Kachess Campground Vegetation and Safety Environmental Analysis

Cle Elum Ranger District
Okanogan-Wenatchee National Forests

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File Code: 2300
Date: March 26. 2002

Dear Friend,

Enclosed is your copy of the long-awaited Kachess Campground Vegetation and Safety Environmental Assessment. The public comment period is open from now until April 30. Please let us know any thoughts or comments you may have about this document, and please let us know if you want a copy of the Decision Notice and Response to Public Comments, which we will prepare following the comment period. You will not receive a copy of that document unless we hear from you.

As you remember, the Kachess Campground is infected with high levels of root disease, and may be less safe every year as a result. Approximately 29 campsites have already been closed pending this analysis, due to safety concerns. The EA addresses six alternatives for dealing with that problem, as well as providing for long-term soil and vegetation rehabilitation.

The preferred alternative is #2, which removes the maximum number of trees, thereby opening the maximum number of sites and making the campground as safe as possible. As you will see in the EA, there are fairly major tradeoffs to each of the alternatives. I prefer alternative 2 because, in the "big picture", I believe that providing people a place to camp in an existing developed campground is preferable to them camping in an ever-expanding number of unregulated dispersed sites outside the campground. Our experience over the past several years has been that, when the campground is full, people do not simply go home. Instead they find a flat spot, which may or may not have been cleared of vegetation by previous campers, and settle in for the weekend. Many of these dispersed sites create far more impacts to soil and water than sites in a campground. This is a growing trend District-wide, and I believe it important to take whatever actions we can, including the reopening of sites under this project, to counter this situation.

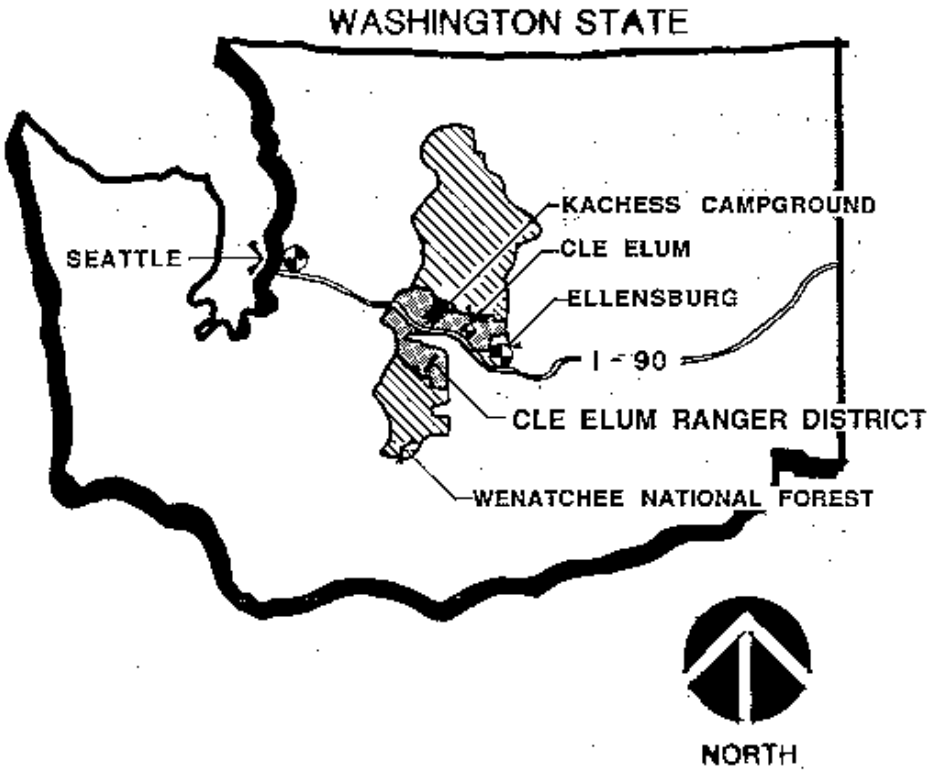
I further believe it is important that the sites we provide in a campground be reasonably safe. Given the information provided by Forest Service pathologist Dr. Paul Hessburg – the best knowledge we have at this time – removing this number of trees is the only way to accomplish this. The EA also includes provisions for revegetation and soil restoration to make the campground healthy and safe in the long term.

If you wish to comment, or if you simply want to stay on the mailing list, please let us hear from you by April 30.

Sincerely,

/s/ Catherine Stephenson

CATHERINE STEPHENSON
District Ranger



REGIONAL CONTEXT
FIGURE 1

KACHESS CAMPGROUND VEGETATION AND SAFETY ENVIRONMENTAL ANALYSIS

CHAPTER I - INTRODUCTION

Kachess Campground is located on the Cle Elum Ranger District, Wenatchee National Forest, on the shore of Lake Kachess in section 32, T.22N., R.13E., W.M. It is one of the largest Forest Service campgrounds in the Pacific Northwest, consisting of 150 campsites, twenty-nine of which are currently closed, plus two day-use areas and two boat launching ramps. It is extremely popular, generally filling up by noon Friday on a summer weekend. Including day-users, an estimated 2000 people per weekend use the campground. It is located in a mixed-age forest consisting primarily of Douglas-fir, Pacific silver fir, and western hemlock, with smatterings of numerous other species (see section III-D, Vegetation, for details).

A. PROPOSED ACTION

The proposed action is to mitigate the safety hazard at Kachess campground, while preserving, to the extent possible, the campground setting, old-growth habitat, and riparian habitat, as well as meeting existing land and resource plans.

B. PURPOSE OF AND NEED FOR ACTION

The purpose of this action is to make Kachess Campground safe, in both the short term and long term, and to develop a healthy stand of vegetation that will meet the long-term management objectives of the campground. This is driven by the underlying need to comply with laws, regulations, and Forest Plan standards which call for providing a variety of recreation experiences within the National Forest.

C. HISTORY OF THIS ANALYSIS

- **1992:** Forest Service conducts a facility assessment in Kachess Campground for the purpose of applying for money to upgrade and reconstruct some of the facilities (toilets, water system, etc.) During the assessment process, we begin to realize that the overall health of the trees in Kachess has been steadily declining, despite decades of hazard tree removals, and at least one sanitation-type timber sale.
- **June 1993**: At the District's request, Forest Service pathologist Paul Hessburg evaluates the trees in the campground. He determines that a large portion is infected with at least four different species of root and stem diseases (see full letter in Appendix B)
- **Summer 1993**: Forest Service completes a tree-by-tree mapping of the campground and determines the full extent of the diseases (see section III-D - vegetation).
- **November 1993**: This analysis is started to determine how to manage the campground vegetation in light of this disease information. We held public

meetings, conducted informational mailings, and put articles in several papers. Approximately 140 public comment letters were received. (Chapter IV)

- **Autumn 1994**: U.S. Fish and Wildlife Service expresses concern over the fact that a plan has not yet been developed for management of the Snoqualmie Pass Adaptive Management Area. (The Northwest Forest Plan specified that this AMA plan must precede most activities).
- **December 1994:** Due to this expressed concern, we put this vegetation analysis on hold.
- **December 1998:** With the AMA plan, as well as watershed analysis now complete, this analysis is re-started. We begin to update the Kachess Campground analysis to reflect all new direction developed over the last four years.
- **February 1999**: In this process, we discover that the only known sighting of a survey-and-manage fungus *Acanthophysium farlowii* in the Pacific Northwest is in Kachess Campground.
- **Summer and Fall 1999**: We make repeated attempts to find this fungus with various experts in the field, but without success.
- **October 1999**: We determine that, since we cannot find the fungus, and surveying every single tree for this particular organism is highly impractical, we will need to wait until an Environmental Impact Statement for management of these survey-and-manage fungi is completed before proceeding.* The analysis goes back on hold.
- **January 2001**: This Survey-and-Manage EIS is now complete (see section III-E, Botany), and this analysis is re-activated.

*Note: this fungus was finally located in summer 2001, but its location does not affect the timeframe for completion of this document.

D. MANAGEMENT FRAMEWORK

The 1990 Land and Resource Management Plan for the Wenatchee National Forest, commonly referred to as the "Forest Plan", designates the campground itself as "RE-1, Developed Recreation", in which the objective is to "Provide developed recreation in an Urban to Semi-Primative Recreation Opportunity Spectrum". The land immediately surrounding the campground is designated as "Scenic Travel Retention". The goal here is "To retain or enhance the viewing and recreation experiences along scenic travel routes." The basis for this allocation is to meet the visual quality objective of retention, which simply means that; "human activities are not evident to the casual forest visitor."

In 1994, an amendment to Forest Plans was implemented, which is intended to guide all federal land management within the range of the Northern Spotted Owl. It is called the "Record of Decision for Amendments to Forest Service and Bureau of Land Management Planning Documents Within the Range of the Northern Spotted Owl" but is commonly referred to as the "Northwest Forest Plan". Among other things, it refined land allocations, and designated much of the western part of the Cle Elum Ranger District, including Kachess Campground as the Snoqualmie Pass Adaptive Management Area (AMA). The portions of the campground that are adjacent to Box Canyon creek, Gale

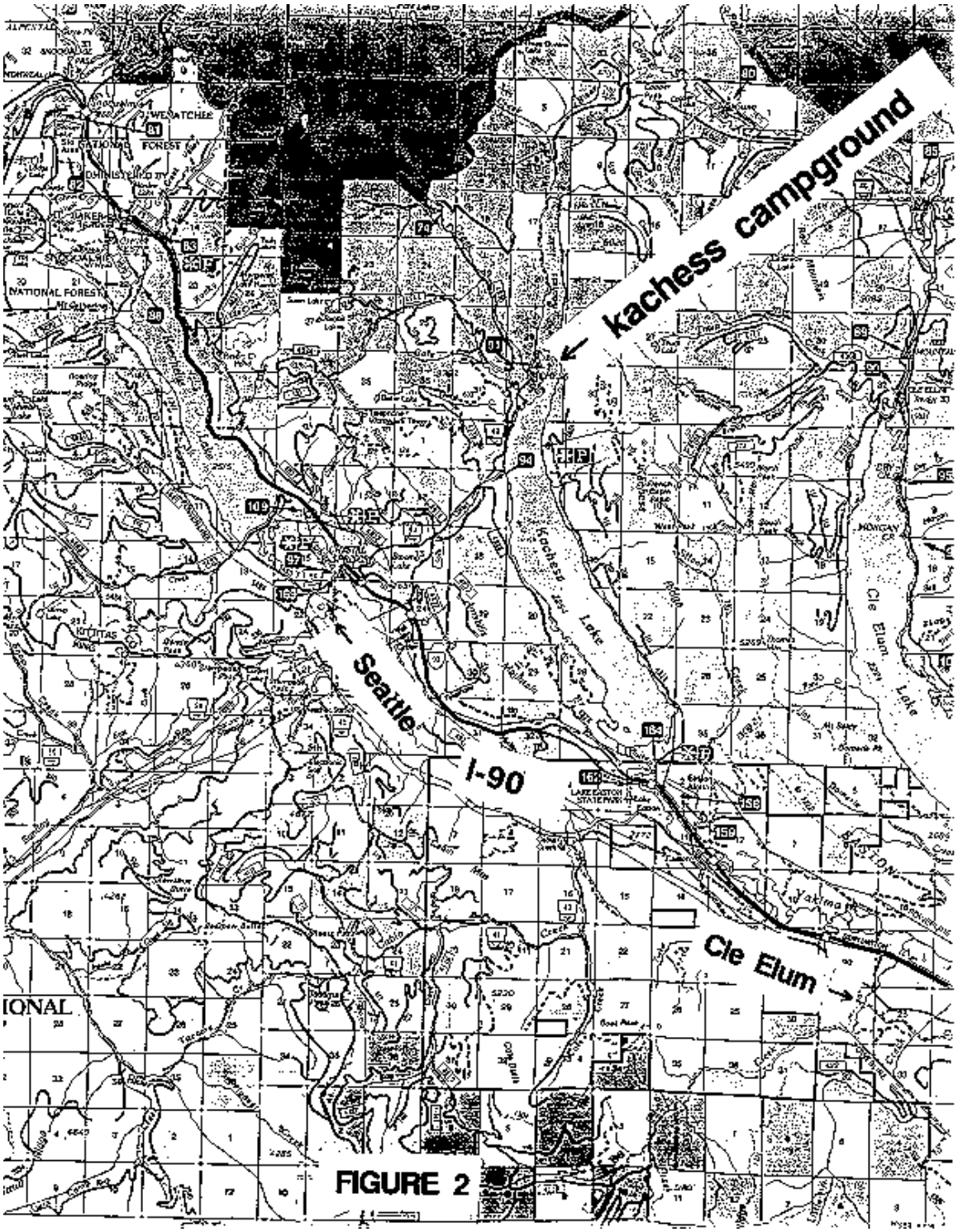

kachess campground
Seattle
I-90
Cle Elum
Kachess Lake
Cle Elum Lake
Yakima
WENATCHEE
NATIONAL FOREST
LAKE EASTON STATE PARK

FIGURE 2

Creek, and Lake Kachess are also covered under the requirements for Riparian Reserves. A plan for the management of the AMA was completed in 1997, and it serves as another amendment to the Forest Plan. Following is a brief description of the requirements for these land allocations:

1. ADAPTIVE MANAGEMENT AREA

The purpose of Adaptive Management Areas is to "encourage the development and testing of technical and social approaches to achieving desired ecological, economic, and other social objectives". The specific emphasis in the Snoqualamie Pass Adaptive Management Area is the "Development and Implementation, with the participation of the U.S. Fish and Wildlife Service, of a scientifically credible, comprehensive plan for providing late-successional forest on the checkerboard lands." The 1997 AMA plan goes on to say that "Existing uses and facilities, such as recreation resorts, developed and dispersed recreation areas, and utility corridors, are considered to be consistent with AMA objectives."

2. RIPARIAN RESERVE

A component of the Forest Plan, which affects Kachess Campground, is the Aquatic Conservation Strategy, which was developed to "restore and maintain the ecological health of watersheds and aquatic ecosystems contained within them on all public lands." The four components of this strategy are 1) Riparian Reserves, 2) Key Watersheds, 3) Watershed Analysis, and 4) Watershed Restoration. The portions of Kachess campground that lie along Gale Creek, Box Canyon Creek or Kachess reservoir are included in a Riparian Reserve. Box Canyon Creek is also a key watershed, but only a very small portion of the campground actually slopes toward Box Canyon, and that small portion is completely within the Riparian Reserve.

The standards and guidelines for riparian reserves are fairly complex. The bottom line is that any activity within a Riparian Reserve has to move toward attainment of what are called the Aquatic Conservation Strategy Objectives. These are listed in Appendix C of this document. Other applicable standards and guidelines include:

"Watershed analysis is required in Riparian Reserves prior to determining how proposed land management activities meet Aquatic Conservation Strategy Objectives".

"Remove salvage trees only when watershed analysis determines that present and future woody debris needs are met and other Aquatic Conservation Strategy Objectives are not adversely affected".

"For existing recreation facilities within Riparian Reserves, evaluate and mitigate impact to ensure that these do not prevent and, to the extent practicable contribute to, attainment of Aquatic Conservation Strategy Objectives".

"Fell trees in Riparian Reserves when they pose a safety risk. Keep felled trees on-site when needed to meet woody debris objectives".

Watershed analysis was completed for the Yakima watershed (which includes Kachess Campground) in 1996. Through on-site visits by Forest Service biologists, as well as informal discussions with U.S. Fish and Wildlife Service, we determined that bank stability is the primary concern within the riparian reserve surrounding the reservoir (refer to section III-G, Aquatic Resources). In addition, 5 campsites in the Gale Creek loop were permanently closed in 1997 following a flood event. Continued campsite use was contributing to the degradation of the riparian reserve, due to bank sloughing.

E. THE PROBLEM

Large portions of the Kachess Campground have for many years been infected by four species of root disease. Over the years, the campground has been managed with an annual hazard tree removal program. Every spring before camping season begins, trees that have become an obvious hazard since the previous year are removed. See Appendix A for specific procedures used. This approach has opened the forest canopy more and more over the years. In recent years, concern has grown that the open stand, much of which has been infected by root disease, is now more susceptible to the wind than in the past. When most of the campground was built in the 1960's, canopy closure was approximately 100%, much like the nature trail area is at present. Today, canopy closure varies from 100% to about 25%. This opening of the canopy allows more wind to penetrate below the canopy and puts the remaining trees more at risk. The opinion of Paul Hessburg, Wenatchee National Forest Pathologist, is that the campground is becoming hazardous as a result of this canopy opening coupled with existing root diseases. Refer to Hessburg's letter in Appendix B. Little quantifiable information exists on the susceptibility of stands to blowdown, other than field experience and professional judgment. Nevertheless, many professionals are concerned that the hazard is increasing as the canopy becomes more open. This document examines several different alternative methods of mitigating that hazard.

In the summer of 1993, the Forest Service conducted a root disease survey of the campground, mapping the location, species, visible condition, and diameter of every tree. In addition, all stumps were examined for evidence of root disease. Four root disease pathogens have been identified and mapped in the campground: laminated root rot (*Phellinus weirii),* annosus root disease (*Heterobasidion annosum)*, brown cubical rot (*Phaeolus schweinitizii)*, and armillaria root disease (*Armillaria ostoyae)*. A systemic dwarf mistletoe infection (*Arceuthobium tsugense)* was also found in the western hemlock at various levels of infection. Figure 4 shows the location of different species of root disease in the campground.

