries, other TE&S species, and the protection of the South Fork, given its status as a Candidate for Wild and Scenic River.

Considering the priorities and possible limitations above, timber stands need to be identified where timber harvesting will support these priorities. Suitable harvesting systems, whether even or uneven-aged or sanitation/salvage, and the level of annual harvest possible also need to be identified.

There are extensive areas in the higher elevations of these watersheds where soils were derived from ultramafic rocks. Some of these soils may be serpentinized and may be limiting to timber production in a variety of ways. These soils need to be identified so that decisions can be made regarding the appropriate methods and level of timber harvesting, if any.

6.2 *What and where are the thinning opportunities which will support the resource priorities identified in the LRMP and Northwest ROD management directions?*

Timber stands need to be identified where commercial or precommercial thinning will support priorities in the LRMP and Northwest ROD. Thinning can be used for one or a combination of the following reasons: to reduce fuels in order to reduce fire hazard, to increase growth rates and thus decrease the time required to grow trees to a given size, to create or improve wildlife habitat, to enhance the health and vigor of stands and thus reduce damage from insects and diseases, and to increase visual variety.

6.3 *Where are the opportunities for firewood cutting or biomass in these watersheds given the priorities identified in the LRMP and Northwest ROD management directions?*

The LRMP identifies firewood cutting and biomass production as appropriate on Matrix lands. At the same time, retention of hardwoods and appropriate levels of biomass required for protection of water and soil quality, wildlife and plant diversity, riparian zones, and other ecosystem needs are required. Given these requirements, the watershed analysis team sought to discover where the opportunities for firewood cutting and commercial biomass removal existed.

• *(This symbol marks issues specifically raised by members of the public).*

Chapter 3
CHARACTERIZATION OF THE EAST FORK AND SMOKY CREEK WATERSHEDS

Location and Geography

The East Fork of the South Fork (East Fork) and the Smoky Creek watersheds are located in southeastern Trinity County, California at the southernmost extent of the South Fork Management Unit of the Shasta-Trinity National Forest (Map 1, Appendix E). The watershed analysis area encompasses approximately 49,250 acres: 24,657 acres in the Smoky Creek watershed and 24,593 in the East Fork watershed. The analysis area is approximately 22 miles long and averages about 5 miles in width. It is bounded by Black Rock Mountain, North Yolla Bolly Mountains, and Buck Ridge to the south; Red Mountain and Pony Buck Peak to the east; Rattlesnake Ridge to the north; and the mainstem South Fork of the Trinity River (South Fork) to the west.

The East Fork flows westerly from its headwaters then turns northwest before turning westward again prior to its confluence with the South Fork. It is located in the extreme southeast part of the South Fork basin and joins the South Fork approximately 40 miles south of the latter's confluence with the mainstem Trinity River at Salyer. The East Fork has several major subdrainages, including Prospect Creek, Texas Chow Creek, and Dark Canyon Creek. Elevations range from 3000 feet at the mouth of the East Fork to nearly 7800 feet on Black Rock Mountain. The terrain is moderately to very steep, with deeply incised stream channels and few floodplains.

The Smoky Creek watershed comprises several major creeks which drain directly into the South Fork: Smoky Creek, Silver Creek, and Red Mountain Creek. Several smaller unnamed creeks are also contained within the analysis area. All three named creeks have a predominantly southwest flow before entering the South Fork downriver from the East Fork. Elevations range from 2500 feet at the mouth of Silver Creek to nearly 5700 feet on Red Mountain. The terrain is moderately to very steep, with deeply incised stream channels and few floodplains.

The East Fork/Smoky Creek watershed analysis area lies within two overlapping descriptive hierarchies. The area is split between two sections of the National Hierarchy of Ecological Units (USDA 1993): the Klamath Mountains Section and the Northern California Coast Ranges Section. This hierarchy is used to classify land based on a combination of similar climate, physiography, and vegetation. The analysis area also lies within the California Klamath Mountains Province, as described in the *Record of Decision for Amendments to Forest Service and Bureau of Land Management Planning Documents Within the Range of the Northern Spotted Owl* (USDA, USDI 1994) (Northwest ROD). This physiographic province is intended to reflect similarities in geology and climate and also incorporates state boundaries.

Land Status and Allocations

The South Fork encompasses approximately 620,000 acres and is one of four large tributaries to the Trinity River (Map 1, Appendix E). The South Fork can be divided into four smaller units: the Upper South Fork, Middle South Fork, Hayfork Creek, and the Lower South Fork. The East Fork/Smoky Creek watershed analysis area comprises about half of the Upper South Fork Unit, which has been designated as a Tier 1 Key Watershed by the Northwest ROD and Forest Ecosystem Management Assessment Team (FEMAT). Tier 1 Key Watersheds are intended to provide high-quality anadromous fish habitat and will serve as anchors for the potential recovery of depressed fish stocks.

The South Fork is classified as a Wild and Scenic River in both the State and Federal Systems. The Wild and Scenic River Management Plan includes objectives and standards and guidelines for the entire watershed, including its tributaries. Portions of the South Fork, downstream from Forest Glen, are Wild, Scenic, and Recreation components of the National Wild and Scenic River system. From Forest Glen upstream, an additional 25 miles of the South Fork have been inventoried and proposed as an addition to the National Wild and Scenic River system.

Currently, approximately 2.6 percent of the analysis area (1290 acres) is in private ownership, and the remaining 97.4 percent is public lands. All of the public lands are managed by the Shasta-Trinity National Forest. The private lands are small inholdings, with approximately one half of these managed for commercial timber production.

The analysis area includes numerous land allocations as identified in the Shasta-Trinity National Forest Land and Resource Management Plan (USDA Forest Service 1993) (Map 2, Appendix E). About 3700 acres of administratively withdrawn areas and 1430 acres of congressionally withdrawn areas are present. Approximately 60% of the analysis area (29,844 acres) lies within Matrix lands, the majority of which is to be managed on a sustained yield basis for timber production. Approximately 20% of the analysis area (12,789 acres) lies within Late Successional Reserve (LSR) . The LSR, in combination with the other allocations and standards and guidelines in the Northwest ROD, are designed to maintain a functional, interactive, late-successional forest ecosystem.

Climate

The typical winter weather pattern in these watersheds is for storms to move in from the southwest, drop rain at lower elevations and snow at higher elevations, and move out from two to five days, or more, later. These stormy periods are followed by rainless periods with a duration of two days to two weeks or more. As the season progresses into spring the rainy periods decrease and the rainless periods increase, while the daytime temperatures begin to climb and the night time temperatures rise only slightly. Summers are generally rainless, with high temperatures typically in the 80's and 90's (Fahrenheit) and lows in the 60's and 70's. It is common during summers for cumulus clouds to build up during the day, sometimes resulting in lightning storms and cloudbursts by mid to late afternoon. These storms, which can be quite violent, with high, gusty winds, torrential rains, and numerous lightning strikes are the primary natural source of fire ignition. This weather pattern can continue into fall, during which time the daytime temperatures are gradually decreasing and the night time temperatures are falling more rapidly. With the onset of late fall rains, lightning storms generally decrease. Because warm storms sometimes follow cold storms that have deposited snow, the watersheds are susceptible to rain-on-snow events.

Geology, Hydrology, and Aquatics

Overview

The East Fork/Smoky Creek watershed analysis area can be stratified into several sub-watersheds, including the East Fork, Smoky Creek, Red Mountain Creek, and Silver Creek watersheds. Also included in the analysis area is the South Fork itself from Silver Creek up to the East Fork.

Geologic Setting

The East Fork and Smoky Creek watersheds are underlain by three geologic formations whose rocks have been dated as forming between the Early Cretaceous (120 million years old) and the Triassic period (200 million years old). From younger to older rocks, they are the Pickett Peak Terrane (South Fork Mountain schist), Western Jurassic Terrane (Galice Formation) and the Rattlesnake Creek Terrane (Irwin et al 1985) (Map 3, Appendix E).

Approximately 90% of the watershed analysis area lies within the Klamath Mountains geologic province (Western Jurassic and Rattlesnake Creek Terranes), with the area south of the main stem of the East Fork being in the Coast Ranges province (Pickett Peak Terrane). A major inactive fault structure extending from Mt. Diablo in central California to Brookings, Oregon forms the Coast Range Thrust Fault (also known as the South Fork Fault) contact zone between the two geologic provinces. The main stem of the East Fork and the main stem of the South Fork have eroded canyons and now flow along this fault nearly to Hyampom, California.

The southernmost portion of the watersheds, including Black Rock Mountain and North Yolla Bolly Mountain contain the most extensively glaciated landforms in the whole of the South Fork watershed. Both peaks contain well-developed cirques with glacial lakes within.

Hydrologic and Aquatic Setting (Including TE&S Fish Species)

Streams within the analysis area support both resident rainbow trout (*Oncorhynchus mykiss*) and anadromous populations of spring Chinook (*Oncorhynchus tsawytacha*) and winter steelhead (*Oncorhynchus mykiss*). Summer steelhead (*Oncorhynchus mykiss*), although never abundant in the South Fork are also thought to occur sporadically within the analysis area. Both summer and winter steelhead are included in the Klamath Mountain Province Evolutionarily Significant Unit (ESU), and they are presently proposed as threatened under the Endangered Species Act (ESA). Fall Chinook have never utilized habitats in the South Fork much above Hyampom and are therefore absent from streams within the analysis area. Coho salmon (*Oncorhynchus kisutch*) are also not known to utilize habitats in the upper headwaters reaches of the South Fork. The Northern California Coastal Coho Salmon ESU, which includes South

Fork Trinity River fish, is federally listed as threatened under the ESA. Within the analysis area, the greatest amount of anadromous salmonid habitat is found in Smoky Creek, the East Fork, and the South Fork itself. Habitat accessible to anadromous salmonids is also present in the lower reaches of Red Mountain Creek and Silver Creek. Resident rainbow trout (*Oncorhynchus mykiss*) habitat is found in other smaller streams within the analysis area as well as several larger streams which are barred to upstream anadromous fish migration. Because adult escapement monitoring has been conducted at a broad scale--for example, the South Fork above Forest Glen--escapement numbers for individual streams and small segments of the South Fork are generally not available. Redd counts, qualitative observation, and anecdotal information suggest that in recent years, several hundred salmon and steelhead may have utilized the anadromous salmonid habitat found within the analysis area on an annual basis.

Channel types and landforms are very similar throughout the analysis area, with high to very high relief topography and V-shaped canyons dominating the landscape. Stream channels are moderately to deeply entrenched, heavily influenced by bedrock control, and very stable, with little meander and lateral channel movement. Using the Rosgen (1984) channel classification system the majority of the channels are classified as Aa, A and B type channels. The morphology of these stream channels create "high energy" hydrologic conditions that distribute the majority of large wood along channel edges, often at the high water mark and roughly parallel to the Thalweg. Wood that is incorporated mid channel is generally very large (>5 feet) diameter material, often with the root wad attached. Erosion processes and sediment input, storage and routing are clearly the dominant processes which influence aquatic productivity and fish habitat conditions within the analysis area.

While much of the high quality habitat that formerly existed in the South Fork has been severely degraded, properly functioning refugia habitat exists within the analysis area. Within these aquatic refugia, the distribution, diversity, and complexity of riparian and aquatic habitats, including patterns of sediment and wood routing, water quality (including temperature), and flow regimes are still properly functioning. The importance of these refugia habitats is recognized both in the Northwest ROD and in the Shasta-Trinity National Forest's *Aquatic Conservation Strategy (ACS)*. The analysis area lies within Tier 1 Key Watershed as identified in the Northwest ROD. Additionally, the East Fork, Smoky Creek, and Silver Creek subwatersheds ranked 2, 3 and 4 respectively on the list of focal anadromous subwatersheds identified in ACS. These subwatersheds have a high probability of maintaining fish communities, including TE&S fish species, and their habitat and are extremely important, not only within the analysis area, but within the entire South Fork watershed.

Vegetation

Overview

The vegetation patterns and communities of the watersheds have developed as a result of macro- and microclimate conditions influenced by elevation, topography, aspect, unique geologic and soil characteristics, erosional processes, wildfire, cultural factors, prescribed burning, timber harvesting, and, to a lesser degree, grazing.

These conditions have resulted in a mosaic of plant communities dominated by moderate (40-60% canopy cover) to dense (70% or greater canopy cover) stands of Klamath mixed conifer consisting of pole- to large-size trees (see pg. 5-19 for a description of timber strata size and canopy classes). On ultramafic soils the vegetation consists primarily of very sparse (< 25% canopy cover) stands of small- to medium-size Jeffrey pine (*Pinus Jeffreyi*) and incense cedar (*Calocedrus decurrens*). In the numerous plantations in the watersheds are found seedling- to pole-size Douglas-fir (*Pseudotsuga menziesii*) and ponderosa pine (*Pinus ponderosa*). There are also small communities of small- to medium-size red fir (*Abies magnifica*) and white fir (*Abies concolor*) at higher elevations, and patches of shrubland and grassland associated with ultramafic and/or shallow soils.

East Fork

Douglas-fir is mapped as the largest vegetation type in the watershed, comprising nearly 50% of the watershed (Map 6a, Appendix E). Rather than homogenous stands of Douglas-fir, much of this vegetation type is actually composed of Klamath mixed conifer, with smaller stands of montane hardwood. Due to timber harvesting in the northern region of the watershed, the majority of Douglas-fir is composed of small- to medium-size trees with highly variable canopy covers that generally range from 40-70%. One of the largest stands of mature, dense Douglas-fir is found in the Late Successional Reserve (LSR) in the southern portion of the watershed. In this reserve are found the largest trees in the watershed with dense canopies of 70% or greater.

Ponderosa pine is another prevalent vegetation type, comprising 26% of the watershed. Although mapped as ponderosa pine, much of the stands are actually Jeffrey pine/incense cedar types that are found on ultramafic soils in the northwest corner of the watershed and in the Pony Buck Peak area. These stands consist mostly of small to medium size conifers with a sparse canopy cover that is less than 39%. Although the vegetation is sparse in areas with ultramafic soils, there are numerous serpentine adapted herbaceous species found on these soils, many of which are unique and sensitive species.

Plantations, which comprise 1254 acres (~11%) of the Matrix lands and 2153 acres (~9%) of the watershed, are a common feature and are found along Buck Ridge in the southwest, scattered throughout the northwestern half in the Prospect, Texas Chow, and Dark Canyon Creek drainages, and along the northeastern boundary of the watershed. These plantations are well stocked with seedling-, sapling-, and pole-size ponderosa pine and Douglas-fir.

Other significant vegetation types in the watershed include 1600 acres of red fir in the area of Black Rock Mountain and the Yolla Bolly-Middle Eel Wilderness, with white fir and montane hardwoods also present (see also table 5-12).

Both the LRMP and EUI vegetation data show numerous vegetation types that comprise 1% or less of the watershed. These include montane chaparral, mixed chaparral, montane hardwood conifer, herbaceous cover, montane riparian, barren, annual and perennial grasslands, foxtail pine/subalpine conifer, and wet meadow/lacustrine.

Smoky Creek

The watershed in part consists of a mosaic of fragmented stands of mixed conifer in what originally were dense stands of mixed conifer and Douglas-fir (Figures 3-1 and 3-2). This fragmentation is primarily the result of timber harvesting over the past 40 years.

Current vegetation data shows Douglas-fir as the largest component of Smoky Creek, comprising 50% of the watershed (Map 6b, Appendix E). As in the East Fork watershed, much of what is mapped as Douglas-fir more closely resembles Klamath mixed conifer, with small- to medium-size trees and a highly variable canopy cover.

Ponderosa pine, which comprises 34% of the watershed, is the other prevalent vegetation type in Smoky Creek. This vegetation type is found primarily on the Matrix lands, where frequent harvests have left stands of small- to medium-size ponderosa pine and Douglas-fir with a sparse to medium canopy cover (less than 39%). Although mapped as ponderosa pine, the ultramafic soils in the northern region of the watershed actually have sparse stands of Jeffrey pine and incense cedar, with an herbaceous layer composed of species adapted to serpentine soils.

Numerous plantations are found in scattered blocks in the northwest, south-central and southeast portions of the watershed. These plantations comprise 1555 acres (~8.5%) of the Matrix lands and ~6.3% of the watershed. Most of these plantations were established within the last 15 years and are well stocked with either seedling- or sapling-size ponderosa pine and Douglas-fir.

White fir is also found in the northeastern corner of the watershed in the Red Mountain area.

Those vegetation types that comprise less than 1% of the watershed include streamside, montane shrub, shrublands, and grasslands.

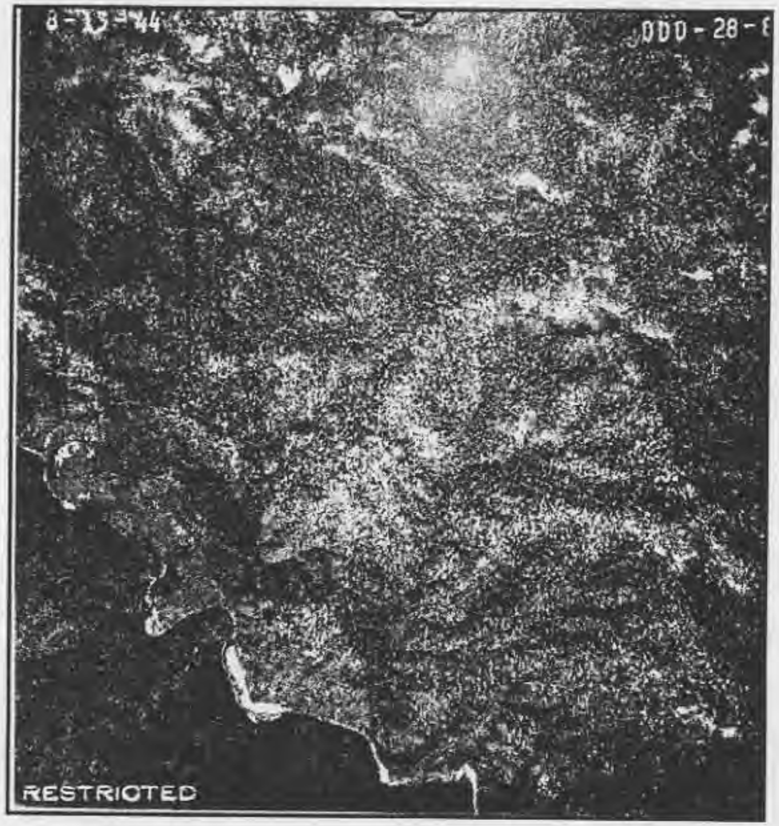

Figure 3-1. Aerial photograph from 1944 showing the original forest structure in the Soap Creek drainage of the Smoky Creek watershed.

Figure 3-2. Aerial Photograph from 1980 of the Soap Creek drainage showing the fragmented vegetation cover as a result of timber harvesting

Threatened, Endangered, and Sensitive (TE&S) Plant Species

Currently there are 14 sensitive plant species, as listed by the US Forest Service (USFS), that are either known or suspected to occur within the watersheds. Except for Oregon fireweed (*Epilobium oreganum*), all of these sensitive plants are serpentine species, and therefore are restricted to the northern regions of the watersheds where ultramafic soils are present. Of the 14 species listed, six have been found within the watersheds through pre-project botanical surveys. The other eight species are suspected to occur within the watersheds due to the availability of habitat on ultramafic soils. Two of these known species (*Eriogonum libertini* and *Haplopappus ophitidis*) are especially unique because they are endemic to the Shasta-Trinity National Forest, with most known populations occurring within Forest boundaries.

There are also three species (*Allotropa virgata*, *Cypripedium fasciculatum*, *Cypripedium montanum*) listed as US Forest Service Survey and Manage species. Although these species have not been found within the watersheds, they are suspected to be present due to available habitat, which includes open coniferous forest and mesic areas.

Catastrophic Fire And Fuels

Fire is the most significant natural-disturbance agent affecting vegetation in the watersheds. Fire records since 1910 show 142 fires of less than 5 acres in size scattered randomly throughout the watersheds, with lightning being the main ignition source (87%). Most of these fires, especially in the higher elevations, were probably low-intensity ground fires that did little damage to larger trees. There have been three larger fires of 17 acres, 160 acres, and 1600 acres in the Smoky Creek watershed and two fires of 11 acres and 40 acres in the East Fork watershed. All but the largest fire were probably not stand-replacement fires. The 1600-acre fire was in an area that has a mosaic of stands with open and dense canopies, so that fire may have been of a high enough intensity to kill trees.

A USFS fire risk assessment, which is based upon historical fire starts, shows a medium risk for these watersheds, with a fire return frequency of one fire every six to eight months. Lightning from summer thunderstorms continues to be the main source of ignition, with most of these fires likely to be in the mid to upper slopes (Maps 7a and 7b, Appendix E).

These watersheds have high road densities in some portions, low to moderate road densities in others, and no roads in others. Generally, the roads receive light traffic, except during hunting season and when logging is occurring. All of the roads and trails and the primitive camps are areas of higher risk for fire ignition by humans.

Before fire suppression occurred in these watersheds it is likely that there were more fires (probably annually) and that they were generally of low to moderate severity, staying mostly on the ground. It was a common practice for cattle and sheep herders to light fires at the end of the grazing season as they left the area and for Native Americans to burn periodically for cultural purposes. These fires burned out the dead and down fuels and ladder fuels (shrubs and small trees) from the understory, encouraged the growth of grass and shrub sprouts, and created stands of large trees with a relatively sparse understory.

Fire suppression has occurred in the watersheds for over 80 years, with a probable increase in snags, dead and down ground fuels, and in ladder fuels composed of shrubs and shade-tolerant understory trees. These conditions are most prevalent in the moderately dense Douglas-fir dominated stands and less prevalent in the open Jeffrey pine dominated stands found on ultramafic soils.

The recent eight-year drought has resulted in an increase in conifer mortality from bark beetles and other agents, with a consequent increase of snags and down woody material. This has increased the volume of flammable fuels in the forest.

Partial cutting has been extensive in portions of these watersheds and in these areas has had the effect of removing most of the large, fire-resistant trees; leaving groups and patches of smaller trees susceptible to fire damage; increasing the quantity and depth of surface fuels; and, by opening the canopy, creating a warmer, drier, and windier environment near the forest floor during times of significant fire danger. All of these factors increase the likelihood that fires will be more severe in the future and will cause more damage to the forest.

Site preparation of clearcuts by broadcast burning or tractor piling and burning was done before these areas were planted, so dead and down fuels are relatively light in these plantations. Shrub and grass regrowth is heavy in some plantations and, when combined with the dense conifer regeneration, makes these plantations very susceptible to extensive damage should a fire occur.

Commodities Production

Partial harvesting was initiated in Matrix lands before 1965 and possibly as early as the mid 1950's. This harvesting was primarily done by tractors using "release cut" and "individual tree cut" silvicultural systems. Extensive harvesting was done in the East Fork watershed in Prospect, Texas Chow, and Dark Canyon Creek drainages and east to Stuart Gap; in the Smoky Creek watershed in the upper Silver and Smoky Creek drainages and in the mid to upper Red Mountain Creek, Dog Gulch, and Soap Creek drainages. Many of these partial-cut stands did not adequately regenerate and were subsequently clear cut and planted.

Although regeneration harvesting (clear cutting) has been done in these watersheds since 1960, most has occurred since 1980. Logging was mainly done using tractors, with cable logging on steeper ground. In the East Fork watershed, plantations are scattered throughout the area north of the East Fork and on Buck Ridge south of the East Fork. These plantations total 2153 acres and comprise about 9% of the watershed, with 1254 acres (~11%) on Matrix lands (Map 9a, Appendix E). In the Smoky Creek watershed plantations are located primarily in the mid to upper Silver Creek drainage, in the southwest portion and the upper Smoky Creek drainage, in the Red Mountain Creek drainage, and in the upper drainage of Dog Gulch and Soap Creek. These plantations total 1561 acres and comprise about 6.3% of the watershed and 8.5% of Matrix (Map 9b, Appendix E).

Lands that are capable, available, and suitable (CAS) for timber and which have not been clearcut are predominately covered by the M3P and M3G commercial conifer strata, with lesser amounts of M2P, M2G, and M4G, and some M6G, D3G, and D4G in the Smoky Creek watershed (Maps 10a and 10b, Appendix E)..

A large portion of the mapped M3P stratum is found on ultramafic soils, which are unproductive (Dunning site class VI) or unregenerable due to toxicity, shallow depth, or rockiness (Maps 11a and 11b, Appendix E). Most of the M3P stratum on productive sites above the Bramlet Road in the Smoky Creek watershed and in the East Fork watershed has been partial cut. About two-thirds of these stands are on high productivity sites (Dunning site class I-III) and typically have a sparse residual overstory of medium- to large-size conifers (size class 3 & 4), with a sparse to moderately dense understory of clumps and patches of pole- to small-size conifers (size class 2 & 3). There are opportunities in these stands to improve growth and vigor through intermediate harvests. The rest of the M3P stratum is on low productivity sites (Dunning site IV-V) and often has an understory of canyon live oak.

Most of the mapped M3G stratum is on high productivity sites, except for that portion in the Smoky Creek drainage below the Bramlet Road, which is mostly on low productivity sites. Most of the stratum on high productivity sites has been partial cut and typically has a sparse residual overstory of medium- to large-size conifers with a moderately dense to dense understory of clumps and patches of pole- to small-size conifers. There are opportunities in these stands to improve growth and vigor through intermediate harvests. Most of the M3G stratum on low productivity sites has not been logged and is relatively difficult to access. There are limited opportunities to harvest in these stands.

The largest standing volume and highest present value is in the M4G stands, which are primarily found in the Smoky Creek watershed below the Bramlet Road from Smoky Creek southeast to the watershed boundary. These stands typically have a moderately dense to dense cover of large size conifers, primarily Douglas-fir, sugar pine, and ponderosa pine, which are showing signs of decadence. There are opportunities to regenerate these stands and generate high volumes of sawlogs through green tree retention, shelterwood, or group selection harvests.

Wildlife Species and Habitats

Overall, little detailed data on wildlife species are available for these watersheds. However, surveys for northern spotted owls (*Strix occidentalis carina*) (NSO's) have been conducted by both Shasta-Trinity National Forest personnel and Pacific Southwest Range and Experiment Station personnel. Other information was available from a Riparian Inventory conducted along Smoky Creek during 1994 (USDA Forest Service1994a), a herpetological study done in the East Fork (USDA 1995), and some point counts of birds done in both watersheds during 1994. Anecdotal observations of TE&S species also have been recorded.

A total of 28 TE&S, Protection Buffer, or Survey and Manage vertebrates (not including fish) are known or suspected to occur in the watersheds (see Tables 5-22 and 5-23, pp. 5-64 and 5-65). In particular, these watersheds have high densities of NSO's relative to other watersheds within the South Fork drainage area. With regard to NSO densities, Smoky Creek ranked 6th out of 19 watersheds analyzed, while East Fork ranked 12th; combined, the watersheds ranked 8th.[1] Moreover, of all the watersheds within the South Fork Trinity River drainage area, both Smoky and East Fork are relatively unique, owing to the large quantity of Matrix land within them and their juxtaposition to and/or quantity of LSR. For this reason, these watersheds are important for maintaining connectivity between and among disjunct LSR's.

East Fork

The center of six NSO activity centers (1.3-mile radius circle) occur in the East Fork watershed. Three other activity center areas overlap the watershed boundary and an additional five activity center boundaries are within 1 miles (1.6 km) of the watershed boundary (not counting those in the Smoky Creek watershed--see below). The significance of this watershed for NSO's includes both production of young and maintenance of adequate dispersal habitat/corridors to ensure that both immigrating and emigrating owls can successfully disperse (i.e. find an appropriate area in which to establish a home range).

There are three recorded northern goshawk (*Accipiter gentilis*) sightings in the watershed, and another two that are adjacent to the watershed boundary. One peregrine falcon (*Falco peregrinus*) eyrie exists within 2 miles (3.2 km) of the watershed boundary, but no observations of peregrines within the watershed have been recorded (note: C. Downer [1993] listed peregrine falcons on species lists he developed, but it is not clear if this observation was within the watershed boundary). Owing to the generally large home-range size of peregrines (Newton 1979), these birds probably forage within the watershed. No bald eagles (*Haliaetus leucocephalus*) have been observed within the watershed, nor have bald eagles been observed nesting within 5 miles (8 km) of the watershed boundary. However, the South Fork as a whole probably provides some foraging habitat for bald eagles. A variety of neotropical migrant birds breed in the area, but the only data available are from point counts conducted during a few days in 1994. Six pacific fisher (*Martes pennanti pacifica*) sightings have been recorded for the area since 1988. Additionally, three fishers were observed within 2 miles (3.2 km) of the watershed boundary; no further data on fishers are available for the area. Northern pond turtles (*Clemmys marmorata*) inhabit South Fork (Hayfork Ranger District data). Foothill yellow-legged frogs (*Rana boyleii*) also occur within the watershed (USDA 1995).

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[1] Ranking of watersheds with respect to densities of NSO's was done by dividing the number of known NSO activity centers by watershed area - only active centers were used, not overlap of the circle created with the 1.3-mile radius which approximates the entire activity center. The above analysis involved using only six activity centers for East Fork and nine for Smoky Creek. However, if we considered activity centers that are both within these watershed areas and those that are within 1 mile of their borders (suggesting a high probability of use of these watersheds by those NSO's), the total number of activity centers climbs to 33. (These are minimum numbers. The lack of sightings may be due to the isolation of the area and may not necessarily reflect the quantity of critical habitat.)

The area is dominated by trees 12 to 24 inches (30.5 - 61 cm) in diameter at breast height (dbh), but the East Fork also contains a sizable area with 24-inch (61 cm+) dbh trees or larger. The landscape is quite fragmented, including lands within the LSR. Interspersed within older (>24" dbh) stands of the LSR are patches of younger stands which may serve as interior "edges" and reduce the quality of the area for interior forest birds and other wildlife associated with older forests.

Smoky Creek

There are nine NSO activity centers completely within the watershed, three activity centers which overlap the boundary by more than 1/3 of their area, and seven others within one mile (1.6 km) of the watershed boundaries (not counting those in the East Fork watershed). Most of the NSO activity centers are in size-class 3 (12-24" dbh) forest lands. Several are in the most fragmented part (the southeast) of the watershed, but this is also the area with the most size-class 4 (plus very small patches of size-class 6) stands. Many nest sites are in or very near riparian reserves.

Northern goshawks have been seen in and near the watershed on a number of occasions in recent years. Almost half of the observations of goshawks (4 of 9) were within NSO activity centers. One nesting territory is known within the watershed. Peregrine falcons have not been observed in the watershed, and the closest eyrie (inactive the last few years) is over 3 miles (4.8 km) away. However, if that eyrie is used again, those falcons would probably forage in the Smoky Creek watershed periodically. The only sightings (two) of bald eagles were of single individuals on the South Fork along the watershed boundary, during the early 1980's. There are no known bald eagle nests in the watershed or within 5 miles (8 km) of it, (nesting activity would most likely be along the mainstem South Fork rather than the interior of the watershed). During point counts conducted within the watershed in 1994 many birds were identified, including some neotropical migrants which probably breed there. Willow flycatchers (*Empidonax traillii*) were not detected during the 1994 riparian surveys nor during point-count surveys that year, and suitable willow flycatcher habitat was not identified in the watershed during those surveys. Suitable habitat for this species, if any, is most likely to be found along South Fork and in some of the wet meadow habitats. Pacific fishers were identified in the watershed twice between 1990-1995; one detection was during a trackplate survey of minimal effort. In the 1980's several pacific fishers were observed within 5 miles (8 km) of the watershed.

Pacific giant salamanders were the most common species found during riparian surveys of Smoky Creek in 1994. However, during those surveys, northwestern pond turtles in several age classes were found in several locations on mainstem Smoky Creek, including the area near the headwaters, and they are known to occur in the South Fork on the watershed boundary (Hayfork Ranger District data). There was also one sighting of a northern red-legged frog (USDA Forest Service 1994b)

Most of the watershed is forested with trees that are 12 to 24 inches (30.5 - 61 cm) dbh. Historically, much of the forests were probably late successional (i.e. multi-storied canopies with >70% canopy coverage) whereas presently, approximately 25 percent of the area has late succesional characteristics. This change has likely had an effect on wildlife in the area. For instance, areas that currently have adequate nest sites (large trees with snags, etc.) for NSO's, may not provide optimal foraging habitat because prey species' habitat (understory) may be inadequate. The northwestern part of the watershed (approximately one-eighth of the area) has been designated as part of a critical habitat unit for the NSO.

Human and Public Use Values

There are no human communities within the boundaries of the analysis area. The closest town, Forest Glen, lies along the South Fork, less than a mile downstream from the analysis area (Map 1, Appendix E), but businesses that would benefit from recreationists coming into the area are further away (Hayfork to the northeast and Mad River to the northwest—both about 15 miles (25 km) away--are the closest towns with services). Abundant salmon runs used to draw a significant amount of seasonal human activity to this area. After the 1964 flood, however, salmon runs drastically declined and fisheries were no longer an economic stimulus for the area. Currently, fishing is prohibited from Forest Glen into the headwaters of the South Fork and its tributaries.

The remoteness of the watersheds does not lend itself to year-round habitation. Of the ten small parcels of private land, three have residents throughout the year. The remaining land is administered by the USFS.

Relative to its population and remoteness, the analysis area experiences a high degree of recreational use. The Yolla Bolla Wilderness Area, Chinquapin and East Fork roadless areas, the South Fork and a variety of scenic trails, including the South Fork National Recreation Trail, attract horsepackers, hikers, hunters, river recreationists, and mountain bikers to the area.

The analysis area, and the South Fork watershed in general, has experienced continued timber harvesting by private land owners and the USFS. This activity, in conjunction with the 1964 flood, has been directly connected to severe environmental damage in adjacent watersheds (MacCleery 1974), and since the 1964 flood the fisheries have declined. Diverse opinions have developed regarding continued management within the watersheds. Some people living in and around the Hayfork area desire some logging to continue either because they believe it is necessary for the continued health of the forest now that fire suppression eliminates the natural thinning process that once occurred, or because it is their livelihood. On the other hand, other residents, members of nearby communities, and recreationists who visit the area desire rehabilitation of the watersheds and retention of the remaining old growth. They view the healing of the watershed not only as an intrinsic value, but an economic value to the local communities. Many residents of the watersheds who witnessed the changes--the decline of the salmon, the landslides, and the loss of the old growth forest and its wildlife--expressed a deep sense of loss because of those changes. Residents of the analysis area who were interviewed, and even some residents living downstream near the confluence of the South Fork, including some whose livelihoods depend upon logging in the watershed, unanimously expressed their desire to "leave it alone and let it heal" (Bensen 1997, Steffensen 1997, K. Wilson 1997, Berol 1995).

Chapter 4
REFERENCE CONDITIONS

Climate

Weather patterns before Euro-Americans entered the watersheds were probably similar to those found today, although studies in the Sierra Nevada suggest that the climate in the twentieth century has been unusually warm and moist when compared with previous centuries (Stine 1996, Woolfenden 1996, Hughes and Brown 1992, Graumlich 1993). For a description of current weather patterns, see page 5-1.

Geology, Hydrology, and Aquatics

Geologic and Hydrologic Conditions Relative to Land Use: 1944

Analysis of the 1944 aerial photographs of the East Fork of the South Fork (East Fork) and Smoky Creek watersheds indicate little to no logging-road construction and observable timber harvesting had yet occurred. Faint tracts of known recreational and hunting jeep routes are discernible. In essence, the 1944 photos suggest that the vast majority of the upper South Fork Trinity River (South Fork) above the town of Forest Glen functioned as undisturbed wilderness. The photos exhibit very few streamside debris slides or active inner gorge failures along the main stem of the South Fork above Forest Glen, as well as in the Silver, Smoky Creek, Red Mountain, or East Fork watersheds. There are many areas in the upper half of the Smoky Creek watershed (largely above the present 29 or Bramlet Road) and in the Prospect, Texas Chow, and Dark Canyon Creek sub-watersheds exhibiting minimal vegetative cover. These areas of sparse natural vegetative ground cover correlate very well and appear controlled by the presence of ultramafic and serpentinized bedrock outcrops. Obvious recent indications of any sizable, historic wild fires are absent in the 1944 photos, except for the 1600-acre fire in the Silver Creek drainage in 1924.

Throughout the East Fork and Smoky Creek watersheds, most of the lower order tributary stream channels, as well as along most of the main stem, higher order stream channels, generally display steep channel gradients in the photos. They are largely bounded by competent bedrock sideslopes, have closed riparian canopy conditions, and appear relatively stable. The few obvious, short openings in the riparian canopy are most frequently located on the inside of prominent bends in the channel (point bars), or in the lowest gradient reaches where the channel was naturally wider and alternating longitudinal bar forms would be expected to be present, or associated with isolated debris slides.

Along the main stem of the South Fork within the watershed analysis area, the photos reveal fairly widespread but discontinuous openings in the riparian canopy. An estimated 60-70% of the main stem length exhibits a narrow open canopy, while another 10% of the stream length is obvious gravel bars. Active debris slides are very infrequent, and those present are generally small in size. The main stem is bounded by steep, inner gorge sideslopes for the most part, although discontinuous, elevated stream terraces are present along the channel especially below the mouth of Red Mountain Creek.

Geologic and Hydrologic Conditions Relative to Land Use: 1965

In the mid 1950's, a major wildfire, the Jones Burn, occurred immediately to the north and east of the East Fork watershed in the headwaters of the Hayfork Creek and Beegum Creek watersheds. It appears that coincident with extensive salvage logging following the fire, widespread road construction and tractor timber harvesting began in the East Fork watershed. In December, 1964, the flood of record occurred in the upper South Fork. Within the watershed, several months of arctic storms produced thick snowpacks, which were followed by huge tropical rainstorms. Numerous reports and studies documented widespread road and hillslope erosion, as well as significant stream channel changes throughout the South Fork watershed (McCleery, 1974; LaFaunce 1975, California Department of Water Resources 1979, Irizarry et al 1985, Haskins and Irizarry 1988, Pacific Watershed Associates 1994). However, few reports are available which document what were the actual storm affects within the East Fork and Smoky Creek watersheds. The following discussion, based largely on analysis of 1965 aerial photos, describes discernible channel changes and watershed response in the upper South Fork triggered by the 1964 storm.

By 1965, the 30 (Wild Mad) Road had been constructed all the way through the East Fork drainage and across the South Fork itself, and the Prospect Creek and Texas Chow sub-watersheds of the East Fork had been extensively roaded and selectively harvested. Within Smoky Creek watershed, the 29 (Bramlet) and the 29N49 roads and numerous other roads had been constructed, and selective timber harvesting had occurred upslope of the 29 Road (Maps 5a and 5b, Appendix E) . Sediment source inventories performed throughout the watersheds during 1996 indicate approximately 65% of the current East Fork road network, and 45% of the Smoky Creek road network was constructed by 1965 (Pacific Watershed Associates and Trinity County Resource Conservation District, unpublished reports). This equates to approximately 133 miles of road in the watersheds. Within the Prospect and Texas Chow sub-watersheds, as well as the upper half of the Smoky Creek watershed above the Bramlet Road, the photos reveal extensive tractor skid trail networks throughout the harvested areas.

The 1965 aerial photos indicate that after the 1964 storm, the main stem of the South Fork both within the watersheds and upstream to approximately Shell Mountain Creek was a continuously open channel, with the stream bed showing strong evidence of aggradation or additions of channel-stored sediment. In the photos, the whole length of the stream channel appears to have been recently re-worked; major pools were infrequent; and many sections of the summer low-flow channel displayed multiple (braided) channels. Within the same reach of the main stem, approximately 24 discrete streamside debris slides and/or incidences of channel widening (bank erosion) are visible. All of these erosional features occurred on steep, inner gorge hillslopes with only one slide (where the 30 Road crosses the South Fork) having obvious past land management linkages. The main stem erosional features alone do not account for the amount of channel filling suggested by the aerial photos.

In the photos, tributary stream response to the 1964 storm is most apparent in the lower 4 miles of the East Fork main stem, and in the lower 1.5 miles of Smoky Creek. Both reaches can be characterized as sediment storage or response reaches. Inner gorge sideslopes were present throughout 60 percent of both reaches, while raised stream terraces, floodplains, and larger alternating longitudinal gravel bars formed streambanks along the remaining 40 percent of the reaches. Both stream reaches displayed fairly narrow, open riparian canopies with wider openings associated with distinct streamside debris slides. Locally braided channels are present, especially in the East Fork, suggesting some aggradation had occurred. The aerial photographs suggest that the East Fork main stem experienced more severe channel changes than Smoky Creek.

Approximately 20 streamside debris slides were present adjacent the East Fork stream channel. The vast majority appear to be natural inner gorge failures, most of which occurred at the outside of prominent bends in the channel and on un-managed hillslopes. Approximately six slides appear to have been associated with the recently constructed 30 Road or with timber harvesting on the private parcel located just downstream of the 30 Road bridge crossing. Within the Smoky Creek stream channel, approximately 8 streamside debris slides are present, all of which occurred on unmanaged inner gorge hillslopes.

With the exception of a narrow debris torrent, which originated from the glacial terrain adjacent Black Rock Mountain, mass movement features are generally absent throughout the remainder of the watersheds. Likewise, excluding the lower portions of the two main stem stream channels, all the remaining stream channels throughout the watersheds display little to no storm damage to the riparian canopy or significant evidence of aggradation or filling by sediment.

While mass movement features are generally absent, the aerial photos reveal significant amounts of fluvial erosion and probably surface erosion during the 1964 storm. As mentioned previously, the upper portions of the East Fork, Smoky Creek, and Red Mountain Creek, as well as all of the Prospect Creek and Texas Chow sub-watersheds were heavily roaded and tractor logged by 1964. Many of the road and skid trail stream crossings show evidence of partial or complete failure. Many others showed evidence of being recently re-constructed, and several gullies are apparent on the hillslopes down the road from stream crossings which probably represent erosion associated with diverted streams. The extensive, relatively young road and skid trail network throughout the managed areas undoubtably served to extend the natural drainage network and funnel large amounts of finer grained sediments to adjacent stream channels.

The analysis of historic aerial photos suggests that in the upper South Fork above Forest Glen the watershed response to land use and the 1964 storm was only moderately severe when compared to other portions of the South Fork. This conclusion is supported by Hickey (1969) who provides the only physical data to document channel changes in the upper South Fork above Forest Glen as a result of the 1964 storm. Hickey reports at the US Geological Survey gauging station at Forest Glen, stream bed elevations increased by 2.2 feet between 1964 and 1965. This is a modest amount of change when compared to the documented 12.9 feet of channel filling which occurred at another gauging station located near the mouth of the South Fork, approximately 60 river miles downstream.

The watershed responses associated with the 1964 storm in the upper South Fork watershed above Forest Glen are within a predictable range. Bedrock geology and topographic position largely controlled the distribution of debris slides and mass movement features. Virtually all slides occurred on hillslopes underlain by the Galice Formation and the South Fork Mountain schist, both of which have long been recognized as the most unstable bedrock geologies in the South Fork watershed (California Department of Water Resources 1979, Haskins et al 1980). In addition, virtually all slides occurred on inner gorge sideslopes to streams, many at the outside of bends in the channel, both of which are geomorphic locations where one would expect a higher incidence of landsliding (LaHusen 1984, Furbish and Rice 1983, Haskins 1981). Finally, roads constructed on the schist or Galice geologies within the watersheds totalled only four to five miles in length (i.e. the 30 Road), yet virtually all landslides with some management influence occurred along the small percentage of roads or associated with timber harvesting on these geologies.

Given the standards for laying out roads and timber harvests in the 1950's and 1960's, it is not surprising to document high rates of accelerated fluvial erosion from roads, skid trails, and harvested areas. During that era, drainage structures were not designed to accommodate very infrequent but large storms, and fish and water-quality friendly road drainage techniques were not yet understood or developed.

Fish Abundance and Habitat

The 1964 flood event is without question recognized as a significant event which caused widespread and catastrophic change to the South Fork Trinity River, followed by a precipitous decline in anadromous fish abundance in the South Fork. Prior to the 1964 flood the South Fork as a whole was described as having scattered large, deep pools interspersed with shallow pools, riffles, and rapids. During the 1964 storm, tons of bedload were introduced into the aquatic system, causing widespread channel aggradation and infilling of pools. Although quantitative stream channel characteristics were not measured within the East Fork and Smoky Creek watersheds prior to the flood event, insight into the severity of the effects on fish habitat in the South Fork as well as the recovery that is believed to be continuing today can be found in internal memorandums and reports generated by the California Department of Fish and Game (DF&G) following the flood event.

Survey results following the 1964 event indicate that substantial infilling of pools occurred within the South Fork below the East Fork confluence (Healey 1969). Recovery in the form of pool formation and fewer fines in gravel bars were first noted in 1969 (Healey, unpublished), and, in a 1980 memorandum, LaFaunce indicated that recovery seemed to be progressing in a downstream direction with the best pool habitat found above Silver Creek (LaFaunce 1980, unpublished). Comparison of quantitative pool data collected by the US Forest Service (USFS) in 1989 (USDA Forest Service 1989) to the information contained within the memorandums, also supports the recovery trend. In a memorandum following a 1970 DF&G survey of the South Fork from the East Fork confluence to Forest Glen, Rogers (unpublished) stated that "only about five holes exceeded six feet in depth." The 1989 habitat-typing data for the same stream reach indicated that there were 28 pools greater than six feet deep.

The distribution of salmonid species within the South Fork did not change appreciably following the 1964 flood event; however, the number of fish returning to the South Fork, including the analysis area changed dramatically. Healey (unpublished) estimated that 7,000 to 10,000 spring Chinook entered the South Fork to spawn in 1963. In the fall immediately prior to the 1964 flood event, LaFaunce (1964) estimated the population of spring Chinook in the South Fork to be 11,600 fish. Those are the only population estimates available prior to the 1964 flood. Snorkel counts following the event were dramatically lower, with fewer than 50 fish observed during several years in the 1970's and 1980's. As described in Chapter 5, a recent trend of increasing numbers of returning spring Chinook has been observed in the 1990's (see Tables 5-2, 5-3, and 5-4). Estimates of coho and steelhead prior to the 1964 event, not only within the analysis area but within the South Fork as a whole, are unavailable.

Vegetation

Information for this section comes from 1944 black and white aerial photos, 1965 Soil Conservation Service black and white aerial photos, 1980 and 1995 USFS color aerial photos, 1989 1:24000 USFS black and white orthophotos, Geographic Information System (GIS) maps of fire starts and acreage burned, GIS timber strata maps, the USFS/Soil Conservation Service Soil Survey for the Shasta-Trinity National Forest, a 1940 administrative map, and a pre-1940 topographic map.

Overview

The 1944 aerial photographs indicate there was little large scale, human activity in the watersheds prior to this date. In the photos, there are less than a half dozen roads in both watersheds, and no timber harvesting is evident. The vegetation consists mostly of Klamath mixed conifer, with extensive, dense areas of this vegetation type in the Smoky Creek watershed (See Fig. 3-1, pg. 3-7), and in the drainages and north slopes of the East Fork watershed. More moderate stands are found throughout the East Fork on south aspects, steep slopes, ridges and areas of shallow soils. Dense stands (70% or greater canopy cover) of montane riparian and Klamath mixed conifer were found in the drainages and tributaries of the creeks throughout both watersheds. Along the northern boundary of the watersheds are found ultramafic soils in the following areas: White Rock, Pony Buck Peak, and the upper portions of Texas Chow and Dark Canyon Creeks. These areas were historically sparsely vegetated, with serpentine indicator species such as Jeffrey pine, incense cedar, and gray pine. The LSR that overlaps portions of the East Fork and Smoky Creek watersheds was densely forested with late-successional stands of Douglas-fir.

East Fork

Review of 1944 aerial photographs indicates there was little human activity in the watershed prior to this date. In the photos, there are only three roads in the watershed (USFS Roads 35, 28N19, and 28N10), none of which appears to have been associated with logging. The aerial photos also indicate there was no timber harvesting in the watershed prior to 1944.

Due to this lack of logging, the vegetation conditions at that time were a result of soil type, depth, and rockiness, aspect, elevation, and fire history, including fire suppression since 1906. Beginning in the Prospect Creek drainage, the forest was quite variable. In general, the west slope of the drainage was dominated by dense stands of Klamath mixed conifer, with patches and stringers of sparse stands of hardwoods and mixed conifers (the latter were likely the result of shallow, rocky soil and south aspects). In the upper portion of the drainage around Red Mountain where ultramafic soils predominate, the forest consisted of sparse stands of small- to medium-sized Jeffrey pine and incense cedar.

In the upper drainage between the two forks of Prospect Creek the forest consisted of a mosaic of sparse conifer stands with bare areas and shrub stands, which resulted from shallow, rocky soils and southerly aspects. From the upper drainage to the confluence of the two forks there was a mosaic of Klamath mixed conifer stands of dense to moderately dense large trees (dbh greater than 24 inches).

The area between the east fork of Prospect Creek and the divide with Texas Chow Creek was also quite variable. The lower portion of this area to approximately the confluence of the two forks of Prospect Creek was dominated by bare and brushy patches with sparse conifer stands. The majority of this area was a mosaic of moderately stocked, large-sized trees of Klamath mixed conifer over a lower canopy of densely stocked, pole size white and Douglas-fir. Approximately a quarter of this area consisted of dense stands of large size trees. The vegetation from the confluence of the two forks of Prospect Creek to the divide between Hayfork Creek and the East Fork was similar to that found between the two forks, as described above.

In the Texas Chow drainage and its tributaries, the vegetation consisted of dense montane riparian and Klamath mixed conifer. In the upper drainage, directly below USFS Road 35, the area was forested with moderate stands of mixed conifer. Below this area to the 28N10 road, ultramafic soils are present, which resulted in an extensive area of sparse stands(<40% canopy cover) of Jeffrey pine and incense cedar. From this area to the confluence with the East Fork, the vegetation primarily consisted of moderate to dense stands of Klamath mixed conifer, with dense patches of pole-size white and Douglas-fir. Throughout this area were also small brush stands, bare areas, and sparse conifer stands.

The inner gorge and northerly slopes of Dark Canyon Creek and its tributaries were forested with dense stands of large trees (size classes 4-6) of Klamath mixed conifer, with dense montane riparian vegetation found directly along the main creek and tributaries. The southerly slopes in the lower drainage consisted of medium to dense stands of hardwoods and shrubs, with a sparse canopy of mixed conifer. On the east slopes of the drainage where ultramafic soils are found, the vegetation consisted of a mosaic of bare soil, brushfields, and sparse stands of Jeffrey pine and incense cedar. Stands in the upper drainage on the west side of the creek and in the mid drainage on the east side consisted of moderately dense stands of Klamath mixed conifer.

In the Pony Buck Peak area, which is underlain by ultramafic soils, the vegetation consisted of very sparse (<20%) to sparse (<40%) canopy cover of Jeffrey pine and incense cedar. Below this area, towards the East Fork, the vegetation consisted of dense stands of montane riparian and Klamath mixed conifer in the main drainage, with dense Klamath mixed on northerly aspects and moderately dense stands on other aspects.

The area around White Rock is also underlain with ultramafic soils, with the vegetation consisting of sparse stands of Jeffrey pine and incense cedar, with bare patches found on ultramafic or limestone rock outcrops. The main drainage below White Rock was forested with dense stands of montane riparian and Klamath mixed conifer, with dense stands of Klamath mixed conifer also found on westerly aspects. The east side of the drainage consisted of moderately dense stands of mixed conifer, with patches of dense canyon live oak and shrubs on ridges and steep, southerly aspects. At the confluence with the East Fork, the upper slopes of the drainage consisted of moderate to dense stands of shrubs and canyon live oak, with a sparse overstory of conifers.

The vegetation south and east of Star Mountain was similar to that surrounding White Rock, except there were more areas of sparsely stocked forest.

In comparing current and historic reference conditions in the East Fork portion of the LSR, it appears that the overstory vegetation composition has remained similar over the past 50 years. In the 1944 aerial photographs, the vegetation in the LSR consists of dense stands of primarily Douglas-fir with a canopy cover of 70 percent or greater. The overstory canopy consists of large trees (size classes 4-6) with an average diameter at breast height (dbh) probably greater than 24 inches. Below this canopy there was probably an understory of pole- and small-size Douglas-fir. This vegetation cover was a result of the shaded, northerly aspect of the area, as well as the soil type (the area is underlain with Hugo-Neuns complexes, which are deep, loamy, soils that are conducive to conifer growth). There are small areas where the canopy cover is moderately dense (20-60%). Such stands are mainly associated with areas of shallow soil, such as on ridges and rocky outcrops.)

Because there was no logging in the southeastern area of the LSR, the historic vegetation structure and composition can be deduced from the current vegetation conditions of that area. Without major disturbances such as fire or logging, it can be theorized that these stands exhibited characteristics of a mature, late-successional forest, consisting of an overstory of larger trees (dbh > 24 in.) with an understory of pole- and medium-size trees with numerous woody debris and snags throughout the stands. (This has been dramatically changed in the Buck Ridge area, where there have been numerous clearcuts.)

Smoky Creek

In the Hell Gate area, along the north side of the South Fork, the terrain consists of a steep ridge paralleling the river. This ridge appears to have been dominated by dense stands of montane shrubs. This vegetation pattern was probably a result of the steep slopes and southwesterly aspect of the area, and is a pattern that is still seen today.

The vegetation from this steep area towards Rattlesnake Ridge consisted of dense stands of Klamath mixed conifer, where canopy cover was greater than 70%. These stands probably consisted mainly of pole (or larger) size classes.

In the Silver Creek area of the watershed, vegetation cover was more fragmented. From the north side of the South Fork, there were stands with very sparse canopy cover (<10%) on southeasterly aspects. Along Silver Creek, the vegetation consisted of stands of mixed conifer with sparse to moderate canopy cover. There were numerous patches of very sparse to barren vegetation cover that were associated with serpentine soil and rocky outcrops. Greater areas of sparse cover (< 20%) were prevalent in the area above Swim Meadow. Such sparse cover was, and still is, a result of the ultramafic soils of that area. In viewing 1995 aerial photographs, this area still has a sparse cover of vegetation, which indicates the slow regeneration capability of the area. In the drainages to the west of Silver Creek, the vegetation appears to have consisted of Klamath mixed conifer of moderate canopy cover, with dense stands found on north aspects. This is another area that has been severely impacted by roads and timber harvesting over the past four decades.

Along Red Mountain Creek, from its confluence with the South Fork and north to the east fork of Smoky Creek, the vegetation consisted of uniform, dense stands of Klamath mixed conifer, where canopy cover was 70 percent or greater (the structure is now more patchy due to timber harvesting in this area). The composition and cover of this vegetation changed on the north side of the east fork of Smoky Creek, and continued towards the Red Mountain area. This is another area of the watershed that is composed of ultramafic soils, and consisted of characteristically sparse stands of Jeffrey pine and incense cedar where overstory canopy cover was less than 20%. In looking at the current vegetation conditions in this area, the cover and composition are quite similar, indicating that there has not been significant regeneration or growth in these stands within the past 50 years.

The area directly below the ultramafic soils on Red Mountain appears to have been dominated by stands of moderate to dense mixed conifer, which are now of sparse to medium cover due to extensive timber harvesting in this area. The area between the South Fork and the current road network also appears to have been populated with moderate to dense stands of Klamath mixed conifer. No roads or harvesting have occurred in this area, so the dominant vegetation patterns of the past still prevail.

In the area of Soap Creek and Dog Gulch at the southeastern end of the watershed, the vegetation consisted of moderate to dense stands of primarily Klamath mixed conifer, with dense stands of Douglas-fir in the drainages and north aspects. This vegetation changed abruptly in the Red Mountain area, where the presence of ultramafic soils resulted in a sparse cover of Jeffrey pine and incense cedar. As in the other areas with ultramafic soils, the vegetation has remained similar over time.

Catastrophic Fire & Fuels

Fire regime studies in the Sierra Nevada suggest that forest ecosystems are outside of their historical range of variability as to fire frequency and severity and associated stand structures and landscape mosaics (Skinner and Chang 1996). This is primarily due to the fire exclusion policy which has dominated suppression efforts since the early 1900's. This policy has been successful in minimizing low-severity fires and most moderate-severity fires which were characteristic of the pre-1850's. This has resulted in an increase in shrubs and understory trees, ladder fuels which can enable a fire to reach the overstory canopy, resulting in stand replacement fires. Extreme-severity fires, which are highly resistant to control, have in fact increased in recent decades. The scenario in the Sierra Nevada is probably also characteristic of these watersheds.

Studies in the Sierra Nevada (Weatherspoon and Skinner 1996) indicate that the fire-suppression organization has been able to reduce the number of large human-caused fires and area burned but has not been effective in reducing the number or size of large lightning fires. This is attributed to the fact that lightning fires tend to occur as simultaneous, multiple ignitions which, in unusually dry years, can quickly exceed the suppression capacity of the regional fire organization. Historically in the East Fork and Smoky Creek watersheds 87% of the fires have been lightning caused.

Fire is the most important natural disturbance agent which has affected vegetation in these watersheds. Studies by Carl Skinner (unpublished) in the Klamath Mountains indicate a pre-1850 (before Euro-Americans influenced fire regimes) fire return interval of 14-15 years in Douglas-fir/mixed conifer, 12 years in Jeffrey pine/white fir, 11 years in ponderosa pine/mixed conifer and canyon live oak/mixed conifer, and 36 years in riparian zones. Initial data samples from a study by Carl Skinner and Alan Taylor in the Jud-Rusch area of the Hayfork Ranger District (Skinner and Taylor 1995 and 1996) indicate a fire return interval of five years or less, which is likely also representative of these watersheds. However, few of these fires resulted in stand-replacement fires over significant portions of the landscape.

Weather patterns before Euro-Americans entered the watersheds were probably similar to those found today, although studies in the Sierra Nevada suggest that the climate in the twentieth century has been unusually warm and moist when compared with previous centuries (Stine 1996, Woolfenden 1996, Hughes and Brown 1992, Graumlich 1993). Historically there have been alternating periods of relatively wet and dry weather lasting for 10-20 years each (USFS 1994). From 1986-1994 there was a drought which resulted in severe moisture stress to trees and increased mortality from bark beetles and other agents. This had the effect of increasing the amount of dead standing and down fuels.

Before Euro-Americans came to Trinity County, it was common for Native Americans to set fires for cultural purposes. It is likely that the forests at that time were composed of a relatively open overstory of large mixed conifers with a sparse conifer and hardwood understory and a light shrub layer. Trees probably had fewer limbs on the lower boles due to fire scorching of the foliage. There were probably fewer dead and down ground fuels and fewer ladder fuels composed of shrubs and shade-tolerant understory trees. Although no historical records of vegetation conditions were located, 1944 aerial photos tend to substantiate at least the size and density of overstory trees. Comparison of vegetation on ultramafic soils in 1944 and recent aerial photos in general show modest changes in ground cover, including an increase in the size and quantity of trees.

Before fire suppression occurred in the watersheds, around 1906, it is likely that there were more fires (probably annually) and that they were generally of low severity and stayed on the ground. It was a common practice for cattle and sheep herders to light fires at the end of the grazing season as they left the area. These fires burned out the ladder fuels, shrubs, and small trees from the understory and encouraged the growth of grass.

From the 1950's to the 1980's, lookouts were the primary method used for fire detection. Lookouts were located at Black Rock, Red Mountain, Horse Ridge, Pickett Peak, Dubakella Mountain, and Tomhead Mountain. There were also about four mobile fire patrol people on each District. Fire suppression forces were maintained at White Rock Guard Station, Pine Root, Forest Glen, Harrison Gulch, and Hayfork Ranger Stations, Basin Gulch and Peanut CCC Camps, Saddle Camp, and Post Mountain Camp. Aerial attack forces were stationed at the Northern California Service Center in Redding.

Helispots were developed at various locations to provide rapid access. In the East Fork watershed these were at Black Rock Mountain, Stuart Gap, one mile north of Grasshopper Camp, Pony Buck Peak, Pine Root Saddle, on the 41 road just north of the Roseburg property, near Devil Camp, and one-half mile southeast of Flyblow Camp. In the Smoky Creek watershed these were at Snow Gap and on the ridge about one and one-half miles southeast of Mud Springs.

Tanker or helicopter fills were also developed at various locations. In the East Fork watershed these were at McCullah Springs, at White Rock Guard Station and just north of there on road 28N45, at Clarence Springs, Black Rock Lake, a spring three-quarters of a mile northwest of McCullah Springs, Pine Root Station, on Prospect Creek where it crosses the 29 road, on road 28N27 one-quarter mile south of the junction with the 29 road, where the 30 road crosses the east fork of Prospect Creek, Texas Chow Creek, Dark Canyon Creek, and the mainstem East Fork, one-quarter mile up the East Fork from the 30 road, and on 28N40 just west of Fern Glade Unit C. In the Smoky Creek watershed these were at Foss Camp, where the 29 road crosses the East Fork of Smoky Creek, at Swim Meadow, and at Mud Springs.

East Fork

The critical resources which were at risk in the East Fork watershed before it was entered by Euro-Americans were the forests which protected the watershed from erosion, provided habitat for wildlife, and provided for the cultural and spiritual needs of the Native Americans who resided in the vicinity. These forests covered most of the landscape, except for serpentine barrens and portions of other ultramafic areas, rocky brushfields, and rock outcrops at White Rock and near Black Rock and North Yolla Bolla Mountain. These forests were at various stages of development, but in general were in a later successional stage than at present. They were primarily composed of Klamath mixed conifer, with red fir near Black Rock and North Yolla Bolla Mountain, and Jeffrey pine, gray pine, and incense cedar in ultramafic areas north of the East Fork.

White Rock, the nearby meadow, and the surrounding forest were unique as they contain the only limestone outcrop and only four wet meadows in this watershed; the meadow is surrounded by late successional Klamath mixed conifer, and this area had spiritual significance for Native Americans.

A USFS fire risk assessment, which is based upon historical fire starts, shows a fire return frequency of one fire every eight months. Fire records since 1910 show 77 fires of less than 5 acres in size scattered randomly throughout the watershed, with lightning from summer thunderstorms being the main source of ignition (68 fires). Most of these fires were in the mid to upper slopes, and in higher elevations and areas of ultramafic soils were probably low intensity ground fires that did little damage to larger trees.

There have been two larger fires in this watershed: the 1949 lightning-caused Prospect Creek fire of 11 acres on Prospect Creek west of Flyblow Camp and an unnamed, man-caused 40-acre fire in 1920 northwest of Pony Buck Peak and north of Dark Canyon Creek. The unnamed fire appears to have been in what is now small- to medium-sawtimber-sized stands with dense canopies, so it is unlikely that it was a stand replacement fire. The Prospect Creek fire appears to have been in what is now dense pole-size stands and small- to medium-sawtimber-size stands with open canopies, so it is possible that it was at least in part a stand-replacement fire.

The man-caused Hermit Fire in 1988 burned 7600 acres in the South Fork drainage southwest of the watershed. This stand-replacement fire burned up to the LSR boundary. Salvage logging was done in the burn, but there is still a large volume of snags and down trees which, when combined with the grass and shrub regrowth, makes the burn area susceptible to a hot reburn. A portion of this area was reburned by the 1996 Rock fire. A reburn in this area could still be a threat to the LSR.

There are extensive areas of ultramafic soils on which pre-1850 vegetation conditions were likely similar to those which currently exist. Comparison of vegetation on ultramafic soils in 1944 and recent aerial photos in general show modest changes in ground cover, including an increase in the size and quantity of trees. These areas were likely characterized by three fuel conditions:

1. Serpentine barrens and semi barrens were either substantially bare of all vegetation or had sparsely scattered shrubs mostly under four feet tall; trees, primarily gray pine, Jeffrey pine, and incense cedar, under 24 inches dbh; and ladder fuels were few to nonexistent. Areas of this type were found along what are now Road 41 and the ridge road from Pine Root Saddle to Red Mountain. These areas thus had a low fuel hazard.
2. Other areas had a moderately dense covering of a combination of 3- to 6-foot tall coffeberry, leather oak, silk tassel, mountain mahogany, or manzanita, sometimes with scattered conifers, and generally with many rock outcroppings. Areas of this type were found along what is now Road 41 and in the Devil's Camp area. These areas had a moderate fuel hazard but fires would have stayed on the ground.
3. In some ultramafic areas there was an open stand of conifers over 12 inches dbh, with some patches and clumps of seedling-, sapling-, and pole-size conifers and a light to moderately dense cover of shrubs. There were scattered logs and a light litter layer in these areas. The fuel hazard was light to moderate in these areas and it is unlikely that crown fires occurred as ladder fuels were limited and shrub height was low. An area of this type was located on Red Mountain and near Devil's Camp.

Smoky Creek

The critical resources which were at risk in the Smoky Creek watershed before it was entered by Euro-Americans were the forests, which protected the watershed from erosion, provided habitat for wildlife, and provided the cultural and spiritual needs of the Native Americans who resided in the vicinity. These forests covered most of the landscape, except for serpentine barrens and portions of other ultramafic areas, rocky brushfields, and rock outcroppings. These forests were at various stages of development, but in general were in a later successional stage than at present. They were primarily composed of Klamath mixed conifer, with Jeffrey pine, gray pine, and incense cedar in ultramafic areas surrounding Red Mountain, along the divide between Hayfork and Rattlesnake Creeks, in the upper Smoky Creek and north fork of Smoky Creek areas, and in the mid to upper Silver Creek drainage.

Fire was the most important natural disturbance agent affecting vegetation in the Smoky Creek watershed. A USFS fire risk assessment, which is based upon historical fire starts, shows a high risk for this watershed, with a fire return frequency of one fire every six months. Fire records since 1910 show 70 fires of less than 5 acres in size scattered randomly throughout the watershed, with lightning from summer thunderstorms being the main source of ignition (60 fires). Most of these fires were in the mid to lower slopes below the Bramlet Road (USFS 29). Fires in the higher elevations, ridgetops, and areas of ultramafic soils where trees and ground vegetation were sparse were probably low-intensity ground fires that did little damage to larger trees.

There have been three larger fires in this watershed: the 1918 unnamed, man-caused fire of 100 acres in the lower Soap Creek drainage, the 1924 lightning-caused "No Name #39" fire of 1600 acres at mid elevation in the west branch of Silver Creek, and the lightning caused 1951 Silver Creek fire of 17 acres in the upper drainage between the two forks of Silver Creek near the divide between Silver Creek and Rattlesnake Creek. The unnamed fire appears to have been in what is now small- to large-sawtimber-size stands with dense canopies, so it is possible that it was in part a stand replacement fire. The "No Name #39" fire appears to have been in what is now a mosaic of dense pole-size stands and small- to medium-sawtimber-size stands with dense to open canopies and brushfields with sparse, pole-size trees, so it is likely that it was at least in part a stand-replacement fire. The Silver Creek Fire appears to have been in what is now small- to large-sawtimber-size stands with dense canopies, so it is unlikely that it was a stand-replacement fire.

As discussed above in the East Fork section, there are extensive areas of ultramafic soils on which pre-1850 vegetation conditions were likely similar to those which currently exist. Serpentine barrens and semi barrens were found along the divide between Rattlesnake Creek and Silver and Smoky Creeks and along the divide running from Mud Springs to Red Mountain. These areas thus had a low fuel hazard. Other areas had a moderately dense covering of shrubs and sometimes scattered conifers, generally with many rock outcroppings. Areas of this type were found along the divide between Red Mountain and Mud Springs. These areas had a moderate fuel hazard but fires would have stayed on the ground.

In some ultramafic areas there was an open stand of small- to medium-size conifers with a light to moderately dense cover of shrubs. The fuel hazard was light to moderate in these areas and it is unlikely that crown fires occurred, as ladder fuels were limited and shrub height was low. Extensive areas of this type were located on Red Mountain and near Devils Camp.

Wildlife Species and Habitats

Information for this section is based on interpretation of wildlife habitat conditions from 1944 black and white aerial photos, with additional information gathered by team ethnobotanist Randi Anderson (interviews, etc.) about conditions prior to and during the early period of white settlement, and from museum records, and Shasta-Trinity National Forest (STNF) records. The WA team biologists could locate no historic records of TE&S wildlife in the watersheds. Because of this, it should be recognized that the following section is largely conjectural because it is not possible to ground-truth what we have interpreted from the 1944 aerial photos, and it is from these aerial photos that we have made "best guess" estimates of what conditions existed for the TE&S species in the past.

East Fork

The most extensive block of Late Successional (LS) habitat was south of the East Fork in what is currently Late Successional Reserve (LSR); it was (and is) mostly Douglas-fir with more than 70% canopy cover. Substantial blocks of LS habitat (mostly mixed conifer) also appear to have occurred on the western side of the Prospect Creek drainage (mid elevevation) and in lesser amounts in the area between Prospect and Texas Chow Creeks, and in north-facing slopes on Texas Chow and Dark Canyon Creek. The headwaters and smaller tributaries were often lined with narrow corridors of large-diameter trees, providing some structural elements of LS habitat, but which were generally all "edge" (i.e., not occurring in wide enough patches to provide a LS microclimate).

There are several records from 1926 (STNF) of northern spotted owl (NSO) in the vicinity of the watershed. Locations were across the South Fork (south side) from the East Fork; each of these sites was surveyed in more recent years (at least once in the last 25 years), and were determined to be active NSO sites; activity centers (which had little to no overlap into the watershed) were determined. Although very little data were associated with the records (they simply appear to be detections), they do strongly suggest long standing presence of NSO in the area. As in Smoky Creek, for fish-eating avian species like bald eagles and osprey, nesting sites would have been available and food was apparently extremely abundant, especially in the South Fork itself. There appear to have been numerous areas of open and semi-open forest habitat with large trees suitable for goshawks, flammulated owls, white-headed woodpeckers, pygmy nuthatches, and black-capped chickadees.

It is not likely that the watershed supported significant numbers of the herpetofaunal species associated with headwater/low order streams in LS habitats (for example, tailed frog, southern torrent salamander) because of the paucity of closed-canopy LS habitats at mid-to-high elevations in the watershed. Past conditions in streams are particularly difficult to ascertain from aerial photos, but we expect that foothill yellow-legged frogs and Northwestern pond turtles were relatively abundant. Red-legged frogs probably occurred most commonly in and around suitable aquatic sites in LS forest habitats at lower elevations south of the East Fork. If suitable maturnity roosts and hibernacula (within their migratory ranges) were available, all of the bat species might have occurred in the watershed since day and night roosts as well as substantial foraging habitat appear to have existed.

Smoky Creek

Some of the area now designated as LSR (e.g. mid-elevation drainages west of Silver Creek) appears to have been dense mixed conifer habitat with large trees mixed in with more moderate sized trees; although surrounded above and below with more sparsely forested areas, it was probably adequate for many of the species considered dependent on LS habitat. In addition to LS habitats in what is now the LSR, a large area below Red Mountain and much of the east side of the Smoky Creek drainage below the east fork of Smoky creek, appears to have been largely LS habitat with 70% or more canopy cover. Other LS-type habitats occurred immediately adjacent to watercourses, resulting in fairly narrow linear riparian corridors. Even prior to timber harvesting in the watershed, much of the rest of the watershed was composed of lightly forested (less than 40% canopy cover) or shrub habitats.

It appears that the watershed could have supported populations of LS-dependent species such as Pacific fisher, red tree vole, and the NSO. There are several records from 1926 (STNF) of NSO in the vicinity of the watershed. Locations were across the South Fork (south side) from Smoky Creek; each of these sites was surveyed in more recent years (at least once in the last 25 years), and were determined to be active NSO sites; activity centers (which had little to no overlap into the watershed) were determined. Although very little data were associated with the records (they simply appear to be detections), they do strongly suggest long-standing presence of NSO in the area. (see pg. 4-20 for anecdotal evidence of spotted owl presence in the watershed historically). Gertrude Patton, who was born in 1915 and who was raised at the confluence of Dog Gulch and the South Fork, recollected that wolverine, mink, otters and fishers were very common (see also pg. 4-20 for anecdotal evidence of these species in the watershed historically).

In the Smoky Creek watershed, two areas along the South Fork look like they might have been willow flycatcher habitat (large, flat, wet meadows). One, west of the mouth of Silver Creek, was (and is) on private land. The other is near the extreme northwestern end of the watershed and appears to have consisted of a linear meadow area and a crescent-shaped meadow upstream; both were located at the base of very steep terrain. For fish-eating avian species like bald eagles and osprey, nesting sites would have been available and food was apparently extremely abundant, especially in the South Fork itself. There appear to have been numerous areas of open and semi-open forest habitat with large trees suitable for nesting goshawks, flammulated owls, white-headed woodpeckers, pygmy nuthatches, and black-capped chickadees.

It is not likely that the watershed supported significant numbers of the herpetofaunal species associated with headwater/low order streams in LS habitats (for example, tailed frog, southern torrent salamander) because of the paucity of closed-canopy, LS habitats at mid-to-high elevations in the watershed. Past conditions in streams are particularly difficult to ascertain from aerial photos, but we expect that foothill yellow-legged frogs and Northwestern pond turtles were relatively abundant. We do not feel able to judge whether red-legged frogs were ever abundant in the watershed; if they were, it was probably in lower elevation, dense-canopy habitats. If suitable maturnity roosts and hibernacula (within their migratory ranges) were available, all of the bat species might have occurred in the watershed since day and night roosts as well as substantial foraging habitat appear to have existed (see Chapter 5 for the types of roosts, hibernacula and foraging habitats each species typically uses).

Human and Public Use Values

Historically, the East Fork and the Smoky Creek watersheds were inhabited by the Nor-El-Muk Wintu which is the northern subgroup of the larger Wintun tribe that inhabited much of northern California. The Nor-El-Muk apparently inhabited the Trinity River Basin down to Big Bar, the Hayfork Creek area, and the upper South Fork (Dubois 1935). It is believed the Hill Nomlaki also inhabited parts of the upper South Fork drainage. The Nomlaki, or Central Wintu, occupied the foothills to the west of the Sacramento Valley from Cottonwood Creek south to Stoney Creek and as far west as the summit of the Coast Range. Downstream from the Wintu, along the South Fork were the Tsnungwe, whose territory encompassed the lands from Kirkham Creek on the Trinity River (which were lands shared with the Hupa), up through Cedar Flat near Burnt Ranch (which was shared with the Chimariko) from ridge to ridge up to the New River summit, and from the South Fork confluence with the main stem Trinity River up to Grouse Creek. There was a "neutral zone" between the Tsnungwe and Nor-El-Muk territories which lay from Grouse Creek up to Hyampom (D. Magdelena 1997). The Hupa lived downstream from the Tsnungwe lands along the mainstem Trinity River.

The Wintu of pre-contact times maintained a subsistence lifestyle, gathering the wild edible and medicinal plants, hunting the animals, and catching the anadromous fish that migrated up the South Fork and its tributaries. Their primary and most reliable foods were acorns, salmon, and deer. The salmon runs were thick then, and most years the Wintu had more than enough for their needs. Their diet was supplemented with roots, tubers, fresh greens, seeds, pine nuts, and berries as well as deer, bear, small mammals, birds, crawfish, and clams (Dubois 1935). Seasonal migrations to food gathering sites or hunting and fishing sites were common.

It is believed other tribes utilized this area as well: the Chimariko, Yuki, Nongatl, Wailaki. The Lassik tribe apparently made yearly pilgrimages into the Yolla Bollas for salt. Many archaeological sites were destroyed by early logging operations; this has made it difficult to determine just how permanent the settlements were in the South Fork prior to contact time. The lands of the South Fork may have served more as a neutral trade zone in the recent past for the Nomlaki, the Wailaki, the Nor-El-Muk, and perhaps the Chimariko and Tsnungwe as well, rather than a place of permanent settlements (R. Patton 1997). There are very old permanent sites from the Borax period on South Fork Mountain and large midden sites along the upper South Fork from a time that pre-dates contact time. USFS archaeologists have identified and documented a proliferation of "summer camps" or seasonal occupation sites with lithic scatter and projectile points, permanent occupation sites with house pits and middens, food procurement sites, and chert quarry sites, where material for tools was excavated from rock outcrops. The locations of these sites are documented and mapped but will not be revealed in this document in order to protect their remains. Limestone outcrops were, and continue to be, of great significance to the Wintu (R. Patton 1997).

Jedediah Smith was the first white man to cross South Fork Mountain, in 1828. Other Europeans arrived in the watershed in the late 1800's. With the coming of the Europeans came the demise of the Native American cultures. Many Wintu died from battle, disease, starvation, or were moved out of their homelands. Those that remained either worked for or married white people (R. Patton 1997). The battles between whites and native people that occurred elsewhere most likely did not occur in the upper South Fork. It may be that many of the Wintu living in the area simply moved over South Fork Mountain and into the Mad River drainage to escape white people (R. Patton 1997).

Settlers primarily homesteaded. A total of 34 homesteads were settled along the South Fork in the early days (Steffensen 1997). Two of the homesteads were probably settled as early as the 1870's or 1880's. It was the abundance of fish, wildlife and grazing potential that brought Europeans to the South Fork. Europeans of various nationalities and Chinese settled in the East Fork and Smoky Creek watersheds, but their populations remained small.

Though some tried gold mining, this area never produced much gold. Gold was not as abundant in the South Fork as it was in adjacent river systems. Other settlers ran cattle and sheep, fished, trapped, operated pack trains of mules, ran a sawmill, and raised crops for sale. A Russian who lived at the Norris Place, which ultimately became Mary Lee Steffensen's place, was well known in the earliest days of settlement for the potatoes he raised and sold in nearby Harrison Gulch. Bob Watson, who built a fish dam near the mouth of Smoky Creek, transported fish all the way to Weaverville and the La Grange Mine. His route, which took two days of travel time, became known as the Old Fish Trail. He was able to pack the fish in ice from an icehouse at Wildwood after the first day of travel and then continue on to Weaverville (R. Patton 1997, see also Jones 1981, pg. 373).