In 1994, 29 campsites, including the entire Thetis loop, were temporarily closed pending completion of this analysis. According to Hessburg's input, the hazard was highest in these sites, and we felt uncomfortable leaving them open for visitor use at that time.

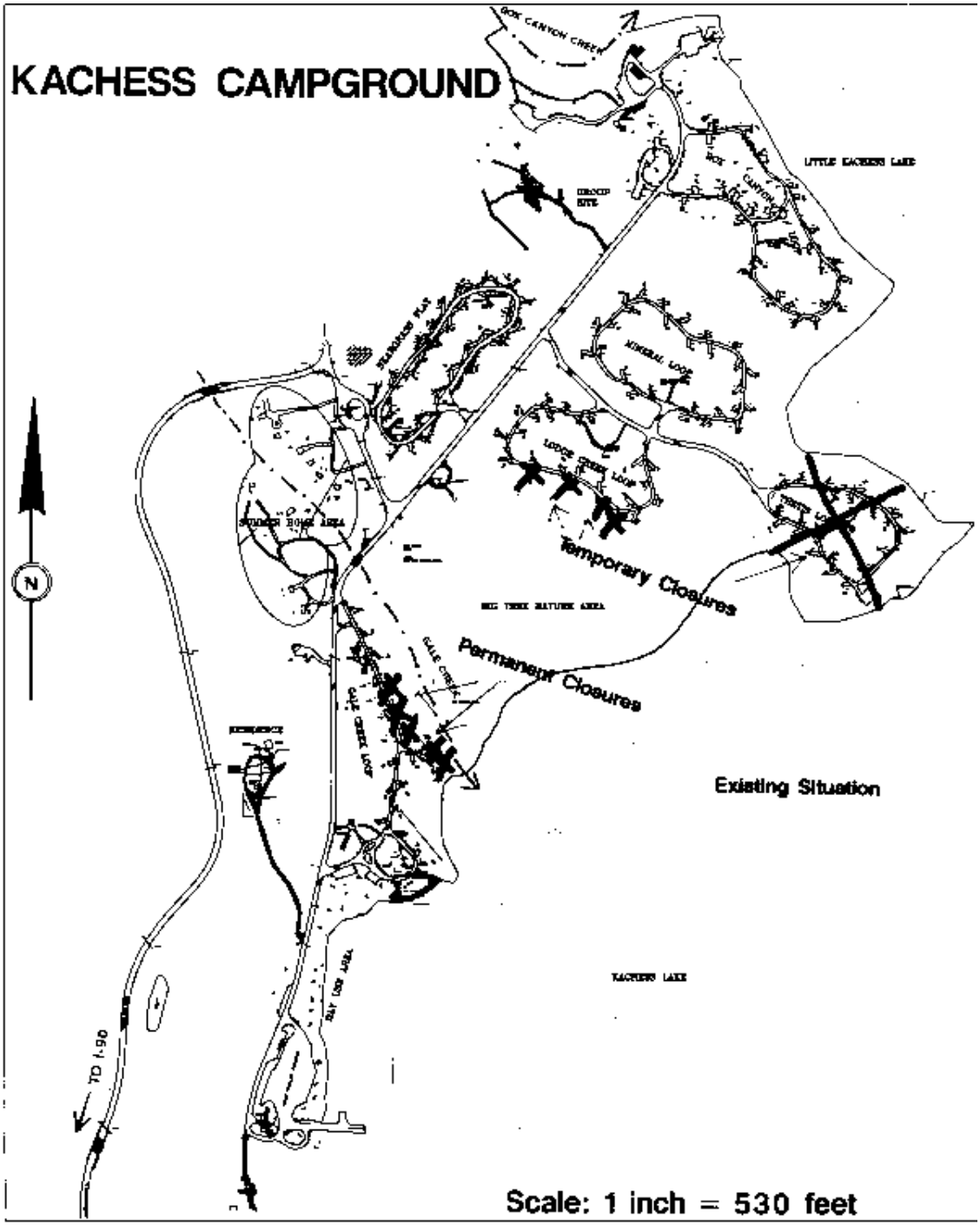

KACHESS CAMPGROUND
OAK CANYON CREEK
LITTLE KACHESS LAKE
DISCUS SITE
SEARCHER FLAT
MINERAL LOOP
LODGE CREEK LOOP
SUMMER HOME AREA
BIG TREE NATURE AREA
Temporary Closures
Permanent Closures
GALE CREEK
GALE CREEK LOOP
RESERVOIR
BAY LOOP AREA
KACHESS LAKE
TO I-90
N
Existing Situation
Scale: 1 inch = 530 feet

FIGURE 3

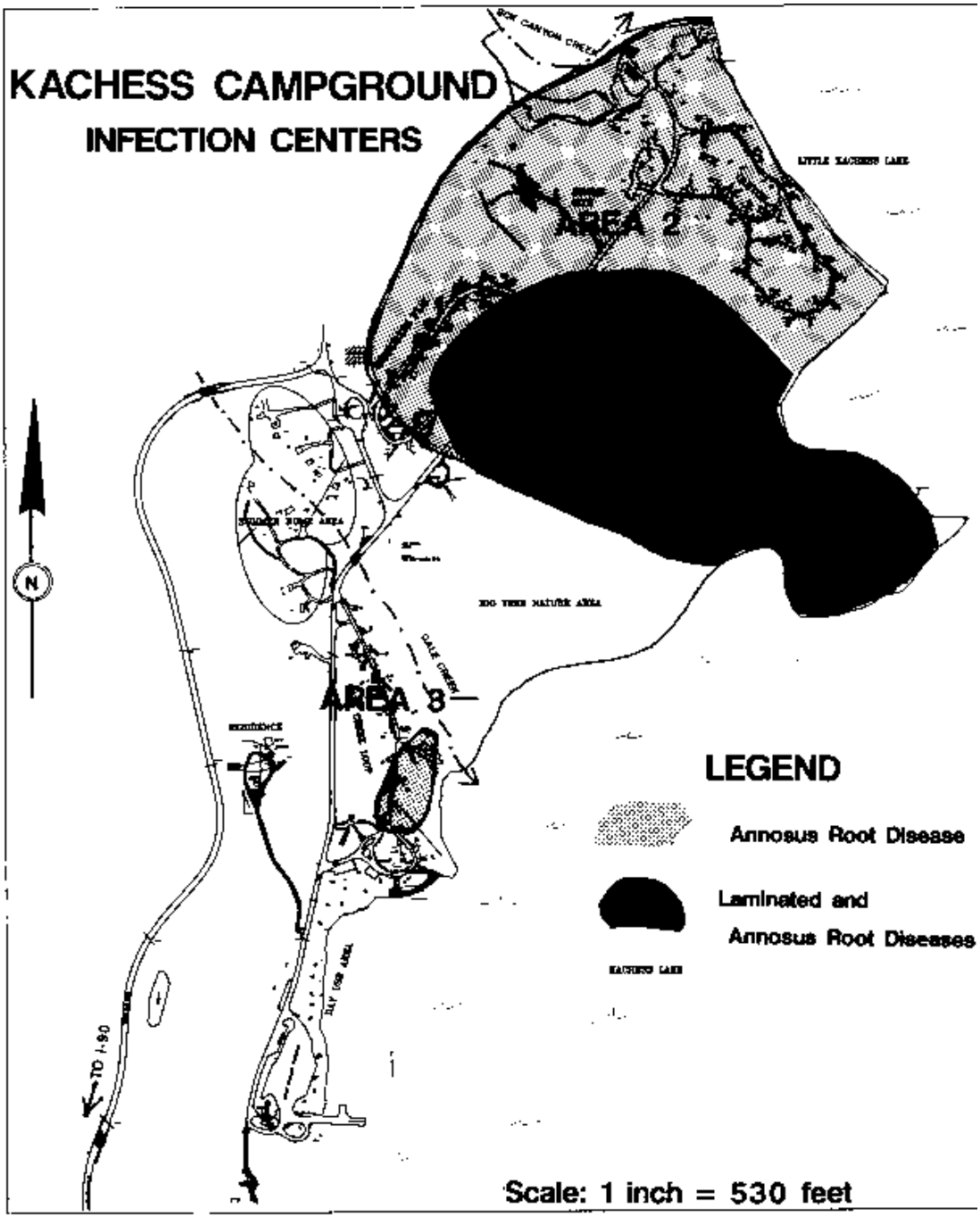

KACHESS CAMPGROUND
INFECTION CENTERS
AREA 2
AREA 3
N
LEGEND
Annosus Root Disease
Laminated and
Annosus Root Diseases
TO I-90
Scale: 1 inch = 530 feet

FIGURE 4

F. LAWS, REGULATIONS, AND ORDERS

The following list contains the laws, regulations, and Executive Orders that were considered when preparing this analysis.

- National Environmental Policy Act of 1969
- Native American Graves Protection and Repatriation Act of 1990
- Archeological Resources Protection Act of 1979
- American Indian Religious Freedom Act of 1978
- Alpine Lakes Area Management Act of 1976
- Endangered Species Act of 1973
- Clean Water act of 1972
- National Historic Preservation Act of 1966
- Executive Order 12898 (environmental Justice)
- Executive Order 11593 (cultural)
- Executive Order 11990 (wetlands)
- Executive Order 11988 (floodplains)
- Wenatchee Forest Plan as Amended

G. DECISION TO BE MADE

The decision to be made through this analysis is: what, if any, treatment needs to be done to keep the campground safe, both for the immediate future, and in the long run, as well as to begin soil and vegetation recovery to meet management objectives?

CHAPTER II - ALTERNATIVES

A. INTERDISCIPLINARY TEAM

An Interdisciplinary Team (IDT) was convened to analyze the proposed action and develop alternative actions. The objectives of this assessment are to 1) describe and document the analysis of each management alternative, 2) disclose the environmental consequences of implementation, and 3) meet the requirements of the National Environmental Policy Act (NEPA).

The IDT as identified by the District Ranger on February 3,1994 consisted of:

Tim Foss	Project Team Leader
Lin Cole	Recreation specialist
Henry Maekawa	Landscape Architect
Bryce Cotton	Contract Specialist

In addition, the following people functioned as specialists, providing input to help the interdisciplinary team with the analysis:

Russell Klatt	Fisheries Biologist
Jim Trowbridge	Silviculturist
Jo Richards	Wildlife Biologist
Debbie Curry	Information/Education Specialist
Paul Hessburg	Pathologist
Patty Garvey-Darda	Botanist
Shan Madden	Cultural Resource Specialist
Bill Ehinger	Hydrologist
Paul Flanagan	Entomologist
Tina Mayo	Fish Biologist
Jim Bannister	Cultural Resource Specialist
Mike Ames	Recreation Specialist
Viva Worthington	Botanist

B. ISSUES

The issues were developed by the team in conjunction with information obtained through the scoping process. Approximately 140 scoping letters outlining the project were sent to a wide number of interested members of the public including: nearby landowners, summer cabin permittees, people we knew who camped there a lot, environmental organizations, and all people who had expressed an interest in being informed of all projects. In addition, there were articles in six different newspapers on both sides of the mountains. We also held a public meeting to inform the public about the problem and where we were headed with this analysis.

The issues identified include:

1. SAFETY. This is the primary issue driving this analysis. As previously discussed, there is concern that the campground is becoming unsafe due to root disease and wind. Relevant questions include: How can we best protect people and campground facilities for the long term? Do we need to make changes in vegetation to keep the campground safe in the future?

2. RECREATION EXPERIENCE AND SCENIC QUALITY. Many members of the public have expressed that the old-growth "forested" feel of Kachess Campground is what makes it special. They are concerned about anything we might do to change that . Relevant questions include: How would scenic character and recreation setting be affected by any tree removal? How would that change recreation opportunities both in and out of the campground? Would it make the campground noisier? How would nearby summer home owners be affected? How would the big tree area be affected?

3. FISH, WILDLIFE, AND PLANTS. Even though it is a campground, this area provides habitat for many species of wildlife and plants. The two streams flowing through the campground provide habitat for several species of fish. Relevant questions include: How would any tree removal affect the old-growth forest? Would it affect threatened, endangered, or sensitive species including Bull Trout and Spotted Owls? How would it affect other species including cavity excavators, resident fish, lichens, fungi, and small wildlife?

4. CULTURAL RESOURCES. Humans have camped in this area for thousands of years, and some relics remain. What effect would any tree removal and ground disturbance have on these cultural resources?

5. SOIL PRODUCTIVITY. Soil in many parts of the campground has been compacted by years of heavy foot traffic. This may or may not have contributed to the spread of disease, but has definitely affected the health of all the vegetation within the campground, including the site's ability to recover from any disturbance. Relevant questions include how can we prevent further degradation, and what actions can be taken to rehabilitate existing compacted areas?

C. ALTERNATIVES CONSIDERED

The ID team identified six practical and feasible alternatives that were within the scope of this analysis and that gave consideration to the issues identified during the scoping process. These alternatives were formulated with adaptive management in mind . Learning opportunities of various kinds were incorporated into each alternative except number 1. A detailed description of the environmental effects of implementing these alternatives is given in Chapter III, Affected Environment and Environmental Consequences.

Alternatives that were eliminated from in-depth study because they were considered either not practical, not environmentally sound, or they were beyond the scope of this project will be mentioned here then eliminated from further discussion.

Following is a description of the various treatment zones referred to in the alternative descriptions and shown on the alternative maps.

“Full treatment” (pink): Cut all "at risk" trees (those trees that are a hazard now or have the probability of becoming one as identified in the "Hessburg letter" of 6/10/93 in Appendix A), which, because of size, lean, or location, are capable of hitting a campsite or other "target". This includes all Douglas-fir and grand fir larger than 12 inches in diameter in the laminated root disease pocket and armillaria pockets; all Douglas-fir outside the laminated root disease pockets that are infected with brown cubical rot that are determined to be hazardous; and all western hemlock and Pacific silver fir over 140

years old in annosus pockets. Also remove any hemlocks heavily infected with mistletoe. Refer to section III-D, Vegetation, for a discussion of the various root diseases. Figure 4 shows their locations.

"Partial treatment" (purple): Remove some, but not all, of the at-risk trees as described under the individual alternative.

No treatment (blue): No tree cutting. Routine road and trail maintenance only.

Intermediate treatment -Riparian reserve (yellow/green): Cut only obvious hazard trees, following the same guidelines as described in alternative 1 and Appendix A. Normally leave all debris from felled trees on site (it can be moved around to meet management objectives). If an event, such as a windstorm, results in an inordinate amount of woody debris on the ground, a fish biologist will determine how much of this is needed to meet aquatic conservation strategy objectives. Any debris over and above this amount may be removed if needed to meet other management objectives.

Intermediate treatment - Snag Retention areas (orange): Follow the riparian reserve prescription, but high-top all cedar trees >16 inches and all other trees >18 in dbh that need to be cut at or above 20 feet if it can be done safely. Catalog and keep a record of the location, condition, and use by wildlife of these high-topped trees. Felled tops will be left on site. The intent here is to provide "stepping stones" with decaying wood structure in the intensively managed matrix around the big tree area, enhancing connectivity. (Note: Snag retention areas have been purposely located as far from "targets" as possible so very little cutting should be needed at all.)

Intermediate treatment - Routine hazard tree treatment (white): Routine hazard tree cutting as described in alternative 1 and Appendix A.

ALTERNATIVE 1. NO CHANGE. Continue current management, including traditional annual hazard tree removals. The rules for hazard tree evaluation would remain the same (see Appendix A). Existing sites that are closed would remain closed.

Full treatment acres: 0
Partial treatment acres: 0
Intermediate treatment acres: 94*
No treatment acres: 16
Approximate number of trees cut initially: 75
Approximate number of trees cut annually thereafter: 75
Total number of campsites open: 116

Total removal: about 75 trees per year.

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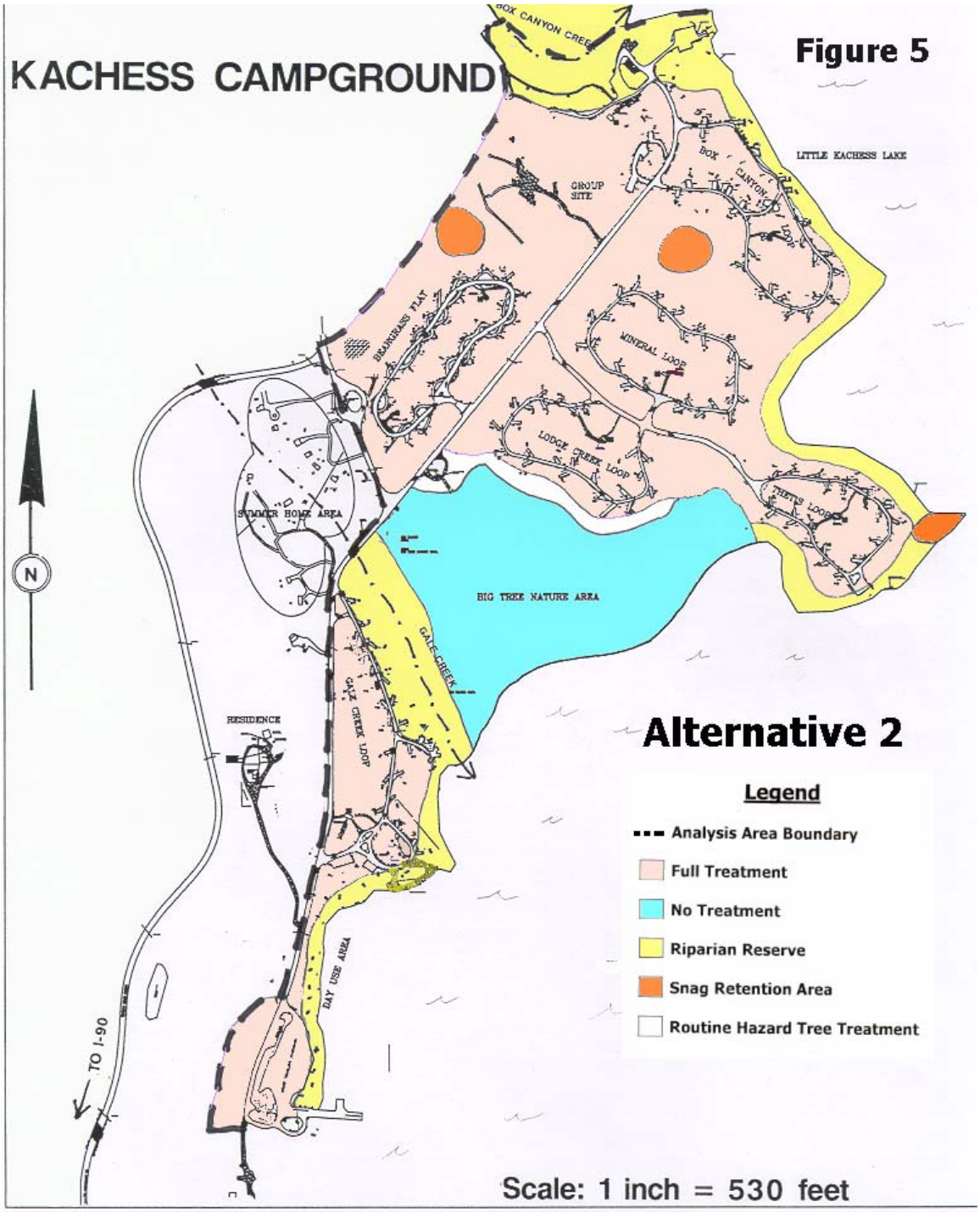
ALTERNATIVE 2. FULL TREATMENT (figure 5) The objective of this alternative is to make the campground as safe as possible, and to open as many of the temporarily-closed sites as possible. This involves cutting all "at risk" trees (those trees that are a hazard now or have the probability of becoming one as identified in the "Hessburg letter" of 6/10/93 in Appendix B) which, because of size, lean, or location, are capable of hitting a campsite or other "target". This includes all Douglas-fir and grand fir larger than 12 inches in diameter 1/ in the laminated root rot pocket and armillaria pockets; all Douglas-fir outside the laminated root rot pockets that are infected with brown cubical rot that are determined to be hazardous; and all western hemlock and Pacific silver fir over 140 years old in annosus pockets. Also, any hemlocks heavily infected with mistletoe would be removed. Open all 29 sites that are currently temporarily closed. This would entail hazard tree management in a strip along the north edge of the big tree area. This strip would be treated using the routine hazard tree prescription. In this strip, all cedar trees >16 inches and all other trees >18 in diameter that need to be cut would be high-topped at or above 20 feet if it can be done safely and if money is available to do so.

1/Note: Dr. Hessburg's letter recommended removal of all Douglas-fir and grand fir trees in this situation over 6 inches diameter. Based on field reconnaissance, we concluded there are very few trees between 6 and 12 inches diameter that would be hazardous. The IDT therefore made the decision to treat to a minimum diameter of 12 inches.

Full treatment acres: 79
Partial treatment acres: 0
Intermediate treatment acres: 18*
No treatment acres: 13
Approximate number of trees cut initially: 3000
Approximate number of trees cut annually thereafter: 2-5
Total number of campsites open: 145

**Intermediate treatment includes riparian reserves, snag retention areas, and routine treatment areas.*


KACHESS CAMPGROUND
Figure 5
BOX CANYON CREEK
LITTLE KACHESS LAKE
GROUP SITE
BOX CANYON LOOP
BEARGRASS FLAT
MINERAL LOOP
LODGE CREEK LOOP
THETA LOOP
SUMMER HOME AREA
BIG TREE NATURE AREA
GALE CREEK
GALE CREEK LOOP
RESIDENCE
DAY USE AREA
TO I-90
N
Alternative 2
Legend
Analysis Area Boundary
Full Treatment
No Treatment
Riparian Reserve
Snag Retention Area
Routine Hazard Tree Treatment
Scale: 1 inch = 530 feet

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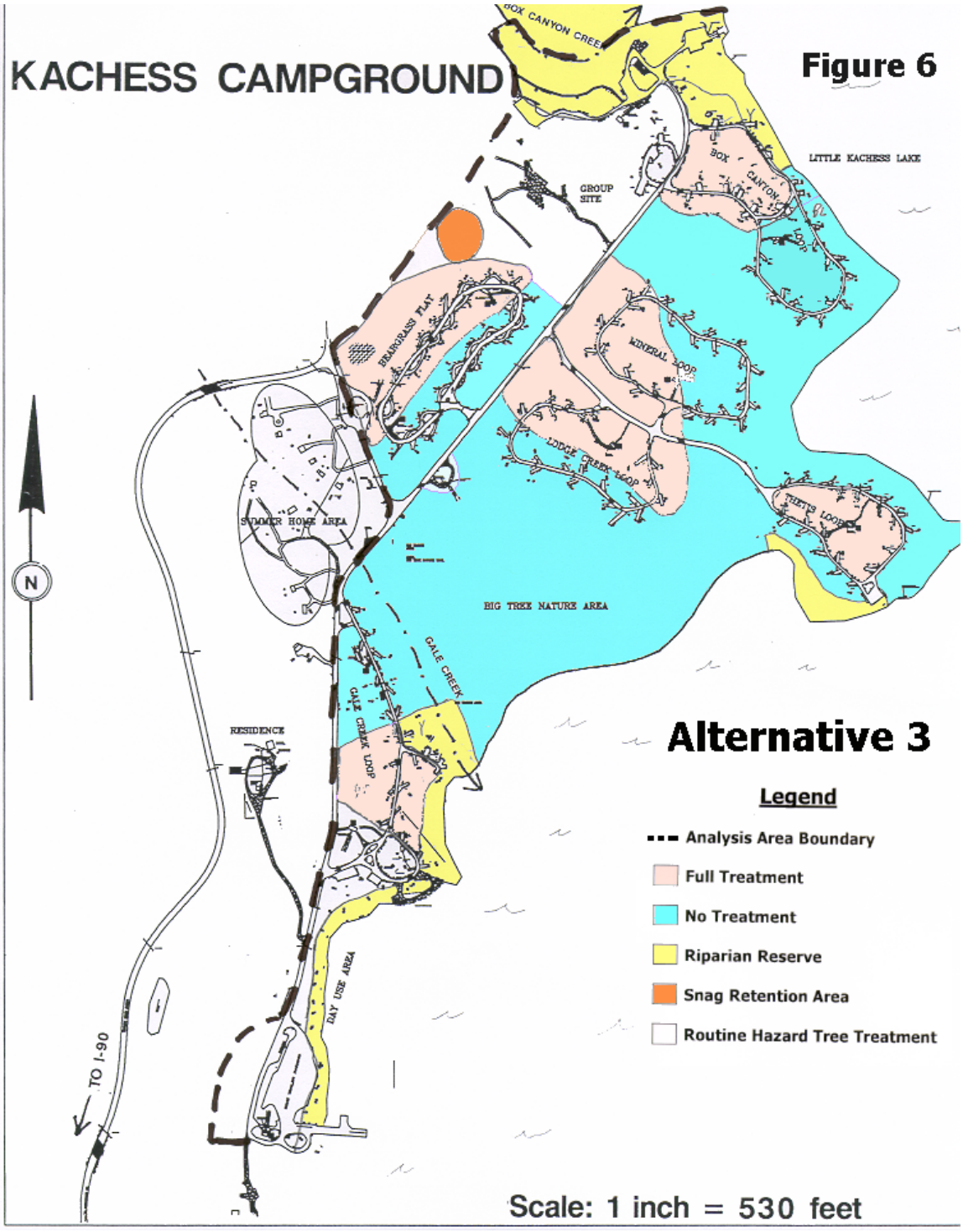
ALTERNATIVE 3. TREAT ABOUT HALF OF EACH LOOP, UTILIZING THE ABOVE PRESCRIPTION (figure 6). The objective of this alternative is to make at least part of each loop safe, but to avoid the visual shock of treating the entire campground at once, even at the expense of reducing the number of campsites. Treated portions are shown on the following map. Campsites in the untreated portions of each loop would be closed for about 20 years, at which time those portions would be treated and re-opened. The campground would then be put on a rest-rotation system. One loop would be closed for five years to allow vegetation to recover while the rest of the campground would be open for recreation. After five years, that loop would be re-opened and another one would be closed, continuing throughout the campground over the years. Individual campsites could remain closed for a longer period of time or even permanently if their vegetation recovery is taking longer than the rest of the loop or if their placement is contributing to soil degradation. Six campsites in Box Canyon Creek Loop and Thetis Loop closest to the lake shoreline, as well as existing closed sites in Lodge loop would be permanently closed (figure 6a). Those areas would be loaded with jackstrawed cull woody debris and heavily replanted with the largest trees and shrubs possible to obtain native riparian vegetation. The group site and day use areas would be managed under the "routine treatment" prescription.

Full treatment acres: 40
Partial treatment acres: 0
Intermediate treatment acres: 10*
No treatment acres: 60 (44 of these acres would be treated in 20 years)
Approximate number of trees cut initially: 1400
Approximate number of trees cut annually thereafter: 5-10
Total number of campsites open: 70 now, 117 in 20 years after second harvest is complete and rest-rotation scheme implemented.


KACHESS CAMPGROUND
Figure 6
BOX CANYON CREEK
LITTLE KACHESS LAKE
GROUP SITE
BOX CANYON LOOP
BEARGRASS FLAT
MINERAL LOOP
LODGE CREEK LOOP
THIEF'S LOOP
SUMMER HOME AREA
BIG TREE NATURE AREA
GALE CREEK
GALE CREEK LOOP
RESIDENCE
DAY USE AREA
TO I-90
N
Alternative 3
Legend
Analysis Area Boundary
Full Treatment
No Treatment
Riparian Reserve
Snag Retention Area
Routine Hazard Tree Treatment
Scale: 1 inch = 530 feet

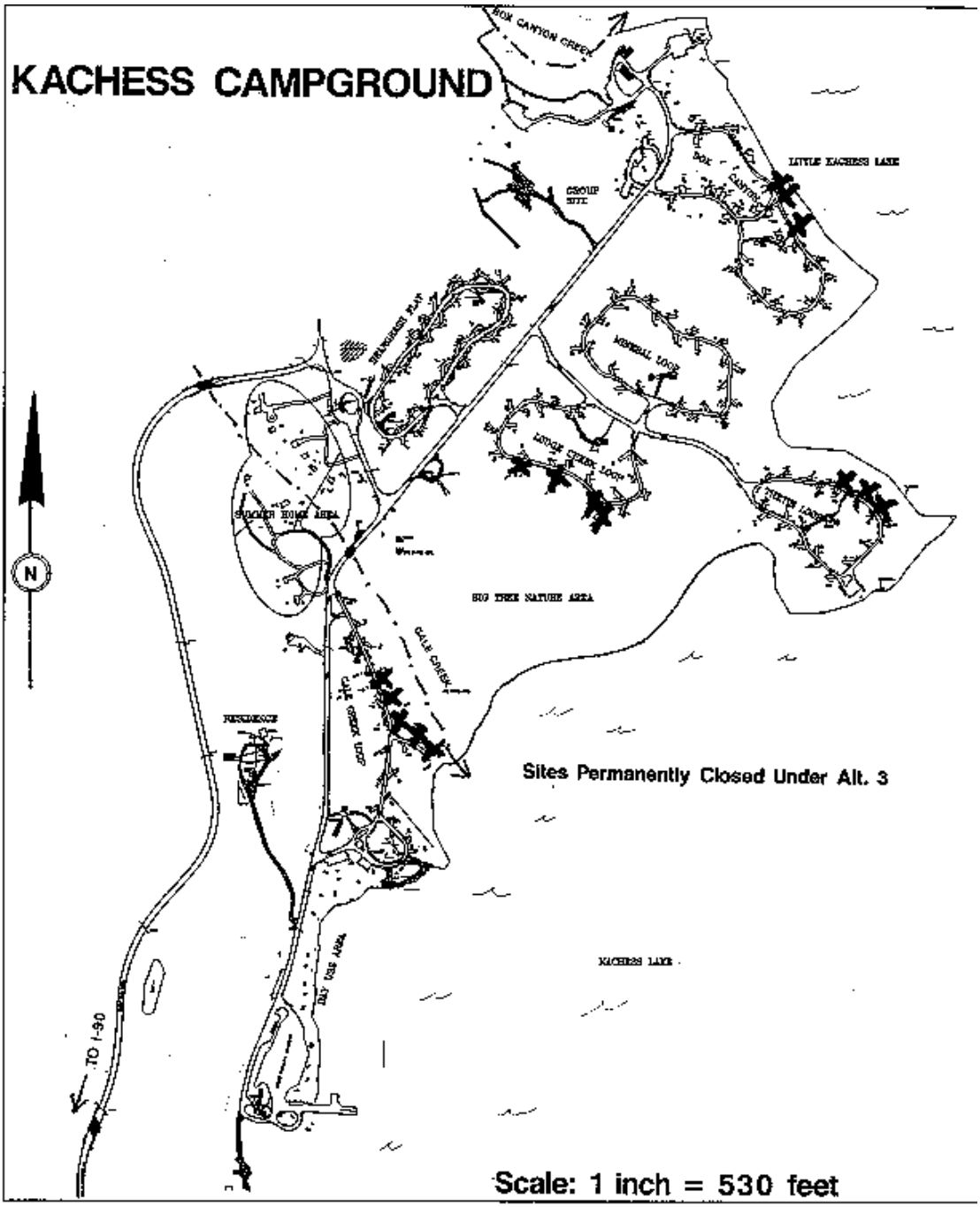

KACHESS CAMPGROUND
BOX CANYON CREEK
LITTLE KACHESS LAKE
GROUP SITE
MEADOW LOOP
LODGE GREEN LOOP
SUCKER HOME AREA
BIG TREE NATURE AREA
GALE CANYON
CAMP GREEN LOOP
RESIDENCE
DAY USE AREA
KACHESS LAKE
TO I-90
N
Sites Permanently Closed Under Alt. 3
Scale: 1 inch = 530 feet

FIGURE 6A

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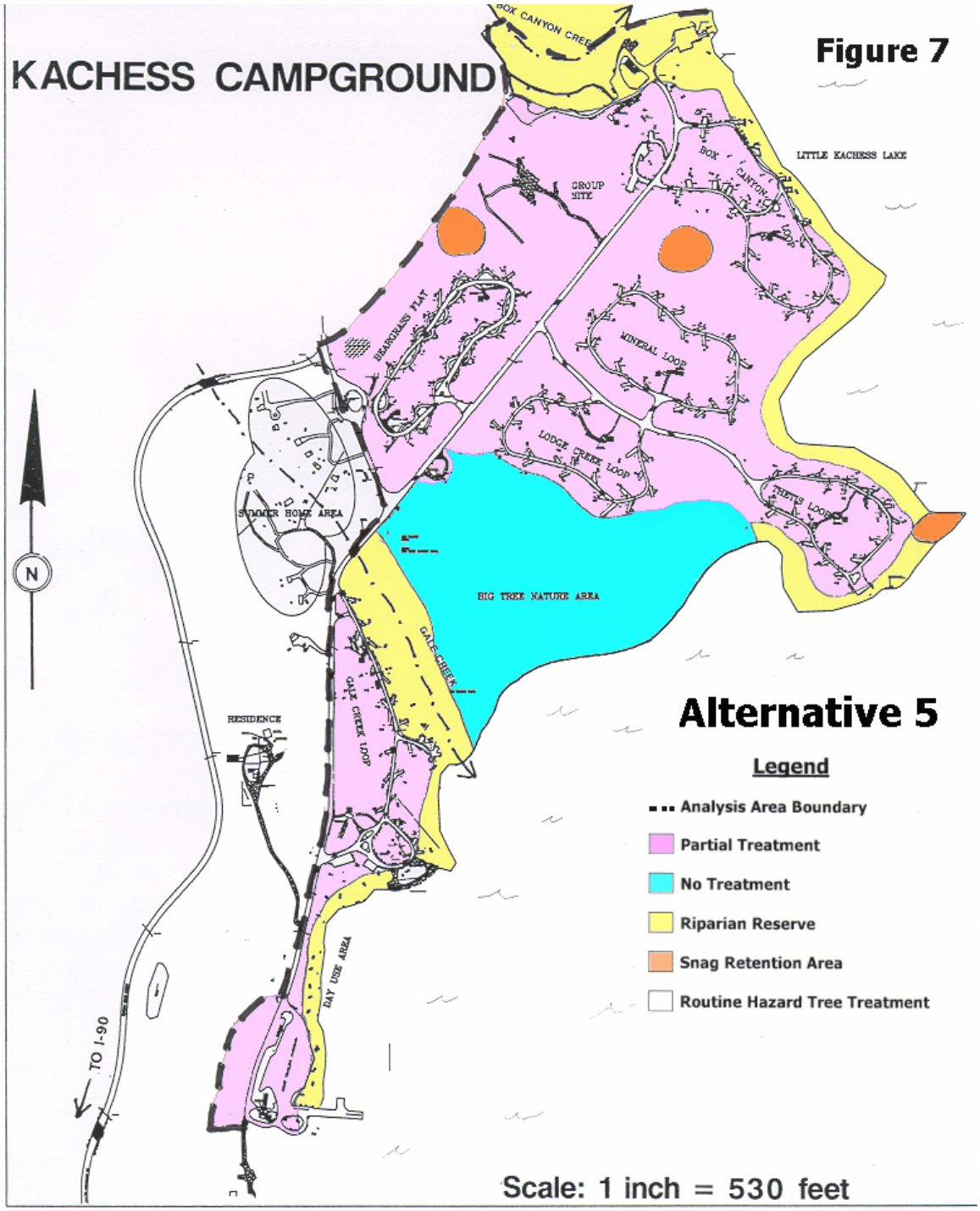
ALTERNATIVE 5. PARTIAL TREATMENT ACROSS THE CAMPGROUND (figure 7). The objective of this alternative is to reduce some of the hazard tree risk in the campground, while retaining some of the big trees for the purpose of maintaining some visual integrity. It would remove approximately 1/3 to 1/2 of the trees recommended for removal in alternative 2. These would be the trees that appear most at risk, and would include small clumps in places, generally less than an acre in size, to create openings in which shade-intolerant regeneration could get started. The public would be informed via signs that some hazard may remain in the campground. Six campsites in Box Canyon Loop and the Thetis Loop that are closest to the lake shoreline, as well as existing closed sites in Lodge loop would be permanently closed (figure 7a). Those areas would be loaded with jackstrawed cull woody debris and heavily replanted with the largest trees and shrubs possible to obtain native riparian vegetation. All other sites that are presently temporarily closed would be opened.