Gertrude Patton, who was born in 1915 and was raised at the Upper Bramlet Place along the South Fork at the confluence of Dog Gulch, recollects how her family raised pigs and grew their own crops to get by. Potatoes were an especially important crop. Fish were plentiful, especially the summer salmon. They rested in pools that were approximately 50 feet deep (G. Patton, 1997). Wolverine, mink, otters, and fishers were very common; so common, that her father trapped many "varmints" in his orchard and her mother stewed them up to feed to their chickens in order to keep them laying eggs (G. Patton 1997). Travel was on foot or horseback.

During the peak period of the Gold Rush, many supplies--primarily fish, venison, and deer hides--were needed by the miners. Trinity River gold mining had muddied the waters and salmon had stopped running, so fish had to be procured elsewhere. Initially, these food supplies were obtained in adjacent areas. As those resources were depleted, the food had to be brought in from further away. The people who procured these foods became known as the "hidehunters." The South Fork became the hub of the hidehunters' activities because it was so full of wildlife and fish, and because of its proximity to the Gold Rush areas. The hidehunters worked throughout the South Fork from the 1860's into the early 1900's. Deer were so plentiful that it was common for a team of men to kill 30-40 deer on each trip (R. Patton, 1997). The Upper Bramlet Place, which was homesteaded in 1913, was one of the sites used by the hidehunters for skinning their hides. According to Ray Patton, so many hides were cleaned there that the ground was covered two feet thick with deer fur at any given time (R. Patton 1997). Some of the hides gathered were taken to Red Bluff. Many of the hidehunters were native people from tribes other than Wintu; oftentimes, they were Cherokee members.

In the late 1800's sheep were grazed in the watersheds of the upper South Fork, particularly in the Yolla Bolla Wilderness and the lands north of there. Most of them were driven in from the central valley near Red Bluff along trails known as the Humboldt Trail and the Tedoc Trail. The Tedoc Trail is thought to be an old Indian trail (for a map of historical sites, see Jones 1981).

At that time the land was considered Public Domain with no restrictions. The sheep were herded from meadow to meadow during grazing season, and were eventually herded either to market or to winter range in the valley. Some sheep stayed in the watersheds throughout the entire year. By the late 1800's, cattle were herded in the upper South Fork. They used the same trail systems, which became known as "driveways." The sheep herders and the cattle herders did not coexist harmoniously because their stock had different grazing needs. In particular, the sheep grazed right down to the ground, making grazing difficult for any cattle that followed. The Mad River, on the west side of South Fork Mountain, which was once part of the Trinity National Forest, was a major grazing ground for sheep and cattle. Approximately 25% of the sheep and 50% of the cattle that entered the country on the driveways were herded into the Mad River drainage (Coop 1997).

According to research being done collaboratively by the USFS and the University of California Cooperative Extension, the USFS began active management of these lands in 1906, when it became National Forest land. At that time, the USFS, concerned about preserving the resources that were being damaged by livestock, developed a permit system and an assessment of the damages done. Allotments were granted and enforcement of rules began. USFS guard stations were established throughout the watersheds in order to oversee grazing practices. (Coop 1997 and Feraro 1997). The 1910 Trinity Range Report indicates actions taken by USFS at this time:

> No more than 1700 cattle and horses should be grazed in this district hereafter, and no sheep or goats should be allowed under any circumstances if it can be possibly avoided. This is the only course that will result in any permanent betterment of range conditions, and assist those slopes to properly reseed to the coniferous trees where nature is being retarded. Light grazing will do more toward reforestation in a large part of this district than any other method that would be within the means of the service to employ. The difference in the numbers of stock from 3624 head of cattle and horses and 3750 head of sheep and goats grazed in 1908 to 1342 head of cattle and horses and no sheep and goats in 1910, speaks for itself.

According to range researchers, ranchers maintained the Native American practice of using fire to manage the landscape prior to management by the USFS. Common anecdotes related by "old-timers" refer to the guidance given them by their fathers and grandfathers that "the last man out of the forest drops the match," meaning that when all the herds and herders were out for the season, the forest was set on fire. Because this was done regularly, the fires rarely devastated the landscape (L. Feraro 1997). Instead, regular, low intensity fires kept the meadow lands open and the forest free of downed woody material, making it easier for the herds to maneuver and creating fresh green forage.

The early efforts of the USFS in fire suppression are clearly noted in the Trinity Grazing Report (1910), Hoopa section:

> The open grass prairies in the northern and northwestern part of the Reservation are the result of continuous, burning by the Indians in former years. Through the efforts of the Forest Service and cooperation by the Indian Service, this burning has been almost discontinued.

By 1910, USFS policy was clearly directed for tree seedling survival rather than range. Sheep and cattle grazing peaked around WW I when the demand for meat was high. By WW II Sheep were no longer grazed in the watersheds and cattle grazing, which experienced a slight peak during WW II, gradually tapered off to what it is today (Coop 1997 and Feraro 1997).

Mining in the watersheds was minimal, amounting to a few small operations that were not productive. Some of the settlers panned and sluiced enough gold to keep their finances afloat, but that was the extent of it. Other minerals extracted from this area included manganese, chromite (which was a strategic mineral during WW II and the Korean War), and limestone, but none of these were mined in great quantities.

During the 1930's and 1940's a road and trail system was created in this area as part of the California Conservation Corp's work during the Great Depression. The intent was to "open up the country" for logging and other activities. Red Mountain Motorway, Highway 36, and the White Rock Road were built during this period. The Wildwood Inn on old 36 and the Forest Glenn Inn were resorts for the elite during this period (R. Patton 1997).

Timber harvesting began in earnest in the 1950's, in the boom time after WW II. Technologies had become refined, roads were more easily created, and there were many war veterans needing work. One of the first large timber sales in the watersheds was the Prospect Sale. It was a ten-year sale, called a "Chief Sale," signed off by the President which had to generate more than 50 million board feet (mbf) of timber. It was sold in 1954 to R.L. Smith under the condition that he process the lumber in Trinity County. This was the type of timber sale that helped "open up" the country in the post war years. Very few restrictions existed regarding logging at that time, so until the Forest Practice Act of 1973 was passed, there was a great deal of poor quality road building and logging that caused severe problems on the landscape and in the rivers (MacCleery 1974, pp. 1- 17). The floods of 1955 and especially 1964 compounded these problems immensely in adjacent watersheds.

Residents of the South Fork speak of time in terms of "before the '64 flood" and "after the '64 flood." Emelia Berol, who researched the history of the lower South Fork in 1995, was told by all the people she interviewed that the damage done by the 1964 flood was much more severe than any damage caused by previous floods. After the flood, residents recount how the fish runs began to decline. Max Rowley, who moved into Willow Creek in 1936 and who worked for the USFS for 30 years, told Berol that "even in the Indian legends there is no historical evidence of there having been a flood year in the past 1,000 years to compare to the 1964 storms. Village sites were flooded that had never been flooded before, and some of the sites are believed to have been in use for at least 6,000 years, possibly as long as 8,000 years" (Berol 1995).

The same sorts of accounts surfaced with people interviewed for this watershed analysis. Everyone commented on how the fish used to be incredibly plentiful and how they declined after the logging and the 1964 flood; how the river filled up with sediment, and how there were no longer deep pools in which the fish could stay cool. They also commented on how wildlife diversity and density diminished.

Historical Accounts of the Watersheds

The following section is a selection of short accounts and observations made by people interviewed for this watershed analysis. They paint a picture of how the watershed used to be. They are grouped according to subject.

Changes in River Structure and Fisheries

- *There were three of four deep pools near where I was raised. Oh, they were about 50 feet deep. The fish used to hole up there in the summer to keep cool.*

- *I used to visit my Grandmother (at the Upper Bramlet Place) in the 1940's and we'd go down to the river (mainstem of the South Fork) to catch fish for breakfast, and as fast as she could throw the line in, she'd pull out a fish. They were trout, about 6 to 8 inches long.*

- *Around 1951 the holes were black with salmon.*

- *After the 1964 flood the salmon deteriorated.*

- *In January and February the steelhead came up the river and even swam up into the little bitty streams where their backs were halfway out of the water.*

- *At the bridge where the Wild/Mad Road crosses the East Fork the hole used to be real real deep. One time in the early 50's my family hiked up to that pool to catch some fish. The hole was solid black with salmon. Now the hole is not very deep at all compared to what it used to be.*

- *Before the logging there used to be natural debris piles that occurred, that helped make fish spawning habitat. Now channel widening caused by floods and logging inhibit the debris piles from building up.*

- *Near Elisha Jane's Place (Payne Place, two miles up the East Fork) there used to be thousands of fish. This area is an historic spawning place.*

- *My father used to tell me stories about the river being black with salmon.*

- *There used to be a big pool that fish holed up in at Double Cabins.*

Changes in Wildlife

- *I used to see lots of Spotted Owls before the logging happened. There were so many, they often came into the cabin. There used to be lots of wolverines and fishers too.*

- *I never saw any ravens before the logging days.*

- *There used to be tons of salmon and we'd see lots more animals before the country was logged.*

- *There used to be lots of fisher and wolverines and otters before the '64 flood and all the logging.*

- *People came to the South Fork because it was so rich with wildlife and fish.*

- *The South Fork was the core of the hidehunter activity because it had so much abundance in it.*

Logging

- *In the 1940's the Indians still used to come up into the country here and their children would spend the summer alone up here living off the land. It was a common practice. After the logging got into full swing, they no longer came up.*

- *Many of the prescribed burns have been too hot and have harmed the landscape.*

- *Because of logging we are way beyond the "natural range of variability" in Smoky Creek, so any more clear cuts or prescribed fires that burn too hot will push us out of that range.*

- *Even people who have logged in these woods all their life say to leave it alone so it can heal.*

- *There have been some very bad timber sales recently, even after the 1973 Forest Practice Act.*

- *After they started logging, I went back to the country and I didn't recognize it, it had changed so much.*

Chapter 5
CURRENT CONDITIONS

Introduction

This section of the watershed analysis is meant to provide a detailed description of ecosystem functions in the watersheds at the present time. Information for this chapter was based on extant USFS (USFS) data, Geographic Information System (GIS) data, historic photos, field data collection, and interviews with residents of the area and others knowledgeable about the watersheds. In many cases the discussion that follows has direct bearing on the Issues and Key Questions identified in Chapter 2; in these instances the relationship of the researched information and the particular issue or key question is clearly noted. Not all of the information included in the chapter, however, has direct bearing on the particular issues and questions identified by the watershed analysis team at the beginning of their researches. In these cases, the relationship of findings to issues and key questions is not explicitly stated.

Climate

The typical winter weather pattern in these watersheds is for storms to move in from the southwest, drop rain at lower elevations and snow at higher elevations, and move out from two to five days, or more, later. These stormy periods are followed by rainless periods with a duration of two days to two weeks or more. As the season progresses into spring the rainy periods decrease and the rainless periods increase while the daytime temperatures begin to climb and the night time temperatures rise only slightly. Summers generally have high temperatures typically in the 80's and 90's (Fahrenheit) and lows in the 60's and 70's. It is common during summers for cumulous clouds to build up during the day, resulting in lightning storms and cloudbursts by mid to late afternoon. These storms, which can be quite violent, with high, gusty winds, torrential rains, and numerous lightning strikes are the primary natural source of fire ignition. This weather pattern can continue into fall, during which time the daytime temperatures are gradually decreasing and the night time temperatures are falling more rapidly. With the onset of late fall rains, lightning storms generally decrease.

Geology, Hydrology, and Aquatics

Overview

The East Fork of the South Fork (East Fork) and Smoky Creek watersheds are located in the headwaters of the South Fork Trinity River (South Fork) watershed and include all sub-basins to the north of the South Fork from Silver Creek upstream. There are three major streams located in the watersheds. They are the South Fork and two fifth-order tributaries, the East Fork and Smoky Creek. Several third-order streams--Silver Creek, Red Mountain Creek, and Dark Canyon Creek--are also located within the watersheds. Silver Creek is located at the northeastern portion of the watersheds and enters the South Fork downstream of Smoky Creek. Red Mountain Creek, also a tributary of the South Fork, is located immediately upstream of Smoky Creek. Dark Canyon Creek, the remaining third-order stream found within the watersheds, is a tributary of the East Fork. Prospect Creek, a fourth-order stream, is also a tributary to the East Fork, entering it immediately downstream of Dark Canyon (Map 4a, Appendix E).

The South Fork and the East Fork flow in a nearly continuous northwesterly direction for over 20 miles through or along the edge of the watersheds. The largest tributary watersheds of those two streams, however, generally do not exceed five miles in length from ridgetop to mainstem confluence. Elevational change within the larger tributaries is generally 1900-2600 feet. Elevation change from the headwaters of the East Fork to the South Fork at Silver Creek is approximately 4600 feet. Over 3,000 feet of elevational change occurs in the upper three miles of the headwaters, with the remainder flowing at a fairly uniform gradient averaging approximately 2 percent.

Geologic Setting

The East Fork and Smoky Creek watersheds are underlain by three geologic formations whose rocks have been dated as forming between the Early Cretaceous (120 million years old) and the Triassic period (200 million years old). From younger to older rocks, they are the Pickett Peak Terrane (South Fork Mountain schist), Western Jurassic Terrane (Galice Formation), and the Rattlesnake Creek Terrane (Irwin et al 1985) (Map 3, Appendix E).

Approximately 90 percent of the watersheds lie within the Klamath Mountains geologic province (Western Jurassic and Rattlesnake Creek Terranes), with the area south of the main stem of the East Fork being in the Coast Ranges province (Pickett Peak Terrane). A major inactive fault structure extending from Mt. Diablo in central California to Brookings, Oregon forms the Coast Range Thrust Fault (also known as the South Fork Fault) contact zone between the two geologic provinces. The main stem of the East Fork and the main stem of the South Fork have eroded canyons and now flow along this fault nearly to Hyampom, California.

The South Fork Mountain schist is typically a fine-grained mica and quartz-rich metamorphic rock which is widely reported as being very unstable and prone to mass movement and deep gully erosion (Haskins 1981, California Department of Water Resources 1979, Haskins et al 1980). The South Fork Mountain schist underlies most of the LSR lands and plantation patch cut-blocks located south of the main stem of the East Fork, but the schist is largely absent in the Smoky Creek watershed.

The Galice Formation consists of mildly metamorphosed and slaty sedimentary siltstones, greywacke sandstones and conglomerates, along with some fine-grained layered volcanic rocks, presumably air-fall ashes and tuffs. The Galice Formation is essentially absent in the East Fork watershed, but underlies the lower hillslopes adjacent the South Fork for an average 0.5 to 2.5 mile wide area in the Smoky Creek watershed (i.e. much of the LSR or unmanaged old growth areas within the watershed). The Galice Formation contains the largest percentage of active landslides per unit area (6%) in the whole of the South Fork watershed (California Department of Water Resources 1979). This rate is twice that occurring on the South Fork Mountain schist (3%), and strongly reflects the sensitive nature of steep, inner gorge slopes adjacent the main stem South Fork.

The Rattlesnake Creek Terrane underlies approximately 70 percent of the combined East Fork and Smoky Creek watersheds, including nearly all of the Prospect, Dark Canyon and Texas Chow Creeks, as well as the Silver Creek and Red Mountain Creek watersheds. The Rattlesnake Creek Terrane is best characterized as a tectonic melange or dismembered ophiolite, and as the names imply is quite varied both lithologically and structurally. The melange largely consists of a highly sheared and fractured ultramafic and serpentine-rich matrix of weak materials which surround all sizes (from tens of feet in diameter to several 100 acres) of more resistant blocks of mafic and leucocratic volcanic rocks, cherts, clastic sedimentary rocks, limestones and assorted high to low grade metamorphic rocks. The Rattlesnake Creek Terrane has been intruded by several plutons (i.e. magma which has cooled beneath the land surface at great depths) ranging from gabbroic to dioritic in composition. These intrusive rocks underlie approximately l0 percent of the watersheds and include the Smoky Creek, Silver Creek, Brushy Mountain, and Star Mountain plutons.

Landforms throughout the Rattlesnake Creek Terrane are highly broken, discontinuous and hummocky, with many closed depressions and benches (small flats) present, and contain stream channels with highly varied degrees of incision. Together these features highlight the role that now largely dormant and inactive, pre-historic, deep-seated, complex landsliding and slump earthflow processes have played in shaping the topography. Most of the pre-historic landslides are largely stable in our current global climatic regime. However, Haskins (1990) considered many of the dormant landslide features highly vulnerable to re-activation as a consequence of major wildland fires, poorly located timber harvesting units, and/or to a lesser degree, poorly located road construction.

Stream Channel Morphology

Sub-basins and individual streams within the watersheds are very similar. The topography is mountainous, with stream channels flowing through steep "v-shaped" canyons with sideslopes commonly in excess of 70 percent. Stream channel morphology is moderately to deeply entrenched, heavily influenced by bedrock and structural controls including faults, and very stable with little sinuosity. Rosgen channel type information has not been gathered for many of the streams within the watersheds. Based on the observed land form and stream channel entrenchment, as well as the substrate and channel gradient data that are available, it appears that the majority of the channels can be classified as A2, B1, B2, and B3 Rosgen channel types.

Channels of this type are characteristically fairly "high energy" channels through which bedload and large wood are rapidly routed. While bedrock and other structural features are largely responsible for shaping channel features such as residual pool depth and width to depth ratio, wood plays an important role in providing cover, additional channel complexity, as well as nutrients in these systems, which are generally characterized as being nutrient poor. Members of the WA team made reconnaissance surveys of anadromous portions of the East Fork and Smoky Creek in May of 1997. Based on qualitative observation of large wood densities made during those surveys, it appears that large wood is common and present at expected or higher levels for the channel types present within the watersheds.

A trend toward increasing pool depth, and thus better pool quality, appears to be occurring within stream channels in the watersheds. This trend, which appears to be occurring in a "top down" fashion within the South Fork is discussed in greater detail in Chapter 4. Stream surveys focusing on pool depth data are being conducted during summer 1997 in selected streams within the watersheds, including the main stem of the South Fork. The 1997 survey data will be compared to the 1989 survey data to provide information regarding the recovery trend that is believed to be occurring.

The May 1997 reconnaissance inventories conducted by WA team members along the lower portions of the East Fork and Smoky Creek indicate main stem channels are in a state of dynamic equilibrium, and appear to have responded well to moderately high stream flows experienced during this past winter (peak storm return interval is estimated as a 5- to 10-year flood). Isolated incidences of streambank erosion were observed, however virtually all locations were in non-bedrock bounded (alluvial) terrace and floodplain bank settings where one would expect moderately large floodflows to recruit sediments. Importantly, where bank erosion was observed, the opposite side of the channel invariably was observed to experience additions of stored sediment either on point bars or on the floodplain, further suggesting a fair degree of channel stability. It appears that active channel widths were not significantly changed by moderate floodflows experienced over the last several years.

Although quantitative data are not available, the amount of fine sediment in streamcourses is the most readily identifiable difference between streams within the watersheds. Streams within the Smoky Creek, Silver Creek, and Red Mountain sub-watersheds do not have high fine sediment concentrations, while the East Fork , including the Dark Canyon subwatershed, have noticeably higher levels of fines. Based on the 1997 reconnaissance inventories, Smoky Creek contains some of the cleanest and well sorted gravels observed in Northern California streams by team members D. Hagans and E. Johnston

Riparian Reserves

Riparian vegetative conditions are integrally tied to the process and function of the aquatic ecosystem. Streamside vegetation controls the environment (light, temperature, nutrient regimes), provides the food or energy base, and creates the physical structure for small- to medium-size streams (Murphy and Meehan 1991) In particular the importance of large wood in streams of forested landscapes is widely recognized (Bisson et al 1987; Sedell et al 1988). The linkages between streamside vegetative condition and instream habitat condition are complex and vary depending on stream size/order, geology, topography, climate, etc. However, it is generally agreed that a properly functioning aquatic ecosystem is one in which the rich structural and compositional diversity of streamside areas is maintained.

For analysis purposes, a Riparian Reserve system overlay was created using GIS. The recently completed inventory of roads in the watersheds, which included stream location and classification data for all road crossings, was used to develop the coverage. The team relied upon interpretation of contour crenulations to delineate streams and stream classes in nonroaded portions of the watersheds. Riparian Reserve widths for fish-bearing, permanently flowing nonfish-bearing, and intermittent and ephemeral nonfish-bearing channels were delineated consistent with the *Record of Decision for Amendments to Forest Service and Bureau of Land Management Planning Documents Within the Range of the Northern Spotted Owl* (USDA, USDI 1994) (Northwest ROD). Riparian vegetative conditions were analyzed using the Capable, Available, Suitable (CAS) stand size/canopy overlays, the 1990 and 1995 aerial photographs, and reconnaissance field trips.

Throughout several of the watersheds, Riparian Reserves are intact and appear to be functioning properly. With some exceptions, a healthy, unmanaged and contiguous riparian corridor exists along all fish bearing streams in the watersheds. The exceptions are where roads cross Riparian Reserves and the private parcel along the lower East Fork where timber harvesting and grazing continue. In the Silver Creek, Smoky Creek, Red Mountain Creek and the upper East Fork subbasins, healthy riparian stands extend throughout much of the headwater reaches. Although some Riparian Reserves in the headwater areas of these subbasins have been compromised, at a landscape level they appear healthy. Dense stands which are typically considered to be overstocked and/or possess an abundance of fuel and fuel ladders are generally uncommon. Only a few densely stocked riparian stands were identified in Silver Creek. In these riparian stands, an abundance of ladder fuels could carry fire into the larger, dominant trees present in the stand. Additional ground verification will be required in these stands to fully appraise stand conditions within riparian reserves..

There are several sub-basins within the watersheds where riparian vegetative condition has been compromised. Heavy partial cutting throughout the upper portions of Prospect Creek, including Texas Chow Creek, and in Dark Canyon have created conditions where the Riparian Reserves are understocked with conifers, contain very few large trees, and an abundance of willow and/or alder. In these drainages, the ecological processes and linkages of these riparian areas are dysfunctional.

Water Temperature

Long-term stream temperature data do not exist for the South Fork. However, stream temperature data have been collected at several locations within the watersheds (Ranken, unpublished data). These include Smoky Creek and the East Fork immediately above their confluence with the South Fork, Prospect Creek immediately above its confluence with the East Fork, and the South Fork at Smoky Creek (Maps 4a and 4b, Appendix E). Stream temperature data have also been collected in the Upper South Fork at the 30 road concrete bridge (immediately above the confluence with the East Fork). At each of these locations daily high and low temperatures were collected using thermographs. The number of years that data were collected differs depending on the site. For instance a single year of data were collected in 1996 at the Prospect Creek site while temperature data at the South Fork at Smoky Creek site were collected in 1992-1994 and 1996.

The 68° F upper limit considered optimal for salmonids and the 75° F upper limit considered lethal for salmonids (Reiser and Bjorn 1979) were used to evaluate the stream temperature data recorded within the watersheds. Stream temperatures differed between years, presumably due to differences in climatic variables which influence water temperature (snowpack, rainfall, air temperature, etc.). Daily high stream temperatures above 68° F were recorded during the summer at all of the sites at some time during the period when data were collected. The number of days when this occurred are presented in Table 3-1. Stream temperatures above 75° F were not recorded within the watersheds.

Because climatic variables differ between years and because data were not collected at all of the sites during the same years, comparison between some of the sites are difficult to make. However, some general relationships between the sites can be seen. For instance, the South Fork at Smoky Creek consistently had more days when temperatures above 68° F were recorded than other sites within the watersheds. The East Fork by comparison had relatively few days where temperatures above 68° F were recorded (34 days were recorded in 1992; however, no other 1992 data exist for comparison purposes). The South Fork at the concrete bridge seemed to track well with the South Fork at Smoky Creek, suggesting that the Upper South Fork has a substantial warming effect on the South Fork below the confluence.

Although there were a number of days when daily high temperatures exceeded 68° F, no daily lows above 68° F were recorded. It is assumed that salmonids seek thermal refuge during warm periods and move more freely during cooler periods. Clearly the amount of thermal refugia and the extent and duration of warm periods when refugia habitat must be used can be critical. The amount of time during each day that the temperature exceeded 68° F could be calculated using the available temperature data and would likely differ depending on the time of year. The analysis would be complex and time consuming however, and was not completed as part of this analysis. This more rigorous analysis was not completed mainly because the ecological processes which affect water quality are considered to be functioning properly. For instance, the riparian vegetative community and associated canopy is well developed throughout much of the watersheds and very little domestic or extractive water use occurs within the analysis area. Additionally, the pattern and range of temperatures recorded is consistent with wilderness streams in the Trinity basin such as the North Fork Trinity River (Ranken unpublished).

Table 5-1. Number Of Days Where Daily High Exceeded 68° F For Each Site (1989 - 1996)

Year	Smoky Creek	East Fork	Prospect Creek	South Fork at Smoky Creek	South Fork at 30 Road
1989	--	--	--	--	19
1990	--	4	--	--	31
1991	--	34	--	--	--
1992	18	--	--	24	36
1993	0	--	--	0	0
1994	17	4	--	30*	26*
1995	--	--	--	--	--
1996	--	--	4	0	--

-- Denotes no temperature data recorded

* Stream temperature exceeding 68° F was recorded on the first day when the thermograph was placed at the sampling location (7/9 for South Fork Smoky Creek and 7/13 for South Fork 30 road)

Extent and Range of Anadromous Fish Habitat

Accessibility to and use of habitat within the watersheds is understood in a general sense; however, detailed and credible information regarding migration barriers is in some instances absent. Surveys conducted during the 1970's and 1980's often include information such as the height and location of "barriers" without making a clear distinction between full and partial, flow-dependent barriers. More recent surveys conducted in the late 1980's and into the 1990's focused primarily on microhabitat typing and the reports generated from these surveys frequently do not provide detailed information about the location or nature of migration barriers.

Despite the information gaps, it is generally agreed upon by the watershed scientists and fisheries bilogists involved in this analysis, that very little habitat is accessible to anadromous fish in the third- and fourth-order streams within the watersheds. Anadromous fish passage into Dark Canyon Creek is blocked immediately above its confluence with the East Fork at the 30 road culvert. A barrier to fish migration is located within the first quarter to half mile of Prospect Creek above its confluence with the East Fork (Underwood and Strate, unpublished report; Kaufner, unpublished report). A partial, flow-dependent barrier is located at the mouth of Red Mountain Creek (Dean 1997) and a full barrier to anadromous fish passage is located approximately a half mile above its confluence with the South Fork (Cindy Carrigan 1997). No known migration barriers exist in Silver Creek (Randy Bashaw 1997) . Anadromous passage into the east and most of the middle forks of Smoky Creek is blocked by bedrock falls; however the rest of Smoky Creek is accessable to anadromous fish. The most extensive habitat accessible to anadromous fish extends from the South Fork up into the East Fork, where habitat conditions rather than barriers appear to restrict anadromous fish occupance. The majority of the anadromous fish habitat is thus found in the South Fork, the East Fork, and Smoky Creek.

Fish Species (Including TE&S Fish Species)

Spring Chinook and winter steelhead are the dominant anadromous fish stocks found within the watersheds. Within the South Fork, spring and fall Chinook salmon are both temporally and spatially separated with spring run fish utilizing habitats in the upper portion of the basin including habitats within the East Fork/Smoky Creek watersheds. Fall run Chinook are not found within the watersheds as they do not occupy habitats much above Hyampom. The National Marine Fisheries Service (NMFS) currently is preparing a status review of Chinook salmon throughout their range on the west coast of the United States in response to a petition to list Chinook as threatened or endangered under the Endangered Species Act (ESA) (60 FR 30263, June 8, 1995). Summer steelhead are present within the South Fork; however their abundance is both historically and currently very low. Their occurrence in the South Fork has been described as incidental (Pacific Watershed Associates, 1994). Within the South Fork basin, both winter and summer steelhead are included in the Klammath Mountain Province (KMP) ESU. The Klamath Mountain Province Evolutionary Significant Unit (ESU) was first proposed for threatened status in March of 1995 (59 FR 14253). The NMFS has extended the final decision date for Klamath Mountain Province steelhead several times, most recently in August of 1997. Presently, they remain a proposed species requiring consultation with NMFS as mandated by the ESA.

The Northern California coastal coho salmon ESU, which includes South Fork fish, is listed as threatened under the ESA (62 FR 24588 May 6, 1997). The NMFS has not yet identified critical habitat for the ESU. Because anadromous fish habitats within the analysis area are accessible to coho salmon, and because headwater areas influence downstream reaches, ESA processes require consultation on all activities occurring within the South Fork.

Information regarding the abundance of coho salmon is quite sketchy not only for the watersheds, but for the South Fork as a whole. Much of the information for the South Fork is anecdotal, although juvenile surveys in Butter, Olsen, and Eltapom Creeks confirmed accounts by local residents that coho salmon are occasionally seen within the South Fork (Pacific Watershed Associates 1994). These tributary streams are located near Hyampom, CA, which is downstream of the analysis area. No information, anecdotal or otherwise could be found for habitats within the watersheds. It is unlikely that substantial numbers of coho salmon have ever entered the South Fork watershed, with current utilization of habitats within the watersheds incidental at best. This is not surprising, since coho salmon are more commonly found in lowland alluvial streams with greater quantities of backwater and off channel habitats than are found in the entrenched, structurally controlled channels found within the South Fork.

Pacific Lamprey

Pacific lamprey are also present in the South Fork. Their abundance in the South Fork, including the analysis area, however, is not well documented.

Spring Chinook

Spring Chinook enter the South Fork in the spring and hold in pools throughout the summer prior to spawning in the fall. California Department of Fish and Game (DF&G) snorkel monitoring of adult spring Chinook salmon has been conducted in the South Fork for most of the years following the 1964 flood. Although total adult run estimates are greatly reduced form historic levels, monitoring data collected in the past six years indicates that a slight recovery in run strength is occurring (Table 5-2) (California Department of Fish and Game 1991, 1992, 1993, 1994, 1995, 1996)

Table 5-2. Annual Number Of Spring Chinook Counted During Snorkel Surveys in the South Fork, 1991 - 1996.

Year	Count
1991	66
1992	166
1993	284
1994	243
1995	579
1996	1,097

The surveys indicate that holding adult spring Chinook distribute themselves throughout the South Fork and the East Fork in a pattern that is fairly consistent between years (Bill Jong 1997). The fewest fish are found in the East Fork, with increasing numbers found in downstream reaches. The greatest concentrations of holding spring Chinook are found immediately downstream of the watersheds (Table 5-3).

Table 5-3. Distribution of Spring Chinook in and near the East Fork and Smoky Creek, 1996.

Stream Reach	Number of Fish Counted
East Fork Confluence to Red Mt. Creek	31
Red Mt. Creek to Silver Creek	41
Silver Creek to Forest Glen	126
Forest Glen to Hidden Valley	188
Hidden Valley to McClellan Place	319

Variation between years is assumed to be dependent upon base summer low flows, with upstream migration hampered due to low flows and the pattern of higher fish concentrations in downstream reaches even more pronounced during low flow years (Mike Dean, personal communication). Spring Chinook snorkel monitoring has rarely been conducted, if at all, in Smoky Creek or in the East Fork above the 30 Road bridge. Mike Dean indicated that Smoky Creek was surveyed once in the early 1990's; however, no adult spring Chinook and very few juveniles were observed. It is probable that a few spring Chinook may hold in Smoky Creek and the upper unsurveyed portion of the East Fork. However, the numbers of fish are likely quite low with no utilization at all occurring during some years, particularly low flow years.

The onset of spawning activity differs slightly between years, from mid September to the beginning of October, but follows a pattern where spawning activity occurs first in upstream reaches and progresses downstream. Spawning occurs very close (on average less than a mile) from locations where fish hold throughout the summer (LaFaunce 1964). Thus, spawning activity is limited mainly to the mainstem South Fork. Even the larger fifth-order Smoky Creek and the East Fork do not have an abundance of the larger (10-12 square feet) areas of 3 to 4 inch gravel that spring Chinook prefer for spawning (Dean 1997).

Juvenile spring Chinook spend a year in fresh water, with outmigration in the South Fork occurring from April through mid June. The South Fork from the East Fork confluence down to Hitchcock Creek is thought to be an important rearing area, not only for fish emerging from redds in that reach, but perhaps for juveniles in downstream reaches which may migrate upstream to escape increasing summer water temperatures (Dean 1997).

Winter Steelhead

In general, steelhead are capable of utilizing most of the habitats within the watersheds where full barriers do not prohibit upstream migration. Steelhead enter the South Fork and migrate to spawning areas during the late fall and winter and spawn in the spring thereby avoiding low flow conditions. By utilizing habitat during these periods of the year, accessibility of habitats upstream of partial flow-dependent barriers is not an issue. Winter steelhead, unlike spring Chinook utilize smaller "pockets" of suitable spawning gravel. This also accounts for their more extensive utilization of habitats throughout the watersheds to include some of the smaller streams within the analysis area as well as the upper reaches of some of the larger streams such as the East Fork.

Quantitative information regarding steelhead abundance and habitat utilization within the watersheds is limited. Adult escapement monitoring has been geared toward the entire South Fork and not individual reaches or tributaries. Also, because of their life history, winter steelhead are very difficult to monitor. Juvenile densities have been calculated for various streams within the watersheds; however long-term trend data do not exist. And because of the variability between year class strengths, water year, and other environmental conditions, comparisons between tributaries is unreliable.

For nearly a decade, the DF&G has tried to monitor adult escapement into the South Fork through immigrant and emigrant weir operations (Petersen mark recapture population estimate). The South Fork watershed, however is extremely prone to sudden flow increases, often overtopping weirs and causing monitoring efforts to be suspended. Unfortunately it is during these high flow events when peak upstream steelhead migration occurs. Thus the escapement data from the weirs is often incomplete and population estimates biased. Despite these difficulties, population estimates were generated for the 1988/89 through 1993/94 sampling years. During that six-year period the estimated population of winter steelhead in the South Fork averaged 2,574 fish, ranging between 969 and 3,741 fish (California Department of Fish and Game 1989, 1990, 1991, 1992, 1993, 1994).

Redd counts have been conducted in several streams within the watersheds (Table 5-4) (California Department of Fish and Game 1990, 1991, 1992, 1993, 1994, 1995). These data provide some insight regarding steelhead use of the individual streams, where counts were made and provide an opportunity to compare the relative abundance of redds between streams within a given year. However, comparisons between years (trend analysis) is unreliable since redd survey results may be influenced by the magnitude and frequency of high flow events which occur between the time when redds are made and the survey is conducted, and the effort made by agency personnel to document fisheries abundance and utilization.

Table 5-4. Steelhead Redd Counts for Smoky Creek, East Fork, and Silver Creek, 1990 - 1995.

Year	Smoky Creek	East Fork	Silver Creek
1990	16	38	4
1991	12	52	0
1992	17	78	4
1993	4	22	0
1994	8	41	0
1995	6	8	2

Illegal Harvest of Salmonids

Sport fishing is closed throughout the headwaters of the South Fork, including the analysis area. Illegal harvesting of salmon and steelhead continues, however, and is recognized as a serious problem in the South Fork (Pacific Watershed Associates 1984). Spring Chinook are particularly vulnerable to poaching, as they spend a considerable number of weeks in the river during summer low flows when spearing, shagging, and chicken-wire weirs/seines are all used to take fish. During drought or years with very low summer and fall flows perhaps as much as half the spring salmon run in the South Fork is illegally harvested (Yount 1997).

Dominant Ecological Processes Shaping Fish Habitats

In general, stream channels within the watersheds have not been affected by the suite of management activities that have altered water quality and fish habitat conditions in other portions of the South Fork watershed. Mining, grazing, and water use all have and do still occur to some degree within the watersheds. The effects of these activities are not observable at the landscape scale. However, road building and timber harvest have occurred within the watersheds and have exacerbated the effects of past flood events. A detailed discussion of past road building and timber harvest activities and their role in the 1964 flood event can be found in Chapter 4.

The South Fork, like the rest of the Klamath basin, has been shaped by disturbance. The natural disturbances, principally fires and floods, have occurred over time at various intensities and frequencies ranging from small-scale annual disturbance to infrequent but large-scale catastrophic events. Erosion processes at work during these events are the principle agents which have shaped the aquatic habitats to which fish have evolved. Habitats are of course, altered and shaped more rapidly by erosion processes at work during catastrophic events.

Erosional processes currently operating in the watersheds are as follows: isolated streambank erosion caused by streamflow being deflected into banks; a variety of largely natural, shallow landslide processes; and surface erosion of cutbanks, ditches and road prisms along segments of the extensive road network, which delivers fine-grained (<10mm) sediment to lower-order stream-channel culverts. Presently, the most serious erosional threat is from accelerated land-use-caused erosion and sediment delivery. The two likliest contributers of sediment caused by human impacts are the risk of catastrophic culvert failure and extensive fluvial and gully erosion occurring on hillslopes throughout the watersheds, and the risk of widespread natural or land-use-related mass movements occurring throughout the portions of the East Fork watershed south of the main stem, or along the main stem of the South Fork (i.e. hillslopes underlain by South Fork Mountain schist bedrock or the Galice Formation).

Since the 1964 storm, rainfall intensity and duration records, and peak flow records indicate the upper South Fork has experienced no greater than a 10- to 15-year return interval storm. Between 1965 and the late 1980's, timber harvesting, with the advent of patch cutting, and additional road construction continued at a high rate in the watersheds. A significant portion of the new road construction and patch cutting occurred on the Buck Ridge area and south of Stuart Gap; both of these areas are underlain by South Fork Mountain Schist and are therefore prone to mass movement (Map 3, Appendix E). The lack of significantly sized, infrequent storms since these roads were built and portions of the hillslopes harvested suggests the managed areas have not been tested by a major storm (Table 5-5).

To better understand the magnitude of these existing and potential erosion and sediment production risks, sediment source inventories, which were sponsored by the South Fork Coordinated Resource Management Plan (CRMP) and funded by the Trinity River Restoration Program, were conducted throughout the watersheds during 1996 by the Trinity County Resource Conservation District and Pacific Watershed Associates personnel (unpublished reports). The goals of the inventory were to identify erosion control and prevention projects throughout the watersheds which would reduce sedimentation risks, provide additional protection for water quality resources, and benefit anadromous fishery recovery efforts throughout the South Fork.

During the field inventories, a suite of data was collected at all stream crossings in the watershed, and at all other locations along the road system where past and or future erosion could result in the delivery of sediment to a stream channel. This first set of data was collected simply to characterize past and/or future sediment yield. At each location where erosion was ongoing or the potential for erosion existed, a second set of data was collected to characterize erosion potential associated with the ditches, road prisms, and cutbanks. Both data sets were analyzed and sites were prioritized for corrective actions based on several factors. These included the amount of erosion presently occurring at the site as well as the potential for future erosion at the site, the likelihood or risk of the erosion actually occurring, the magnitude of potential impacts to water quality, the ease or difficulty of performing the corrective action, and the costs to conduct the work.

If during the field inventory, high-flow channel characteristics (field predicted width and depth of peak flows) suggested the culvert at any stream crossing was undersized for the 100-year storm discharge, as well as sediment and debris in transport, the drainage areas were determined and the expected 100-year return interval storm flow culvert size was calculated.

Roads throughout the watersheds were classified based on their apparent level of maintenance and whether there were potential sites to treat along the route (See Table 5-5). Approximately 55 percent of the roads in the watersheds appeared to be receiving some level of maintenance. Along another 27 percent of the roads, stream crossings have been partially or completely excavated and the road prism drainage improved, indicating a formal effort has been made to hydrologically close or decommission the route. Along the remaining 18 percent of the road system, indications of periodic maintenance are not apparent. It appears that as the USFS road maintenance budget continues to shrink, currently maintained roads will begin to show indications of lower maintenance levels.

The inventory identified nearly 245 miles of maintained, abandoned and/or "hydrologically closed" (decommissioned or closed) roads have been constructed in the 77 square mile area (see Table 5-5). Road densities average 3.8 mi/mi^2 for the East Fork watershed; however this is misleading because there is an approximately 9 square mile area of roadless LSR land located south of the main stem of the East Fork. Actual road densities in the managed portions of the East Fork are 4.95 mi/mi^2. Within the Smoky Creek watershed, road densities average 2.44 mi/mi^2 for the whole watershed, however, they actually approach 4 mi/mi^2 when the currently un-roaded areas are subtracted from the total acreage.

Table 5-5. Maintenance Classification of Roads in East Fork and Smoky Creek		
Classification	**East Fork (miles)**	**Smoky Creek (miles)**
Maintained	84.1	61.3
Abandoned, Driveable	16.9	8.7
Abandoned, not Driveable	10.6	8.9
Decommissioned	41.9	11.5
Totals	153.5	90.4

Field inventories indicated the risk of significant or frequent mass movement processes occurring throughout the watersheds is low based on the number of potential or existing slides identified (Tables 5-6 & 5-7). Instead, the inventory revealed the presence of over 610 stream crossings which have been constructed throughout the watersheds, each with a varying risk of failure, and nearly 55 road ditch relief culverts which are currently delivering runoff and sediment to stream channels.

A total of 738 past and/or future erosion sites were mapped during the field inventory. Of these, 224 (30%) are currently stable and no physical mitigation is suggested. An additional 180 (24%) of the sites have a low probability of additional future erosion and thus low immediacy for treatment. Based on the inventory, 62 sites throughout the watersheds have a high or high-moderate treatment immediacy, and a total of 204 sites have a moderate immediacy for performing erosion prevention or "storm-proofing" activities prior to the next large storm in the watershed. Based on the inventory, it is estimated approximately 120,000 yds^3 of sediment yield to stream channels is possible if no storm proofing activities are undertaken.

Stream crossings constructed with a diversion potential have the road or ditch sloping downhill (down road) from the centerline of the stream. If the culvert plugs, streamflow would be diverted out of the natural channel and travel some distance down the road before re-entering a stream channel. Frequently, gullies which form on road beds and adjacent hillslopes from stream diversions yield larger quantities of sediment to nearby stream channels than the volume of fill which could erode at the stream crossing fill itself (Weaver et al 1995, Hagans et al 1986). Tables 5-8 and 5-9 show results of the analysis of the erosion risk associated with stream crossings throughout the watersheds. Of the 474 stream crossings along maintained and abandoned roads, 208 (44%) have a diversion potential, and 233 (49%) were judged to have a moderate to high potential to plug during larger storms. The plug potential is based on evidence of large amounts of sediment and organic debris in transport, damage to the culvert, configuration of the culvert inlet in relation to the stream, or an estimate of the peak flow channel dimensions in relation to the culvert size.

Drainage areas were determined and estimated 100-year peak flows were calculated at 223 stream crossings in the watersheds. A program being developed by Six Rivers National Forest, based on likely rainfall durations, was used to calculate expected peak flows. The Aquatic Conservation Strategy (ACS) within the Northwest ROD, requires culverts at stream crossings in key watersheds to be sized to accommodate the 100-year flow as well as organic debris in transport. The analysis and field evidence indicated 123 culverts need to be replaced with larger culverts in order to have a better chance to function properly during a 100-year return interval flow. In addition, there are 45 stream crossings throughout the watersheds with apparently undersized culverts at crossings with very deep fills, ranging up to 30 feet deep at the inboard edge of the road. Clearly there is a significant potential for accelerated fluvial erosion throughout the watersheds as a result of 20-, 50- or 100-year return interval storms occurring in the watershed.

Inventory results indicate nearly 13 miles of road and ditch are annually feeding fine sediment to stream channels throughout the watersheds. All locations where this process of erosion and sediment delivery are now known. Disconnecting these portions of road from stream channels is a relatively simple process and will be addressed in Chapter 6.

Table 5-6. Number Of Sites To Treat, By Immediacy And Road Type, Smoky Creek

Road Class	# of Sites Mapped	Slide Sites	Stream Xing Sites	Ditch Relief Culvert Sites	Road Bed & Gully Sites	# of Sites to Treat	Treatment Immediacy					No Treat Sites	Past Sediment Yield (yds^3)	Future Sediment Yield (yds^3)
							High	High to Mod.	Moderate	Mod. to Low	Low			
Maintained	177	1	142	18	16	158	16	6	72	11	53	19	1,600	116,300
Abandoned Driveable	38	0	33	0	5	29	5	1	11	4	8	5	400	7,300
Abandoned Not Driveable	24	1	16	1	6	14	0	1	0	5	8	9	1,400	6,000
Decommis-sioned	52	1	43	0	8	22	0	1	7	0	14	33	800	1,000
Totals	291	3	234	19	35	223	21	9	90	20	83	66	4,200	130,600

Table 5-7. Number Of Sites To Treat, By Immediacy And Road Type, East Fork

Road Class	# of Sites Mapped	Slide Sites	Stream Xing Sites	Ditch Relief Culvert Sites	Road Bed & Gully Sites	# of Sites to Treat	Treatment Immediacy					No Treat Sites	Past Sediment Yield (yds^3)	Future Sediment Yield (yds^3)
							High	High to Mod.	Moderate	Mod. to Low	Low			
Maintained	258	9	215	33	2	198	5	23	89	63	18	60	4,200	118,600
Abandoned Driveable	38	1	31	1	5	27	1	1	13	9	3	11	1,400	7,000
Abandoned Not Driveable	43	5	35	1	2	22	0	1	8	6	7	21	4,400	3,900
Decommis-sioned	108	2	97	0	9	42	0	1	4	19	18	66	2,100	1,500
Totals	447	17	378	35	18	289	6	26	114	97	46	158	12,100	131,000

Table 5-8. Failure Potential Risk Analysis At Stream Crossings, Smoky Creek

Road Class	# of Xings	Xings w/ Diversion Potential	Xings w/ Plug Potential			# of CMP's Analyzed for 100 yr storm	# to Replace CMP	# to Install CMP	CMP's with Inlet or Outlet Problems
			High	Moderate	Low				
Maintained	142	98	22	56	62	76	40	18	16
Abandoned, Driveable	33	5	4	4.	19				
Abandoned, not Driveable	16	4	0	5	7				
Decomission	43	2	0	1	0	0	0	0	0
Totals:	234	109	26	66	88	76	40	18	16

Table 5-9. Failure Potential Risk Analysis At Stream Crossings, East Fork

Road Class	# of Xings	Xings w/ Diversion Potential	Xings w/ Plug Potential			# of CMP's Analyzed for 100 yr storm	# to Replace CMP	# to Install CMP	CMP's with Inlet or Outlet Problems
			High	Moderate	Low				
Maintained	218	87	22	100	96	147	83	27	21
Abandoned, Driveable	30	10	4	17	9				
Abandoned, not Driveable	35	4	4	0	1				
Decomission	95	2	2	0	0	0	0	0	0
Totals:	378	103	32	117	106	147	83	27	21

Vegetation

Overview

This section provides a summary of the current structure and composition of the vegetation types within the Smoky Creek and East Fork watersheds. This summary was based on field checks, the LRMP (US Forest Service 1993), vegetation maps, and the 1992 Ecological Unit Inventory (EUI) vegetation maps for the East Fork watershed. Frequently, however, information in the LRMP and EUI data sets don't agree, and sometimes one or both don't agree with observations by team members made during field trips to the area during the course of this analysis. Discrepancies are noted in the text where there is significant doubt as to the veracity of the data. The most frequently inconsistant data was found in the EUI data sets, so wherever possible LRMP and ground truth data were used unless otherwise stated (see Chapter 7, "Recommendations for Data Gaps" for recommendations concerning EUI data).

Douglas-fir

According to the LRMP vegetation maps, Douglas-fir (*Pseudotsuga menziesii*) comprises 50 percent of both the Smoky Creek and East Fork watersheds (Tables 5-10 and 5-11). Although this classification was based upon dominant species, the actual composition of many "Douglas-fir" stands is more diverse. Douglas-fir tends to dominate in more shaded areas, such as north-facing slopes, in canyons and ravines, and also along stream corridors. In these areas, sugar pine (*Pinus lambertiana*), ponderosa pine (*P. ponderosa*), and white fir (*Abies concolor*) are associated with Douglas-fir in small amounts. Other tree species include Pacific madrone (*Arbutus menziesii*), canyon live oak (*Quercus chrysolepis*), and incense cedar (*Calocedrus decurrens*) (Taylor and Teare 1979).

On more open slopes, stands are more of Klamath mixed conifer (WHR classification), with Douglas-fir, ponderosa pine, incense cedar, sugar pine, and white fir, as well as some hardwoods such as canyon live oak and black oak (*Quercus kelloggii*) (Mayer and Laudenslayer 1988). On more exposed areas, such as south aspects and ridges, the mixed conifer tends to be dominated by ponderosa pine, with incense cedar and Douglas-fir associated with it.

In the East Fork watershed Douglas-fir is found at elevations from 3000 to 5500 feet (920-1680 m). In the north half of the watershed Douglas-fir stands are composed of small- to medium-size trees (size class 3), with variable canopy coverage (most of the canopy cover ranges from 40 to 69 percent, with patches of more sparse cover in the plantations). Dense stands of Douglas-fir are located in the LSR (Map 13a, Appendix E).

In the Smoky Creek watershed, Douglas-fir stands are found in the central region of the watershed and along the north side of the South Fork (Map 13b, Appendix E). These stands generally range in elevation from 2624 to 4600 feet (800-1240 m) although stands do extend up to 5300 feet (1620 m) in the northern region of the watershed. The majority of these stands are size class 3, with a variable canopy density that ranges from less than 20 percent to 69 percent (Map 6b. Appendix E). Dense (canopy $\geq$ 70%)

Douglas-fir stands with large trees (size class 4) are found primarily in the southern portion of the watershed in the Murphy Gulch area.

Table 5-10. 1986 LRMP Vegetation Types, East Fork

Vegetation Type	% Watershed	Acreage
Douglas-fir	50	12,213
Ponderosa pine	26	6,478
Plantations	7	1,721
Red fir	6	1,583
White fir	4	1,094
Private lands	3	703
Montane shrub	1	254
Herbaceous cover	<1	152
Misc. shrubs	<1	93
Streamside	<1	64
Barren (rocks)	<1	50
Grasslands	<1	46
Foxtail pine	<1	48
Water (lakes)	<1	6
Total		24,505

Table 5-11. 1986 LRMP Vegetation Types, Smoky Creek

Plant Communities	% Watershed	Acreage
Douglas-fir	50	12,367
Ponderosa pine	34	8,367
Plantations	4	917
Mixed conifer	3	607
White fir	4	917
Private lands	3	703
Streamside	<1	116
Montane shrubs	<1	101
Misc. shrubs	<1	69
Grasslands	<1	25
Total:		24,189

The herbaceous component of Douglas-fir stands is quite variable and diverse, depending upon the location of the stand. In the shaded understory that is characteristic of Douglas-fir stands, common species include mountain dogwood (*Cornus nuttallii*), prince's pine (*Chimaphila umbellata*), Oregon-grape (*Berberis nervosa*), bracken fern (*Pteridium aquilinum*), wild rose (*Rosa* sp.) and California brome (*Bromus carinatus*).

Klamath Mixed Conifer

Klamath mixed conifer comprises 20 percent of the East Fork watershed, mostly in the northeastern section of the watershed, as well as in the center of the LSR (Table 5-12). Klamath mixed conifer also comprises extensive areas of the Smoky Creek watershed, although much of this is mapped as Douglas-fir, so the actual percentage of mixed conifer is probably much higher. Stands of Klamath mixed conifer consist of at least three conifer species, such as Douglas-fir, sugar pine, ponderosa pine, and white fir, with some hardwoods such as canyon live, white, and black oak. In the East Fork watershed, Klamath mixed conifer is generally comprised of trees 11-24 inches in diameter at breast height (dbh), with moderate to dense canopy cover (40-100%).

Table 5-12. 1995 EUI Vegetation Types, East Fork

WHR Code	Vegetation Type	% Watershed	Acreage
DFR	Douglas-fir	29	7060
KMC	Klamath mixed conifer	20	4912
PPN	Ponderosa pine	12	2920
No data	No data	10	2345
RFR	Red fir	7	1602
MHC	Montane hardwood conifer	6	1422
MHW	Montane hardwood	6	1373
WFR	White fir	4	861
JPN	Jeffrey pine	3	662
MCH	Mixed chaparral	2	555
MRI	Montane riparian	<1	239
MCP	Montane chaparral	<1	210
AGR	Annual grassland	<1	144
SCN	Subalpine conifer	<1	106
PGR	Perennial grassland	<1	63
BAR	Barren	<1	45
PJN	Pinyon-juniper	<1	39
WTM	Wet meadow	<1	20
MPO	Unidentified	<1	6
LAC	Lacustrine	<1	6
	Total		24,590

Late-Successional Stands (Old Growth Forest)

The Shasta-Trinity National Forest (STNF) defines late-successional stands as those containing size classes 4a to c and older (USDA Forest Service 1993 1986). Although old growth stands are characterized by large trees, there are many other characteristics and attributes that define an old growth forest. Late successional stands can be characterized as having a mature overstory of conifers (Douglas-fir, white fir, sugar pine, ponderosa pine) where dbh is size classes 5 and 6, with an understory of younger pole- and sapling-size trees. The understory component of shrubs, grasses, and forbs can be sparse in shaded areas, and quite dense where there are breaks in the overstory canopy that allow light to reach the forest floor. A lush herbaceous layer often contains mosses and ferns, with numerous downed woody debris, such as logs, branches, and snags (Beardsley and Warbington 1996).

The vegetation of these LS stands is dominated by Douglas-fir, which comprises over 50 percent of the overstory canopy. Other tree species that comprise the overstory layer include white fir, ponderosa pine, and sugar pine. From field visits it appears the overstory trees have a wide variability of sizes, with average dbh ranging from 18 to 36 inches. Although some large trees with dbh of 5 to 6 feet were seen in some stands, such sightings were infrequent. (As indicated by the LRMP vegetation map, there are few stands 5 and 6G stands.)

Below the upper canopy is a lower canopy composed of black oak, canyon live oak, madrone, and some tan oak (*Lithocarpos densiflora*). The lower canopy also is characterized by the presence of numerous sapling- (0-5 in. dbh) and pole-size trees of primarily Douglas-fir. These juvenile trees tend to form dense stands on north slopes and in drainages.

In the LS stands, the understory is generally open, except where there is a profusion of juvenile tree growth. The forest floor tends to be littered with woody debris, with downed logs averaging from 18 to 26 inches, dbh. Although some large, downed trees (dbh 4-5 ft.) were seen during field visits, such sightings were rare, indicating that large-size debris is rather infrequent in the LSR. The density of downed material also varies widely, depending on the past management practices of the area.

The herbaceous understory is generally sparse, with patches of vegetation found in the sunny areas of the forest floor. Common herbaceous species include somewhat shrubby species such as creeping snowberry (*Symphoricarpos mollis*) and wild rose with numerous forbs such as trail plant (*Adenocaulon bicolor*), hawkweed (*Hieracium albiflorum*), Pacific starflower (*Trientalis latifolia*), bracken fern, Oregon-grape, and wild iris (*Iris* sp.).

The vegetation composition of the East Fork portion of the LSR is similar to that of the Smoky Creek portion. The overstory canopy is dominated by Douglas-fir, with numerous trees with dbh of 24 inches or greater, and canopy cover 70 percent or greater. In areas that were field checked, a few scattered trees of dbh 5 to 6 feet were present, with an understory of scattered saplings from 8 to15 inches, dbh. The forest floor is rather open and consists of forbs such as prince's pine, white-veined wintergreen (*Pyrola picta*), trail plant, snowberry, hawkweed, and Idaho fescue (*Festuca idahoensis*).

Ponderosa Pine

Ponderosa pine is the other large vegetation type within both watersheds. In the East Fork, ponderosa pine is found in the northwest corner of the watershed and around the Pony Buck area. Elevation for ponderosa pine ranges from 3018 to 5576 feet (920-1700 m). In the Smoky Creek watershed, ponderosa pine stands range in elevation from 3500 to 5300 feet (1080-1620 m) and are found in the northern and eastern portions of the watershed.

Much of the area where ponderosa pine is found is comprised of ultramafic soils such as serpentine. Although the LRMP vegetation maps list ponderosa pine in these areas, the plant communities actually consist of Jeffrey pine (*Pinus jeffreyi*) and incense cedar, species which are commonly found on ultramafic soils (the EUI vegetation maps show some of the ultramafic areas as having Jeffrey pine stands.). For both watersheds, the dominant trees are size class 3, with a sparse canopy cover that is less than 39 percent.

Stands where ponderosa pine dominates tend to be on drier, exposed slopes, such as south aspects and ridges. In these areas the open canopy allows for the establishment of numerous shrub and herbaceous species on the forest floor. Such species consist of white-leaf manzanita (*Arctostaphylos viscida*), mountain whitethorn (*Ceanothus cordulatus*), green-leaf manzanita (*A. patula*), bunchgrasses (California brome and blue wildrye), and lupine (*Lupinus* sp.).

Jeffrey Pine/Incense Cedar (Serpentine Flora)

A distinctive flora can be found in the large expanses of ultramafic soils (especially serpentine) in the northern regions of the watersheds. This unique flora has evolved in response to the harsh conditions of ultramafic soils, primarily due to chemical infertility of major plant nutrients such as nitrogen, phosphorus, potassium, and calcium (Whittaker 1954). Such harsh edaphic conditions result in a sparse vegetation community, but one that is rich with unique plant species (Kruckeberg 1984). Such unique biota is especially seen on serpentine soils, where narrow endemics have evolved in harsh soils where other plant species cannot survive (Kruckeberg 1951).

The dominant plant community consists of an overstory of Jeffrey pine, gray pine (*Pinus sabiniana*), and incense cedar. The shrub component often consists of serpentine chaparral shrub such as buckbrush (*Ceanothus cuneatus*), white-leaf California coffeeberry (*Rhamnus californica*). The herbaceous layer is sparse and includes such forbs as *Streptanthus* sp., *Mimulus* sp., *Epilobium minutum*, *Allium* sp., and *Galium* sp. Native bunchgrasses are also found on the serpentine soils within the watersheds, such as squirreltail (*Elymus elymoides*) and Idaho fescue. Often several sensitive plant species are found at a site (see section on plant species of concern) such as Dubakella mountain buckwheat (*Eriogonum libertini*), Peanut sandwort (*Minuartia rosei*), and serpentine goldenbush (*Ericameria ophitidis*). (Note: Information on species composition on ultramafic soils was obtained from the sensitive plant population reports on file at the STNF Supervisor's Office.)

White Fir

In the Smoky Creek watershed this plant community is found in the area below Red Mountain from 4200 to 5600 feet (1300-1700 m). In the East Fork watershed, white fir is found in the LSR and on the south side of Star Mountain, at elevations from 5000 to 6000 feet (1540-1840 m), and also just south to southeast of Pine Root. These stands are generally comprised of small to medium size trees (size class 3), with canopy cover ranging from 20 to 39 percent in the Smoky Creek, and 40 to 69 percent in the East Fork.

A field check (conducted on 4-13-97) of the white fir along the Stuart Gap trail revealed that stands were dominated with white fir, with red fir also present. In openings and on ridges, Jeffrey pine and incense cedar were also seen. The understory was open and covered with forest duff, with minimal woody debris. Few shrubs were seen in the understory, but a diverse herbaceous layer was present and included such species as yellow violet (*Viola* sp.), *Horkelia* sp., *Ribes* sp., shooting stars (*Dodecantheon hendersonii*), *Lomatium* sp., yarrow (*Achillea millefolium*), and western needlegrass (*Achnatherum occidentalis*).

Red Fir

Red fir (Abies magnifica) is only found within the southern section of the LSR in the East Fork watershed, and in the northern corner of the Yolla Bolla wilderness on the Black Rock mountain range. This community forms a subalpine forest of nearly 1,600 acres at the higher elevations from 5970 to 7675 feet (1820-2340 m), and is primarily composed of small- to medium-size trees (size class 4) with a canopy cover of 40 to 69 percent. Within in this stand are patches of dense canopy greater than 70 percent, as well as patches of pole-size trees with a canopy cover of 20 to 39 percent.

A field check (conducted on 4-13-97) of the areas revealed white fir was also present in the stand as well as some foxtail pine along the Black Mountain ridge. Numerous large size trees were present, with dbh 5 feet or more. The understory was dense with either woody debris or young, sapling-size red firs. Few herbaceous species were seen, which was probably due to it being early summer with snow still on the ground.

Montane Riparian

The riparian areas of the Smoky Creek and East Fork watersheds are highly variable and complex, consisting of the South Fork, major creeks, and intermittant mountain springs. The following is a brief and highly generalized summary of the type of riparian areas found within the watersheds.

Along the South Fork, riparian conditions are characterized by wide variations in yearly water flow and the abundance of rocky material that line the shores. The actual band of riparian vegetation that lines the river is quite narrow, with mixed conifer forest present almost to the water's edge. (This is true for major streams in the watershed, such as Smoky Creek).

The dominant tree species along the South Fork and major streams is generally white alder (*Alnus rhombifolia*), with other species including California big-leaf maple (*Acer macrophyllum*), white oak (*Quercus garryana*), black cottonwood (*Populus balsamifera* ssp. *trichocarpa*), and Oregon ash (*Fraxinus latifolia*). Common shrubs include *Salix* sp., such as *Salix lasiolepis*. Riparian areas associated with high elevation springs are commonly dominated by mountain alder (*Alnus incana* ssp. *tenufolia*), which forms thickets around springs and streams.

Seeps and Springs

Areas that are formed from seeps and springs provide a unique habitat for mesic plant species that are not found elsewhere in the watersheds. These areas generally form small pools and bogs, where the standing water exists year round and the area is well shaded with an overstory of conifers (Keeler-Wolf 1984). These sites do contain some riparian trees and shrubs such as alder, but herbaceous species are the dominant vegetation. These species included sedges (*Carex amplifolia* and *C. vesicaria*), rushes (*Juncus balticus*), and other mesic species (Keeler-Wolf 1984).

There are also highly mineralized seeps and springs adjacent to large serpentine areas, such as those found in the Silver Spring and Swim Meadow areas. These water sources form as a result of the "highly fractured and faulted nature of ultramafic outcrops" (Kruckeberg 1984). Because of the highly mineralized content of the water, the plant species that have evolved on these seeps and springs are unique and distinctive, such as *Hastingsia serpentincola*, which is found on well drained, exposed serpentine. Other more common mesic species that have been found in serpentine seeps in the Smoky Creek area include *Cirsium douglasii* var. *breweri*, *Hastingsia alba*, and *Sisyrinchium idahoense*, and *Rhynchospora capitellata* (Taylor and Teare 1979).

Seeps and springs also are possible habitats for those sensitive plant species associated with moist areas, such as Oregon fireweed (see TE&S Plant Species, pg. 5-25).

Montane and Mixed Chaparral

According to the LRMP vegetation maps, montane shrub communities comprise less than 3 percent of each watershed. In the Smoky Creek watershed montane shrub is found below the Hell's Gate area, at elevations from 2100 to 3700 feet (640-1120 m). In the East Fork watershed montane shrub is found below White Rock Station at elevations from 4700 to 5200 feet (1420-1600 m) and below Black Rock mountain. Small stands of mixed chaparral are also found scattered throughout the East Fork watershed.

Montane shrub occurs in the watersheds as a climax community on steep slopes or rocky ridges at higher elevations where shallow soils preclude the establishment of conifers. However, this community more commonly exists as a successional community after fire or logging disturbance in mixed conifer stands, with continued disturbance needed to maintain this shrub community. Although the LRMP maps show little acreage composed of shrubs, the actual shrub component of the watershed is probably much greater, due to harvesting and thinning activities that would promote the growth of shrubs. Shrub communities are commonly found in harvest areas and in young plantations.

Montane shrub usually consists of a dense thicket of mountain chaparral species such as huckleberry oak (*Quercus vaccinifolia*), green-leaf manzanita, white-leaf manzanita, pinemat manzanita (*A. nevadensis*), dwarf ceanothus (*Ceanothus prostratus*), Fremont's silk tassel, giant chinquapin (*Chrysolepis chrysophylla)* and bush chinquapin (*C. sempervirens*) (Keeler-Wolf 1984). Mixed chaparral usually consists of more lower montane shrub species, such as chamise (*Adenostoma fasciculatum*), as well as common manzanita species like green-leaf and white-leaf manzanita.

Montane Hardwood Conifer

In the East Fork watershed approximately 1400 acres, or nearly 6 percent of the watershed, have been mapped as montane hardwood conifer, where hardwoods and conifers each comprise at least 33 percent or more of total canopy cover. Common species of this plant commmunity include oaks such as canyon live, black, and Oregon white oaks, as well as Douglas-fir, ponderosa pine, and sugar pine.

Foxtail Pine/Subalpine Conifer

This small community (48 acres) is located on the exposed, dry rocky ridges in the subalpine zone found in the north section of the Yolla Bolla wilderness at elevations from 7300 to 7800 feet (2200-2380 m). Soils are shallow and rocky, with harsh weather conditions (snow, wind) precluding the establishment of dense forest stands. Instead, the canopy is an open mixture of foxtail pine, white fir, western white pine, and some red fir in protected locations. The understory is also open, with exposed gravels and rock outcrops. Herbaceous species in this open environment include pinemat manzanita, yarrow, bottlebrush squirrel tail, *Erigonum* sp., and *Phlox* sp.

Herbaceous Cover/Annual and Perennial Grasslands

On the ridges above timberline, such as in the Yolla Bolla wilderness, grasses and forbs are the prevalent plant species. In these exposed areas, the soils are shallow and rocky, and weather conditions are harsh and variable (strong winds, deep snows, etc.). Common grasses include the bottlebrush squirrel tail, and forbs such as yarrow, phlox, bunchgrasses, and buckwheat. Also in the East Fork watershed are scattered patches of both annual and perennial grasslands that are found in meadows and glades.

TE&S Plant Species

Vascular Plant Species of Concern

Plant species of concern are grouped into four categories: 1) USFS sensitive species 2) Federally listed threatened and endangered 3) State listed threatened and endangered and 4) California Native Plant Society (CNPS) rare and endangered species (Table 5-13). USFS sensitive plants are those species eligible for listing under the ESA, or whose viability is of concern. Federally listed species are those with threatened or endangered status; the same is true for state listed species. The CNPS list includes species that are considered by the Society to be rare in California.

In order to locate plant species of concern within the watersheds, a search was made of the 1996 California Native Plant Society's Inventory of Rare and Endangered Vascular Plants (electronic version), the 1996 DF&G RAREFIND database, and the

Forest Service Sensitive and Endemic Plant List (USDA Forest Service 1993, Appendix P) and sensitive plant population reports and map (STNF Supervisor's Office).

The RAREFIND search found no known occurrences of sensitive plant species (including state or federally listed) within the watersheds, although listings were found for species outside the watershed boundaries in the South Fork, Yolla Bolla and Dubakella mountains.

The CNPS search revealed one rare species, Shasta chaenactis (*Chaenactis suffrutescens*), which is listed as a CNPS 1B species (this indicates that this plant is rare in California and is eligible for state listing). There is one known population of Shasta chaenactis in the Smoky Creek watershed. The CNPS database also listed six additional species that occur within the same map quadrangles as the East Fork and Smoky Creek watersheds (because the database does not list specific locations of the species, it is not possible to determine whether the listed populations occur directly within the watersheds). Those species include Oregon fireweed (*Epilobium oreganum*), Nile's madia (*Madia doris-nilesiae*), Stebbin's madia (*Madia stebbinsii*), clustered green-gentian (*Swertia fastigiata, = Frasera umpquaensis*), Howell's linanthus (*Linanthus nuttallii* ssp. *howellii*), and Tracy's sanicle (*Sanicula trayci*). All of these species are also listed on the USFS Region 5 (California) list of plant species of concern for the STNF.

Forest Service Sensitive and Endemic Plants

From the Forest Service Sensitive and Endemic Plant list, a total of 12 species were listed within the following four management areas where the watersheds are located: Indian Valley/Rattlesnake Creek #19, South Fork Mountain #20, Wildwood #21, and Yolla Bolla Middle Eel Wilderness. This list includes two endemic species, serpentine macronema (*Haplopappus ophitidis*) and Dubakella Mountain buckwheat (*Eriogonum libertini*), whose populations are found mostly or exclusively within the STNF. One species, the Lassic sandwort (*Minuartia decumbens*), is suspected to occur within the Yolla Bolla area on dry serpentine soil, although no populations have yet been found. The remaining nine species are listed as sensitive by the USFS. These species include Oregon fireweed, Nile's madia, Stebbin's madia, clustered green-gentian, Howell's linanthus, Peanut sandwort (*Minuartia rosei*), rough raillardella (*Raillardiopsis scabrida*), pale yellow stonecrop (*Sedum laxum* ssp. *flavidum*), and Canyon Creek stonecrop (*Sedum paradisum*).

Table 5-13. TE&S, Endemic And Survey And Manage Vascular Plant Species Known or Suspected to Occur in The East Fork and Smoky Creek Watersheds.

Common Name *Scientific Name*	**Status**[1]	**Known or Suspected**
Sugar stick *Allotropa virgata*	ST-SM	suspected
Mountain lady's slipper *Cypripedium montanum*	ST-SM, CNPS 4	suspected
Clustered lady's slipper *Cypripedium fasciculatum*	ST-SM, CNPS 4	suspected
Oregon fireweed *Epilobium oreganum*	R5 Sensitive, CNPS 1B	suspected
Dubakella Mountain buckwheat *Eriogonum libertini*	ST Endemic, CNPS 4	known
Shasta chaenactis *Chaenactis suffrutescens*	ST Sensitive (not yet officially listed), CNPS 1B	known
Serpentine macronema *Haplopappus ophitidis*	ST Endemic, CNPS 4	known
Howell's linanthus *Linanthus nuttallii* ssp. *howellii*	ST Sensitive, CNPS 1B	suspected
Stebbin's madia *Madia stebbinsii*	R5 Sensitive, CNPS 1B	known
Nile's madia *Madia doris-nilesiae*	R5 Sensitive, CNPS 1B	suspected
Lassic sandwort *Minuartia decumbens*	ST Sensitive, CNPS 1B	suspected
Peanut sandwort *Minuartia rosei*	R5 Sensitive, CNPS 1B	known
Rough raillardella *Raillardiopsis scabrida*	ST Sensitive, CNPS 4	suspected
Tracy's sanicle *Sanicula trayci*	R5 Sensitive, CNPS 1B	suspected
Pale yellow stonecrop *Sedum laxum* ssp. *flavidum*	R5 Sensitive, CNPS 1B	known
Canyon Creek stonecrop *Sedum paradisum*	ST Sensitive, CNPS 1B	suspected
Clustered green-gentian *Swertia fastigiata = Frasera umpquaensis*	R5 Sensitive, CNPS 2	suspected

[1]Status:

ST-SM = Shasta-Trinity National Forest (STNF) Survey and Manage species,
ST Endemic = Endemic to STNF,
ST Sensitive = STNF sensitive species,
R5 Sensitive = USFS's Region 5 (California) sensitive species,
CNPS 1B = California Native Plant Society rare, threatened or endangered plants in California and elsewhere,
CNPS 2 = Species rare, threatened or endangered in California but more common elsewhere,
CNPS 4 = watch list (plants of limited distribution)

USFS Survey and Manage Species

The USFS also lists species that are to be protected through Survey and Management Standards and Guidelines (USDA Forest Service 1993 1986, Appendix R). These include three vascular plants known to occur in the STNF: mountain lady's slipper (*Cypripedium montanum*), clustered lady's slipper (*Cypripedium fasciculatum*), and sugar stick (*Allotropa virgata*). Although none of these species have been found within the watersheds, there is the possibility of occurrence due to available habitat, such as moist streambanks and mixed evergreen coniferous forest. (Populations of clustered lady's slipper have been found just outside of the East Fork watershed, in the vicinity of Star Mountain.)

The Survey and Manage list also includes dozens of non-vascular plants such as lichens, fungi, and bryophytes. Whether any of these species occur within the watersheds would need to be determined with further research and botanical surveys.

Watershed Sensitive and Endemic Plants

From the USFS sensitive plant population reports (on file at the STNF Supervisor's Office) four sensitive and two endemic plant species have been found within the watersheds. These species were found through site evaluations for specific projects, such as timber harvests, or incidental sitings along roads. Because no large-scale botanical survey has been done do locate populations of sensitive plants, it is suspected that many more populations exist, especially on ultramafic soils.

All of known populations consist of unique species that are associated with rocky serpentine soils, either in openings in Jeffrey pine or mixed conifer stands, or on barren scree slopes and ridges. Two species, Dubakella Mountain buckwheat and serpentine macronema, are especially unique, because they are found almost exclusively within the STNF. Sensitive plant species that have been found in the watershed are listed below:

Dubakella Mountain Buckwheat (*Eriogonum libertini*). This species is endemic to the ultramafic soils of the STNF, with more than 90 percent of all known populations occurring within the Forest boundaries. It is found on rocky, barren ultramafic soils in chaparral and open Jeffrey pine/incense cedar woodlands from 2500 to 5500 feet (760-1680 m).There are twelve known populations within the watersheds, with the number of plants per population ranging from 5 to 250 (plant population reports - STNF Supervisor's office). Commonly associated with these populations are sensitive serpentine species such as Peanut sandwort and serpentine macronema, as well as more common herbaceous species such as bottlebrush squirrel tail, fireweed, nakedstem buckwheat, popcorn flower, and monkey flower.

Serpentine macronema (*Haplopappus ophitidis*). This endemic species is also restricted to the ultramafic soils of the STNF and is found at elevations from 2600 to 5600 feet (790-1700 m). Serpentine macronema inhabits serpentine outcrops, ridges, barrens, and in open Jeffrey pine/incense cedar forests on serpentine soil. A total of 13 populations of this species have been found in the watershed. Associated with these populations are other serpentine species such as Dubakella mountain buckwheat and Peanut sandwort, as well as other uncommon serpentine species such as *Allium hoffmanii, Lomatium trayci, Strepthanthus drepanoides*, and *Asclepias solanoana*.

Shasta chaenactis (*Chaenactis suffrutescens*). This species, considered rare in the STNF, is found on dry, open slopes and serpentine soil in lower and upper montane coniferous forests, from elevations of 2600 to 6900 feet (800 to 2100 m). One population of Shasta chaenactis has been found in the Smoky Creek watershed, but other populations may exist due to available habitat.

Stebbin's madia (*Madia stebbinsii*). This sensitive species is endemic to the southern Klamath Ranges and inner North Coast Ranges of California where it is found in rocky serpentine openings in chaparral and Jeffrey/gray pine woodlands. There are three known populations within the watersheds, which are found at elevations from 4,000 to 5,000 feet (1200-1500 m). The number of individuals within these populations is quite large, with 1,000-2,000 plants per population. These populations are found amongst open gray and Jeffrey pine stands, with shrubs such as leather oak, buckbrush, and Fremont's silktassel.

Peanut sandwort (*Minuartia rosei*). This perennial is found on rocky serpentine slopes and openings in Jeffrey pine and mixed conifer forests at elevations from 2500 to 5800 feet (750-1350 m). There are six known locations of sandwort in both the East Fork and Smoky Creek watersheds, with approximately 15 to 20 plants per population. These populations are associated with open stands of Jeffrey pine and incense cedar, with such shrubs as leather oak and buckbrush. Also found with these populations are other serpentine species, such as Dubakella mountain buckwheat and serpentine macronema.

Pale yellow stonecrop (*Sedum laxum* ssp. *flavidum*). This succulent perennial is endemic to the southern Klamath Ranges, where it grows on rocky outcrops at elevations from 2500 to 6000 feet (760-1830 m). Within the watersheds there are two known locations of this species; both of which are on ultramafic soils. Because this stonecrop grows on rock outcrops that are mostly unaffected by timber harvesting, it faces the least impact from any timber activities within its vicinity.

Catastrophic Fire and Fuels

The discussion of catastrophic fire and fuels that follows directly addresses two of the issues and key questions outlined in Chapter 2:

Issue 5.1, What and where are the critical and unique resources at risk from catastrophic fire in these watersheds; and

Issue 5.2, What are the fire risks (chances of fire ignition), weather patterns, and fuel hazards (fuel types, amounts, and conditions) in different areas of these watersheds?

Information used to develop this section came from the 1990
LRMP (USDA Forest Service 1993), 1944 Soil Conservation Service black and white aerial photos, 1985, 1990, and 1995 USFS color aerial photos, 1989 USFS black and white orthophoto quads, the GIS 90 database and a fire coverage database, a map of tanker fills and helispots in the watersheds, conversations with various Hayfork Ranger District fire personnel, and field checking.

There are currently two staffed lookouts which can detect fires in these watersheds, Horse Ridge and Tomhead Mountain. Black Rock lookout, which looks directly into the East Fork drainage, was closed in the early 1980's. Pickett Peak lookout, which looks directly into the Smoky Creek drainage, is currently unstaffed.

There is currently one mobile fire patrol person on each District and one temporary patrol person on the Hayfork Ranger District. Fire suppression forces are maintained at Harrison Gulch (two engines), Hayfork (one engine), and Ruth Stations (one engine), with one California Department of Forestry and Fire Protection engine in Hayfork. The closest air attack forces are stationed at the Northern California Service Center in Redding, with a response time, if they are available, of 20 to 30 minutes.

Developed helispots continue to provide access to various locations in both watersheds. Those developed tanker and helicopter fills which were visited appear to be serviceable.

Fire suppression has been done in these watersheds for over 90 years, with probable increases in snags, dead and down ground fuels, and ladder fuels composed of shrubs and shade-tolerant understory trees. Although there are no historical nor recent fuel inventories to substantiate the magnitude of these increases, comparison of 1944 and recent aerial photos show evidence of it. These conditions are most prevalent in the moderately dense to dense mixed conifer stands and less prevalent in the open Jeffrey pine and/or gray pine dominated stands found on ultramafic soils.

Fuel inventories are non-existent for these watersheds. Fuel inventories were done following clear cutting to determine site preparation needs on cut blocks. Site preparation was the main fuel treatment done. This treatment effectively reduced fuels on the plantations, but did little to reduce fuels in the surrounding areas.

Weather patterns in these watersheds are as described on page 5-1. Of most influence on catastrophic fire are the summer lightning storms which are the primary source (87%) of fire ignitions during dry, hot periods in late summer when fuels are most flammable. Studies in the Sierra (Weatherspoon and Skinner 1996) indicate that the fire-suppression organization has been ineffective in reducing the number or size of large lightning fires because lightning fires tend to occur as simultaneous, multiple ignitions which, in unusually dry years, can quickly exceed the suppression capacity of the regional fire organization. Reductions in suppression forces on the STNF in recent years are likely to hamper suppression effectiveness in similar situations and may well lead to an increase in catastrophic fires.