Full treatment acres: 0
Partial treatment acres: 75
Intermediate treatment acres: 17*
No treatment acres: 18
Approximate number of trees cut initially: 1400
Approximate number of trees cut annually thereafter: 30-40
Total number of campsites open: 135

ALTERNATIVE 6. CLOSE MOST OF CAMPGROUND, EXCEPT DAY-USE AREAS.

The objective of this alternative is to reduce risks in a developed site by simply abandoning the site. Roads would be closed and facilities removed from the closed areas. A closure order prohibiting motorized access would most likely be necessary. The area would still be available for dispersed walk-in camping, like most anywhere else on the National Forest. The day-use areas near Gale Creek and Box Canyon Creek have a much lower hazard than the rest of the campground and so could remain open. They would continue to receive routine hazard tree cutting as at present.

Full treatment acres: 0
Partial treatment acres: 0
Intermediate treatment acres: 15*
No treatment acres: 95
Approximate number of trees cut initially: 2-8
Approximate number of trees cut annually thereafter: 2-8
Total number of campsites open: 0


KACHESS CAMPGROUND
Figure 7
BOX CANYON CREEK
LITTLE KACHESS LAKE
GROUP SITE
BOX CANYON LOOP
BEARGRASS FLAT
MINERAL LOOP
LODGE CREEK LOOP
THETA LOOP
SUMMER HOME AREA
BIG TREE NATURE AREA
GALE CREEK
GALE CREEK LOOP
RESIDENCE
DAY USE AREA
TO I-90
N
Alternative 5
Legend
Analysis Area Boundary
Partial Treatment
No Treatment
Riparian Reserve
Snag Retention Area
Routine Hazard Tree Treatment
Scale: 1 inch = 530 feet

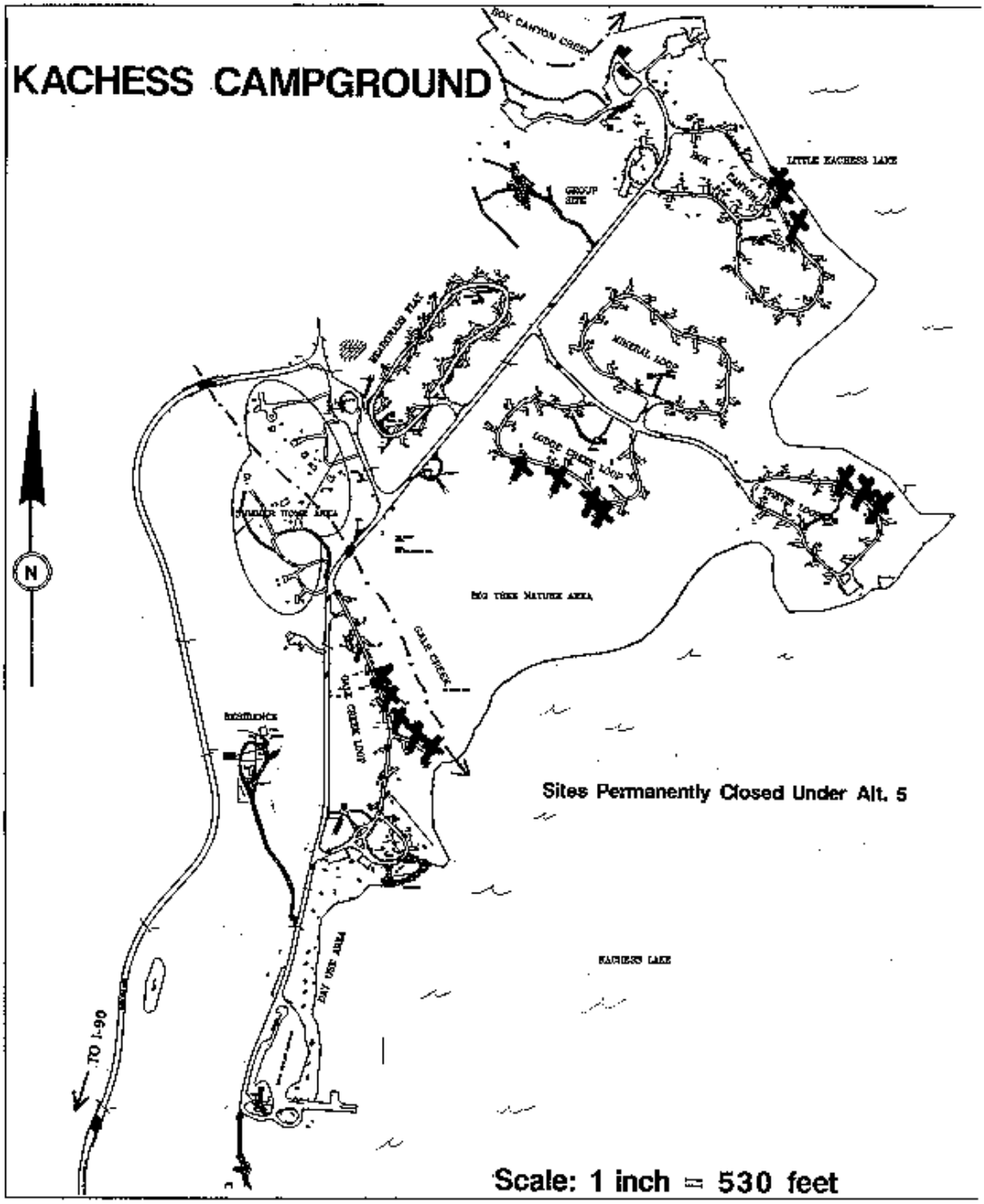

KACHESS CAMPGROUND
BOX CANYON CREEK
LITTLE KACHESS LAKE
GROUP SITE
BOX CANYON
RHODODENDRON FLAT
MINERAL LOOP
LODGE CREEK LOOP
TENT LOOP
BIG TREE NATURE AREA
GALE CREEK
GALE CREEK LOOP
INFORMATION
DAY USE AREA
KACHESS LAKE
TO I-90
N
Sites Permanently Closed Under Alt. 5
Scale: 1 inch = 530 feet

FIGURE 7A

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ALTERNATIVE 7. CLOSE SITES IN THE MOST CRITICAL AREAS; CONTINUE ANNUAL HAZARD TREE REMOVAL UNDER EXPANDED GUIDELINES IN THE REMAINDER OF THE CAMPGROUND, AND UTILIZE A REST/ROTATION SYSTEM (figure 8). This alternative is essentially a combination of alternatives 1 and 6 with a few modifications. The Thetis Loop would be permanently closed, because it is the most heavily infected loop, and would require the heaviest cutting to make it even partially safe. The presently-closed sites in the Lodge Creek loop would be permanently closed. Also, approximately half of the Gale Loop would be permanently closed, (the five presently-closed sites plus two others), the objective being to maximize rehabilitation of the riparian zone along Gale Creek. Three sites in Box Canyon loop closest to the shoreline would also be permanently closed (figure 8a). The remaining loops would be managed on a "rest-rotation" basis. One loop would be closed for five years to allow vegetation to recover while the rest of the campground would be open for recreation. After five years, that loop would be re-opened and another one would be closed, continuing throughout the campground over the years. Individual campsites could remain closed for a longer period of time or even permanently if vegetation recovery is taking longer than the rest of the loop or if the campsiste's placement is contributing to soil degradation. In the open portion of the campground, annual hazard tree evaluation and removal would continue, but would follow an "expanded" set of guidelines. This would include all trees that would be cut under current hazard tree guidelines (Appendix A), plus the oldest 10-20% of trees considered "at risk" under the Hessburg Letter (Appendix B). The older the trees are, the greater the likelihood of extensive root disease. The public would be informed via signs that some hazards may remain in the campground.

Full treatment acres: 0
Partial treatment acres: 65
Intermediate treatment acres: 10*
No treatment acres: 35
Approximate number of trees cut initially: 150-200
Approximate number of trees cut annually thereafter: 100-150
Total number of campsites open: 111

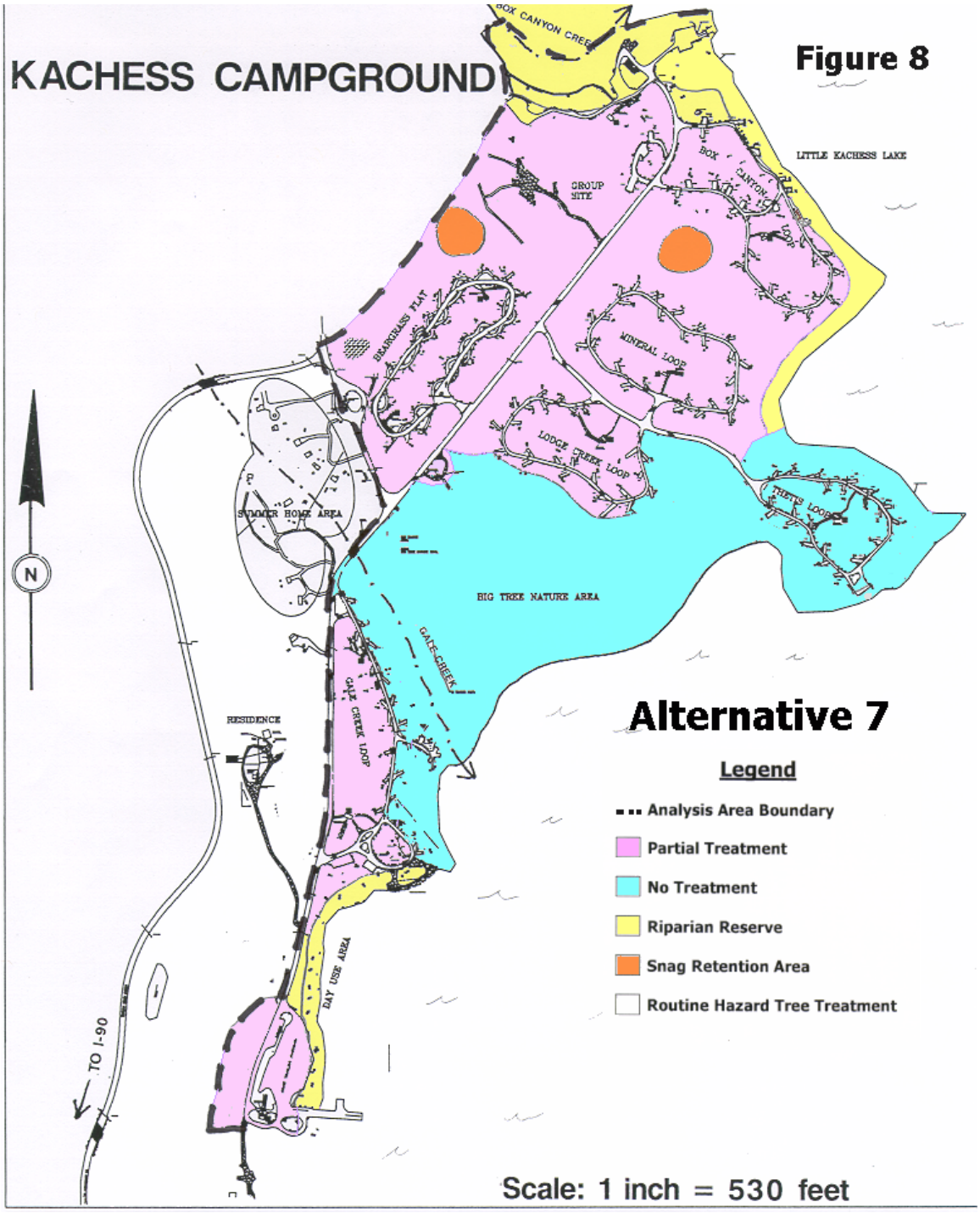
**Intermediate treatment includes riparian reserves, snag retention areas, and routine treatment areas.*

Alternatives dropped from further consideration:

a. Close and relocate campground. This would cost several million dollars, and there is a very low likelihood of getting the money to do this, nor are there any sites that would provide the same setting as Kachess.

b. "Top" hazard trees. We decided this could be a component of all alternatives on a site-specific basis.

NOTE: THERE IS NO ALTERNATIVE 4


KACHESS CAMPGROUND
Figure 8
BOX CANYON CREEK
LITTLE KACHESS LAKE
GROUP SITE
BOX CANYON LOOP
BEARGRASS FLAT
MINERAL LOOP
LODGE CREEK LOOP
THETIS LOOP
SUMMER HOME AREA
BIG TREE NATURE AREA
GALE CREEK
GALE CREEK LOOP
RESIDENCE
DAY USE AREA
TO I-90
N
Alternative 7
Legend
Analysis Area Boundary
Partial Treatment
No Treatment
Riparian Reserve
Snag Retention Area
Routine Hazard Tree Treatment
Scale: 1 inch = 530 feet

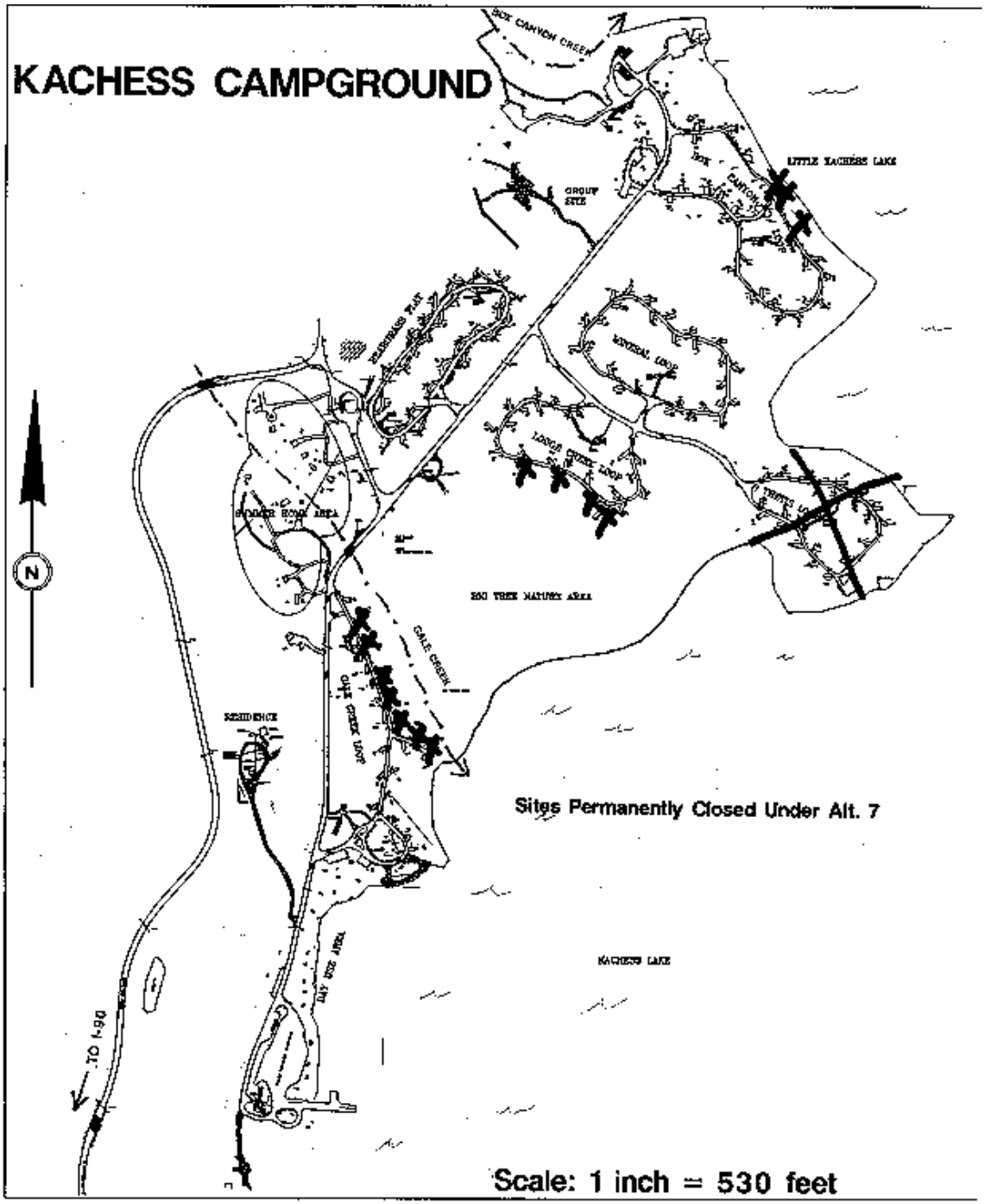

KACHESS CAMPGROUND
SIDE CANYON CREEK
LITTLE KACHESS LAKE
GROUP SITE
SIDE CANYON
MEMORIAL LOOP
LOOP CREEK LOOP
BOOMER BOOM AREA
BIG TREE NATURE AREA
GALE CREEK
GALE CREEK LOOP
RESIDENCE
Sites Permanently Closed Under Alt. 7
KACHESS LAKE
DAY USE AREA
TO I-90
N
Scale: 1 inch = 530 feet

FIGURE 8A

MEASURES COMMON TO ALTERNATIVES 2-5 AND 7.

OPERATIONAL REQUIREMENTS

Cut only those trees that, because of size, lean, or location, could fall on a campsite or use area (restroom, picnic area, playground, parking area, etc.)

Logging would be done by helicopter between September 15 (to avoid Marbled Murrelet nesting season) and the time the main road (Forest road #4900) is groomed for winter recreation (approximately December 1). The landing would be in the lakebed near the Box Canyon boat launch, and the service landing, where the helicopter is fueled and serviced, would be on an old cleared landing approximately a mile to the west, well away from any water. Any trees that fall on or next to an existing road may be picked up with a self-loading log truck. Should the value of the wood preclude a commercial timber sale, this logging would be done by a service contract.

In areas screened by shrubs and/or removed from campsites, some trees would be cut to leave high stumps (4-6' in height, >18" stump diameter, 1-2 per acre). These will be marked for retention. Their locations will be mapped for future monitoring to determine rate of decay, longevity, and use by wildlife. Stumps will be cut as low as practical in and near campsites.

All residual vegetation would be required to be protected (realistically expect 5-20% damage, depending on alternative selected). Any sapling trees that are damaged beyond recovery would be removed.

If any Threatened, Endangered, Proposed, Sensitive, or Survey and Manage plant, bryophyte, fungi, or lichen species are found at any point in time prior to or during implementation of this project, work would be halted until the District Botanist is consulted and necessary mitigation measures are enacted.

Wash all heavy equipment used in this project prior to entering the campground to minimize the introduction of noxious weeds.

SLASH TREATMENT

The objective of slash treatment is to maintain the campground setting, consistent with soil productivity requirements, minimize the danger of a wildfire, and utilize the opportunity for adaptive management.

Leave all cull logs needed for traffic management, stream/shoreline restoration, vegetation protection, and any other management needs. In addition, leave a minimum of 120 linear feet of sound logs per acre greater than 16 inches diameter and 16 feet long, according to the Northwest Forest Plan. This is to provide logs in a variety of decay classes to provide for long-term soil productivity. In the interest of adaptive

management, greater and lesser amounts may be left in some areas; the specific locations will be agreed upon by the members of the ID Team following logging. The objective is to monitor and learn about the effects of different levels of woody debris on soil productivity and campground setting. In all cases, there would be a minimum of 360 linear feet of large woody debris left every three acres. In most cases, cut limbs off the top side of these logs where visible from a campsite or other facility, but leave limbs attached to the bottom and sides to aid in foot traffic control.

Remaining slash (over and above the amounts to be left as specified above), will be dealt with as follows:

a. Any material of commercial value will be sold. This will depend on the state of the highly volatile chip market at the time.
b. Remaining slash that is sound enough and large enough (> about 6") will be bucked into firewood lengths and hauled to central locations around the campground.
c. Remaining slash will be lopped and scattered and left to decompose into the soil.
d. If it still appears there is too much slash following these operations, the remainder will be chipped and either sold commercially, or hauled out of the campground to a central area, such as a rockpit where it can be made available to other projects as needed.

Note: Items b, c, and d would be accomplished by the District fire crew, Kittitas County corrections crew, and if necessary, a service contract.

REVEGETATION AND SOIL PROTECTION

Following tree cutting and slash cleanup, the intention is to restore soil productivity, revegetate openings with disease-resistant tree and shrub species, and help manage foot traffic in the campground.

- Create an "exclosure area" in the following places:
    - 1) along the Box Canyon Creek streambank from the tree line down to the normal high water mark.
    - 2) in the riparian reserve along the shoreline of the eastern edge of the peninsula.
    - 3) along the shoreline near the Gale Creek boat launch between the parking area and the beach.
    - 4) along the Gale Creek streambank in areas where previous revegetation efforts have not taken hold.

    These exclosures can be accomplished through fencing and/or loading the site with an average of 700-800 linear feet of logs per acre, arranged in a bridge fashion (laid across one another at various angles). Either must be done in a manner to be visually pleasing and must be at least 3 feet high to be effective. Provide a few well-defined paths through the areas so people can access the large rocks or lakebed below them. Heavily replant the exclosure areas with the largest vegetation possible to obtain native riparian vegetation.

- Continue to prohibit cross-country travel of motorized vehicles in the lake drawdown zone. In conjunction with this, prohibit bicycle use though the upper vegetated area of the drawdown zone.

- Prohibit snowmobile use anywhere in the campground, except for cabin owners' access to their cabins.

- Discontinue firewood gathering in the facility to allow organic matter to accumulate and decompose thus building soil. This would also provide substrate for bryophyte, fungi and lichen species and would be in compliance with the Aquatic Conservation Strategy of maintaining and restoring species composition and structural diversity of plant communities (USDA and USDI, 1994). Selected areas may be periodically opened to firewood gathering if needed to achieve management objectives, such as cleaning up large accumulations of limbs and broken wood around a restroom or other facility.

- Apply different revegetation techniques in rehab areas to maximize density of seral shrub components, and monitor organic matter accumulations around the perimeter of the acceptable activity area. As a general guide, plant:

1. An average of nine 4-8' conifers* per campsite and disturbed area where full treatment is done.
2. An average of five 4-8' conifers* per campsite and disturbed area in partially treated areas.
3. An average of 10 shrubs and 10 small trees of varying sizes per campsite and other disturbed areas to maintain vegetation cover.
4. Appropriate grass, forbs, and other ground cover in disturbed areas where native vegetation is not present.

* Resistant species such as western white pine, western larch, lodgepole pine and western red cedar where openings are large enough to warrant. Existing western hemlock and Pacific silver fir under 140 years old can be retained and managed provided mistletoe is not present. Use the largest seedlings that are practical.

- Use native plants and local seed source for all vegetative plantings. All planted vegetation will be protected from trampling.

- Use a tiller or bucket excavator to loosen compacted soil where necessary to achieve effective revegetation.

- A site-specific restoration/revegetation plan will be developed between recreation, soil/water, silviculture, and botany specialists following tree cutting and slash treatment. This plan will specify which treatments will be implemented in which locations in order to best serve revegetation and soil restoration objectives. It will address the measures noted above, as well as the following:

- scattering of slash
- relocation of remaining logs

- flush-cutting or grinding of stumps in visually sensitive areas. (Remove most of stumps and slash visible from campsites, trails, picnic areas, and roadways. Use a stump grinder where appropriate, otherwise cut flush with the ground surface. Retain existing stumps in advance stages of decay).

SOIL REHABILITATION (ADAPTIVE MANAGEMENT APPROACH)

- Define the acceptable "footprint" for each campsite i.e. picnic tables, fire rings, tent pads, etc. (size will average about 1600 square feet for single sites and 3600 square feet for double sites). Also plan a trail network that connects campground loops and desirable destinations, but reduce the overall density of soil disturbance. Limit foot traffic to these designated paths and "footprints" to prevent further soil compaction.

- Apply different ground disturbance prevention methods (foot traffic control devices) such as placement of logs, sticks, vegetation, signing, etc. around the perimeter of acceptable campsite footprints and outside of established trails, as described above, to reduce the area of disturbance and maintain an acceptable disturbance footprint. Physical barriers, such as logs, must be at least hip high to be effective. The objective is to establish and maintain a diverse understory plant community.

- Compare soil porosity restoration techniques using a tiller and bucket excavator, in combination with different barrier techniques to protect newly restored soils.

- Test the application of mulch materials (chipped wood from on-site) to enhance vegetation recovery and compaction reduction. These chips from chipping operations not removed from the site will be mixed into the topsoil in selected areas for the purpose of adaptive management.

- Other soil rehabilitation ideas that may come up during project implementation may be implemented by agreement of the interdisciplinary team, provided they meet all the objectives and provisions of this document. Refer to Appendix D for a full discussion of soil rehabilitation.

- Monitor progress as described in appendix E.

CAMPGROUND FACILITIES

Require protection of all improvements. (Realistically there will be a certain amount of unavoidable damage). Repair any damaged facilities to original condition.

Roads, trails, parking areas, and campsites will be raked or swept clean of debris following this project.

There are 5 sites on the north side of the Gale Creek loop that were permanently closed in 1997. These will remain permanently closed under all alternatives.

OTHER

Designate approximately 200-foot wide riparian reserves along each side of Gale Creek and Box Canyon Creek. Apply the riparian reserve prescription to these areas except where no cutting would occur anyway under the particular alternative.

Designate a 20-60 foot wide "bank protection" strip along the lakeshore. The exact width will be specified by a fisheries biologist based on individual characteristics of the particular location. Apply the riparian reserve prescription to this strip except where no cutting would occur anyway under the particular alternative.

Develop and place signs to interpret what was done in the campground and why. Also display interpretive signs in the campground and picnic areas to inform the public about the root diseases, forest health, and recreation conflicts.

Develop and implement an education program for encouraging campers to bring firewood from outside campground. (Firewood – not cut within the campground – is also available for sale by the concessionaire).

Remove the existing roads, tables and structures from camping areas to be closed in alternatives 3,6, and 7 to expedite the revegetation of these areas.

Protect the known site of the fungus, *A. farlowii* by strategically placing logs to establish an area around the clump of trees where the fungus exists. This will discourage foot traffic and follow the Conservation Plan for *A. farlowii* (appendix F). Remove any fire rings within 100 feet of the known site of *A. farlowii* so recreationists are not tempted to break off dead limbs from the trees (the substrate for this species) and use them for firewood.

Use of chainsaws and other equipment for slash treatment under this project, as well as any future hazard tree cutting will *not* be suspended in the spring even if spotted owls are found nesting in the big Tree Area or within ¼ mile of the project area and on the same side of the lake. Use of equipment during the spring is the only way the campground can be readied to open for the summer season

There will no entry for purposes of hazard tree management in the big tree area. All "fixed targets" within the big tree area (signs and benches) will be removed, to eliminate the need for hazard tree management. Routine clearing of trees that fall across the trail will continue, but will be done between September 15 and April 15 unless marbled murrelet surveys confirm they are not present.

All known heritage resource sites will be avoided and monitored during project activity. The helicopter landing site will be approved by the District Heritage Manager. Site specific reforestation and soil rehabilitation will be reviewed by the District Heritage Manager.

Monitor the campground and picnic areas yearly for the occurrence of noxious weeds and if found, treat populations, using the appropriate combination of hand and chemical methods, under the 1999 categorical exclusion for noxious weed control on designated administrative and recreation sites.

Monitor progress in achieving objectives as described in Appendix E.

CHAPTER III - AFFECTED ENVIRONMENT AND ENVIRONMENTAL CONSEQUENCES

This section describes the existing condition of the physical, biological, social and economic environment and the probable effects of the various alternatives on the proposed action area environment.

A. SAFETY

AFFECTED ENVIRONMENT

As discussed in Chapter 1, the safety concern in this campground is caused by a combination of a root-disease infected stand and a canopy becoming more and more open. The root disease centers have been mapped as shown on Figure 4. Further information is also contained in section D - "vegetation". Research has shown that only 30-50% of root-disease-infected trees are detectable by above-ground and root-collar symptoms (P. Hessburg, 1993, pers. conv.). What is not known, however, is how hazardous the "undetectable" trees are. This is probably something which can never be fully quantified, because the hazard depends on how extensive the infection is, which side of the tree contains the most heavily-infected roots, which way the tree leans, which way the next summer windstorm will blow from, etc.

Historically, most blowdown in this campground has occurred in the winter, though summer blowdown has been gradually increasing over the years. In summer 1990, five trees in the Thetis Loop blew down in a thunderstorm. Then in summer 1998, 28 trees blew down in 15 minutes on a Sunday afternoon. This included trees of all sizes throughout the campground. In both cases, fortunately, the campground was sparsely occupied and no one was hurt. Had these events occurred on a Saturday, there almost certainly would have been casualties. The concessionaire that operates the campground reports there is almost always at least one or two trees that have blown down in the summer in recent years.

ENVIRONMENTAL CONSEQUENCES

Alternative 1
In the opinion of the Forest Pathologist and others, the rate of blowdown is likely to remain constant under this alternative, or perhaps rise gradually over the years as the canopy continues to open.

Alternative 2
This alternative would make the campground as safe as it can be made, while still remaining open, according to the best information available at this time (Appendix B). All trees capable of reaching a campsite or other use area would be younger than their pathological rotation (see section D- vegetation for a definition). In the longer range, the overstory would be comprised mainly of tree species resistant to root disease. In the

"intermediate treatment" areas (riparian reserves, snag retention areas, and routine-treatment areas) the hazards would be about the same as at present.

Alternative 3
This alternative would likely increase the blowdown risk in the untreated portions of the campground. Since these would be closed, however, the hazard would be low - only people traveling through the area would be at risk. In the treated areas, the hazard would be as described under alternative 2.

Alternative 5
The hazard under this alternative would likely be at least as high as at present, and perhaps considerably higher. The remaining stand would be quite a bit more open than at present, but root disease would still be present within that stand.

Alternative 6
Blowdown would probably continue to rise in the closed portion of the campground, due to the elimination of the annual hazard tree removal program. People camped in there (it would still be open to walk-in, dispersed camping) would be at risk although one normally accepts these risks in dispersed camping areas.

Alternative 7
This alternative closes the most hazardous portion of the campground (Thetis loop). In the remainder of the campground, the blowdown hazard would probably remain about the same as at present, since the canopy would continue to open, but the most heavily infected trees would be detected and removed.

B. LEGAL SITUATION

According to the Office of General Counsel, the Forest Service's legal arm, there are two laws that affect Forest Service liability in this campground. The Washington Recreational Use Statute, a State law, protects forest landowners from lawsuits arising from recreational use of their land. The intent is to encourage landowners to keep their lands open to recreation. It does NOT apply, where a fee is charged, as in this campground. In other words, under State law, a landowner can be sued for accidents arising in a fee site.

On the other hand, under Federal law, a Federal agency can only be sued in situations where Congress has specifically permitted lawsuits by the public. The Federal Tort Claims Act is a law which allows the American people to sue the government over cases involving liability, except as excluded in the act. The Discretionary Function Exclusion is one such exception. It provides that, when an agency makes a decision which it is legally able to do, and this decision involves some hazard to the public, and the public is duly informed of this hazard, the agency cannot be sued. Not all judges interpret this the same, however, so this is not complete protection. This exclusion has been used successfully as a defense many times in the past, and the Office of General Counsel knows of no cases in which the Forest Service has lost campground liability lawsuit.

C. RECREATIONAL RESOURCES

AFFECTED ENVIRONMENT

1. ROS CLASS: Recreational Opportunity Spectrum or "ROS" is a classification system for designating what types of recreation are appropriate on what areas of the National Forest. For Kachess campground, the ROS class is "Rural", within campground limits, with a peripheral setting of "Roaded Natural". Rural is characterized by substantially modified natural environment intended to enhance specific recreation activities within the campground. The setting outside the campground, Roaded Natural, is characterized by predominantly natural environments with roads open to the public within 1/4 mile.

2. DEVELOPMENT LEVEL: This refers to the level of services that the campground provides. The level in Kachess is Level IV and higher. Specific facilities within this Level include flush toilets (10), paved roads (5 mi. internal), piped water (40 hydrants and 7 miles of buried waterline), on-site host residence, staffed entry and information station, concrete boat launch, and multiple fee stations. There are also some lower-standard structures such as vault toilets, tables, stoves, traffic control barriers, information bulletin boards, variable signing, parking areas, paved and unpaved spurs, pull throughs, and children's play area. Kachess campground is one of the largest developed campgrounds in the Forest Service Pacific Northwest Region.

3. LANDFORM: The campground is sited on about 120 acres of fairly level ground which was partially or wholly the alluvial fan distributed by two streams, Gale Creek and Box Canyon Creek, and possibly Thetis Creek on the south end of the site. The streams flow into Kachess Lake, a manmade reservoir, which was once two natural lakes with a stream connecting. The lakeshore provides about 2/3 of the boundary of the campground and is in predominantly a deposition (building-up) status with only about 20% in a scouring status (where the shoreline is wearing away). Scouring is occurring near the main boat launch, along Box Canyon Creek and on a short stretch of the north side of the Peninsula.

4. OPPORTUNITIES: Kachess Campground is located about 55 miles from the Puget Sound metropolitan area, and is easily accessed off I-90. The campground is easily accessible (approximately 1 hour) by over 4 million people. Winter provides snow and winter recreation opportunities as well. Site capacity is technically 1155 people at one time (PAOT); however, actual counts may yield crowds of 2000 or more on sunny summer weekends. On-site opportunities include:

- Six separate camping loops (Gale Cr., Beargrass, Lodge Cr., Thetis, Mineral, and Box Canyon) totaling 150 campsites. Five of these sites were permanently closed in 1997, and an additional 29 are temporarily closed. There are also 40 day-use picnic sites and a large group camping area.
- Two boat launches, one concrete surfaced and one of natural materials, offer lake access.
- Eastside climate, which offers what many consider to be ideal camping/picnicking weather.