Recently, about nine years of drought (1986-1994) have resulted in an increase in conifer mortality from bark beetles and other agents, with a consequent increase of snags and dead and down woody fuels. This has increased the volume of flammable fuels in the forest by an unknown amount.

East Fork

Catastrophic Fire

The critical and unique resources which are at risk in the East Fork watershed are the LSR; Riparian Reserves in the Matrix; plantations in both Matrix and the LSR; the area surrounding the White Rock campground, guard station, and White Rock itself; high value focal (refugia) subwatersheds that are important within the watersheds and within the entire South Fork watershed; and the forests and brushfields which protect the watershed from erosion.

The LSR is unique in that it has a relatively large, intact block of late successional forest of Klamath mixed conifer, with stands of red fir at higher elevations. Most of this intact forest is found south of the East Fork. Much of the forest north of the East Fork in the LSR has been logged by partial cutting, with some clear cutting. The LSR is critical for the survival and health of wildlife dependent on late successional forests, as the forests to the west, north, and east have been extensively logged or burned in the past three decades.

Riparian Reserve is an expanded concept of what were once termed stream buffers. These buffers in Matrix are unique in that they are the only areas where contiguous stringers of moderately dense, late successional trees are found in what is otherwise a landscape sparsely stocked with large trees. These buffers were designated and left uncut in previous timber sales and are critical for preserving the health and integrity of watercourses and for providing travel corridors for dispersal of wildlife dependent on late successional forests.

There are 139 plantations totaling 1254 acres (1314 acres according to Ranger District Stand Record Cards) in Matrix and 31 plantations totaling 812 acres in the LSR. These plantations range in age from 8 to 37 years (mostly 8 to 18 years) and are generally well stocked with trees varying from 2- to 30-feet tall. These plantations represent a substantial investment in time and resources by management, administrative, technical, and field personnel, and contract labor, as well as an investment in access roads, nursery and storage facilities, and fire infrastructure. Future timber outputs depend upon the continued production of these plantations. They are vulnerable to fire and are a critical resource in the watersheds. Given the fire regime in these watersheds many of these plantations will likely burn before they reach rotation age.

The 17 plantations (comprising 512 acres) in the LSR on Buck Ridge are from 26 to 30 years old with trees from 30- to 40-feet tall. These plantations are of particular significance, as they have substantially fragmented the late successional forest. Were they to burn in a fire, large openings would be created and their development into late successional habitat would be delayed for an additional 30 years.

The White Rock campground, guard station, meadow, and the surrounding area--including the limestone outcrop to the north--are unique, as there is only one limestone outcrop and only four known wet meadows in this watershed; the willows in the meadow are the best willow fly catcher habitat in the watershed; the meadow is surrounded by late successional Klamath mixed conifer, and this area has historical significance for Native Americans and for Euro-Americans.

The East Fork watershed has been designated a Tier I Key Watershed, and as such the maintenance of a high level of water quality is a top priority. Catastrophic fire can seriously affect water quality, as it is highly dependent upon vegetative cover along watercourses and in upland areas. The forest--including understory shrubs, forbs, and grasses, which protect soil from erosion--are critical resources in this watershed.

Fuels

Fire is the most important natural disturbance agent affecting vegetation in the East Fork. A USFS fire risk assessment, which is based upon historical fire starts, shows a medium risk for this watershed, with a fire-return frequency of one fire every eight months. Lightning from summer thunderstorms continues to be the main source of ignition (87% of starts), with most of these fires likely to be in the mid to upper slopes.

This watershed has high road densities north of the East Fork and west of Pony Buck Peak and on Buck Ridge. Road density is moderate in the northeastern portion of the watershed. The Wild-Mad Road (USFS 30) and the ridge road from Pine Root Saddle to Stuart Gap (USFS 35) are main, chip-sealed roads which get light traffic except during hunting season and when logging is occurring. The Old Bill Mine Road (USFS 41), a mid slope road which is an alternate route to Stuart Gap, and the Bramlet Road (USFS 29) also get light traffic for most of the year. There are several trails which access the Yolla Bolla-Middle Eel Wilderness which get light to moderate traffic, depending upon the time of year.

All of the roads and trails and the primitive camps at White Rock, Devil Camp, and Flyblow Camp are areas of higher risk for fire ignition by humans. The most well-used roads--29, 30, 35, and 41--probably have the highest risk.

Extensive partial cutting by overstory removal, selection, sanitation, and/or salvage had been carried out since about 1955 in what is now Matrix, north of the East Fork. This harvesting left a forest which is now generally composed of a sparse overstory of trees larger than 12 inches in diameter over an understory mosaic of dense clumps, patches, and scattered individual seedlings, saplings, and poles interspersed with shrubs and bare openings. Openings created along roads have in many places filled in with shrubs and seedling-, sapling-, and pole-size conifers. In rocky areas, especially along Road 41 east of Dark Canyon Creek, there are many small- to medium-size canyon live oak in the understory. These areas tend to have little ground cover, although patches of shrubs are found in some openings.

Partial cutting has had the effect of removing most of the large, fire resistant trees, leaving groups and patches of smaller trees with thin bark and crowns close to the ground, which are susceptible to fire damage. It has also increased the quantity and depth of surface fuels, and, by opening the canopy, created a warmer, drier, and windier environment near the forest floor during times of significant fire danger. All of these factors increase the likelihood that fires will be more severe and will cause more damage to the forest.

Clear-cut harvesting was eventually done in many stands which did not regenerate or grow satisfactorily following partial cutting, as well as in unentered stands on Buck Ridge. Site preparation by broadcast burning or tractor piling and burning was done in these plantations before planting, so dead and down fuels are light to non-existent in most plantations. But moderate to dense shrub and grass regrowth in many plantations, combined with the generally well-stocked trees, has created a high fuel hazard. Due to the small size of trees in these plantations, they are especially vulnerable to fire damage, as was demonstrated during the 1987 fires on the Hayfork Ranger District.

Where both partial cutting and clear cutting occurred, stream buffers were left undisturbed to provide shade, retain the structural integrity of the stream channels, and provide a filter strip. The highest density of large, fire-resistant trees tends to be found in these zones. These zones also tend to have a moderate to dense midstory of conifers and hardwoods and moderately dense understory of trees and shrubs.

The fuel hazard outside the perimeter of the LSR is quite variable. The following information was developed from aerial photo interpretation and should be ground truthed, primarily to verify surface and understory fuel conditions.

From Stuart Gap to North Yolla Bolla Lake there are moderately dense stands of medium- to large-size white and red fir with a midstory of variable density, smaller trees. There are numerous logs and a well-developed duff and litter layer on the ground, with a relatively sparse shrub layer. Clearcutting and partial cutting in the area around Stuart Gap has created a mosaic of forest and gaps which has broken the continuity of the canopy and ground fuels.

From North Yolla Bolla Lake, around the south end of the LSR within the Wilderness, to the Blossom Cabin area, there are extensive rocky openings which have only scattered trees and shrubs. From the area of Black Rock Mountain west, the Hermit Fire in 1988 killed most of the forest, so there is now an extensive area with a high fuel load of snags and logs. This area is separated from the LSR by rocky openings.

From the Blossom Cabin area down Buck Ridge to one-quarter mile northwest of West Low Gap, the forest has been logged and is a mosaic of sparse to moderately dense stands of small- to medium-size trees. There appears to be a sparse to moderate shrub layer and many treeless openings. Fuel concentrations are generally light in this area.

From West Low Gap to the East Fork there are relatively uniform, dense stands of small- to medium-size Douglas-fir, ponderosa pine, and black oak. Some clear and partial cutting has occurred in these stands, so the continuity of the tree canopy is broken to a degree. The understory tree and shrub layer is sparse except in openings. There is a moderate amount of dead and down fuels.

From the East Fork north and eastward to just east of Prospect Creek there are moderately dense to dense stands of small- to medium-size conifers mixed with small hardwoods and interspersed with brushy openings sparsely stocked with trees. There appear to be areas where fuel ladders could carry fire into overstory canopies.

From Prospect Creek east to Warren Dick's property the forest is largely on ultramafic soils and is sparse, with a moderately dense shrub layer. Dead and down fuels are scattered and the fuel hazard is low.

From Warren Dick's property east to the Roseburg property, the forest is generally composed of densely stocked small- to medium-size conifers, with some hardwoods, interspersed with clearcuts and grasslands. Ground fuels are generally light in this area and the hazard of fire reaching the canopy appears to be low.

From the Roseburg property north to the divide the forest has been fragmented by partial and clear cut timber harvesting and consists of sparse to dense stands of small to large conifers with a light to moderate shrub layer. There are generally light to moderate levels of dead and down fuels.

From the divide southeast to the area near White Rock Guard Station, the forest is generally composed of sparse to moderately dense small- to medium-size mixed conifers interspersed with clearcut blocks. There is a light shrub layer and near White Rock, a sparse to moderately dense understory of canyon live oak and conifers. Dead and down fuels are generally light, so there is little fuel to carry a ground fire or generate enough heat to carry fire into the canopy.

From White Rock south and east below 28N10, the forest is mainly composed of sparse to moderately dense large mixed conifers with a midstory of sparse to moderately dense small- to medium-size conifers and canyon live oak. The shrub layer is light, and there is little dead and down fuel. North of Perry Patton's property is an area of ultramafic soil with a sparse stand of small- to medium-size conifers, a light shrub layer, and minor amounts of dead and down fuel.

From 28N10 northeast of the Patton place to Stuart Gap the forest is composed of sparse to moderately dense small- to medium-size conifers and canyon live oak which has been partially cut and is intermixed with clearcuts. There is a light to moderate shrub layer and little dead and down fuel.

The area immediately surrounding the meadow at the White Rock Guard Station is forested with moderately dense to dense stands of large mixed conifers with moderately dense midstories of small- to medium-size conifers. There is a light ground cover of shrubs and seedling and sapling conifers and a well developed duff and litter layer. The area west and north of these stands along 28N45 has been mostly clearcut, site prepared, and planted and has moderately dense to dense stands of small- to medium-size mixed conifers between the clearcuts. The area to the south and east is composed of a mosaic of sparse to dense stands of large trees over moderately dense to dense small conifers and canyon live oak. There is a light shrub layer and only minor amounts of dead and down fuels.

There are extensive areas of ultramafic soils in this watershed which are generally characterized by three fuel conditions:

1. Serpentine barrens and semi barrens are either substantially bare of all vegetation or have sparsely scattered shrubs and trees, primarily gray pine, Jeffrey pine, and incense cedar. Areas of this type are found along Road 41 and on the ridge road from Pine Root Saddle to Red Mountain. These areas have a low fuel hazard.
2. Other areas have a moderately dense covering of a combination of 3- to 6-foot tall coffeberry, leather oak, silk tassel, mountain mahogany, or manzanita, sometimes have scattered conifers, and generally have many rock outcroppings. Areas of this type are found along Road 41 and in the Devils Camp area. These areas have a moderate fuel hazard, but fires would tend to remain on the ground.
3. In some areas the shrubs are light to moderately dense and there is an open stand of conifers larger than 12 inches in diameter, with some patches and clumps of seedlings, saplings, and poles. The litter layer is light and there are only scattered logs on the ground. The fuel hazard is light to moderate in these stands and it is unlikely that crown fires would occur, as ladder fuels are limited and shrub height is low. An area of this type is found on Red Mountain and near Devils Camp.

The fire hazard map (Map 7a, Appendix E) from the STNF GIS-90 database shows the potential for fire causing damage to vegetation. It is based upon Forest fuel models, the level of fire spread rate, the difficulty of fire suppression, average fire weather conditions 90 percent of the time (early summer weather), and the number of fire starts per 1000 acres. It shows a medium hazard for most of the watershed, with a high hazard for the private land and Prospect Unit 19 and a low hazard for M2G stands, some M3P stands, a M3G stand, a R3P and R3G stand, a couple of brushfields, and Prospect Unit 29. It is unclear why these particular areas are considered low hazard, especially the M2G stands which on the Smoky Creek map are shown as high hazard and which would likely suffer severe damage from a fire. It should be noted that the hazard map is inaccurate, as fire starts per 1000 acres was based upon an incorrect watershed acreage, early summer fire weather does not accurately portray catastrophic fire conditions in late summer, and fuel models are for ground fires and do not apply to crown fires. Under such fire weather conditions, which occur approximately 10 percent of the time, it is likely that the hazard would increase one class.

Shaded fuel breaks have been planned and created along the top of the divide paralleling Road 35, along the 28N23 road from Road 35 to 28N10, along Buck Ridge from the Buck Ridge I timber sale south, and at other unknown locations (built in the 1970's in conjunction with timber sales). Some of the older portions of these fuelbreaks need maintenance as they have been invaded with shrubs and small trees which are reducing their effectiveness. Some portions of the fuel break along Road 35 have been recently constructed. It is estimated that about 70 percent of this fuelbreak has been constructed.

Smoky Creek

<u>Catastrophic Fire</u>

The critical and unique resources which are at risk in the Smoky Creek watershed are the LSR, Riparian Reserves and Spotted Owl Activity Centers in the Matrix, plantations in both Matrix and LSR, the Special Interest Area (SIA), the proposed research Natural Area (RNA), the Administratively Withdrawn Corridor along the South Fork, high value focal (refugia) subwatersheds that are important within the watersheds and within the entire South Fork watershed, and the forests and brushfields which protect the watershed from erosion.

The LSR is unique in that it has several intact blocks of late successional forest of Klamath mixed conifer which are set aside for the survival and health of wildlife dependent on late successional forests. Most of this forest is found in a mosaic in the eastern half of the LSR near or adjacent to the parcels of private property. The LSR is critical, as the forest to the north and east has been extensively logged in the past three decades.

Riparian Reserves in the previously logged area of Matrix above the Bramlet Road and in the Red Mountain and Silver Creek areas below the Bramlet Road are unique in that they are the only areas where contiguous stringers of moderately dense late successional trees are found in what is otherwise a landscape sparsely stocked with large trees. These buffers are critical for preserving the health and integrity of watercourses and for providing travel corridors for dispersal of wildlife dependent on late successional forests.

There are 84 plantations totaling 1555 acres in Matrix and one plantation of unknown size in the Randolph Fire area in the LSR (Ranger District Stand Record Cards). These plantations range in age from 4 to 25 years (mostly 4 to 16 years, with the Randolph Fire plantation being 37 years) and are generally well stocked with trees varying from 2- to 30-feet tall. They are found primarily in the upper Smoky Creek and Silver Creek drainages and in the Red Mountain Creek, Dog Gulch, and Soap Creek drainages. These plantations represent a substantial investment in time and resources by management, administrative, technical, field personnel, and contract labor as well as an investment in access roads, nursery and storage facilities, and fire infrastructure. Future Forest timber outputs depend upon the continued production of these plantations. They are vulnerable to fire and are a critical resource in this watershed.

The plantation in the LSR is located within the Randolph Fire area and is 37 years old, with trees from 25 to 35 feet tall. This plantation is significant as it is in an area composed of a mosaic of conifers and hardwoods less than 12 inches in diameter and rocky, brushy openings with fragmented forest to the north and east. Were this plantation to be burned again in a fire, it would set back the development of this area into late successional habitat for an additional 40 years.

The SIA is located on ultramafic soils where the Bramlet Road crosses the East Fork of Smoky Creek. This area has a concentration of western azaleas.

The proposed Smoky Creek RNA is unique as it is primarily on ultramafic soils with a variety of vegetation types. This RNA offers an opportunity to study and monitor an ultramafic ecosystem, including the effects of management on such an ecosystem.

The Administratively Withdrawn corridor along the South Fork runs from the southeast corner of the watershed to the mouth of Silver Creek. This corridor is critical for maintaining the integrity of the inner gorge area of the South Fork, a candidate Wild and Scenic River, and the scenic viewshed of the South Fork Trail.

The Smoky Creek watershed has been designated a Tier I, Key Watershed and as such the maintenance of a high level of water quality is a top priority. Catastrophic fire can seriously affect water quality as it is highly dependent upon vegetative cover along watercourses and in upland areas. The forest, including understory shrubs, forbs, and grasses, which protect soil from erosion, are critical resources in this watershed.

Fuels

Fire is the most important natural disturbance agent affecting vegetation in the Smoky Creek watershed. A USFS fire risk assessment, which is based upon historical fire starts, shows a high risk for this watershed, with a fire return frequency of one fire every six months. Lightning from summer thunder storms continues to be the main source of ignition. Most of these fires are likely to be in the mid to lower slopes below the Bramlet Road (USFS 29).

This watershed has a high road density in the upper Silver and Smoky Creek drainages and in portions of the Red Mountain Creek and upper Dog Gulch and Soap Creek drainages. There are only a few roads in the lower Silver and Smoky Creek drainages and in the ultramafic area around Red Mountain. The Bramlet Road is a main, aggregate-surfaced road which gets light traffic except during hunting season and when logging is occurring. The South Fork trail, which parallels the South Fork, gets light to moderate traffic depending upon the time of year, and the Smoky Creek trail is rarely used.

All of the roads and trails and the primitive camps at Foss Camp and Red Mountain are areas of higher risk for fire ignition by humans. The Bramlet Road, being the most well used road, probably has the highest risk.

Extensive partial cutting by overstory removal, selection, sanitation, or salvage was done in what is now Matrix above the Bramlet Road, as well as below the road in the southwestern area of Smoky Creek, in the Red Mountain, Soap Creek,, and Dog Gulch drainages. This harvesting left a forest which is now generally composed of trees larger than 12 inches in dbh over an understory mosaic of dense clumps, patches, and scattered individual seedlings, saplings, and poles, interspersed with shrubs and bare openings. Openings created along roads have in many places filled in with shrubs and seedling-, sapling-, and pole-size conifers. In rocky areas, especially along the Bramlet Road north of the east fork of Smoky Creek, there are many shrubs from small- to medium-size canyon live oak. These areas tend to have little ground cover, although patches of shrubs are found in some openings.

As in the East Fork watershed, partial cutting has had the effect of increasing the likelihood that fires will be more severe and will cause more damage to the forest.

Clear-cut harvesting was eventually done in many stands which did not regenerate satisfactorily following partial cutting as well as in unentered stands southeast and southwest of Snow Gap. As in the East Fork watershed, site preparation in most of these plantations before planting practically eliminated dead and down fuels. But moderate to dense shrub and grass regrowth in many plantations, combined with the generally well stocked trees, has created a high fuel hazard. Due to the small size of trees in these plantations, they are especially vulnerable to fire damage.

As in the East Fork watershed, stream buffers were left undisturbed during logging and generally have the highest density of large, fire-resistant trees found in logged areas.

The fuel hazard outside the perimeter of the LSR is quite variable. From Hellgate along the west side of the South Fork to the mouth of Silver Creek, the forest is primarily composed of unentered stands of dense, medium- to large-size Douglas-fir. There are numerous logs and a well developed duff and litter layer on the ground, with a relatively sparse understory and shrub layer.

From the mouth of Silver Creek along the east side of the LSR to 29N58, the forest is a variable mix of stands of moderately dense to dense, small- to large-size mixed conifers; dense pure black oak stands; mixed oak and conifer stands; brushfields with scattered, small conifers and hardwoods; serpentine barrens and semi barrens; and clearcut blocks. Ground fuels are quite variable depending on the vegetation type, with shrubs being dense in the brushfields (created by the No Name #39 Fire); moderate in the conifer forests; sparse in the serpentine barrens and dead and down fuels sparse in the brushfields, barrens, and oak stands; and light to moderate in the conifer forests. There are well developed fuel ladders in many forested areas, but the mosaic of fuel types limits the ability of crown fires to travel for long distances.

The northeast portion of the LSR is outside of the Smoky Creek watershed so is not addressed in this analysis although in general it borders a forested area of dense small- to large-size trees fragmented by clearcuts.

The Administratively Withdrawn Corridor along the South Fork and its upslope border are primarily composed of dense, small- to medium-size Douglas-fir-dominated stands mixed with some mostly pure black oak stands, grassy openings, and patches of medium- to large-size conifers. Shrubs are generally sparse and scattered, midstories are sparse and composed of black oak and conifers, dead and down fuels are light to moderate, and duff and litter layers are well developed.

The area south of the SIA is a sparse conifer forest on ultramafic soils, with a sparse shrub layer and light leaf litter and dead and down fuels. The area north of the SIA is a mix of bare areas with a moderate shrub layer and moderate to dense canyon live oak with scattered small- to medium-size conifers. Ground fuels are light in this area.

As in the East Fork, there are extensive areas of ultramafic soils which are generally characterized by three fuel conditions:

1. Serpentine barrens and semi barrens are found along the divide between Rattlesnake Creek and Silver and Smoky Creeks and along the divide running from Mud Springs to Red Mountain. These areas have a low fuel hazard.
2. Other areas have a moderately dense covering of 3- to 6-foot tall shrubs, sometimes with scattered conifers and generally have many rock outcroppings. These areas have a moderate fuel hazard but fires should remain on the ground.
3. In some areas the shrubs are light to moderately dense and there is an open stand of conifers larger than 12 inches in diameter, with some patches and clumps of seedlings, saplings, and poles. Logs are scattered and there is a light litter layer. The fuel hazard is light to moderate in these areas and it is unlikely that crown fires would occur as ladder fuels are limited and shrub height is low. Extensive areas of this type are found on and in the vicinity of Red Mountain.

The fire hazard map (Map 7b, Appendix E) from the STNF GIS-90 database shows the potential for fire to cause damage to vegetation. It shows a medium hazard for most of the watershed, with a high hazard for M2G stands, some M3P stands, including some stands on ultramafic soils on Red Mountain--a block of M3G stands in the mid Smoky Creek drainage, and an M6G stand in the Red Mountain Creek drainage. It is unclear why these particular areas are considered high hazard, as the M2G stands were considered low hazard in the East Fork watershed, and the M3P stands on ultramafic soils on Red Mountain are open, with little ground cover and a low probability of sustaining a fire.

Shaded fuel breaks have been planned and created along the top of the divide between Smoky and Silver Creeks and Dubakella and Rattlesnake Creeks from the top of Red Mountain to Hellgate (about 50% completed), on the ridge between Smoky Creek and Red Mountain Creek from Snow Gap southwest to Suds Unit 12 and west to the top of Suds Unit 4, and at other unknown locations (built in the 1970's in conjunction with timber sales). It appears that a fuelbreak was also created along the top of the divide between Soap and Red Mountain Creeks and Prospect Creek from one-quarter mile south of 28N27 to just north of 29N49. Some portions of these fuelbreaks need maintenance as they have been invaded with shrubs and small trees which are reducing their effectiveness.

Commodities Production

The commodities discussion that follows directly addresses three of the issues and key questions outlined in Chapter 2:

- Issue 6.1, "Given the LRMP and Northwest ROD management directions, what and where are the timber harvest opportunities within the watersheds?"
- Issue 6.2, "What and where are the thinning opportunities which will support the resource priorities identified in the LRMP and Northwest ROD management directions?" and
- Issue 6.3, "Where are the opportunities for firewood cutting or biomass in these watersheds given the priorities identified in the LRMP and Northwest ROD management directions?"

Information used to develop this section came from inventory data used to develop the 1990 LRMP (US Forest Service 1993), with updating of the plantation layer in 1993 from aerial photography; a fire database; stand record cards at the Yolla-Bolla and Hayfork Ranger District offices; the USFS/SCS Soil Survey of Shasta-Trinity Forest Area, California, 1965; 1944 Soil Conservation Service black and white aerial photos; 1985, 1990, and 1995 USFS color aerial photos; 1989 USFS black and white orthophoto quads; conversations with various Ranger District personnel; and ground truthing. Stands delineated on the stratification maps were classified using the LRMP timber stratification system. The following tables explain the codes used in this stratification system.

Table 5-14: 1990 LRMP Timber Type Codes

Code	Timber Type	Species
M	Mixed Conifer	ponderosa pine, Jeffrey pine, Douglas-fir, sugar pine, white fir, incense cedar
D	Douglas-fir	Douglas-fir (80+%), white fir, ponderosa pine, sugar pine, incense cedar
R	Red fir	red fir (primarily), white fir (minor)
SX	Miscellaneous Shrubs	various shrub species
GR	Grass	various grasses
XX	Plantation	even-aged plantations (XX1 = 0-10 yrs in 1995, XX2 = 11-20 yrs in 1995, XX3 = 21+ yrs in 1995)

There are numerous discrepancies in the vegetation typing between the GIS 90 data layers showing timber strata, canopy closure, and size class, the 1989 orthophoto quads, and 1985, 1990, and 1995 aerial photos showing current stand conditions. These discrepancies appear to be largely in canopy closure, where densities are sometimes off by two classes, and sometimes where serpentine barrens or stands of gray pine or sparse Jeffrey pine stands on ultramafic soils have been mistakenly identified as commercial stands. Some of these discrepancies are discussed below in the individual watershed sections, and in some cases the strata codes have been changed on the CAS maps, which show timber canopy closure and size class.

Table 5-15. 1990 LRMP Timber Size Classes

Code	Seral Stage (dbh* Range)	Crown Diameter**
1	seedling & sapling (1-5.9")	0-5 feet; seedlings & saplings
2	early mature (6-10.9")	6-12 feet; poles
3	mid mature (11-24.9")	13-24 feet; small to medium timber
4	mid to late mature (25-40")	25-40 feet; large sawtimber
5	late mature to old growth (40+")	>40 feet; large sawtimber
6	two-storied stands	overstory density <20% and size class 4 or 5, understory density >70% and size class 1 or 2

* dbh – Diameter at Breast Height – The diameter of a tree measured at 4 ½ feet above the ground on the uphill side of the tree.

** Crown diameter classes are based on the predominant crown size of the commercial (conifer) species in the stands.

Table 5-16. 1990 LRMP Timber Crown Cover (Density)

Code	Crown Cover*
S	0-19%
P	20-39%
N	40-69%
G	70+%

* Crown cover percentages apply only to the commercial (conifer) component of the stand. They are a ratio of the total crown area to the stand (polygon) area.

Table 5-17. 1990 LRMP Timber Stratification Codes

Code	Strata Included
M2P	M2S & M2P
M2G	M2N & M2G
M3P	M3S, M4S, M5S, M3P, M4P, & M5P
M3G	M3N & M3G
M4G	M4N, M4G, M5N, & M5G
M6G	M6N & M6G
D3G	D2N, D2G, D3N, & D3G
D4G	D4S, D4P, D4N, D4G, D5S, D5P, D5N, & D5G
R3P	R3S, R3P, R4S, R4P, R5S, & R5P
R3G	R3N & R3G

A number of common and predictable "pest complexes" are responsible for the majority of mortality and growth loss in these watersheds. These complexes are 1) dwarf mistletoe and bark beetles, 2) root disease and bark beetles, and 3) drought with overstocking and bark beetles (USFS 1996). In these typical patterns of mortality, trees are stressed because of dwarf mistletoe, root diseases, and/or overstocking, which is aggravated by drought, and are finally killed by bark beetles because they do not have the resources to defend themselves against attack.

Current pest conditions, as far as was determined, are at endemic levels and have evolved as a result of decades of fire suppression and logging. Pests are found throughout the watersheds where there is always some level of damage and/or mortality to live trees. In terms of ecosystem function, this is normal and beneficial as it provides biological diversity and structural complexity.

An exception to this is white pine blister rust, a serious pest of sugar pine which was first introduced into California in Siskiyou County in 1929. A study of blister rust in the southern Sierra (Kinloch et al 1990) has shown that trees of all sizes, including old growth, are susceptible to extensive damage and death from the rust. Plantations were found to create favorable conditions for the rust by stimulating the proliferation of Ribes, and therefore rust inoculum, and creating conditions favorable for formation of dew on tree seedling foliage, which enhanced spore germination and host penetration. The study found it likely that the rust will become pandemic within the next few decades and that the prospects for regeneration of sugar pine are bleak.

It is unknown whether a similar scenario will play out in these watersheds, but blister rust is widespread. Sugar pine, along with Douglas-fir, is the most prevalent species in many of the M3G and M4G stands in the Smoky Creek watershed and in many of the riparian zones and M3P and M3G stands in the East Fork watershed. Harvesting has removed most of the largest sugar pines from partial cuts and all of them from clearcuts. Because of its susceptibility to rust there has been only a minor amount of sugar pine planted, and that only in a few plantations. Under current management practices it is likely that sugar pine will become a minor component in regenerated stands and the watershed as a whole, with unknown ecological consequences.

Black stain root disease (*Leptographium wageneri*) has not been identified as a major pest in these watersheds but it appears to be present and is known to cause serious mortality to Douglas-fir in other areas, especially in plantations. This disease appears to be aggravated by soil disturbance and thinning as it enters the root zone through stumps and basal trunk wounds.

There are a number of host-specific dwarf mistletoes found in these watersheds, but little mistletoe was seen during numerous field trips. Bark beetle damage was noticeable but did not appear to be unusually heavy.

East Fork

In general, the forest north of the East Fork on Matrix lands is a mosaic of early successional, moderately stocked (but quite variable) stands dominated by pole to small sawtimber size Douglas-fir and ponderosa pine, with a component of sugar pine, incense cedar, white fir, black oak, and canyon live oak. Most of the medium and large sawtimber-size trees were removed in partial cuts, leaving scattered residuals. These residuals are denser along watercourses where they were generally either unharvested or only lightly harvested. The forest landscape created by partial cutting has abundant edge, vertical and horizontal structural diversity, spatial complexity, and genetic variability, but it is deficient in later successional stages, interior habitat, and medium to large snags.

Clearcutting since the 1960's has created plantations on 11 percent of the Matrix. These plantations are moderately to heavily stocked with a preponderance of planted seedling and sapling ponderosa pines and Douglas-fir, with natural seeding creating a species mix similar to that in the original stands on some plantations. The forest landscape created by clearcutting, in contrast to partial cutting, currently has less edge, minimal stand vertical and horizontal structural diversity, less spatial complexity and genetic variability, no later successional stages, and minimal interior habitat and snags except in adjacent forest. This landscape does have a high proportion of early successional habitat of grass, forbs, shrubs, and seedling and sapling trees.

On ultramafic soils in the northwestern portion of the watershed and in the area of Pony Buck Peak are found sparsely stocked stands dominated by small to medium sawtimber-size Jeffrey pine, mixed with incense cedar and gray pine and occasionally Douglas-fir, sugar pine, and white fir. On the south side of Star Mountain are stands of moderately dense, small- to medium-size white fir sawtimber, with a component of Douglas-fir and sugar pine. Intermixed with the forest cover are patches of grassland and montane shrubs that are generally associated with ultramafic and/or shallow soils.

The area from Texas Chow Creek to Stuart Gap is largely underlain by ultramafic soils which generally have a moderate to low productivity (Dunning Site III-V). There are also inclusions of unproductive, Dunning Site VI soils. Locations of and conditions on ultramafic soils are discussed below.

Most of the rest of the Matrix is on Deadwood family soils (map symbol 32, 34, 35) derived from shale and Neuns family soils (202, 203, 204, 205, 206, 208) derived from metamorphic rock. Deadwood soils tend to be shallow (15" to moderately fractured shale) and droughty, which is evidenced by observing road cuts along 28N10, the abundant canyon live oak above and below the road, and sparsely vegetated areas on aerial photos. They are generally of low productivity or unproductive, with a Dunning Site of V-VI.

The Neuns family soils are deeper (23" to highly fractured metamorphic rock) and less droughty, and are of low to moderate productivity, with a Dunning Site Class of III-IV.

The GIS-90 productivity class layer shows a large portion of the CAS lands (see definition under Timber Harvest Opportunities, below) as highly productive (Dunning Site Class I-III). From the soils maps, perusal of stand record cards, and field observation it is concluded that these lands are generally at the low end of this range (Dunning Site Class III).

The USFS/SCS Soil Survey of Shasta Trinity National Forest Area, California, is a third-order survey that "was intended to provide soils information for broad land management planning and [was] not intended for use in project level work." Many soil map units in this survey are made up of two or more major soil complexes and often have inclusions of other soils or soil components. None of these are individually mapped. The regenerability ratings for soils discussed below in this section are not always accurate. Well-stocked plantations have been established on soils described as having low survival and plantability potential. Based on a study of aerial photos and field checking, soil productivity ratings are sometimes inaccurate. For these reasons, soils information from this survey was not used by itself to determine unproductive areas for removal from the Matrix landbase.

Most of the CAS lands are on slopes of less than 40 percent, so they are suitable for tractor logging, which has been the dominant logging system used in the past.

Timber Harvest Opportunities.

Commodities opportunities in the LSR, Administratively Withdrawn Areas (Limited Roaded Motorized Recreation Area, Unroaded Non-Motorized Recreation Area, RNA, and SIA), and Riparian Reserves in both watersheds were not identified in this analysis as the LRMP management direction for these areas is for non-scheduled, non-chargeable commodity outputs. The silvicultural systems prescribed are mainly salvage and sanitation, with the goals of reducing fuel hazards and hazards to humans and/or improving wildlife habitat and forest health. Due to the limited accessibility of all of these areas and the restrictions on roading and harvesting, only minor outputs can be expected.

To determine the area of forestland in the East Fork where scheduled harvesting can occur (Matrix allocation), described in the LRMP (USDA Forest Service,1993, Appendix I) as CAS timberland, the following areas were eliminated from consideration: private lands, Congressionally reserved areas (Yolla Bolla-Middle Eel Wilderness), administratively withdrawn areas (Limited Roaded Motorized Recreation Areas and Unroaded Non-Motorized Recreation Areas), Riparian Reserves, Late-Successional Reserves, one northern spotted owl (NSO) activity center (100 acres), and unproductive (Dunning Site VI, non-commercial forest types), non-regenerable (continuous slopes >80%, areas with a high year around water Table, areas of moderate serpentine mineralogy, areas with coarse rock fragments within one foot of the surface making up greater than 60 percent of soil profile where AWC <=1.9", or areas where AWC is <1.3" and Dunning Site class is IV or V), and extremely unstable lands (including active landslides and inner gorges).

Acreages removed from Matrix include 2357 acres for Riparian Reserves, 1224 acres for unproductive soils, and 68 acres for the matrix portion of an NSO activity center (Table 5-18). As some of these withdrawals overlap, their total additive acreage is more than what was actually withdrawn.

The GIS 90 Database has layers which show areas of geologic instability, inner gorge, high erosion hazard, non-forest type, and unsuitable soils for timber production and regeneration. Only the regeneration suitability layer was used to help determine CAS lands. This layer was superimposed over a layer showing unproductive areas, which was generated by digitizing overlays of 1989 USFS 1:24000 black and white orthophoto quads. Bare and sparsely vegetated areas which showed little change from 1944 aerial photos to 1990 or 1995 photos were delineated on these quads. Many of these areas were field checked to determine their productivity. Areas designated unsuitable in the regeneration suitability layer which were outside of the unproductive areas were compared with recent photos, soils maps, and some field checking to determine whether they were in fact unregenerable. If so, they were also removed from the suitable land base.

The layers showing geologic instability and inner gorges were not used, as some of the delineated areas were in fact not unstable nor inner gorges (most notable, a ridge shown as an inner gorge!). The erosion hazard layer was not used as it does not exclude lands from CAS classification. The non-forest type layer was not used as some of the types were, at least in part, forested, and most of this layer corresponded to the unproductive layer generated from orthophotos. The layer showing land not suitable for timber production was not used, as most of the areas designated as unsuitable were plantations.

The area designated Matrix lies north of the East Fork and is allocated to Prescription VIII, Commercial Wood Products Emphasis (USDA Forest Service 1993, 4-166). Matrix lands comprise 11,467 acres (~47% of the watershed), but with the withdrawal of non-CAS lands, the CAS Matrix lands total 8062 acres (~33% of the watershed) (see Table 5-18).

While reviewing stand record cards, it was found that many plantations had portions varying from 5 to 20 percent which were unregenerable because of shallow or rocky soils. These areas were not removed from the Matrix land base as it is presumed that similar conditions exist throughout the Forest and are reflected in the per acre volumes and annual growth rates shown in LRMP D-3 (USDA Forest Service,1993). But it should be noted that conservatively, an additional 8.9 percent of the Matrix is in fact unsuitable for timber production, which would reduce the CAS Matrix to about 7256 acres (~30% of the watershed) (Table 5-19).

Table 5-18. Watershed Acreages

	East Fork	Smoky Creek
Watershed	24,593	24,657
Matrix	11,467	18,378
CAS Matrix	8062	12,531
Riparian Reserves	2357	2807
NSO Activity Centers (M)	68	409
Unproductive Soils (M)	1224	2754
Unmapped Unproductive Soil Inclusions (M)	1024	1562
Low Productivity Soils (M)	2222	6395
Watershed Plantations	2153	1561
Matrix Plantations	1254	1555
CAS Matrix Plantations	1042	1370
Wildlife Corridor (M3G & M4G) (M)	0	1776

M = Matrix

Partial harvesting was initiated in Matrix lands in about 1955. This harvesting was primarily done by "release cut" (overstory removal), "individual tree cut" (single tree selection), sanitation, and salvage. Harvesting began in the Prospect and Texas Chow drainages and moved east into the upper drainages of Dark Canyon Creek and on to Stuart Gap. Many of these logged stands did not regenerate adequately and were subsequently clear cut and planted. It is not feasible to get an exact acreage for these partial cuts, as records are difficult to locate and regeneration cuts have been made in varying portions of them. Evidence from orthophoto quads, aerial photos, and field reviews indicate that harvesting was extensive in the above mentioned drainages.

Although regeneration harvesting (clear cutting) has been done in this watershed since 1960, most has occurred since the mid 1980's. Plantations are scattered throughout the area north of the East Fork and on Buck Ridge south of the East Fork. These plantations total 2153 acres (Ranger District Stand Record Cards show 2126) and comprise about 9 percent of the watershed. Approximately 1254 acres (District Stand Record Cards show 1314 acres) of these plantations, representing 11 percent of the Matrix, are in the Matrix lands north of the East Fork, with 1042 acres (13% of CAS) on CAS Matrix (see Table 5). Refer to Thinning Oportunities, below, and Appendix D, Plantation History and Treatments, for a description of plantation conditions.

The CAS Matrix lands which have not been clear cut (7020 acres, 87% of CAS) are predominately covered by the M3P and M3G commercial conifer strata, with lesser amounts of M2P, M2G, and M4G. For LRMP timber volume calculations, strata with a density of S and P and those with N and G were combined. In some cases strata with different size classes were also combined (see Table 5-19). For each of these combined strata an average volume per acre was calculated for the entire STNF (USDA Forest Service 1993, Appendix D-3). It should be noted that in a watershed where a preponderance of a particular stand density and/or size class occurs there will be an over or under estimation of actual per acre volumes in that watershed. Also note that a low crown density or size class could be due to adverse site conditions or previous partial cutting. Misinterpretation of strata could lead to a level of scheduled timber sale harvests from a watershed that are not supported by site conditions.

Table 5-20 shows a breakdown of the combined strata into their included substrata for the East Fork watershed. The M3P strata is predominately M3S and the M3G strata is predominately M3N due to partial cutting in these stands, shallow and rocky soils, and/or low productivity soils derived from ultramafic rock. There are also a number of stands which are incorrectly labeled on the timber strata map.

In order to meet LRMP FORPLAN timber harvest goals, the highest priority stands for harvest are those stratified as M3P (USDA Forest Service 1993, Appendix C-1). These stands are intermixed with M3G stands throughout the Matrix land, although they tend to dominate in the upper Prospect and Texas Chow Creek drainages. On CAS Matrix lands the M3P stratum is composed of 1770 acres of M3S and 2072 acres of M3P stands (calculated using LRMP timber strata data) containing the volumes shown in Table 5-20 below.

From field checking it appears that many of the larger trees were harvested from M3P stands in partial cuts or salvage sales. In general, these stands have a mixed conifer (mostly DF, SP, and PP) overstory of mostly size class 3 trees, with some smaller size 4, with a 10 to 30 percent canopy closure and an understory (mostly DF and PP) of mostly size class 2 trees, with some size 1, with a canopy closure of 10 to 40 percent (some up to 60%). These stands appear to be relatively healthy, growing well, and have only endemic levels of pest populations, dwarf mistletoe, and bark beetles being the most obvious.

Table 5-19. East Fork Timber Strata

Stratum	Watershed *	Matrix#	CAS Matrix#	Stratum	Watershed #	Matrix#	CAS Matrix#	Watershed		Matrix		CAS matrix	
	Acres	%	Acres	%	Acres	%		Acres	%	Acres	%	Acres	%
M2P	122	0.5	61	0.5	49	0.6	M2S	0	0	0	0	0	0
							M2P	84	0.3	61	0.5	49	0.6
M2G	485	2.0	193	1.7	150	1.9	M2N	17	0.1	9	0.1	7	0.1
							M2G	215	0.9	184	1.6	143	1.8
M3P	7649	31.1	5576	48.6	3842	47.7	M3S	3672	14.9	2972	25.9	1770	22.0
							M3P	3950	16.1	2604	22.7	2072	25.7
							M4S	0	0	0	0	0	0
							M4P	31	0.1	0	0	0	0
							M5S	0	0	0	0	0	0
							M5P	0	0	0	0	0	0
M3G	5792	23.6	4143	36.1	2823	35.0	M3N	4598	18.7	3505	30.6	2372	29.4
							M3G	1461	5.9	638	5.6	451	5.6
M4G	5490	22.3	82	0.7	20	0.2	M4N	82	0.3	0	0	0	0
							M4G	5408	22.0	82	0.7	20	0.2
							M5N	?	?	?	?	?	?
							M5G	?	?	?	?	?	?
M6G	33	0.1	0	0	0	0	M6N	0	0	0	0	0	0
							M6G	33	0.1	0	0	0	0
R3P	313	1.3	0	0	0	0	R3S	291-	1.2-	0	0	0	0
							R3P	22+	0.1+	0	0	0	0
							R4S	0	0	0	0	0	0
							R4P	0	0	0	0	0	0
							R5S	0	0	0	0	0	0
							R5P	0	0	0	0	0	0
R3G	1266	5.1	0	0	0	0	R3N	633+	2.6+	0	0	0	0
							R3G	633-	2.6-	0	0	0	0
TOTAL	21,150	86.0	10,055	87.7	6884	85.4		21,130	85.9	10,055	87.7	6884	85.4

* From GIS 90 Timber Strata Map
# From merging of GIS 90 Timber Size and Canopy Density layers
? Unknown

The next highest priority stands for harvest are those stratified as M3G and M4G. The M3G stands are intermixed with M3P stands throughout the Matrix land, but they tend to dominate in the mid elevation zones of the Prospect, Texas Chow, and Dark Canyon Creek drainages. On CAS Matrix lands the M3G stratum is composed of 2372 acres of M3N and 451 acres of M3G stands containing the volumes shown in Table 5-20 below.

From field checking it appears that many of the larger trees were also harvested from M3G stands in partial cuts or salvage sales. In general these stands have a sparse mixed conifer (mostly DF, SP, and PP) residual overstory of larger size class 3 trees and smaller size 4 with an understory (mostly DF and PP) primarily of smaller size class 3 trees and larger size 2, with a canopy closure of 40 to 90 percent. These stands appear to be relatively healthy and have only endemic levels of pest populations, dwarf mistletoe and bark beetles being the most obvious. There are opportunities for commercial thinning in some of these stands, as growth is slowing due to excessive stocking.

The only M4G stands in Matrix are along the lower portion of Dark Canyon Creek and an unnamed tributary just east of Warren Dick's place. These stands appear to be mostly within Riparian Reserves, although a narrow strip borders the reserves. The M4G stratum, which is all M4G, comprises 20 acres on CAS Matrix lands and contains the volumes shown in Table 5-20 below.

Table 5-20. East Fork Timber Stratum Volumes on CAS Matrix Lands

Stratum#	Acres	Volume/Acre* (MBF)	Total Volume (MBF)	Average Age Basal Area Weighted*	Annual Growth* (CuFt/Ac/Yr)	Potential Growth* (CuFt/Ac/Yr)	Stratum#	Acres	Volume/Acre^ (MBF)	Total Volume^ (MBF)
M2P	49	8.2	401.8	140	14	52	M2S	0	0	0
							M2P	49	?	?
M2G	150	22.4	3360.0	90	58	52	M2N	7	0	0
							M2G	143	?	?
M3P	3842	16.8	64,545.6	120	34	52	M3S	1770	?	?
							M3P	2072	?	?
							M4S	0	0	0
							M4P	31	0	0
							M5S	0	0	0
							M5P	0	0	0
M3G	2823	28.9	81,584.7	180	40	52	M3N	2372	?	?
							M3G	451	?	?
M4G	20	28.9	578.0	180			M4N	0	0	0
							M4G	20	?	?
							M5N	?	?	?
							M5G	?	?	?
TOTAL	6884		150,470.10					6884		?

From merging of GIS 90 Timber Size and Canopy Density Layers
* From USDA Forest Service 1993, Appendix D-3
^ No volume/acre Data Available
? Unknown

The East Fork and the Chinquapin Roadless Areas (RARE II) were identified as areas of particular concern to the public (USDA Forest Service 1993, 3-24), a portion of which wanted them designated Wilderness by Congress. The LRMP direction (USDA Forest Service 1993, 4-59) for the portions of these areas within CAS Matrix is that no new roads may be constructed in unroaded portions of inventoried (RARE II) roadless areas in Tier 1 Key Watersheds.

The released portion of the East Fork Roadless Area north of Perry Patton's property is mostly on low productivity soils, with inclusions of unproductive soils. The stands found here are a mosaic of mostly M3P through M3G intermixed with unproductive areas. Presently, the only feasible method for logging most of these stands is by helicopter; however, stands near 28N10 could be economically logged with cable systems. The economic feasibility of logging and managing these stands needs to be investigated.

There are three parcels of private land in the East Fork watershed totaling 640 acres or 2.6 percent of the watershed (per the Assessor's parcel map; the land allocation map shows 664+ acres). The 160-acre, T-shaped parcel, owned by Warren Dick, was commercially thinned using tractors in 1995. The 320-acre parcel south of Pony Buck Peak, owned by Roseburg Forest Products, was tractor and cable logged from 1993 to 1996 using a combination of clearcut, shelterwood removal, sanitation, salvage, and commercial thin prescriptions. The 160-acre parcel owned by Perry Patton adjacent to the Limited Motorized Recreation Area was tractor logged between 1993 and 1996 using a combination of shelterwood removal, sanitation, salvage, and commercial thin prescriptions. These properties are sparsely to moderately stocked with a combination of small diameter conifers and hardwoods, mostly Douglas-fir, ponderosa pine, black oak, and canyon live oak.

Thinning Opportunities

Thinning opportunities generally fall into two broad categories: precommercial and commercial. Either precommercial or commercial thinning can be done for multiple reasons, including to enhance vigor and growth of selected trees in or out of plantations, to reduce pest problems, to enhance wildlife habitat for selected species, and/or to reduce fuels to protect targeted resources.

In order to meet LRMP FORPLAN timber harvest goals, the highest priority stands for thinning are those stratified as M3G, with M2G stands being of secondary priority (USDA Forest Service 1993, Appendix C-1). The M3G stratum is found throughout the Matrix land, although it tends to dominate in the midwest area of the watershed. On CAS Matrix lands the M3G stratum is composed of 2372 acres of M3N and 451 acres of M3G stands containing the volumes shown in Table 5-20 above.

From field checking it appears that many of the larger trees have been harvested from M3G stands in partial cuts or salvage sales. In general, these stands have a sparse, mixed conifer (mostly DF, SP, and PP) residual overstory of larger size class 3 trees and smaller size 4 with an understory (mostly DF and PP) primarily of smaller size class 3 trees and larger size 2, with a canopy closure of 40 to 90 percent. These stands appear to be relatively healthy and have only endemic levels of pest populations, dwarf mistletoe and bark beetles being the most obvious. There are opportunities for commercial thinning in some of these stands as growth is slowing due to excessive stocking.

The M2G stratum is primarily found in the headwaters areas of Dark Canyon and Texas Chow Creeks and in the mid elevations of Prospect Creek. On CAS Matrix lands the M2G stratum is composed of 7 acres of M2N and 451 acres of M3G stands containing the volumes shown in Table 5-20 above. The stands in Dark Canyon and Texas Chow Creeks are in a contiguous block and appear to be a result of past partial cutting which generally left a sparse residual overstory canopy of size class 3 and 4 conifers over a mosaic of M2S to M2N stands. Portions of this stratum are actually composed of M3P, M3G, or D3G stands. These stands appear to be relatively healthy and have only endemic levels of pest populations, dwarf mistletoe and bark beetles being the most obvious. There are opportunities for both precommercial and commercial thinning in these stands, as growth is slowing due to excessive stocking.

Plantations planted prior to 1984 on the Old Dark Canyon, Chow, and half of the Pony Buck II timber sales were planted exclusively with ponderosa or Jeffrey pine and are now dominated by sapling- and pole-size pines. Douglas-fir was not planted because in the early eighties Douglas-fir nursery stock was unreliable. Since 1984, plantations have generally been planted with a combination of Douglas-fir and ponderosa pine, with some exclusive planting of Jeffrey pine on ultramafic soils on the Devil sale, and are now dominated by seedling or sapling size trees. All units have had at least some natural seeding of Douglas-fir, ponderosa pine, sugar pine, white fir, and/or incense cedar and sprouting of oaks and/or madrone and in general are well stocked with healthy, vigorous trees.

Records show that precommercial thinning has been done in Units A and B of the Old Dark Canyon sale, Unit 19 of the Prospect sale, and Units 10 and 13 of the Devil sale on Matrix. In plantations with a high component of ponderosa pine, thinning favored other species. These plantations are well stocked with healthy, vigorous trees and do not appear to need any further treatments at this time.

Plantations in the other units and sales on Matrix, Old Devil (planted 1962), Old Dark Canyon (1968), Chow (1980 and 1981), Pony Buck II (1984), Peak (1984-1987), Dark Canyon 1 (1988), Prospect (1988-1990), and Devil (1989-1992) are also generally well stocked with healthy, vigorous trees. Most of these plantations will need to be thinned and released in the future in order to attain projected yields. See Appendix D, Plantation History and Treatments, for treatment needs.

There are a number of plantations within what is now an LSR. On Buck Ridge are thirteen plantations from the Fern Glade timber sale (½ planted with Douglas-fir and ½ with ponderosa pine/Douglas-fir in 1971-1973) and four from the Buck Ridge I sale (planted with ponderosa pine in 1969). These plantations are variably stocked with healthy, vigorous ponderosa pines and Douglas-fir. Stocking levels shown in Appendix D are from a walk-through survey to determine if the minimum stocking levels of 150 trees per acre had been attained. Actual stocking levels may be much higher than those shown. Fern Glade Units A, B/B2, and J were precommercial thinned in 1991, at which time the trees were reaching the upper diameter limit for precommercial thinning. If it is desired to shorten the time for the other plantations to attain late-successional attributes, they could be thinned for biomass in the future.

In the LSR in the Pony Buck Peak area are six plantations, two from the Old Dark Canyon sale (planted 1968), one from the Pony Buck II sale (1984), and one from the Dark Canyon 1 sale

(1988). These plantations are generally well stocked with healthy, vigorous ponderosa pines and Douglas-fir.

In the LSR in the Stuart Gap area are four plantations from the Rat Trap II sale (planted 1985-1987) and two, and portions of four others, from the Peak sale (1984-1987). These plantations are generally moderately to well stocked with healthy, vigorous ponderosa pines, with some Douglas-fir.

Although most plantations were planted with a combination of ponderosa pine and Douglas-fir, and occasionally Jeffrey pine and sugar pine, experience is showing that natural seeding is returning some plantations to a species mix similar to that found in the original stands within 10 to 15 years. As funding becomes available, forest managers would like to thin plantations to 125 to 200 trees per acre, generally within 7 to 10 years following planting, in order to reduce thinning slash and to lower costs. Crop trees would be selected to create a mix of all species found in natural stands. Spacing would be varied to select for the most vigorous trees and holes would be left where stocking is sparse. Competing brush and hardwoods would generally not be cut unless they were dense canyon live oak, madrone, manzanita, whitethorn, or deerbrush (Jost 1997).

Unsuccessful attempts have been made to plant sugar pine, which is susceptible to white pine blister rust. A study in the southern Sierra Nevada (Kinloch and Dulitz 1990) found that the risk of infection is higher in plantations than in natural stands and that the prospects for artificial or natural regeneration are "extremely bleak" without development of resistant trees. The STNF cooperates with the Placerville Nursery in a program to identify blister rust resistant trees. Cones are collected from these trees and sent to the nursery, where seedlings are grown for five years and tested for resistance. In the summer of 1997 two blister-rust-resistant trees were located on the Trinity side, one in the Dubakella area and one on Penny Ridge. Experience has shown that only 1 out of 2000 large, cone-bearing trees shows resistance.

Firewood Cutting and Biomass Production

Historically there has been only incidental firewood cutting and no biomass production in this watershed due to the long travel distances to population centers, although cull decks on Buck Ridge have been sold in the past. Recently, the USFS has tried unsuccessfully to sell a biomass thinning sale in the Jones Burn just north of Pine Root Saddle.

In the future, if people are willing to travel the long distances to this watershed, there will be opportunities for firewood cutting and biomass production when stands are thinned to increase vigor and growth rates or to reduce fuel ladders and biomass. If fuelbreaks are constructed, expanded, or maintained along main roads and ridges, there will be easy access to quantities of firewood and biomass.

Site Conditions on Ultramafic Soils Limiting to Timber Production

Dubakella and Weitchpec family complexes of soils derived from ultramafic rocks (map symbols 43, 45, 47, 341, 342, 344, and 349) occupy portions of the mid to lower slopes of Texas Chow Creek, an area just north of Warren Dick's property, a portion of the upper slopes of the Dark Canyon Creek drainage, and on the mid slopes to ridgetop from just east of White Rock Campground to Stuart Gap.

Dubakella family soils (43, 45, 47) typically range in pH from 7.0 to 7.5 and have a Ca/Mg imbalance which limits growth and the range of adapted plant species. They are 26 inches deep with 30 to 50 percent gravel, cobbles, and stones in the first foot of soil, increasing to 65 percent in the next 6 inches and 85 percent to bedrock, and have a low to moderate seedling survival potential. They have an AWC of 1.8 to 4.2 and a productivity of Forest Survey Site 5 to 6 (Dunning Site III-V).

The stands found on the Dubakella family complex soils on Matrix are primarily 3P and 3N stands, with some 3S stands, composed of gray pine, Jeffrey pine, and/or incense cedar. One plantation from each of the Old Devil 1, the Devil 44, and the Prospect 46 timber sales have regenerated satisfactorily on these soils.

Weitchpec family soils (341, 342, 344, 349) range in pH from 6.5 to 7.9 and also have a Ca/Mg imbalance which limits growth and the range of plant species which can survive. They are 25 inches deep with 30 percent gravel in the first 5 inches of soil (increasing to 35-45% in the next 20"), and have a low to moderate seedling survival potential. They have an AWC of 2.4 to 4.0 and a productivity of Forest Survey Site 5 to 6 (Dunning Site III-V).

About 60 percent of the Weitchpec family soils are found on Matrix. The stands found on these soils are primarily 3P mixed conifer stands with a few 3S and 3G stands. Plantations from the Old Dark Canyon, Pony Buck II, and Peak Timber Sales have regenerated satisfactorily on these soils.

There is a small area of Dunsmuir family (map symbol 50) on the mid slopes of the Dark Canyon Creek drainage and Dunsmuir-Olete families complex (map symbol 54) in the White Rock area.

Dunsmuir family soils, derived from ultramafic rocks, typically range in pH from 5.6 to 6.0 and have a moderately low Ca/Mg imbalance which may limit the range of adapted plant species. They are 53 inches deep with 20 to 35 percent gravel in the first 7 inches of soil and 20 to 55 percent gravel and cobbles down to bedrock. They have an AWC of 6.5 to 10.0 and a high seedling survival potential (Forest Survey Site 3-5, Dunning Site I-III).

Olete family soils, derived from ultramafic rocks, typically range in pH from 6.5 to 7.0, have a Ca/Mg imbalance which limits growth and the range of adapted plant species. They are 35 inches deep with 30 percent gravel in the first 6 inches of soil and 35 to 55 percent gravel and cobbles down to bedrock. They have an AWC of 2.5 to 4.0, a low to high seedling survival potential, and a productivity of less than 20 cu. ft./ac./yr (Forest Survey Site 7, Dunning Site VI).

The stands found on the Dunsmuir and Olete family soils on Matrix are primarily 3P and 3N (some 3G) mixed conifer stands with some 3S Jeffrey pine and incense cedar stands on more serpentinized (Olete family) soils. On the Dunsmuir-Olete family soils a significant portion of the understory trees are canyon live oak. Five plantations from the Pony Buck II sale and three from the Old Dark Canyon sale have regenerated satisfactorily on these soils.

There is a small area of Ishi Pishi family, deep-Ishi Pishi family complex soils (map symbol 153) on the mid slopes of the unnamed creek south of Pony Buck Creek. This area is all in LSR.

Ishi Pishi family, deep-Ishi Pishi family complex soils, derived from ultramafic rock, have a pH of 7.0 and a Ca/Mg imbalance which limits growth and the range of adapted plant species. They range from 34 to 48 inches deep with 20 to 30 percent gravel and cobbles in the first 3 to 7 inches of soil and 30-80 percent gravel down to bedrock. They have an AWC of 3.5 to 6.9 and a low to high seedling survival potential (Forest Survey Site 4-6, Dunning Site II-V).

There is a small area of Rock outcrop-Gozem family complex soils (map symbol 260) on the mid slopes of the East Fork of Dark Canyon Creek drainage.

Gozem family complex soils, derived from serpentinized peridotite, typically range in pH from 6.5 to 6.8, have a Ca/Mg imbalance which limits growth and the range of adapted plant species. They are 18 inches deep with 35 percent gravel and cobbles in the first 4 inches of soil, 45 to 55 percent gravel down to bedrock and 45 percent of the surface in rock outcrops. They have an AWC of 1.5 to 2.4, a very low to low seedling survival potential, and a productivity of less than 20 cu. ft./ac./yr (Forest Survey Site 7, Dunning Site VI). These soils are considered unsuitable for timber production based upon the suitability criteria in the , Appendix I (USDA Forest Service 1993).

The stand found on the Gozem family complex soils is a 3S mixed conifer stand with a moderately dense understory of canyon live oak. About 50 percent of the area is in a plantation from the Pony Buck II sale which has regenerated satisfactorily.

There are also small areas (and some inclusions not shown on the map) of Grell family complex (map symbol 89), Beaughton family (map symbol 12), Beaughton-Dubakella families complex (map symbol 13), Beaughton family-Rock outcrop complex (map symbol 15), and Rock outcrop-Lithic Haploxeralfs-Beaughton family complex (map symbol 265) soils in the Prospect, Texas Chow, Dark Canyon drainages, in the McCullah Spring and White Rock area, and southeast of Pony Buck Peak. These soils are considered unsuitable for timber production based upon the suitability criteria in the LRMP, Appendix I (USDA Forest Service 1993).

Grell family complex soils (89), derived from serpentine rock, typically range in pH from 7.5 to 8.0, have a Ca/Mg imbalance which limits growth and the range of adapted plant species, are possibly toxic, have poor aeration, and are extremely cold. They are 12 inches deep with 40 to 60 percent gravel and cobbles in the first foot of soil and 20 percent of the surface in rock outcrops. They have an AWC of 0.8 to 2.3, a very low to moderate seedling survival potential, and a productivity of less than 20 cubic feet per acre per year (Forest Survey Site 7, Dunning Site VI).

The stands found on the Grell family soils on Matrix are primarily 3P and 3G (and some size class 2) mixed conifer stands with some 3S Jeffrey pine and incense cedar stands. There is one recent plantation from the Prospect sale which has regenerated satisfactorily, and most of the forest has been partial cut.

Beaughton family soils (12), derived from ultramafic rocks, typically range in pH from 7.5 to 8.0, have a Ca/Mg imbalance which limits growth and the range of adapted plant species, are possibly toxic, have poor aeration, and are extremely cold. They are 16 inches deep with 25 percent gravel in the first 3 inches of soil and 50 to 60 percent gravel, cobbles, and stones down to bedrock. In some areas they have up to 20 percent rock outcrops on the surface. They have an AWC of 1.6 to 2.1, a very low to low seedling survival potential, and a productivity of less than 20 cubic feet per acre per year (Forest Survey Site 7, Dunning Site VI).

The stands found on the Beaughton family, Beaughton-Dubakella families complex (13), and Beaughton family-Rock outcrop complex soils (15) are primarily 3S and 3P gray pine stands, with some Jeffrey pine and incense cedar, and some 3N mixed conifer stands with a canyon live oak understory. One plantation from the Dark Canyon sale has regenerated satisfactorily on these soils and one is only partially stocked.

Lithic Haploxeralfs (265), derived from serpentine rock, typically range in pH from 6.5 to 8.0, have a Ca/Mg imbalance which limits growth and the range of adapted plant species, are possibly toxic, and have poor aeration. They are 17 inches deep with 20 to 35 percent gravel in the first 4 inches of soil, 40 to 50 percent gravel down to bedrock and 55 percent of the surface in rock outcrops. They have an AWC of 1.3 to 1.8, a low seedling survival potential and a productivity of less than 20 cubic feet per acre per year (Forest Survey Site 7, Dunning Site VI).

About 67 percent of the Rock outcrop-Lithic Haploxeralfs-Beaughton family complex soils are found on Matrix. These are mostly limestone rock outcrops with primarily 3S and 3P mixed conifer stands surrounding them. There are no plantations on these soils.

Smoky Creek

Sparse stands of small- to medium-size Jeffrey pine sawtimber mixed with incense cedar, Douglas-fir, sugar pine, and white fir tend to predominate in the eastern portion and along the northern border of the watershed. These stands are generally associated with ultramafic soils. A large stand of poorly stocked, small- to medium-size white fir sawtimber is found in the northeastern portion of the watershed below Red Mountain, with smaller stands found throughout the higher elevations.

The main forest type found in the central area of the watershed bordering Smoky Creek and its tributaries and along the north side of the South Fork of the Trinity is composed of moderately dense, small to medium size sawtimber stands dominated by Douglas-fir mixed with ponderosa pine, sugar pine, incense cedar, white fir, and black oak.

In the southeastern portion of the watershed is an extensive area of dense, large Douglas-fir sawtimber mixed with ponderosa pine, sugar pine, incense cedar, white fir, and black oak, with five patches of sparse residual large sawtimber over dense seedlings and saplings in the southern half of the watershed.

Plantations dominated by seedling and pole-size Douglas-fir and ponderosa pines are scattered throughout the northwest and south portions of the watershed. Patches of montane shrubs and grassland are widely scattered throughout the watershed.

About half of the Matrix is underlain by ultramafic soils, which are generally of low productivity (Dunning site IV-V) or unproductive (Dunning site VI). The area around Red Mountain and the proposed RNA is largely ultramafic soils. Locations of and conditions on ultramafic soils are discussed below.

Most of the rest of the Matrix is on Deadwood family soils (map symbol 32, 34, 35) which are unproductive or of low productivity. There are also some Neuns family soils (203, 205, 206, 208) which are of moderate to low productivity.

The GIS 90 productivity class layer shows a large portion of the CAS lands as highly productive (Dunning Site Class I-III). From the soils maps, perusal of stand record cards, and field observation it is concluded that these lands are generally at the low end of this range (site III).

Most of the CAS lands are on slopes of less than 40 percent, so they are suitable for tractor logging, which has been the dominant logging system used in the past.

Timber Harvest Opportunities

To determine the CAS lands in the Smoky Creek watershed, the following areas were eliminated from consideration: private lands, administratively withdrawn areas (Unroaded Non-Motorized Recreation Areas, a candidate RNA, and an SIA), LSR's, Riparian Reserves, four NSO activity centers (100 acres per center), and unproductive, unregenerable, and unstable lands. Acreages removed from Matrix include 2807 acres for Riparian Reserves, 2754 acres for unproductive soils, and 409 acres for NSO activity centers (see Table 5-18). As some of these withdrawals overlap, their additive total acreage is more than what was actually withdrawn.

Most of the watershed is allocated to Matrix, Prescription VIII, Commercial Wood Products Emphasis (USDA Forest Service 1993, 4-166). Matrix lands comprise 18,378 acres (75 % of the watershed), but with the withdrawal of non-CAS lands, the CAS lands total 12,531 acres (51% of the watershed) (see Table 5-18).

As mentioned above under the East Fork, many plantations had varying portions (5-20%) which were unregenerable because of shallow or rocky soils. These areas were not removed from the Matrix land base but it should be noted that conservatively, an additional 8.5 percent of the Matrix is unsuitable for timber production, which would reduce the CAS Matrix to 11,278 acres (~46% of the watershed) (see Table 5-18).

Partial cutting was initiated on Matrix lands above the Bramlet Road (USFS Road 29) before 1965 and possibly as early as the mid 1950's. This harvesting was done by overstory removal, sanitation, and/or salvage. Harvesting occurred in the upper Silver and Smoky Creek drainages and in the mid to upper Red Mountain Creek, Dog Gulch, and Soap Creek drainages and on private land. Many of these stands did not adequately regenerate and were subsequently clear cut and planted. It is infeasible to get an exact acreage for these partial cuts, as records are difficult to obtain and regeneration cuts have been made in varying portions of them.

Although regeneration harvesting has been done in this watershed since the 1960's, most has occurred since 1980. Plantations planted between 1960 and 1969 are located primarily in the eastern, mid to upper portion of the Red Mountain Creek drainage and the upper portion of Dog Gulch. Plantations planted between 1970 and 1979 are mostly found in the upper drainage of Dog Gulch and Soap Creek, with a couple in the mid Silver Creek drainage. Plantations planted between 1980 and 1989 are mostly scattered throughout the upper Silver

Creek drainage, in the southwest portion of Smoky Creek, and in the lower Red Mountain Creek drainage. Plantations planted between 1990 and 1996 are primarily found in the upper Smoky Creek drainage and in the mid portion of the Red Mountain Creek drainage. These plantations total 1561 acres and comprise about 6.3 percent of the watershed (8.5% of the Matrix lands), with 1370 acres on CAS Matrix (see Table 5-18).

The CAS lands which have not been regenerated (11,161 acres, 89% of CAS Matrix) are predominately covered by the M3P and M3G commercial conifer strata, with lesser amounts of M2P, M2G, M4G, M6G, D3G, and D4G.

Table 5-21 below shows a breakdown of the combined strata into their included substrata for Smoky Creek. The M2P stratum is all M2P and the M3P stratum is predominately M3P, with inclusions of serpentine barrens which are essentially non-productive. The M3G stratum is predominately M3N above the Bramlet Road due to partial cutting in these stands, about half M3N northwest of Smoky Creek due to low productivity soils, and primarily M3G southeast of Smoky Creek, where it is mostly unlogged.

In order to meet LRMP FORPLAN timber harvest goals, the highest priority stands for harvest are those stratified as M3P (USDA Forest Service 1993, Appendix C-1). These stands are intermixed with M3G stands throughout the Matrix land, but they tend to dominate on ultramafic soils on the upper slopes of the watershed. These soils tend to be unproductive or marginally productive due to a chemical imbalance and high rock content. On CAS Matrix lands the M3P stratum is composed of 1085 acres of M3S and 3193 acres of M3P stands containing the volumes shown in Table 5-22 below.

Many of the larger trees have been harvested from 3P stands above Bramlet Road by overstory removal, sanitation, and salvage. In general these stands are similar to those in the East Fork watershed with a sparse (10-30% canopy) mixed conifer (mostly DF, SP, and PP) overstory of mostly size class 3 trees, with some smaller size 4. The understory (mostly DF and PP) is typically mostly size class 2 conifers, with some size 1, with a canopy closure of 10 to 40 percent (some up to 60%). These stands appear to be relatively healthy, growing well, and have only endemic levels of pest populations, dwarf mistletoe and bark beetles being the most obvious.

The next highest priority stands for harvest are those stratified as M3G, M4G, M6G, D3G, and D4G. The M3G stands are intermixed with M3P stands throughout the Matrix land, but they tend to dominate in the Smoky Creek drainage. On CAS Matrix lands the M3G stratum is composed of 2584 acres of M3N and 1960 acres of M3G stands containing the volumes shown in Table 5-22 below.

The M3G stands below the Bramlet Road have generally never been harvested and are composed of mostly size class 3 mixed conifers (mostly DF, SP, and PP) with scattered clumps, patches, and individuals of size class 4.

Table 5-21. Smoky Creek Timber Strata

Stratum	Watershed*	Matrix#	CAS Matrix#	Stratum	Watershed#	Matrix#	CAS Matrix#						
	Acres	%	Acres	%	Acres	%		Acres	%	Acres	%	Acres	%
M2P	676	2.7	640	3.5	518	4.1	M2S	0	0	0	0	0	0
							M2P	676	2.7	640	3.5	518	4.1
M2G	630	2.6	262	1.4	230	1.8	M2N	308	1.2	126	0.7	103	0.8
							M2G	264	1.1	136	0.7	127	1.0
M3P	8560	34.7	7258	39.5	4278	34.1	M3S	3085	12.5	2764	15.0	1085	8.7
							M3P	5341	21.7	4494	24.5	3193	25.5
							M4S	0	0	0	0	0	0
							M4P	8	0	0	0	0	0
							M5S	0	0	0	0	0	0
							M5P	0	0	0	0	0	0
M3G	8855	35.9	6338	34.5	4500	35.9	M3N	4481	18.2	3612	19.7	2584	20.6
							M3G	4415	17.9	2726	14.8	1916	15.3
D3G	55	0.2	55	0.3	55	0.4	D3N	0	0	0	0	0	0
							D3G	55	0.2	55	0.3	55	0.4
M4G	3331	13.5	2213	12.0	1696	13.5	M4N	34	0.1	21	0.1	15	0.1
							M4G	3173	12.9	2192	11.9	1681	13.4
							M5N	?	?	?	?	?	?
							M5G	?	?	?	?	?	?
M6G	226	0.9	40	0.2	31	0.2	M6N	0	0	0	0	0	0
							M6G	226	0.9	40	0.2	31	0.2
TOTAL	22,333	90.5	16,806	91.4	11,308	90.1		22,066	89.5	16,806	91.4	11,308	90.1

* From GIS 90 Timber Strata Map
\# From merging of GIS 90 Timber Size and Canopy Density layers
? Unknown

The M3G stands above the Bramlet Road are generally found in and bordering riparian zones, where they were left uncut during the extensive partial and clear cutting which occurred in this area. From field and photo checking it appears that in some of these stands the larger trees were harvested in partial cuts or salvage sales. In general, these stands have a mixed conifer (mostly DF, SP, and PP) residual overstory of larger size class 3 trees and smaller size 4 with an understory (mostly DF and PP) primarily of size class 3 trees and larger size 2, with a canopy closure of 40 to 90 percent. These stands appear to be relatively healthy and have only endemic levels of pest populations, dwarf mistletoe and bark beetles being the most obvious. There are opportunities for harvesting and commercial thinning in some of these stands, as growth is slowing due to excessive stocking.

The M4G stands are primarily in a band at lower elevations from Smoky Creek southeast to the confluence of the East Fork and the South Fork and in a cluster in the northwest corner of the watershed mostly within the LSR. On CAS Matrix lands the M4G stratum is composed of 15 acres of M4N, 1681 acres of M4G, and apparently no acres of M5N and M5G stands. Volumes found in these strata are shown in Table 5-22 below. These stands tend to have a large component of Douglas-fir and sugar pine, with some ponderosa pine, white fir, and incense cedar. They are showing signs of decadence, evidenced by dead, broken, and flat tops and heart and butt rots.

The relatively few M6G stands are found primarily in the lower Red Mountain Creek drainage and in the Spot and Rowski Creek drainages in the northwest corner of the watershed. The stands in these locations are in either LSR or Unroaded Nonmotorized Recreation designations. On CAS Matrix lands the M6G stratum is composed of 31 acres of M6G, with no M6N stands. There is no volume shown in the LRMP for this stratum. The stands in Matrix are a good example of what a shelterwood with reserves would look like after forty years: a dense understory with a sparse overstory.

The D3G and D4G strata appear in the GIS database, but there is minimal acreage in each stratum and no visible polygons appear on the timber strata map at the scale used. An exception to this is the 55-acre stand in Silver Creek shown on the timber strata map as M2G which is actually D3G.

The released portion of the Chinquapin Roadless Area north of Smoky Creek surrounding the proposed RNA is mostly on low productivity soils, with inclusions of unproductive soils. The stands found here are a mosaic of M3S through M3G intermixed with unproductive areas. Presently the only feasible method for logging most of these stands is by helicopter. Stands near the Bramlet Road could be economically logged with cable systems. The economic feasibility of logging and managing these stands needs to be investigated.

Table 5-22. Smoky Creek Timber Stratum Volumes on CAS Matrix Lands

Stratum#	Acres	Volume/Acre * (MBF)	Total Volume (MBF)	Average Age Basal Area Weighted*	Annual Growth* (CuFt/Ac/Yr)	Potential Growth* (CuFt/Ac/Yr)	Stratum#	Acres	Volume/Acre ^ (MBF)	Total Volume^ (MBF)
M2P	518	8.2	4247.6	140	14	52	M2S	0	0	0
							M2P	518	?	?
M2G	230	22.4	5152.0	90	58	52	M2N	103	?	?
							M2G	127	?	?
M3P	4193	16.8	70,442.4	120	34	52	M3S	1077	?	?
							M3P	3116	?	?
							M4S	0	0	0
							M4P	0	0	0
							M5S	0	0	0
							M5P	0	0	0
M3G	4404	28.9	127,275.6	180	40	52	M3N	2515	?	?
							M3G	1889	?	?
D3G	55	35.7	1963.5	160	68	104	D3N	0		
							D3G	55		
M4G	1674	28.9	48,378.6	180	?	?	M4N	15	?	?
							M4G	1659	?	?
							M5N	?	?	?
							M5G	?	?	?
M6G	31	?	?	?	?	?	M6N	0	0	0
							M6G	31	?	?
Total	11,105		257,459.7+					11,105		?

From merging of GIS 90 Timber Size and Canopy Density layers

* From USDA Forest Service 1993, Appendix D-3

^ No volume/acre data available

? Unknown

The released portion of the Chinquapin Roadless Area from Murphy Gulch to Soap Creek is mostly on high productivity soils, with small inclusions of low productivity and unproductive soils. The stands found here are primarily M4G and M3G, some of the highest volume stands in the watershed. There are also some low volume M3P stands in the lower Red Mountain Creek and Dog Gulch drainages. Most of these stands are below existing roads and could be cable logged. Presently the only feasible method for logging the rest of these stands is by helicopter.

There are seven parcels of private land in the Smoky Creek watershed totaling 651 acres, 2.6 percent of the watershed (the land allocation map shows 632 acres). There is no record of timber harvesting on these parcels since about 1983. Ownership of the parcels is as follows: a 30 acre (about 17 ac in the watershed) parcel at the mouth of Farley Creek and a 70 acre parcel (the Bramlet Place) south of Dog Gulch are owned by J. L. Randolph, a 54+ acre parcel at the mouth of Rowski Creek is owned by R. Flint, a 150 acre parcel north of Peyton Creek drainage and a 160 acre parcel at Swim Meadow are owned by F. Randolph, a 40 acre parcel northwest of the mouth of Silver Creek is owned by J. Ostrat, and a 160 acre parcel west of Murphy Gulch is owned by M. L. Steffensen.

Thinning Opportunities

In order to meet LRMP FORPLAN timber harvest goals, the highest priority stands for thinning are those stratified as M3G, with M2G stands being of secondary priority (USDA Forest Service 1993, Appendix C-1). The M3G stratum is found throughout the Matrix land, although it is mostly found in the Silver and Smoky Creek drainages. On CAS Matrix lands the M3G stratum is composed of 2584 acres of M3N and 1916 acres of M3G stands containing the volumes shown in Table 5-22 above.

From field checking it appears that many of the larger trees have been harvested from M3G stands in partial cuts or salvage sales above the Bramlet Road. In general, these stands have the same composition as those in the East Fork, as described above. These stands appear to be relatively healthy and have only endemic levels of pest populations, dwarf mistletoe and bark beetles being the most obvious. There are opportunities for commercial thinning in some of these stands, as growth is slowing due to excessive stocking.

There is very little M2G stratum in this watershed. What there is is primarily found in the Soap Creek drainage below the Bramlet Road and in the lower Smoky Creek drainage. On CAS Matrix lands the M2G stratum is composed of 103 acres of D2N and 127 acres of D2G stands containing the volumes shown in Table 5-22 above. These stands are mostly in large blocks and may be a result of past fires, which appear to have left a sparse residual overstory canopy of size class 3 and 4 conifers over a dense stand of size class 2 Douglas-fir. Portions of this stratum are actually composed of D3G stands. These stands appear to be relatively healthy and have only endemic levels of pest populations, dwarf mistletoe and bark beetles being the most obvious. There are opportunities for both precommercial and commercial thinning in these stands, as growth is slowing due to excessive stocking.

Plantations were generally planted with a combination of Douglas-fir and ponderosa pine, with exclusive planting of combinations of ponderosa, Jeffrey, and sugar pine on ultramafic soils in some units on the West Smoky sale. These units are now dominated by seedling or sapling size trees, with some pole size trees in older plantations. All units have had at least some natural seeding of Douglas-fir, ponderosa pine, sugar pine, white fir, and/or incense cedar. In general these plantations are well stocked with healthy, vigorous trees, with the exception of units 2 and 4, which are understocked because needed thinning and site preparation treatments were not done after harvesting due to public pressure.

Stand Unit Records indicate that Unit 1 of the Foss timber sale, Units D and E in the Red Dog sale, and Units 14-18, 20, 21, 24-26, 41-46, 49, 53, 54, 57-60, 65, and 66 in the Silversnake sale have been precommercially thinned and released from shrub competition. These plantations are well stocked with healthy, vigorous trees and do not appear to need any further treatments at this time. The rest of the plantations in the Red Dog (planted 1971 & 1982), Dog Gulch (1983 & 1984), Suds (1984-1985), Silversnake (1984-1986), Spider (1987 & 1990), Rare Dog (1988), Foss (1990-1995), and West Smoky (1995) sales are also generally well stocked with healthy, vigorous trees. Most of these plantations will need to be thinned and released in the future in order to attain projected yields. See Appendix D, Plantation History and Treatments, for needed treatments.