- The Cascade Range, with scenic views and hiking/hunting experiences.
- Kachess reservoir, which yields several varieties of fresh water fish and provides for many popular water sports such as swimming, boating, water skiing, and jet skiing.
- The campground itself, which offers a managed environment where families can experience a forest outing, yet take advantage of the amenities.

5. EXPERIENCE: The old-growth setting of this campground gives a real "woodsy" feel to the visitor to the area. Many openings allow the sun in and yet shade can be found at nearly every site. Throughout the area, 10 to 15 foot conifers mixed with lower profile deciduous growth afford privacy to many sites. The older sections of the campground, Box Canyon and Gale Creek, are more open and exposed from site to site. Opening up the tree canopy in recent years has allowed more sun and breeze to the ground, which in turn has helped some undergrowth to become established, seems to have reduced the mosquito population and prevents dense concentration of campfire smoke. During the day, people throng to the beaches, trails and picnic areas in a truly urban tolerance of crowds and then at night retreat to their own campsites to be '"alone". Many of the visitors to the site return year after year and many come with friends or extended family for a social outing.

6. CHANGING LANDSCAPE: Annual hazard tree analysis and removal of the defective trees has changed the canopy of the entire campground significantly. The formula for tree removal selection has relied on visual and sounding inspection. Various conditions receive higher hazard points than others and some species (notably hemlock and true fir) would be taken with fewer visible flaws than others. Therefore, one stand may have been opened up more than another. Also, the conditions of winter have been relied on to some extent to knock over high hazard trees and this would normally occur in areas that are more susceptible to wind throw than others. The results of hazard analysis and abatement over the years are:

- Large and small openings in the canopy with reproduction in various stages of development within them.
- Numerous stumps of variable sizes exist throughout the campground.
- Numerous logs on the ground throughout the campground; some being used as traffic barriers.
- Reduction of some species in preference to more hardy and/or sunlight tolerant ones.
- Evidence of ten years of revegetation efforts in day use areas, along the roads and between camp units, including larger stock specially grown by the nursery.

7. PROPOSED RECONSTRUCTION: Kachess Campground was entered into the Capital Investment Program (CIP) in the 1980s. The intent was to upgrade the facilities and add public-requested amenities (i.e. showers, parking, etc) without actually reducing the opportunities available. Since that time, commercial power has been installed to the

campground boundary. The reconstruction feasibility study has been completed but was shelved pending the outcome of this vegetation and safety analysis. Following whatever vegetative management activities result from this EA, this feasibility study will be reconsidered. Expansion of the camping opportunities is not planned.

8. OTHER INFLUENCES: Private land across the lake from the campground has been logged in recent years. Extensive clearcuts have changed the visual background of the lake and have drawn many adverse comments from the visiting public. Further up the lake, the terrain is very steep and cliffy and provides excellent mountain goat habitat. Recurrent over-flights by Navy fighters have drawn significant comments from the public. The noise of these aircraft, which are supposed to fly at least 500 feet from ground level, is very intense in the campsites and may be experienced several times per day. The noise seems to be even greater since much of the canopy has opened up, though for some people, the view and sound of these low flyers is exciting.

Many years of drought, together with the large numbers of people, have had a definite effect on the vegetation of the Kachess area. Poor forest health has likely been exacerbated by the low average precipitation, which in turn has allowed insects and diseases to cause further decline of the vegetation. Consequently, the views up the lake and toward the surrounding mountains include a mosaic of browned over and rich green growth. The campground and surroundings have been affected by these years of poor water supply.

ENVIRONMENTAL CONSEQUENCES

EFFECTS COMMON TO ALL ALTERNATIVES:

- All treatments for hazard tree reduction and rehabilitation would, over time, heavily alter the site and setting (some more rapidly than others).

EFFECTS COMMON TO ALTERNATIVES 2-7:

- Many of the campground users would inevitably be unhappy with the changed setting. There may be considerable discontent of some campers who do not believe the need for the project and who would find “their favorite place” altered.
- Necessary rehabilitation measures to the facilities and vegetation would be costly and time consuming.
- There would be a need for an extensive information and education program with an increase in signs and posters to inform the public and also to control their activities.
- Administration of the site would become more complex for both the concessionaire and permit administrator as a result of probable changes in management practices and permit requirements.

EFFECTS COMMON TO ALTERNATIVES 2-5 AND 7:

- Altered appearance throughout the campground with a drastic change in the recreation setting for several years. Reduced presence of old growth tree trunks.
- High probability of a campground closure during a period when it is traditionally open due to the extent of treatment and mitigation work to be done. (i.e. close early in the fall to remove trees and open later in the summer after cleanup and major mitigation projects are completed. High probability of at least a partial season closure.)
- Constructed or placed foot and bicycle barriers to protect the regeneration efforts.
- The prohibition of firewood gathering (cutting is currently prohibited) would be a significant change from current management and would add to the already extensive information and education program that would be required. Enforcement would add to the management responsibilities of the campground concessionaire. Strict enforcement would likely necessitate the development of a Forest Order prohibiting the gathering of firewood in the campground.
- The public may be unhappy with a prohibition of the gathering of firewood. It may be construed by some as a requirement to buy firewood from the concessionaire.
- The creation of "exclosure areas" along the Box Canyon creek streambank, in the riparian reserve along the shoreline of the eastern edge of the peninsula, and along the shoreline near the Gale creek boat launch between the parking area and the beach may be viewed negatively by users of the site. These are very popular areas for swimming, wading, picnicking, sunbathing, and fishing. Information and education requirements would be substantial, creating additional workload for the managers of the site.
- Jackstrawing these exclosure areas with large cull woody debris and/or fencing them would be viewed by many as also negatively impacting the aesthetics of the setting.
- Jackstrawed large woody debris on streambanks and shorelines may be a safety hazard as some people would try to climb on and through it.
- The activities that people have previously enjoyed in the exclosed areas would likely take place elsewhere on streambanks and shorelines such as the peninsula or uplake necessitating additional exclosures. People want to be by the water; it is primarily what attracted them here in the first place.

Alternative 1

In general, this alternative would continue the existing situation, which is a gradual decline in the campground setting. Effects include:

- Continued heavy annual impact on the camping environment from downed trees, slash deposits, and for some, the noise and interruption of the actual falling operation, which often entails a commercial timber sale.
- Least impact on campground operation, maintenance, and special use permit.
- Gradual reduction over time in numbers of large trees as well as wildlife habitat.

- Residual hazards of unhealthy trees that do not meet the criteria for felling but may be at greater risk, especially during heavy winds.
- Continued above average costs of the annual hazard analysis and felling operation involving concessionaire and Forest Service personnel.
- Ineffective revegetation efforts due to shady patches, damage by annual falling/skidding operations, and consequential lack of natural regeneration.
- Continued opening of the canopy to wind and, therefore, wind thrown trees.
- Continued gradual lessening of the "old growth character" throughout the campground.
- Probable long-term availability of logs for traffic control and unit delineation.
- Continued gradual deterioration of the present recreation setting with a gradual noticeable change to the present recreation experience for some indefinite number of years.
- No change in current number of campsites and site capacity.
- Does not directly address the reopening of temporarily closed sites.
- Postpones making a decision to address the root disease problem.

Alternative 2

- Definitely altered appearance throughout the campground with a drastic change in the recreation setting for many years, including:
- Larger openings and more sunlight to the ground in Thetis, Lodge, Mineral, Box Canyon and Beargrass loops (small section in Gale Cr.).
- Open canopy and extended views of middle and back ground.
- Faster growth of and more dense young trees and deciduous plants.
- Reduction in diversity of forest types and therefore, of the individualized settings in the various loops.
- Probable turnover in the campground clientele with some long-time campers leaving and new ones taking their place.
- Safest environment for human habitation and facilities
- Warmer campsites with less shade on the ground for several years.
- Possible brief reduction of revenues until new population "finds" the area.
- Highest possibility of discontented campers who do not believe the need for the project and who would find "their favorite place" altered.
- Less initial privacy from site to site.
- Initial increased noise throughout the campground with the reduction in sound barriers.
- Probable increase in airflow at ground level and through the treetops.
- More appearance of an even-age stand in the Peninsula and Box Canyon loops.
- Gale Creek Loop not altered as much as the rest of the campground.
- Possible increase in blow down threat to big tree area.
- Significant reduction in the "wilderness" setting; a transition into more of a "park like" setting.
- Better views of the lake from more points for the short term, which may be considered either good or bad by the viewers.

- More obvious contrast between treated and untreated stands (i.e. big tree area).
- Substantial amount of slash and cull logs to deal with.
- The most expensive in terms of site restoration (repair to facilities and revegetation) required.
- Provides for reopening the 29 temporarily closed sites in Thetis and Lodge loops.
- Highest probability of a campground closure during a period when it is traditionally open due to the extent of treatment and mitigation work to be done. (i.e. close in early fall to remove trees and open later in the summer after cleanup and major mitigation projects are completed.) High probability of an entire season closure.
- Likely to require special use permit modification after negotiation with the concessionaire.

Alternative 3

- Larger openings and more sunlight to the ground in treated areas.
- Probable turnover in the campground clientele with some campers fearing the leave-trees and others disliking the cutover areas.
- Would reopen some of the closed sites in part of Thetis and Lodge loops but close others in Lodge, Mineral, and Beargrass for a net loss of about 30 more sites for the next 20 years.
- Safer environment for human habitation and facilities in the treated areas.
- Altered appearance throughout the campground with a drastic change in the recreation setting for several years.
- Reduced presence of old growth hemlock and Douglas fir greater than 12”DBH in the root disease areas.
- Open canopy and extended views from some points.
- Faster and denser reproduction rate in treated segments of loops.
- Reduction in diversity of plant life and therefore, a varied setting (i.e. old growth “wilderness” vs. even aged uniformity) in designed juxtaposition.
- Pockets of warmer campsites with less shade on the ground.
- Considerable discontent of some campers who do not believe the need for the project and who would find ‘their favorite place” altered.
- Areas of less privacy from site to site than existing condition.
- Increased noise in parts of the campground due to reduction in sound barriers, but less so than under alternative 2.
- Possible increase in airflow at ground level and through the treetops, however, as opposed to Alt. 2, more tree crowns would be retained.
- Significant reduction in the “wilderness” setting; a transition into more of a “park like” setting in treated pockets.
- More discernable contrast between treated and untreated stands (i.e. big tree area and halves of loops not treated).
- Decrease in opportunities to view natural forested setting within the root disease pockets.
- Approximately ½ the amount of excess slash and cull logs to deal with as in Alt. 2.
- Expensive in terms of site restoration (repair to facilities and revegetation) required.

- High possibility of a campground closure during a period when it is traditionally open due to the extent of treatment and mitigation work to be done. (i.e. close early in the fall to remove trees and open later in the summer after cleanup and major mitigation projects are completed. High probability of at least a partial season closure.)
- Significant reduction in campground revenues with little corresponding reduction in management responsibilities (the closed portions of loops would still be within the campground boundary).
- No change in maintenance requirements for facilities within the closed portions of loops. These costs would remain whether maintenance is performed annually or prior to a loop's reopening after 20 years of facility deterioration
- Will require special use permit modification after negotiation with the permittee.

Alternative 5

- Blow down hazard may increase due to open canopy AND continued root disease presence.
- Fewer openings and likely smaller openings than Alt.2.
- Approximately ½ the amount of excess slash and cull logs to deal with as in Alt. 2.
- Sites with more sun to-the-ground than at present.
- Better acceptance of the campground by campers and therefore probably less revenue impact than Alt.2.
- Some loss of privacy, especially in the annosus and phellinus pockets, until the reproduction and deciduous species fill in.
- Like Alt.2, the need for barriers to protect seedlings and plants until they fill in well.
- Increased noise transmission in the areas where greatest numbers of trees are removed.
- Increased airflow on the ground where canopy is opened most.
- Some stand structural diversity in most of the campground. Less than Alt.1 but greater than Alt.2.
- Increased time needed to perform the annual hazard analysis; more costly process.
- Some reduction in the "wilderness" feel of the campground in the minds of the users.
- Most of the consequences of Alternative 2 applied to a lesser degree.
- Expensive in terms of site restoration (repair to facilities and revegetation) required.
- High possibility of a campground closure during a period when it is traditionally open due to the extent of treatment and mitigation work to be done. (i.e. close early in the fall to remove trees and open later in the summer after cleanup and major mitigation projects are completed.) High probability of at least a partial season closure.
- Only partially reduces the identified increased hazard trees risks.
- Need to inform and educate the public about the conditions of the site through media means and on-site contacts.
- Would require special use permit modification after negotiation with the permitee.

Alternative 6

- Transition of land base from developed to dispersed camping site.
- Many unhappy campers as a result of the loss of a very popular campground.
- Many happy campers as a result of a new relatively unregulated dispersed camping area on the shore of Lake Kachess.
- Large one-time cost to remove facilities.
- Loss of value of capital improvement projects and other facilities.
- Increased law enforcement and fire protection costs to monitor area because there would no longer be on-site managers.
- Savings of annual maintenance and operation costs.
- Displacement of many campers who prefer a developed site to other developed sites with attendant impacts at those.
- Will require an extensive I&E program.
- Will require special use permit modification after negotiation with the permitee.

Closing the developed campground and turning it into a dispersed camping area would most likely exchange one set of problems for another. This was a very popular dispersed camping area prior to the development of the existing facilities. The attractions that drew people here in the first place (large trees, Lake Kachess, Box Canyon and Gale creeks) would remain and would continue to attract recreationists. The remaining day use facilities would add to that attraction. Federal regulations for developed recreation sites offer management tools for the site that would not be available should it become a general forest dispersed camping area:

- Site capacity: Even though the capacity of Kachess campground is quite large, experience has shown that due to the popularity of the attractions, even more people may crowd into the site than are currently using it.
- Designated campsites: As a dispersed area, people would camp and build campfires wherever they please. The areas on the lakebed, beaches, and riparian areas are expected to be very popular, as would areas adjacent to the remaining roadways. .
- Operation of vehicles: Currently vehicles are restricted to designated roadways. Although there would be a motorized closure in place, experience has shown there would always be some violators.
- Firewood. Gathering of smaller pieces of firewood laying on the ground is currently allowed in the campground. As a dispersed camping area, the use of chain saws, axes, hatchets, and other firewood cutting tools would proliferate.
- Activities. Primarily by enforcement of the regulations for developed recreation sites, Kachess is a family campground with family oriented activities occurring there. That is not the case on most of the popular, heavily used dispersed areas on the district. Large groups of people gather to party and generate problems of drug and alcohol use, vandalism, litter, and sanitation. These activities would inevitably have a negative impact on the remaining adjacent day use facilities.

- Human waste: Experience has shown that, in any popular dispersed camping area where there are no restrooms, human waste becomes a significant – and disgusting – part of the landscape. That would definitely be the case in Kachess under this alternatve.

Recent experience has indicated that it is likely that there would be at least as many people camped in the area with a significantly greater impact on the vegetation, soil, and wildlife in parts of the area than currently exists in the managed developed site. The identified safety concerns would still be present. Costs associated with the operation and routine maintenance of the site are currently born by the campground concessionaire. All costs associated with maintenance and enforcement activities of a dispersed area would be borne by the Forest Service. In the event operation and maintenance of the remaining day use facilities proved to be not economically viable for concession operation, the Forest Service would have to reassume those costs as well.

Alternative 7

- Continued heavy annual impact on the camping environment from downed trees, slash deposits, and for some, the noise and interruption of the actual falling operation, which often entails a commercial timber sale.
- Initial permanent closure of approximately 34 sites with significant additional reduction of capacity as loops are closed for "rest-rotation".
- Significant reduction in campground revenues with little corresponding reduction in management responsibilities (the closed loops would still be within the campground boundary).
- Maintenance requirements and costs for facilities within the closed "rest-rotation" loops would remain whether maintenance is performed annually or prior to a loop's reopening after five years of facility deterioration.
- Continued gradual reduction over time in numbers of large trees as well as wildlife habitat (people enjoy the presence of small animals).
- Some residual hazards of unhealthy trees that do not meet the criteria for felling but may be at risk, especially during heavy winds.
- Continued above average costs of the annual hazard analysis and felling operation involving concessionaire and Forest Service personnel.
- Ineffective revegetation efforts due to closed canopy, damage by annual falling/skidding operations, and consequential lack of natural regeneration.
- Continued opening of the canopy to wind and, therefore, wind thrown trees. This would likely be more of a winter hazard to facilities than to campers.
- Continued gradual lessening of the "old growth character" throughout the campground.
- Probable long-term availability of logs for traffic control and unit delineation.
- Gradually developing old-growth "walk-through" areas along Gale Creek and the Thetis peninsula.
- Would require special use permit modification after negotiation with the permitee.

D. VEGETATION - TREES

AFFECTED ENVIRONMENT

Over thirty years of management activities have changed the campground vegetation, including overstory, understory and ground cover. The annual hazard analysis program, the timber sale approximately 15 years ago, and blowdown salvage timber sales have all contributed to changing the stand. Many suppressed saplings and pole-size trees now comprise the overstory once dominated by large old-growth trees. Opening up the stand has also created a flush in ground vegetation, including shrubs, forbs and grasses in areas not heavily impacted by campground use.