Firewood Cutting and Biomass Production

As in the East Fork watershed, there has been only incidental firewood cutting and no biomass production in this watershed due to the long travel distances to population centers. In the future if people are willing to travel the long distances to this watershed, there will be opportunities for firewood cutting and biomass production when stands are thinned to increase vigor and growth rates and reduce fuel ladders. Should fuelbreaks be constructed along the Bramlet Road and main ridges, there will be easy access to quantities of firewood and biomass.

Site Conditions on Ultramafic Soils Limiting to Timber Production

Dubakella and Weitchpec family complexes of soils, derived from ultramafic rocks (map symbols 46, 47, and 256), occupy two large areas in this watershed. One of these areas, with 46 and 256 soils, is southwest and west of Red Mountain and extends southwest as far as the Bramlet Road in the Red Mountain Creek drainage and west almost to the confluence of the east fork of Smoky Creek and Smoky Creek. In the Red Mountain area 30-45 percent of the surface is rock outcrops. The 46 and 256 soil types are considered unsuitable for timber production based upon serpentine mineralogy and surface and subsurface rock as per the suitability criteria in the LRMP, Appendix I (USDA Forest Service, 1993). The stands found on the Dubakella family complex soils in the Red Mountain area are primarily 3S Jeffrey pine and incense cedar stands, with some 3P and incidental 3N and G stands.

The stands found on the Dubakella and Weitchpec family complex soils on Matrix in the North Fork of Smoky Creek drainage and in the mid to upper Silver Creek drainage are primarily a mosaic of 3S, 3P, and 3N Jeffrey pine and incense cedar stands mixed with

Douglas-fir, ponderosa pine, gray pine, and canyon live oak, with some 3G stands in draws. The candidate RNA is almost exclusively on this soil type (47). There are numerous small serpentine barrens or semi-barrens scattered throughout this area. One plantation from the Silversnake timber sale has regenerated satisfactorily on these soils.

There are also small areas (and some inclusions not shown on the map) of Grell family complex (map symbol 89), Beaughton family (map symbol 12), and Beaughton-Dubakella families complex (map symbol 13) soils in the upper Peyton and Smoky Creek drainages. These soils are considered unsuitable for timber production based upon the suitability criteria in the LRMP, Appendix I (USDA Forest Service 1993).

Grell family complex soils, which have a very low to moderate seedling survival potential, and a productivity of less than 20 cu. ft./ac./yr (Forest Survey Site 7, Dunning Site VI) have stands of mostly 3S, with some 3P, Jeffrey pine and incense cedar.

Beaughton family soils have a very low to low seedling survival potential and a productivity of less than 20 cu. ft./ac./yr (Forest Survey Site 7, Dunning Site VI). The stands found on the Beaughton family and Beaughton-Dubakella families complex soils in the Matrix are primarily 3N and 3G Klamath mixed conifer, with some 3S and 3P stands. There has been some partial cutting in a small portion of this area and Units 16-18 of the West Smoky sale are on these soils. Based on first year survival exams, these plantations appear to be regenerating satisfactorily.

Wildlife Species and Habitats

Threatened, Endangered, and Sensitive Species

The following section on Threatened, Endangered, and Sensitive (TE&S) species addresses three of the issues and key questions identified in Chapter 2:

2.1, What ecological factors limit the distribution and abundance of TE&S species that occur within the watersheds?

2.2, What is the importance of the watersheds to TE&S species in the larger geographic area?

2.3, Can the watersheds contribute to keeping Sensitive species from becoming Threatened and Endangered?

Because baseline data do not exist for many species, our treatment of these questions is based on habitat conditions (quantity and quality) and our professional opinion when published sources of information are unavailable. Baseline inventory and monitoring of vertebrate species' populations have been minimal on TE&S species (except the NSO) within East Fork and Smoky Creek watersheds. In fact, even the presence of some species (e.g., bats) predicted to occur in the watersheds (California Wildlife Habitat Relationships model [Mayer and Laudenslayer 1988]) are yet to be confirmed. Therefore, rather than analyze abundances, distribution, survival, and reproduction of TE&S species in the watershed , we mainly examined the condition of their habitats in the watersheds. Although a variety of factors can influence a species distribution and abundance (e.g., food abundance, competitors, disease, abiotic factors, and other habitat features), most of these factors are strongly related to vegetation composition and structure (hereafter, habitat). Thus, unless otherwise noted, we have defined the condition of those habitats that appear to be most influential (i.e., potentially limiting) in determining each species' distribution and abundance in the watersheds. For NSO's we were able to include data that are specific to the watersheds. When necessary, we also used data gathered outside the watersheds but within or near the STNF. In all cases, we tried to synthesize the best scientific information, using peer-reviewed scientific literature whenever possible.

Species that the USFS is mandated to manage include state and federally listed threatened or endangered species, Forest Service Sensitive species, Survey and Manage species, and Protection Buffer species (Table 5-23). California Department of Fish and Game (DF&G) Species of Special Concern (Table 5-24) are those which are vulnerable for a variety of reasons. However, the USFS is not mandated to manage for Species of Special Concern. Our treatment of these species is meant to assist USFS administrators and decision makers so that they are aware of: (1) the species' presence (known or suspected) in the watersheds and (2) the species' habitat needs. Furthermore, the identification of these species and their habitat needs is an attempt to address Key Question 2.3—Can the watersheds contribute to keeping sensitive species from becoming Threatened or Endangered?--for which the basic answer is "yes." Although these watersheds alone cannot keep these species from becoming listed they can contribute to this effort. Only through knowledge of their existence and habitat needs can minimal impacts on these species be realized in a managed landscape.

Herpetofauna

Site-specific information on amphibians and reptiles in the Smoky Creek and East Fork watersheds is limited and comes from four sources: a terrestrial herpetofauna survey conducted by North State Resources in August, 1995 at 19 "priority sites" and eight additional sites (a total of approximately 60 acres were surveyed) within East Fork watershed; nine aquatic surveys in the East Fork watershed were done in 1995; a Habitat Typing Report on Smoky Creek prepared by North State Resources in February 1995; and a riparian inventory on a subset of reaches of Smoky Creek conducted by STNF in July and August, 1994. None of the surveys were systematic or random; it appears that "priority" sites (those most likely to contain the species of interest) were identified ahead of time and these were the areas surveyed; therefore, survey results are probably not indicative of widespread presence of species of interest across the landscape--instead they may identify isolated populations. In general, amphibians were not abundant in the watersheds, which was probably a function of hot, arid summer conditions and relatively nutrient poor streams (as identified in the Fisheries Section). However, Pacific giant salamanders (*Dicamptadon tenebrosus*) were fairly widespread, and they are a predator on other amphibian species. *Ensatinas* were the most commonly encountered amphibians in East Fork during surveys (USDA 1995). Bullfrogs, which are known to prey on other amphibian species, were not found in the watersheds during these surveys, but they have been found in surrounding watersheds (e.g. Post Creek, Penney Ridge vicinity) and in the South Fork (Downer 1993).

Table 5-23. TE&S; Protection Buffer; and Survey and Manage vertebrates (excluding fish) known or suspected to occur in the watersheds. This list was compiled from California Department of Fish and Game Natural Diversity Data Base (August 1994), the U. S. Fish and Wildlife Service Endangered Species home page, the Northwest ROD for Protection Buffer and Survey and Manage species, and the California Wildlife Habitat Relationship (WHR) model.

Name	Status[1]	Known or Suspected
BIRDS		
Northern goshawk *Accipiter gentilis*	CSC, FSS	known
Bald eagle *Haliaeetus leucocephalus*	SE, FT	known
American peregrine falcon *Falco peregrinus anatum*	SE, FT	suspected
Northern spotted owl *Strix occidentalis caurina*	FT	known
Flammulated owl *Otus flammeolus*	PB	suspected
White-headed woodpecker *Picoides albolarvatus*	PB	known
Willow flycatcher *Empidonax traillii*	SE	suspected
Pygmy nuthatch *Sitta pygmaea*	PB	suspected
MAMMALS		
Silver-haired bat *Lasionycteris noctivagans*	SM	suspected
Long-legged myotis *Myotis volans*	SM	suspected
Red tree vole *Phenacomys longicaudus*	CSC /SM	suspected

[1] CSC = California Department of Fish and Game species of special concern, FSS = Federal sensitive species, SE = State endangered, FT = Federal threatened, PB = Protection Buffer, SM = Survey and Manage.

Table 5-24. California Department of Fish and Game Species of Special Concern known or suspected to occur within the watersheds .

Name	Known or Suspected
AMPHIBIANS AND REPTILES	
Northern red-legged frog *Rana aurora aurora*	known
Foothill yellow-legged frog *Rana boylii*	known
Tailed frog *Ascaphus truei*	suspected
Southern torrent salamander *Rhyacotriton variegatus*	?[2]
Northwestern pond turtle *Clemmys marmorata mormorata*	known
BIRDS	
Cooper's hawk *Accipiter cooperi*	known
Sharp-shinned hawk *Accipiter striatus*	known
Osprey *Pandion haliaetus*	known
Ruffed grouse *Bonasa umbellus*	suspected[3]
Vaux's swift *Chaetura vauxi*	known
Black-capped chickadee *Parus atricapillus*	suspected
Yellow warbler *Dendroica petechia brewsteri*	suspected
Yellow-breasted chat *Icteria virens*	suspected
MAMMALS	
Pacific fisher *Martes pennanti pacifica*	known
Spotted bat *Euderma maculatum*	suspected
Pallid bat *Antrozous pallidus*	suspected
Townsends big-eared bat *Corynorhinus townsendii* (previously *Plecotus townsendii*)	suspected

[2] ?=May be within the species range.

[3] We do not treat the ruffed grouse further in this analysis because it is currently a hunted game bird in California. Thus, it is difficult to take seriously the designation species of special concern when hunting is still allowed.

Red-legged Frog

Ecological Limitations to Distribution and Abundance.

There are two subspecies of red-legged frog: the northern red-legged frog (*R.a. aurora),* which is a Species of Special Concern in California and the California red-legged frog (*R.a.draytonii),* which is federally listed as threatened. According to a US Fish and Wildlife Service (USFWS) letter of guidance (Pierce 1994), between the distinct ranges of the two subspecies, a zone of overlap exists in northern California where frogs exhibit morphological and behavioral characteristics of both subspecies; red-legged frogs in this zone are considered *R. a. aurora* and not included in the listing. The watersheds falls within this zone of overlap.

The species is generally associated with slow streams and pools more than one meter deep, with abundant emergent vegetation. It may not require permanent water, but does require standing water at least through mid-summer for tadpole metamorphosis. In the non-breeding season, adults disperse into moist forest habitats.

During the Riparian Inventory, the one red-legged frog found was in the north fork of Smoky Creek and was identified by surveyors as a California red-legged frog (USDA Forest Service 1994a). Some areas in Smoky Creek were identified as having steep banks and impassible gorges, which therefore were not surveyed (USDA Forest Service 1994). No red-legged frogs were found during terrestrial or aquatic surveys in East Fork (USDA 1995). Although there are a number of deep pools along some of the streams in the watershed area, very few seem also to have adequate emergent vegetation for red-legged frogs. The South Fork has areas of appropriate physical habitat for red-legged frogs, but the presence of bullfrogs and fish (both predators of red-legged frogs) using the same habitats probably preclude red-legged frogs from abundances of any magnitude there. Thus, water bodies meeting the requirements of red-legged frog appear to be very limited (e.g. a few stream areas and ponds) in the watershed area.

Importance in the Larger Geographic Area.

These watersheds are probably of little significance to the species on larger spatial scales because of the limited quantity of appropriate habitat.

Foothill Yellow-legged Frog

Ecological Limitations to Distribution and Abundance.

The foothill yellow-legged frog is generally found in the lower sections of larger tributaries, where water is present year-round and water temperatures are warm. More specifically, it is associated with slow stretches of streams interspersed with riffles having cobble substrates and boulders (Hayes and Jennings 1988, Nussman et al 1983), and egg masses and larvae are found in shallow, low-flow margins/sidewaters adjacent to sparsely vegetated gravel bars (Lind et al 1996). This species has been a candidate for federal listing as a threatened species (Federal Register 1994) and it is a California Species of Special Concern (Jennings 1987), largely because of habitat loss and population decline in the species' southern range. Only one foothill yellow-legged frog was found (East Fork upstream of Dark Canyon) during terrestrial surveys in the East Fork watershed, but adults and larvae were found at several of the 1995 aquatic survey sites in the East Fork and habitat at East Fork sites generally was identified as good potential habitat for these frogs (USDA 1995). Trout (adults and parr) were present in several of the East Fork sites where frogs/larvae were found; the fish are potential predators on the frogs (on tadpoles especially). Foothill yellow-legged frogs were mentioned in the Habitat Typing Report for Smoky Creek as "abundant and observed throughout the entire stream," and they were also reported from several sites during riparian inventory that same year (USDA Forest Service 1994). Predation by bullfrogs is probably less of a problem for this species because aquatic habitat requirements do not overlap as much as they do between bullfrogs and red-legged frogs. Therefore, we expect that yellow-legged frogs may be abundant on the South Fork despite the presence of bullfrogs.

Importance to Larger Geographical Context.

These watersheds are probably important for the foothill yellow-legged frog on a Forest-wide, if not larger, scale because of the continued presence of good quality aquatic substrates (i.e. lack of siltation) in appropriate habitats and widespread occurance of the species in both watersheds.

<u>Tailed Frog</u>

Ecological Limitations to Distribution and Abundance.

Tailed frogs (including adults) are found in clear, cold (<15° C), swift streams (Welsh 1990). Juvenile tailed frogs take several years to mature so perennial water is essential. Nussbaum et al (1983) reported that tailed frogs disappeared from logged areas, possibly in response to increased stream temperatures due to removal of canopy cover. Water-temperature information collected during East Fork aquatic surveys indicated that in mid-summer, a few sites at mid-to-late morning had water temperatures well below (11-12° C) the upper thresholds for tailed frogs, but others were approaching or exceeded the 15° C limit; we expect that sections of creeks outside old-growth areas and particularly those low in the system have temperatures exceeding the upper limits for this species during many days in summer (see also Water Temperature, pg. 5-5). Tailed frogs were not found in the East Fork surveys, nor were they found during aquatic surveys of reaches of Smoky Creek in 1994. This does not mean that tailed frogs are absent from the watersheds, because most of the East Fork surveys were terrestrial (and tailed frogs are rarely found away from water). To our knowledge no aquatic surveys in East Fork were conducted in the roadless late-successional forest areas, and the aquatic surveys in the Smoky Creek watershed were not widespread. The most likely areas for this species in the watersheds are perennial stretches of streams with significant canopy cover, such as within riparian reserves in 3G and 4G habitats. Given the patchiness of some of these areas within the watersheds, it is likely that any tailed frog populations existing in them are isolated from each other (they do not disperse across terrestrial habitats, especially in this type of arid environment) and would have little chance of recolonization following localized extirpations. The area where tailed frogs, if present, are most likely to persist is the large block of late successional forest in the roadless area of the East Fork. We should also note that Downer (1993) reported finding a tailed frog on the South Fork ("crossing to Site V") in May 1992; we do not have site specific information on the location of the sighting, but the South Fork (a large stream with summer temperatures significantly above 15° C) seems to us to be an unusual location in which to find this species.

Importance to Larger Geographical Context.

We cannot assess the importance of these watersheds to tailed frogs in the larger geographic context because we do not know if tailed frogs are present in these watersheds. If tailed frogs do exist in these watersheds, then those sites are likely to be important refugia for this species in this inland region.

<u>Southern Torrent Salamander</u>

Ecological Limitations to Distribution and Abundance.

The southern torrent salamander is found in conifer-dominated forests with large (>21" or 53 cm) trees and greater than 80 percent canopy closure (Welsh and Lind 1996) in seeps and other slow flowing, cold clear headwater (first to third order) streams (Welsh and Lind 1996) below about 1470 meters (4830 ft). Larvae take approximately three years to metamorphose. Adults generally remain within the splash zone of seeps, and, in the heat of summer (May-Sept), may aestivate. Although the westernmost boundary of the watershed analysis area (western Smoky Creek watershed) is approximately five miles from the easternmost extent of the currently cited range of the southern torrent salamander, it is included here because extensions to the ranges of herpetofauna are occasionally identified, and it may be happening with this species (Bornstein 1997) as it becomes more intensively studied. Some limited habitats meeting these criteria probably exist in the watershed areas, most likely on north facing slopes in the LSR near the South Fork in the East Fork. However, the potentially suitable forest habitat (70 % canopy closure, perennial headwaters) in Smoky Creek watershed is at best extremely limited (i.e., northwest prong of Silver Creek, part of mainstem Smoky Creek, part of Red Mountain, part of Dog Gulch, and part of Soap Creek and the adjacent unnamed creek), generally steep, and may not provide suitably slow stream habitat. Therefore, habitat for the torrent salamander in the watershed area appears extremely limited unless a range extension significantly greater than five miles east of the current limit is identified (e.g., to headwaters of Dark Canyon and the southeast forks of East Fork which seem to offer better forest habitat; however, there is more sediment in these streams than in the streams in Smoky Creek [Truman and Pacific Watershed Associates 1996]); headwater areas are also likely to be some of the least protected stream areas.

No southern torrent salamanders were found during the herpetofauna surveys in the watersheds (USDA Forest Service 1994, USDA 1995). But this is certainly not conclusive evidence of their absence, since all of the surveys were conducted when adults were likely aestivating and difficult to find.

Importance in the Larger Geographic Area.

If this species does occur here, their abundance is likely to be especially low given that it is at the far end of the species' range. Therefore, these watersheds are unlikely to be important for the species at larger spatial scales.

Del Norte Salamander

Ecological Limitations to Distribution and Abundance.

No known sites are identified in the Forest, however Appendix B of the Final Environmental Impact Statement for the Forest's LRMP (USDA Forest Service1993) mentions that it is possible that this species may occur "on the Trinity Forest close to Six Rivers NF," and M. Gertsch stated that lack of surveys may be the reason the species has not been identified on the forest. The southwestern part of Smoky Creek watershed is within three miles (4.8 km) of Six Rivers National Forest.

Importance in the Larger Geographic Area.

If this species does occur here, their abundance is likely to be especially low given that it is at the far end of the species' range. Therefore, these watersheds are unlikely to be important for the species at the larger spatial scales.

Northwestern Pond Turtle

Ecological Limitations to Distribution and Abundance.

The northwestern pond turtle feeds on invertebrates (and to a lesser extent, aquatic plants and carrion) in streams and ponds. They nest on land and, above Central California, hibernate on land as well. Like amphibians, their needs for both aquatic and terrestrial habitats makes them particularly vulnerable to environmental changes such as habitat alteration, roads, etc. (Holland 1991). Along the mainstem Trinity River and the South Fork, turtles were overwhelmingly associated with pool habitats with low flow rates and underwater refugia along edges of the rivers (Reese 1996). Emergent basking sites (e.g. woody debris) and/or warm water were also important components of favorable turtle habitat (Reese 1996). Shallow river margins are necessary for hatchling and juveniles (Holland 1991). This species has been declining in abundance throughout its range (Holland 1991), and both the southern and northern subspecies were candidates for Federal Listing in the early 1990's (before category 2 candidates were eliminated). Damming of streams and the resultant changes in flows tend to decrease flood dependent (early successional) streamside vegetation while increasing later successional vegetation and decreasing open gravel bars--all of which seem to have negative repercussions for pond turtle reproduction (Reese 1996). Presence of adult turtles does not necessarily indicate a viable population or currently suitable habitat for persistence of the population; because of their longevity (up to 40 years), adults may survive in areas that may no longer be suitable for reproduction and/or juvenile survival (e.g. especially in areas where habitat perturbation has occurred in recent decades).

To our knowledge, the only turtle surveys in the watersheds were conducted on several reaches of Smoky Creek (USDA Forest Service 1994). Adult pond turtles were found at three of the sites surveyed; at one of the sites juveniles were also found. In addition, several adult turtles were discovered at a small pond during aquatic amphibian surveys in East Fork (White Rock); it was noted by surveyors that one of the turtles was being chased by a "huge" trout (USDA 1995), evidence that predation may be a significant problem for successful turtle reproduction there. The most likely additional areas for pond turtles include other ponds such as the one at Foss Camp in Smoky Creek (logs in pond provide sunning sites), and habitat along the South Fork.

Importance in the Larger Geographic Area.

Given the patchiness of habitat available, particularly in the arid interior region, and the resulting isolation of populations, these watersheds (where there is evidence of successful reproduction) are probably important to the species on a Forest level and perhaps larger spatial scales. Since many of the waterways that this species historically inhabitated have been dammed (the resulting loss of open gravel bars and change in streamside vegetation have been linked to decreased suitability for pond turtles) the South Fork (which is not dammed) and its tributaries may play an increasingly important role as habitat for this species.

Birds

Cooper's Hawk

Ecological Limitations to Distribution and Abundance.

Within California, Breeding Bird Survey (BBS) data indicate that Cooper's hawks have declined by an average of 7.4 percent annually from 1980 through 1994 (USGS, Biological Resources Division Home Page 1995). Cooper's hawks nest in deciduous, mixed, and evergreen forests (Titus and Mosher 1981, Reynolds et al 1982), and often in areas with fragmented habitats (Rosenfield et al 1991). Nesting Cooper's hawks in Oregon used forest stands ranging from 30 to 70 years old. Canopy cover at nests ranged from 64 to 95 percent while the dbh of nest trees varied from 8 to 10 inches (21 to 52 cm) (reviewed by Rosenfield and Bielefeldt 1993). Hunting habitat for Cooper's Hawks can vary from dense forest to totally open, even grassland, habitat (J. Dunk, personal observation).

Suitable nesting habitat for Cooper's hawks includes size class 2N, 3N, 2G, and 3G habitats which are abundant throughout East Fork but most abundant in the central and north-central portions of East Fork (Map 6a, Appendix E). In Smoky Creek, nesting areas are primarily adjacent to much of the southern boundary and to the west of the main stem of Smoky Creek with lesser amounts to the east of Smoky Creek (Map 6b, Appendix E). It is unlikely that habitats on ultramafic soils will support nesting Cooper's hawks because of the very open structure of the habitat and minimal canopy coverage.

Further, overstocked plantations are not suitable habitat for nesting due to lack of appropriate flying space. Nearly all of the terrestrial areas, excepting overstocked plantations, are suitable foraging habitat for Cooper's hawks.

Currently, the distribution and abundance of Cooper's hawks in the watersheds are unknown. However, during a field visit, one was seen at Mud Springs in very open habitat and later with prey flying into a stand of conifers with high (G) canopy cover (suggesting an active nest site). Much of both watersheds currently appears to be suitable for Cooper's hawks, and unless a very large proportion of both areas becomes homogenous, their numbers should remain stable from a habitat structure perspective. However, if their prey populations decline (e.g., neotropical migrant songbirds), Cooper's hawk populations could decline. However, they also eat a variety of mammals (Fitch et al 1946).

Importance in the Larger Geographic Area.

Both watersheds have substantial Cooper's Hawk habitat especially compared to watersheds primarily composed of chaparral. Forest-wide, these areas probably can be considered of importance, but not critical. As spatial scale increases, the importance of these watersheds for Cooper's Hawks is probably lessened because of the wide distribution of Cooper's Hawks in California and North America.

<u>Northern Goshawk</u>

Ecological Limitations to Distribution and Abundance.

No formal large-scale survey efforts for northern goshawks have been undertaken in either watershed. However, one breeding territory is known in the Silver Creek drainage of Smoky Creek. This territory was checked four times between 1985 and 1997 and was occupied three of those times (but not the last time, in 1995) and produced young during two years. The area was identified as 3G habitat that was fragmented, but still suitable. This territory is in Matrix land and was checked apparently because of its proximity to a timber sale.

Northern goshawks are considered a Forest Service Sensitive species. Also, there have been at least two petitions in the past five years to list the northern goshawk as either threatened or endangered (Block et al 1994). Northern Goshawks show some degree of plasticity in their selection of nest sites (Hall 1984). For example, Hall (1984) studied goshawk nesting habitat in the Six Rivers National Forest and found that goshawks nested in stands that were relatively young and even-aged, but also contained some sparsely distributed mature and old-growth trees. However, specific nest sites (0.04 ha circular plots centered on nests) were described as being multi-storied with trees averaging 23 inches (58 cm) dbh (Hall 1984). Reynolds et al (1982) described nest sites in Oregon as mature/old-growth conifer stands containing an average of 482 trees/hectare. Along with nest-sites, post-fledging areas (estimated to be approximately 168 hectares [730 m radius circle] around nests) are also considered to be very important for successful reproduction in goshawks and should be included in "nesting habitat" (Kennedy et al 1994).

For this analysis, we consider stands composed of size class 3G or greater trees that also contain some residual mature/old-growth components to be potentially suitable goshawk nesting habitat. Within East Fork, suitable nesting habitats exist in large part within LSR lands. Little suitable nesting habitat exists in the northwestern portion of East Fork. In Smoky Creek, nesting habitat is primarily along the southern boundary, in the south-south-central portion of the area, adjacent to the mainstem of Smoky Creek, and a few areas in the northwest portion of the area (see Table 5-25 for quantity of 3G, 4G, and 4N habitats, and Maps 13a and 13b, Appendix E, for distribution of these habitats).

Dense stands of small diameter trees are typically of little value to goshawks owing to the limited amount of flight space. Foraging habitat in both the East Fork and Smoky Creek includes nearly all areas except densely stocked plantations with small diameter trees.

Importance in the Larger Geographic Area.

Presently, both watershed areas have some relatively high-quality goshawk habitat. Based on this and the juxtaposition of these watersheds to the large portion of LSR along Buck Ridge and South Fork Mountain, these areas take on more relative importance, especially considering the uncertain status (i.e. possible listing in the near future) of northern goshawks. Owing to the low densities at which goshawks generally occur, we believe that the loss of only a few breeding pairs would be a fairly significant loss, not only at the scale of the STNF, but also at larger scales.

<u>Sharp-shinned Hawk</u>

Ecological Limitations to Distribution and Abundance.

Sharp-shinned hawks primarily nest in young, relatively even-aged stands of conifers with relatively high canopy cover (Reynolds et al 1982). They prey almost exclusively on small birds (Reynolds and Meslow 1984), many of them neotropical migrant songbirds. Sharp-shinned hawk nesting habitat is primarily in size class 2 and 3G areas. In East Fork, patches of these habitats are primarily in previously clearcut habitat, largely in the southwest portions of the area. Approximately one-third of East Fork appears to be suitable nesting habitat. In Smoky Creek, suitable nesting habitat is primarliy to the west of Smoky Creek, though there is some habitat to the east of the creek. More than one-third of Smoky Creek appears to be suitable nesting habitat. It is unlikely that nesting habitat in either watershed currently limits sharp-shinned hawk numbers. Nearly all of the watersheds are suitable foraging habitat for this species.
Importance in the Larger Geographic Area.

Table 5-25. Quantity of 3G, 4G, and 4N habitats by land allocation and watershed (in acres).

EAST FORK	3G	4G	4N
Land Allocation			
Adaptive Management	15.9	0.1	0.0
Administratively Withdrawn	32.5	37.9	0.0
Congressionally Withdrawn	418.0	15.2	0.0
Late successional Reserve	997.9	5252.9	82.0
Matrix	594.8	100.5	0.0

SMOKY CREEK	3G	4G	4N
Land Allocation			
Adaptive Management	8.6	0.0	0.0
Administratively Withdrawn	1196.3	425.5	0.0
Congressionally Withdrawn	0.0	0.0	0.0
Late successional Reserve	473.1	554.6	13.4
Matrix	2687.1	2217.5	21.0

At the scale of both STNF and beyond, we believe that these watershed areas are relatively unimportant to sharp-shinned hawks because of their wide distribution and ability to inhabit and successfully reproduce in modified forest habitats. Because they are commonly found nesting in young stands of trees, Matrix lands will likely provide substantial sharp-shinned hawk nesting habitat.

Bald Eagle

Ecological Limitations to Distribution and Abundance.

Bald eagles have been seen on the South Fork on the boundary of the Smoky Creek watershed, but are not known to have nested in either watershed or within 5 miles of either one. Suitable bald eagle nesting habitat includes: close proximity to fish-bearing water (Lehman 1979), large diameter trees greater than 39 inches (100 cm) that rise above the surrounding canopy (Anthony et al 1982), and low levels of human disturbance (Gerrard and Bortolotti 1988). The most likely potential nesting habitat for bald eagles in both watersheds is along the South Fork itself. Non-breeding bald eagles have similar requirements except that nest trees are not needed. However, adequate perch-sites near foraging areas are needed. The most suitable non-breeding bald eagle habitat in both watersheds is also along the South Fork.

Importance in the Larger Geographic Area.

Currently these watersheds probably only provide foraging opportunities for bald eagles. Relative to other areas on STNF and within the larger bioregion, these watersheds are much less important for bald eagles because of their apparent lack of supporting even one breeding pair (though to our knowledge, no systematic surveys have been done in the watersheds). Areas within the STNF such as Shasta Lake are considered of major importance to bald eagles state-wide and support many breeding pairs. If nesting occurs in either watershed, the importance of the watershed in which it occurs in will assume greater importance.

Osprey

Ecological Limitations to Distribution and Abundance.

Specific data on osprey do not exist for either watershed, except for one sighting in 1994. Osprey are usually migratory in northern California, with most individuals breeding here, but wintering to the south. Nest sites and prey abundance are the two factors that are most limiting to osprey. Osprey nests are almost always in the tops of large broken-top trees (Poole 1989) which are usually dominant or co-dominant in stands. Generally their nests are close to water, but they will fly greater than three miles (5 km) from nests to forage (J. Dunk, personal observation). Some of the larger tributaries to the South Fork, including the East Fork, may contain adequate fish resources to support breeding osprey, but osprey numbers are likely to be greatest along the South Fork.

Importance in the Larger Geographic Area.

These watersheds are relatively unimportant to osprey at both the scale of STNF and larger scales because Osprey are well distributed throughout the region and the country, and are found at much higher breeding densities elsewhere in STNF (e.g., along lakeshores and the mainstem Trinity River).

American Peregrine Falcon

Ecological Limitations to Distribution and Abundance.

Peregrine falcons are not known to currently use either watershed (however, to our knowledge, no systematic surveys of them have been conducted in either watershed). The closest identified nesting site (eyrie) is greater than three miles (4.8 km) from East Fork, and the nearest sightings were at least one mile (1.6 km) outside the watershed boundaries (note: Downer [1993] observed peregrines during a compilation of general species' lists, but it is uncertain as to whether his observation was within the watersheds). Peregrine falcons in wildlands predominantly nest on rock outcrops or cliffs that are inaccessible to terrestrial predators. However, they are known to nest on a variety of structures including buildings in cities and in broken-top snags in some areas. At least one potential eyrie area (rock outcrop) exists in Smoky Creek (J. Dunk and S. Steinberg, personal observation), and there may be others. Peregrine Falcons prey almost exclusively on small to medium-size birds, and both watersheds have the potential to provide significant foraging opportunities for falcons nesting in or near the watersheds.

Importance in the Larger Geographic Area.

These watersheds are relatively unimportant to peregrine falcons relative to other areas within the STNF and at larger spatial scales. However, if breeding takes place in one of the watersheds, its importance will increase because of the low abundance of breeding peregrines at the scale of the entire state.

Northern Spotted Owl

Ecological Limitations to Distribution and Abundance

Critical Habitat. Critical habitat for the threatened northern spotted owl (*strix occidentalis caurina*) (NSO) is a legal designation identified under the Endangered Species Act, having been designated on January 15, 1992 (57 FR 1796). The intent of critical habitat is to provide the physical and biological features that were the basis for determining the habitat to be critical. Those physical or biological features are referred to as "primary constituent elements," and may include, but are not limited to:

(1) space for individual and population growth, and for normal behavior;
(2) food, water, air, light, minerals, or other nutritional or physiological requirements;
(3) cover or shelter;
(4) sites for breeding, reproduction, rearing of offspring, germination, or seed dispersal; and generally,
(5) habitats that are protected from disturbance or are representative of the historic, geographical, and ecological distributions of a species.

The primary constituent elements NSO critical habitat include:

(1) forests which provide nesting, roosting, or foraging habitat, including stands which currently provide foraging habitat for resident spotted owls, even if the stand may not currently provide nesting conditions;
(2) forest stands with adequate tree size and canopy cover to provide some protection from avian predators and at least minimal foraging opportunities. It is important to note some dispersal habitat may not provide nesting, roosting, or foraging habitat, though nesting, roosting, and foraging habitat will provide for dispersal;
(3) lands that have the potential to produce nesting, roosting, foraging, or dispersal habitat sometime in the future, though not currently in such a habitat condition.

Critical habitat within the analysis area includes #CA-38, identified by the USFWS as some of the best owl habitat in the province. This long, linear-shaped critical habitat unit overlaps different land allocations, and it was extended eastward from the former Habitat Conservation Area boundary on the southern end to connect to the Yolla Bolly-Middle Eel Wilderness Area and the Southern Interior Coast Range subprovince. This extension included high quality habitat with three additional owl pairs. The significance of this critical habitat unity for northern spotted owls is demonstrated by the expectation that this area will provide contiguous habitat to support 22 nesting pairs over time. This unit 2 to 4 miles east of #CA-37, and these two areas, form the southern extent of the Northern Interior Coast range subprovince. Critical habitat unit #CA-36 lies seven miles to the north and east, and #CA-35 is five to six miles to the north.

Nesting and Roosting Habitat Conditions. Nearly all studies that have examined nesting and roosting habitat in the Klamath Province and California. Coast provinces have found few differences between nest and roost habitat structure (see review in Bart and

Earnst 1992, pp 294-299). All studies reported canopy cover greater than 80 percent and an average of between 4 and 16 trees per acre of greater than 35 inches (88 cm) dbh, 13 to 23 trees per acre of 21 to 25 inches (53 to 63 cm) dbh, and larger numbers of small diameter trees. At larger spatial scales, NSO's have been found to select areas with more mature and old-growth forest that was less fragmented (Hunter et al 1995). NSO's select areas with complex forest structure (forests with uneven age and size distributions of trees) for nesting, roosting, and foraging in the Klamath province (Bart and Earnst 1992). Most areas within the watersheds that meet these criteria are areas containing size class and canopy cover values of 3G and 4G (Maps 15a and 15b, Appendix E).

The center of six NSO activity centers (1.3-mile radius circle) occur in East Fork. Three other activity center (AC) areas overlap the East Fork watershed boundary and an additional five activity center boundaries are within 1.3 miles of the watershed boundary (these do not include those present in the Smoky Creek watershed - see below). Because NSO's have large home ranges (see Gutiérrez et al 1995 for review) and can disperse long distances (Thomas et al 1990, Gutiérrez et al, in preparation), the owls in East Fork likely interact with owls from adjacent watersheds and beyond. The significance of the East Fork unit for spotted owls includes both production of young and maintaining adequate dispersal habitat/corridors to ensure that both immigrating and emigrating owls can successfully disperse (i.e. find an appropriate area in which to establish a home range), particularly between distant LSR patches. Most nests of spotted owls within and adjacent to this watershed unit are in, or adjacent to, riparian reserves and/or contain areas with size class 3 or greater trees.

The centers of nine NSO AC's are in the Smoky Creek watershed, with three activity centers which overlap the boundary by more than one third of their area (but the centers of those activity centers are in other watersheds), and seven others within one mile of Smoky Creek's boundaries. Most of the NSO AC's are in size-class 3 (12-24" dbh) forest lands. Several are in the most fragmented part (the southeast) of the watershed, but this is also the part with the most size class 4 (plus very small patches of size-class 6) stands. Many nest sites are in or very near riparian reserves.

The following data on known NSO nesting success (summarized in Table 5-26) should be evaluated with the understanding that the survey effort has not been consistent for all AC's -- most have not been surveyed every year and some apparently were surveyed only once or twice over the last 20 years. Nine NSO AC's are either completely or partially within the East Fork watershed. Young have never been detected at six of the AC's; and in fact, females have never been detected at two of the AC's. Young have been produced on two AC's completely within the watershed (1991 and 1992; 1990 and 1992, respectively), and on one (1991) that slightly extends into the watershed boundary. It should be recognized that AC's are drawn as circles around roost or nest sites, but there is no reason to believe that the birds' actual territories are circular. However, without an extensive study to delineate territory or home-range boundaries for each NSO, circular areas serve as an accepted approximation of the owls AC.

Table 5-26 . Northern Spotted Owl Activity Centers. For each watershed, activity centers above the dotted line are entirely within the watershed boundary; activity centers below the dotted line are partially within the watershed. Data Range refers to the first and last year for which data exists for a particular activity center; data on individual activity centers generally were not gathered each year within that range.

Watershed	Owl #	Data Range	Source	Status	Repro.Yr.	# Young
East Fork	TR101	1981-94	STNF	pair	----	---
East Fork	TR168	1974-94	STNF	pair	1990&92	2,2
East Fork	TR271	1974-94	STNF	male		
East Fork	TR272*	1985-94	STNF	pair	----	---
East Fork	TR273*	1989-92	STNF	pair	1991&92	2,2
East Fork	#100	1996	PSW	pair	----	---
----------	----------	----------	----------	----------	----------	
East Fork	TE013	1974-93	STNF	male		
East Fork	TE090	1989-92	STNF	pair	1991	1
East Fork	TR012	1926,73-90	?/STNF	pair	----	---
==========	==========	==========	==========	==========	==========	==========
Smoky	TR014	1973-91	STNF	pair	1991	1
Smoky	TR016	1973-90	STNF	pair	1984	2
Smoky	TR017	1973-89	STNF	indiv.		
Smoky	TR018	1973-84	STNF	pair	----	---
Smoky	TR304	1989-90	STNF	male		
Smoky	#842	1996	PSW	pair	----	---
Smoky	#120	1996	PSW	indiv.		
Smoky	#129	1996	PSW	male		
Smoky	#036	1996	PSW	male		
----------	----------	----------	----------	----------	----------	
Smoky	TR010	1973-90	STNF	pair	1990	2
Smoky	TR015	1973-89	STNF	pair	1982&84	1,2
Smoky	TR360/#091	1985-96	STNF/PSW	pair	1986	1

*probably same territory--in very close proximity; NSO's not detected on both in same year.

On average, NSO's only reproduce every two or three years. However, some pairs reproduce successfully nearly every year and others almost never successfully reproduce. Thus, the AC where two young were produced in each of two consecutive years is particularly noteworthy though it is unknown whether the individual adults were the same both years. More than 75 percent of the land within the AC's that produced young had at least 40 percent canopy coverage and contained at least 11 inch (28 cm) dbh trees (based on GIS maps).

Twelve NSO AC's are either completely or partially within the Smoky Creek watershed. Young are not known to have been produced on seven of the AC's. Two pairs of NSO are known to have produced young within the Smoky Creek watershed, one in 1984 and one in 1991. In addition, three other pairs with AC's partially within the watershed produced young in recent years: one in 1982 and 1984, one in 1986, and one in 1990. Unlike many of the individual owls detected in the watershed, the AC's of all reproductive pairs above included at least 60 percent forest habitat having at least 40 percent canopy coverage and 11 inches (28 cm) dbh trees.

In some portions within NSO range, barred owls (*Strix varia*) are believed to be displacing NSO's from territories and in some cases, interbreeding with them (Dark et al, in press); currently, this does not appear to be a problem in either Smoky Creek or East Fork watersheds because barred owls were never detected during systematic NSO surveys in the watersheds in 1996 (Zabel 1996), and have only been detected elsewhere on the Shasta-Trinity National Forest on approximately two occasions (Bardolf 1997).

<u>Dispersal Habitat Conditions</u>. Dispersal habitat is habitat that contains at least 40 percent canopy coverage according to the USFWS (Bornstein 1997). This definition should be considered the minimum acceptable quantity/quality of habitat for dispersal. Miller et al (1997) reported that dispersing NSO's used both older forests (mature and old-growth) and forests with closed canopies significantly more frequently than expected in Oregon. They also reported that NSO's that used clearcuts during dispersal had a significantly higher probability of mortality than owls that used clearcuts less or not at all. Based on GIS data, there are 12,555 acres (5,167 ha) of dispersal habitat in East Fork (51% of the watershed); most (7,402 acres [3,076 ha]) is in the LSR. Approximately 50 percent of the southern one third (particularly south of the East Fork itself) of the East Fork watershed is largely unfragmented in terms of dispersal habitat. Although the two "arms" (central and eastern) of the designated LSR in East Fork which extend northward are currently fragmented and quite rudimentary in terms of dispersal habitat, the riparian zones within the easternmost arm could in the future (as seral stages mature), provide good additional dispersal habitat connecting the large block of LSR/less-fragmented habitat in the south through surrounding Matrix and private lands to the Beegum and Upper Hayfork watersheds to the north. Aerial photographs from 1944 revealed that even prior to extensive logging in East Fork, the area within the more central, western-most arm of the LSR contained only sparsely distributed trees with little overall canopy cover, so this central arm of theLSR will probably provide dispersal habitat only within riparian reserves. According to STNF data on habitat structure along Buck Mountain, much of that area should meet the definition of dispersal habitat; however, our field visits and aerial photograph interpretation showed that some of this area does not have adequate structure (canopy closure) for NSO dispersal at present. Riparian reserves may serve as dispersal habitat (especially wider reserves along fish-bearing streams) in addition to providing nesting habitat, as the structure of the forest within reserves becomes more complex. The most problematic areas for dispersal are the sparsely covered areas near and at the ridgetops, mostly due to ultramafic conditions.

Overall, approximately 12,172 acres (5,009 ha) of Smoky Creek is potential dispersal habitat based on information from GIS maps. This represents 49 percent of the the entire watershed. 71 percent of the dispersal habitat is in Matrix, 19.4 percent in Administratively Withdrawn Area (AWA), 9.7 percent in LSR, and ;less than one percent in Adaptive Management Area (AMA). Higher elevation dispersal habitat is generally more fragmented, partly because of ultramafic soils, and partly because of prior timber harvesting in those areas. Currently, most potential dispersal habitat for NSO in the Smoky Creek watershed consists of a swath along the mainstem of Smoky

Creek going up through the middle intermittent tributary west of Mud Springs and then linking with the Upper Hayfork watershed along Dubakella Creek (better) or north on the ridgetops to South Dubakella Mountain (more sparse) (Map 4b, Appendix E). Field visists and aerial photo evaluation of these habitats confirmed the adequacy of habitat for NSO dispersal there. In spot-checking areas identified on the GIS layer as being adequate dispersal habitat with air photos, we found some discrepancies (e.g., southeast of the mouth of Smoky Creek below a cut patch identified on GIS as dispersal habitat clearly is not dispersal habitat when looking at air photos). Therefore, the GIS layer should not be used alone for determining dispersal habitat but should be used in conjunction with and cross-checked with air photos (or on-site verification). Another linear linkage exists between the LSR at the south boundary of Smoky Creek watershed up northwest of Rowski Creek and/or between Rowski and Spot Creeks which, from GIS maps then connect with the middle fork of Little Rattlesnake Creek and then to the mainstem of Little Rattlesnake Creek. Other fairly intact dispersal habitat includes the area around Murphy Gulch, the mid-section of Red Mountain Creek, and lower Soap Creek. Connectivity of dispersal habitat between Smoky Creek and East Fork watersheds appears adequate along the southern portion of the two watersheds, and this habitat is likely to remain at current levels, if not improve, in the future since it most of it is designated as LSR and AWA.

Importance in the Larger Geographic Area.

Because of the relatively large quantity of high-quality habitat within the watersheds, the existence of intact dispersal corridors from these watersheds and the LSR to other LSR's, the relatively high density of NSO activity centers within and adjacent to the watersheds, both watersheds are considered to be important at the scale of STNF and beyond. Recent demographic meta-analysis (Burnham et al 1996) showed the NSO to be declining at a rate of approximately 4.5 percent annually ($\lambda = 0.9548$, SE = 0.017) throughout its range. Similarly, for the most intensively studied population nearest East Fork and Smoky Creek (at Willow Creek, CA), the NSO population was estimated to be declining at a rate of approximately 3.5 percent annually (Franklin et al 1996). Thus, the loss of even a single breeding pair should be considered significant for a species whose overall population is already declining.

Flamulated Owl

Ecological Limitations to Distribution and Abundance.

Flamulated owl habitat is generally open ponderosa pine forests (though they also use forests with Douglas-fir and other species) containing a dense understory of brush (McCallum 1994). Flamulated owls are secondary cavity nesters (i.e. they cannot excavate their own cavities, but utilize those made by other species, primarily woodpeckers); thus, suitable cavities are needed for nesting. Nesting habitats have been described as old-growth (Reynolds and Linkhart 1992) and habitats that had been selectively logged (Howie and Ritcey 1987). In northwestern California, Marcot and Hill (1980) described flamulated owl territories as being on ridgetops and in xeric mid-slope habitats containing two-layered canopies. These habitat needs closely match 3G and 4G type habitats that have not been logged or that have been selectively cut (and possibly some 3 to 4P and N with dense understory such as along creeks) and which contain some residual old-growth forest components such as snags (for nest sites). In East Fork, suitable nesting habitat exists in the southern (LSR), central, and east-central portions of the watershed. We estimate that approximately 4,000 acres of suitable nesting habitat exist in East Fork. In Smoky Creek, nesting habitat is primarily along the southern boundary, in the south-south-central portion of the area, adjacent to the mainstem of Smoky Creek, and a few areas in the northwest portion of the watershed.

Importance in the Larger Geographic Area.

Because of the relatively large quantity of apparently suitable habitat, we consider these watersheds to be of intermediate importance for flamulated owls at the scale of STNF and of less importance at larger spatial scales. However, little is known about the demography of flamulated owls overall, and no surveys are known to have been conducted within either watershed.

White-headed Woodpecker

Ecological Limitations to Distribution and Abundance.

Pines, often mixed with other species, are a common component of white-headed woodpecker habitat. Dixon (1995, cited in Garrett et al 1996) reported that white-headed woodpeckers in south-central Oregon selected areas of multi-storied old-growth ponderosa pine with greater than 51 percent canopy cover, greater than 12 square meters/hectares basal area of greater than 21 inches (53 cm) dbh trees, and greater than 30% shrub cover. White-headed woodpeckers will also occupy areas that have been burned or cut as long as residual large-diameter live and dead trees are present (Raphael and White 1984, Raphael et al 1987). During a site visit, a white-headed woodpecker was seen near the White Rock camp, an area classified by STNF as 3G habitat. However, the area appeared to be largely 4G habitat dominated by ponderosa pines, many of which measured greater than 39 inches (100 cm) dbh (J. Dunk and S. Steinberg, personal observations). Suitable white-headed woodpecker habitats within the watersheds are primarily areas of 3N, 3G, 4N, and 4G habitats (Maps 6a dn 6b, Appendix E). To be suitable, 3N habitats should also contain some residual old-forest components.

In East Fork, considering canopy cover and tree diameter only, approximately one third of the watershed is suitable for white-headed woodpeckers. The northwestern portion of East Fork is unsuitable. Similarly, in Smoky Creek, greater than one third of the watershed appears suitable, with most habitat being along the south boundary and to the west of Smoky Creek. However, the size, distribution, and abundance of snags is unknown for both watersheds and thus it is likely that less area in each watershed is suitable.

Importance in the Larger Geographic Area.

As with flamulated owls, neither the abundance nor demography of white-headed woodpeckers is known for either watershed. These watersheds may be of intermediate importance to this species at the scale of STNF, and of less importance at larger spatial scales because of their relatively wide distribution.

Vaux's Swift

Ecological Limitations to Distribution and Abundance.

Between 1980 and 1994, BBS survey data indicate that Vaux's swifts have declined by eight percent annually. Vaux's swifts communally nest and roost in hollow trees, particularly old-growth trees (mean dbh = 27" [67.5 cm] in Oregon [Bull and Collins 1993]). They forage in forest openings and areas over open water bodies, including streams (Grinnell and Miller 1944). LSR areas adjacent to the South Fork and perhaps riparian reserves along the lower East Fork river with hollow, large-diameter trees near forest openings are the likely habitat in both watersheds. Because of the importance of snags and the current lack of data on their size, distribution, and abundance in the watersheds, it is difficult to attempt to quantify the amount of suitable habitat in either watershed. Much of both areas could be suitable if appropriately sized and situated snags are available.

Importance in the Larger Geographic Area.

If a substantial roost (i.e. > 1,000 birds) exists in either watershed, that area would be of relatively great importance at the scale of the STNF and possibly larger spatial scales as well. Without a substantial roost, neither watershed is likely to be of much relative importance to Vaux's swifts at larger spatial scales.

Willow Flycatcher

Ecological Limitations to Distribution and Abundance.

The willow flycatcher is a USFS Region 5 Sensitive Species, and a USFWS Region 1 (which encompasses the USFS Region 5) Sensitive Species. It is believed that historically the bulk of the population occurred in central and southern California; they may never have been very common in northern California, but little survey effort was expended in northern California (Harris et al 1987). Population declines are attributed to loss of wide riverbottom habitat and possibly also to cowbird nest-parasitism which this species is susceptible to at low elevations (Harris et al 1987 and references therein).

Importance in the Larger Geographic Area.

Breeding habitat for willow flycatchers is generally characterized as riparian vegetation of small tree or shrub thickets, especially willows, separated by openings (R.A. Wilson 1995, Sedgwick and Knopf 1992 and references therein, Harris et al 1987). This species selects habitat containing a high percentage (50-70%) of willow cover (Sedgwick and Knoft 1992, Sanders and Flett 1989). Willow flycatchers forage in meadows, particularly those that are large (> 8 ha) and wet (Serena 1988, Harris et al 1987). During the breeding season willow flycatchers seem to prefer areas with standing water, possibly because prey (mosquitoes and other flying insects) are more common in such areas (R.A. Wilson 1995, Harris et al 1987). Very little willow habitat was identified by surveyors on Smoky Creek , and it was deemed too scanty or inadequate to serve as habitat for this species; for this reason, no willow flycatcher surveys were conducted (USDA Forest Service 1994). Likewise, it appears (from air-photo analysis) that willow clumps on the South Fork are scattered and very thin, thus unlikely to provide much suitable breeding habitat for flycatchers. During extensive surveys on the lower 14 miles (23 km) of the South Fork (outside the watershed areas, below Surprise Creek) during the breeding season in 1992 no willow flycatchers were found (R.A. Wilson 1995). Wilson (1995) stated that willow vegetation along the South Fork (at least the lower part) is scanty, probably due to the regular flood flows that scour vegetation from the riverbanks. It is possible, however, that willow flycatchers may use areas along the South Fork during migration, even if they do not breed there.

Importance in the Larger Geographic Area.

Neither watershed appears to be of much relative importance to willow flycatchers at larger spatial scales because of the minimal quantity and quality of habitat.

<u>Black-capped Chickadee</u>

Ecological Limitations to Distribution and Abundance.

Black-capped chickadee breeding habitat is generally considered to be woodland edges, especially areas with alders (*Alnus* sp.) or birches (*Betula* sp.) (Smith 1993). Black-capped chickadees are also secondary cavity nesters, with nests most often in dead snags or rotten branches, though they also use woodpecker holes and bird boxes. Snags within Matrix, AWA, Congressionally Reserved Area (CRA) lands, riparian reserves, and LSR edges should provide adequate nesting sites for black-capped chickadees. Much of this habitat exists in both watershed areas.

Importance in the Larger Geographic Area.

These watersheds are of little importance to black-capped chicadees at larger spatial scales because of the chickadees' wide distribution and relatively high abundance.

<u>Pygmy Nuthatch</u>

Ecological Limitations to Distribution and Abundance.

Pygmy nuthatches are generally associated with ponderosa-pine-dominated habitats, and their abundance responded linearly to increased ponderosa pine foliage volume and an index to food availability (the index was a combination of percentage canopy cover--optimal was between 50 and 75 percent--and height of overstory - taller was better) (O'Brien 1990). However, this species is not considered an obligate ponderosa pine inhabitant. In the watersheds, pygmy nuthatch habitat is similar to that of white-headed woodpeckers (USDA/USDI 1994) - 3N, 3G, 4N, and 4G habitats containing some ponderosa pine (Maps 6a dn 6b, Appendix E).

Importance in the Larger Geographic Area.

These watersheds are considered to be of intermediate importance to pygmy nuthatches at the spatial scale of STNF because there is a fair amount of relatively high-quality habitat intact within the watersheds, and of less importance as scale increases.

Yellow Warbler

Ecological Limitations to Distribution and Abundance.

Breeding habitat for yellow warblers is generally dense brush along riparian areas. Specific bush species are less important than the dense structure of the bushes (Knopf and Sedgwick 1992). It is likely that yellow warblers nest within both watersheds, but few of the areas near streams/creeks/rivers that were observed during field visits had dense brushy vegetation and no yellow warblers were detected during bird surveys in Smoky Creek (USDA Forest Service 1994). However, owing to the large number of streams in the watersheds, it is likely that some habitat exists.

Importance in the Larger Geographic Area.

Neither watershed is likely to be of much relative importance to yellow warblers at larger spatial scales owing to their wide distribution and relative abundance.

Yellow-breasted Chat

Ecological Limitations to Distribution and Abundance.

Yellow-breasted chats are considered to be nearly an obligate riparian habitat species during the breeding season. Their nesting habitat generally consists of low dense shrubs near or adjacent to streams (Brown and Trosset 1989). No yellow-breasted chats were detected during bird surveys in Smoky Creek (USDA Forest Service 1994b), nor were any detected during field visits. Of the streamside vegetation observed during field visits, little appeared suitable for chats. However, owing to the large number of streams and the fact that we were not able to visit all potential habitat (habitat adjacent to much of East Fork or the South Fork itself), it is likely that some breeding habitat for chats exists within the watersheds.

Importance in the Larger Geographic Area.

At larger spatial scales, neither watershed appears to be of importance to yellow-breasted chats. The lack of much true riparian vegetation limits the importance of these areas.

Mammals

Pacific Fisher

Ecological Limitations to Distribution and Abundance.

Pacific fisher have been seen in both watersheds on several occassions over the past 10 years (see Chapter 3). Although fisher are known to use a variety of habitat types, Dark (1997) reported that on the STNF they generally selected areas with greater than 50 percent canopy cover in forests with large, multi-storied canopies. Similarly, Buck (1982) reported that fishers (near Big Bar, CA) occurrred most frequently in stands composed of mature, closed-canopy conifers. As a first approximation of current fisher habitat we overlayed areas containing at least 50 percent canopy cover with those containing at least size class 4 (24" dbh) trees. Powell and Zielinski (1994 and citations therein) stated that fishers generally avoid nonforested areas, sometimes areas as narrow as 25 meters across. Roads may serve as at least partial barriers to fisher movements, and there are many miles of roads in both watersheds; the South Fork Coordinated Resource Management Plan (Truman and Pacific Watershed Associates 1996) states that these two watersheds have some of the highest road densities in the entire STNF. Furthermore, Rosenberg and Raphael (1986) reported that fishers were "area sensitive" species in northwestern California. Their findings suggest that as forested landscapes become more fragmented, with openings, fishers will become less prevalent (Powell and Zielinski 1994).

Thirty one distinct patches of fisher habitat (as defined above) exist in Smoky Creek. However, the total area of these patches is much less than 20 percent of Smoky Creek. These fragments of habitat exist primarily in the south-south-central and south-south-east portion of Smoky Creek. A few small patches also exist in the northwest portion of Smoky Creek. The adjacent LSR will likely function as a source habitat once habitat in Smoky Creek becomes more suitable. Further, riparian reserves will become important habitat including dispersal corridors, as they develop a more complex structure (i.e. multi-level canopies). We expect that the dispersal habitat identified for NSO's (see above) will also serve as dispersal, foraging, and possibly breeding habitat for fishers. On average, there are three miles of roads per square mile of area in Smoky Creek. The highly fragmented nature of Smoky Creek may be negatively impacting fishers.

Eight distinct patches of fisher habitat exist in East Fork, with the largest patch representing greater than 85 percent of the total suitable habitat in the watershed. Nearly all currently suitable habitat is in the southern portion of East Fork and within LSR-designated land. The potential exists to increase the quantity and quality of habitat, particularly within the LSR, as much of it is currently sub-optimal. Mean road density in East Fork is 3.5 miles of road per square mile. The fragmented nature of East Fork may be negatively impacting fishers.

Importance in the Larger Geographic Area.

Owing to the lack of data on fishers in the watersheds we are uncertain as to their relative importance at larger spatial scales. However, based on the amount of LSR in and adjacent to the watersheds and intact dispersal corridors (see Dispersal Habitat discussion of NSO, page 80) in both watersheds, it is likely that these watersheds are of much greater relative importance to this species than many other watersheds in the STNF. Similarly, because of the apparent reduction in fisher numbers and distribution over the past 100 or more years, sites containing fishers presently are more important even at larger spatial scales.

Red Tree Vole

Ecological Limitations to Distribution and Abundance.

Red tree voles are considered to be closely associated with mature coniferous forests in western Oregon and northwestern California. Gillesberg and Carey (1991) reported that trees used for nesting by red tree voles were significantly larger in dbh than those that were not used (39" vs 31" [100 cm vs. 78 cm]). To our knowledge, red tree voles have not been observed within the watersheds, but no surveys have been done and they are not a ubiquitous species. The primary red tree vole habitat within the watersheds closely matches the descriptions of nesting and roosting habitat for NSO's (see above, pg. 78): 3G and 4G habitats. Although 3G habitats are defined as having trees of 24 to 36 inches (61-91 cm) dbh, many 3G sites observed during site visits had trees greater than 36 inches (91 cm).

Importance in the Larger Geographic Area.

These watersheds are probably of intermediate to relatively great importance to red tree voles at the scale of STNF because of the distribution and abundance of late successional stands, but of less importance at large spatial scales.

Bats

To our knowledge, no surveys for bats have been conducted in either the Smoky Creek or East Fork watersheds, and there are no specific data on bats in these watersheds. During our limited fieldwork in May 1997, bats (not identified to species) were seen in several areas in the watersheds (J. Dunk and S. Steinberg, personal observations). Also, data on snags (densities and sizes), which are important habitat components for bats, are extremely limited for these watersheds. The state of knowledge about bats species that do not hibernate in large colonies in caves (e.g. most of the species below) is rather sparse, so the discussions below are, of necessity, conjectural to some extent.

Given the lack of information on local roost (particularly maternity roosts) and hibernation sites, which are vitally important to all the bat species in determining their presence in any given area within their known range, we cannot speculate on the importance of these watersheds to any of the species at larger spatial scales (Key Question 2.2). If roosts and appropriate hibernation sites are available to these species within acceptable foraging and "migrating" distances respectively, then these watersheds may be used by any or all of the below species.

Spotted Bat

Ecological Limitations to Distribution and Abundance.

Little is known about this elusive and somewhat solitary bat. The WHR model did not identify the spotted bat as as species likely to occur in the Hayfork and Yolla Bolly Districts, but we believe this is based on outdated range maps for the species, not on lack of appropriate habitat. As a result of better survey methods in recent years, researchers are finding that although rare, this species' range is much more widespread than previously thought (Aida Parkinson, Redwood National Park, pers. comm.), residing year-round from low desert to high mountain habitats in the west; a range extension into the Trinity Alps has recently been identified (Pierson 1996). This species has been associated with ponderosa pine forests, mixed conifer, and Jeffrey pine, as well as other habitats (Marcot 1979) which are less common in these watersheds. Diurnal roosts are mainly in crevices in cliffs, and possibly also mines and caves. Few hibernation locations have been found, but spotted bats are not believed to migrate far from summer sites. This species forages late at night, and specializes on moths and has been found to forage in wet meadows and forest edges (Pierson 1996). In Oregon, lepidopterans (including moths) were more common in uncut forested riparian areas than in clearcut riparian areas (Hayes and Adam 1995). Therefore, it is possible that in addition to wet meadows (which occur but are not common in these watersheds), edges of riparian reserves and late successional stands might be important foraging areas for this species in these watersheds. In addition, like other bat species, it requires open water sources within a few miles of foraging and roosting areas. Areas in these watersheds that likely meet this species known or suspected foraging, roosting and water requirements are fairly widespread. However, due to the paucity of information on this species' wintering requirements, we cannot determine whether hibernation sites are also likely to be available in the vicinity.

Pallid bat

Ecological Limitations to Distribution and Abundance.

This ground-foraging species is typically associated with open desert habitats, but is also found in many other vegetation types (Marcot 1979, although the STNF's modified WHR model lists only 4, mostly chaparral, vegetation types) including arid or riparian shrub habitats and also dry forests including ponderosa pine (USDA 1994). In arid places, they are more common near open water, although some have been found in desert areas with no identifiable source of water (Hermanson and O'Shea 1983 and references therein). Potential appropriate foraging habitats occur in these watersheds. Although LRMP vegetation maps show montane shrub habitats comprising less than one percent of each area, the shrub component of the watersheds is probably much greater (see Tables 5-10 and 5-11). However, lack of appropriate water bodies near the majority of shrub habitats in these watersheds may limit suitability of these habitats for the pallid bat. It is unknown whether this species might utilize the generally dense shrub habitats of early succession stages after clearcuts. Grassland areas in the watersheds might also be appropriate foraging areas but are extremely limited (either private lands or a few meadow areas). The most likely areas for this species to occur are the sparse ultramafic forested habitats below 6,000 feet, with stock ponds or log ponds nearby, and the open areas along the South Fork.

Day and night roosts include crevices in rocky outcrops, buildings, and sometimes trees (Marcot 1979) and bridges; they are intolerant of disturbance at the roost (Barbour and Davis 1969). In these watersheds, open pit mines, abandoned buildings (e.g. White Rock ranger station), rock outcrops, and bridges are potential roost sites, in addition to trees. Pallid bats have been described as sedentary and unlikely to travel great distances between summer sites and winter hibernacula (Barbour and Davis 1969). Pallid bats awaken periodically during hibernation and forage and drink in the winter (Pierson 1996); therefore, open water may be necessary near hibernation sites. Although few hibernation sites have ever been discovered, caves with free water were identified as a special habitat requirement for hibernation (Marcot 1979). We do not know of any such caves in the watersheds, nor where the nearest suitable caves are. In summary, appropriate foraging habitats, and probably roost sites, occur in the watersheds, but suitable hibernation locations are probably the limiting factor for presence of pallid bats here.

Silver-haired Bat

Ecological Limitations to Distribution and Abundance.

This species has a large range, but it is patchily distributed, being very abundant in some areas and uncommon in others. In the Pacific Northwest, this species forages in or near coniferous and mixed deciduous forest habitats with water courses in the vicinity, and takes a variety of insects. Although Hayes and Adam (1995) found silver-haired bats foraging in logged rather than uncut habitats in their Oregon study area, this species has been most commonly found in older forests (Perkins and Cross 1988), probably because of the presence of suitable roost sites (Campbell et al 1996). Silver-haired bats generally roost in cracks and crevices in tree bark or in tree cavities (Barbour and Davis 1969, and others) of species such as Douglas-fir and ponderosa pine (Perkins and Cross 1988, Campbell et al 1996). Campbell et al (1996) in Washington and Betts (1995) in Oregon found that these bats roosted in large trees and, most often, in well-decayed snags (mean dbh of 47 cm in the Washington study); Campbell et al (1996) also found that roost trees were much taller than surrounding trees (citing flight access and microclimate advantages as possible reasons), and that roosts were all greater than 100 meters upslope from riparian foraging areas (again suggesting thermoregulatory advantage in the warmer upslope sites). Although silver-haired bats may change roosts frequently, they tend to choose new roosts in the vicinity of the old one (Betts 1995). Most, if not all populations migrate from summer sites to wintering sites where they roost in mines, caves, hollow trees, under loose tree bark, rock crevices, and buildings (Kunz 1982). Given a variety of adequate summer roost sites (large trees and snags), this species is likely to occur in these watersheds since suitable foraging habitat along riparian corridors seems to be abundant. Although wintering sites may be lacking, it would not preclude this species (which probably migrates elsewhere for the winter) from occurring here during other times of year.

Long-legged Myotis

Ecological Limitations to Distribution and Abundance.

This species is associated with mid-to-high elevation (generally 2,000-3,000 m) coniferous forests (ponderosa, mixed conifer, Jeffrey pine) and riparian areas. It forages in open areas on moths and other insects. Hollow trees and large snags have been identified as important day roosts for this species in central Oregon forests (Ormsbee 1995). This bat may also roost in rock crevices, mines, abandoned buildings, and under loose tree bark (Warner and Czaplewski 1984). In these watersheds, forests on ultramafic substrates may serve as suitable foraging habitat for this species, particularly in areas where large trees and/or snags which could serve as roosts remain in adjacent riparian corridors. Long-legged myotis hibernates in caves or mines, but may be active in winter. We have no information on whether hibernation sites occur in these watersheds, or how far this species may migrate to hibernacula.

Townsends Big-eared Bat

Ecological Limitations to Distribution and Abundance.

The Townsend's big-eared bat has a large range distribution and is found from sea level to more than 3,000 meters (Pearson et al 1952). But populations of the western subspecies have declined considerably in Oregon, Washington, and California. In coastal California, populations have declined precipitously in recent decades (65% decline in number of individuals, 46 percent decline in maternity roosts, etc.), with the main cause of the decline being human disturbance of roosts (Pierson 1988); surveys of some hibernacula in Shasta County indicated that big-eared bats may be declining there as well (Pierson 1988).

In some areas it forages in forest openings, on forest edges, and along roads (Kunz and Martin 1982, Clark et al 1993). However, in northern California, Rainey and Pierson (1993) found this species foraging within forest habitats and thick riparian corridors. This species is considered somewhat sedentary, with no known long-distance migrations; the maximum migration distance known in California was approximately 32 kilometers (Pearson et al 1952).Townsends big-eared bat has more restrictive roost requirements than the other species above. This species is colonial, roosting and hibernating in clusters on open spaces in mines, the ceilings of caves, buildings, and bridges (Barbour and Davis 1969); as a result, they are more visible and vulnerable to disturbance than species which utilize crevices. Recently, the possibility of their roosting in large hollow trees and snags has been identified (G. Fellers personal communication, in Gellman and Zielinski 1996). Individuals show strong site fidelity and return to the same roost for many years; nursery roosts seem to be made up of multi-generational colonies of females and their young (Pierson 1988 and references therein). This species is highly sensitive to disturbance at roosts, thus the impact of human activities in or around roosts can be very great and long-lasting (Pierson 1988, and references therein).

This species has not been identified in the East Fork or Smoky Creek watersheds, but is known from a number of caves on the Forest, including caves in both Yolla Bolla and

Hayfork districts (from Appendix 2: Known Sites of Component 1 Survey & Manage Species and Protection Buffer Species on the STNF as of January 1997); a spring (March/April) survey was conducted by Bruce Marcot and others in 1979, and the caves were considered to be hibernacula (Marcot 1994). Bats within the watershed analysis area would probably be able to travel the distance to one or more of these caves (the nearest is 6-7 miles) for hibernation, but they would still need appropriate maternity roosts and day roosts nearby. Given the apparent lack of caves and underground mines in East Fork and Smoky Creek, the most likely roost sites in the watersheds would be old barns and other abandoned buildings (e.g. at White Rock). Foraging areas are probably not limiting in these watersheds.

Other Species

Eighteen mollusks were identified in the LRMP as Survey and Manage species (USDA Forest Service 1993, Appendix R), as well as several guilds of arthropods (not identified to species level). Apparently, the Forest has no data on any of these invertebrates, and the LRMP does not even specify whether these invertebrates should be suspected to occur on the STNF. Therefore, we can make no inferences with regard to these species in either watershed.

Late Successional Reserve

The Condition of the LSR

LSR's were established to "protect and enhance conditions of late-successional and old-growth forest ecosystems, which serve as habitat for late-successional and old-growth-related species including the NSO. These reserves are designed to maintain a functional, interacting, late-successional and old-growth forest ecosystem" (USDA/USDI 1994). Furthermore, late succesional (LS) habitats are mandated to be "well distributed" by both the National Forest Managment Act of 1976 and the Northwest ROD (USDA/USDI 1994). In evaluating whether LS habitats are well distributed, we follow the recommendation of Raphael and Marcot (1994) who stated "Well distributed is described in relation to the dispersal or movement capabilites of particular species...." Thus, the maintenance and/or creation of corridors between LSR's, and among LSR's and LS habitats within other land allocations are intended to satisfy this requirement.

Much of the information for evaluation of the LSR's and LS habitats in these watersheds comes from examination of GIS map layers provided by STNF and are based on 1979 data generated by aerial photograph interpretation. We also supplemented these map layers with both field visits and examination of recent (1990 for East Fork, 1995 for Smoky Creek) and historic (1944) aerial photographs.

By one USFS definition (USDA Forest Service 1993, 3-6), LS forests consist of 4c or larger (WHR size classes: Mayer and Laudenslayer 1988), which corresponds to 4G and 5G timber strata. Another USFS definition (USDA Forest Service 1993, 4-15) describes old-growth stands as 4a-c and older where average tree size is 21 inches (53 cm) dbh or greater, which roughly corresponds to timber strata 4S and greater.

After field visits, the watershed analysis (WA) team agreed that for this analysis, LS habitats (habitat types with adequate canopy cover and structural elements) in these watersheds would be defined as size class and canopy cover 3G, 4G, and 4N. After evaluating some 3G stands in the field, we were confident that in general they were LS habitats (multistoried canopies, snags, dead and down woody debris, etc.). Moreover, some stands classified by STNF GIS layers as 3G were considered to actually be 4G stands (J. Dunk and S. Steinberg, personal observations). However, field visits also revealed that some areas classified as 4G had been selectively cut with only the smaller trees being left (e.g., along portions of Buck Ridge in East Fork and within the central portion of Smoky Creek in Matrix land). Although there appeared to be errors in stand classification both ways (i.e. some habitats being classified as having larger trees and greater canopy cover when they really had less, and others classified as having smaller trees when they actually had larger trees), the acreages used below are likely to be overestimates of actual acreages of LS habitat, probably by approximately 10 percent. This is because some stands classified as 3G were really 4G which did not change the quantity of LS habitat, whereas a stand classified as 4G that was really 3N or smaller, would result in an overestimate of LS habitat. In addition, a small portion of LSR (992 acres in Smoky Creek and 120 acres in East Fork) is found on ultramafic soils. Because of the inherently poor conditions on these soils, the result is sparse vegetation growth; these areas will probably never have the typical characteristics of a mature, late-successional forest as found in other areas within the LSR.

East Fork

In the East Fork, the LSR comprises the southern half of the watershed, from the confluence of the East Fork with the South Fork to the Yolla Bolla Wilderness area, with an arm extending up to the Pony Buck Peak area and also up to White Rock (Map 2, Appendix E). There are two large parcels of private property within the LSR; one along Hwy. 30 and another in the northern half of section 36 (T28N, R11W), neither of which are included in subsequent calculations or discussion.

The East Fork portion of the LSR is 10,594 acres (4,360 ha) which represents 43 percent of the watershed. Within East Fork portion of the LSR a total of 6,333 acres (2,606 ha) are classified as 3G, 4G, or 4N (i.e. LS). This total consists of 998 acres (411 ha) of 3G, 5,253 acres (2,162 ha) of 4G, and 82 acres (34 ha) of 4N. This 6,333 acres (2,606 ha) of LS habitat represents 59.8 percent of the LSR and 26.04 percent of the 24,593 acre (10,121 ha) watershed (Map 18a, Appendix E). Much of this acreage consists of a fairly continuous band of LS habitat approximately 12 miles (19.2 km) long and 3 miles (4.8 km) wide paralleling the southern boundary of the watershed; this band of LS habitat consists primarily of 4G (6,350 acres [2,613 ha], some outside the LSR), but also includes 3G stands in the wilderness area of the watershed, as well as a few 3G stands in adjoining matrix lands. This band is fragmented in the Buck Ridge area of the LSR by nearly 20 old clear cuts (Map 9a, Appendix E). Compared with the surrounding 4G stands, these regenerating (either naturally or planted) clear cuts consist of pole-size trees with sparse to moderate canopy (i.e., 2S or P stands). The area of the LSR to the east of West Low Gap is a roadless area and has never been entered for timber harvesting, so stands within this area are in their natural conditions. The 4G band is also fragmented by a large stand of Douglas-fir with moderate canopy cover that is located below Black Rock Mountain. On the eastern boundary of the watershed, the 4G band is fragmented by two regenerating clear cuts.

The arm extending up to Pony Buck Peak is approximately 3.25 miles (5.2 km) long and 2.5 miles (4 km) wide, and is mostly comprised of 3S and P stands of Douglas-fir and Klamath mixed conifer, with 10 regenerating clear cuts of 1S stands. Beginning at the block of 4G in the southern region of the LSR, the next LS stands are two 4G (98 acres [40 ha] total) stands approximately 1.6 miles (2.5 km) to the north near the 28N10 road. From these stands the next 4G stands (181 acres [74 ha]) are located approximately 1.75 miles (2.6 km) to the north around Dark Canyon Creek, near Pony Buck Peak. Less than 0.15 miles (0.25 km) from this stand are two stands of 3G (20 and 50 acres [8 and 20.5 ha]) around the 28N23 road.

From Stuart Gap to White Rock, the LSR is 1.5 miles (2.4 km) wide and 1 mile (1.6 km) long (from the 4G band in the southern area of the LSR to the northern boundary of the watershed). Here there are two stands of 3G (70 and 84 acres [29 and 34.5 ha]) that are separated by distances ranging from 0.5 mile to 1.5 miles (0.8 to 2.4 km). The remaining stands of these areas are comprised of 3P, with three regenerating clear cuts of 1S and P.

Although it is not designated as part of the LSR, the northern corner of the Yolla Bolla Wilderness (i.e., the Black Rock Mountain area) is adjacent to the LSR and provides a continuation of undisturbed, mostly LS stands. The stands within this region of the wilderness consists primarily of 3G and N stands of red and white fir.

There are seven distinct LS stands within the East Fork portion of the LSR, with the largest one representing greater than 90 percent of all LS area. There is less fragmentation in the East Fork portion of the LSR than in Smoky Creek's, but it is still rather substantial. Significant fragmentation within the LSR reduces the overall quality of the existing LS stands. This reduction in quality is a function of both biotic and abiotic edge-effects. The four primary concerns we have regarding edge are: 1) isolation of less-mobile LS species (see connectivity section below and section on Corridors for discussions of this issue), 2) increased opportunity for brown-headed cowbird (*Molothrus ater*) brood parasitism, 3) an increase in the abundance of potential nest predators (e.g., of neotropical migrant birds, NSO's, etc), and 4) edge-induced impacts on microclimate within LS stands. As an index of fragmentation, we divided the linear distance of edge (i.e. perimeter) around LS polygons by the area of LS habitat. The total amount of edge around LS polygons within the LSR is approximately 480,987 feet (150,271 m), whereas if the LSR were entirely composed of LS forest, there would be approximately 100,066 feet (30,500 m) of edge. Furthermore, East Fork's portion of the LSR currently contains approximately 6,333 acres (2,606 ha) of LS habitat. The index to fragmentation (linear distance of edge divided by area of LS habitat) in the East Fork LSR is approximately 58 meters:1 hectare, whereas it would be 7 meters:1 hectare if edges only existed along the perimeter of the LSR. Because of edge-effects, the amount of functional LS habitat within the LSR is less than the total area within 3G, 4G, and 4N polygons. Based on the general finding of Paton (1994), we considered the first 164 feet (50 meters) of land inside the LSR boundary as not properly functioning LS habitat. The 164 feet was the average distance that edge-related predation and brood parasitism were influential on neotropical migrant songbird nesting success. With regard to microclimate, we feel that 164 feet (50 m) is a very conservative estimate of edge-effects. For example, Chen et al (1992) reported that for Douglas-fir forests, "The depth-of-edge influence, when calculated as the point along the clearcut-forest gradient at which a given variable has returned to a condition representing 2/3 of the interior forest environment, ranged from 16 to 137 meters for variables related to distance from edge." The amount of functional LS habitat within the LSR excluding the 50 meter transition zone around the perimeter of LS polygons is approximately 4,596 acres (1,891 ha), whereas if the entire LSR were LS habitat the amount of functional area would be approximately 10,236 acres (4,212 ha). The last figure probably somewhat overestimates potential functional habitat because the two arms of the LSR are on ultramafic soils and these areas will never produce the type of closed-canopy LS habitat found in other areas of the watershed. However, the forests on this substrate would create a "soft" edge relative to clearcuts/plantations.

Currently, the portion of LSR in East Fork has two semi-intact corridors/connections with two other LSR's. The riparian areas along an unnamed tributary and the East Fork in the eastern arm of the LSR come close to connecting with the portion of the LSR in the Beegum watershed (Map 2, Appendix E). However, the riparian areas are narrow, and the ridgetop areas above the headwaters of these streams are very sparsely covered and represents a barrier to dispersal by herpetofauna considered in this analysis and red-tree voles. Exposure to arid conditions for herpetofauna and predators for both herpetofauna and voles are likely reasons for this. While the more open habitats at these higher elevations are not complete barriers for other species (e.g., NSO), the openness of the landscape presents significantly higher risks of predation to these organisms.

Smoky Creek

The Smoky Creek portion of the LSR is located in the northwestern corner of the watershed, encompassing the area between Hell Gate campground and the Peyton Creek area, extending to the northern and southern boundaries of the watershed (Map 2, Appendix E). Within the LSR there are three private parcels, located in sections 29, 33 (T1S, R8E), and 30 (T29W, R12W), which are excluded from the following calculations and discussion. The Smoky Creek portion of the LSR is 2,195 acres (903 ha) which represents 13.8 percent of the watershed. Within the Smoky Creek portion of the LSR, a total of 1,041 acres (428 ha) is classified as 3G, 4G, or 4N (i.e. LS). This total consists of 473 acres (195 ha) of 3G, 555 acres (228 ha) of 4G, and 13 acres (5 ha) of 4N. This 1,041 acres (428 ha) of LS habitat represents 47 percent of the LSR and 4.1 percent of the 24,657 acre (10,147 ha) watershed.

These LS stands occur as fragmented patches throughout the Smoky Creek portion of the LSR (Map 6b, Appendix E) of all 3G, 4G, and 4N areas with land allocations identified). Beginning in the area of the Hell Gate campground, there is a small 4G patch of 26 acres (11 ha). The next LS stand is a 3G of 32 acres (13 ha) located 0.5 miles (0.8 km) to the south in section 20. The following stand is located 1.75 miles (2.8 km) away, in section 29. This is large stand comprised of 509 acres (209 ha) of 3 and 4G stands that extends to the Rowski Creek area. (The region between this stand and the previous one consists of plantations and a large regenerating clear cut, where size classes average 2 and 3P.) There is also a stand of 5G that forms a band along the east side of Rowski Creek. Nearly adjoining this is a 154-acre (63 ha) stand of 3 and 4G in between Spot and Peyton Creeks, with a 53-acre (22 ha) stand of 4G on the headwaters of Peyton creek. In the southern corner of the LSR, there is a small stand of 4N joined with some 3G (112 acres [46 ha] total).

There are a total of nine separate LS stands within the portion of LSR in Smoky Creek. Although some of these stands connect to one another by way of other watersheds or land allocations, they do not connect within the LSR. There is a total of 146,342 feet (44,605 m) of edge around LS polygons and 1,041 acres (428 ha) of LS habitat. The perimeter to area ratio is 104 meter:1 hectare. Inside the 50 meter buffer area, the LSR contains 564 acres (232 ha) of LS habitat. Thus, from a nest predation, brood parasitism, and microclimate standpoint, only 54 percent of the LS habitat within the LSR is considered functional (though this does not consider connectivity).

Another factor affecting the condition of the LSR is connectivity of this portion of LSR with other portions. Connectivity concerns are primarily for wildlife species that inhabit these areas. The Smoky Creek portion of the LSR and the LS habitat within it provide connections to other LSR areas in both the Happy Camp and Hidden Valley watersheds, though the quantities and distribution of LS habitats in the LSR portions of those watersheds were not evaluated. The Smoky Creek portion of the LSR can be connected with the portion in Upper Hayfork watershed through LS habitats in AWA allocation and Riparian Reserves within Smoky Creek: east-southeast along the South Fork, then north up Smoky Creek and eventually connecting with Dubakella Creek. Currently, this connection is not composed of mainly LS habitat, but it is relatively intact. The open ridgetop areas between the headwaters of Smoky Creek and Dubakella Creek are undoubtedly a barrier to dispersal by herpetofauna considered in this analysis. Similarly, red-tree voles are unlikely to successfully traverse this area. Exposure to arid conditions for herpetofauna and predators for both herpetofauna and red-tree voles are likely reasons for this. While the more open habitats at higher elevations are not complete barriers for other species (e.g., NSO), the openness of the landscape presents significantly higher risks of predation to these organisms than is found in their more typical habitats.

The current condition of the LS stands within the Smoky Creek portion of the LSR indicates that they are functioning only partially as LSR's were intended to function. Most LS stands still need to develop a greater proportion of large-size trees, with more snags (including large-diameter snags) and woody debris. The stands that are not currently LS habitats (i.e. those <3G) within the LSR need much more time (>100 years) to develop into LS stands. As a whole, the LSR does not currently appear to have sufficient amounts of older timber strata to fully function as a LS forest, but if the stands are allowed to develop, they should mature into LS and old-growth habitats.

Influence of Surrounding Lands on the Integrity and Functioning of the LSR

East Fork

Unlike Smoky Creek, LS habitat in East Fork is not well distributed among the various land allocations (Map 18a, Appendix E), with the LSR containing 84 percent of all LS habitat, with the next largest amount (9.2%) being in Matrix. However, most of the non-LSR LS habitat is near the LSR and thus, organisms within those non-LSR LS habitats should be able to more easily interact with organisms in the LSR and move among the areas more easily. Within the East Fork watershed, lands around the LSR are highly fragmented and create many "hard" edges around the LSR.

We do not address fragmentation outside the LSR (as we do for Smoky Creek, see below) because nearly all of the LS habitat is within the LSR. We also analyzed effects of fragmentation by adding 164-foot (50 m) buffers to the inside of every LS polygon in all land allocations. The area inside the buffered area can be considered the "functional" stand (polygon) size as opposed to its actual size. When all LS polygons in East Fork were buffered by 50 meters, the quantity of functional LS habitat was 4,596 acres (1,891 ha) which represents 61 percent of the mapped LS habitat (i.e. 61% of the habitat could be considered functional, not considering connectivity). This can be compared to approximately 10,500 acres (4,300 ha) of functional habitat if a 164-foot (50 meter) transition zone was placed around the LSR (this estimate of potential functional habitat is likely an overestimate owing to the fact that ultramafic soils exists in part of the designated LSR - both "arms" in particular).

Within the LSR, there are 6,333 acres (2,606 ha) of LS habitat (i.e., area within 3G, 4G, and 4N polygons). This represents 25.8 percent of the watershed which is well above the minimum requirement of at least 15 percent LS forest within fifth order watersheds (USDA Forest Service 1993, 4-63).

Compared with Smoky Creek, the portion of the LSR in the East Fork has greater acreage and the LS areas within it are much less fragmented. Furthermore, East Fork has more functional LS habitat (all allocations) currently than does Smoky Creek. In its current condition, the East Fork portion of the LSR offers fairly continuous cover of LS stands, at least in the southern region of the LSR. It is apparent that various areas within the LSR, such as the clear cuts in the western section, are regenerating after timber harvesting and need time to develop into LS and old-growth stands. The areas that need the greatest development are riparian corridors within the LSR "arms" that extend toward the northern boundary of the watershed. In order for these riparian areas within the LSR arms to act as corridors between the East Fork and Beegum portions of the LSR, they need to consist of LS stands in order to provide the appropriate habitat conditions. Owing to ultramafic soils, much of the remainder of these arms will probably never have more than 50 percent canopy cover and will probably only support small-diameter trees. Lastly, the riparian areas (e.g., headwaters) immediately north (upslope) of the LSR arms up to the ridgetop are very important, but scantily forested, connections between the East Fork portion of the LSR and the Beegum watershed.

Smoky Creek

To evaluate how lands within the watershed, but outside the LSR, influence the integrity and functioning of the LSR in Smoky Creek, we evaluated the extent, fragmentation,and connectivity of LS stands in all land allocations, with emphasis on AWA because they are unlikely to be used for timber harvesting. Furthermore, we believe (based on assessing LS habitats on maps) the more detailed evaluation of the combined LSR and AWA areas is representative of LS habitats within Matrix as well because of the distribution and fragmentation of LS habitats. Combining LS habitats within AWA and LSR, we examined fragmentation by comparing the ratio of linear distance of perimeter (edge) to area to the same ratio assuming no fragmentation.

Presently, the total amount of edge around LS polygons is approximately 356,470 feet (108,652 m), compared to only 95,010 feet (28,959 m) of edge if there was only edge around boundaries of the land allocations (not including the shared edges of LSR and AWA). Furthermore, Smoky Creek currently contains approximately 2,663 acres (1,096 ha) of LS habitat within both LSR and AWA designations. The current perimeter-to-area ratio is 99 meters :1 hectare, whereas it would be 12.6 meters:1 hectare if edges only existed along the perimeter of the land allocations. Within Smoky Creek, a total of 7,596 acres (3,126 ha) of LS habitat exists in all land allocations (Map 18b, Appendix E). However, the functional area of LS habitat is only 4,263 acres (1,903 ha; 56% of the mapped LS habitat, and this does not include connectivity considerations). Because only 13.7 percent (1,041 out of 7,596 acres) of LS habitat in Smoky Creek is within the LSR, the importance of LS land outside the LSR is significantly increased. In particular, the LS habitats along Smoky Creek and especially the 4G areas to the east of Smoky Creek and north of the AWA are of importance to the integrity of the LSR in particular, and LS habitat in general. These areas are especially important because they should facilitate dispersal of wildlife, and appear to be the best opportunity for connectivity, with the portions of the LSR in Upper Hayfork and East Fork watersheds, respectively.

Within LSR and AWA designations, there are 2,663 acres (1,622 acres in AWA and 1,041 acres in LSR) of LS habitat (area within 3G, 4G, and 4N polygons) in Smoky Creek, representing 10.8 percent of the watershed. The LRMP (USDA Forest Service 1993, pp. 4 to 63) requires that at least 15 percent of the land in each fifth-order watershed be in LS habitat. Thus, in addition to LS habitat in LSR and AWA, at least another 1,233 acres (4.2%) of LS habitat needs to be retained until such time as "replacement" LS habitat develops in the LSR or AWA. Since NSO activity centers in Matrix are considered 120 acre "unmapped" LSR's, the seven NSO activity centers in Matrix lands can contribute to this acreage.[4]

Human and Public Use Values

Human and public use values in the watershed are diverse. Uses include: timber harvesting, Native American traditional uses, non-timber forest product harvesting, recreation, residential use, and grazing.

Timber Harvesting

There are diverse opinions concerning timber harvesting, and it has become a source of controversy in the county as well as in the watersheds. There is a general desire by some members of the public that other land uses prevail within the watersheds, such as recreation, spiritual renewal, and wildlife and botanical protection simply because timber harvesting has been the most prevalent land use to date. More specifically, some people are concerned about harvesting methods, especially clear cutting. Public concern regarding prescribed burning after clear cutting has been mentioned. It is the public's perception that many of the prescribed burns have been too hot and have harmed the landscape. They maintain that we are way beyond the "natural range of

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[4] Note: only those NSO activity centers discovered before 1994 can have 120-acre "unmapped LSR's delineated around them" (USDA/USDI 1994).

variability" in Smoky Creek, so any more clear cuts or prescribed fires that burn too hot will push us out of that range (J. Bower 1997). Other public concerns stem from the damage caused to the South Fork watershed by 1964 flood. Due in large part to its underlaying geology (see Geology, above pg. 5-1), the watersheds experienced less damage due to the 1964 flood than was experienced in stretches of river further downstream. But, the condition of the entire South Fork watershed since the 1964 flood and its associations with logging has made harvesting in the watershed a social issue. It is the public's perception that not enough is known about these associations and many people have expressed their desire that harvesting be reduced or eliminated altogether from the watersheds. Many residents in the watersheds and downstream want the land to have a chance to rest and recuperate. Members of the Tsnungwe tribe downriver expressed the same desire (Bensen 1997).

Peoples' concerns have been validated by scientific studies since the flood that point to the connection between 1964 flood damage and past harvesting methods in the watershed (Pacific Watershed Associates 1994, MacCleery 1974). The East Fork was specifically mentioned as one of the tributaries on the east side of the South Fork having "significant problems related to cumulative effects of intensive timber management over wide portions of the watershed" (Pacific Watershed Associates 1994, pp. IV-10; Irizarry et al 1985) and one of the eastern tributaries considered to be approaching its "Threshold of Concern" for cumulative watershed effects (Pacific Watershed Associates 1994, pg. IV-11; Haskins and Irizarry 1988.) The fact that the watersheds lie within a Tier I Key watershed fuels the fires of social opinion.

On the other side of this issue is the concern that the recent harvesting quota reductions will cause economic hardships throughout local communities and the county. Schools and roads in the county receive 25 percent of timber receipts, and harvest reductions have reduced those funds. It is difficult to attribute exact numbers to the amount of timber and monies that the watersheds have generated in the past, but based on the amount of old growth left in the watersheds, substantial monies for schools and roads were once generated. Timber harvesting has been a primary component of the county economy and its communities are now struggling to develop economic alternatives. In an economic report published by Brian Greber (1994), Trinity County was rated as one of the most timber dependent counties in the Northwest ROD area. Prior to recent harvest reductions, 80 to 95 percent of the *manufacturing* employment in Trinity County was in the timber industry and that figure was most likely higher in the community of Hayfork (Danks 1997). Given this, the development of economic alternatives represents a major community wide transition on practical and perceptual levels, and it requires an immense amount of time and energy.

After the Sierra Pacific Industries mill closure in the community of Hayfork, May 1996, alternatives related to the timber industry have been slowly evolving. Utilizing small diameter wood from thinning operations for making furniture, wine racks and boxes is becoming possible with the use of a specially designed light-weight yarder and a small size "economizer" mill that can cut 2 by 2's, 2 by 4's, 2 by 6's and cants (squared off logs). Stewardship contracts that involve long-term management of a given area by a contractee, and include diverse projects from timber harvesting to wildlife enhancement, are evolving in coordination with the USFS (Danks 1997; L. Jungwirth

1997). As yet, however, nothing has replaced the economic benefit brought in by timber.

Native American Traditional Uses

Historically, fishing was one of the primary traditional uses in the watershed area. It is now forbidden due to low fish populations. Again, this is highly significant for the South Fork watershed as a whole and for the tribal people who used to obtain their food here. Ethnobotanical uses currently occur on a small scale. Redbud, bear grass, and hazelnuts are gathered for basketry, medicinal plants and acorns are gathered as well. There are several spiritual sites in the area that are significant to the Wintu. In order to preserve the sites, their exact locations are being withheld from the public.

Land management decisions affect the state of the landscape and the consequent state of the species used by the Wintu. Restoration of the landscape and within the watercourses would serve to enhance the gathering of wild species by the Wintu and other tribal people in the surrounding areas. It must be noted that more traditional use of the land could occur were it not for existing land use practices and their impacts (Chilcot 1996; R. Patton 1997).

Non-Timber Forest Product Harvesting

Non Timber Forest Products (NTFP's) "include but are not limited to posts, poles, rails, landscape transplants, yew bark, shakes, seed cones, Christmas trees, boughs, mushrooms, fruits, berries, hardwoods, forest greens (ferns, huckleberries, beargrass, Oregon Grape, and mosses), and medicinal forest products." (USDA Forest Service 1993, pp. 4-40) Harvesting of NTFP's is increasing throughout the Pacific Northwest.

To date, harvesting NTFP's has not occurred to any large extent within the watersheds due to their remoteness. However, harvesting of NTFP's is one of the economic alternatives being developed by the community of Hayfork. Currently, a Hayfork woman is acting as a local broker for non-native plant species, in particular, mullein and yarrow. In the two years she has been acting as a broker, gatherers have doubled their harvests of these species. The USFS as well as local people who are interested and concerned about NTFP harvesting have been discussing the pros and cons of harvesting. Gathering information has been compiled and is being used for education in anticipation of increased NTFP harvesting. (Everett 1997; Johnson 1997).

Recreation

Though recreation use in and adjacent to the watersheds is low relative to other more highly used areas, it is on the increase. Recreation uses include hiking, camping, hunting, boating, 4-wheel drive and off-road vehicle use, horse packing, and mountain biking.

With the recent changes in the economic structure of Hayfork and its surrounding areas, the Hayfork Action Team (HAT) has set development and enhancement of recreation as one of its primary goals (Veil 1997). HAT's focus lies in the lands within and adjacent to the Yolla Bolla Wilderness and throughout the South Fork drainage.

Smoky Creek and East Fork watersheds fall within lands being considered appropriate for recreational enhancement and encouragement.

Hiking, Horsepacking, and Mountain Biking. The Yolla Bolla Wilderness, part of which lies within the East Fork watershed, and the LSR lands adjacent to it already draw a fair amount of usage from backpackers, day hikers, and horse packers. Two old-growth areas, specifically, draw hikers and campers. Most of one area and portions of the other lie within the watershed analysis boundaries. These two areas were designated roadless during the Rare II inventory. They are: 1). the 5,195 acres of roadless LSR land to the north of and adjacent to the Yolla Bolla Wilderness; and 2). the approximately 21,520 acres of roadless land that makes up the Chinquapin Roadless Area, a portion of which lies within the Smoky Creek watershed. These lands were proposed for wilderness designation during the Rare II process. They were not given wilderness protection but were classified as Released Roadless and were cited in the Land and Resource Management Plan (US Forest Service 1993) on pp. 3 through 24 as being priority roadless areas of high public concern. They contain some of the last sizable old growth habitats in the area and are some of the last intact interior forests remaining in northern California (Bornstein 1997). In addition to their inherent wildlife and botanical significance, they are significant simply for the intrinsic value of old growth wilderness (Steffensen 1997).

This is another area of social concern. A sizable constituency supports wilderness designation of these lands. They include the California Wilderness Coalition, North Coast Environmental Center, Klamath Forest Alliance, Mendocino Environmental Center, Friends of Chinquapin, Lovers of Old Growth and Trinity South Fork Up-River Friends. On page 4 through 59 of the LRMP (US Forest Service 1993), it states that roadless areas in Key watersheds shall have no new road construction. Currently, much of the Rare II lands in East Fork watershed lie within LSR allocations. Some areas are classified as harvestable, but the steep terrain will make it a lower priority than other lands. Rare II lands in the Smoky Creek watershed fall into many classifications that discourage harvesting: RNA, AWA, NSO AC's, the proposed wildlife corridor, and unproductive and low productivity soils. Some of the land qualifies as harvestable, but again, the terrain and low productivity will make it a low priority. The above mentioned constituency maintains that these stipulations, though helpful, do not entirely protect these old-growth lands from timber harvesting. They propose it be designated wilderness because that designation removes all possibility of harvesting.

Other members of the public feel this land should be available for harvesting in order to maintain the economy of the local communities. This issue has been debated for over 20 years.

The South Fork Trail, which is a "Designated National Recreation Trail," runs along the South Fork River, connecting the Chinquapin Roadless Area with the Yolla Bolla Wilderness. It passes through the Smoky Creek and East Fork watersheds. The upper South Fork from Forest Glen to the headwaters is exceptionally beautiful. It is proposed as Wild and Scenic and is understandably drawing more and more hikers and recreationists. Hikers, mountain bikers, and horse packers pass through virgin stands of old growth along the entire South Fork Trail from Forest Glen up to the crossing at the East Fork. In addition, views of South Fork Mountain's old growth forest enhance the experience for most of the trail. Some clear cuts are visible from the trail, but they don't predominate the views until the upper reaches of the South Fork Trail. The upland areas outside of the inner gorge, however, have been heavily logged and do not afford such breathtaking views.

Illegal use of the South Fork Trail by motorcycles is increasing, which is causing some concern. The trail is low gradient and adjacent to the river for much of its length. Motorcycles and off-road vehicles exacerbate erosion which in turn affects the health of the fisheries.

Trinity County Resource Conservation District in conjunction with the USFS has been repairing the South Fork and Smoky Creek Trails. This trail enhancement will likely increase the recreation usage along these trails. Mountain bikers and horse packers will especially be drawn to the area as the trails are improved because of their need for wider, more well maintained trails. Horsepacking is popular in the watersheds and the adjacent wilderness. Packers often access the Yolla Bollas from the LSR lands that lie within the East Fork watershed and they utilize the South Fork Trail as well. There is a horse packing business in the East Fork watershed which is run by Perry Patton out of his 160-acre parcel located directly on the East Fork.

All of the above factors point to an obvious emphasis on increasing recreation usage in the area and to the fact that recreation is a key component of the land use in these watersheds.

Hunting. Deer, bear small game and bird hunting are fairly extensive in the watersheds (Knight 1997). Hunters disperse throughout the watershed, making base camp at established campsites where there are springs and along creeks. They also utilize dry camps along ridge tops and low gaps. These sites tend to be historic and prehistoric sites. The most heavily used camps have been surveyed for archaeological significance, but more surveying needs to be done. It is highly likely that use of these camps has reduced the presence of historic and prehistoric artifacts, making it difficult to assess the significance of the sites. Areas used heavily by hunters are: Prospect Creek, Foss Camp, Snow Gap, Smoky Creek, Grasshopper Camp, Devil Camp, Flyblow Camp, White Rock, Pine Root Spring, West Low Gap, and the Yolla Bolla Wilderness. Recent fires and clear cuts have enhanced the vegetation browsed upon by deer, so hunters often concentrate their efforts in and around these areas. Recent articles appearing in *Petersen's Hunting* and *Outdoor Life,* which are widely distributed magazines, described the Yolla Bollas as one of the most easily accessed and best hunting areas in the north state, which may contribute to an increase in hunting use here (Knight 1997).

Boating and Rafting. Boating and rafting in the watersheds is minimal and is confined to the main stem of the South Fork. During the summer months, many stretches of the river are too shallow for boating, so this limits the number of interested participants and consequently reduces the impacts from this activity.

Fishing. Fishing in the upper South Fork has been prohibited due to declining fish populations. Considering the South Fork used to be one of the prime fishing drainages in the Pacific Northwest, this prohibition is highly significant.

Off-Road Vehicle Use. The extensive road system within the watersheds (3.5 mi./acre in East Fork and 3 mi./acre in Smoky Creek) tends to encourage road and off-road vehicle recreation use in the area. Most of the upland area is so remote that motorized use is of little consequence except during hunting season when a great deal of "road hunting" occurs. In general, though, the entire area is experiencing an increase in motorized recreation use which is evidenced by the illegal motorcycle use along South Fork Trail mentioned earlier and the heavy jeep usage along a jeep trail near the mouth of Smoky Creek (Steffenson 1997; K.Wilson 1997). The Red Mountain Motorway, adjacent to the watershed analysis area, is under consideration for inclusion in the California Heritage Road System (Viel 1997). If this comes to pass, there will be increased attention drawn to the lands adjacent to the motorway and people will seek recreation there. Again, this points to the fact that recreation is becoming a significant land use.

Residential

Residential use of the watersheds is very low. There are currently 11 private parcels of land totaling 1352.61 acres (640 in East Fork and 712.61 in Smoky Creek). One parcel is owned by a timber company, and three of the remaining residential parcels are resided upon year round. The area is difficult to access; 4-wheel drive is necessary during the dry months and winter snows often make access impossible except by foot. Consequently, residents have imposed little impact upon the watershed, though there is one summer resident who withdraws water from the South Fork through a 4-inch pipe. The water system is left running throughout the year. A break in the line could cause serious erosion damage. There are no phone lines or any form of easy communication, so those who live here must be very self sufficient and self contained.

Grazing

There are two cattle allotments in the watersheds: the Post Creek allotment and the Upper South Fork allotment.

<u>Post Creek Allotment</u>
Total allotment size = 58,000 acres
Total head of cattle = 81
Number of permittees = 3
Administrator - Bob Hilderbrand, Hayfork Ranger District

Only 8,000 acres of the Post Creek allotment fall within the Smoky Creek watershed. This 8,000-acre area is utilized by 10 head of cattle during May 1 through October 15. Suitable grazing area in this portion of the Smoky Creek watershed is very limited. Areas of concern include 7-Up Cedars which contains wet meadow ecosystems susceptible to overgrazing if cattle are not controlled. Some of these meadows have been fenced off in the past.

Upper South Fork Allotment

Total allotment size = 57,000 acres
Total head of cattle = 117 head
Number of permittees = 1
Administrator - Randy Jost, Yolla Bolla Ranger District

Of the total acres included in this allotment, 18,900 acres are suitable for grazing. This means that food and water are available on terrain accessible to cattle. The season of use is May 15 through October 15. There are portions of four different sub watersheds within the allotment boundary including portions of Happy Camp and Upper South Fork. An estimated one sixth of the total head (approximately 20 head), utilize the Smoky Creek watershed and one third (approximately 40 head), use the East Fork watershed at times throughout the season.

The Smoky Creek watershed has two fence exclosures around sensitive riparian areas and the East Fork has one. No areas within this allotment have been identified for vegetation enhancement by the USFS. Most of the grazing in both allotments occurs on transitional range that was created by logging, which has kept forest land in a low seral stage of development, not including areas that have been planted. As manipulation of these areas is decreased, available forage will also decrease which may result in lower stocking rates. No sensitive plant study has been performed on the allotments.

Grazing also occurs on a 160-acre parcel of private land in East Fork. It is not known how many cattle are run on this land, but the cattle do cross the East Fork randomly which could cause destruction of salmon and steelhead redds and erode banks.

Chapter 6
SYNTHESIS AND RECOMMENDATIONS

The Process of Synthesis

This step of the analysis process is designed to synthesize and interpret information collected in the previous steps. Emphasis is placed on understanding ecosystem processes and functions as they relate to management plan objectives identified in Chapter 2, Issues and Key Questions. Trends and discrepancies with respect to watershed conditions were thoroughly evaluated and weighed against the management objectives identified. The watershed analysis (WA) team focused the majority of discussions and deliberations on common, recurring themes consistent with the identified issues and key questions which had somewhat competing management implications. The following themes resulted from these discussions:

- Identify commodities opportunities within matrix lands versus the need to acknowledge Tier 1 Key Watershed status of the analysis area and maintain existing high quality water and aquatic habitats, consistent with the Shasta-Trinity National Forest (STNF) Aquatic Conservation Strategy (ACS).

- Reduce sediment production risk associated with existing roads verses need to maintain transportation system to facilitate land management objectives (i.e. fire hazard management, timber management, recreation, etc.).

- Identify and improve dispersal corridors and other habitat needs for Threatened, Endangered, and Sensitive (TE&S) species versus need for timber outputs within Matrix lands.

- Attempt to reconcile expectations from the public versus the specific management direction contained within the STNF Land and Resource Management Plan (LRMP) (US Forest Service 1993).

To facilitate discussions along these and other themes, the WA team used matrices and Geographic Information Systems (GIS) data layers. Various GIS maps (for example, stand size class, road network, and fire history maps) were overlaid to assist with identification of opportunities consistent with competing management objectives. This was a give-and-take process and trade-offs were necessary to achieve balance in the overall land management direction. Both specific and general recommendations resulted from this process and are consistent with management objectives and ecosystem functions. These recommendations are found in this chapter and in summary form in Chapter 7, High-Priority Recommendations.

Overview: Issues and Key Questions

This chapter is designed to follow the format of Chapter 2, Issues and Key Questions, in order to provide the follow up to the issues raised in that chapter. Thus, the major sections of this chapter correspond to those in Chapter 2:

- Late Successional Reserve (LSR) Protection/Enhancement and Wildlife Corridors
- Threatened, Endangered and Sensitive (TE&S) Species
- Erosional Processes, Water Quality, and TE&S Fish Species
- Human and Public Use Values
- Catastrophic Fire and Fuels
- Commodities Production

Since the intention of this chapter, however, is to *synthesize* information obtained during the course of the analysis, and overlay disciplinary perspectives with the aim of generating recommendations for enhancing the health of the ecosystem and the quality of resources, many of the individual issues and questions identified in Chapter 2 are simultaneously addressed in the recommended actions proposed in the discussions that follow. For example, the issue of thinning (Issue 6.2) has bearing on several other questions and is intertwined with the discussion below about lands surrounding LSR's (Issue 1.2), creating or protecting wildlife corridors that connect LSR's and other LS habitat within and among watersheds (Issue 1.1), as well as the potential for fire in important LS habitat within the watersheds (Issues 1.4, 5.1, 5.2) and which roads and when might roads in the LSR be scheduled for hydrologic closure (Issue 3.4). Thus, identifying specific issues and key questions in this chapter and responding to them separately is impractical. Here, as elsewhere, when a specific issue or key question is discussed separately and at length, it is identified. Otherwise, it remains intertwined with other issues and questions in the discussion.

Late Successional Reserve Protection and Enhancement

Overview

In order to synthesize the information we obtained and simultaneously evaluate the various competing demands on the WA area, we overlaid map coverages containing the following information: (1) Fire risk, (2) Thinning opportunities, (3) Corridors to other LSR's, (4) Risk of sedimentation to streams (i.e. fish and water quality concerns), (5) Cultural considerations, and (6) Habitats of late successional species.

Currently, other than loss of late successional (LS) habitat, the major negative impact to LS species within the LSR in both Smoky Creek and East Fork is fragmentation (see Chapter 5, pg. 5-91 for a more complete discussion of the effects of fragmentation). Along with fragmentation, a major potential risk to the LSR's is catastrophic fire. The recommended strategy to reduce the risk of catastrophic fire is discussed in detail under Catastrophic Fire below in this section. Connectivity among LSR's is considered in detail under Wildlife Corridor below.

Based on our evaluation of the various map layers, we recommend that the plantations on Buck Ridge within the East Fork portion of the LSR be thinned as soon as possible. Thinning should decrease competition among trees for light, water, and nutrients, and thus accelerate growth rates and subsequently decrease the extent of "hard" edges that now exist and accelerate the rate at which these plantations develop LS characteristics. Because road decommissioning (see below) is also a priority recommendation in this area, our recommendation is to thin first, then decommission the road (see Maps 5a and 9a for East Fork roads and plantations). The second priority for thinning is in the plantations in the eastern (short) arm of the East Fork portion of the LSR that goes north toward the Beegum watershed. In the narrow band of Matrix above this arm, we recommend that a shaded fuel break be created to help protect the LSR from fire, while maintaining 40 o 70 percent canopy cover (if ecologically possible given the soil type and site conditions) to facilitate connectivity between the East Fork LSR and the LSR in the Beegum watershed (see USDA Forest Service 1997). Furthermore, this East Fork-Beegum connection would also facilitate connecting the Smoky Creek portion of the LSR to the Beegum portion via the East Fork portion of the LSR.

It is well understood that hard edges affect the physical and biological integrity of interior forest habitat by altering microclimate and creating opportunities for nest parasitism and predation. The magnitude of those effects may vary depending on a variety of factors, such as stand condition, slope, topography, and the actual amount of contiguous hard edge which exists along the LSR boundary. Various studies have documented the distances at which effects occur. For instance, Robinson (1990) found that the effects of brood parasitism was significant even 400 meters into forests (away from edges). Based on Robinson (1990), we recommend minimization of edge effects within 500 meters of the LSR through selection of management activities which do not create hard edges. The linear distance of LSR/Matrix edge in East Fork is 63,552 feet while it is 13,058 feet in Smoky Creek. The total acreage in the transition zone where edge effect would be considered is 2,246 acres (1,517 in CAS lands) in the East Fork and 578 acres in Smoky Creek. We further recommend that STNF study the impacts of both brood parasitism, nest predation rates (on both neotropical songbirds and LS species such as Northern Spotted Owls [NSO's]), and the distance the abiotic factors influence climate at varying distances from forest edges. Based on results of the recommended study, modification of the transition zone width which has been recommended would be warranted.

Wildlife Corridors

The purpose of a wildlife corridor is to facilitate movement of organisms between or among habitats. For this WA, the proposed corridors are intended to meet the needs (as much as possible given the competing demands and current conditions of the land base) of LS species. When evaluating potential areas for corridors, we overlaid maps containing the following information: (1) LSR's, (2) LS habitats (see Chapter 5 for a definition of LS habitat) in all land allocations, (3) Fish habitat/sedimentation risks/water quality, and (4) TE&S species habitats. We also based our recommendations on whether each watershed currently had at least 15 percent LS habitat within all land allocations, and whether that LS habitat was protected (i.e. within an area that would not be harvested). The 15 percent LS habitat is a minimum requirement within all fifth-order watersheds (USDA/USDI 1994).

East Fork

The East Fork watershed differs from the Smoky Creek watershed in that nearly all of the existing LS habitat is within the LSR. The LS habitat within the LSR in East Fork represents approximately 25 percent of the entire watershed, greatly exceeding the 15 percent minimum LS habitat requirement. Further, the LSR itself is quite large and will eventually provide the majority of the corridors to other portions of this LSR. Our recommendation for a corridor in East Fork is in the narrow band of Matrix north of the eastern LSR arm which separates the East Fork from the Beegum watershed (Map 2, Appendix E) of this area). The riparian areas in this "arm" currently should provide a travel coridor for LS species, but there is no specific provision for dispersal protection on the Matrix lands north of this arm; we recommend that this area of Matrix be maintained as a shaded fuel break that maintains 40 to 70 percent canopy coverage based upon site specific conditions. This will help protect the LSR from fire as well as facilitate connectivity and dispersal among the Beegum, East Fork, and Smoky Creek watersheds (for a more complete discussion of dispersal corridors see Dispersal Habitat under Northern Spotted Owl in Chapter 5).

We believe that our recommendations will provide protection for currently listed TE&S species and that, if enacted, these recommendations will contribute to keeping many species that are currently designated as "species of concern" or "sensitive" from becoming listed as threatened or endangered. However, even if all recommendations we have made are implemented, these WA areas are much too small to "rescue" these species without a much larger-scale and coordinated plan of habitat protection.

Smoky Creek

In the Smoky Creek watershed, LS habitat in the LSR and AWA combined represents an estimated 10.4 percent of the entire watershed (from GIS maps). Matrix lands in Smoky also contain significant quantities of LS habitat--enough that in all, approximately 25 percent of the Smoky Creek watershed is LS habitat. We recommend that all current LS habitat in the AWA be maintained and not entered for timber harvesting, consistant with prescriptions I and II in the LRMP, pp. 4-45 to 4-47 (US Forest Service 1993) The primary corridor we recommend includes all LS habitat adjacent to Smoky Creek up to the middle tributary of the east fork of Smoky Creek (Map 16, Appendix E). Most of the proposed corridor is within Matrix lands. We recommend that management activities within this corridor maintain and enhance existing dispersal corridor characteristics. The combined acreage of LS habitat in Matrix within this corridor is 1,776 acres (731 ha). Based on GIS maps, the combined acreage of LS habitat in AWA- and LSR-designated lands within the Smoky Creek watershed is 2,663 (1,096 ha) acres. Thus, under our recommendation, a total of 4,439 acres (1,827 ha) of LS habitat would be maintained, which constitutes approximately 18 percent of the total Smoky Creek watershed. Although this percentage exceeds the 15 percent minimum, we believe it is somewhat of an overestimate because field visits by several WA team members revealed discrepancies between areas identified as 3G and 4G habitats (i.e. LS habitat) on GIS maps, and what was actually observed; thus, some of the LS polygons (on the GIS maps) in the proposed corridor may not be LS habitat.

Moreover, we evaluated recent (1995) aerial photographs, and, based on that evaluation, we believe that the quantity of 3G and 4G habitat was indeed overestimated in the GIS layers. Thus, the actual acreage of LS habitat recommended by this WA team is likely to be within 1 percent of the 15 percent minimum. We believe that overall, the proposed corridor will function well for most LS organisms. Further, the proposed corridor lies along Smoky Creek, a high-value anadromous fish stream with importance not only within the analysis area, but the entire South Fork watershed. It, in fact, ranked third among all focal watersheds containing anadromous fish habitat in the STNF ACS. The proposed corridor contains intact high-value riparian and upland habitats that help create the "refugia" conditions found in Smoky Creek. Establishing the corridor as proposed would thus provide added assurance for the continued existence and function of Smoky Creek as a focal subwatershed with extremely high fisheries value. After many of the designated riparian reserves throughout Matrix lands have acquired LS characteristics (>100 years from now), they should provide additional suitable routes for LS species to move between LSR's; at that time the corridor recommended in this analysis may become less important for them, but would remain important for anadromous fish.

Threatened, Endangered, and Sensitive Species

Threatened, Endangered, and Sensitive (TE&S) species in the watershed include both plant and animal species. Earlier chapters noted documentation and field work that identified known TE&S species in the watersheds. The following discussion presents recommendations for ensuring the survival of TE&S species in the watersheds.

Plants

The issue of TE&S plant species within the WA area is an important one, considering the numerous populations of sensitive plant species that are found on the ultramafic soils within the watersheds, and because of the potential for additional species and populations that have yet to be found. Because of the lack of extensive botanical surveys to locate sensitive plant species on the ultramafic soils in the watersheds have not been conducted, there is the potential for the existence of additional populations that have yet to be identified.

Current knowledge of TE&S plant species within the WA area is limited, especially on the extent and long-term viability of populations. With continued timber and plantation activities on ultramafic soils, there is concern over the cumulative effects of such activity on the long-term viability of sensitive plant species. It is apparent that a program is needed to document sensitive plant populations and monitor the status of these populations over time. We recommend no future timber harvesting and road building occur on areas underlain by ultramafic and serpentine rocks and soils until detailed and systematic plant species surveys are conducted and the results are analyzed.

Clear with Jim

Wildlife Species and Habitats

- We recommend maintenance and enhancement of the unique and large interior blocks of old growth forest that this LSR provides to minimize forest fragmentation effects. Because of this, we recommend thinning plantations and decommissioning roads - as recommended elsewhere (see Chapter 7, Priority I) in this analysis.

- Treat riparian reserves in a manner which will maintain and enhance them in accordance with ACS objectives.

- Establish a policy of snag retention and recruitment consistant with STNF's snag simulator model and draft snag guidelines. Given the critical importance of snags for many wildlife species--including old-growth-associated species such as the NSO; goshawk; cavity-nesting birds; furbearers, including fisher, marten, and small mammals--the snag guidelines should only be considered as a minimum threshhold, with higher numbers of snags retained and recruited where possible across the landscape. The basis for higher numbers of snags is further explained by Jimerson's (1989) data discussed in the footnote below.[1]

- Retain and/or enhance old stock/logging ponds in the watersheds for use by native herpetofauna and bats.

- Protect springs and headwater streams in LS habitats (by retaining 100 feet of forest cover, or the height of site-potential tree, around them).

- Retain large- and medium-sized down woody debris for species such as fisher.

- Because of discrepancies found during field visits and aerial photo evaluation, we also recommend ground-truthing the 3G, 4N, and 4G habitats identified on the GIS maps before initiating further timber harvesting in these areas. If stands are less than as classified in the GIS, then the available habitat to be retained to maintain LS habitat must be revisited and adjusted.

Erosional Processes, Water Quality, and TE&S Fish Species

The 1964 flood is the dominant event of record in the South Fork of the Trinity River (South Fork). The effects of the flood, exacerbated by management practices, resulted in significant changes to aquatic habitats and a precipitous decline of anadromous salmonids. Today, the South Fork appears to be recovering in a "top down" fashion as the River purges itself of the tremendous influx of bedload that entered streams during

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[1] Because snags are of such great importance to many vertebrates and invertebrates, it is important to retain adequate numbers of snags in managed areas, particularly Matrix. Retain many currently existing snags, especially large snags in all land allocations. Retain and recruit for snags of varying sizes with particular emphasis on retention and recruitment of larger-sized (≥20" dbh and >50' tall; c.f. Jimerson 1989) snags, tree species, and configurations (e.g. in clumps, solitary, etc.) to accommodate the needs of a variety of species (various bats and bird species as identified in this document). It is important to maintain at least two large sized (≥20" dbh and >50' tall), two medium sized (>20" dbh and 20-50' tall), and at least five small sized (> 5" dbh and ≥ 10' tall) snags per acre on average in Matrix (the average being taken over 40 acre blocks [as per LRMP 4-62]). The number of snags per acre in the varying snag size classes were taken from Jimerson (1989) who found an average of 2.07 large snags/acre, 1.94 medium snags/acre, and 20.67 small snags/acre on the Gasquet Ranger District of the Six Rivers National Forest, CA. However, we recommend fewer small snags than Jimerson (1989) found and recommend emphasis on large- and medium- sized snags. Our recommendation differs from LRMP (4-62) which recommends an average of 1.5 snags per acre that are at least 15" dbh and 20' tall. Our rationale for recommending emphasis on medium and large snags is that the smaller-sized snags may not provide adequate thermal environments for snag-dependent wildlife - especially in these analysis areas that experience extreme weather conditions in both summer and winter. Snag recruitment will probably be possible in the 15 percent uncut portions of green-tree retention cuts.

the 1964 flood. Within the analysis area, which is located in the headwaters or "top" of the South Fork watershed, processes that maintain stream habitat appear to be functioning properly. Many of the subwatersheds that lie within the analysis area have been recognized as important refugia areas for recovery of fish populations and their habitats.at a larger scale (unpublished STNF ACS 1997), in this case, the entire South Fork.

In a report prepared for the Pacific Rivers Council, Frissell (1993) describes a strategic management approach which emphasizes the importance of securing high quality refugia habitats such as those found within the analysis area. In securing these subwatersheds, existing habitats with healthy ecosystem function and existing populations of aquatic species are retained over the long term and form the cornerstone for improvement of the status and abundance of wild fish populations, including those which are federally listed as threatened and endangered, as well as aquatic ecosystem function at a much larger scale.

The urgency to conduct restoration activities that secure or "storm proof" habitats within the analysis area is driven not only by the high value condition of the habitats but also because of the risk that presently exists to those habitats. A significant flood event has not occurred in the South Fork watershed since the 1964 flood event. However, significant timber harvest and road building activity has occurred, creating a sizable road network with numerous culverts which are undersized for the 100-year flood event standards as identified in the *Record of Decision for Amendments to Forest Service and Bureau of Land Management Planning Documents Within the Range of the Northern Spotted Owl* (USDA, USDI 1994) (Northwest ROD).

The Northwest ROD identifies three primary components of a watershed restoration program: the control of road-related runoff and sediment production, the restoration of riparian vegetation, and the restoration of in-stream habitat complexity. Through our analysis, we have found that the ecological processes associated with riparian condition and instream habitat complexity within the analysis area are, for the most part, properly functioning and probably not significantly altered from reference conditions. Therefore, with few exceptions, we recommend that restoration efforts be strictly focused on erosion control and that the work be conducted primarily on the road system (we see very few locations or opportunities where cost-effective instream or riparian work needs to be done or could be performed). We recommend that the risk of accelerated, man-caused erosion and sediment delivery to streams be reduced immediately throughout the analysis area. This includes not only reducing the risk of catastrophic storms causing widespread failure at numerous stream crossings, but also addressing annual contributions of fine sediment being delivered to stream channels by actively reducing the length of road, cutbank, and inboard ditch along USFS level 1, 2, 3, and 4 roads.

The Northwest ROD provides direction to control and prevent road-related runoff and sediment production by either decommissioning (hydrological closure) or upgrading roads. Technically sound techniques to complete either are well tested and documented in a variety of reports (Weaver and Sonnevil 1984, Weaver et al 1987, Pacific Watershed Associates 1990, National Park Service 1992, Harr and Nichols 1993, Pacific Watershed Associates 1994, Pacific Rivers Council [Chapter 4] 1996, and

Trinity County Resource Conservation District 1998). Although we do provide priority rankings for sediment reduction and treatment urgency, our focus is on the entire headwater area and not on individual streams or habitat segments. Again, one of the most important features of these headwater refugia areas is their connection to downstream South Fork habitat and their contribution to the recovery which is occurring as previously mentioned in a "top down" fashion.

During the synthesis process, several issues were discussed which need to be addressed prior to any road decommissioning or hydrologic closure activities taking place in the WA area. The issues include: 1) reducing the risk of catastrophic wildland fires, i.e. similar to those which burned large areas within the South Fork watershed during 1987, 2) reducing fire risks as well as the need for pre-commercial/commercial thinning within plantation clear cuts throughout the WA area, particularly the plantations within or adjacent LSR lands on Buck Ridge and near White Rock, and 3) potential conflicts of road decommissioning with either implementing the LRMP within Matrix lands or recreational uses.

Creating a series of fuel breaks along prominent ridges throughout the WA area, to attempt to control the spread of catastrophic fires, will pose no significant conflict with prioritizing erosion control activities. Roads located high on the hillslopes or on the ridges pose minimal risk of erosional processes delivering sediment to stream channels. As a result, no roads in these hillslope positions would or should ever be proposed for decommissioning, based on protecting aquatic resources.

As stated earlier, both management-related and natural mass-movement risks are highest on hillslopes underlain by either the South Fork Mountain schist or the Galice Formation. Both rock types primarily underlie LSR and AWA areas within the WA area (Map 3, Appendix E). Numerous clear cut patches are located south of the East Fork along Buck Ridge within the LSR. Many of the roads accessing the patch cuts and plantations are high-priority roads for decommissioning based on the high risk of rain-on-snow storms triggering debris slides and torrents; this could directly impact anadromous reaches of the East Fork watershed.

The WA team concluded that thinning of the plantations located within the LSR lands in the East Fork watershed (to more rapidly promote old growth characteristics and for fuel reduction purposes) should be the highest priority and undertaken as soon as possible. This will facilitate pursuing decommissioning activities along many of the dead-end spur roads of the 28N40 road (Map 5a, Appendix E).

Road densities are very high within the Matrix lands in the WA area. The FEMAT report (1993) suggests road densities should be lowered by approximately one-third in Key Watersheds. However, based on the sediment source inventory and the identified risks to fish and water quality, most road routes within the Matrix lands could either be decommissioned or upgraded to substantially reduce threats and protect water resources.

We recommend road densities be reduced within the Matrix lands by properly "closing, not gating or blocking" selected roads. This recommendation doesn't mean actual decommissioning (ie., officially taking the roads out of the system), but instead implies excavating all stream crossings and "storing" the road route as a temporary road until it is needed for future management activities. However, the decision as to which roads in the Matrix should be closed properly should be made at the same time as silviculture decisions and commodities opportunities are developed along each route.

Accelerated, man-caused erosion associated with either road upgrading or decommissioning activities should be very minimal if hydrologically sound procedures and project layout occur. Contrary to many laypersons perspective, accelerated post-project erosion is almost always a function of poorly designed and implemented projects. Project planners can essentially eliminate any significant post-project erosion when decommissioning roads by following several simple rules. These are clearly explained in the reports referenced earlier in this synthesis.

Preliminary Erosion Control and Protection Plan

On Maps 5a and 5b (Appendix E) individual road routes and sites for treatment have been identified. The road routes are divided into two categories based on whether they are candidates for upgrading (storm-proofing) preventative actions or for decommissioning (hydrologic closure) actions.

Roads identified for upgrading are further separated into routes which STNF has "identified" (Category #1) and "not identified" (Category #2) as primary and secondary long-term transportation routes. Roads identified for decommissioning are separated into routes which STNF has indicated National Environmental Policy Act (NEPA) documentation may exist or has been done for the route (Category #3), and roads where no NEPA or environmental impact analysis has been performed (Category #4). Tables 6-1 and 6-2 (roads recommended for treatment by priority and category) identify routes by category along with the road length and number of sites to treat.

Road Upgrading

Proposed "road upgrading activities" are recommended to occur along 62 miles (82 percent) of the roads listed in Table 6-1 (East Fork) and along 48 miles (75 percent) of the roads listed in Table 6-2 (Smoky Creek).

Road upgrading tasks include both installing and/or replacing stream crossing culverts which are damaged or not designed to accommodate the 100 year return interval flow and accompanying sediment load, as well as installing properly sized, secondary overflow flood-relief culverts at the mid-point of the fill prism where stream crossings have extremely deep headwall depths. For example, the sediment source inventory indicated there are 45 stream crossings throughout the WA area with apparently undersized culverts at crossings with very deep fills, ranging up to 30 feet deep at the inboard edge of the road (tables 5-8 and 5-9, Failure Potential at Stream Crossings). Rather than proposing to completely excavate these deep fills, it was proposed in the field to install the proper-sized culvert at the vertical mid-point of the fill to provide additional crossing-failure protection while still minimizing road storm-proofing costs.

Additional upgrading activities include cleaning culvert inlets of stored sediment and debris which is reducing the capacity of the culvert to handle flood flows, as well as installing trash racks well upstream of the culvert inlet, and downspouts or energy dissipation below culvert outlets where fillslope erosion is occurring.

A critical component of road upgrading activities will be to disconnect the identified segments of road which serve as extensions of the natural drainage pattern. These road segments not only negatively affect storm hydrographs, but annually deliver varying amounts of generally fine-grained (small pebbles and finer) particles to nearby stream channels. Along the roads identified for upgrading in Tables 6-1 and 6-2, over 67,000 feet of ditch and road prism is proposed to be reshaped to disconnect the road, ditch, and cutbank from the stream system.

Disconnecting the road from the streams can be accomplished in a number of ways. Along paved roads we recommend a combination of techniques including filling inboard ditches and allowing sheet flow across the road, removing virtually all non-essential grader berms along the outside edge of the road, and either excavating a series of broad rolling dips (which drain the ditch) down through the pavement and then re-rocking the whole length of the dip or installing additional ditch-relief culverts, where needed, up the road from the identified segments of road.

Along non-paved roads, we recommend physically converting insloped and/or ditched road shapes to flat and/or slightly outsloped road prisms (with no inboard ditches), where safety concerns will not be compromised. In situations where a flat or insloped road is necessary, broad and frequent rolling dips should be utilized, which drain the ditch, to create numerous small road- and cutbank-drainage areas along the road. As a last resort, additional ditch-relief culverts could be utilized; however, this practice will only increase the amount of maintenance needed.

Table 6-1. East Fork Roads Recommended for Treatment, by Category and Treatment Priority.

Road Name	Category (#1,2,3,4)[1]	Treatment Priority	Miles of Road	Number of Sites to Treat	Future Sediment Yield (yds)[2]	Costs for Site Treatment[3]	Feet of Road & Ditch to Treat	Costs for Road Treatment	Total Costs Each Road
28N40	upgrade(#1)	first	5.14	12	22,600	$37,200.	3,500	$5,600.	$42,800.
30	upgrade(#1)	second	13.72	51	47,275	$170,800.	14,000	$22,500.	$193,300.
41	upgrade(#1)	third	14.70	46	32,400	$129,700.	13,000	$20,800.	$150,500.
29	upgrade(#1)	fourth	3.73	7	2,175	$18,900.	2,200	$3,500.	$22,400.
28N27	upgrade(#1)	fifth	4.46	12	1,300	$16,900.	300	$250.	$17,150.
28N26	upgrade(#1)	sixth	4.58	9	850	$14,800.	700	$1,100.	$15,900.
28N19	upgrade(#1)	seventh	2.12	5	7700	$3,800.	150	$160.	$3,960.
Sub-Totals:		7 Roads	48.45	142	114,300	$392,100.	33,850	$53,310.	$445,410.
28N45	**upgrade(#2)**	**first**	**4.64**	**11**	**1,450**	**$23,100.**	**400**	**$320.**	**$23,420.**
28N48	**upgrade(#2)**	**second**	**3.15**	**10**	**1,800**	**$8,950.**	**230**	**$200.**	**$9,150.**
28N22	**upgrade(#2)**	**third**	**6.12**	**6**	**465**	**----**	**600**	**----**	**$1,500.**
Sub-Totals:		**3 Roads**	**13.91**	**27**	**3,715**	**$32,050.**	**1230**	**$520.**	**$33,550.**
28N55	decom(#3)	first	1.56	4	780	$5,100.	0	----	$5,100.
28N40-B	decom(#3)	second	1.24	1	770	$6,000.	0	----	$6,000.
28N22-A	decom(#3)	third	2.07	5	800	$7,500.	0	----	$7,500.
28N55-4	decom(#3)	fourth	0.25	1	470	$2,600.	0	----	$2,600.
Sub-Totals:		4 Roads	5.12	11	2,820	$21,200.	0	0	$21,200.
28N41	decom(#4)	first	1.22	5	4,300	$35,000.	0	----	$35,000.
28N10-B	decom(#4)	second	0.84	2	1,900	$16,900.	0	----	$16,900.
28N40-A	decom(#4)	third	0.47	6	1,435	$11,500.	0	----	$11,500.
28N40-1	decom(#4)	fourth	0.81	1	1,300	$6,600.	0	----	$6,600.

Table 6-1. East Fork Roads Recommended for Treatment, by Category and Treatment Priority.

Road Name	Category (#1,2,3,4)[1]	Treatment Priority	Miles of Road	Number of Sites to Treat	Future Sediment Yield (yds)[2]	Costs for Site Treatment[3]	Feet of Road & Ditch to Treat	Costs for Road Treatment	Total Costs Each Road
28N77	decom(#4)	fifth	0.63	5	1,350	$8,700.	0	----	$8,700.
28N66	decom(#4)	sixth	1.29	7	800	$6,400.	0	----	$6,400.
29N30-G	decom(#4)	seventh	1.42	3	350	$2,600.	0	----	$2,600.
28N51-A	decom(#4)	eighth	1.95	5	280	$2,400.	0	----	$2,400.
Sub-Totals:		8 Roads	8.63	34	11,715	$90,100.	0	0	$90,100.
Totals:	22 Roads		76.11	214	132,550	$535,450.	35,080	$53,830.	$590,260.

[1]The road routes are divided into two categories based on whether they are candidates for upgrading (storm-proofing) preventative actions or for decommissioning. Roads identified for upgrading are further separated into routes which STNF has "identified (i.e. category #1)" and "not identified (i.e. Category #2)" as primary and secondary long term transportation routes. Roads identified for decommissioning are separated into routes which STNF has indicated NEPA documentation may exist or has been done for the route (i.e. Category #3), and roads where no NEPA or environmental impact analysis has been performed (i.e. Category #4).

[2] Future sediment yield should be viewed as the maximum amount of sediment which could be delivered to stream channels in the East Fork watershed if no road storm-proofing or road decommissioning activities occur. Each site identified during the sediment source inventory has a different probability or likelihood of the erosion occurring, therefore it is highly unlikely the total volume of sediment yield could be realized during a given storm.

[3]Cost to treat sites are noted on the attached printouts for each road. They includes heavy equipment and labor costs, a 25 percent logistics/contingency escalation factor and culvert costs. They do not include any costs for mulch and revegetation materials, or the cost to apply mulch and revegetate the sites, costs for re-rocking or re-paving road prisms or costs for trash rack materials.

[4]Along the roads to upgrade, the following feet of road prism and ditch must be disconnected from either stream crossing sites or from ditch relief culverts which are contributing sediment to nearby streams.

Table 6-2. Smoky Creek Roads Recommended for Treatment, by Category and Treatment Priority.

Road Name	Category (#1,2,3,4)[1]	Treatment Priority	Miles of Road	Number of Sites to Treat	Future Sediment Yield (yds^3)[2]	Costs for Site Treatment[3]	Feet of Road & Ditch to Treat[4]	Costs for Road Treatment	Total Costs each Road
28N27	upgrade(#1)	first	2.79	7	1,272	$14,470.	300	$ 240.	$14,710.
29	upgrade(#1)	second	12.29	53	61,586	$208,275.	18,000	$28,800.	$237,075.
29N49	upgrade(#1)	third	5.54	20	6,470	$ 60,000.	4,100	$ 6,600.	$66,600.
29N62	upgrade(#1)	fourth	8.11	23	18,680	$42,800.	1,800	$2,900.	$45,700.
29N75	upgrade(#1)	fifth	4.25	8	1,705	$ 2,625.	1,000	$1,600.	$4,225.
29N71	upgrade(#1)	sixth	2.60	3	1,854	$ 250.	650	$ 560.	$810.
Sub-Totals:		6 Roads	35.58	114	91,567	$328,420.	28,550	$40,700.	$369,120.
29N48	upgrade(#2)	first	2.81	7	3,603	$24,050.	1000	$1,600.	$25,650.
29N76	upgrade(#2)	second	2.06	6	6,155	$13,000.	700	$1,100.	$14,100.
28N72	upgrade(#2)	third	0.95	3	366	$3,050.	200	$160.	$3,210.
28N25	upgrade(#2)	fourth	1.89	3	5,866	$875.	550	$560.	$1,435.
28N38	upgrade(#2)	fifth	2.40	4	4,955	$1,130.	900	$720.	$1,850.
28N31	upgrade(#2)	sixth	1.94	3	3,231	$950.	500	$400.	$1,350.
Sub-Totals:		6 Roads	12.05	26	24,176	$43,055.	3850	$4,540	$47,595.
29N62-C	decom(#3)	first	2.93	9	2,431	$16,000.	0	0	$16,000.
29N74	decom(#3)	second	2.00	7	1,801	$13,125.	0	0	$13,125.
28N27-A	decom(#3)	third	0.63	3	366	$2,625.	0	0	$2,625.
Sub-Totals:		3 Roads	5.56	19	4,598	$31,750.	0	0	$31,750.
28N28	decom(#4)	first	1.75	5	1,744	$13,070.	0	0	$13,070.
29N11	decom(#4)	second	3.35	13	1,532	$11,500.	0	0	$11,500.

Table 6-2. Smoky Creek Roads Recommended for Treatment, by Category and Treatment Priority.

Road Name	Category (#1,2,3,4)[1]	Treatment Priority	Miles of Road	Number of Sites to Treat	Future Sediment Yield (yds^3)[2]	Costs for Site Treatment[3]	Feet of Road & Ditch to Treat[4]	Costs for Road Treatment	Total Costs each Road
28N12	decom(#4)	third	1.52	7	2,438	$19,930.	0	0	$19,930.
29N11-B	decom(#4)	fourth	0.74	3	379	$2,625.	0	0	$2,625.
29N11-C	decom(#4)	fifth	0.20	6	527	$4,375.	0	0	$4,375.
29N62-A	decom(#4)	sixth	1.24	4	310	$1,950.	0	0	$1,950.
28N73	decom(#4)	seventh	1.13	1	393	$1,900.	0	0	$1,900.
Sub-Totals:		7 Roads	9.93	39	7,323	$55,350.	0	0	$55,350.
Totals:	22 Roads		63.12	198	127,664	$458,575.	32,400	$45,240.	$503,815.

[1] The road routes are divided into two categories based on whether they are candidates for upgrading (storm-proofing) preventative actions or for decommissioning. Roads identified for upgrading are further separated into routes which STNF has "identified (i.e. category #1)" and "not identified (i.e. Category #2)" as primary and secondary long term transportation routes. Roads identified for decommissioning are separated into routes which STNF has indicated NEPA documentation may exist or has been done for the route (i.e. Category #3), and roads where no NEPA or environmental impact analysis has been performed (i.e. Category #4).

[2] Future sediment yield should be viewed as the maximum amount of sediment which could be delivered to stream channels in the Smoky Creek Compartment if no road storm-proofing or road decommissioning activities occur. Each site identified during the sediment source inventory has a different probability or likelihood of the erosion occurring, therefore it is highly unlikely the total volume of sediment yield could be realized during a given storm.

[3] Cost to treat sites, along with the recommended treatment immediacy, are noted on the attached printouts for each road. The database can easily be manipulated to sort sites for treatment, by immediacy and/or costs to treat, as well as to determine which sites could be treated with routine maintenance procedures verses sites requiring some level of NEPA documentation. The itemized costs includes heavy equipment and labor costs, a 25 percent logistics/contingency escalation factor and culvert costs. They do not include any costs for mulch and revegetation materials, or the cost to apply mulch and revegetate the sites, costs for re-rocking or re-paving road prisms or costs for trash rack materials.

[4] Along the roads to upgrade, the following feet of road prism and ditch must be disconnected from either stream crossing sites or from ditch relief culverts which are contributing sediment to nearby streams.

Road Decommissioning or Proper Closure

Road decommissioning activities largely involve the complete and proper excavation of road fill placed in stream crossings, and re-establishing natural hillslope drainage patterns. Most intervening segments of road prism, ditch and/or cutbank between identified sites along a road can either be very frequently drained with a series of cross-road drains excavated into the road prism, or by removing any remnant road berms and mildly outsloping the road, including the complete burial of any inboard ditches. The disposal of spoil products derived from many of the stream crossing excavations can be used to outslope the road also. The practices of severe outsloping and re-contouring the hillslope through road obliteration will not be required anywhere in the East Fork drainage to effectively decommission or hydrologically close roads. As stated earlier, few fillslopes along roads in the watersheds exhibit indications of slope instability which could deliver sediment to stream channels, and as a result do not necessitate excavating the fillslope. Finally, we strongly recommend that road routes proposed for decommissioning be thoroughly ripped and de-compacted to promote infiltration and assist in revegetation efforts along the routes.

Tables 6-1 and 6-2 provide a breakdown of the number of stream crossings or sites which can be treated as part of normal road maintenance activities, and which will require some level of NEPA review and documentation.

Discussion of Specific Roads to Decommission

The WA Team evaluated expected short and long term forest management needs along the majority of road routes recommended for decommissioning throughout the WA area (i.e. Category #3 and #4 roads in Tables 6-1 and 6-2). As a result of the analysis, the road routes have been divided into three groups: 1) those which could be decommissioned immediately, 2) those which should have the identified thinning and fuels reduction activities performed in the next 3 to 5 years, and then properly closed or decommissioned, and 3) those road routes which should be retained as driveable routes for future land-management activities. These later routes should be upgraded, or "storm-proofed," as soon as possible.

Road Routes to Decommission Immediately

East Fork

28N22A Road. This road is upslope and parallel to 28N22 and downslope from the 35 road. The road crosses at the lower end of Prospect unit 4 (planted in 1988) and ends just east of Devil unit 17 (logged in 1989, not planted). The stands above and below the road are about half open M3P and half open M3N and appear to have a light to moderately dense understory of pole-size conifers, canyon live oak, and/or shrubs. Most of these stands appear to have been partially cut using tractors. Riparian reserves, which have the densest M3N stands, occupy part of this area. About half of the area accessed by this road is on 40 percent or less slopes, with the rest on 40-55 percent. This road could be decommissioned, as the stands will not need treatment for decades and could be cable logged uphill in the future from the 35 road or tractor logged downhill to 28N22.

28N51A Road. This spur road starts at a spur off of 28N26, crosses through Prospect units 8 and 10 and across the tops of units 3, 4, and 5 (planted in 1988), and connects with the spur roads above and below. The stands above and below the road are mostly M3S and M3P and they and the plantations appear to have been partially cut using tractors. The area accessed by this road is on 40 percent or less slopes. This road could be decommissioned as the stands will not need treatment for decades and could be cable logged uphill in the future from 28N27 or tractor logged downhill to 28N26.

28N40B Road. This spur road on Buck Ridge starts at 28N40 and runs southeast to the top of Fern Glade units L and M planted in 1972. In 1982 these units had over 150 trees per acre (TPA) and stand record cards show they are slated for thinning in 1998, although it is unclear why, as 1990 photos do not show overstocking, and in fact show many unstocked areas and areas of heavy brush. It is unlikely that funding will become available for shrub control or replanting on these units. There are areas which were partial cut in the vicinity of these units and unstocked openings should be planted as soon as possible. As the road and units are in LSR, the road should be decommissioned.

28N10B Road. This spur road begins at 28N10 and accesses Rat Trap II units 1, 2, and 25, which were planted in 1985. Fifth year survival exams show that both units 1 and 25 have over 400 TPA, with unit 2 having 217 TPA. Both the road and the units are in the LSR. It is recommended that units 1 and 25 be precommercially thinned within the next few years to 125 to 200 TPA to accelerate their development into late-successional stands. Following thinning, it is recommended that the road be decommissioned.

28N40A Road. This spur road on Buck Ridge starts at 28N40 and runs east down to the East Fork. It was used to access stands for partial cutting in what is now LSR. 1990 photos show many gaps in these stands. These gaps should be assessed for stocking, interplanted if understocked, and the road decommissioned.

28N41 Road. This spur road on Buck Ridge starts at 28N40 and runs southeast through Fern Glade unit F to unit K, planted in 1971 and 1973, with over 150 TPA in 1982. Examination of aerial photos show that large areas of unit K are understocked, with heavy grass cover, while unit F appears to be mostly adequately stocked. There are also some partial cut areas near the beginning of the road which appear to have unstocked openings. It is recommended that these gaps be planted as needed. It is unlikely that funding will become available for grass or shrub control or replanting on the plantations. As the road and units are in LSR, the road should be decommissioned.

Smoky Creek

28N28 Road. This road could be decommissioned as it will not be needed for over 40 years. This road is upslope and parallel to 28N25. The stands above and below the road for the most part have been heavily logged, with the exception of one M3N stand which has some large trees in it. A riparian reserve occupies part of this stand. The majority of stands along this road are M2S, with some very open M3P. It may be possible to cable log most of this ground in the future from road 29 and a spur near the ridge. Some of the ground below the road near its end is over 40 percent.

28N27A Road. This road could be decommissioned as it will not be needed for 40+ years. This road is upslope and parallel to 28N27 and below the 29 road and a spur from it which begins at the point of the ridge and ends at Spider unit 1. The road crosses the lower portion of units 1 and 2 of the Spider timber sale (planted in 1987). The rest of the stands above and below the road for the most part are very open M3P, and appear to have a moderately dense understory of canyon live oak and/or shrubs. These stands appear to have been partial cut using tractors. Riparian reserves occupy part of this area. Much of the area accessed by this road is on 40 to 55 percent slopes, with some less than 40 percent. The entire area could be cable logged in the future from road 29 and the spur near the ridge.

28N11B Road. This road takes off from 29N11 and runs west downhill, parallel, and south of 29N49. The stands below the road are for the most part M3S, with some patches of M3P and open M3N above the road. Riparian reserves generally have M3N stands. Most of the area accessed by this road is on slopes of less than 40 percent, with some slopes of 40 to 55 percent. It is recommended that the road be decommissioned as the stands will generally not require harvest or treatment for decades.

28N73 Road. This road is upslope and parallel to the 29 road and below 28N25. The road crosses the lower portion of units 5 and 72 of the Foss timber sale (planted in 1990) and ends north of a tributary to Red Mountain Creek. The small area of open M3P stands north of the creek has been partial cut with tractors and borders a large, unproductive area of ultramafic soils and sparse stands. The rest of the stands above and below the road for the most part are M3P and appear to have a moderately dense understory of pole-size conifers and canyon live oak. Riparian reserves occupy part of this area. Most of the area accessed by this road is on 40 percent or less slopes, with some 40 to 55 percent. The road from Foss unit 7 to the end could be permanently decommissioned, as the area north of the creek could be cable logged in the future from 28N25.

29N75B Road. This road is a spur off 29N75 which accesses the bottom of West Smoky units 14-16 (planted in 1986). All of these units, but especially unit 16, have clumps of dense pole-size trees which would benefit from thinning. There are patches of M4G and M3G above and below the road and between units 14 and 15 which are recommended to be reserved from harvesting to serve as part of the Smoky Creek dispersal corridor for late-successional wildlife species. The rest of the stands are M3S, P, and N and are either on low-productivity soils or have been partial cut. Most of the area accessed by this road is on 40 percent or less slopes, with a small amount of 40-55 percent slopes near the main creek crossing. It is recommended that the spur be water barred from 29N75 to the east end of unit 16 and be decommissioned from there to its end.

Road Routes to Decommission in the Next 3 to 5 years

East Fork

29N30G Road. This spur road starts at the 30 road, runs east parallel to and above it, and ends in a large patch of M3N, with patches and clumps of M3G within and upslope from it. The stands above and below the road are mostly M3S and M3P, except for some M3G stands near the beginning of the road, and appear to either be on unproductive soils or to have been partially cut using tractors. The area accessed by this road is on 40 percent or less slopes, except for a small area of 40 to 55 percent slopes near the end of the road in and around unit 35 of the Devil sale.

It is suggested that the M3G stands, and clumps within the M3N stands, be commercially thinned, that unstocked openings be site prepared and planted, and the M2P stand be thinned before this road is decommissioned. The stands should not need treatment for decades after thinning and planting and could in part be cable logged uphill in the future from 28N27 or tractor logged downhill to 28N26.

28N55 Road. This spur road starts at 28N23 and runs northeast until it dead ends. It is east of Texas Chow Creek and parallel and upslope from it. It runs below Prospect units 42 and 43 and above Devil unit 35. The stands accessed by this road are mostly a sparse M3N, with some M3S and M2P, on less than 40 percent slopes. These stands have been partially logged and have many openings which, on photos, appear to be sparsely stocked. It is recommended to treat these stands as needed, commercial and precommercial thinning dense clumps and planting understocked or unstocked areas. Following treatments this road could be decommissioned.

Smoky Creek

28N12 Road. This road takes off from the 29 road and accesses the bottom of Suds units 6, 7, and 11 (planted 1984). Below these units is a large patch of M4G which is recommended to be reserved from harvesting to serve as part of the Smoky Creek dispersal corridor for late-successional wildlife species. Beyond the end of the road and southwest of the units is a patch of D2N and D2G which has scattered size 3 and 4 trees which could be harvested. These stands would reach late-successional characteristics sooner, and potentially replace some of the M4G stands in the dispersal corridor, if they were opened up with a selection harvest and a combination commercial and precommercial thinning.

The stands near the beginning of the road are mainly M3N, with some M3P on low-productivity soils. Most of the area accessed by this road is on 40 percent or less slopes, with a small amount of 40 to 55 percent slopes near the main creek crossing. It is recommended that within the next three to five years the spur be extended to allow a selection harvest and a combination commercial and precommercial thinning of the D2N stand. Following thinning, it is recommended that the road be decommissioned along the segment shown on the map.

29N62C Road. This spur takes off from 29N62 and runs south and east, where it ends at Silver Creek. It accesses Silver Springs units 1 and 2 (planted 1972?) and

Silversnake unit 66 (planted 1984) as well as a large D3G stand which would benefit from a commercial thinning. The stands above the road, with the exception of the D3G stand, are on low-productivity or unproductive soils. These stands are mostly M3S, with a patch of M2G (which would benefit from precommercial thinning) east of the first creek crossing and some M3N stands near the end of the road.

The area below the road is a combination of M3S and M3N stands. The 3N stands are interspersed with clumps of 2G. A selection harvest and precommercial and commercial thinning would be appropriate here. Most of the area accessed by this road is on slopes of less than 40 percent, with some slopes of 40 to 65 percent in the vicinity of unit 66. It is recommended to retain this road to facilitate management of the timber stands, and to thin or harvest appropriate stands within the next 3 to 5 years. Following management activities, the road should be closed properly until access is needed 30 years in the future.

30N29C, 29N11 and 29N11C Road. This road is upslope and parallel to the 29 road. It takes off southeast of Snow gap, runs north adjacent to a large, unproductive ultramafic area and ties in with 29N11. The road crosses the lower end of Foss units 8 and 10 (planted in 1990). The stands above the road in the ultramafic soils for the most part are non-commercial, open M3P, with some patches of commercial M3P and open M3N, while the stands below the road are open M3N, with some M3P. Riparian reserves generally have the densest stands of trees.

Much of the area accessed by this road is on slopes of less than 40 percent, with some slopes of 40-55 percent in the mid section of the road and along the main creek. It is recommended that the central portion of the road through the ultramafic area be decommissioned. On either side of this zone dense clumps within the stands could be commercially and precommercially thinned, unstocked areas could be site prepared and planted, and the road could then be decommissioned for most of its length. The south segment should remain open to access the proposed Defensable Fuel Profile Zone.

Road Routes to Retain for Long-Term Forest Management

East Fork

28N26C Road. This spur road starts at 28N26 and runs west parallel to a small draw until it dead ends at Prospect unit 37. The stands accessed by this road are mostly M2G, with some M3N, on less than 40 percent slopes. Unit 37 was planted in 1988, had over 600 TPA in 1992, and is slated for precommercial thinning in 2001. As this road will be needed to access unit 37 and the M2G stands for thinning, it is recommended that it be kept in the road system.

Smoky Creek

29N76B Road. This spur takes off from 29N76 and runs west downhill, parallel, and south of it. The stands above and east of the switchback are M3S and include West Smoky unit 14. The stands to the east are M3N. Riparian reserves generally have M3N stands. Most of the area accessed by this road is on slopes of less than 40 percent, with some slopes of 40 to 65 percent east of the switchback. It appears from aerial photos that after the road switched back to the west it originally ran west for about one-half mile to access the M3N stand. Rather than decommission this road it is advisable to continue to use it along its original grade to allow access to the M3N stands for tractor logging.

29N74 Road. This spur takes off from 29N62 and runs southwest to 29N67. It accesses Silversnake units 15, 16, and 46 (planted 1984 and 1986) as well as large patches of D3G and D4G and a patch of M2P on high productivity soils on slopes of less than 40 percent. It is recommended to retain this road to facilitate management of the plantations, harvesting of the M3G and M4G stands, and thinning of the M2P stand.

29N62A Road. This road is a spur off 29N62 which accesses Silversnake units 54, 56 (not cut), 57, and 58 (planted in 1984). These units were scheduled for thinning in 1993, although there is no record that this was done The rest of the stands accessed by this road are a mosaic of M3S, P, N, and G stands on low productivity soils. Most of the area accessed by this road is on 40 percent or less slopes, with a small amount of 40 to 55 percent slopes to the south of the end of the road. This spur is mostly on a ridge, with only one crossing of a minor draw. It is recommended that the spur be retained in the system to facilitate management of the plantations and thinning of the M3N and M3G stands.

Specific Project Recommendations

Two specific projects need to be addressed as soon as possible to prevent direct and indirect impacts to anadromous fisheries in the WA area. The first is the culverted fill crossing on the 30 Road at Dark Canyon Creek, which is not only undersized to accommodate the 100-year storm flow and debris in transport, but also is a barrier to upstream fish migration (Site 430). The crossing fill is very deep, and will be an expensive project, but nothing short of replacing the existing culvert with a 11 to 12 foot diameter, open-bottom arch culvert will provide for year-round fish passage. It is estimated that approximately 13,000 cubic yards will need to be excavated and re-installed in order to replace the culvert.

The second project in need of immediate attention is a 150-foot long series of gabion bank protection or rip-rap which was placed along the East Fork main stem at the base of the active, deep-seated landslide at Site 448 along the 30 Road. The gabions are failing due to slow hillslope creep, and deformation of the structure appears to be increasing during the last two wet water years. Continued failure of the gabion structure will deposit a tremendous amount of wire into an anadromous portion of the East Fork, and pose a high risk of forming a jam, and/or directly harming fish.

It is recommended the gabions be completely removed, the rocks within the gabions be introduced to the stream channel, and the base of the landslide be protected with another structure, preferably large boulders. Engineering will need to perform mass balance analysis and model the hillslope to determine the appropriate long-term corrective measures.

Riparian Reserves

As has been previously mentioned in this analysis, at a landscape level and as regards aquatic habitats, Riparian Reserves appear to be functioning properly in most sub-basins except Prospect Creek (including Texas Chow) and Dark Canyon Creeks. Treatment opportunities appear limited in both healthy and compromised Riparian Reserves. At a landscape level riparian stands of conifers that are overstocked and/or exhibit high fuel hazard conditions are uncommon. Where Riparian Reserve stand density is high, the stand is generally dominated by willow and/or alder (this type of stand condition is readily identifiable on the air photos in many riparian stands in upper Prospect Creek). Additionally, treatments involving commercial extraction of small diameter material appear to be economically infeasible at present, perhaps because of the remoteness of the area. The Jones biomass sale for instance, which is located near the Prospect Creek area in the upper Hayfork Creek drainage, has been put out for bid but remains unsold.

This is not to say that individual sites within the Riparian Reserve system are not deserving of treatment or cannot be entered, or that treatments will remain economically infeasible. For instance, there are possible treatment opportunities within Silver Creek where fuel loading and fuel ladders exist within some riparian stands. In these stands it may be prudent to pursue opportunities to reintroduce prescribed fire into the stand in an attempt to reduce the fuel hazard. There also may be opportunities to pursue thinning treatments to improve stand conditions (i.e., to assist the riparian reserve in attaining late successional characteristics) in selected portions of the Riparian Reserve system, a system so vital to the dispersal of a number of wildlife species.

It is clear, however, that at a landscape scale, issues associated with riparian stand condition are not nearly as visible or critical as the aquatic health risk created by the present road system or the need to retain existing and intact dispersal corridors. Therefore, we recommend that treatments such as prescribed burns, and precommercial and commercial thinning treatments be identified and analyzed site specifically through the NEPA process and that the scheduling and priority placed on those projects be kept in the context of ecosystem process and function at the landscape scale. Lastly, the Riparian Reserves within this analysis area are so important to salmonid recovery throughout the South Fork, that we recommend strict adherence to the ACS as outlined in the Northwest ROD. Future treatments in Riparian Reserves should not occur unless it can be clearly demonstrated that the activity will benefit ecosystem functions and processes, in particular, maintaining or increasing its quality for fish and wildlife.

Human and Public Use Values

The four high-priority recommendations developed by the WA team directly address many of the issues raised by the public. The thinning projects on Buck Ridge and from White Rock to Stuarts Gap address public concerns in the following ways:

- The thinning projects generate timber sales from the analysis area and represent potential local employment.

- Thinning enhances the chances these stands will develop old growth characteristics more rapidly, which will ultimately increase functioning LSR land area.
- Thinning lessens the chance that catastrophic fire can get a foothold in these thick homogenous stands, which will hopefully protect the LSR lands adjacent to the plantations. This protection of LSR is of concern to many members of the public.
- The decommissioning of access roads, once thinning is completed, will also serve to protect the LSR lands from road failures and consequent erosion and the impacts of traffic.
- In addition, the WA team's recommendation to maintain and enhance the LSR lands (outside of plantations) addresses the concern for continued healing and encouragement of biological diversity in the watershed.
- The harvesting operations from White Rock to Stuarts Gap will not conflict with spiritual or recreational needs, as they lie outside of those areas of sensitivity.

The creation of a wildlife corridor along Smoky Creek and the protection of LSR stands it affords addresses the publics' concerns in these ways:

- It protects old growth wildlife species that reside there or move through that area.
- It enhances water quality and fisheries which is a public concern.
- It ensures more slope stability.
- It protects areas in which people recreate.

The proposed road upgrades and decommissioning:

- will help prevent further erosion in the watershed, which will help fisheries recover, thereby addressing a significant public concern.
- Also, many people have considered this area "over-roaded," which encourages motorized recreation. Reduction of usable roads will help balance the usage of motorized and non-motorized recreation.

Catastrophic Fire and Fuels

As outlined in the Commodities section below, vegetation conditions on these watersheds prior to the initiation of fire suppression were largely a result of soil conditions and periodic (probably annual) fires started by lightning and set by Native Americans and Euro-American cattle and sheep ranchers. These fires were probably mostly of low to moderate severity and mostly consumed dead and down fuels, shrubs, and seedling-, sapling-, and pole-size trees.

Partial cutting, which was initiated around 1955, has created a mosaic of early successional, even- and uneven-aged patches, and clumps of trees ranging in size from sapling and pole to small sawtimber, which vary from sparse to good stocking. Most of the large, fire resistant trees were removed in these harvests, leaving groups and patches of smaller trees with thin bark and crowns near the ground susceptible to fire damage. Harvests also increased the quantity and depth of surface fuels and by opening the canopy, created a warmer, drier, and windier environment near the forest floor during times of significant fire danger. All of these factors have increased the likelihood that fires will be more severe and will cause more damage to the forest now than they did in the past.