The stand has also been changed over the years by wind. Wind predominantly predominant blows during the winter and early spring, blowing down the weakened trees and reducing hazards. These winds have caused some property damage from blowdown to facilities in the campground. Summer winds in July and August, even though not very frequent, have caused some blowdown and property damage.

The campground is located in various western hemlock and silver fir forested plant associations. (Lillybridge, Kovalchik, Williams, Smith 1995). The overstory is dominated by old-growth Douglas-fir and western hemlock.

In the more remote and less frequently used portions of the campground there is a very diverse ground vegetation composed of a variety of shrubs and forbs. In high impact areas, the abundance of vegetation is dependant upon proximity to travel ways and campsites. Heavy recreation use near campsites has resulted in little or no vegetation cover. High recreation use has caused severe soil compaction and loss of soil resulting in exposing the upper portion of the horizontal rooting system of trees.

Around campsites in the Thetis Loop, which was closed in 1994, vegetation is growing back now that disturbance has been reduced. Shrubs and forbs are recovering in areas between campsites where previous soil compaction was low to moderate. Around heavily used campsites where soil compaction is high, vegetation is much slower in growing back, but growth is occurring.

Four (4) root disease pathogens have been identified and mapped in the campground: laminated root rot (*Phellinus weirii),* annosus root disease (*Heterobasidion annosum)*, brown cubical rot (*Phaeolus schweinitizii)*, and armillaria root disease (*Armillaria ostoyae)*. A systemic dwarf mistletoe infection (*Arceuthobium tsugense)* was also found in the western hemlock at various levels of infection.

Pathological rotation is the point in time when trees are losing as much volume to decay as they are gaining in annual growth. Prior to this pathological rotation age, trees add more wood than the decay fungi are removing. Following this age, the decay fungi are decaying wood faster than the tree is adding it. Soil compaction, root damage from

pedestrian and vehicle traffic, and slow growing trees (due to crowding) all contribute to shortening the pathological rotation age in the campground for the overstory trees. The old-growth trees present in the stand were well established prior to the campground development. Soil compaction and root damage are reducing the growing ability of the trees, thereby slowing growth even more than natural conditions and making the trees more susceptible to the root diseases present in the stand. Soil compaction is having a detrimental effect on the younger trees, reducing the ability for roots to spread, thereby increasing the susceptibility to the root diseases present in the stand at a much younger age.

The root disease pathogens help divide the current campground forest cover into three areas, describing the major infection centers:

Area 1

This area encompasses the Thetis Creek, Mineral Creek, and Lodge Creek camping loops. Laminated root rot was the major root disease pathogen found, with small isolated annosus root disease pockets found.

Approximately 45% of the overstory is 200+ years old, dominated by Douglas-fir and western hemlock. Approximately 25% of the remaining overstory is 150 to 200 years old. The remaining 30% is 100-150 years old. Overstory composition is dominated by western hemlock (68%) and Douglas-fir (28%), with smaller amounts of Pacific silver fir, grand fir, western red cedar, and western white pine.

Area 2

This area encompasses the Box Canyon and Beargrass camping loops, along with the group site and north picnic site and boat launches. Annousus root disease was the major root disease pathogen found, with isolated pockets of brown cubical rot and armillaria root disease identified.

Approximately 41% of the remaining overstory is 100 to 150 years old, 31% is 150 to 200 year old, and 28% is 200 years plus old. Overstory composition is dominated by western hemlock (58%) and Douglas-fir (32%), with minor amounts of western red cedar, Pacific silver fir, grand fir, and lodgepole pine.

Area 3

This area encompasses the Gale Creek camping loop and the south day use and boat launch areas. A small isolated pocket, along with a few isolated stumps, were identified with annosus root disease.

Approximately 42% of the overstory is 100 to 150 years old, 23% is 150 to 200 years old, and 40% is 200 years plus old. Overstory composition is dominated by Douglas-fir (59%) and western hemlock (27%). Minor amounts of western red cedar, Pacific silver fir, grand fir, lodgepole pine and western white pine can be found.

The disease centers are shown in figure 4. Note that there are also smaller pockets of infected trees scattered throughout the campground.

The following is a description of the existing stand condition as of the survey that was completed in the summer of 1993. The stand condition has changed somewhat since 1993 due to annual tree hazard identification and removal of hazardous trees.

Overstory trees – greater than twelve (12) inches (dbh)

Lodge Creek Loop – 14.2 acres

laminated root rot, annosus root rot

		Total Number of Trees by Species							
Age Class	Diameter Class DBH	Douglas-fir	Western Hemlock	Western Red Cedar	Pacific silver fir	Grand fir	Lodge-pole pine	Western White pine	% Age Class
100=150	12-16”	6	58	21	101	3	---	---	37%
150-200	16-20”	10	56	12	29	3	---	---	22%
200+	20” +	102	82	18	8	---	---	---	41%
%Stand /Species		23%	39%	10%	27%	1%	---	---	

Mineral Loop – 10.5 acres

laminated root rot, annosus root rot

		Total Number of Trees by Species							
Age Class	Diameter Class DBH	Douglas-fir	Western h Hemlock	Western Red Cedar	Pacific silver fir	Grand fir	Lodge-pole pine	Western White pine	% Age Class
100=150	12-16”	19	122	2	6	1	---	---	30%
150-200	16-20”	38	106	10	1	---	---	---	31%
200+	20” +	85	103	3	---	---	---	---	39%
%Stand /Species		29%	68%	2%	1%	---	---	---	

Thetis Loop – 10.3 acres

laminated root rot, annosus root rot

		Total Number of Trees by Species							
Age Class	Diameter Class DBH	Douglas-fir	Western Hemlock	Western Red Cedar	Pacific silver fir	Grand fir	Lodge-pole pine	Western White pine	% Age Class
100=150	12-16”	9	66	24	5	---	---	---	23%
150-200	16-20”	9	79	7	1	1	---	---	22%
200+	20” +	99	138	12	---	---	---	---	55%
%Stand /Species		23%	63%	10%	1%	---	---	---	

Box Canyon Loop – 12.5 acres

annosus root rot

		Total Number of Trees by Species							
Age Class	Diameter Class DBH	Douglas-fir	Western h Hemlock	Western Red Cedar	Pacific silver fir	Grand fir	Lodge-pole pine	Western White pine	% Age Class
100=150	12-16”	43	279	1	2	---	3	5	39%
150-200	16-20”	74	200	2	---	2	4	4	33%
200+	20” +	69	166	---	---	---	---	1	28%
%Stand /Species		22%	75%	.34%	.33%	.33%	1%	1%	

North Boat Launch and Picnic Areas – 7.0 acres

annosus root disease

		Total Number of Trees by Species							
Age Class	Diameter Class DBH	Douglas-fir	Western Hemlock	Western Red Cedar	Pacific silver fir	Grand fir	Lodge-pole pine	Western White pine	% Age Class
100=150	12-16”	28	74	6	10	---	60	4	37%
150-200	16-20”	49	54	---	---	---	15	1	22%
200+	20” +	83	30	---	1	---	3	1	41%
%Stand /Species		38%	38%	1%	3%	---	19%	1%	

Group Site - 7.0 acres

annosus root rot, armillaria root rot

		Total Number of Trees by Species							
Age Class	Diameter Class DBH	Douglas-fir	Western Hemlock	Western Red Cedar	Pacific silver fir	Grand fir	Lodge-pole pine	Western White pine	% Age Class
100=150	12-16”	34	90	---	---	---	4	---	46%
150-200	16-20”	36	59	---	---	---	---	---	34%
200+	20” +	14	40	---	---	---	---	---	20%
%Stand /Species		30%	68%	---	---	---	2%	---	

Beargrass Loop– 17.5 acres

annosus root rot, brown cubical rot, armillaria root rot

		Total Number of Trees by Species							
Age Class	Diameter Class DBH	Douglas-fir	Western Hemlock	Western Red Cedar	Pacific silver fir	Grand fir	Lodge-pole pine	Western White pine	% Age Class
100=150	12-16”	22	138	8	2	19	2	1	37%
150-200	16-20”	41	94	12	---	6	---	2	22%
200+	20” +	134	51	6	---	7	---	2	41%
%Stand /Species		36%	52%	5%	---	6%	---	1%	

South Boat Launch and Picnic Areas – 4.0 acres

annosus root rot

		Total Number of Trees by Species							
Age Class	Diameter Class DBH	Douglas-fir	Western Hemlock	Western Red Cedar	Pacific silver fir	Grand fir	Lodge-pole pine	Western White pine	% Age Class
100=150	12-16”	17	40	4	---	2	2	---	37%
150-200	16-20”	28	12	1	---	---	1	1	22%
200+	20” +	74	3	3	---	1	---	4	41%
%Stand /Species		61%	28%	4%	---	2.5%	2%	2.5%	

Understory trees – under twelve (12) inches (dbh)

Lodge Creek Loop

	Range in Age of Trees by Species/Diameter Class						
Diameter Class	Douglas-fir	Western Hemlock	Western Red Cedar	Pacific Silver fir	Grand fir	Lodgepole pine	Western White pine
6 - 8”	---	45-147	75-95	44-127	---	---	---
8 – 10”	---	65-125	40-110	66-134	---	---	---
10 – 12”	---	-108	-68	73-165	---	---	---

Mineral Loop

	Range in Age of Trees by Species/Diameter Class						
Diameter Class	Douglas-fir	Western Hemlock	Western Red Cedar	Pacific Silver fir	Grand fir	Lodgepole pine	Western White pine
6 - 8”	---	45-165	53-155	53-125	---	---	---
8 – 10”	---	70-165	97-132	102-122	---	---	---
10 – 12”	---	75-205	-68	73-165	---	---	---

Thetis Loop

	Range in Age of Trees by Species/Diameter Class						
Diameter Class	Douglas-fir	Western Hemlock	Western Red Cedar	Pacific Silver fir	Grand fir	Lodgepole pine	Western White pine
6 - 8”	---	65-175	---	51-98	---	---	---
8 – 10”	---	67-110	---	69-95	---	---	---
10 – 12”	---	94-135	135	---	---	---	---

Box Canyon Loop

	Range in Age of Trees by Species/Diameter Class						
Diameter Class	Douglas-fir	Western Hemlock	Western Red Cedar	Pacific Silver fir	Grand fir	Lodgepole pine	Western White pine
6 - 8”	34-76	45-163	---	55-110	83	24-52	---
8 – 10”	84-135	52-131	120	---	---	36-52	---
10 – 12”	47-157	63-167	---	188	---	---	76

North Boat Launch and Picnic Area

	Range in Age of Trees by Species/Diameter Class						
Diameter Class	Douglas-fir	Western Hemlock	Western Red Cedar	Pacific Silver fir	Grand fir	Lodgepole pine	Western White pine
6 - 8”	53-67	32-121	---	127	---	35-79	73
8 – 10”	44-84	75-124	66	63-130	---	48-120	62
10 – 12”	63-127	62-133	---	---	---	52-136	---

Group Site

	Range in Age of Trees by Species/Diameter Class						
Diameter Class	Douglas-fir	Western Hemlock	Western Red Cedar	Pacific Silver fir	Grand fir	Lodgepole pine	Western White pine
6 - 8”	66-140	41-155	---	62-127	---	48-53	---
8 – 10”	145	63-108	---	---	---	43-68	---
10 – 12”	88-104	67-127	---	---	---	66	---

Beargrass Loop

	Range in Age of Trees by Species/Diameter Class						
Diameter Class	Douglas-fir	Western Hemlock	Western Red Cedar	Pacific Silver fir	Grand fir	Lodgepole pine	Western White pine
6 - 8”	---	85-195	---	62-132	---	---	---
8 – 10”	---	65-182	---	45-146	---	---	---
10 – 12”	---	104-210	---	114-175	---	---	---

Gale Creek Loop

	Range in Age of Trees by Species/Diameter Class						
Diameter Class	Douglas-fir	Western Hemlock	Western Red Cedar	Pacific Silver fir	Grand fir	Lodgepole pine	Western White pine
6 - 8”	54-92	54-93	63-92	---	56-113	---	---
8 – 10”	67-102	66-125	85-113	---	74-115	---	---
10 – 12”	84-124	75-116	55-130	---	57-123	---	---

South Boat Launch and Picnic Area

	Range in Age of Trees by Species/Diameter Class						
Diameter Class	Douglas-fir	Western Hemlock	Western Red Cedar	Pacific Silver fir	Grand fir	Lodgepole pine	Western White pine
6 - 8”	52	34-94	52-64	---	35	---	---
8 – 10”	51-107	57-101	---	---	---	---	---
10 – 12”	56-69	66-82	47-79	---	---	---	---

ENVIRONMENTAL CONSEQUENCES

Common To All Alternatives

Some level of treatment would occur in all alternatives. Treatment would result in opening up the stand to various degrees, resulting in making the stand more exposed to winds. There is no firm data or available research, to indicate how large an opening in the stand would make the stand more prone to blowdown. There was a brief increase in blowdown after the last timber harvest, though it was not clear whether the timber harvest had anything to do with it. The effect on blowdown under the various alternatives cannot be answered with certainty, but it is assumed that there would be some increase in blowdown after any treatment that leaves larger trees standing.

Alternative 1 – *No Change*

The current hazard tree analysis and treatment program would continue. This type of vegetation management program only deals with the short-term management. Annual entry to remove hazard trees would result in new disturbance during harvest.

Stands would be left in a climax condition (shade tolerant species), which are more susceptible to damage by insects and identified root diseases in the campground. There would be insufficient healthy young trees in most stands to replace the older overstory component as it dies or is removed. Many existing seedling and sapling trees have grown under the closed canopy, becoming less vigorous and healthy. These trees often have poor crown ratios and form class, often resulting in optimum screening between campsites, but these trees become more susceptible to root diseases at a younger age.

Recommended pathological rotation age has been exceeded in the majority of the campground, increasing the susceptibility of the remaining stand to root pathogens and insects. The root disease centers have the potential to spread since intolerant and intermediately susceptible species are being left.

Alternative 2 – *Full Treatment*

Long-term sustainable management is being addressed. Yearly hazard tree analysis and removal (currently averageing 75 trees per year) would consist of considerably fewer numbers. Identified root disease centers would be treated, removing the intolerant and intermediately susceptible species, replacing with more tolerant species. There would be one major harvest entry followed by very minor yearly entries, thereby less disruption to both users and vegetation management efforts.

Removal of the large old-growth trees can produce beneficial changes in vegetation vigor. Loss of the "old-growth" characteristic would occur in parts of the campground, but stand openings would increase sunlight penetration to the forest floor. This alternative would present the opportunity to modify the abundance, structure, and vigor of shrub and herbaceous species, while giving existing trees more room to grow. Variety in stand structure, function, composition, color, texture, big game forage are some of the favorable results.

Creating large openings in the laminated root disease centers would favor establishment of seral, more disease tolerant species. Openings in the annosus disease centers would favor vigorous, healthy growing trees of both seral and climax conifer species. Sunlight penetration would promote an increase in shrub and herbaceous species that is currently lacking.

Disease tolerant species (western white pine, lodgepole pine, and western red cedar) currently exist in limited numbers in most stands. These species would be favored as leave trees and would be planted after harvest, providing for some additional structure and diversity in the remaining stand after treatment.

Alternative 3 – *Treat About Half of Each Loop, Utilizing Prescriptions From Alternative 2*

Long-term sustainable vegetation management would occur in treated portions and have the same effects as Alternative 2.

In untreated areas, log-term sustainable vegetation management is not being addressed. This late-successional stand would still be prone to damage by insects and root diseases currently found in the campground. Delaying treatment in portions of the stand allows the stand to progress closer to, or past, pathological rotation. Continuation of danger to campground users from hazard trees exists since these untreated stands are adjacent to open portions of the campground, travel routes and general recreation use.

Conversion to more root disease tolerant conifer species would occur in treated areas, but the spread of the root disease cannot be controlled with susceptible species remaining in the root disease centers in untreated areas. The untreated portions of the stand would continue to progress toward a more climax succession and would not provide large

enough openings to regenerate shrubs and herbaceous species, or for young trees to grow vigorously without a natural stand-opening event (wind storm, fire, etc.).

Alternative 5 *– Partial Treatment Across the Campground*

This alternative does not address long-term sustainable vegetation management. Many trees close to or over pathological rotation that have no visual signs of root disease would be left. It would be difficult to identify trees with infected small roots. After opening up the stand the remaining infected trees would have a high potential for blow-down or damage due to wind.

Leaving susceptible trees with no visual signs of infection in known root disease centers only off the eventual mortality due to root diseases. Opening up the stand may allow the trees to grow for a while, but trees already infected would succumb. Future expansion of the root disease centers would continue. Yearly hazard tree analysis and treatment would continue removing trees left after the initial treatment, and disturbing vegetation on a yearly basis. The number of trees to be removed in the annual tree hazard analysis is anticipated to be less than current program.

Alternative 6 *– Close most of the Campground – Except day-use areas*

Climax stand conditions would continue. Hazards would still exist to dispersed recreationists that are using the area. Natural processes for stand replacement would occur slowly over time. The stand would become more decadent as time goes by. As openings are created with the death of trees by natural causes (insects, disease, or wind) a new stand would start to regenerate, though reproduction would likely be trampled in areas that see heavy dispersed camping. Root diseases would continue to be a vital part of the stand renewal process. The root disease centers would continue to have the potential to expand and remain active in the stand.