Since the advent of clearcutting in 1960, but mostly since 1980, about 11 percent of the Matrix in the East Fork and 8.5 percent in Smoky Creek has been clearcut and planted. The resulting plantations are moderately to heavily stocked with seedlings and saplings, with moderate amounts of grass and shrubs. Trees in these plantations are highly susceptible to damage from wildfire and given the fire regime in the watersheds, many will likely burn before they reach rotation age.

Catastrophic, or high severity, fire was identified as a primary threat to the critical and unique resources in these watersheds. These resources were identified as the LSR, Riparian Reserves, and NSO Activity Centers in the Matrix, plantations in both Matrix and LSR, high value focal (refugia) subwatersheds that are important within the analysis area and within the entire South Fork watershed, and the forests and brushfields which protect the watershed from erosion. Resources specific to each watershed are the area surrounding the White Rock campground, guard station, and White Rock itself in the East Fork watershed and the Special Interest Area (SIA), the proposed Research Natural Area (RNA), and the Administratively Withdrawn Area along the South in the Smoky Creek watershed.

The WA team prioritized the resources needing protection from catastrophic fire as follows: 1) mapped and unmapped LSR's, 2) Riparian Reserves and dispersal corridors for late-successional species, 3) plantations, 4), forests on productive soils, and 5) southern and western aspects (areas most susceptible to catastrophic fire conditions).

Throughout the west the severity of and acreage burned by catastrophic fires are on the increase and are resulting in substantial damage to resources and cost to the taxpayer. Catastrophic fire is becoming more likely in these watersheds because of the recent reduction in fire suppression forces and the increase of ground and ladder fuels since the initiation of fire suppression around 1906. There have also been over three decades of logging on Matrix lands, which has resulted in a decrease in large, fire-resistant trees and an increase in the number and density of small diameter trees with crowns close to the ground. These small diameter trees are susceptible to scorching and create fuel ladders which can carry fire into tree canopies, resulting in the loss of substantial areas of productive forest during catastrophic-fire weather conditions. If fire travels into the canopies of trees in the LSR there could be substantial losses of late-successional habitat which would take centuries to replace.

Catastrophic fire, by its very nature, is difficult (some would say impossible) to control. Current thought (Weatherspoon et al 1996) is to create a network of defensible fuel profile zones (DFPZ's) to provide areas where fire control is feasible and to minimize the possibility that such fires will do extensive damage. The strategy within these zones is to reduce fuel quantities, concentrations, arrangements, and ladders by harvesting, thinning, removal of shrubs, and under burning to mimic low- and moderate-severity fire regimes. DFPZ's should be combined with area-wide fuel reduction treatments to give the greatest protection from catastrophic fire.[2]

Some corollary benefits of DFPZ's are that they would be managed for large, high quality trees which, when harvested, would provide valuable sawlogs. Lower stand densities should reduce moisture stress on individual trees and thus reduce losses due to insects and disease. If DFPZ's were created on ridges and upper southerly and westerly slopes, stand conditions would likely be similar to the open presettlement forests which were dominated by large trees. It is probable that total evapotranspiration would be reduced, resulting in increased water yields, which would likely benefit the fisheries. Especially if prescribed fire is used, forage conditions should improve in open areas, which would benefit livestock and wildlife grazers. Habitat diversity and aesthetic variety would increase in landscapes deficient in forests dominated by open, large-trees.

DFPZ's alone are inadequate to reduce the fuel hazards in these watersheds. They need to be combined with area-wide fuel reduction treatments to give the greatest protection from catastrophic fire.

It is recommended that an overall strategy for fuel reduction on Matrix lands outside of DFPZ's be developed to reduce the amount of fuels and break up their vertical and horizontal continuity. This strategy should utilize silvicultural treatments to reduce fuel loads and ladders, piling and burning, lopping and scattering, chipping, or biomass reduction of fuels, and/or underburning using DFPZ's, roads, and natural openings as control points. In all scenarios, the LRMP direction to maintain dead and down material, hardwoods, and snags at naturally occurring levels should be followed (USDA Forest Service 1993, 4-44, 4-61 & 62, 4-67). On Perscription VIII Matrix lands the guideline is to maintain an average of five tons of unburned dead and down material on slopes less than 40 percent (and on steeper slopes where feasible), with four to six large logs over 10 feet long. This may require building fire lines around snags and logs to be retained before prescribed burning is done. Retain blister rust free sugar pines whenever possible when thinning.

Underburning of natural fuels using low-intensity ground fires should begin immediately and be done every 5-6 years across the entire watershed, or at least in areas which were, and may in the future be identified as high priority areas for protection from catastrophic fire. Unless this is done at the scale of the fuel buildup, it will not be adequate to reduce it and return the landscape to a condition suitable for reintroducing fire as a ecosystem management tool. Burning will require pre-treatment of fuels through silvicultural treatments and piling in many areas, as many stands presently have significant fuel ladders. If this pretreatment is not done, it is likely that ground fuels will be recreated within five years at almost the same density due to falling of trees killed in the initial burn (Agee 1997). Burning is recommended during seasons when the chance of fire escape is minimal and when air conditions are favorable. This burning

[2] Before any hazardous fuel reduction projects are proposed, an economic analysis should be performed to find the optimum combination of fuel treatment methods to meet the desired fuels results. The Northwest ROD has a goal of restoring fire to its natural role in the ecosystem. An economic analysis of alternative methods to reduce hazardous fuels should include the relationship of the methods to the goal of restoring fire to its natural role in the ecosystem.

can currently be done for about $50 per acre.

The LRMP specifies that the WA process will provide information to determine the amount of coarse woody debris to be retained when applying prescribed fire. This was not done as part of this analysis. Studies by fire ecologists have shown that most coarse woody debris burns in low intensity fires (Thornburgh 1997), so it is recommended that fire lines be built around snags and logs to be retained before prescribed burning is done.

LRMP management direction is for fuelbreak construction on the Forest is to be considered when it compliments health/biomass reduction needs, where very high and extensive resource values are at risk, and to protect communities (USDA Forest Service 1993, 4-17). Fuel treatments are prioritized in the LRMP (USDA Forest Service, 1993, pp. 4 to 18) as follows: 1) public safety, 2) high investment situations (plantations, structures), 3) known high fire occurrence areas, and 4) coordinated resource benefits (ecosystem maintenance for natural fire regimes).

It is recommended by the WA team that primary and secondary DFPZ's be created by widening existing shaded fuelbreaks along main and spur ridges and roads and connecting them with natural barriers. The primary DFPZ's could be constructed along the main ridges to a ¼-mile width using individual tree selection, sanitation, and/or salvage harvesting and/or commercial or precommercial thinning from below. Enough trees would need to be harvested in this zone to create an open (<60% canopy closure) stand dominated by large trees of fire-tolerant species, creating a discontinuity of horizontal and vertical crown fuels which would produce a low probability of a sustained crown fire. Blister-rust-free sugar pines should be retained whenever possible.

Following harvest, surface fuels reduction using prescribed fire and/or mechanical fuel-reduction techniques may need to be implemented. Fewer logs and snags than elsewhere in the forest should be left, especially near ridgetops, to prevent the possibility of logs creating hot spots and snags spotting for long distances. But enough snags and logs should be left to maintain soil productivity. This may require building fire lines around snags and logs to be retained before prescribed burning is done. Secondary DFPZ's could be constructed along spur ridges and main, mid-slope roads to a 1/8-mile width, with stand characteristics as described above. These DFPZ's could then be used as anchor lines for area-wide prescribed fire treatments.

Where DFPZ's cross Riparian Reserves, it is recommended that fuels either not be treated or be minimally treated by prescribed burning or other methods designed to meet the objectives outlined in the Northwest ROD ACS (USDA Forest Service 1993, 4-53 & 55). Because of their relatively moist environment, it is unlikely that these zones would become a fire conduit across a DFPZ if adequately staffed with suppression forces. The short term consequences of fuel reduction activities in Riparian Reserves, if any, should be analyzed and carefully weighed against the long term benefits of reducing the damage from catastrophic fire. That analysis should occur on a site specific basis and be conducted at the NEPA level.

Planning and construction of a DFPZ network is a top priority and should be done within the next ten years if funding is available. As individual portions of the DPFZ are constructed, adjjacent areas should be simultanesoulsy treated to reduce fuel loads. In the East Fork a total of 14.7 miles (2352 acres) of primary DFPZ's are recommended for construction, with about 11.9 miles (1904 acres) of this presently in fuel breaks or sparsely vegetated, requiring little additional work (Map 8a, Appendix E). A total of 16.9 miles (1352 acres) of secondary DFPZ's are recommended, with about 3.8 miles (304 acres) of this already in fuel breaks or sparsely vegetated, requiring little additional work. In Smoky Creek a total of 19 miles (3040 acres) of primary DFPZ's are recommended, with about 16.9 miles (2704 acres) of this presently in fuel breaks or sparsely vegetated, requiring little extra work (Map 8b, Appendix E). A total of 28.5 miles (2280 acres) of secondary DFPZ's are recommended, with about 5.3 miles (424 acres) of this already in fuel breaks or sparsely vegetated, requiring little additional work.

From a practical standpoint, the highest priorities for construction of DFPZ's are those areas which currently would not function effectively as DFPZ's but could be brought to acceptable standards most quickly and inexpensively (see paragraphs following below). Fuelbreaks currently cost from $500 to 700 per acre to construct, so multiproduct timber sales, where high-value products subsidize the removal of lower value material, should be considered as a way to fund DFPZ construction.

Recommendations for Constructing DFPZ's

Refer to maps 8a and 8b, Appendix E, for the following discussion of constructing primary and secondary DFPZ's.

<u>Primary DFPZ's</u>

Construct primary DFPZ's along main ridges. Leave at least 60 percent canopy cover where DFPZ's overlap LSR's. Retain blister-rust-free sugar pines whenever possible. Site specific treatments in the LSR will be addressed at the NEPA level. Utilize natural openings with sparse vegetation wherever possible. Construct primary DFPZ's at:

- The main divide along the northern watershed boundaries from Red Mountain southeast to Stuart Gap and north to Mud Springs and then east through the LSR to Hellgate (first priority for completion). Leave at least 60 percent canopy cover where the fuelbreak crosses the top of Spot Creek and in the dispersal corridor east of White Rock.
- Buck Ridge from the East Fork to the Hermit Rock area.
- The ridge between Prospect and Soap Creeks from Red Mountain to below 28N26.

<u>Secondary DFPZ's</u>

Construct secondary DFPZ's along main roads and spur ridges. Leave at least 60 percent canopy cover where DFPZ's are in LSR. Retain blister rust free sugar pines whenever possible. Site-specific treatments in the LSR will be addressed at the NEPA level. Utilize natural openings with sparse vegetation wherever possible. Construct secondary DFPZ's at:

- Road 30 (Wild-Mad Road).
- Road 28N10 (Old Bill Mine Road) from junction with 28N23 east to Stuart Gap.

- Road 29 (Bramlet Road).
- The ridge along 28N23 from 35 Road to junction 28N10 then tying in with open areas along 28N23 and along north side of the LSR to Road 30.
- The ridge between Smoky and Red Mountain Creeks from the open stands on Red Mountain just above 29N11 to Snow Gap, then southwest to Suds Timber Sale unit 8 and Rare Dog unit 1.
- The ridge paralleling 29N75 from Mud Springs to the Bramlet Road (Road 29).

Construct secondary DFPZ's along LSR boundaries (1600 feet wide). Leave "soft" edges with not less than a 60 percent canopy closure. Retain blister rust free sugar pines whenever possible. Utilize natural openings with sparse vegetation wherever possible. Construct secondary DFPZ's:

- From Road 35 east of McCullah Springs to the natural opening north of 28N19, then east along 28N19 to 28N10.
- At the ridge paralleling 29N67 and 29N67A east of the LSR in the Smoky Creek watershed from 29N58 on the divide to the LSR boundary northwest of the mouth of Silver Creek.

Construct secondary DFPZ's around NSO activity centers (1/8-mile wide) and late-successional stands within the wildlife corridor on Smoky Creek (1/8-mile wide). Leave "soft" edges with not less than a 60 percent canopy closure. Construct secondary DFPZ's at:

- One NSO activity center in the East Fork watershed, four in Smoky Creek.
- The wildlife corridor in Matrix on Smoky Creek. The east side will be protected by DFPZ's described above. Construct a DFPZ along the ridge, connecting open, unproductive areas from Road 29 along the east side of the proposed RNA to the boundary of the Non-motorized Recreation Area, if logging is found to be economically feasible.

Other Recommendations

DFPZ's will need to be maintained every 10 or so years, or as needed, by thinning, brushing, and/or underburning. Underburning would restore in part the natural role of fire in the stands and is the preferred method. Alternating portions of the DFPZ's would periodically need to be regenerated using long-rotation, low-density group selection. This system would favor shade intolerant, fire-tolerant species and provide a single canopy layer which would discourage crown fires. Blister-rust-free sugar pines should be retained whenever possible. A few trees should be left to become snags, but fewer than in other forested areas.

Other projects which were identified to meet LRMP and ecosystem goals in these watersheds are as follows:

- Perform a fuels inventory for all proposed projects prior to and following implementation. Use the inventory as part of a monitoring plan and for mandatory requirements for burn plans.
- Thin plantations and construct DFPZ's around groups of plantations. Retain blister rust free sugar pines whenever possible.

- Thin dense stands using a combination of precommercial and commercial thinning. Retain blister-rust-free sugar pines whenever possible.
- Treat activity fuels to F.S.M. 5150 requirements on all projects which manipulate vegetation.
- Underburn the area from Stuart Gap south to the trailhead along the ridge and between units during the Winter or Spring (high priority).
- Underburn the area around White Rock Guard Station and campground and White Rock itself during the Winter or Spring.
- Underburn the area around the SIA in the east fork of Smoky Creek during the Winter or Spring.
- Underburn in the LSR if recommended in the Fire Management Plan.
- Spot burn brushlands using DFPZ's and roads as control points to create a fuel mosaic.

The LRMP specifies that a Fire Management Plan will be prepared for the LSR as part of a Management Assessment (USDA Forest Service 1993, Chp. 4, 37-40). This was not done as a part of this analysis, but a programmatic plan for all the LSR's on the Forest is currently being developed by the State Office. The LRMP specifies that until this plan is completed, wildfire will be suppressed to avoid loss of habitat, the goal being to limit the size of all fires. It may be found prudent to allow low- and moderate-intensity wildfires to burn in the LSR's. On the Klamath National Forest all lightning-caused fires in LSR's are considered prescribed fires, unless they do not meet the goals and objectives for such fires, in which case they are considered wildfires and are suppressed (Perkins, J. 1997).

In this analysis, opportunities were identified for creating DFPZ's within and near the boundaries of the LSR. The LRMP specifies that silvicultural activities in the LSR will be geared toward reducing the risk of fire and will focus on younger stands (USDA Forest Service 1993, 4-37). The goal is to accelerate the development of late-successional conditions while making the stands less susceptible to natural disturbances. The plantations on Buck Ridge and near Stuart Gap in the LSR could be thinned to meet this goal (see recommendations for Commodities Production, below, pg. 6-28).

It is advisable to prepare and implement a monitoring plan to monitor fire starts, fuel conditions, effectiveness of DFPZ's for controlling fire, cost/benefit ratios of DFPZ's and other fuel treatments, and effects of DFPZ's and underburning on wildlife and soil productivity.

The GIS fire layer apparently had accurate fire-start data, but the fire risk and hazard data was evidently inaccurate. The risk and hazard data would be useful if it were revised to fit reality. It is recommended that an accurate GIS database be developed and periodically updated for supporting fire and fuel-management decision making in the context of adaptive management.

Currently fuel models used on the Forest are for ground fires and do not accurately predict crown fires. As more crown fires are occurring, it is advisable to create a fuel model to predict the behavior of these fires to aid in developing fuel treatment and fire protection strategies.

The Klamath National Forest uses a First-Order Fire Effects Model with a Direct Attack map and the Fire Effects Information System (available on the Internet – through "Yahoo") to show fire effects on various resources (Perkins, J. 1997). If this process is not being used on the Shasta-Trinity N.F. it should be considered for use.

Questions that need to be answered to improve the fuels and fire component of ecosystem management decision making are:

- What are the effects of forest health treatments on fire behavior, epizootics, and fish and wildlife habitat?
- Are fuel breaks effective in slowing fire spread?
- Do ground fires blow up when they hit logging slash?
- Do slower burning hardwoods cool fires?
- Are uniform stands of small trees more or less fire prone than old growth forests?
- Does thinning reduce fire hazard?

Commodities Production

The following section on commodities production has been written without reliable slope stability data. The LRMP data sets used to develop the analysis for the watersheds did not have slope stability data included (a column was set aside for this information, but the data was not yet available at the time this watershed analysis was undertaken). Filling in this data gap is one of the recommendations made by the WA team as part of its Recommendations for Data Gaps in chapter 7 of this report (pp.7-5 through 7-7).

Overview

Vegetation conditions prior to the initiation of fire suppression (around 1906) were largely a result of soil conditions and periodic (probably annual) fires started by lightning or set by Native Americans and Euro-American cattle and sheep ranchers. Judging from 1944 aerial photos, the forest on Matrix was composed of a relatively open overstory of large mixed conifers with a sparse conifer and hardwood understory and a light shrub layer. There were probably fewer dead and down ground fuels and fewer ladder fuels composed of shrubs and shade-tolerant understory trees. Unproductive soils were generally un-vegetated or sparsely vegetated with small trees.

With the advent of fire suppression, the role of fire as a dominant ecological process was reduced. Since 1910, 147 fires of less than five acres and five larger fires of 11 to 1600 acres have been recorded in these watersheds. Eighty-seven percent of these fires were caused by lightning. These burned in total fewer than 2500 acres, or 5 percent of the watershed analysis area, over a period of 85 years.

From 1906 to 1955, the period between initiation of fire suppression and the advent of harvesting, it is likely the development trend in the forest was for increasing tree size and canopy density and creation of small tree understories in places and an increase in snags and dead and down material. It is likely that grassy openings decreased in number and size, with a corresponding increase of shrubs. These changes were likely slower and less noticeable on unproductive soils. These changes may have been beneficial to what are now considered TE&S species.

Comparison of vegetation on 1944 and recent aerial photos generally shows only minor changes in ground cover on unproductive soils. These changes include an increase in the size of trees which existed in 1944 and a minor amount of tree regeneration and shrub growth. This trend is expected to continue into the future.

Partial cutting, which was initiated around 1955, has created a mosaic of early successional, even- and uneven-aged patches, and clumps of trees ranging in size from sapling and pole to small sawtimber, which vary from sparse to good stocking. Most of the large overstory trees were removed in these harvests, leaving scattered residuals. These residuals are denser along watercourses where they were generally either unharvested or only lightly harvested. The forest landscape created by partial cutting has abundant edge, vertical and horizontal structural diversity, spatial complexity, and genetic variability, but is deficient in later successional stages, interior forest, and medium to large snags.

In areas of partial cutting, about 90 percent of the Matrix in the East Fork and about 55 percent in Smoky Creek, there is a mosaic of even- and uneven-aged timber strata. In these areas M3S and M3P stands comprise about 46 percent of the area and M3N and M3G stands comprise about 32 percent in the East Fork and 35 percent and 15 percent in Smoky Creek respectively. Left alone, the uneven-aged stands will continue to develop as uneven-aged groups and patches with a mix of species, size classes, and canopy layers. Eventually, in the absence of fire or management, shade-tolerant species will dominate the stand. The even-age stands will generally develop an overstory canopy of variable density with a sparse understory.

All of the stands are expected to increase in volume of merchantable trees over time, but not as rapidly as they would with stocking control. Without stocking control it is likely that there will be an increase in populations of insects deleterious to trees, with a resulting increase in tree mortality. Stocking control treatments should vary depending upon the needs of each stand and should be determined at the time of project planning. It is expected that a combination of treatments would be used, including commercial and precommercial thinning, site preparation, and interplanting.

Since the advent of clearcutting in 1960, but mostly since 1980, 11 percent of the Matrix in the East Fork and 8.5 percent in Smoky Creek has been clear-cut and planted. Most plantations were planted with a combination of ponderosa pine and Douglas-fir, and occasionally Jeffrey and sugar pine, although sugar pine plantings have been largely unsuccessful due to white pine blister rust. The resulting plantations are moderately to heavily stocked with a preponderance of seedling and sapling ponderosa pines and Douglas-fir, which are generally growing rapidly. Experience has shown that natural seeding is beginning and will return some plantations to a species mix similar to that in the original stands within 10-15 years. The older plantations have been thinned for stocking control and are also growing well. Most of these plantations are expected to continue growing rapidly and should produce poles and sawlogs from intermediate and final harvests within 35 to 105 years.

The forest landscape created by clearcutting, in contrast to partial cutting, currently has less edge, minimal stand vertical and horizontal structural diversity, less spatial complexity and genetic variability, no later successional stages, probably no interior habitat, and minimal snags except in adjacent forest. This landscape does have a high proportion of early successional habitat of grass, forbs, shrubs, and seedling and sapling trees.

Future timber yields from Matrix lands are limited primarily by soil productivity, as 10.7 percent of the Matrix is on mapped unproductive soils in the East Fork watershed (15% in Smoky Creek), 8.9 percent on unmapped unproductive inclusions in the East Fork (8.5% in Smoky), and 19.4 percent on soils of limited productivity in the East Fork (34.8% in Smoky Creek) (see Table 5-18 and Maps 11a and 11b). Understocking in some of the partial cut areas may also be limiting future yields.

Sustainability of a healthy, productive ecosystem is the primary goal in these watersheds. Discovering what the elements of a healthy ecosystem are is an ongoing process requiring research, observation, and monitoring. The ecosystems on Matrix, and in those portions of LSR which have been logged, have undergone dramatic changes since harvesting was initiated about 35 years ago, and to a lesser extent, in the 90 years since fire supression was initiated. It is expected that human influences on air quality, climate, pests, pathogens, wildlife, fire, and vegetation will continue to increase in the future, with unpredictable effects on the ecosystems.

Given these uncertainties and our limited knowledge of how ecosystems function, it behooves the USFS to adopt a management approach which retains the genetic, structural, landscape, and temporal diversity which is critical to ecosystem resilience (this, and much of the following information, is from Franklin et al 1996). In these watersheds it is strongly recommended that ecological and genetic diversity and soil productivity be maintained by accommodating early successional species, providing coarse, woody debris and snags of all sizes, creating multi-structured and multi-species stands, protecting riparian habitats, and providing for diverse and functional landscapes.

Early successional species can be accommodated by using silvicultural prescriptions, including wide spacing when planting and early precommercial thinning, which delay canopy closure and maintain open forest conditions for long periods. Wide spacing can reduce planting, release, and thinning costs and, while probably reducing total yields, may have little effect on the ultimate value of the stand as trees will grow to a larger diameter in a shorter time. Open stands of large trees are also less susceptible to damage from high severity fires.

Coarse woody debris, in the form of snags and logs, is as important to the forest ecosystem as live trees. It provides habitat for more than 20 percent of the forest fauna and is important in nutrient and energy flows, as a source of soil organic matter, as a site for a-symbiotic nitrogen fixation, and in erosion control. Silvicultural prescriptions should be designed to preserve existing coarse woody debris and to provide for future sources of it. Establish a policy of snag retention and recruitment consistant with STNF's snag simulator model and draft snag guidelines. Given the critical importance of snags for many wildlife species--including old-growth-associated species such as the NSO; goshawk; cavity-nesting birds; furbearers, including fisher, marten, and small mammals--the snag guidelines should only be considered as a minimum threshhold, with higher numbers of snags retained and recruited where possible across the landscape. The basis for higher numbers of snags is further explained by Jimerson's (1989) data discussed in the footnote below.[3]

Suitable green trees of various sizes, species, and spatial arrangements should be designated as sources of future snags and logs and their mortality should be spaced out over the stand rotation. It would be advisable to leave uncut a portion of the size class 4 and large size 3 residuals, as they are a structural component which is relatively scarce on much of the harvested area and will eventually provide high-quality snags and logs as well as a seed source in the event of severe fire. Also, attempt to leave the litter and duff layer as undisturbed as possible, except for periodic burning where appropriate.

Multi-structured and multi-species stands tend to improve soil fertility and have greater ecological resiliency and reduced susceptibility to pests. A mix of conifers and hardwoods enhances both chemical and physical soil properties. Hardwoods provide important habitat elements for both flora and fauna. Stands of mixed structure could take many forms, with multiple objectives and could be created by various silvicultural prescriptions, including individual and group selection and shelterwood with reserve trees retained throughout the rotation.

The linkages between the forest and streams are numerous and complex. To a large degree, forests control the environment (light, temperature, and nutrient regimes), energy base (food), and physical structure of small- to medium-sized streams. In-stream photosynthesis and stream temperature are regulated by the amount of light received, which is regulated by the height, density, and species of vegetation in the riparian zone. This linkage is tightest along small streams and decreases in proportion to the ratio of vegetation height to channel width.

Riparian vegetation is known to capture nutrients traveling from upland areas and to eventually transfer these nutrients and carbon from the terrestrial to the aquatic system through litterfall (leaves, branches, and logs). These inputs are the primary source of

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[3] Because snags are of such great importance to many vertebrates and invertebrates, it is important to retain adequate numbers of snags in managed areas, particularly Matrix. Retain many currently existing snags, especially large snags in all land allocations. Retain and recruit for snags of varying sizes with particular emphasis on retention and recruitment of larger-sized (≥20" dbh and >50' tall; c.f. Jimerson 1989) snags, tree species, and configurations (e.g. in clumps, solitary, etc.) to accommodate the needs of a variety of species (various bats and bird species as identified in this document). It is important to maintain at least two large sized (≥20" dbh and >50' tall), two medium sized (>20" dbh and 20-50' tall), and at least five small sized (> 5" dbh and ≥ 10' tall) snags per acre on average in Matrix (the average being taken over 40 acre blocks [as per LRMP 4-62]). The number of snags per acre in the varying snag size classes were taken from Jimerson (1989) who found an average of 2.07 large snags/acre, 1.94 medium snags/acre, and 20.67 small snags/acre on the Gasquet Ranger District of the Six Rivers National Forest, CA. However, we recommend fewer small snags than Jimerson (1989) found and recommend emphasis on large- and medium- sized snags. Our recommendation differs from LRMP (4-62) which recommends an average of 1.5 snags per acre that are at least 15" dbh and 20' tall. Our rationale for recommending emphasis on medium and large snags is that the smaller-sized snags may not provide adequate thermal environments for snag-dependent wildlife - especially in these analysis areas that experience extreme weather conditions in both summer and winter. Snag recruitment will probably be possible in the 15 percent uncut portions of green-tree retention cuts.

energy and coarse, woody structure for small, heavily shaded streams. It has been found that areas of late-successional forest have a rich diversity of these inputs relative to young coniferous stands or recent clear-cuts. It is recommended that most, if not all, large trees be retained in Riparian Reserves and that any salvage or other silvicultural treatments be designed to meet the objectives of the ACS (USDA Forest Service 1993, 4-53 & 54). Retaining large, fire resistant trees will help insure that, in the event of fire, a canopy will remain in the riparian zone.[4]

A diverse and functional landscape provides habitat for a variety of wildlife, insect, fungal, and plant species. In portions of these watersheds where extensive partial and clearcutting have removed most of the large trees, it is essential to create greater structural diversity. Some of this diversity could be provided in Riparian Reserves, some by managing for larger trees adjacent to Riparian Reserves and LSR, some by retaining or growing larger trees in wildlife corridors and around NSO activity centers, and some by growing larger trees in DFPZ's (see the Catastrophic Fire and Fuels section, above).

The WA team identified a number of ecosystem elements and resource concerns in the Matrix which could affect or be affected by timber management. Wildlife dispersal corridors in the ridge area between Star Mountain and Stuart Gap in the East Fork and along Smoky Creek were identified as a high priority to facilitate dispersal of late-successional species into other LSR's. Transition zones were identified as necessary to enhance and protect the unique mapped and unmapped LSR's. As these watersheds are Tier 1, Key Watersheds, protection of water quality is a primary goal and sediment introduction into watercourses from roads or management operations was identified as a significant resource concern. Catastrophic fire, with its potential adverse effects on LSR, dispersal corridors, plantations, vegetative cover, and cultural and recreation

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[4] The Institute for Sustainable Forestry in Redway, California, under the umbrella of the national SmartWood program, certifies forest land management practices. It recently prescribed riparian protection measures for two non-industrial timber management plans in the Mattole watershed, a highly impacted watershed which supports Coho salmon. These standards, which should be considered for use on a project level, are as follows:

Class I Watercourse (fish bearing or domestic water supply). At least 80 percent of the overstory canopy and 75 percent of the understory cover will be retained following harvest operations. If this standard cannot be maintained over a 200' linear distance, harvest operations will be deferred until the retention standards can be met.

Class II Watercourse (supporting aquatic life, or fish seasonally). Same as for a Class I watercourse.

Class III Watercourse (capable of transporting sediment, but may be dry except during storms). Watercourses will have a 25' ELZ (Equipment Limitation Zone - measured from the centerline of the draw) except at prepared road crossings. On slopes greater than 50 percent, the ELZ will be 50'. A minimum of 50 percent of the existing overstory canopy and 50 percent of the existing understory vegetative cover within the ELZ will be retained following harvest operations. If this standard cannot be maintained over a 200' linear distance, harvest operations will be deferred until the retention standards can be met, except prescribed fire may be used to reduce fuel ladders. No heavy equipment will be operated in this zone except where specified in the plan. Soil deposited during timber operations in a Class III watercourse other than at a temporary crossing will be removed and debris deposited during timber operations will be removed or stabilized before the conclusion of timber operations or before October 15. Any temporary crossings will be removed before the winter period.

sites, was considered a particularly significant ecosystem element. The White Rock area was found by the team to be ecologically, culturally, and historically unique.

The LRMP management direction for Matrix lands in these watersheds is Prescription VIII, Commercial Woods Products Emphasis. It is specified that these lands are to be managed for the sustainability of the ecosystem and that an optimum yield of wood fiber will not be expected (USDA Forest Service 1993, pp. 4-67, 159, 163, 167). Silvicultural systems chosen will reflect recommendations made during the interdisciplinary WA and will depend upon current stand conditions and the type of vegetative cover desired in the future (USDA Forest Service 1993, 4-26). Timber management should follow all applicable guidelines in the LRMP, including those on pp. 4-27 and Appendix C (USDA Forest Service 1993).

Guidelines for determining the appropriate silvicultural systems for various site specific conditions are listed in the LRMP, C-2 through C-3. The analysis team recommended appropriate silvicultural systems below in the thinning and harvest recommendations for the various timber strata, in the section on wildlife corridors, and in recommendations for the released portions of the Chinquapin and the East Fork Roadless Areas. A description of each stratum for each watershed is given in the Commodities Production section under Current Conditions (Page 5-x).

It should be noted that reliable slope stability and soil erodibility information was not available at the time of this analysis, so no erosion-hazard risk was determined for harvest areas. This determination needs to be made at a project level in order to prescribe appropriate silvicultural and logging systems.

Recommendations

Approximately 2684 acres of plantations on Matrix are overstocked (District stand record cards corroborated by field observations). These plantations are found on the Old Devil (planted 1962), Old Dark Canyon (1968), Chow (1980 & 1981), Pony Buck II (1984), Peak (1984-1987), Dark Canyon 1 (1988), Prospect (1988-1990), and Devil (1989-1992) timber sales in the East Fork and the Red Dog (planted 1971 & 1982), Dog Gulch (1983 & 1984), Suds (1984-1985), Silversnake (1984-1986), Spider (1987 & 1990), Rare Dog (1988), Foss (1990-1995), and West Smoky (1995) timber sales in Smoky Creek (see Appendix D).

For plantations which have over 300 trees per acre (TPA) at the time of certification (5^{th} year survival exam - see Appendix D), a survey should be programmed to determine thinning needs, and thinning should be done within the next 7 to 10 years. This is a high priority for funding in order to obtain optimum growth rates and minimize fuel hazards and insect population buildup from excessive slash.

It is recommended to thin plantations to 125 to 200 tpa, generally within 10 to 15 years following planting, in order to reduce thinning slash and to lower costs. The most vigorous artificially and naturally regenerated conifers and hardwoods should be selected to create a species mix similar to that found in the pre-existing stand. Spacing should be varied to select for the most vigorous trees, with holes left where stocking is sparse. Blister-rust-free sugar pines should be favored, and competing brush should not be cut unless it is seriously hampering growth.

Precommercial thin in natural stands, where appropriate, in conjunction with commercial thinning or harvesting to insure survival, accelerate growth, or reduce fuel hazards. Appropriate stands and treatments should be selected at the project level. Select the most vigorous conifers and hardwoods to create a species mix similar to that found in the pre-existing stand. Favor blister-rust-free sugar pines. Do not cut competing brush unless it is seriously hampering growth or causing an unacceptable fuel hazard.

Commercial thin M3G, D3G, D2N, and M2G stands using a thin from below strategy (i.e. remove suppressed, intermediate, and poor quality co-dominant and dominant trees) or other methods appropriate for the stand conditions. This thinning is needed to accelerate growth, maintain stand health, and reduce fuel loads and ladders to allow reintroduction of fire into the ecosystem. Retain blister-rust-free trees whenever possible. Retain existing snags and logs whenever possible and designate suitable green trees for future snags and as wildlife trees as outlined above under coarse woody debris. Follow the guidelines in Appendix O of the LRMP for maintaining soild productivity. The following stands were identified for thinning.

- M2N & G in plantations within the LSR in the Buck Ridge area (1st priority, within 2 years)
- M3G in the White Rock to Stuart Gap area (2nd priority, within 2 years)
- D3G in the mid Silver Creek drainage
- D2G and D2N in the lower south portion of the Smoky Creek drainage
- M3G and D3G in the upper Texas Chow Creek drainage
- M2G in the lower Prospect Creek drainage

The highest priority for commercial thinning is in the M2N and M2G stands in the LSR in the East Fork on Fern Glade units P1, P2, and portions of C, D, E, F, G, H, I, and N (A, B, B2, and J were thinned in 1991) and Buck Ridge I units B through E as needed. The highest priority for precommercial thinning is also in the LSR in East Fork on Rat Trap II units 1, 25, and portions of 2 and 28, and Peak units B-E, G, and I. This thinning is needed to accelerate development of late-successional attributes on these units. All of these units were assessed using 1990 aerial photography, but were not ground surveyed during this analysis. Ground surveying should be done at the project level to determine specific thinning needs. Thinning should be done in 1998 on Fern Glade unit F, and as soon thereafter on Rat Trap II units 1 and 25, so that the roads accessing them (28N10B, 28N40A & B, and 28N41) can be decommissioned. The roads on Buck Ridge are on unstable soils and are experiencing erosion.

If funding permits, those brushy or understocked portions of Fern Glade units C-I and K-M and the gaps in the partial cut areas in their vicinity, and Rat Trap unit 2 should be site prepared and replanted. This should be considered a low priority for funding.

The next highest priority is for thinning (and/or harvesting) in stands accessed by roads which are recommended for decommissioning. Roads 28N55 and 29N30G on the East Fork and 28N12 and 30(29?)N29C on Smoky Creek have been identified, from aerial photo interpretation, as having stands needing treatment. These stands should be scheduled for treatment immediately so as not to delay road decommissioning (see Priority 1, Chapter 7). There may also be treatment opportunities on other roads identified for decommissioning, 28N22A and 28N51A on the East Fork and 28N11B, 28N27A, 28N28, 28N73, and 28N75B on Smoky Creek. Scheduling of harvesting on these roads will need to be coordinated with road decommissioning (see Priority I Recommendations in Chapter 7).

In partial-cut areas on productive soils are numerous under- or non-stocked openings intermixed with conifer stands. These openings, which have variable shrub and tree densities, contribute to the structural complexity of the forest and provide habitat for early successional species. In areas where there are already abundant openings associated with unproductive soils, commodity values could be increased by site preparing and replanting productive openings with conifers. The tradeoffs of this should be considered on a project level and treatments should be done in conjunction with sale activities.

Harvest M3P stands using individual tree and group selection, commercial thinning, shelterwood with reserves, green tree retention, and/or other appropriate silvicultural systems depending upon site specific stand conditions. Precommercial thin in conjunction with harvesting where appropriate.

Harvest M3G stands using clearcutting with green tree retention, shelterwood with reserves, group selection, commercial thinning, and/or other appropriate silvicultural systems depending upon site-specific stand conditions. Precommercial thin in conjunction with harvesting where appropriate.

Harvest M4G stands using clearcutting with green tree retention, shelterwood with reserves, group selection, and/or other appropriate silvicultural systems depending upon site specific stand conditions.For M3P, M3G, and M4G stands, in silvicultural prescriptions which require retention of green trees, retain blister-rust-free sugar pines whenever possible. Retain blister-rust-free sugar pines whenever possible. Retain existing snags and logs whenever possible and designate suitable green trees for future snags and as wildlife trees as outlined above under coarse woody debris. To the extent possible for whatever silvicultural and logging system is prescribed, leave the litter and duff layer as undisturbed as possible. Follow the guidelines in Appendix O of the LRMP for maintaining soil productivity.

The Matrix from Star Mountain southeast and above road 28N45 in the East Fork watershed has been recommended as a late-successional wildlife dispersal corridor by the WA team. It is recommended that a DFPZ be created from the main dividing ridge down 1/8-mile on either side. To allow this area to function as a wildlife corridor, the canopy should not be reduced below 60 percent. Selection harvesting is the recommended silvicultural system for the area from the DFPZ to the LSR boundary. Retain blister-rust-free sugar pines whenever possible during harvesting. This is not to way sugar pine cannot be cut, but retention of seed stock for species survival should be striven for among trees retained.

Late-successional stands (M3G and M4G) totaling 1776 acres in the Matrix bordering Smoky Creek from the Non-motorized Recreation Area to Mud Springs have been recommended as a late-successional wildlife dispersal corridor by the WA team. It is recommended that a DFPZ be created from the main ridge down 1/8-mile on either side. To allow this area to function as a wildlife corridor, the canopy should not be reduced below 60 percent in the Mud Springs area. Selection harvesting or shelterwood with overstory trees reserved until the end of the rotation, leaving at least a 60 percent canopy closure, is the recommended silvicultural system for the stands which interconnect the late-successional stands within this corridor. Retain blister rust free sugar pines whenever possible. Retain existing snags and logs whenever possible and designate suitable green trees for future snags and as wildlife trees as outlined above under coarse woody debris. To the extent possible for whatever silvicultural and logging system is prescribed, leave the litter and duff layer as undisturbed as possible. Follow the guidelines in Appendix O of the LRMP for maintaining soil productivity.

Management activities within the stands in the wildlife dispersal corridor in Smoky Creek should maintain or enhance their existing dispersal characteristics. This may cause a short-term commodity loss in this watershed because it precludes green tree retention in high volume stands until a replacement corridor develops. It may also affect long-term outputs, as some of these stands have probably reached culmination of mean annual increment (MAI) (although there is a wide range of rotation ages which will produce approximately the same MAI) (Kohm and Franklin et al 1997) and should probably be regenerated. Some stands are dense and should be commercially thinned for optimum growth and yield, which will generate short-term outputs. Since many of these stands lie between the roads on the south side of Smoky Creek and the unroaded area to the north of the creek, cable yarding of the area north of the creek may not be feasible.

The wildlife dispersal corridor in Smoky Creek will reduce the short term commodity opportunities in this watershed because it removes high volume stands from harvest until a replacement corridor develops. It may also affect long term outputs as some of these stands have reached culmination of MAI (although there is a wide range of rotation ages which will produce approximately the same MAI) (Kohm and Franklin 1997) and should probably be regenerated. Other stands are dense and should be commercially thinned for optimum growth and yield. Many of these stands lie between the roads on the south side of Smoky Creek and the un-roaded area to the north of the creek, precluding cable yarding of the area north of the creek.

The Chinquapin and the East Fork Roadless Areas (RARE II) were identified as areas of particular concern to the public (USDA Forest Service 1993, 3-24), a portion of which wanted them designated as Wilderness by Congress. The LRMP direction (USDA Forest Service 1993, 4-59) for the portions of these areas within CAS Matrix is that no new roads may be constructed in un-roaded portions of inventoried (RARE II) roadless areas in Tier 1 Key Watersheds.

The released portion of the Chinquapin Roadless Area north of Smoky Creek surrounding the proposed RNA is mostly on low-productivity soils, with inclusions of unproductive soils. The strata found here are a mosaic of M3S through M3G stands intermixed with unproductive areas. Although stands near the Bramlet Road could be economically logged with cable systems, the only feasible method for logging most of the stands in the roadless area is by helicopter, which is costly and historically has created little local employment, another public concern. The economic feasibility of logging and managing these stands needs to be investigated. Given the interest in a Wilderness designation for this area, the importance of a portion of it as a wildlife corridor, its location in a Key Watershed whose upper portion has been extensively logged, the potential cost of logging, the difficulty of managing stands with no road access, and the low productivity of the site, management will be a challenge and probably should be a low priority, and this area should be reevaluated for Matrix status in the next generation of the LRMP.

The released portion of the Chinquapin Roadless Area from Murphy Gulch to Soap Creek is mostly on high productivity soils, with small inclusions of low productivity and unproductive soils. The stands found here are primarily M4G and M3G, some of the highest volume stands in the watershed. There are also some low volume M3P stands in the lower Red Mountain Creek and Dog Gulch drainages. Most of these stands are below existing roads and could be cable or helicopter logged.

Presently, the only feasible method for logging the stands to the southwest of the Rare Dog 1 and Suds 5, 12, and 13 units without building additional roads is by tractor or forwarder, with long skids, or by helicopter. The ridge southwest of these units has been recommended in the Fire section as a location for a DFPZ. Given the interest in Wilderness designation for this area, its location in a Key Watershed whose upper portion has been extensively logged, the potential cost of logging, and the difficulty of managing stands with no road access, harvesting should be for creation of a DFPZ only, with periodic underburns to remove fuel ladders.

The portion of the East Fork roadless area north of Perry Patton's property is mostly on low-productivity soils, with inclusions of unproductive soils. The stands found here are a mosaic of mostly M3P through M3G intermixed with unproductive areas. Presently the only feasible method for logging most of these stands is by helicopter, however stands near 28N10 could be economically logged with cable systems. The economic feasibility of logging and managing these stands needs to be investigated. Given the interest in Wilderness designation for this area, the importance of a portion of it as a wildlife corridor, its location in a Key Watershed whose upper portion has been extensively logged, the potential cost of logging, the difficulty of managing stands with no road access, and the low productivity of the site, management will be a challenge and probably should be a low priority and this area should be reevaluated for Matrix status in the next generation of the LRMP.

Recommendations for Monitoring Refer to Chapter 7.

Recommendations for Data Gaps Refer to Chapter 7.

Chapter 7
HIGH-PRIORITY RECOMMENDATIONS

Introduction

During the course of synthesizing findings from the characterization, current conditions, and reference conditions steps of the watershed analysis process, the watershed analysis (WA) team as a whole identified high-priority projects in the watersheds that, because of the risk of catastrophic failure or threat to water quality, needed immediate attention. These recommendations were made during a process of overlaying maps and findings generated by individual team members to create a cross-discipline picture of watershed conditions and needs. The team found, for the most part, that their recommendations for treatments or actions coincided to a great degree. Out of this discussion agreement was reached on specific sites in the watersheds that warranted high-priority status for treatments. Beyond this, individual team members also identified potential treatments for areas and issues that, though important, did not constitute as great a risk in the short run. Many of these recommendations respond to the issues and key questions raised during the early stages of the analysis. A full discussion of these specific recommendations is contained in Chapter 6, Synthesis and Recommendations. The highest priority recommendations are based on the "do-ability" of these actions to yield immediate benefits.

Riparian Reserves are an important component of the Aquatic Conservation Strategy (ACS) and crucial to the attainment of ACS objectives. This analysis area has many unique values, and proper functioning riparian reserves play a key role in maintaining and enhancing these values. The analysis area contains one of the largest contiguous Late-Successional Reserves in the region, and riparian reserves will serve as important dispersal habitat to link this large LSR to other LSR's in the immediate area. Riparian Reserves are also important for maintaining additional habitat for species such as neotropical migrant songbirds and other riparian-dependant species. Key watersheds are also an important component of the Aquatic Conservation Strategy and are recognized for their high-quality, refugia habitat for at-risk anadromous fish species and stocks of concern. According to the Northwest ROD, "Key Watersheds with high quality conditions will serve as anchors for the potential recovery of depressed stocks". The East Fork/Smoky Creek watershed analysis area is entirely encompassed within a Tier 1 Key watershed which contribute directly to conservation of at-risk anadromous salmonids. This watershed analysis has confirmed the existence of not only high-quality aquatic habitat but also high quality water throughout the analysis area. The maintenance and enhancement of riparian reserves will play a significant part in maintaining and enhancing the existing high quality habitat and high quality water within this analysis area. Considering the unique values mentioned above, the watershed analysis team evaluated the interim riparian reserve widths established in the Northwest ROD and concluded that these widths were sufficient to meet the ACS objectives. This conclusion was reached based on the presence of high-quality habitat, the stream channel types, the underlying geology and overall stability of landscape, and the evidence that recovery from previous disturbance regimes was well on its way. Contributing to this conclusion was also the assumption that any proposed management activity would have to meet the intent of the ACS and furthermore, would maintain and restore riparian reserve condition and function. In addition, the watershed analysis team intentionally avoided making any specific management recommendations within riparian reserves given the existing high-quality habitat and recommends caution when evaluating management needs within riparian reserves.

High-Priority Recommendations

The WA team identified four high-priority areas for projects needed immediately. Three of the areas that need immediate attention are sites in the watersheds that could benefit from a suite of treatments. The first, and most important, of these is the Buck Ridge area in East Fork. The area in the East Fork in Late Successional Reserve (LSR) between White Rock and Stuart's Gap is the second site. The riparian area along the main stem of Smoky Creek is a third area of high-priority recommendation. The fourth high priority project is treatments of roads in both watersheds to prevent catastrophic failure during large storms.

Priority 1: Road Upgrading and Decommissioning to Reduce Risk of Catastrophic Erosion and Sedimentation.

The potential for catastrophic erosion and sedimentation due to failure of roads and crossings in the watersheds is high in the event of a major storm. Because of this, the WA team is recommending that numerous roads in the watersheds be upgraded or decommissioned to reduce the risk of mass wasting due to failure of roads or crossings during high flows. In cases where roads that access plantations in the LSR are recommended for decommissioning then the plantations should be thinned to promote old-growth characteristics before the roads are taken out of service. The following lists include roads recommended for immediate upgrade or closure:

Buck Ridge

Numerous clear-cut patches are located south of the East Fork along Buck Ridge within the LSR. Many of the roads accessing the patch cuts and plantations are high priority roads for decommissioning based on the high risk of rain-on-snow storms triggering debris slides and torrents which could directly impact anadromous reaches of the East Fork watershed.

Removing the roads in the LSR that access plantations would lessen the potential for impact from this area in the event of a large storm. The WA team concluded that thinning of the plantation located within the LSR lands in the East Fork watershed (to more rapidly promote old growth characteristics and for fuels reduction) should be the highest priority action to be undertaken as soon as possible. This will facilitate pursuing decommissioning activities along many of the dead-end spur roads along the 28N40 road (Map 5a, Appendix E).

LSR in East Fork from White Rock to Stuart's Gap

The area between White Rock and Stuart's gap in the East Fork portion of the LSR is recommended for treatments similar to that discussed above for Buck Ridge. Commercial thinning of M3G in the White Rock to Stuart Gap area would accelerate development of late-successional attributes and reduce fire risks in the area. Once this is accomplished, roads in the area should be decommissioned (Map 5a, Appendix E).

Miscellaneous Road Upgrades and Closures

Recommended Road Upgrades:

EAST FORK: 28N40, 28N45

SMOKY CREEK: 28N27, 29N48

Recommended Road Closures:

EAST FORK: 28N22A, 28N51A, 28N40B, 28N10B, 28N41.

SMOKY CREEK: 28N28, 28N27A, 28N11B, 28N73, 29N75B.

Priority 2: Smoky Creek Wildlife Corridor

The team decided that a suitable wildlife corridor for connectivity and dispersal should be established in the riparian area along the main stem of Smoky Creek. Though some of this land falls within Matrix, the WA team is recommending that an enlarged area surrounding Smoky Creek would facilitate dispersal of Northern Spotted Owls (NSO's) in areas where activity centers have been identified. Further, this action would accommodate the need to maintain 15 percent of the watershed for late successional habitat for fifth-order watersheds as outlined in the *Record of Decision for Amendments to Forest Service and Bureau of Land Management Planning Documents Within the Range of the Northern Spotted Owl* (USDA, USDI 1994) (Northwest ROD). Without the addition of these lands for late successional habitat, Smoky Creek watershed falls short of the 15 percent target. The recommendation to maintain additional lands for habitat meets both the needs of wildlife for dispersal and connectivity (the proposed corridor connects the LSR in Smoky Creek with the LSR in the adjacent Upper Hayfork watershed to the northeast), as well as meeting the 15 percent required minimum for late successional stands in this fifth-order watershed.

Priority 3: Fire Protection

85 years of fire suppression and about 40 years of harvesting have created fuel conditions in these watersheds which are conducive to catastrophic (high intensity) fire. The WA team prioritized the resources needing protection from catastrophic fire as follows:

1) mapped and unmapped LSR's,
2) Riparian Reserves and dispersal corridors for late-successional species,
3) plantations,
4) forests on productive soils, and
5) southern and western aspects (areas most susceptible to catastrophic fire conditions).

The team has recommended creating a network of defensible fuel profile zones (DFPZ's) to provide areas where fire control is feasible and to minimize the possibility that fires will do extensive damage.[1] Planning and construction of a DFPZ network is a top priority and should be done within the next ten years if funding is available. The highest priorities for construction of DFPZ's are those areas which currently would not function effectively as DFPZ's but could be brought to acceptable standards most quickly and inexpensively. The first priority for completion is on the divide along the northern watershed boundaries from Red Mountain southeast to Stuart Gap and north to Mud Springs and then east through the LSR to Hellgate.

In conjunction with DFPZ construction it is recommended that an overall strategy for fuel reduction on Matrix lands outside of DFPZ's be developed to reduce the amount of fuels and break up their vertical and horizontal continuity. This strategy should utilize silvicultural treatments to reduce stocking and fuel ladders, piling and burning, lopping and scattering, chipping, or biomass reduction of fuels, and/or underburning using DFPZ's, roads, and natural openings as control points. Underburning of natural fuels using low intensity ground fires should begin immediately and be done every 5-6 years across the entire watershed, or at least in areas which were, and may in the future be identified as, high-priority areas for protection from catastrophic fire.

Specific recommendations for fuels in the LSR were not made at this time, as a programmatic policy for LSR's is currently being developed by the Shasta-Trinity National Forest. For a complete discussion of catastrophic fire protection in the watersheds see Chapter 6, Synthesis and Recommendations.

Priority 4: Commodities Production

Lands considered Capable, Available, and Suitable (CAS) for timber production were identified on Matrix by the WA team forester and timber strata were overlaid to determine the location of potential timber harvest opportunities and whether these opportunities were commercial or precommercial. During the process of synthesizing the findings and recommendations of other team members as well as the management direction in the LRMP and Northwest ROD for maintenance and protection of fisheries and wildlife habitat in these Tier 1 Key Watersheds, priorities were established for thinning and harvesting. Although opportunities for firewood cutting and biomass exist in these watersheds, their remoteness from markets and population centers make these activities economically infeasible at this time. For a full discussion of commodities production and thinning opportunities see Chp. 6, Synthesis and Recommendations. A summary of the highest priority commodities production and thinning opportunities is as follows:

About 2700 acres of plantations on Matrix are overstocked. A survey needs to be programmed to determine thinning needs on these plantations and they should be precommercially thinned within the next 7 to 10 years.

Commercial thinning needs to be initiated in M3G, D3G, D2N, and M2G stands using a

[1] Before any hazardous fuel reduction projects are proposed, an economic analysis should be performed to find the optimum combination of fuel treatment methods to meet the desired fuels results. The Northwest ROD has a goal of restoring fire to its natural role in the ecosystem. An economic analysis of alternative methods to reduce hazardous fuels should include the relationship of the methods to the goal of restoring fire to its natural role in the ecosystem.

thin from below strategy (remove suppressed, intermediate, and poor quality co-dominant and dominant trees) or other methods appropriate for the stand conditions. This thinning is needed to accelerate growth, maintain stand health, and reduce fuel loads and ladders enough to allow reintroduction of fire into the ecosystem.

- M2N & G in plantations within the LSR in the Buck Ridge area (1st priority, within 2 years)
- M3G in the White Rock to Stuart Gap area (2nd priority, within 2 years)
- D3G in the mid Silver Creek drainage
- D2G and D2N in the lower south portion of the Smoky Creek drainage
- M3G and D3G in the upper Texas Chow Creek drainage
- M2G in the lower Prospect Creek drainage

The highest priority for commercial thinning is in the East Fork LSR on Fern Glade units P1, P2, and portions of C, D, E, F, G, H, I, and N (A, B, B2, and J were thinned in '91) and Buck Ridge I units B-E as needed. The highest priority for precommercial thinning is also in the East Fork LSR in Rat Trap II units 1, 25, and portions of 2 and 28, and Peak units B-E, G, and I. This thinning is needed to accelerate development of late-successional attributes on these units. Thinning should be done in 1998 on Fern Glade unit F, and as soon thereafter on Rat Trap II units 1 and 25, so that the roads accessing them (28N10B, 28N40A & B, and 28N41) can be decommissioned. The roads on Buck Ridge are on unstable soils and are experiencing erosion.

If funding permits, those brushy or understocked portions of Fern Glade units C-I and K-M and the gaps in the partial cut areas in their vicinity, and Rat Trap unit 2 should be site prepared and replanted. This should be considered a low priority for funding.

The next highest priority for commercial thinning (and/or harvesting) is in stands accessed by roads recommended for decommissioning. These stands should be scheduled for treatment immediately, not to delay road decommissioning. Roads 28N55 and 29N30G in the East Fork and 28N12 and 30(29?)N29C in Smoky Creek have been identified, from aerial photo interpretation, as having stands needing treatment. There may also be treatment opportunities on other roads identified for decommissioning, 28N22A and 28N51A on the East Fork and 28N11B, 28N27A, 28N28, 28N73, and 28N75B on Smoky Creek.

Recommendations for Monitoring

Ecosystem Monitoring

At present, many agencies and groups monitor specific ecosystem elements in the South Fork, but at present there is no comprehensive effort to monitor ecosystem elements and their interactions at both the watershed and basin level. One schematic for such an ecosystem approach to monitoring has been developed by Richard Hart or Headwaters, an Ashland, Oregon based group dedicated to improving resource management (Appendix G).

TE&S Species

Plants

Currently the only vegetation monitoring conducted in the WA area consists of utilization plots established within the grazing allotments. For general monitoring of plant communities, including sensitive plant species and old growth habitat, there is no systematic monitoring system.

Project Implementation Monitoring

The greatest monitoring need is for post-project site evaluations to determine the effect of harvest activities on sensitive plant populations (Nelson 1997). It is suggested that such monitoring be mandatory to determine if 1) pre-project recommendations were implemented and 2) if these recommendations were effective in protecting plant populations (such recommendations include specific harvesting methods, avoidance of sensitive plant populations, etc). Because the majority of sensitive plant species in the WA area are on ultramafic soils, such monitoring would be focused on those harvest activities that occur on ultramafic soils.

Systematic Monitoring

For TE&S plant species there is no regular, standardized system of monitoring. Currently, monitoring consists of cursory field checks of known populations that are conducted prior to harvest activities, as well as periodic field checks. Such cursory checks consist of subjective observations of the current status of populations with those known from memory or written reports.

It is recommended that a systematic monitoring program be initiated for the sensitive plant populations that are so prevalent on the ultramafic soils in the Smoky Creek and East Fork watersheds (Nelson 1997). Such monitoring is needed to ascertain the cumulative effects of harvest activities on sensitive plant populations.

This could consist of permanent plots where population counts would be used to monitor the health of the populations, preferably this monitoring would be done at a regular interval, with monitoring done not more than five years apart.

Wildlife

Inventorying and Monitoring TE&S Species

- Monitor known nesting sites (goshawk, NSO, etc.) and breeding sites (e.g. turtles).
- Survey for northern goshawks in all major habitat types and in lands with different management histories.
- Survey abandoned buildings for bats; do baseline bat surveys over likely foraging areas.

- Survey and monitor fisher numbers and habitat use, including in lands with different management histories.

- Survey for both Del Norte salamanders and southern torrent (or seep) salamanders. It is unknown whether either species exists in the WA areas. However, this lack of knowledge is primarily a function of a lack of surveys.

Erosional Processes and Water Quality

Monitoring is an essential element of any management action and, according to the Northwest ROD (1994) and the *Land and Resource Management Plan of the Shasta-Trinity National Forests* (LRMP) (USDA Forest Service 1993), should be guided by the results of the watershed analysis. Monitoring allows us to make decisions based on site specific information about how the watershed, and its physical and biological processes, are responding to management actions. Well laid out monitoring plans, and their results, will provide information for updating and revising the watershed analysis, as well as for verifying whether implemented watershed restoration and protection measures are benefiting ecosystem function.

With a continually shrinking Federal work force, successfully implementing and monitoring projects will require the US Forest Service (USFS) to rely more and more on a cooperative effort between federal, state, and non-government individuals and organizations. Groups such as the South Fork Coordinated Resource Management Plan, the Trinity Bio-Region, the Hayfork Watershed Center, and the Trinity County Resource Conservation District can serve as cooperators to encourage other individuals, students, and organizations to participate in a variety of monitoring activities.

The erosion control and prevention (storm proofing) activities we have recommended are designed to maintain and improve aquatic ecosystem function in both tributary and mainstem South Fork channels. These channels however, are very dynamic, responding to a variable mix of environmental and management influences. Therefore, it will be extremely difficult, if not impossible to evaluate the recommended restoration activities by direct measurement of channel changes in tributary and main stem South Fork channels.

Because the system is dynamic, a regimented monitoring approach where channel condition is evaluated at regularly scheduled intervals may not be appropriate. We do feel that tributary and mainstem channel conditions should be monitored. However, an approach focused on channel changes following significant flow events (with a minimal amount of monitoring conducted during long periods where significant flow events have not occurred) may be more appropriate. A monitoring plan that would identify what a "significant" flow event is and what a "minimal" amount of monitoring consists of needs to be developed.

Additionally, a monitoring plan targeted at tributary and mainstem tributary channel conditions should be developed in a larger basin context. We recommend that a primary focus of monitoring be on pool depth and distribution and documenting changes in overall streambed elevation at selected cross sections/profiles in both the

East Fork and Smoky Creek . Those data were collected in the mainstem South Fork above Forest Glen by the Forest Service in 1989 and again in 1997. A mainstem South Fork channel monitoring plan is presently being developed jointly by the Six Rivers and Shasta-Trinity National Forests. The activities called for under this plan may also be influenced by the Environmental Protection Agency's (EPA) direction with regard to the South Fork's status as an impaired water body.

In the absence of a monitoring plan for instream channel condition, implementation monitoring as well as some effectiveness monitoring of road closure/improvement work is still highly recommended. By carefully documenting what activities are implemented at each of the identified sites (implementation monitoring), those sites can then be evaluated following future storm events (effectiveness monitoring). A comparison of road or crossing failures at treated and untreated sites (should any remain at the time when the event occurs) would be particularly valuable. Based on the number of failures we may then be able to draw some assumptions regarding the effectiveness of our restoration activities at reducing the risks associated with the road system on aquatic health. This type of implementation and effectiveness monitoring can be document through photopoints, GIS (each site is entered in a coverage), and written formats.

We also recommend that the adult salmonid escapement monitoring as well as temperature monitoring which is ongoing both within the analysis area and in adjacent downstream reaches be continued. It is recommended that the focus of the adult escapement in the upper portions of South Fork, which includes the analysis area, be primarily directed toward spring Chinook, should monitoring dollars and thus the level of effort be reduced.

We recommend sites selected for ongoing temperature monitoring be at locations within the watersheds and the upper South Fork where we already have collected temperature data in previous years. This will facilitate determining temperature trends. Finally, we recommend temperature monitoring not only of water, but also the riparian air temperature to better understand ambient air influences on water temperature.

Commodities Production

It is recommended that a monitoring plan be prepared and implemented to monitor stand development and yields on partial cuts and plantations, pest problems, the implementation and effectiveness of the soil quality standards mentioned in the LRMP, pages 3 through 18 and Appendix O, and effects of various duff, litter, log, and snag treatments on wildlife.

Recommendations for Future Watershed Analyses

Sediment Source Inventories for Road Networks

This watershed analysis benefitted tremendously from the availability of sediment source inventories on the road network within the analysis area. Therefore, it is highly recommended that sediment source inventories be completed on the road network within proposed watershed analysis areas prior to initiating watershed analysis. This recommendation is especially important for analysis areas located within key watersheds where risk of sediment production is the greatest threat to at-risk fish stocks. The value of this type of detailed data cannot be overstated as it relates to one of the key components of the ACS, Watershed Restoration. Without this detailed, site-specific information relating to sediment risk, watershed restoration efforts will be severely hampered and attainment of the ACS objectives will be much more difficult.

Data Gaps

Erosional Processes and Water Quality

The most significant data gap in the analysis of physical watershed processes in the WA area was the inability to evaluate whether there are slope stability concerns and potential unstable areas within Matrix lands where timber harvest opportunities may exist. As a result, we were unable to adjust Riparian Reserves boundaries to include critical hillslopes and areas of existing or potential slope instability.

The WA team had expected to utilize a Ecological Unit Inventory (EUI) that was performed in the East Fork watershed during 1995. This would have provided up-to-date data on the relative slope stability and dominant erosional processes throughout the East Fork, as well as data on soils, and existing and desired vegetation cover. While great efforts were made by STNF to have the data in a useable format, it wasn't available at the time this WA was being undertaken. We recommend the EUI data for the East Fork be completed as soon as possible to be available for project-level management activities recommended in this WA. Specifically, slope stability rating data for each polygon must be entered into the database.

Likewise, we found data on slope stability and soil erodibility in the LRMP to be either too general or too inconsistent to rely upon. Given these shortcomings, we recommend all future salvage and commercial timber harvest sale areas be carefully evaluated by a geologist for risk of sediment production as a result of proposed management activities. As existing and potentially unstable areas are identified, they should be withdrawn from the CAS and included in the Riparian Reserves.

Commodities

As discussed above, the EUI was not used in this analysis as it became available too late in the process and there were enough inaccuracies in the data and resultant maps to make it unusable without significant work. It is recommended that this data be cleaned up so that the EUI is usable and that an EUI be done for the Smoky Creek watershed using 1995 photos.

It should be noted that reliable slope stability and soil erodibility information was not available at the time of this analysis, so no erosion hazard risk was determined for harvest areas. This determination needs to be made at a project level in order to prescribe appropriate silvicultural and logging systems.

The GIS 90 database had numerous inaccuracies in all layers investigated for this analysis, making it of limited value. Some of these layers (plantations, vegetation type, timber strata, and timber suitability for regeneration) if updated would be more useful. Others (geologic stability and inner gorge type) are hopelessly inaccurate. It is recommended that an accurate GIS database be developed and periodically updated for supporting timber management decision making in the context of adaptive management. It is also recommended that GIS maps and data developed during this analysis be incorporated in GIS 90, or some other database.

The timber strata maps used in the GIS 90 database were developed using 1975 aerial photos. Timber inventories used to develop the timber volume data in LRMP Appendix D were done in the late 1970's. As most of the plantations in these watersheds have been established in the past 15 years and stand conditions have changed, it is advisable to re-delineate stands using 1995 photos and to re-inventory them.

Stand record cards are maintained at Ranger District offices for each plantation. These records are generally thorough and useful, but there are data gaps and the records would be easier to access and use if they were computerized.

In summary, we recommend that STNF:

- Clean up East Fork EUI database.
- Do an EUI for the Smoky Creek watershed using 1995 photos.
- Update and computerize Ranger District stand record cards for plantations.
- Update timber strata maps using 1995 photos.
- Re-inventory timber strata to reflect current stand conditions.
- Update GIS 90 database layers, especially plantations, vegetation type, timber strata, timber suitability for regeneration, geologic stability, and inner gorge type.
- Develop an accurate GIS database for supporting timber management decision making in the context of adaptive management. Incorporate GIS maps and data developed during this watershed analysis in GIS 90, or some other database.
- Do a fuels inventory to characterize the type, quantity, size, and condition of fuels.
- Develop and periodically update an accurate GIS database for supporting fire and fuel-management decision making in the context of adaptive management.
- Prepare and implement a monitoring plan to monitor stand development on partial cuts and plantations, pest problems, implementation and effectiveness of the soil quality standards mentioned in LRMP 3-18, effects of various duff, litter, log, and snag treatments on wildlife.
- Develop tools and software for designing prescriptions and for monitoring.
- Prepare and implement a monitoring plan to monitor fire starts, fuel conditions, effectiveness of DFPZ's for controlling fire, cost/benefit ratios of DFPZ's and other fuel treatments, and effects of DFPZ's on wildlife and soil productivity.

Appendix A
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Appendix B
ABBREVIATIONS AND ACRONYMS

Abbreviations:	Lowercase Letters
Acronyms:	UPPERCASE LETTERS

ac	Acres
ACS	Aquatic Conservation Strategy
AMA	Adaptive Management Area
AWA	Administratively Withdrawn Area
BBS	Breeding Bird Survey
CAS	Capable, Available, Suitable
CCC	California Conservation Crew
cm	Centimeters
CNPS	California Native Plant Society
CRA	Congressionally Reserved Area
CRMP	Coordinated Resource Management Plan
dbh	Diameter at Breast Height--4.5 feet
DF&G	California Department of Fish and Game
EPA	Environmental Protection Agency
ESA	Endangered Species Act
ESU	Evolutionarily Significant Unit
EUI	Ecological Unit Inventory
FEMAT	Forest Ecosystem Management Assessment Team
ft.	Feet
GIS	Geographic Information System
ha	Hectares
HAT	Hayfork Action Team
in.	Inch(es)
KMP	Klamath Mountain Province
LRMP	Shasta-Trinity National Forest Land and Resource Management Plan
LS	Late Successional
LSR	Late-Successional Reserve
m	Meter(s)
mbf	Million Board Feet
NEPA	National Environmental Policy Act
NFTP	Non-Timber Forest Products
MNFS	National Marine Fisheries Service
NRCS	Natural Resources Conservation Service
NSO	Northern Spotted Owl
RNA	Research Natural Area
ROD	Record of Decision
SFTR	South Fork Trinity River
SIA	Special Interest Area
SCS	Soil Conservation Service
SO	Supervisor's Ofice
STNF	Shasta-Trinity National Forest
TE&S	Threatened, Endangered, and Sensitive

tpa	Trees-per-acre
USDA	United States Department of Agriculture
USDI	United States Department of the Interior
USFS	United States Forest Service
USFWS	United States Fish and Wildlife Service
USGS	United States Geological Survey
WA	Watershed Analysis
WHR	California Wildlife Habitat Relationship
WWI, II	World Wars One and Two
yr.	Year

Appendix C
CONTRIBUTING AGENCIES AND INDIVIDUALS

Principal Authors	Discipline	Section(s) Written
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Appendix D
PLANTATION HISTORY AND TREATMENTS

APPENDIX D. PLANTATION HISTORY & TREATMENTS

Smoky Creek Watershed

Sale	Unit	Acres	Site*	Unplant-able^	Pest**	Harvested yr	Harvested % type^^	Planted yr	Planted species%	Survival -5th yr	Survival -5th # type"	Stocking	Height ft	Growth	Competition"" Density / Species	Treatment~ Done	Treatment~ Needed	Yr	Amount
Foss	1	59	III		dmt	88	80 or	91	DF 44	96	534 tpa P					pct		91	40 ac
							20 patch cc		PP 56		855 T								250 TPA
								92	PP 100										
	2	56	III-II	10%		89	patch cc	93	DF 46	91	1st yr RSP					pct		92	
				25-60					PP 54	?	429 P								
				coarse rock				95	JP 83		499 T								
	3	23	III	20	goph	86	strip cc		?		?					pct		92	10 ac
					rust														
	4	106	II			86	30 strip cc	91	DF 44	96	291 P					pct		92	86 ac
							70 imprv		PP 55		501 T								
	5	15	II est			86	cc	90	PP 63	95	589 P								
									DF 36		789 T								
	6	24	III			86	40 imprv	91	DF 53	95	272 P	well		rapid		pct, interplant		91	10 ac
					goph		60 strip cc		PP 47		427 T								
	7	11	II			86	cc	90	PP 63	95	589 P					pct		92	10 ac
									DF 36		789 T								
	8	20	III		dmt	88	80 imprv	90	PP 85	95	696 P							2003	20 ac
							20 patch cc		DF 15		825 T								
	9	10	II			86	patch cc	90	PP 60	95	554 P	well					possible interplant	2003	10 ac
									DF 40		584 T								
	10	9	III	10		86	80 strip cc	90	PP 11	94	666 P							2003	7 ac
									PP 43		846 T								
									PP 46										
	11	2	III	20		88	stand cc	94	PP	97	447 P								
										(3rd yr)	485 T								
	14	20 trav	III	10	goph	88	patch cc	91	DF 53	96	456 P	well df, pp			clo>conif	tubed	tube maintenance		
									PP 47		524 T								
								92	DF 42										
									PP 54										
	15	10	II-I	20-60	deer	88	patch cc	91	DF 2ac	96	728 P	well					possible interplant		
				gravel in				94	PP 23		874 T								
				top 12"					DF 77										
	17	17	II			86	patch cc	90	PP 56	94	354 P							2003	17 ac
						(plan)			DF 44		372 T								
	22-26	15	III	15-20		86	60 patch cc	90	PP	94	496 P	well pp						2003	9 ac
									300 tpa		529 T								
	23	9	II	5		88	patch cc	90	PP 52	94	458 P	lt-mod pp, df	pp, df 2-3		mod grs		scalp for gwth	2003	7 ac
									DF 48		472 T						tube maintenance		
	24	24	I-II	5		86	patch cc	90	PP 37	94	586 P	well pp	pp 3-5	rapid	mod deer<conif, pm>conif		consider release	2003	24 ac
									DF 63		646 T								
	25	10	IA-I	5		86	patch cc	90	PP 50	94	515 P							2003	10 ac
									DF 50		534 T								
	27	7	I-II			86	patch cc	90	PP 85	94	568 P	well pp, df	pp 15-25, df 5-10	rapid				2003	7 ac

									DF 15		665 T								
	28	9	I-II			86	patch cc	90	PP 42	94	626 P	well pp, df	pp, df 4-7	rapid	mod grs, forbs pm>conif			2003	9 ac
									DF 58		681 T								
Suds	1	20.8	II			82	patch cc	84	PP 75	88	588 P							97	25 ac
									DF 25		748 T								
	2	18	II			82	patch cc	84	DF 23	88	533 P							97	18 ac
									PP 77		573 T								
								85	DF 75										
	3	17	II			82	patch cc	84	PP 76	88	606 P							97	17 ac
									DF 24		747 T								
	4	28	II			82	patch cc	84	DF 25	88	671 P							97	28 ac
									PP 75		742 T								
	5	11	II			82	patch cc	85	DF 100	89	291 T	well df, pp	df, pp 8-12	rapid	hvt pm>conif, lt db<conif		rls, pct		
	6	17	II			82	patch cc	84	PP 78	88	494 P							97	17 ac
									DF 22		553 T								
	7	14	II			82	patch cc	84	PP 75	88	393 P							97	14 ac
									DF 25		535 T								
	8	21	II			82	patch cc	84	PP 76	88	576 P							97	21 ac
									DF 24		614 T								
	11	4	II			82	patch cc	84	PP 79	88	550 P							97	4 ac
									DF 24		650 T								
	12	18	II			82	patch cc	85	DF 65	89	502 T	well pp, df	pp, df 8-12	rapid	db<conif, pm>conif		possible pct		
									PP 35		mostly PP/DF								
	13	7	II			82	patch cc	85	DF 51	89	305 P	well pp, df	pp, df 8-12	rapid	db<conif, pm>conif		possible pct	97	7 ac
									PP 49		347 T								
Dog Gulch	10	15	II, III			81	patch cc	83	DF 33	87	493 T	well pp, df, wf, sp		rapid	grs, rose, vetch, bc				
									PP 67										
	11	6	II			81	patch cc	83	DF 45	87	650 T								
									PP 53										
	15	22	III			81	patch cc	83	PP 100	87	300 T								
	16	20	II			81	patch cc	83	DF 60	87	635 T								
									PP 40										
	13	6	II			81	patch cc	83	PP 100	87	841 T								
	12	8	II			81	patch cc	84	DF 25	88	538 T								
									PP 75										
	14	5	III			81	patch cc	84	DF 25	88	600 T								
									PP 75										
	17	25	III			81	patch cc	83	PP 100	87	364 T								
Rare Dog	1	47	IA			86	cc	88	DF 55	92	587 T	well pp, df					tube df, scalp grs		
									PP 45										
	2	36	II			85	cc	88	DF 75	92	515 T	well pp		rapid	grn & clo <conif				
									PP 25										
Spider	1	25	III-			85?	cc	87	DF 50	91	438 T	well pp, df	pp 6-8, df 3-5	rapid	hvy grs, lt bb, grn				
									PP 50										
	2	24	III			85?	cc	87	DF 25	94	513 T								
									PP 75										
								90	PP 100										
Red Dog	A	24	III			bef 72	cc	72	DF ?	85	223 T	well pp, df		rapid	conif>clo, bo, some brsh		pct, possible release		
									PP ?										
								81	PP 100										

	B	17	III			bef 72	cc	72	DF ?	85	271 T	well pp		rapid	clo, pm		pct		
									PP?										
								81	PP 100										
	C	30	III			bef 72	cc	72	DF/PP ?	81	250 T	well pp, wf			clo		pct		
								81	PP 100	(1st yr)									
	D	33	III			bef 82	cc	??	??	87	190 T	well pp, df		rapid	grs, bc, vetch, rose	pct		87	190 tpa
										(post thin)									
	E	44	II-III			bef 80	cc	??	??	83	335 T	well pp, df	pp 15-20, df 2-4	rapid	squaw carpet, grs, vetch	pct		86	200 tpa
West Smoky	2	7	III		hvy dmt	93	or	95	PP 48	95	524 T								
					pp+goph				JP 16	(1st yr)									
									SP 36										
	4	17	III		hvy dmt	93	or	95	PP 35	95	532 T								
					pp+goph				DF 47	(1st yr)									
									SP 18										
	7	40	II			93	or	95	PP 90	95	405 T	mod pp, jp?				tubed	tube maintenance		
									SP 10	(1st yr)									
	8	12	III			92	or	95	JP 100	95	389 T	mod pp, jp?			lt-mod squaw, brsh	tubed	tube maintenance		
										(1st yr)							scalp for gwth		
	10	25	III-IV		hvy dmt	92	or	95	JP 100	95	456 T	lt jp?			lt grs	tubed	replant, tube		
					pp/jp					(1st yr)							tube maintenance		
	13	11	III		hvy dmt	92	or	95	DF 65	95	512 T	mod pp, df				tubed	tube maintenance		
					in pp				PP 35	(1st yr)									
	14	13	II		hvy dmt	92	or	95	DF 70	95	604 T					tubed	tube maintenance		
					pp+goph				PP 30	(1st yr)									
	15	39	II		hvy dmt	92	or	95	DF 67	95	470 T	mod pp, df				tubed	interplant		
					pp+goph				PP 33	(1st yr)							tube maintenance		
	16	33	II			92	or	95 (plan)				well df, wf	df, wf 1-2				possible interplant		
								not planted											
	17	14	II			92	or	95	DF 55	95	472 T								
									PP 45	(1st yr)									
	18	7	III			92	or	95	DF 50	95	444 T	well pp, df	pp 1, df 1				tube maintenance		
									PP 50	(1st yr)									
Silversnake	14	20.1	II			85	patch cc	86	PP 100	90	205 P					pct		93	
											227 T								
	15	24.1	II			85	patch cc	86	PP 100	90	330 P					pct		93	
											359 T								
	16	19.1	II			85	patch cc	86	PP 100	90	242 P					pct		93	
											247 T								
	17	9	III			82	patch cc	84	PP 100	88	282 T					pct		93	
	18	5	II-III			82	patch cc	84	PP 100	88	172 P					pct		93	
	20	23.2	II			85	patch cc	86	PP 100	90	295 P					pct		93	
											339 T								
	21	16.5	II			85	patch cc	86	PP 100	90	200 P					pct		93	
											248 T								
	24	16.9	III			82	patch cc	84	PP 50	89	382 P					pct		93	
									JP 50		494 T								
								85	PP 100										
	25	4	II			83	patch cc	84	PP 71	88	310 P					pct		93	
									DF 29										
	26	5	II			83	patch cc	84	PP 52	88	400 P					pct		93	

									JP 48										
	41	17	III-IV			83	patch cc	84	PP 86	86	187 P					pct		93	
									SP 14	(3rd yr)	198 T								
	42	9	II			82	patch cc	84	PP 67	88	306 P					pct		93	
									DF 33										
	43	11	II			82	patch cc	84	PP 74	86	413 P					pct		93	
									DF 26		488 T								
	44	7.6	II-III			82	patch cc	84	PP 74	89	481 P					pct		93	
									JP 26		550 T								
								85	JP 50										
									PP 50										
	45	8	II			82	patch cc	84	PP 67	88	337 T					pct		93	
									DF 33										
	46	7	II			82	patch cc	84	PP 65	88	310 T					pct		93	
									DF 35										
	49	12	II			?	?	84	PP 67	86	441 P					pct		93	
									DF 33	(3rd yr)	466 T								
	53	5	III			82	patch cc	84	PP 100	88	355 P					pct		93	
	54	7	II			?	?	84	PP 50	88	186 P					pct		93	
									JP 50										
	57	9	II			82	patch cc	84	PP 91	88	225 P					pct		93	
									SP 9										
	58	9	II-III			82	patch cc	84	PP 92	88	292 P					pct		93	
									SP 8										
	59	7	II-III			82	patch cc	84	PP 100	88	210 P					pct		93	
	60	12.7	II-III			82	patch cc	84	PP 62	88	165 P					pct		93	
									DF 38										
	65	9	II			82	patch cc	84	PP 100	88	355 P					pct		93	
	66	10	III			82	patch cc	84	PP 100	89	122 P					pct		93	
								85	PP 100	(6th yr)									
Silver Springs	1	6						72?											
	2	7						72?											

East Fork of South Fork

Sale	Unit	Acres	Site	Unplant-	Pest	Harvested		Planted		Survival -5th		Stocking	Height	Growth	Competition	Treatment			
				able		yr	type%	yr	type%	yr	# type		ft		Density / Species	Done	Needed	Yr	Amount
Devil	1	8	III	30% cfc		89	or	none needed											
	2	3 (28 tot)	III			89	or 28ac	91	DF 55	95	447 tpa T	well pp, df							
								3 ac	PP 45										
	4	12	III	30-50 cfc		89	or	no plant needed											
	5	18	III			89	or	none needed											
	6	2 (6 tot)	III			89	patch cc 2ac	92	PP 100	96	621 T								
							or 4ac	2 ac											
	7	4 (7 tot)	III			89	or 3ac	92	PP 100	96	757 T								
								4 ac											
	8	4	III	30-60 cfc		89	or	no plant needed											
	9	5	III			89	or	no plant needed											
	10	2(tot 15)	?	v. dry site		89	patch cc	90	DF 50	95	211 P					pct		96	12 ac
									JP 50		283 T								300 tpa

								91	PP 100										
	11	3 (16 tot)	?			89	patch cc 3ac	90	DF 50	95	290 T	jp	jp 3-4	rapid	hvy grs, mod db, h, bo				
							or 13ac		JP 50										
								91	PP 100										
	13	7	III			88	cc	89	DF 70	93	597 T						pct	99	
									PP 30										
	14	21	III			89	or	not planted											
	15	3 (7 tot)	II			89	or 4ac	92	DF 67	97	427 T	mod-well pp, df	pp 3-4, df 2-3	rapid	mod grs, lt-mod db, bo		interplant, pct	2002	
							patch cc 3ac		PP 33										
	16	5	--	45+ cfc		89	or	no plant needed											
	17	5	--	40+ cfc		89	or	no plant needed											
												mod-well pp, df	pp, df 1-2		hvy grs, lt bf	df tubed	scalp for gwth		
	18	4	--	40-50 cfc		89	patch cc	92	DF 63	96	369 P						pct	97	4 ac
									PP 27		504 T								
	19	2 (13 tot)	?			89	or 11ac	91	DF 60 (20)	96	641 T						pct	2002	
							patch cc 2ac		PP 40										
								92	PP 100(80)										
	20	4	?			89	patch cc	92	DF 50	96	330 T						pct	2002	
									PP 50										
	21	3 (10 tot)	?			89	or 10ac	91	DF 65	95	407 T								
									PP 35										
	22	1 (8 tot)	?			89?	or 4ac	not planted											
	23	1 (13 tot)	?			89	or 13ac	not planted											
	24	6	--	30 cfc		89	or	no plant needed											
	25	5	--			89	or	no plant needed											
contig. w/#46	26	23	III			89	or	no plant needed											
	27	21	III			89	or	no plant needed											
	28	4 (28 tot)	III		dmt in	89	patch cc 5ac	91	DF 25	95	311 T								
					jp, df				JP 75										
	29	2 (16 tot)	III			89	or 16ac	not planted											
	30	2 (9 tot)	III		dmt in	89	or 9ac	92	DF 100(55)	95	613 T								
					pp			93	PP 100(45)	(3rd yr)									
	31	20	III			89	patch cc 4ac	92	DF 100(63)	95	466 T								
							or 16ac	93	PP 100(37)										
	32	1	III	40-70 cfc		89	or	no plant needed											
	33	25	III			89	or	no plant needed											
	34	1 (2 tot)	III	30-40 cfc		89	or	no plant needed											
	35	9 (38 tot)	III			89	patch cc 9ac	92	DF 100	96	604 T						pct	2002	
							or 29ac		PP ?										
	36	9	--	50+ cfc		89	or	no plant needed											
	37	6	III			89	or	no plant needed											
	38	11	III			89	or	no plant needed											
	39	7 (11 tot)	III			88	patch cc	89	DF 38	93	458 T	mod-well pp	pp 6-12	rapid	lt-mod bb, grs				
									PP 62										
	40	2	III			89	patch cc	92	DF 67	96	234 T	lt-mod pp	pp			tubed			
									PP 33										
	42	4	III			89	or	no plant needed											
	43	2 (13 tot)	III			89	patch cc 2ac	91	DF 55 (45)	95	622 T	well pp, df	pp 2-4, df 1-3		mod grs, wt, h, clo	df tubed	rls (marginal), pct	2003	
							or 11ac		PP 45										
								92	DF 35										

									PP 65 (55)										
	44	6 (28 tot)	III			89	patch cc 6ac	91	DF 25	95	291 T						pct	2001	
							or 22ac		JP 75										
	45	4	III	high cfc		89	or	no plant needed											
	46	10	III			89	or	no plant needed											
	47	2	III	30 cfc		89	or	no plant needed											
	51	2 (7 tot)	III			89	or 7ac	not planted											
	52	2 (3 tot)	III			88	cc 12ac	89	DF 50	93	427 T								
									PP 50										
	53	2 (13 tot)	III			89	or 13ac	91	DF 30	95	606 T						pct	96	
									JP 70										
	54	3	III	serp comp		89	or	none needed											
	61	18	III	area 1 40 cfc		89	or	no plant needed											
				area 2 60 cfc															
	63	2	III			88	patch cc	89	DF 60	93	466 T						pct	99	
									PP 40										
	64	9	III			89	or 9ac	91	JP 100	95	615 T						pct	2001	
	71	3 (14 tot)	III			89	or 11ac	92	DF 100	96	688 T						pct	2002	
							patch cc 3ac												
	72	10	III			89	patch cc	90	DF 50	95	340 P						pct	98	10 ac
									JP 50		427 T								
								91	PP 100										
	84	1	III			89	or	no plant needed											
Old Devil	1	12	III-IV			60	stand cc	62	sp?										
	3	1	III			60	stand cc	62	sp ?										
Prospect	1	18	II-III	10 rock		85	patch cc	88	DF 50	92	567 P						pct	98	18 ac
									PP 50		643 T								
	2	17	II-III	10	goph	85	patch cc 13ac	88	DF 50	92	388 P						pct	98	13 ac
					rust		imprv 4ac		PP 50		463 T								
	3	8	II-III	15-20	rust	85	or 2ac	88	DF 50	92	408 P	mod pp, df					pct, interplant	98	3 ac
							patch cc 3ac		PP 50		486 T								
	4	34	II-III	15-20	goph	85	patch cc 34ac	88	DF 48	92	563 P	well pp		rapid			pct	98	34 ac
					dmt in wf				PP 52		624 T								
	5	19	III	15		85	imprv 5ac	88	DF 50	92	521 P	mod-well pp					pct, possible interplant	98	14 ac
				35 cond			patch cc 14ac		PP 50		638 T								
	6	14	II-III	10		86	patch cc	89	DF 36	94	479 P						pct	2003	14 ac
									PP 64		707 T								
								90	DF 30										
									PP 70										
	7	10	III-IV	30-40		85	imprv 3ac	88	DF 47	92	514 P						pct	98	7 ac
				40-70 cond			strip cc 7ac		PP 53		514 T								
	8	7	II	15		85	patch cc	88	DF 47	92	497 P						pct	98	7 ac
				85 cond					PP 53		569 T								
	9	7	III-	15-20	dmt in	85	patch cc	88	DF 50	92	583 P						pct	98	7 ac
					wf				PP 50		611 T								
	10	11	II-III	10-15 rock		85	patch cc	88	DF 64	92	415 P						pct	98	11 ac
									PP 36		424 T								
	11	40	II-III	10	porky	85	imprv 10ac	88	DF 50	92	398 P						pct	98	30 ac
							patch cc 30ac		PP 50		426 T								

	12	23	II-III	15	porky	85	imprv 6ac	88	DF 50	92	494 P						pct	98	17 ac
							patch cc 17ac		PP 50		527 T								
	13	3	II-III	25		85	patch cc	90	DF 50	94	330 P						pct	2003	3 ac
				75 cond					PP 50		465 T								
	14	6	III	20-25		85	patch cc	88	DF 33	92	583 P						pct	98	6 ac
				75 cond					PP 67		615 T								
	15	7	II-III	10		85	patch cc	88	DF 50	92	514 P						pct	98	7 ac
									PP 50		570 T								
	16	7	II-III	10		85	patch cc	88	DF 100	92	402 P						pct	98	7 ac
											444 T								
	17	6	II-III	10		86	patch cc	90	DF 50	94	324 P						pct	2003	6 ac
									PP 50		340 T								
	18/51	6+6	II-18	30		86	imprv 3ac	88	DF 54	92	421 P						pct	98	9 ac
			III-IV-51	serp			patch cc 9ac		PP 46		435 T								
	19	19	II-III		rust	85	or 5ac	not				well pp, df			clo, bo		pct		179 tpa
	20	4	II-III	10-15		86	patch	93	DF 63	93	292 P	well pp, df			clo, bo				
									PP 37	(3rd)	438 T								
	21	6	II	15		86	patch	89	DF 43	92	389 P	mod pp, df, wf, sp			bo, gc>conif clo, grs, db	pct	pct, replant	2003	6 ac
				20 cond					PP 57		469 T								
								90	DF 50										
									PP 50										
	22	9	III	10-15		87	imprv 2ac	89	DF 50	94	375 P	mod sp, df, pp			hvy db, grs some clo, wo		pct	2003	9 ac
				35 cond			patch cc 7ac		PP 50		569 T								
								90	DF 42										
									PP 58										
	23	12	II-III	5-10		85	patch cc	88	DF 50	92	550 P						pct	2001	12 ac
									PP 50		590 T								
	24/52	7/1	III	10-15		86	strip cc	93	DF 50	95	461 P								
									PP 50	(3rd)	521 T								
	25	9	III	5		86	strip cc	90	PP 100	94	464 P	well pp, sp			conif = clo, db, gc		pct	2003	9 ac
				20 cond							658 T								
	26	10	III	5		87	patch cc	88	DF 55	94	496 P						pct	2003	10 ac
									PP 45		615 T								
								90	DF 6										
									PP 94										
	27	defer logging																	
	28	uneconomic to log																	
	29/48	15/5	III	20	rust	85	patch cc 20ac	88	DF 50	92	598 P						pct	98	12 ac
				40 cond					PP 50	(unit 29)	646 T								
								90	PP 100	(unit 48)	370 P								
									(unit 48)		680 T								
	30A	15	II-III	10		85	imprv 2ac	90	DF 50	95	323 P						pct	2000	15 ac
	(lower)						patch cc 13ac		PP 50		472 T								
	30B	12	II-III	10		85	patch cc	88	DF 52	92	631 P						pct	98	12 ac
	(upper)								PP 48		777 T								
	31	10	III	10		85	patch cc	88	DF 42	92	505 P						pct	98	10 ac
									PP 58		535 T								
	32	3	?	10		86	patch cc	90	PP 100	94	233 P						pct	2003	3 ac

											486 T								
	37	13	II-III	10-15	goph	85	patch cc10ac	88	DF 52	92	573 P						pct	98	10 ac
								10 ac	PP48		612 T								
	38	8	II-III	<10	rust	85	patch cc	88	DF 59	92	497 P	well pp, df	pp 3-5, df 2-4	rapid	mod wt, gb, grs		rls (mod need), pct	98	8 ac
									PP 41										
	39	23	II	<5		85	patch cc 10ac	88	DF 53	92	396 P	well pp	pp 5-8	rapid	mod wt, grs		rls, pct in spots, pct	98	23 ac
									PP 47		469 T								
	40	14	III	25-35		85	patch cc	90	DF 39	95	270 P	lt-mod pp, df	pp, df 2-3		mod brsh, grs		replant?, pct	2001	14 ac
				35 cond					PP 61		326 T								
								91	PP 100										
	41	18	II-III	10		85	patch cc	88	DF 50	92	632 P	well pp, df	pp 4-7, df 2-3	rapid	hvy grs		tube df, pct	98	18 ac
									PP 50		635 T								
	42	10	I-II	<5	rust	85	patch cc	90	DF 53	94	447 P						pct	2000	10 ac
									PP 47		602 T								
	43	13	II	5		85	patch cc	90	DF 47	94	381 P	well pp, df	pp 3-6, df 1-3	mod-rapid	mod bb, wm, grs, bo	tubed	retube df, rls for	2000	13 ac
									PP 53		515 T						gwth, pct		
	44	11	II	10		85	imprv 3ac	88	DF 59	92	558 P						pct	98	8 ac
							patch cc 8ac	8 ac	PP 41		667 T								
	45	6	II-III	10	goph	86	imprv 4ac	90	DF 90	94	272 P						pct	2003	2 ac
							patch cc 2ac	2 ac	PP 60		466 T								
	46	3	III	5	dmt	86	patch cc	90	DF 43	95	427 P						pct	2001	3 ac
									PP 57		534 T								
								91	PP 100										
	47	7	III	10	dmt	85	patch cc	88	DF 53	92	563 P						pct	98	7 ac
									PP 47		563 T								
	49/50	2/7	III	10-15	rust	86	patch cc 9ac	93	DF 35	96	335 P	mod pp, df			conif = clo, db	tubed, replant	tube maintenance		
				50 cond					PP 65	(3rd yr)	421 T								
Chow	1	8	III	hvy log		79	sh seed	80	JP 100	84	210 T								
							removed 82		436 tpa		(SP 70%?)								
	2	23	III			79	sh seed	81	JP 100	85	456 T								
							removed 82												
	3	7	III			79	sh seed	81	JP 100	85	589 T								
	4	13	III			79	sh seed	81	JP 100	85	531 T								
							removed '82												
	5	25	III	hvy log		79	sh seed	81	JP 100	85	531 T								
							removed '82												
	6	4	III	hvy log		79	sh seed	80	JP 100	84	380 T								
							removed '82		436 tpa										
	7	8	III	hvy log		79	sh seed	80	JP 100	84	370 T								
							removed '82		436 tpa										
	8	9	III	hvy log		79	sh seed	80	JP 100	84	210 T								
							removed '82		436 tpa										
	9	4	III	hvy log		79	sh seed	80	JP 100	84	460 T								
							removed '82		436 tpa										
	10	4	III-IV	hvy log		79	sh seed	80	JP 100	84	480 T								
							removed '82		436 tpa										
	11	15	III	hvy log		79	sh seed	80	JP 100	84	313 T								
							removed '82		436 tpa										
Pony Buck II																			

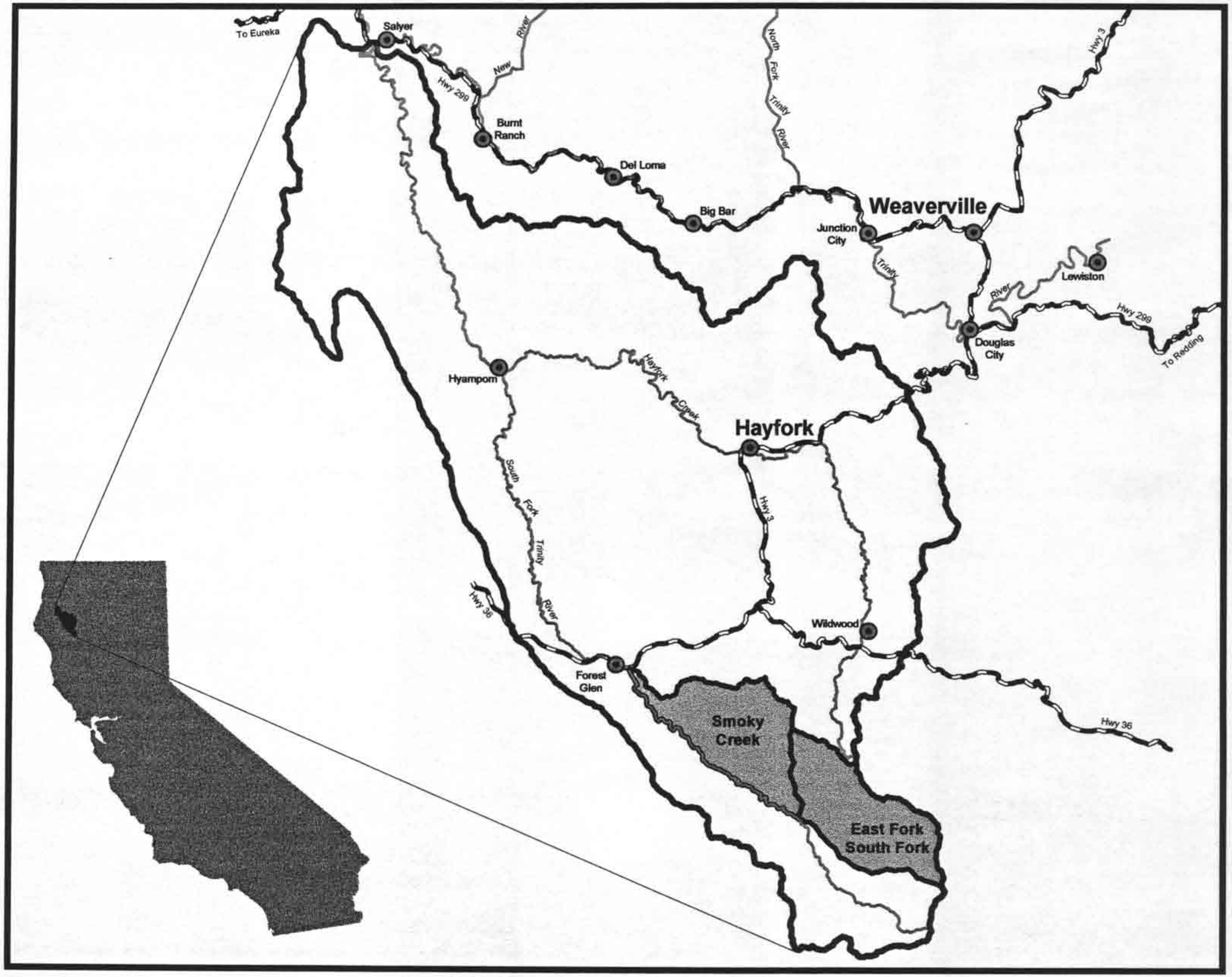
	1	34	III			82	cc 6ac	84	DF 55	88	150 T								
							or 28ac		PP 45										
	2	25	III	soils shallow		82	patch cc	84	PP 100	88	300 P	well pp, df	pp, df 10		some db		pct	98	25 ac
				regen diff.							324 T								
	3	5	III			82	cc	84	PP 100	88	260 P						pct	98	5 ac
											280 T								
	4	4	II			82	cc	84	PP 100	88	225 P						pct	98	4 ac
											250 T								
	5	11	II			82	cc	84	DF 50	88	265 P						pct	98	11 ac
									PP 50		292 T								
	6	14	III			82	cc	84	PP 100	88	250 P	well pp	pp 4-7	rapid	mod clo, wt		rls for gwth, pct	98	14 ac
											300 N								
	7	19	II			82	cc	84	DF 35	88	165 P	mod pp	pp 4-8	mod-rapid	mod wt, lt grs		clear brsh, interplant,	98	19 ac
									PP 65		171 T						rls for gwth, pct		
	8	2	III			82	cc	84	PP 100	88	252 T	well pp	pp 4-7	mod	mod-hvy wt, wm		rls for gwth, pct	98	2 ac
	9	11	III			82	patch cc	84	DF 100	91	450 P						pct	98	11 ac
								86	DF 33		501 T								
									PP 67										
								87	DF 47										
									PP 53										
	10	11	III			82	cc	84	PP 100	88	275 P	well pp	pp 5-7	rapid	mod wt		rls for gwth, pct	98	11 ac
											385 T								
Peak	B/C	29/5	II, III/II			84	patch cc	84	DF 49	91	614 P	well pp, jp, df	pp, jp 4-7	rapid	lt-mod wt	rls for gwth	pct	98	34 ac
									PP 51		703 T								
								87	DF 24										
									PP 30										
									JP 46										
	D	21	III	15		84	patch cc	86	DF 50	91	370 P	well pp, jp, df	pp, jp 2-5, df 2-5	mod	mod wt		interplant, rls for	98	21 ac
				shallow +					PP 50		399 T						gwth, pct		
				duripan				87	DF 20										
									PP 15										
									JP 65										
	E/G	15/13	III/IV,III	10/10	rust	82	patch cc	86	DF 45	91	354 P	well pp, jp, df	pp, jp 4-7, df 2-4	rapid	lt-mod wt, grs		scalp, interplant, pct+R406	98	28 ac
									PP 55		371 T						rls for gwth		
								87	DF 24										
									PP-38										
									JP-38										
	I	7	II			84	patch cc	86	DF 50	91	458 P						pct	98	7 ac
									PP 50		472 T								
								87	DF 8										
									PP 92										
	J	15	III,IV	15		84	patch cc	86	DF 42	90	292 P						pct	98	15 ac
				shallow					PP 58		421 T								
	K	17	III,IV	2 ac + 10%		84	patch cc	86	DF 47	90	355 P	well pp	pp 7-10	rapid	lt wt		pct	98	17 ac
				shallow					PP 53		492 T								
Rat Trap II	1	40	II			84	cc	85	DF 61	90	316 P	mod pp, df	pp 4-7, df 2-5		hvy grs		scalp, interplant, pct	98	40 ac
									PP 39		431 T								
	2	17	II	20		84	cc partial?	85	DF 75	90	206 P						pct	98	17 ac
									PP 25		217 T								
								86	DF 85										

									PP 15										
	25	11	II			84	cc	85	DF 90	91	311 P						pct	98	11 ac
									PP 10		406 T								
								87	DF 53										
									PP 47										
	28	5	II			84	patch cc	85	DF 92	91	641 P								
									PP 8		660 T								
								86	DF ?										
									PP ?										
								87	DF 55										
									PP 41										
									JP 4										
Old Dark Canyon																			
	A	6	III			66	cc	68	PP 100	78	645 T (walk					pct		92	5 ac
										89	600 T thru)								125 tpa
	B	44	III			66	cc	68	P 100	78	450 T (est.)					pct		91	44 ac
										89	400 T (est.)								166 tpa
	C	8	III			66	cc	68	PP 100	91	297 P	mod-well pp, jp	pp,jp2-4,10-15		mod wt		rls for gwth, pct	2001	8 ac
								74	failure		309 T								
								86	PP 100										
								87	JP 100										
	D	12	III			66	cc	68	PP 100	?		well pp	pp 15-25				pct	98	12 ac
	E	18	III			66	cc	68	PP 100	?		well pp, df	pp7-20,df 6-10	rapid	mod wt		rls for gwth, pct	98	18 ac
	F	8	III			66	cc	68	PP 100	?							pct	98	8 ac
Dark Canyon																			
	2	10	IA			86	cc 9ac	88	DF 50	92	476 P	well pp, df	pp 3-4, df 1-3		lt grs, brsh		pct	98	9 ac
									PP 50		516 T								
	4	15	III			86	patch cc	88	DF 50	92	576 P	well pp, df	pp 4-7, df 2-5		lt brsh		rls for gwth, pct	98	15 ac
									PP 50		601 T								
	5	9	II			86	patch cc	88	DF 46	92	529 P	well pp, df	pp 5-7, df 1-3	rapid	lt brsh		tube df, pct	98	9 ac
									PP 54		615 T								
	6	6	III-IV	10		86	cc	88	DF 50	92	679 P	well pp, df	pp, df 7-9	rapid			rls for gwth, pct	98	6 ac
									PP 50		812 T								
	7	16	IV-III	20		86	patch cc	88	DF 47	92	408 P	mod-well pp, df	pp 2-4, df 2-4				pct	98	16 ac
									PP 53		466 T								
	8	22	III	15		86	cc	88	DF 55	92	402 P						pct	98	22 ac
									PP 45		473 T								
	9	15	IV-III	15		86	patch cc	88	DF 50	92	292 P						pct	98	15 ac
				rock, serp					JP 50		343 T								
	11	13	III	20		86	cc	88	DF 53	92	418 P	well pp	pp 3-5, df 2-4	mod	lt grs, mod wt, grn		tube df, pct	98	13 ac
				serp					PP 47		470 T								
	12	13	II-III	5?		86	cc	88	DF 65	92	343 P						pct	98	13 ac
									PP 35		343 T								
	13	40	II-III	cond	dmt	86	cc w/reg	88	DF 43	92	452 P	well pp, df?	pp 2-5		mod grs, lt brsh		pct	98	32 ac
					rust				PP 57		583 T								
	14	10	IV-III	5?		86	cc	88	D 50	92	359 P	mod pp, df	pp 3-4, df 1-5		bb, cb, db, clo, bo	manz rls	pct, interplant	98	10 ac
									P 50		369 T								
	15	5	IV-III	15		86	cc	88	DF 55	92	660 P						pct	98	5 ac
									PP 45		679 T								
	16	4	III	5?		86	patch cc	88	D 50	92	738 P	lt-mod pp	pp 4		clo, db, grs		pct	98	4 ac

									P 50		768 T								
	17	6	III			86	cc	88	D 50	92	824 P	mod-well pp	pp 4-7		clo, db		pct, rls	98	6 ac
									P 50		856 T								
	19	10	I-II	5?		86	imprv 1ac	88	D 47	92	524 P						pct	98	9 ac
							patch cc 9ac		P 53		670 T								
Round Mountain																			
	10											well pp	pp 5-8	rapid					
Buck Rdg. 1	B	17	II		deer	67-68?		69	PP 100	82	150+ tpa								
	C	49	II					69	PP 100	understocked									
	D	12	III-IV	66 marginal				69	PP 100	adequate stocking									
				plantable						given site conditions									
	E	29	II							overstocked to marginally									
										stocked on poor site									
Fern Glade	A	73	II			70	stand cc	72+73	DF 100	82	150+ tpa					pct		91	63 ac
										91	171+ tpa								
	B/B2	37	II			71	stand cc	73	DF 100	80	B <50 tpa					pct		91	15 ac
											B2 >150 tpa								
										91	193 T								
	C	57	II			71	stand cc	73	DF 100	82	150+ tpa						pct	98	57 ac
	D/E	34	II			71	stand cc	73	DF 100	82	150+ tpa						pct	98	34 ac
	F	15	II			71	stand cc	73	DF 100	82	150+ tpa						pct	98	15 ac
	G + H	38 + 26	II			71	stand cc	73	DF 100	82	260T unit H						pct	98	64 ac
	I	43	II			71	patch cc	71	DF 100	82	150+ tpa						pct	98	43 ac
	J	20	II			69	patch cc	71	PP ?	91	178 T					pct		91	20 ac
									DF ?										178 tpa
	K	23	II		goph	69	stand cc	71	PP?	82	<150 tpa						pct	98	23 ac
									DF?										
	L/M	60	II			70	stand cc	72	PP ?	82	150+ tpa						pct	98	60 ac
									DF ?										
	N	12	II			69	stand cc	71	PP?	82	150+ tpa						pct	98	12 ac
									DF ?										
	P1	17	II			69	stand cc	71	PP?	82	<150 tpa						pct	98	17 ac
									DF?										
	P2	14	II			69	stand cc	71	PP?	82	150+ tpa						pct	98	14 ac
									DF?										
* Dunning	^ % unplantable + cause cfc = coarse fragment content cond = conditional serp = serpentine										**goph = gopher dmt = dwarf mistletoe rust = white pine blister rust porky = porcupine deer = deer								
^^or = overstory removal cc = clear cut imprv = improvement cut sh = shelterwood											*tpa = trees per acre P = planted T = total								
**grs = grass bf = bracken fern bc = blackcap brsh = brush bo = black oak clo = canyon live oak pm = Pacific madrone gc = golden chinquapin																			
	db = deer brush wt = whitethorn wm = whiteleaf manzanita gm = greenleaf manzanita bb = buckbrush gb = gooseberry h = hazel cb = coffee berry																		
~pct = precommercial thin rls for gwth = release for growth tube = install seedling protectors scalp = scalp vegetation prior to planting or from around seedlings																			

Appendix E, Map 1

East Fork/Smoky Creek Watershed Location



Communities
Highways
Rivers
South Fork Trinity Watershed
Watershed Analysis Boundary

N
W E
S

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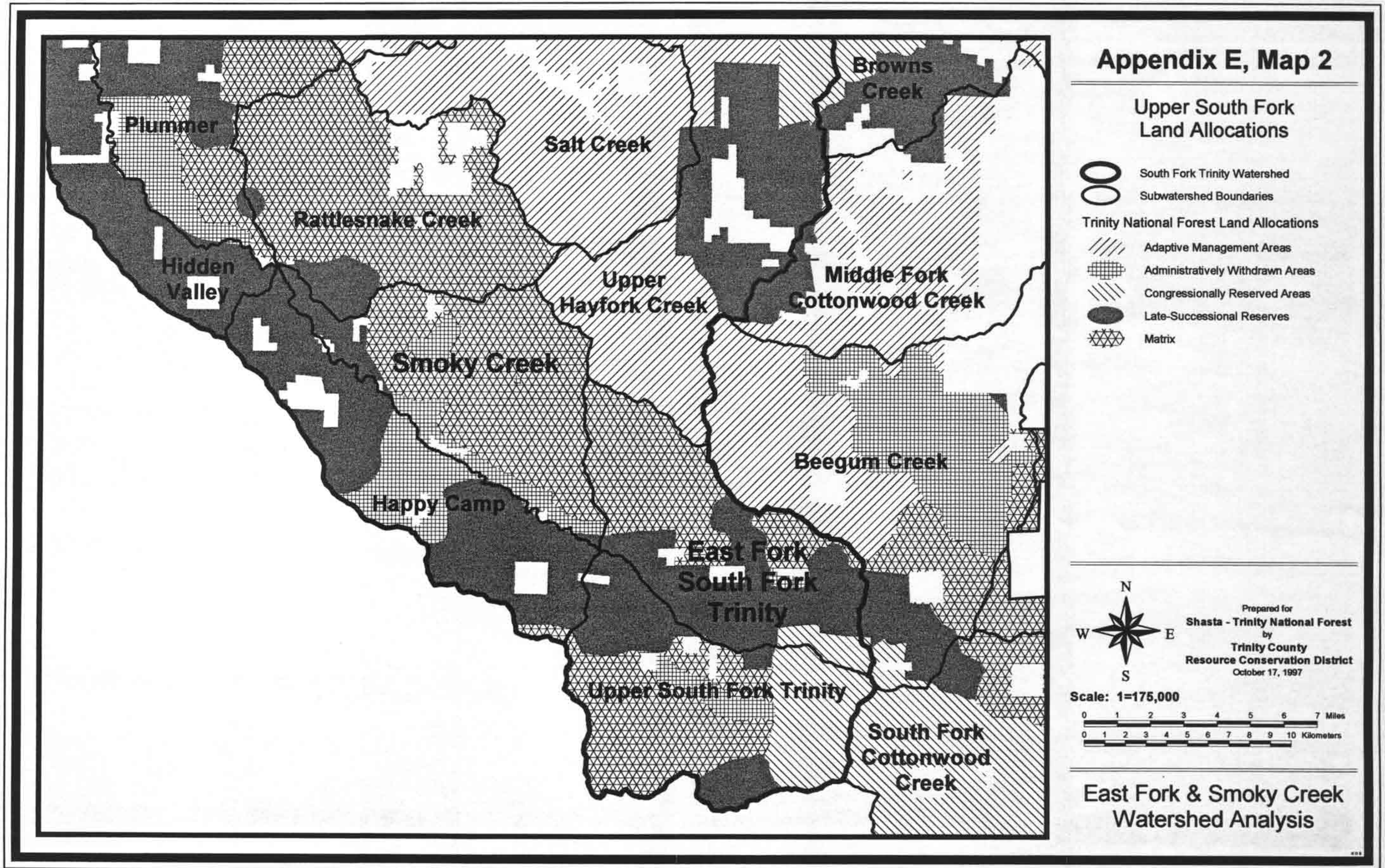
by
Trinity County
Resource Conservation District
October 17, 1997

Scale: 1=400,000

0 5 10 15 Miles
0 5 10 15 20 Kilometers

East Fork & Smoky Creek Watershed Analysis



Plummer
Salt Creek
Browns Creek
Rattlesnake Creek
Hidden Valley
Upper Hayfork Creek
Middle Fork Cottonwood Creek
Smoky Creek
Beegum Creek
Happy Camp
East Fork South Fork Trinity
Upper South Fork Trinity
South Fork Cottonwood Creek
Appendix E, Map 2
Upper South Fork Land Allocations
South Fork Trinity Watershed
Subwatershed Boundaries
Trinity National Forest Land Allocations
Adaptive Management Areas
Administratively Withdrawn Areas
Congressionally Reserved Areas
Late-Successional Reserves
Matrix
N
W
E
S
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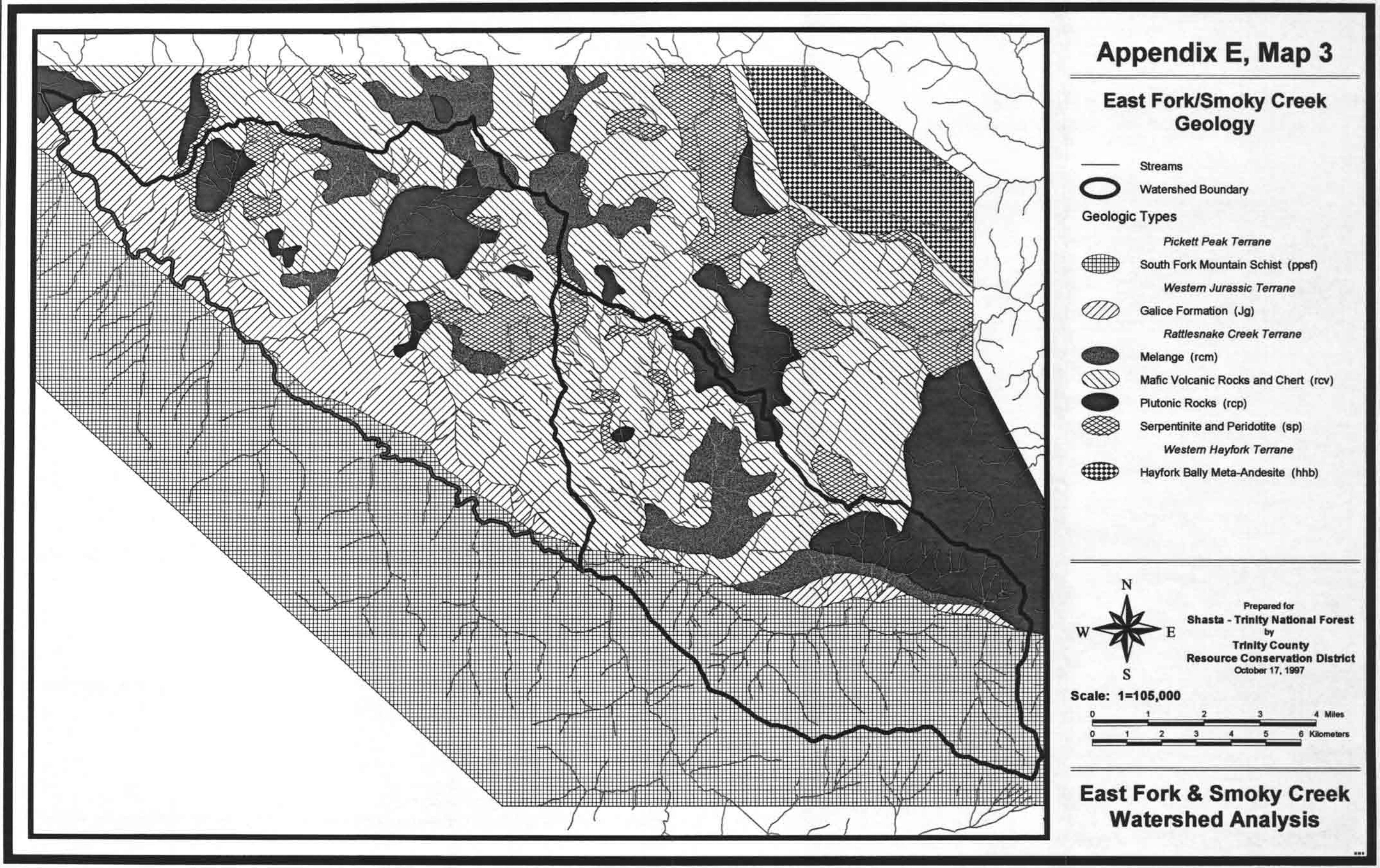
October 17, 1997
Scale: 1=175,000
0 1 2 3 4 5 6 7 Miles
0 1 2 3 4 5 6 7 8 9 10 Kilometers
East Fork & Smoky Creek Watershed Analysis



Appendix E, Map 3
East Fork/Smoky Creek Geology
Streams
Watershed Boundary
Geologic Types
Pickett Peak Terrane
South Fork Mountain Schist (ppsf)
Western Jurassic Terrane
Galice Formation (Jg)
Rattlesnake Creek Terrane
Melange (rcm)
Mafic Volcanic Rocks and Chert (rcv)
Plutonic Rocks (rcp)
Serpentinite and Peridotite (sp)
Western Hayfork Terrane
Hayfork Bally Meta-Andesite (hhb)
N
W
E
S
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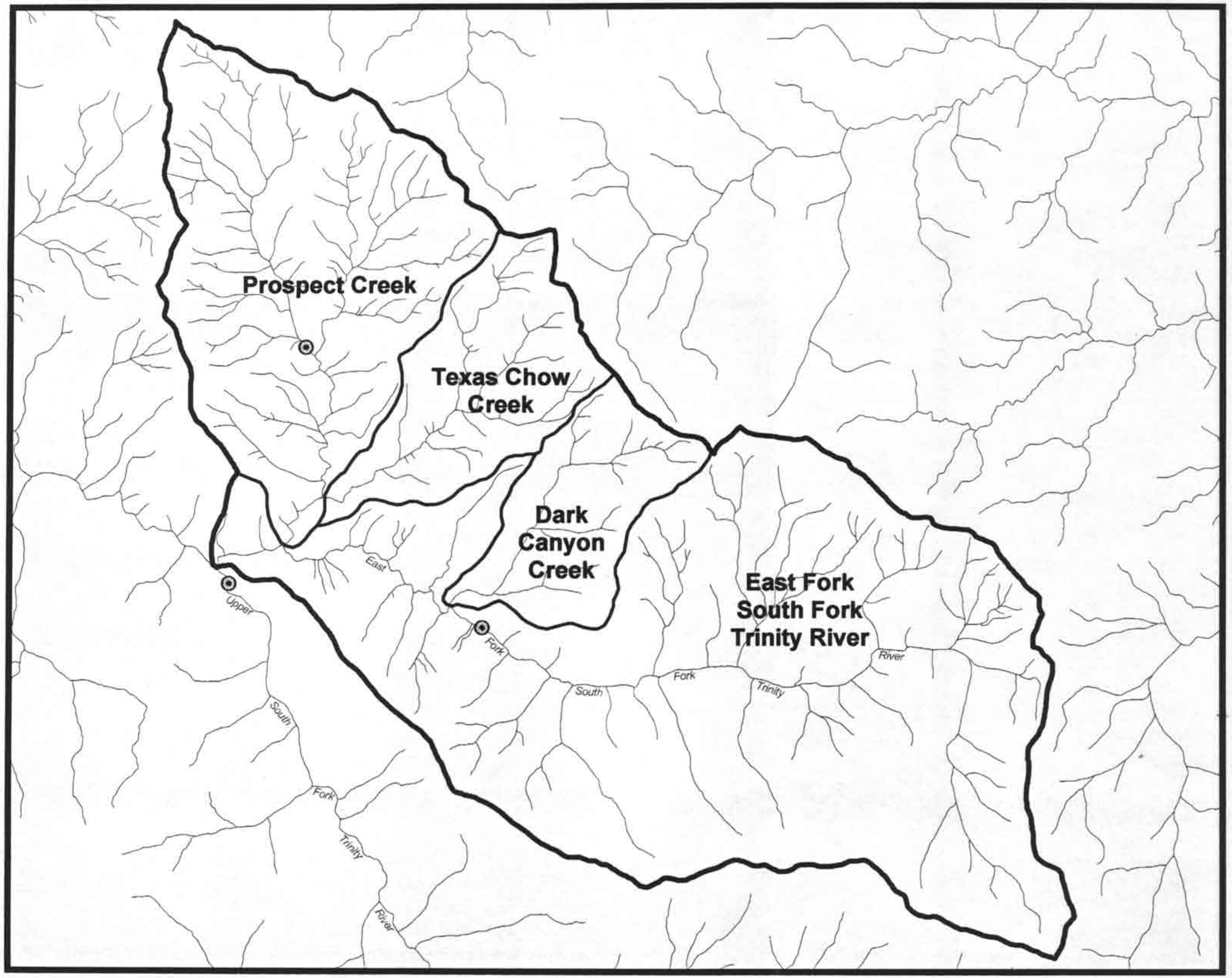
Scale: 1=105,000
0 1 2 3 4 Miles
0 1 2 3 4 5 6 Kilometers
East Fork & Smoky Creek Watershed Analysis



Appendix E, Map 4a

East Fork South Fork Trinity Streams & Monitoring Locations

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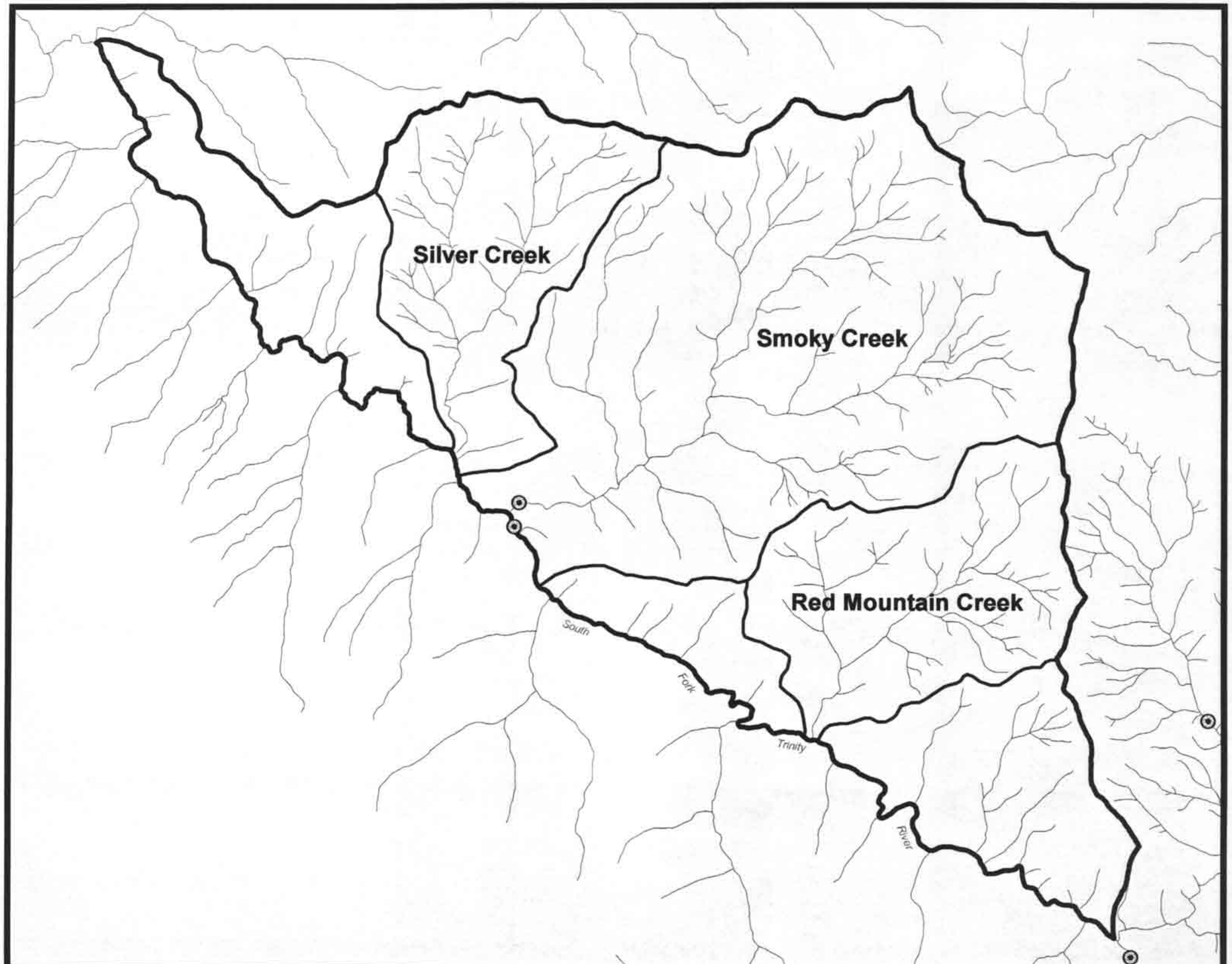
East Fork & Smoky Creek Watershed Analysis

Appendix E, Map 4b

Smoky Creek
Streams & Monitoring Locations

Monitoring Locations
Streams
Subwatersheds
Watershed Boundary



N
W E
S

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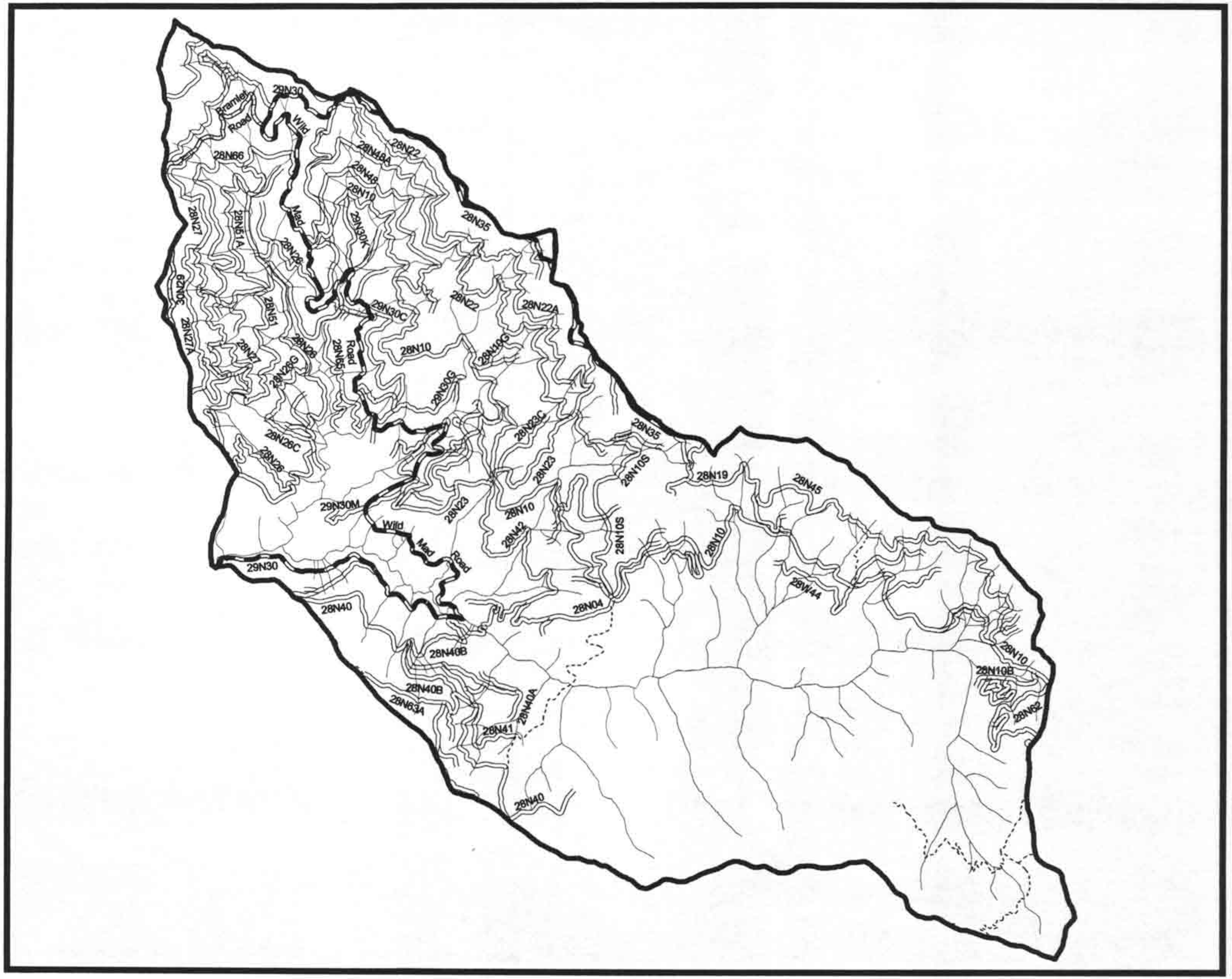
Scale: 1=67,000

0 1 2 3 Miles
0 1 2 3 4 Kilometers

East Fork & Smoky Creek Watershed Analysis



Appendix E, Map 5a

East Fork South Fork Trinity Transportation Network

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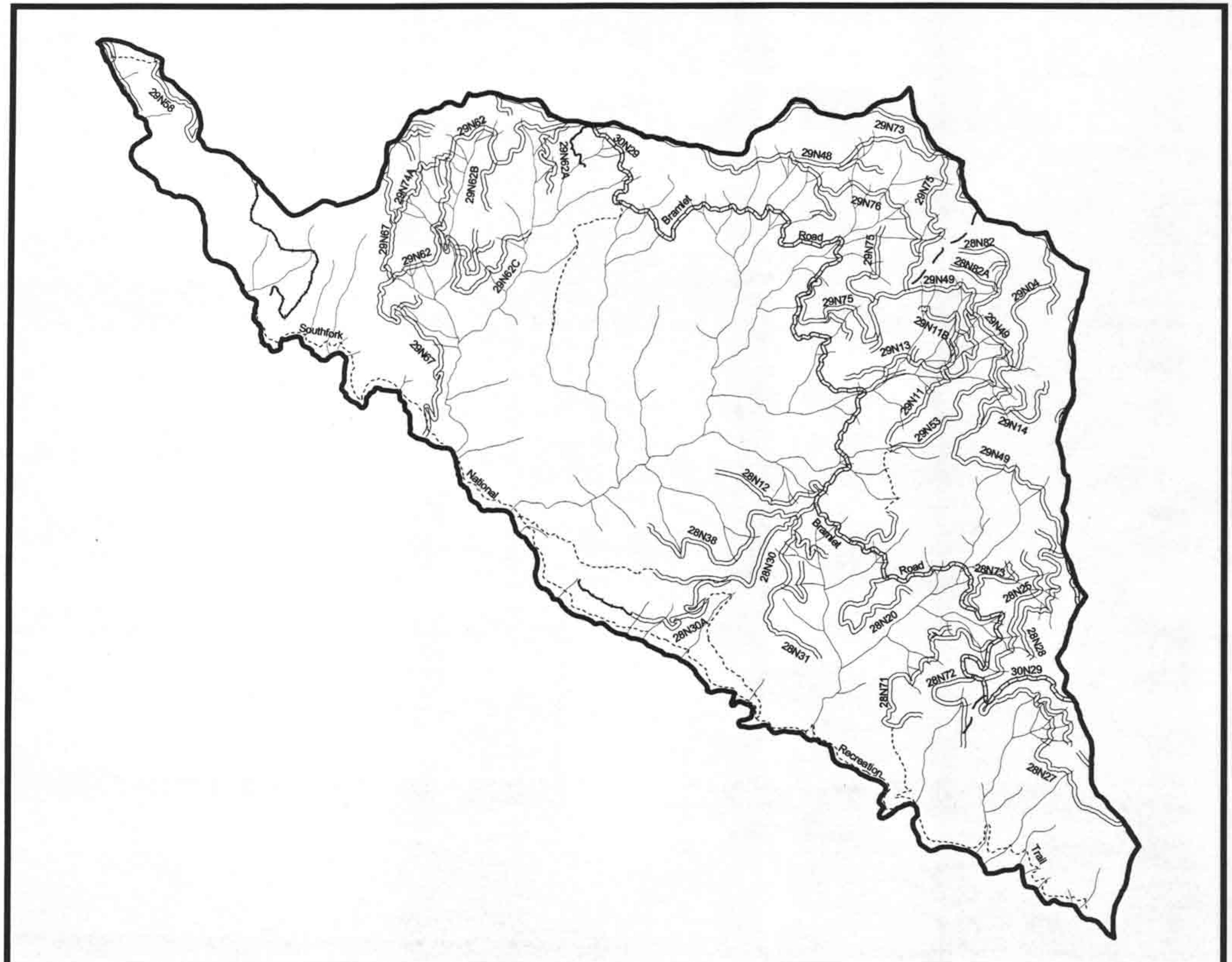
East Fork & Smoky Creek Watershed Analysis

Appendix E, Map 5b

Smoky Creek Transportation Network



Streams
Watershed Boundary

Road Class

Rocked
Dirt
Private
Jeep Trail
Foot Trail

N
W E
S

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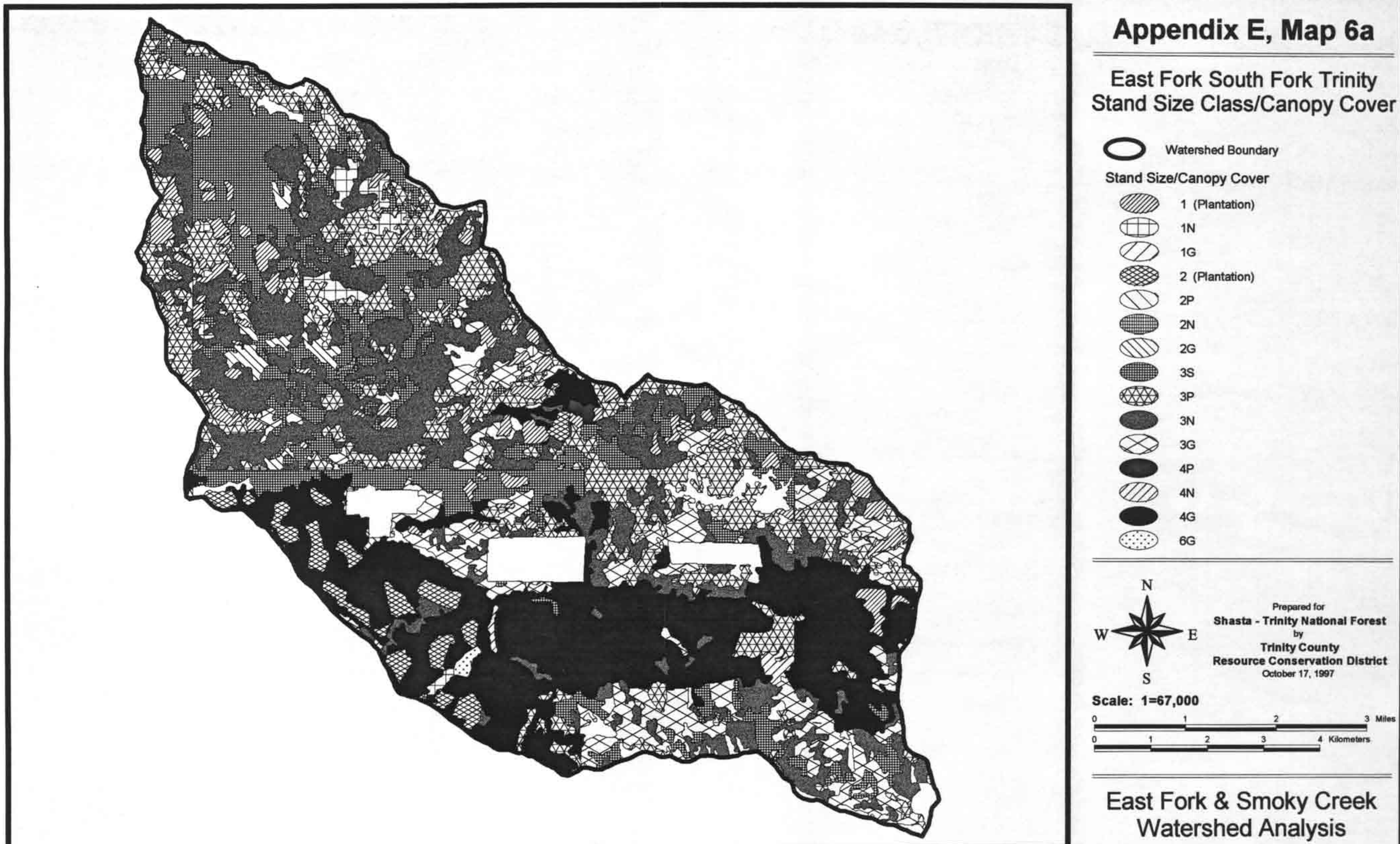
Scale: 1=67,000

0 1 2 3 Miles
0 1 2 3 4 Kilometers

East Fork & Smoky Creek Watershed Analysis

Appendix E, Map 6a

East Fork South Fork Trinity
Stand Size Class/Canopy Cover



Prepared for
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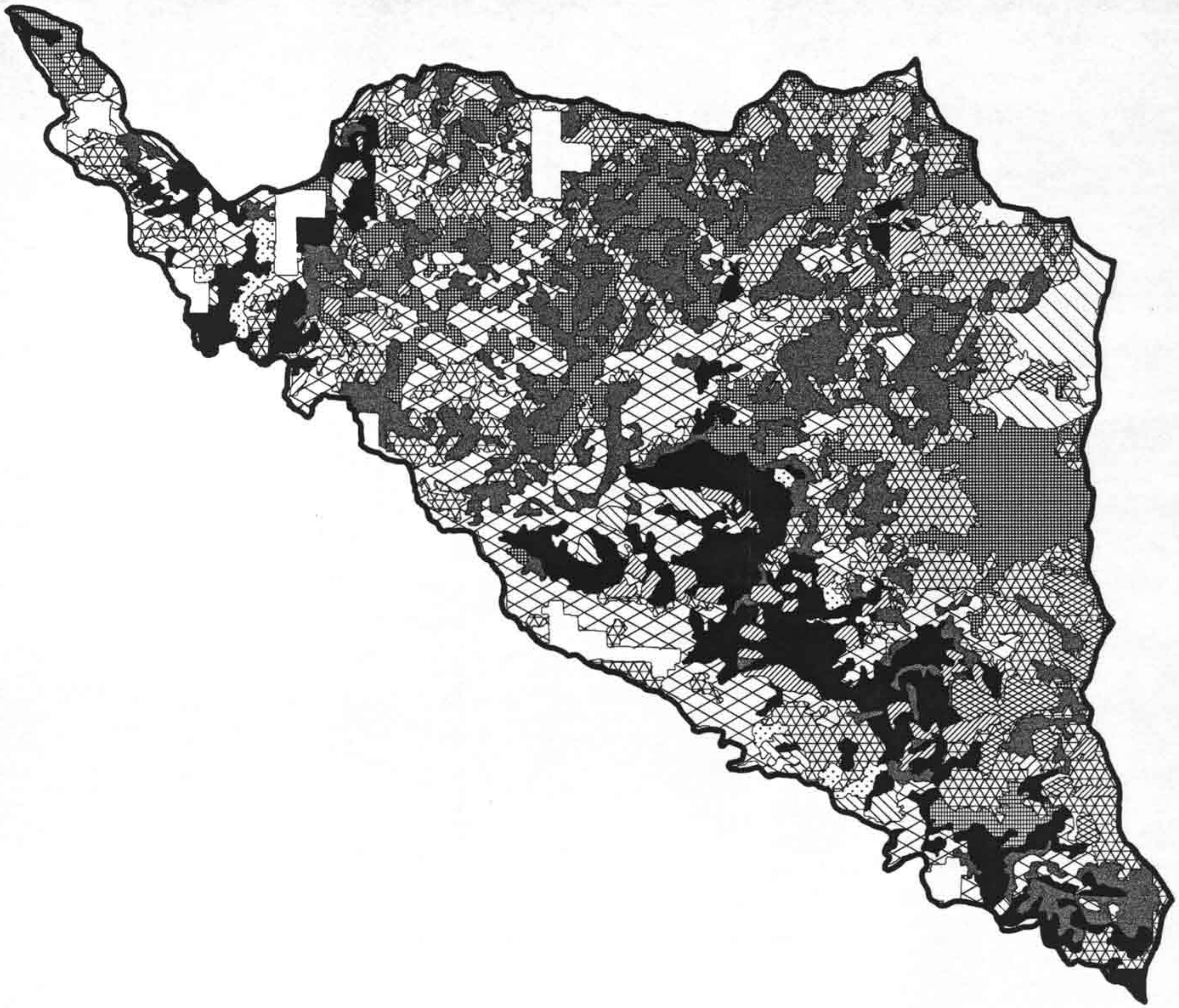
East Fork & Smoky Creek
Watershed Analysis

Appendix E, Map 6b

Smoky Creek
Stand Size Class/Canopy Cover



Watershed Boundary

Stand Size/Canopy Cover

- 1 (Plantation)
- 1N
- 2 (Plantation)
- 2P
- 2N
- 2G
- 3S
- 3P
- 3N
- 3G
- 4P
- 4N
- 4G
- 6G

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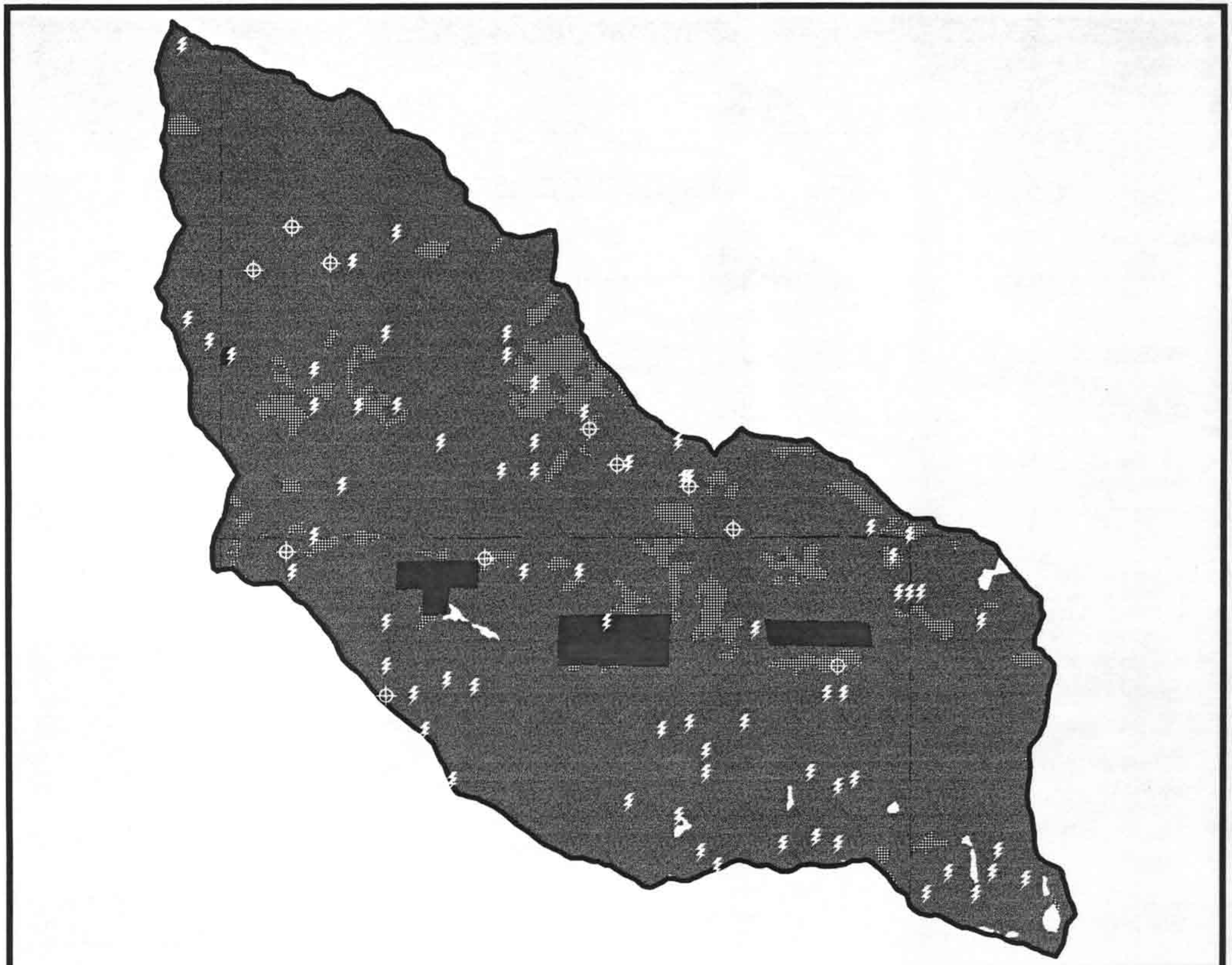
Scale: 1=67,000

East Fork & Smoky Creek
Watershed Analysis



Appendix E, Map 7a

East Fork South Fork Trinity Fire Hazard/Starts by Cause

Fire Starts by Cause

- Human (11 starts)
- Lightning (67 starts)
- Watershed Boundary

Fire Hazard

- High
- Medium
- Low

N
W E
S

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October 17, 1997

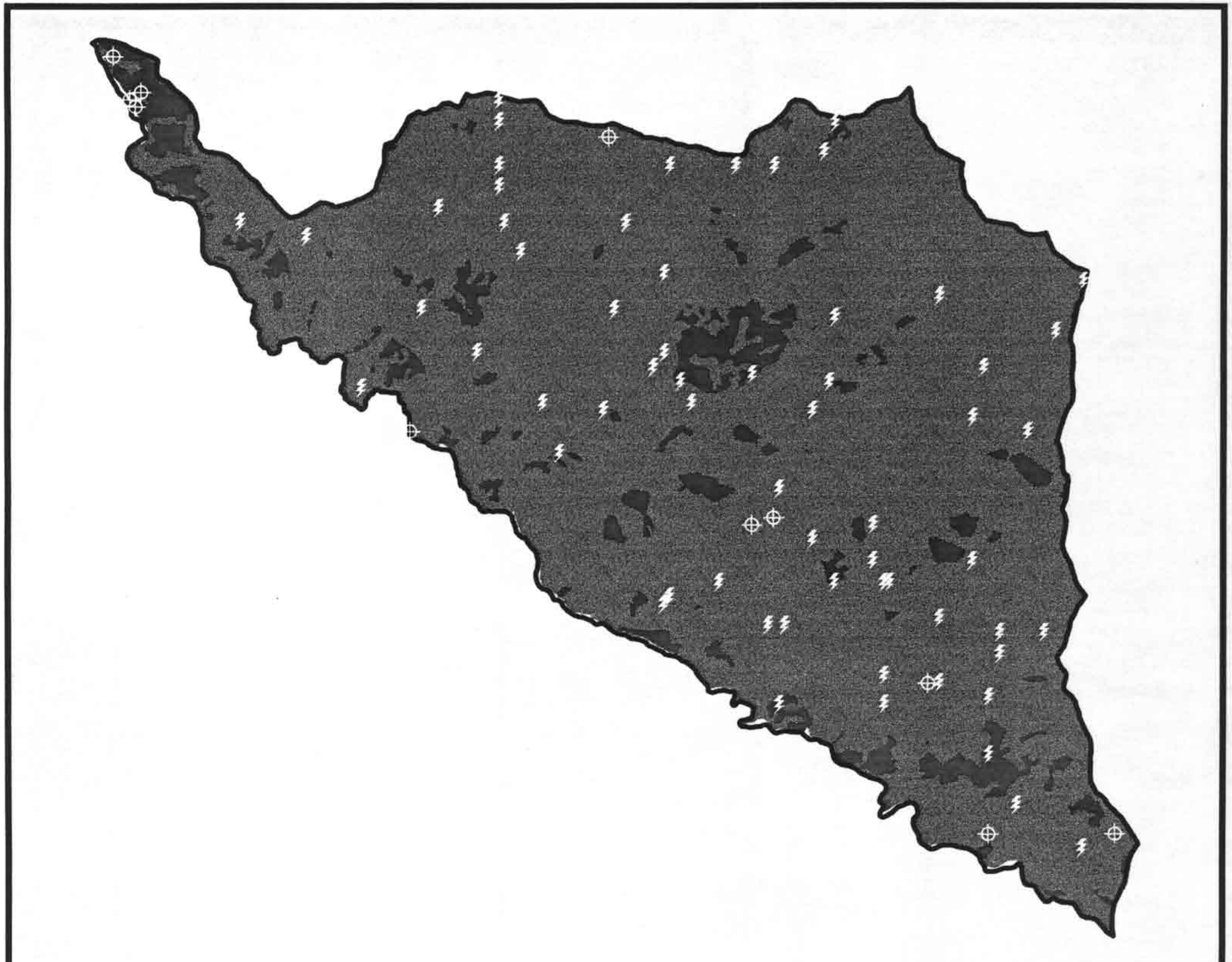
Scale: 1=67,000

0 1 2 3 Miles
0 1 2 3 4 Kilometers

East Fork & Smoky Creek Watershed Analysis

Appendix E, Map 7b

Smoky Creek
Fire Hazard/Starts by Cause



Fire Starts by Cause

- Human (11 starts)
- Lightning (63 starts)
- Watershed Boundary

Fire Hazard

- High
- Medium
- Low

N
W E
S

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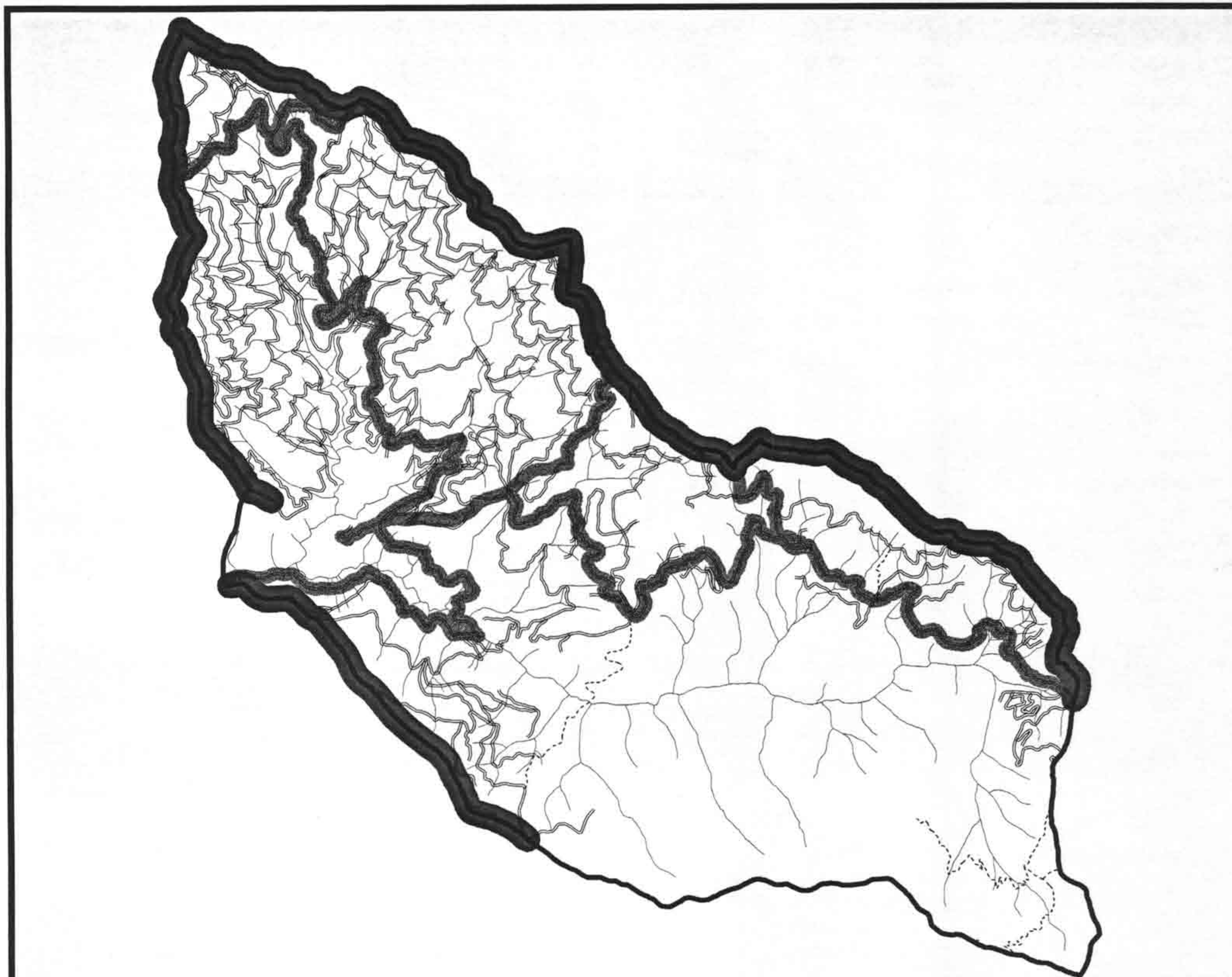
Resource Conservation District
October 17, 1997

Scale: 1=67,000

0 1 2 3 Miles

0 1 2 3 4 Kilometers

East Fork & Smoky Creek Watershed Analysis



Appendix E, Map 8a

East Fork South Fork Trinity Catastrophic Fire Buffers

Defensible Fuel Profile Zones

- Primary
- Secondary
- Streams

Transportation

- Road
- Trail
- Watershed Boundary

N
W E
S

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October 17, 1997

Scale: 1=67,000

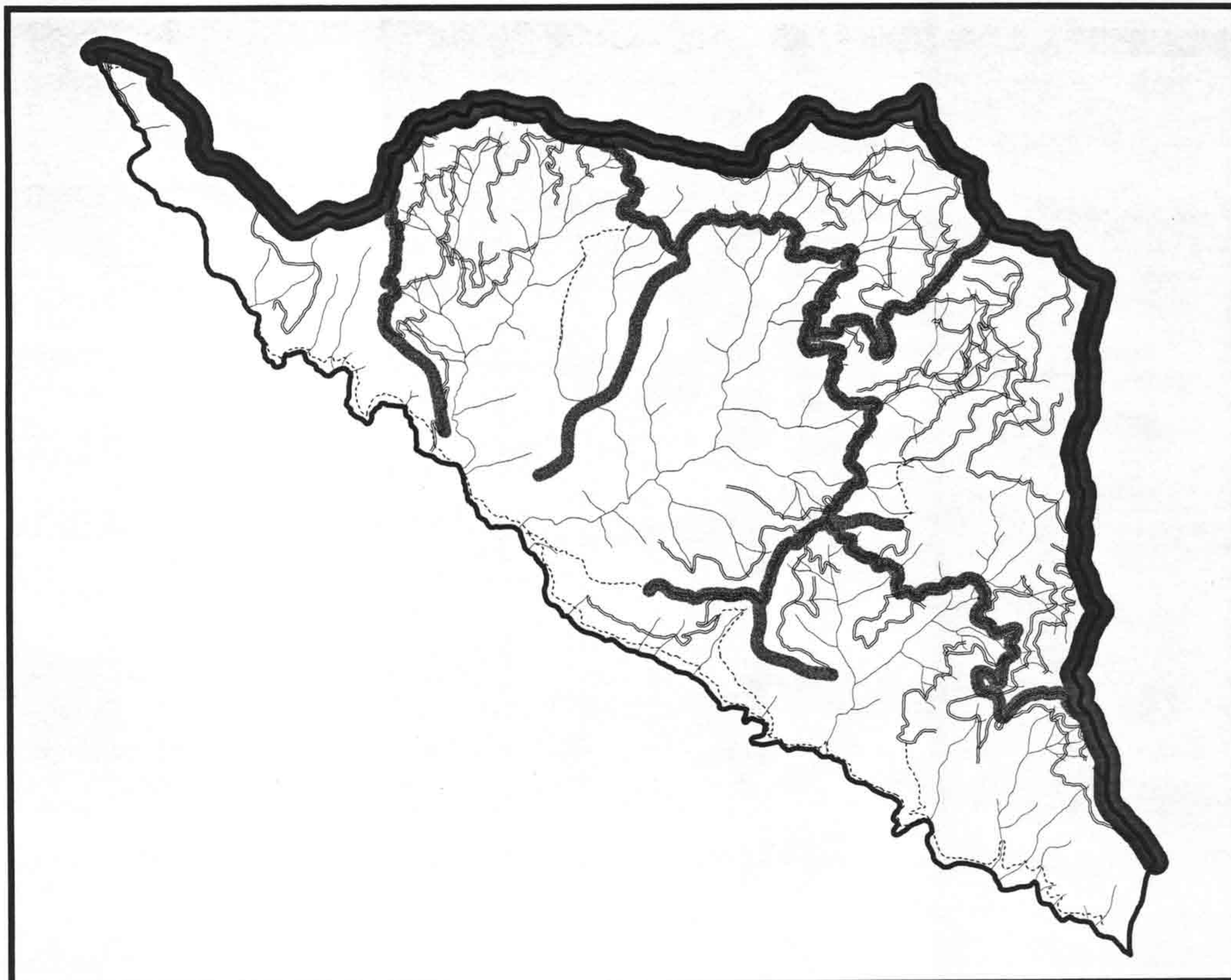
0 1 2 3 Miles

0 1 2 3 4 Kilometers

East Fork & Smoky Creek Watershed Analysis

Appendix E, Map 8b

Smoky Creek Catastrophic Fire Buffers



Defensible Fuel Profile Zones

- Primary
- Secondary
- Streams

Transportation

- Road
- Trail
- Watershed Boundary

N
W E
S

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October 17, 1997

Scale: 1=67,000

0 1 2 3 Miles

0 1 2 3 4 Kilometers

East Fork & Smoky Creek Watershed Analysis

Appendix E, Map 9a

East Fork South Fork Trinity Plantations

Watershed Boundary

Plantations by Decade

- Unknown
- 60 - 69
- 70 - 79
- 80 - 89
- 90 - 97
- Non-Stocked

N
W E
S

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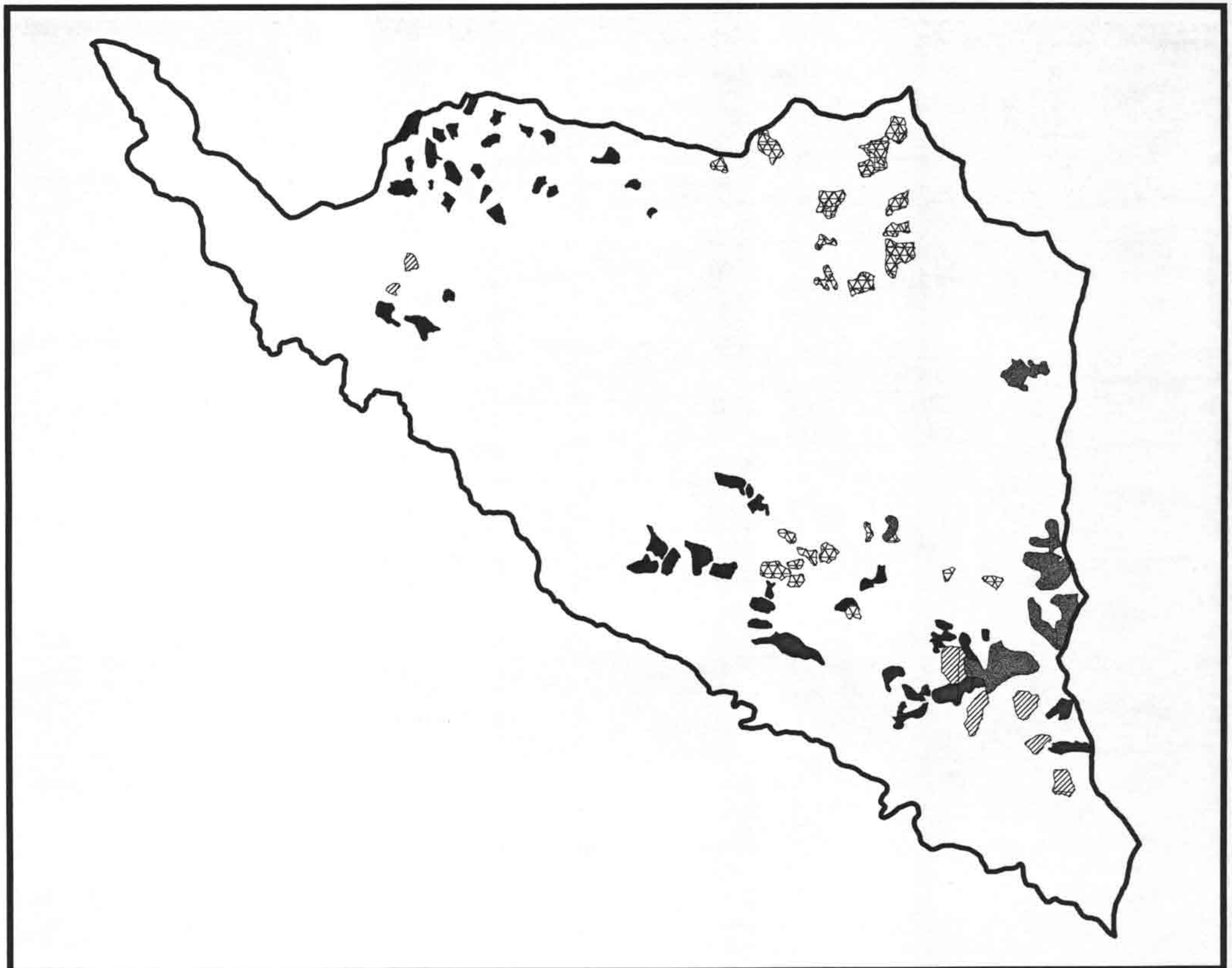
Resource Conservation District
October 17, 1997

Scale: 1=67,000

0 1 2 3 Miles

0 1 2 3 4 Kilometers

East Fork & Smoky Creek Watershed Analysis



Appendix E, Map 9b

Smoky Creek Plantations

Watershed Boundary

Plantations by Decade

- Unknown
- 60 - 69
- 70 - 79
- 80 - 89
- 90 - 97
- Non-Stocked

N
W E
S

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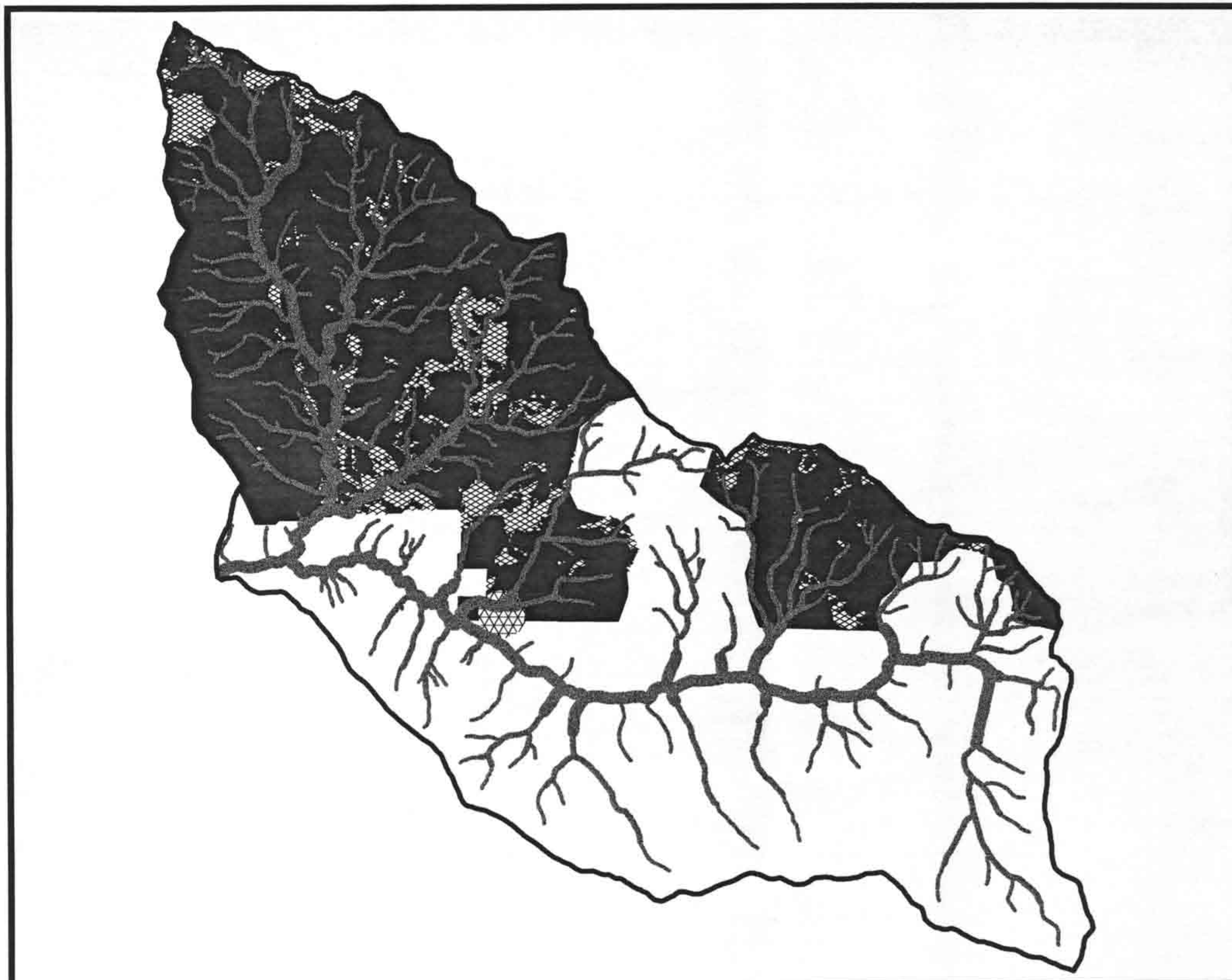
October 17, 1997

Scale: 1=67,000

0 1 2 3 Miles

0 1 2 3 4 Kilometers

East Fork & Smoky Creek Watershed Analysis



Appendix E, Map 10a

East Fork South Fork Trinity CAS Lands

CAS Lands
Owl Activity
Riparian Reserve
Unproductive
Watershed Boundary

N
W E
S

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Resource Conservation District
October 17, 1997

Scale: 1=67,000

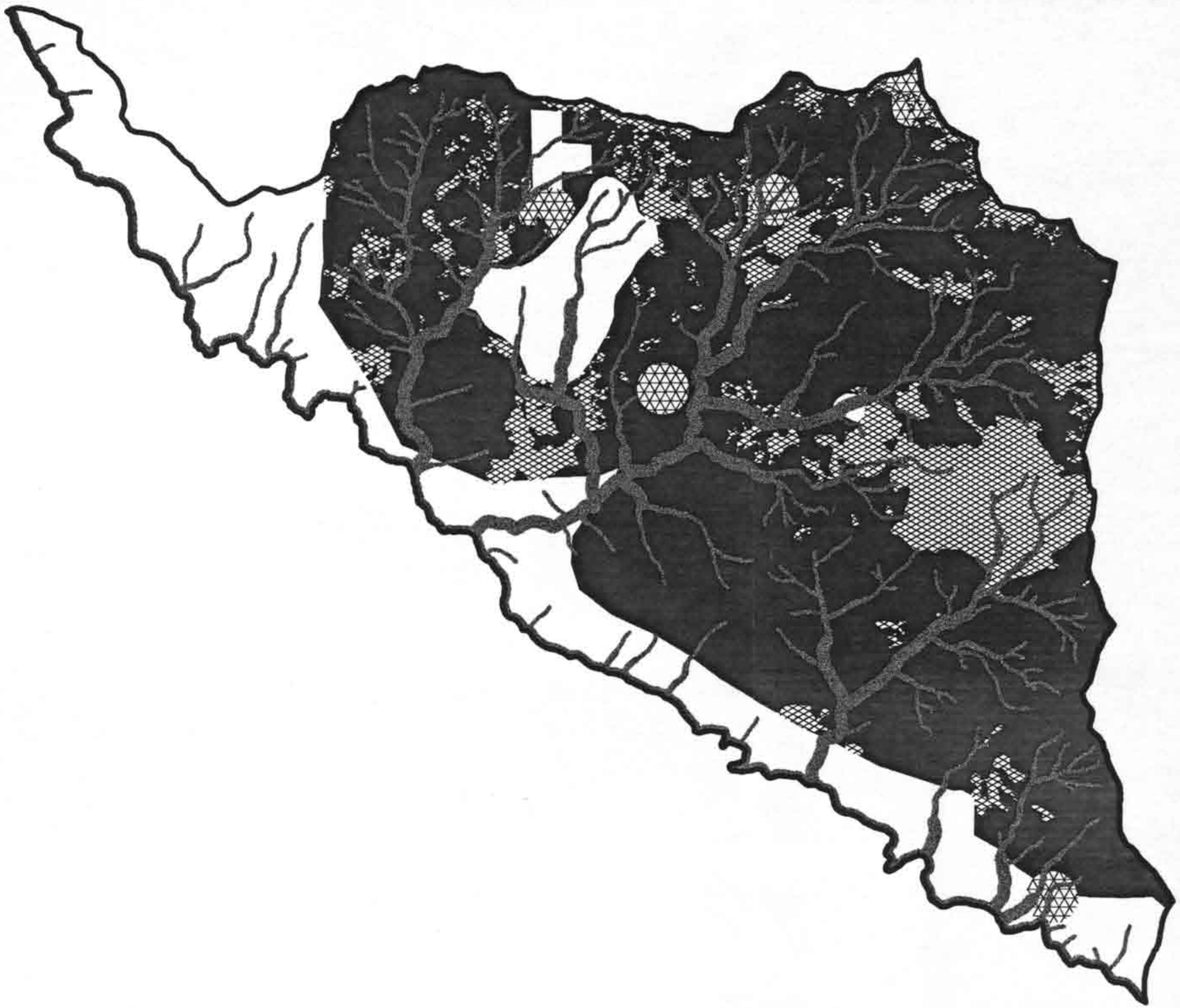
0 1 2 3 Miles

0 1 2 3 4 Kilometers

East Fork & Smoky Creek Watershed Analysis

Appendix E, Map 10b

Smoky Creek CAS Lands



CAS Lands
Owl Activity
Riparian Reserve
Unproductive
Watershed Boundary

N
W
E
S

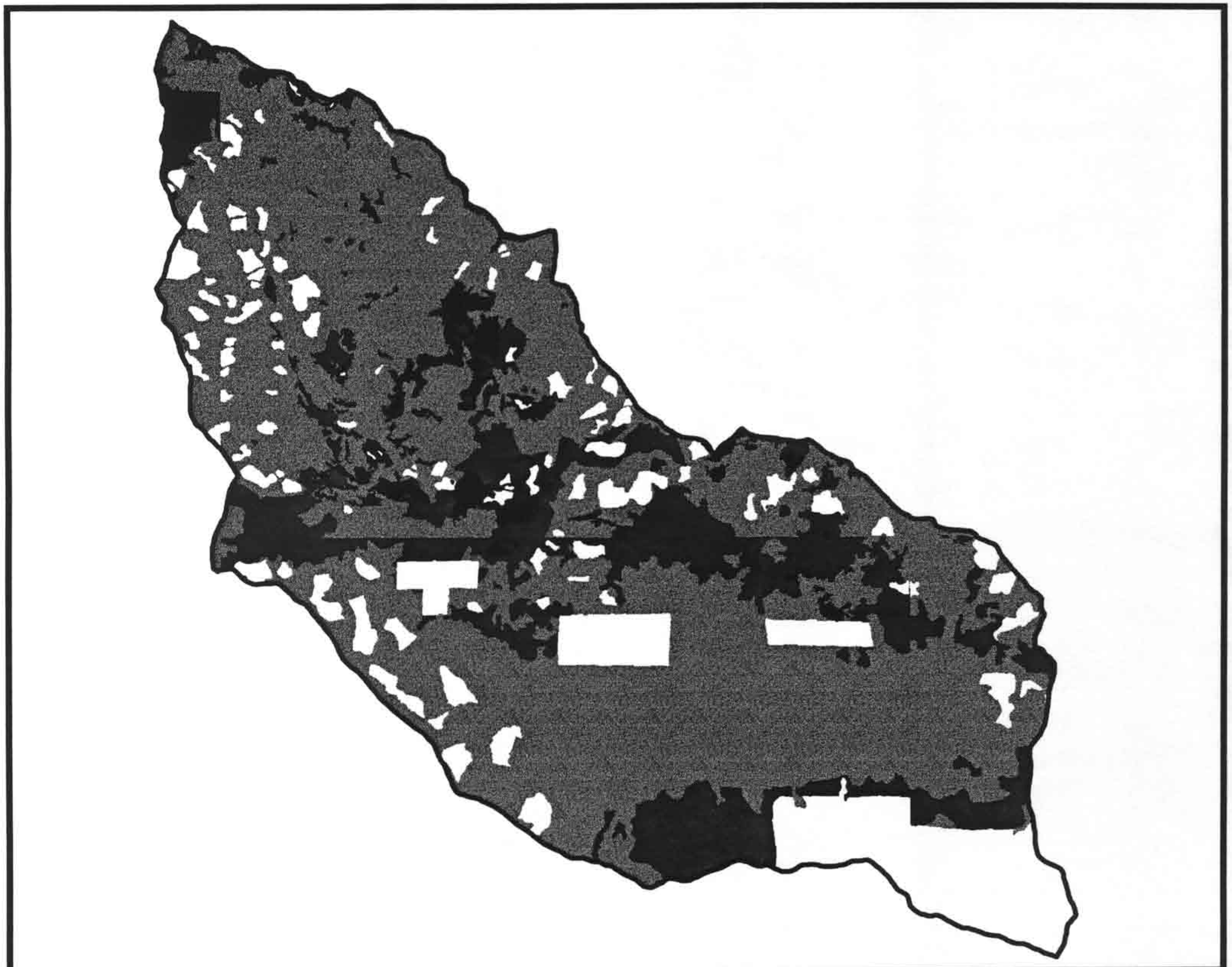
Prepared for
Shasta - Trinity National Forest
by
Trinity County
Resource Conservation District
October 17, 1997

Scale: 1=67,000

0 1 2 3 Miles

0 1 2 3 4 Kilometers

East Fork & Smoky Creek Watershed Analysis



Appendix E, Map 11a

East Fork South Fork Trinity Timber/Soils Productivity

Watershed Boundary

Productivity Class

High Prod. (Dunning I-III)

Low Prod. (Dunning IV-V)

Unproductive (Dunning VI)

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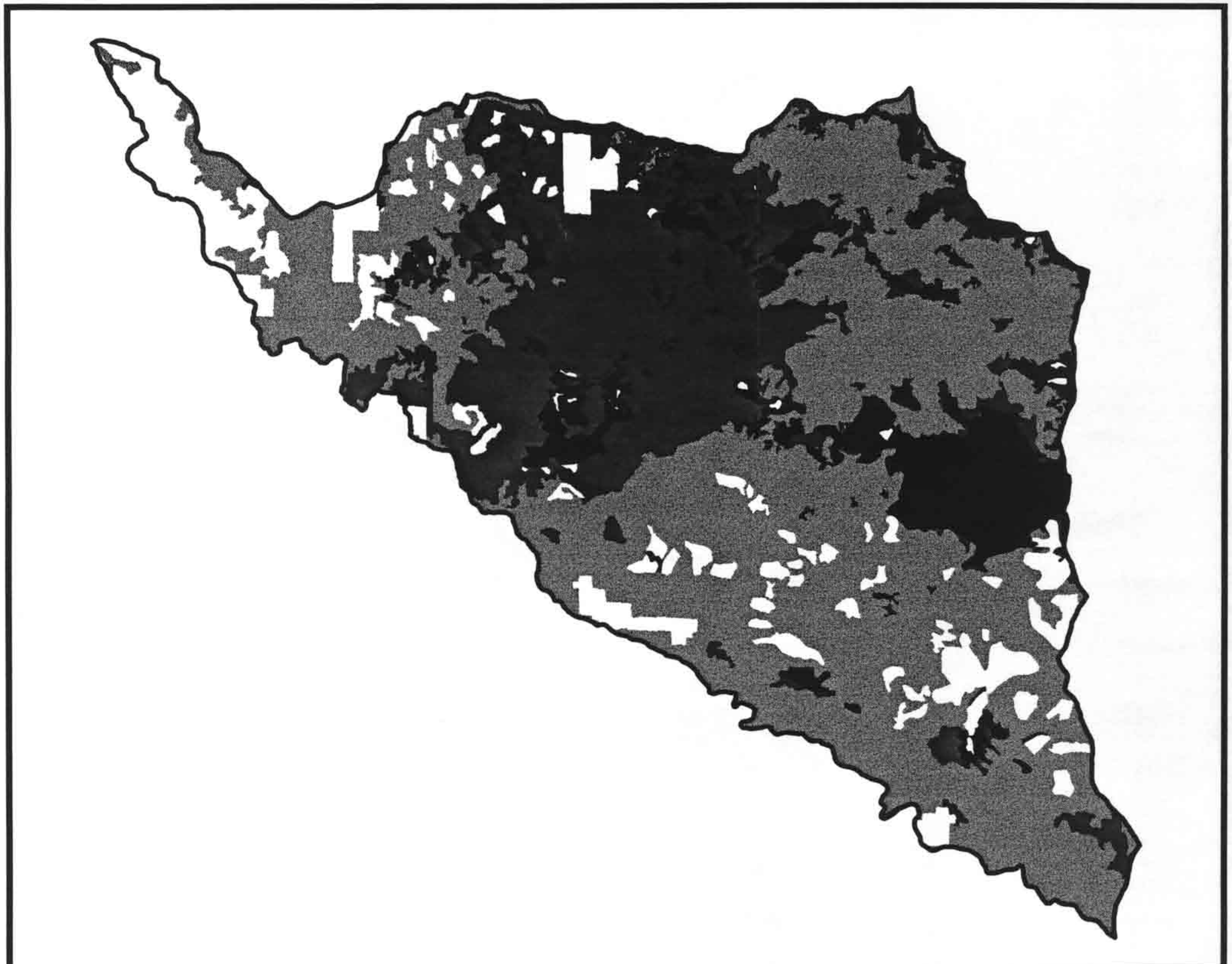
October 17, 1997

Scale: 1=67,000

0 1 2 3 Miles

0 1 2 3 4 Kilometers

East Fork & Smoky Creek Watershed Analysis



Appendix E, Map 11b

Smoky Creek Timber/Soils Productivity

Watershed Boundary

Productivity Class

High Prod. (Dunning I-III)

Low Prod. (Dunning IV-V)

Unproductive (Dunning VI)

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Scale: 1=67,000

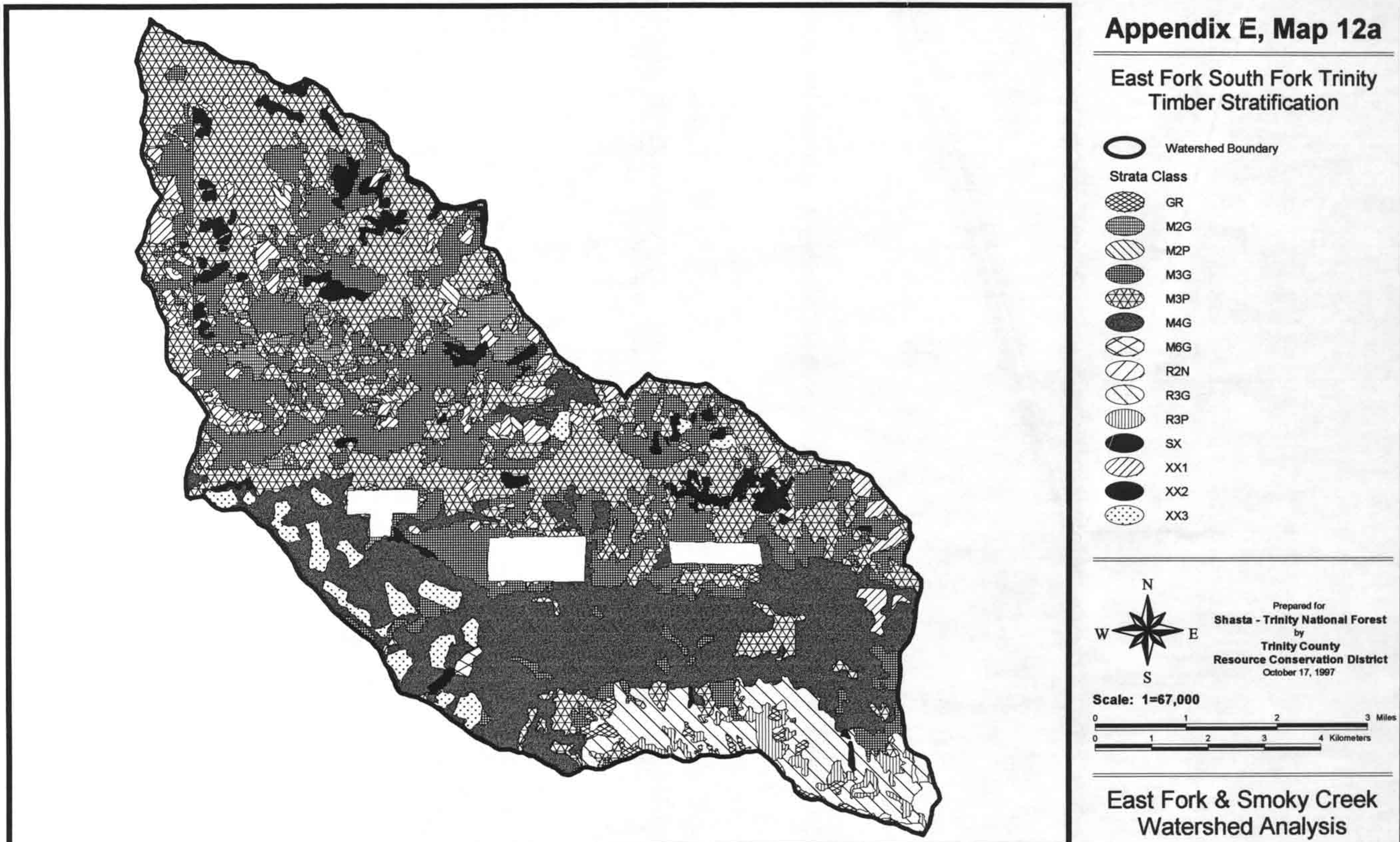
0 1 2 3 Miles

0 1 2 3 4 Kilometers

East Fork & Smoky Creek Watershed Analysis

Appendix E, Map 12a

East Fork South Fork Trinity Timber Stratification



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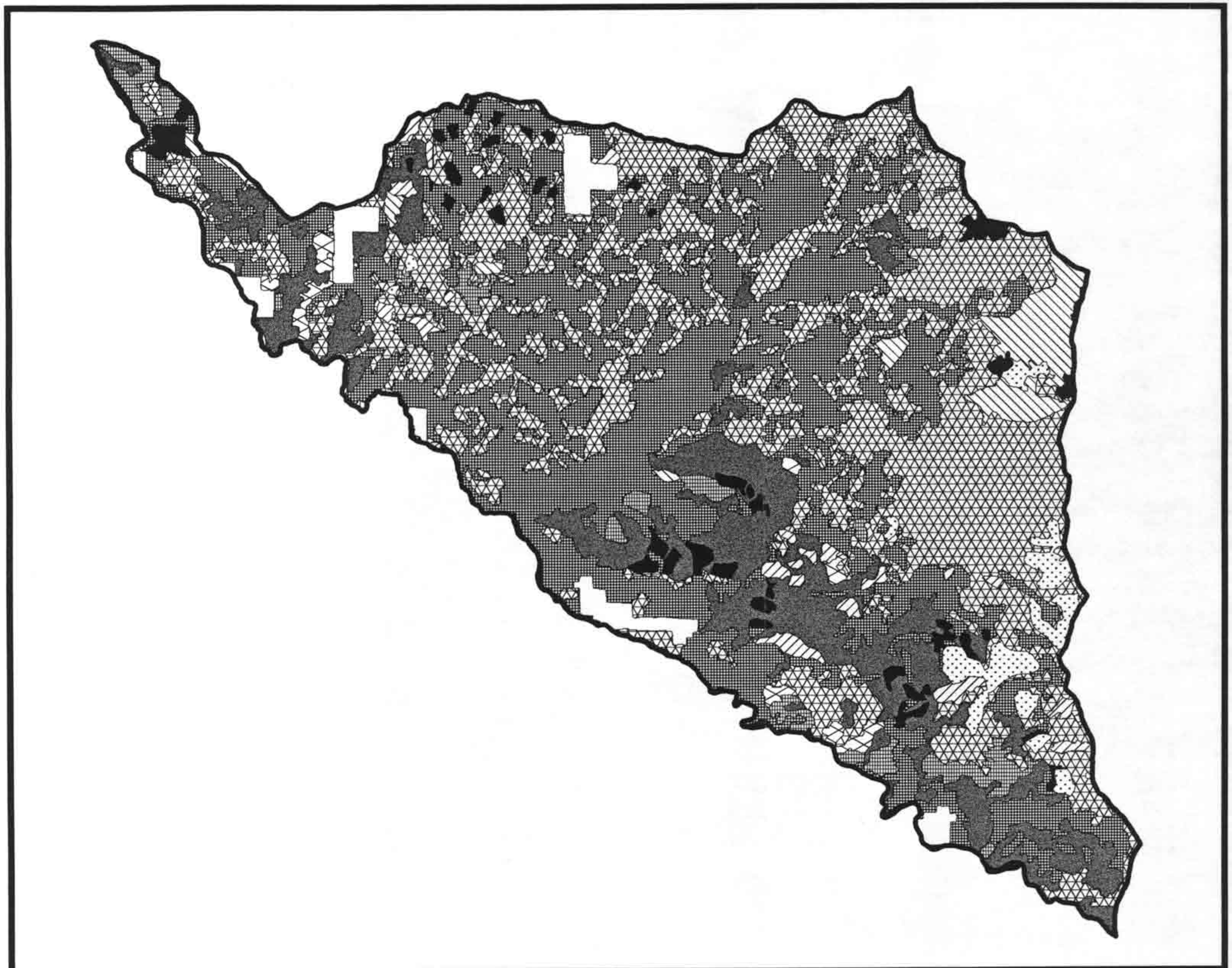
East Fork & Smoky Creek Watershed Analysis

Appendix E, Map 12b

Smoky Creek Timber Stratification



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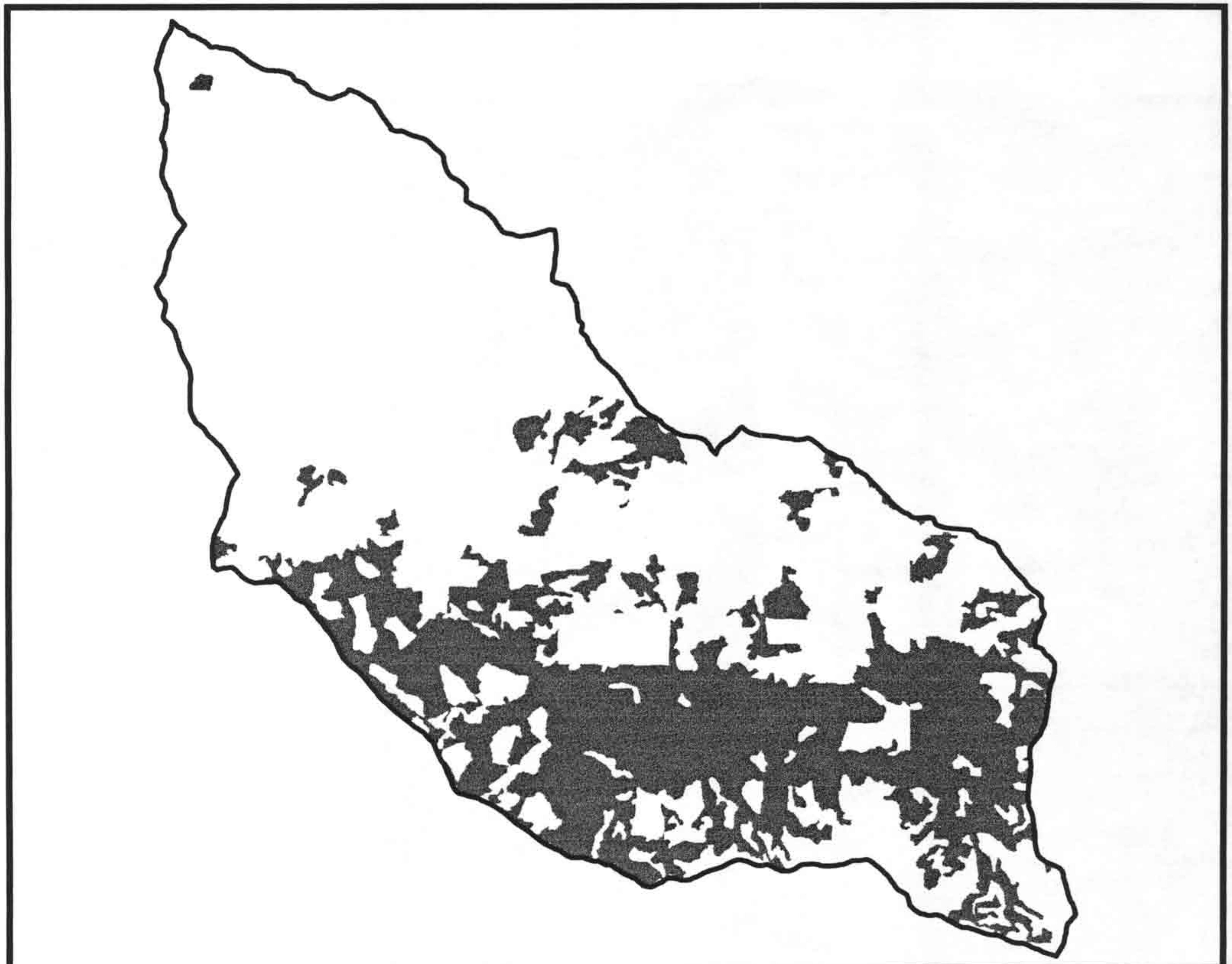
East Fork & Smoky Creek Watershed Analysis

Appendix E, Map 13a

East Fork South Fork Trinity Late Successional Habitat



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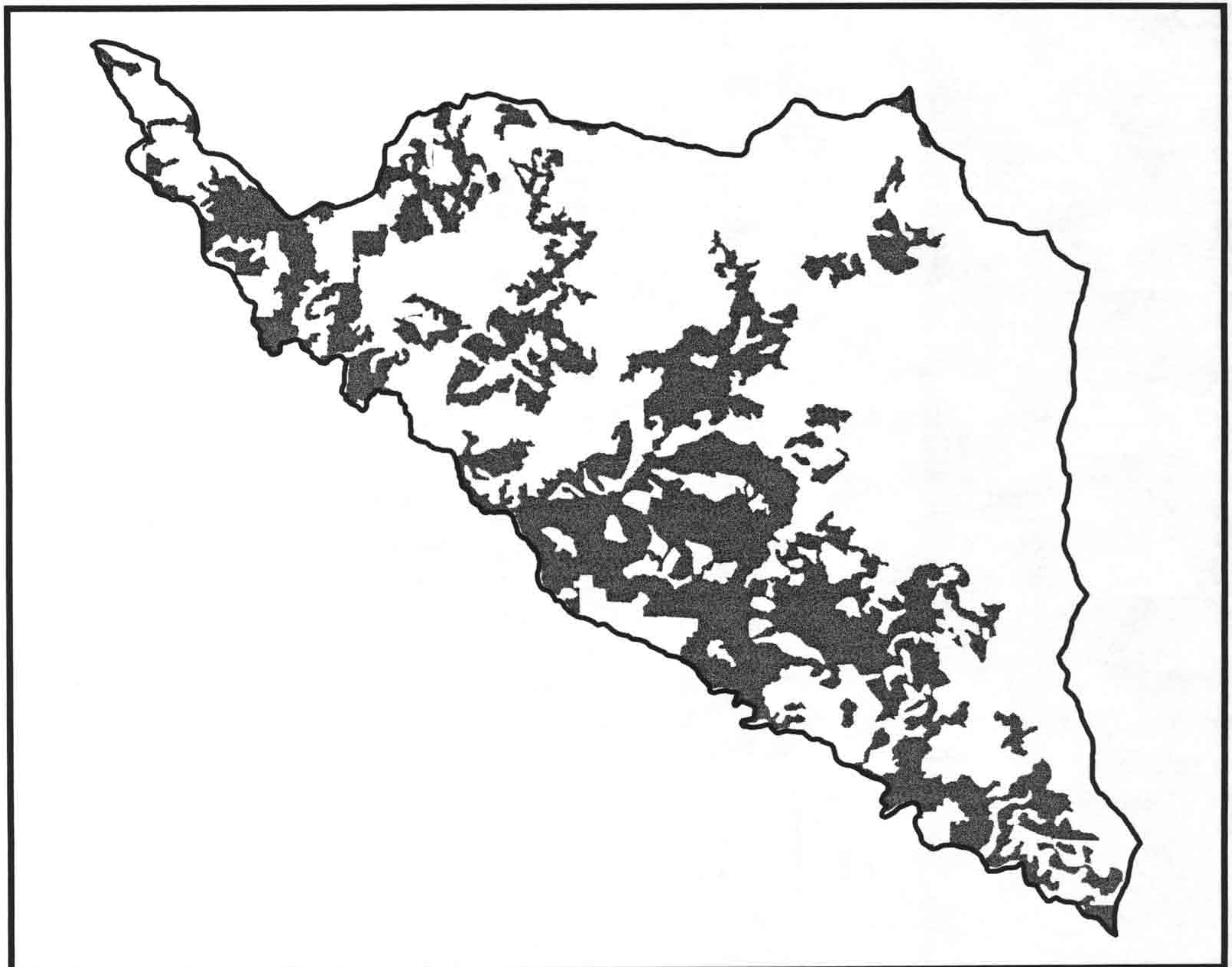
East Fork & Smoky Creek Watershed Analysis



Appendix E, Map 13b

Smoky Creek
Late Successional Habitat

Late Successional Habitat
Watershed Boundary

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Scale: 1=67,000

0 1 2 3 Miles

0 1 2 3 4 Kilometers

East Fork & Smoky Creek
Watershed Analysis

Appendix E, Map 14a

East Fork South Fork Trinity
Dispersal Habitat

Dispersal Habitat

Watershed Boundary

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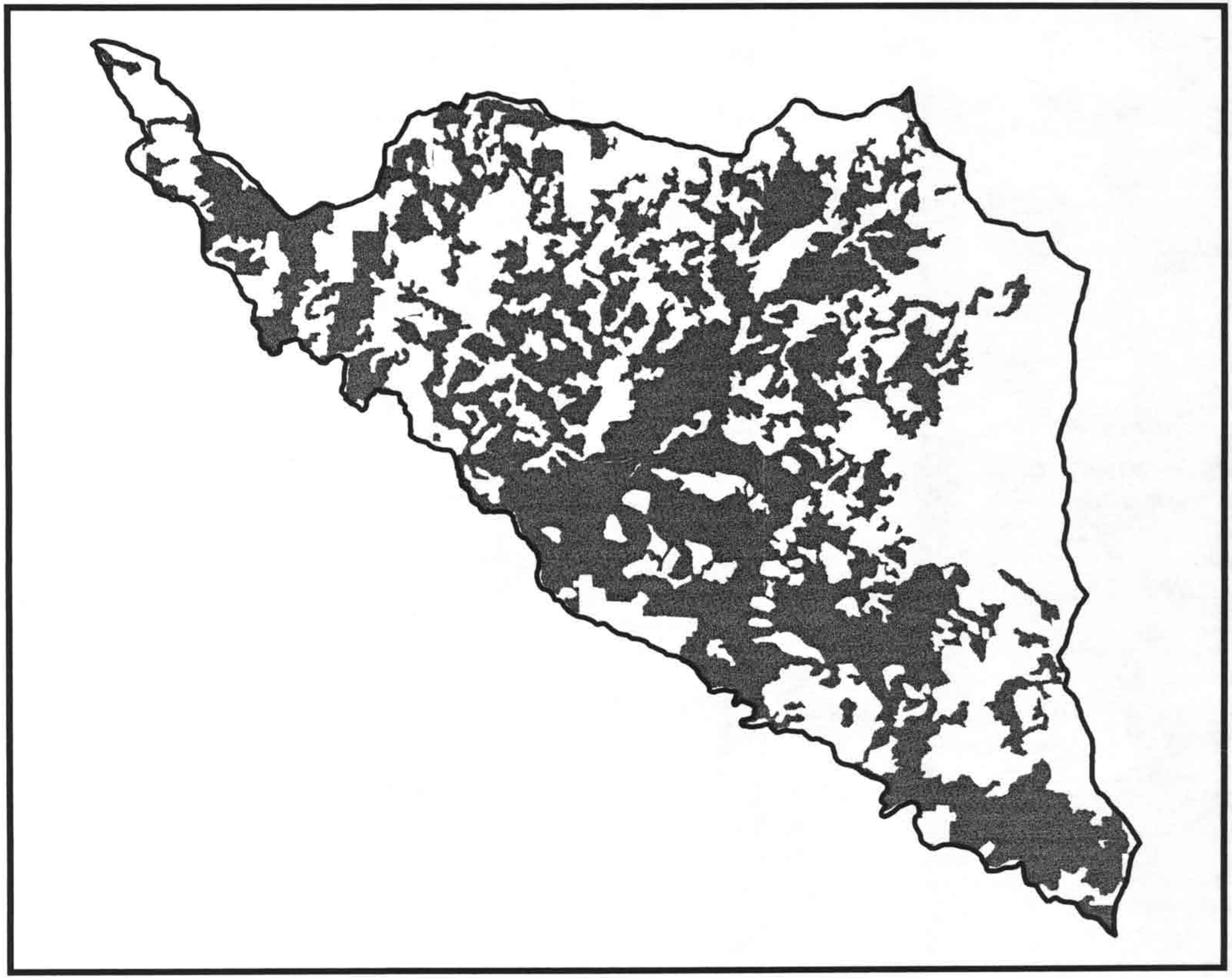
October 17, 1997

Scale: 1=67,000

0 1 2 3 Miles

0 1 2 3 4 Kilometers

East Fork & Smoky Creek
Watershed Analysis



Appendix E, Map 14b

Smoky Creek
Dispersal Habitat

- Dispersal Habitat
- Watershed Boundary

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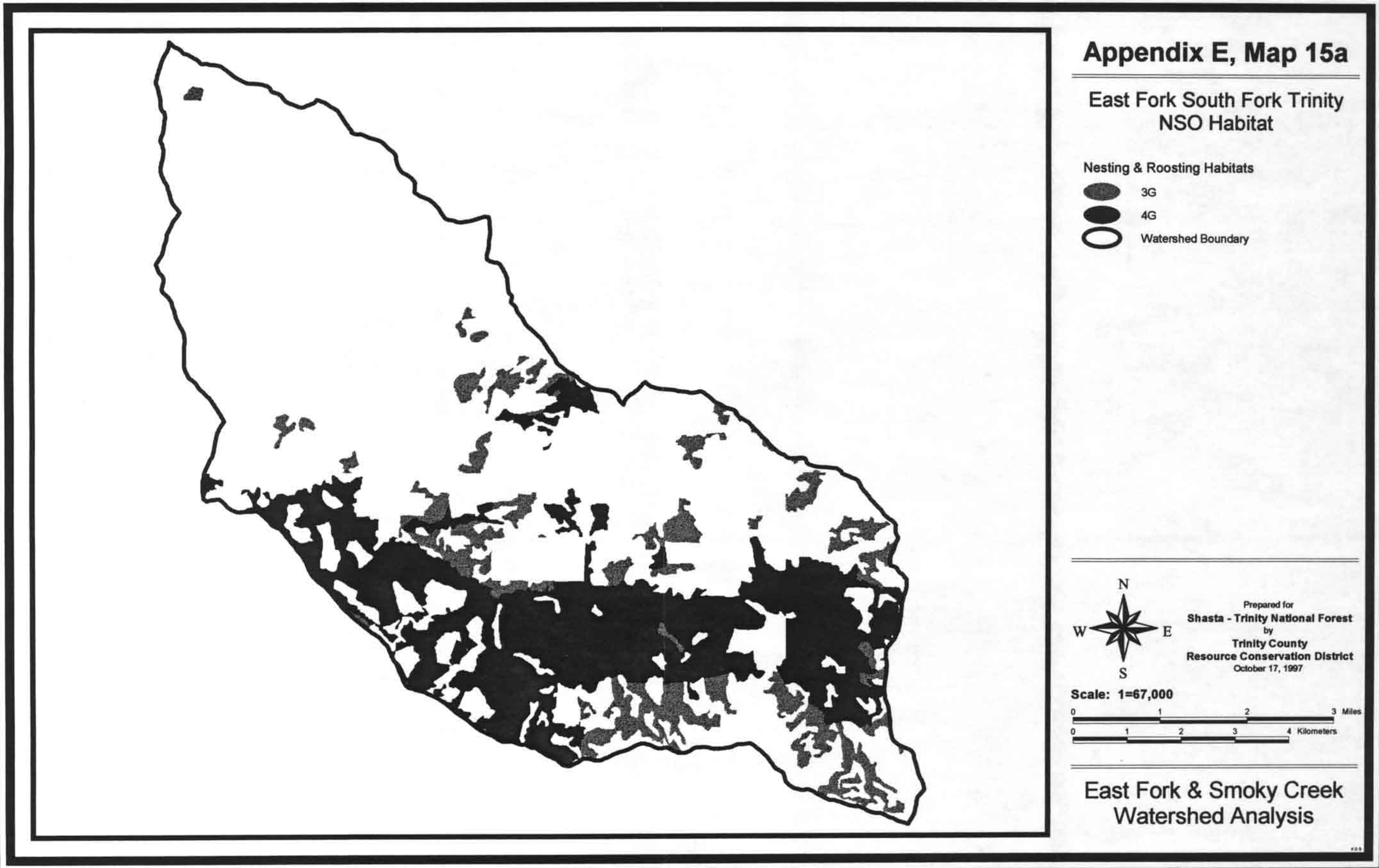
October 17, 1997

Scale: 1=67,000

0 1 2 3 Miles

0 1 2 3 4 Kilometers

East Fork & Smoky Creek
Watershed Analysis



Appendix E, Map 15a
East Fork South Fork Trinity
NSO Habitat
Nesting & Roosting Habitats
3G
4G
Watershed Boundary
N
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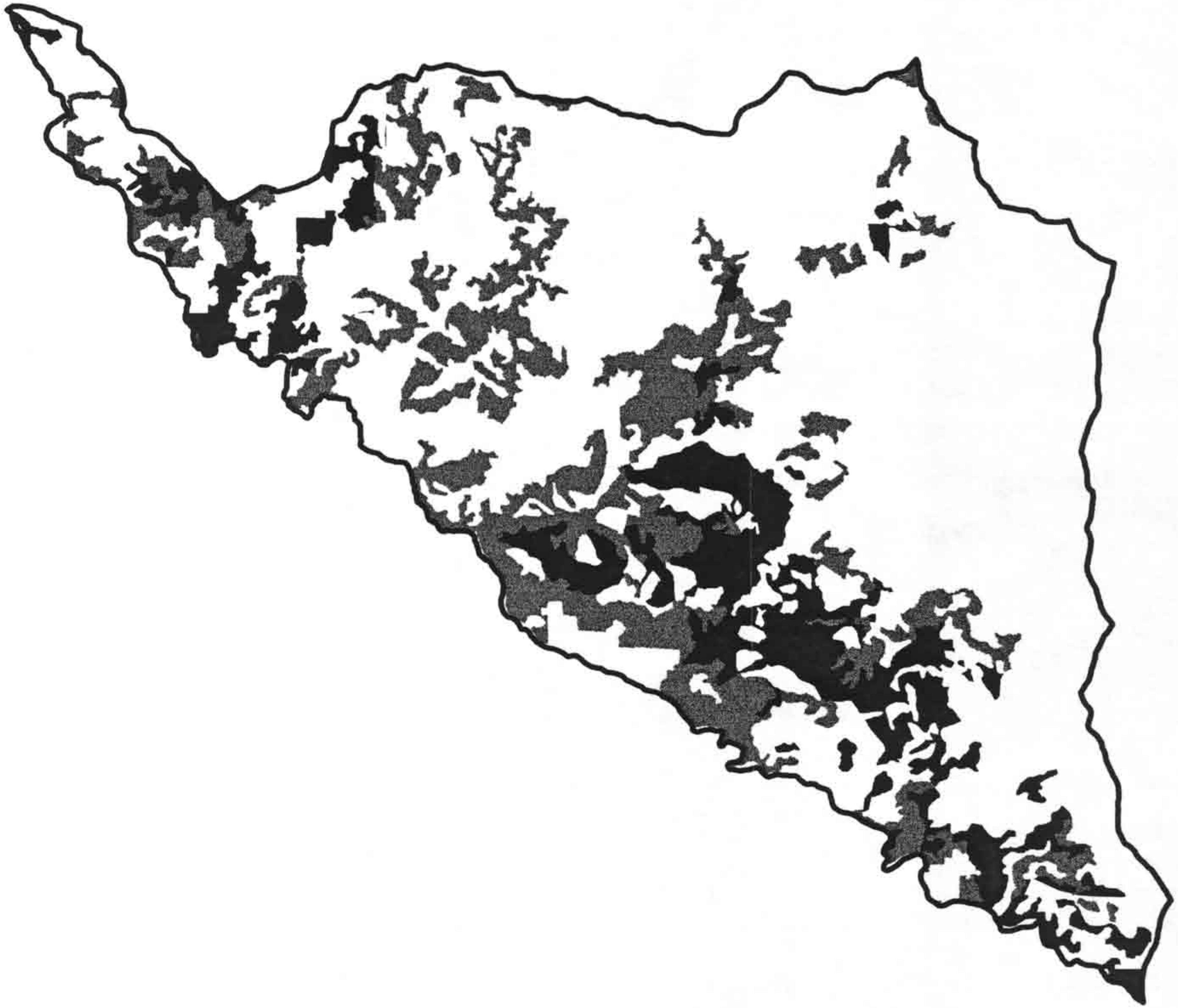
Resource Conservation District
October 17, 1997
Scale: 1=67,000
0 1 2 3 Miles
0 1 2 3 4 Kilometers
East Fork & Smoky Creek
Watershed Analysis



Appendix E, Map 15b

Smoky Creek
NSO Habitat

Nesting & Roosting Habitats

- 3G
- 4G
- Watershed Boundary

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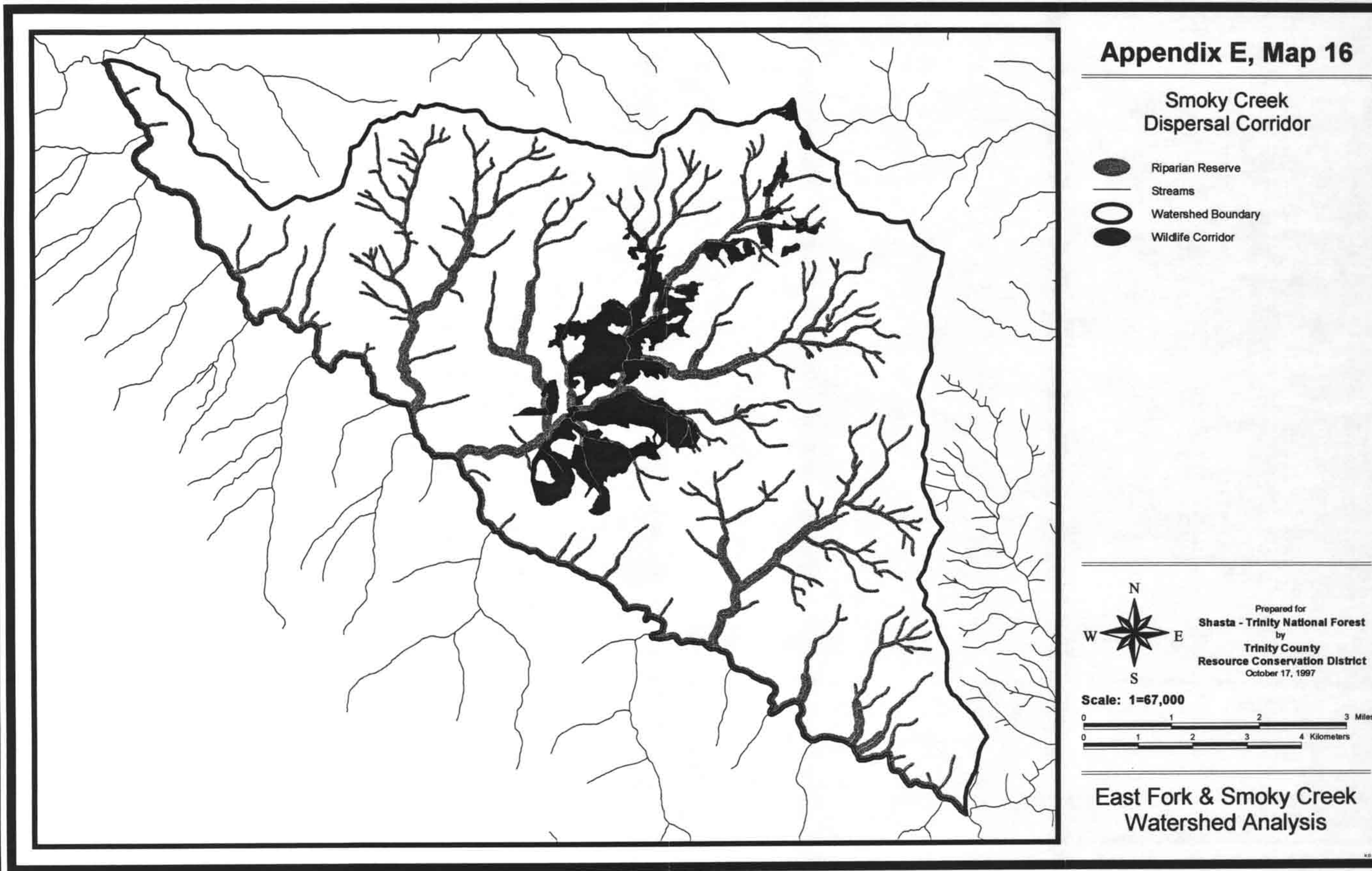
Scale: 1=67,000

0 1 2 3 Miles
0 1 2 3 4 Kilometers

East Fork & Smoky Creek
Watershed Analysis


Appendix E, Map 16
Smoky Creek
Dispersal Corridor
Riparian Reserve
Streams
Watershed Boundary
Wildlife Corridor
N
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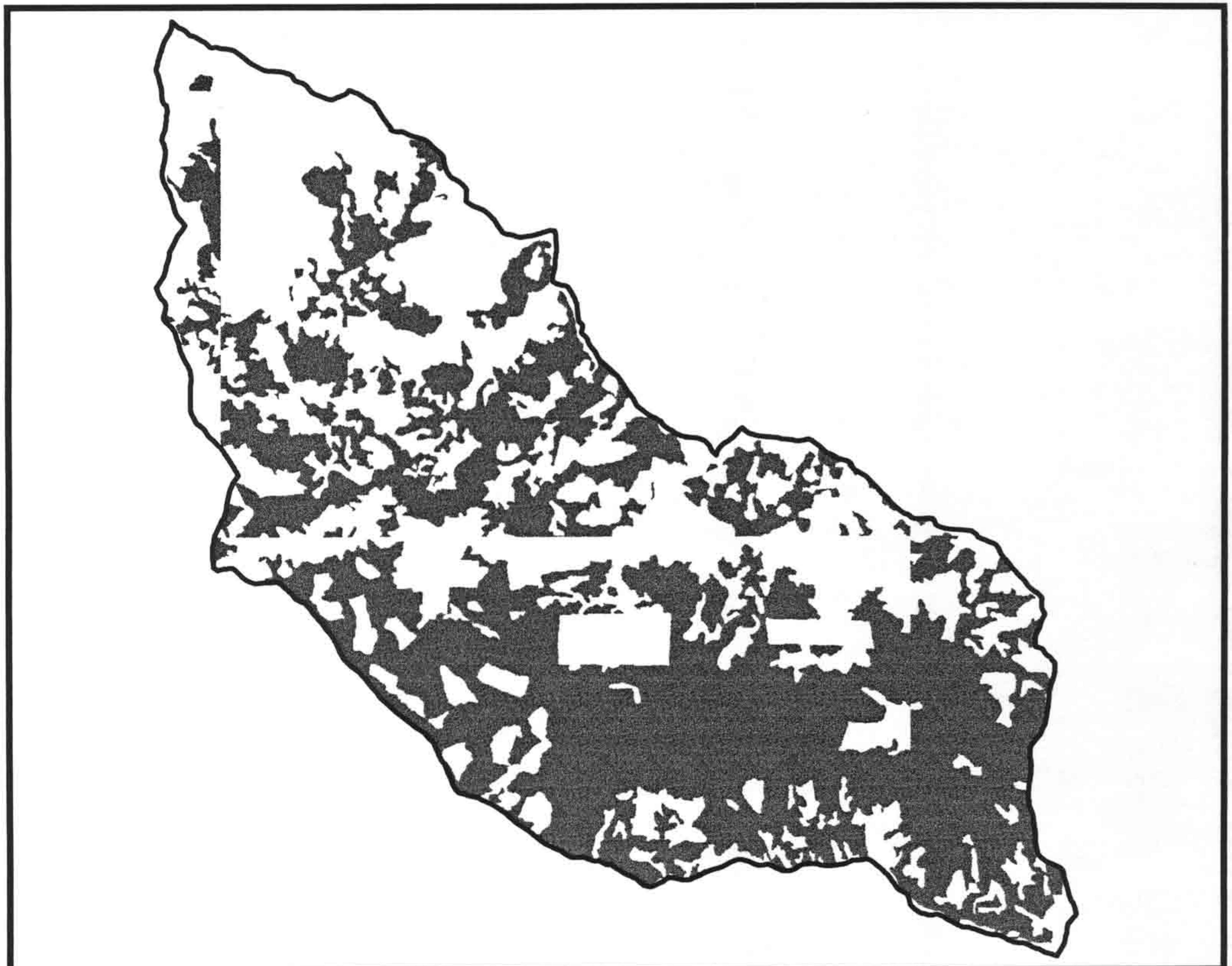
Prepared for
Shasta - Trinity National Forest
by
Trinity County
Resource Conservation District
October 17, 1997
Scale: 1=67,000
0 1 2 3 Miles
0 1 2 3 4 Kilometers
East Fork & Smoky Creek
Watershed Analysis



Appendix E, Map 17a

East Fork South Fork Trinity TE&S Habitat (3N,3G,4N,4G)

TE&S Habitat

Watershed Boundary

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Resource Conservation District
October 17, 1997

Scale: 1=67,000

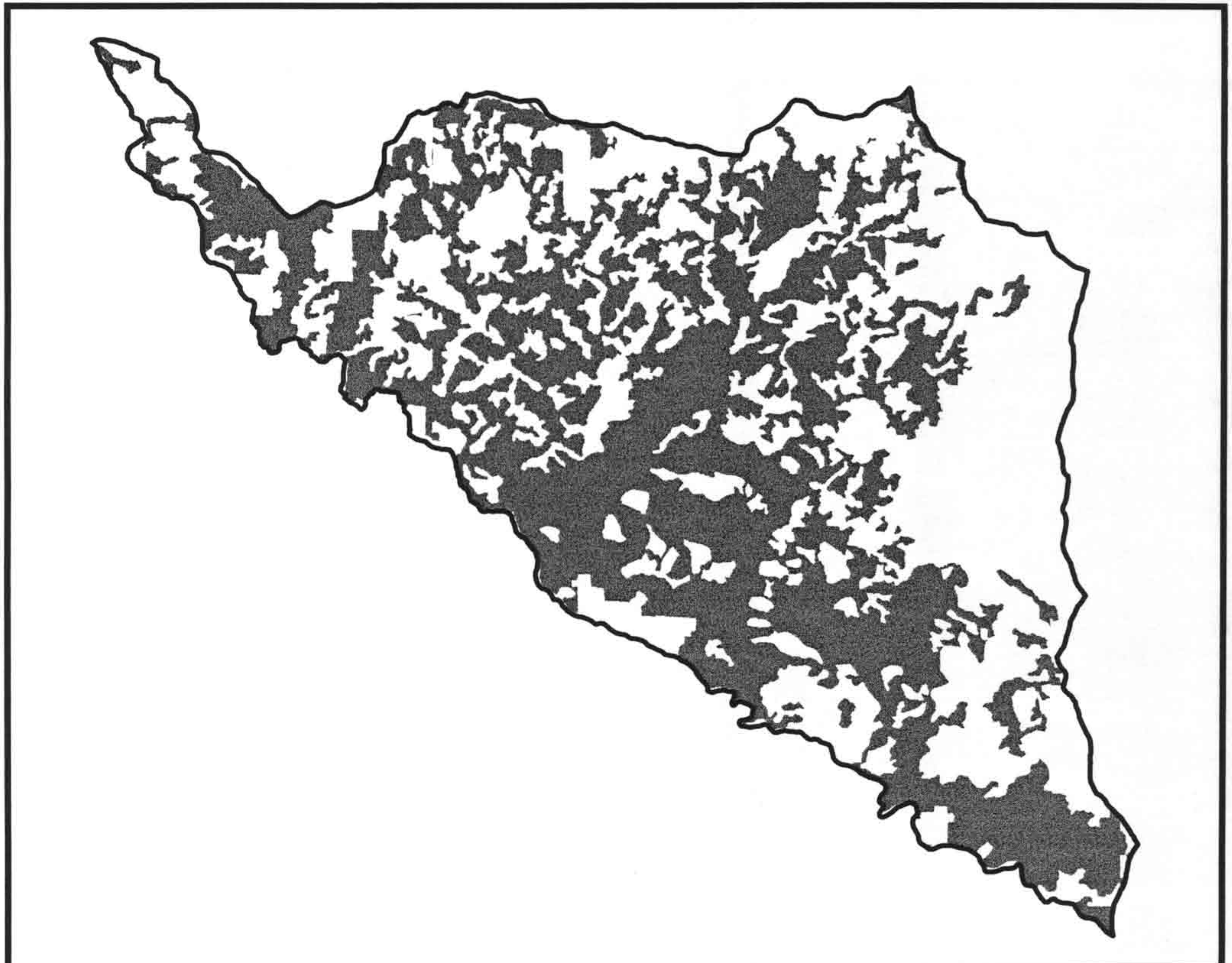
0 1 2 3 Miles

0 1 2 3 4 Kilometers

East Fork & Smoky Creek Watershed Analysis

Appendix E, Map 17b

Smoky Creek
TE&S Habitat (3N,3G,4N,4G)



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Resource Conservation District
October 17, 1997

Scale: 1=67,000

0 1 2 3 Miles
0 1 2 3 4 Kilometers

East Fork & Smoky Creek
Watershed Analysis

Appendix E, Map 18a

East Fork South Fork Trinity LS Habitat by Land Allocation

Watershed Boundary

LSH by Land Allocation

- Administratively Withdrawn Areas
- Congressionally Reserved Areas
- Late-Successional Reserves
- Matrix

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by
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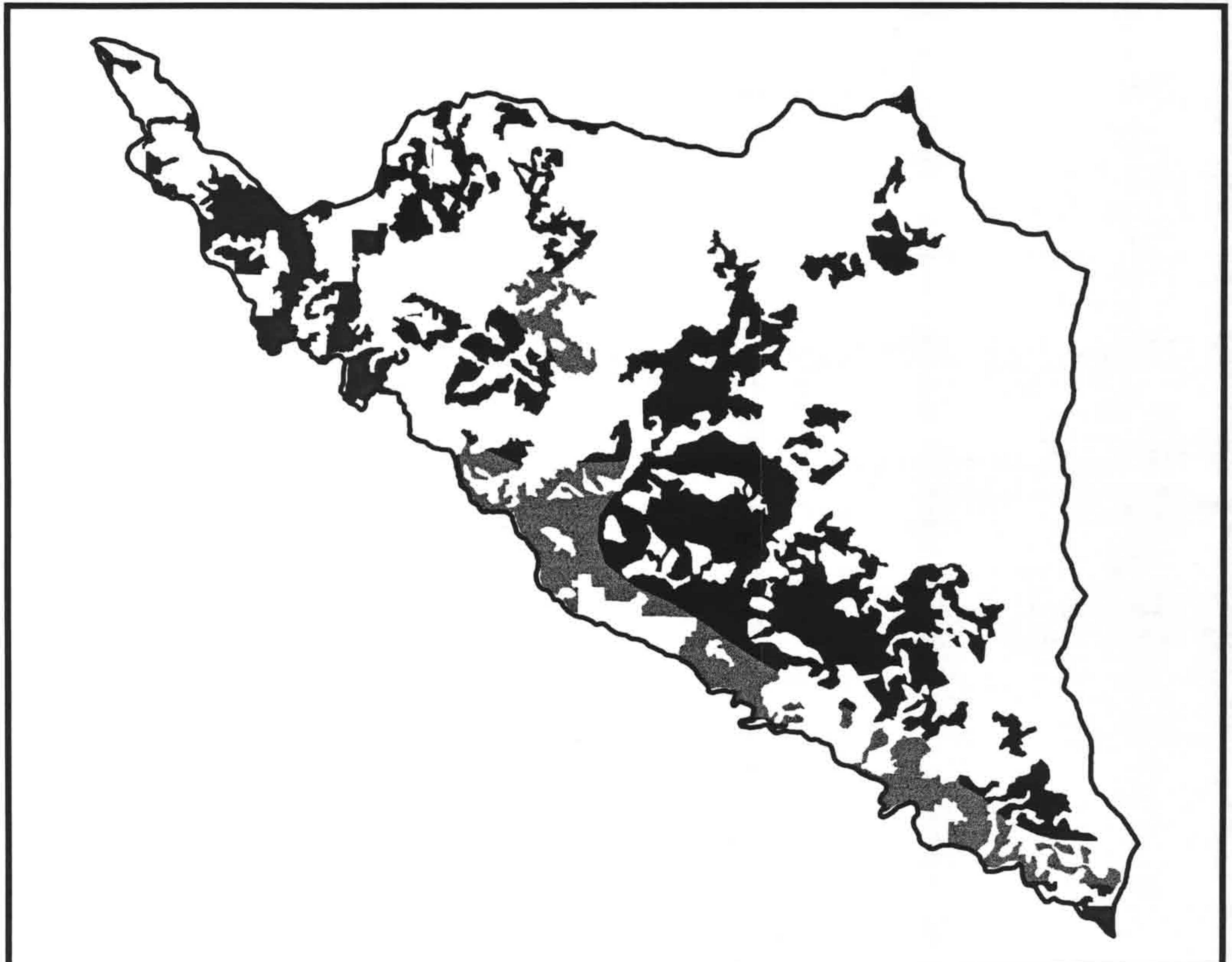
Resource Conservation District
October 17, 1997

Scale: 1=67,000

0 1 2 3 Miles

0 1 2 3 4 Kilometers

East Fork & Smoky Creek Watershed Analysis



Appendix E, Map 18b

Smoky Creek
LS Habitat by Land Allocation

Watershed Boundary

LSH by Land Allocation

Administratively Withdrawn Areas

Late-Successional Reserves

Matrix

N W E S

Prepared for
Shasta - Trinity National Forest
by
Trinity County
Resource Conservation District
October 17, 1997

Scale: 1=67,000

0 1 2 3 Miles

0 1 2 3 4 Kilometers

East Fork & Smoky Creek Watershed Analysis

Appendix F

EAST FORK/SMOKY CREEK WATERSHED ANALYSIS INITIATION LETTER

United States Department of Agriculture	Forest Service	Hayfork Ranger District P.O. Box 159 Hayfork, CA 96041	916 628-5227 TTY/TDD: 916 628-5222

File Code: 1900 DATE: February 5, 1997

SUBJECT: East Fork and Smokey Watershed Analysis Initiation Letter

TO: Watershed Analysis Team

A unique partnership has been established between the South Fork Coordinated Resource Management Plan (CRMP) and the US Forest Service in order to effectively plan and fund fisheries restoration projects within the Trinity River Basin. Together we agree to conduct a watershed analysis so that we can mix limited dollars and expertise, learn from different approaches to watershed analysis, and identify a range of opportunities which are consistent with current Forest Service direction and will promote healthy, sustainable ecosystems.

Public involvement is valuable to this process and should be designed by the team. The WA opportunities and recommendations should be completed by June 30, 1997 in order to allow sufficient field time for NEPA and project implementation. Utilizing existing information with appropriate field validation should help keep us within this timeline. We will begin by examining both East Fork and Smokey Creek watersheds. After step 2, we will need to assess whether the timelines can be met or if we will need to scale down to focus just on the East Fork Watershed.

The Forest Service will provide a Land Management advisor, fisheries biologist and transportation planner who are all familiar with the six step watershed analysis process. We will be open to listen to new ideas that may either improve effieciency or effectiveness of this process.

The East Fork South Fork (EFSF) and Smokey Creek watershed analysis areas (WAA) lie within portions of four different management areas (MA) described in the Shasta-Trinity Land and Resource Management Plan; Indian Valley/Rattlesnake Creek MA #19, South Fork Mountain MA #20, Wildwood MA #21, and Yolla-Bolly Middle Eel Wilderness MA #4. Although the two WAAs lie entirely within Key Watershed, they contain lands with a variety of management prescriptions.

The EFSF WAA is composed mainly of Late Successional Reserve (LSR) and Matrix Prescription VIII (Commercial Wood Product Emphasis) land with only the southern tip of the the WAA located within wilderness (MA #4). A small inclusion of Administratively withdrawn Area Prescription II (Limited Roaded Motorized Recreation) also lies within the EFSF WAA.

The Smokey Creek WAA is largely Matrix Prescription VIII land. The northwestern tip of the WAA in MA #19 is LSR. Two inclusions of Administratively Withdrawn Prescription X (Special Area Management) land are present in the WAA. The first of these is 952 acres in size and is located in the Silver Creek and Smokey Creek drainages (MA #19). The second of the two areas is only 51 acres in size and is located within the East Fork of Smokey Creek drainage (MA #21). Also located within the Smokey Creek WAA in both MA #19 and MA #21 is Administratively Withdrawn Prescription I (Unroaded Non-motorized Recreation) land. This land is located in a corridor that lies alongside the South Fork Trinity River.

Identifying opportunities to meet these management objectives is very important. Refer to the "Desired Future Condition" and "Supplemental Management Direction" in the Shasta Trinity Land Managment Plan (LMP) or consult the LMP advisor on your team for more information. If during the analysis you have concerns about management direction based on biological or physical information please contact Joyce Andersen.

Key management opportunities should include, but not necessarily be limited to fisheries restoration, fuels reduction, late successional forest protection and enhancement and commercial wood products. The range of opportunities should reflect what is learned through this analysis which contribute to sustainable, healthy ecosystems. This analysis should result in helping the decision-maker evaluate what is needed, where on the landscape and why this will promote responsible land stewardship.

The core team consists of Jim Spear (team leader, NRCS), Eric Johnston (fisheries biologist, USFS), Danny Hagans (geologist/hydrologist, PWA), Ken Baldwin (forestry/silviculture, private RPF), Ralph Gutierrez/Jeffrey Dunk/Sabra Steinberg (wildlife biologists, Humboldt State U.). The extended team consists of Mark Stevens (transportation planner, USFS), Kelly Sheen (GIS support, TCRCD), Randi Andersen (heritage resources, TCRCD), Christina Vervreka (botanist, TCRCD), Scott Brennan-Smith (editor/writer, TCRCD), Carol Joroski (Range, NRCS), and ~~???~~ Arlene Kallis (LMP Advisor, USFS). The Team will also involve other agencies during the watershed analysis process including USF&WS and NMFS.

JOYCE ANDERSEN
District Ranger

JIM SPEAR
District Conservationist
NRCS

Appendix G
AN INTEGRATED ECOSYSTEM MONITORING FRAMEWORK

An Integrated Ecosystem Monitoring Framework

Richard Hart 11/19/1997

COMPONENT	INDICATOR	MEASURABLES	METHODS	FREQUENCY
Physical/ Chemical	Watershed Morphology	natural landscape processes; areas that have undergone substantial geomorphic change in the previous 200 yrs.; special climatic/geomorphic features	historical and current compilation of maps, aerial and land-based photos	one time inventory
	Water Condition	flow, temp, pH, DO, N and P nutrient loading	EPA-approved equipment and methods; at selected areas; seasonal fluctuations.	first year baseline; periodic re-sampling.
	Stream Morphology	cross-sections, riparian zone	Rosgenmethod.	
	Atmospheric Inputs	light intensity, temps, moisture	Historical climatic and weather data data loggers placed at selected locations	first year baseline; periodic re-sampling.
	Soil Condition	soil type(s), moisture, compaction, displacement, erosion, puddling, heavy equipment (type/use)	SCS maps; moisture meter; penetrometer; small soil pits; and fixed-transection.	first year baseline; pre- and post stand treatment.
Biological	Habitat Viability	species occurrence & sightings; fragmentation and connectivity	Current condition baseline data compilation; field sampling. Ecotone mapping.	first year baseline; seasonal field sampling.
	Plant Assemblages and Associations	plant association series non-native plant communities plant communities at risk	Ecotone mapping of current species and patterns. Mapping of plant communities associated with soil conditions	field validation after first year baseline.
	Habitat Linkages and Fragmentation	level of heterogeneity at several scales (seral); road, trail, and homestead distribution; livestock effect on vegetation; pattern and location of habitat corridors; contiguous habitats within riparian areas	Historical and contemporary compilation of information from aerial photos to construct an ecotonemap.	approx. every ten years after first yr. baseline.
	Historical Range and Variability	historical composition, range and density of significant plant and animal assemblages; historical population; native/exotic species at unstable pop. levels; dendrochronology study; significant events.	(Same process as above for ecotone mapping.)	(Same as above.)
	Coarse Woody Material and Soil Organics	down wood quantity, quality and distribution; snag quantity, quality and distribution; litter and duff layers, thickness and composition; products of macro-invertebrates.	Measurement of CWM, litter, duff layers on a fixed-line transect.	(Same as above.) Pre- and post-treatment.
Human Dimension	Cultural Influences and Land Use	pattern and extent of human uses (prehistoric to present)	Prehistoric and historic data compilation and map generation for baseline.	One time effort unless new information is discovered.
	Human Values	types of current human uses related to forest commodities; impact of current human uses related to forest amenities	(Same as above.)	(Same as above.)
	Demographics and Economics	location and numbers of human inhabitancy (current) land use patterns and property values employment patterns and income base	(Same as above.)	(Same as above.)

MANAGING FOR FOREST ECOSYSTEM SUSTAINABILITY

An Integrated Ecosystem Monitoring Framework (backside of page) offers an approach to the discipline of forest stewardship. The object is to observe and record the landscape patterns generated and modified by the species that live and use the forest under stewardship. The tools and methods are essentially standard, yet the approach is different. This is a product of experience and collaboration, and by no means represents the final approach to forest monitoring. The following is a brief overview of its function.

Ecotone Mapping

Forest stewardship requires as complete an understanding of the biological diversity and its patterning within and adjacent the stewardship. A naturally forested landscape is a composite of shifting mosaics of irregular patches differing in composition and age, driven by the processes of disturbance, growth, and decay. The proportion of different successional stages and their spatial patterns form the platform on which the land and its watershed diversity are constructed. Disturbance events tend to renew and diversify the forested landscape, provided that they are not too severe or frequent, severing the threads of continuity that are embedded within the shifting mosaic.

A basic tool for determining what is inhabiting the forested landscape is a series of ecotone maps. Mosaic patterns, with their progress across the landscape, can be mapped by using commercial aerial photography. Start with the most recent photos and map the patterns in 20-year segments (1995, 1975, 1955, etc.). Mapping needs to extend beyond the property boundary sufficiently to identify what is transpiring on the landscape. Spatial scale and context are important when assessing and monitoring for habitat maintenance and restoration.

Mapping Basic Landscape Patterns

Inherent to forest productivity are the site's climate, biotic potential, and soil. Modification of any one of these three will affect the other two. Change a site's climate, the biota and soil will change. Change the soil condition, the climate and biota will change. The landscape patterns, as displayed in recent aerial photography, are the present expression of the interplay of the three forces. The patterns become more evident when comparing the present scenario with photos from 30 to 50 years ago. Stand management, roading, and other land use events affect the site's biotic potential, soil condition, and climate. Each of these forces are map material: by measuring soil disturbances (compaction, displacement, puddling, and erosion); measuring the duff and top soil layers for soil life activity and processing; and by identifying the plant communities (sun or shade plants) associated with the site soil conditions. The methodologies that produce this data are uncomplicated.

Mapping Biotic Patterns

Biological diversity is recorded on the maps to assess and monitor structural complexity, special habitats, redundancies, biological legacies and land use. This is accomplished by identifying areas from the aerial photos and ground experience. These areas can be traversed or transected from permanent markers placed at points of biotic transition, such as field/forest edges, roads, mature/young stand edges, etc. Fixed-line transection in conjunction with stand examination, oriented to the compass cardinal points, can be the basis for data on soil conditions, stand structure, large woody material, snags, effective ground cover, special species, sensitive areas, and more. The size, complexity, and condition of the ownership will dictate the percentage of field sampling and data collection. Key to this activity is knowing your position on the landscape, as it is important to be able to return to the same place through the history of the stewardship. This can be accomplished by compass and hip chain or by GPS.

Mapping Disturbance

The amount and distribution of community types across the landscape strongly influence the rate at which virtually all types of forest disturbances propagate and the intensities that they attain. Landscape patterns determine how successfully many species migrate in response to fire exclusion and suppression, fragmentation, land use, and climate change. Insects, pathogens, fire, and wind (all forces that are relatively innocuous and even beneficial when at certain levels) can become highly destructive in a landscape that magnifies, rather than buffers and absorbs their destructive energy. These kinds of pattern information need to be collected and referenced on the ecotone maps.

Summary

I want to reiterate that appropriate monitoring will allow us to pay enough attention to the natural flows, arrangements, and connections that make up a forested ecosystem such that we can grasp what the forest's needs are and respond to them. The actual substance of which the forest environment is made consists of patterns rather than things or individual species. The distinction between growing, shifting, and declining patterns is not arbitrary but can be arrived at objectively through the above survey work.

Richard Hart • 308 Avery St. Ashland OR 97520 • 541/488-1462 • richrok@mind.net

Appendix H

LEGEND FOR GEOLOGIC SYMBOLS ON GEOLOGY MAP (SEE APPENDIX E, MAP 3)

ppsf	**Pickett Peak Terrane, South Fork Mountain Schist:** (Early Cretaceous)-Highly metamorphosed sedimentary and volcanic rocks.
Jg	**Western Jurassic Terrane, Galice Formation:** (Late Jurassic)-Mildly metamorphosed sedimentary shales,greywack and conglomerates and volcanic rocks.
	Rattlesnake Creek Terrane
rcm	**Melange:** (middle Jurassic)-Highly sheared and dislocated mafic volcanic rocks, chert, argillite, serpentine, limestone, amphibolite and other highly altered rocks.
rcv	**Mafic Volcanic Rocks and Chert:** (Jurassic and Triassic)-Mildly metamorphosed mafic volcanic rocks, thin-bedded chert, clastic sedimentary rocks and limestone.
rcp	**Plutonic Rocks:** (Jurassic and Triassic)-Medium to coarse-grained intrusive rocks ranging from gabbro to diorite to granite, including some areas of dikes.
sp	**Serpentinite and Peridotite:** (Age uncertain)-Mainly tectonically altered harzburgite and serpentine, includes minor amounts of greenstone, chert, limestone and other highly altered rocks.
hhb	**Western Hayfork Terrane, Hayfork Bally Meta-Andesite:** (Middle Jurassic)-Mafic volcanic and volcaniclastic rocks ranging from andesite to crystal tuff to tuff breccia.