Alternative 7 *– Close Sites in Most of the Critical Areas, Continue Annual Hazard Tree Removal Under Expanded guidelines in the Remainder of the campground, Utilize a Rest/Rotation System*

Same effects as Alternative 1

Rest rotation of loops would help vegetation start to recover, but five years is not an adequate amount of time for much recovery. Shrubs and herbaceous cover would start to respond, but trees would not have adequate time to recover before the area is open to the public again.

E. BOTANY

AFFECTED ENVIRONMENT

The proposed project area is located on the west side of Lake Kachess. Plant associations include western hemlock/Oregon grape (*Tsuga heterophylla/Berberis nervosa*), western hemlock/vine maple-vanilla leaf (*Tsuga heterophylla /Acer circinatum-Achylys triphylla*), western hemlock/vine maple-wild ginger (*Tsuga heterophylla / Acer circinatum -Asarum caudatum*), and Pacific silver fir/vine maple (*Abies amabilis/ Acer circinatum*). The stands are mostly in a late successional stage, however in the high use areas of the campground and picnic areas, there is a decreased herbaceous understory from which is normal in these plant associations and successional stage. Down woody material of all sizes is also deficient.

Threatened, Endangered, Proposed and Sensitive Plants

Review of the Wenatchee National Forest Botany Database and the Washington Natural Heritage Program Database show no known sites of Federally listed Threatened, Endangered, or Proposed plant species within the vicinity of the proposed project. There is one known site of a USFS Sensitive species, western ladies-tresses (*Spiranthes porrifolia*) approximately 1 mile northwest of the proposed project area. Intuitive controlled vascular plant surveys were conducted within the proposed project area according to protocol by a qualified Botanist on 16 August 1999 and 26 August 1993. No Federally Listed Threatened, Endangered, Proposed, or Sensitive plant species were found (see Appendix G for complete plant list).

Survey and Manage Species

According to Survey and Manage Guidelines in the Northwest Forest Plan predisturbance surveys are required for this proposed project for 6 species of vascular plants (*Botrychium montanum*, *Coptis trifolia*, *Cypripedium fasciculatum*, *Cypripedium montanum, Galium kamtschaticum*, and *Platanthera orbiculata*), 2 species of bryophytes (*Schistostega pennata* and *Tetraphis geniculata*), 1 species of fungi (*Bridgeoporus nobilissimus)*, and 9 species of lichen (*Hypogymnia duplicata*, *Lobaria linita*, and *Pseudocyphellaria rainierensis, Bryoria tortuosa, Leptogium burnetiae* var. *hirsutum, Leptogium cyanescens, Platismatia lacunosa, Ramalina thrausta, Teloschistes flavicans*). (USDA and USDI, 2001)

Vascular Plants

There are no known sites of Survey and Manage vascular plant species within the vicinity of the proposed project area. Surveys for these species were conducted at the same time as PETS surveys and none of the 6 species were found. (Vascular Plant Survey Protocols, Version 2.0)

Bryophytes
There are no known sites of Survey and Manage bryophyte species within the vicinity of the proposed project area. Bryophyte surveys were conducted within the proposed project areas according to survey protocols on 17 May 2001 by a qualified Botanist. Neither of the 2 species were found. (Bryophyte Survey Protocols, Version 2.0)

Fungi
There is one known site of a Survey and Manage fungi species, *Acanthophysium farlowii*, within the proposed project area and 4 known sites of Survey and Manage fungi species within 8 miles of the proposed project area. These species include one site of *Gymnopilus punctifolius,* two sites of *Mycena monticola*, and another site of *Acanthophysium farlowii.* Fungi surveys were conducted for *Bridgeoporus nobilissimus* in the proposed project areas according to survey protocols for on 17 May 2001 by a qualified Botanist. (Survey Protocols for *Bridgeoporus nobilissimus*, Version 2.0). none were found. The *A. farlowii* population was found on Douglas-fir (*Pseudotsuga menzeisii*) trees in the day use area at the south end of the Gale Creek Loop.

Lichen
There is one known site of *Pannaria rubiginosa*, a Survey and Manage lichen within 2 miles of the proposed project area. Surveys for the 9 lichen species were conducted on 17 May 2001 by a qualified Botanist. None of the 9 species were found. (Lichen Survey Protocol, Version 2.0)

Noxious weeds

There are known infestations of Washington State noxious weed species along roads in the vicinity of the proposed project area. These include: bull thistle (*Cirsium vulgare*), diffuse knapweed *Centaurea diffusa*), orange hawkweed (*Hieracium aurantiacum*), hairy cat's ear (*Hypochaeris radicata*), oxeye daisy (*Leucanthemum vulgare*), and dalmation toadflax (*Linaria dalmatica*). A noxious weed risk assessment was completed for the proposed project. There is a high risk that noxious weeds would enter the project area because: 1) there are known sites on adjacent roads; 2) there is a high volume of vehicle and foot traffic in and around the project area, and 3) the site conditions during and after vegetation management favor noxious weed establishment.

Important interactions

Plant growth is directly related to soil health. Healthy soil provides a suitable substrate for plants, a balance of nutrients and water for plants, and supports a community of microorganisms that recycle nutrients through decomposition and helps plants to resist disease. Soil compaction affects soil health by reducing air space and preventing water movement through the soil thus reducing the soil's capacity to support plants. Loss of organic matter including woody debris affects soil health by reducing fertility, soil structure and water holding capacity. (Acton et al., 1995)

ENVIRONMENTAL CONSEQUENCES

Common to All Alternatives:

The proposed project would not affect any Proposed, Threatened, Endangered, or Sensitive plant species or any Survey and Manage plant, bryophyte, fungi or lichen species. Surveys were conducted to protocol and none of these species were found. The known site of *Acanthophysium farlowii* would be protected and conservation measures to ensure the viability of the species would be incorporated in the silvicultural prescription (Conservation Plan, Appendix F).

Alternative 1

With this alternative, compaction of the soils by foot traffic throughout the campground and picnic areas would continue, thus contributing to poor soil health and a decreased herbaceous understory. Also contributing to poor soil health would be the continuing collection of firewood by recreationists. Plant growth would continue to be compromised in the high use areas.

Populations of noxious weeds along the roadside would likely enter the campground via vehicles, foot traffic, and animals. Soils in poor health are a prime environment for noxious weeds. Noxious weeds would eventually be recognized and treated, but may not be recognized at an early stage of encroachment without yearly monitoring.

Alternative 2

This alternative would remove the most overstory trees, approximately 3000. Approximately 79 acres of the site would move to an early to mid successional stage. Species that are tolerant of sun would be favored. This alternative would generate the highest amount of slash over the most acres. With high amounts of slash covering the ground, the public is more likely to stay on designated paths rather than walk through difficult terrain. Further soil compaction would be prevented by people staying on designated paths. More woody debris would be left on the ground because of the mitigation measure to discontinue firewood gathering, and soils would thus be allowed to rebuild organic matter. Future organic matter from overstory trees would be missing. Soils would recover and plant growth would be restored in time. This would be accelerated by restoration projects such as soil tilling, planting native species, and mulching.

Populations of noxious weeds along the roadside would likely enter the campground via vehicles, foot traffic, and animals. Soils in poor health or recently disturbed are a prime substrate for noxious weeds. It is not feasible to require the public to wash vehicles prior to entering the facility, however, the equipment used off the roads in logging or restoration would be required to be cleaned of weed seed before entering the facility.

Planting native species and mulching would slow noxious weed infestation. Monitoring weeds would occur yearly so infestations could be recognized early before allowed to establish.

Alternative 3

Removal of approximately 1400 overstory trees would move approximately 40 acres of the site to an early to mid-successional stage. Species that are tolerant of the sun would be favored in this area. Heavy amounts of slash would be generated in the 40 acres. In this area, the public is more likely to stay on designated paths rather than walk through difficult terrain. This would prevent further soil compaction. Woody debris would be left on the ground and because of the mitigation measure to discontinue firewood gathering, soils would be allowed to rebuild organic matter, however, future organic matter from overstory trees in this 40 acres would be missing. Soils would recover and plant growth would be restored in time. This would be accelerated by restoration projects such as soil tilling, planting native species, and mulching.

Closing portions of the campground for 20 years would likely allow soils to become healthier in these areas due to less compaction from campers and organic matter would be allowed to accumulate at natural rates and therefore plant growth would eventually be restored as soils become more healthy. There would be no restoration in the closed areas which could slow the recovery process.

Populations of noxious weeds along the roadside would likely enter the campground via vehicles, foot traffic, and animals. Soils in poor health or recently disturbed are a prime substrate for noxious weeds. It is not feasible to require the public to wash vehicles prior to entering the facility, however, the equipment used off the roads in logging or restoration would be required to be cleaned of weed seed before entry into the facility. Planting native species and mulching would slow noxious weed infestation. Monitoring weeds would occur yearly so infestations could be recognized early before allowed to establish.

Alternative 5

Removal of approximately 1400 overstory trees in 75 acres would move the site to a mid-late successional stage. Species that are less tolerant of the sun would be favored in these acres. Less slash than in Alternative 2 would be generated in the 75 acres. The public may be less likely to stay on designated paths because it would be easier to move through the forest. One half the amount of woody debris as in Alternative 2 would be left on the ground and because of the mitigation measure to discontinue firewood gathering, soils would be allowed to rebuild organic matter. Overstory trees would be available for future organic matter. Organic matter would be allowed to accumulate at natural rates and plant growth would eventually be restored. Restoration work would take place in the 79 acres to speed the recovery process.

Populations of noxious weeds along the roadside would likely enter the campground via vehicles, foot traffic, and animals. Soils in poor health or recently disturbed are a prime substrate for noxious weeds. It is not feasible to require the public to wash vehicles prior to entering the facility, however, the equipment used off the roads in logging or restoration would be required to be cleaned of weed seed before entering the facility. Planting native species and mulching would slow noxious weed infestation. Monitoring weeds would occur yearly so infestations could be recognized early before allowed to establish.

Alternative 6

With the closure of the entire campground, a substantial amount of dispersed camping is expected and this use would, for the most part, be uncontrolled. The roads to day-use areas would remain open and dispersed campers would enter the facility by car or boat, then walk to camping areas. Campsites would not be designated. It is likely there would be heavy foot traffic in certain areas of the facility. Compaction from heavy foot traffic would continue to contribute to poor soil health and a decreased herbaceous understory.

Firewood gathering would continue. In addition, the use of chainsaws would be allowed. This would further degrade the soils and the herbaceous understory by removing more organic matter than any of the other alternatives.

With vehicles limited to fewer roads, the spread of noxious weeds would be less than the other alternatives. However, noxious weeds would continue to spread via other vectors, including foot traffic, animals, and boats. Noxious weeds may eventually be recognized and treated, but may not be recognized at an early stage of encroachment, when treatment is the easiest and least expensive.

Alternative 7

The site would continue to be in the late successional stage with the removal of 150-200 trees per year. Foot traffic in the closed areas would be less than currently occurs because of less campers and woody debris would be allowed to accumulate. This would allow soils to become healthier and plant growth to be partially restored, perhaps enough to impede foot traffic. Plant growth would be accelerated by restoration projects such as soil tilling, planting native species, and mulching.

Populations of noxious weeds along the roadside would likely enter the campground via vehicles, foot traffic, and animals. Soils in poor health or recently disturbed are a prime substrate for noxious weeds. It is not feasible to require the public to wash vehicles prior to entering the facility, however, the equipment used off the roads in logging or restoration would be required to be cleaned of weed seed before entry into the facility. Monitoring weeds would occur yearly so infestations could be recognized early before allowed to establish.

F. SOILS

AFFECTED ENVIRONMENT

Soil Productivity

Introduction

While "productivity" has historically been focused on long-term commercial wood fiber production, since 1993 the concept of "ecosystem management" and the "enhancement of late-successional habitat" have emerged as driving management objectives on federal lands in the range of the northern spotted owl. These objectives apply the concept of "productivity" with an expanded perspective. This perspective recognizes the importance of multi-storied forest communities, structural habitat components and succession on site productivity and stand development. "Tree mortality is an important and natural process within a forest ecosystem. Diseased and damaged trees and logs are key structural components of late-successional and old-growth forests...dead trees affects the development of future stands and habitat quality for a number of organisms." (USDA/BLM, 1994)

To understand what is meant by soil productivity, its origin in our management guidelines, and how we monitor for its condition, we need to review our past. Powers (1990) describes the early evolution and development of the USFS soil monitoring and standards and guidelines. It was the National Forest Management Act of 1976, Sec. 6(g)(3)(c), which charged the Secretary of Agriculture with ensuring research and monitoring of the effects of each management system to protect the permanent productivity of the land (USDA Forest Service, 1983). The USFS had to define the scope of monitoring they would conduct. Shortly thereafter, "Land productivity was defined as a soil's capacity to support plant growth, as reflected by some index of biomass accumulation."(Powers, 1990) Later, the Forest Service recognized that the soil's capacity to "support plant growth", could be affected by many factors including age, competition, genetic limitations, and management, making it too variable to quantify. Looking for a substitute measure for plant growth as the indicator of productivity, the USFS refined the concept from "land productivity" to "soil productivity", recognizing that the soil along with its climate, physiography, and biology, was what controlled nutrients, moisture and air supplies to plant roots. This led to the shift in monitoring focus, away from the plants themselves, to the soil types and the management disturbances that we now monitor to infer changes in land productivity. Powers points out that monitoring should focus on measurable soil variables that reflect important site processes, as it is "not operationally feasible" to monitor soil and site processes directly. The USFS Soil Management Handbook, (2509.18) now specifies that regional soil scientists would identify regional soil monitoring variables, establish soil quality standards and monitoring methods, which address soil productivity. A summary of guidance on managing soil productivity is summarized as follows:

Regulations and Guidance on Soil Productivity

1976 National Forest Management Act (NFMA)

1990 Wenatchee N.F. Forest Plan Standards and Guidelines

Soil Compaction

Ground Cover

1993 Forest Ecosystem Management Assessment Team Report (FEMAT)

Large woody debris, viability of soil biological communities

1994 Wenatchee Forest Plan as Amended by Northwest Forest Plan

LSR Salvage Guidelines for retention and recruitment of coarse woody debris

As Powers recognized, in the absence of direct measurement of soil and site processes, forest soil conditions can be evaluated, at the site-specific scale, with an inventory of surrogate physical site variables which have been associated with these more complex processes. Field investigations for this project focused on factors and disturbances that directly and indirectly affect soil erosion, water availability in the soil matrix, nutrient cycling, and gaseous exchanges between root and soil atmosphere. These evaluation factors would be discussed in the existing conditions.

Important interactions –How soil health affects site productivity

Importance of Soil Productivity in the Context of the Project Purpose

Why is productivity important to Safety?

Human activities can contribute to soil and plant stresses. Soil compaction, topsoil loss and organic debris removal, may cumulatively add to the advancement of root-rot, as the pathogens select stressed trees(Waring, 1987) and advance the decay of roots and heartwood.

Why is productivity important to the Setting?

Soils provide the growing medium for trees and shrubs that influences the setting and make it desireable for humans, including the appearance of the old growth forest, its associated species, climate and surroundings.

Following the removal of root rot infected trees, growth rates of the next overstory stand, and herbaceous/woody understory community would be dependant on the soil's productivity.

Establishing and maintaining vegetative screening and privacy between campsites is dependent on productive soils.

Why is productivity important to ecosystems and Old Growth Forests?

In providing habitat for viable populations of soil fauna and trophic organisms responsible for decomposition of organic matter and cycling of nutrients necessary in the energy cycle for old growth forests and dependent wildlife species.

Factors evaluated:

- soil compaction, severity and distribution
- the presence and density of understory herbaceous and woody plant communities (soil cover and organic input)
- organic matter availability (fine and coarse), accumulations and distribution
- soil erosion of surface horizons
- recovery rates of organic matter and early seral plant communities.
- conditions which influence severity of impacts throughout the campground

How these Factors Link to Soil Productivity Processes

Associated Site Factor	Soil Productivity Process
% surface disturbance, amount soil loss	soil erosion
soil compaction, org. matter, infiltration	water availability
organic matter content, % soil cover, soil loss	nutrient availability
soil compaction	gas exchange
soil compaction	root growth and nutrient uptake

Key Processes and Disturbances that affect Soil Productivity

While soil compaction, displacement, herbaceous/woody understory development, and soil development and erosion can be evaluated and discussed independently of one another, in reality they are very tightly linked in the process of soil productivity. Typically, soil compaction does not occur without a subsequent loss of understory ground cover. Vegetative ground cover loss rarely occurs without eventually displaying a subsequent loss of surface organic and soil horizons. Change any one of these processes, and you would likely observe changes in the other processes. With that in mind, the processes themselves would be briefly discussed first, independently of each other, followed by a summary of disturbances that cumulatively effect all three processes.

Key Processes

Soil compaction, which is the loss of soil porosity and increase in density, has been shown it can reduce the volume of trees growing on a site by about 1/5, from that of less compacted sites (Froehlich et. al., 1986). Other research has shown that the greater the proportional increase in soil density, the greater the productivity loss. While campground areas immediately in the vicinity of picnic tables, fire rings and tent pads are not areas where growth for commercial purposes is the objective, the success of revegetation of areas adjacent to and between campsites and day use areas, for the objectives of managing the setting and next rotation of overstory trees, is dependent on managing for reduced soil compaction.

Both fine and coarse woody debris are needed for soil development and productivity, as they decay at different rates and provide different nutrients and soil structure functions. The shrubs and herbaceous understories, as well as conifer needles and small limbs, contribute to the finer organic component that is critically important in nutrient cycling for soil productivity. While this size class may contribute only 5-11 percent of the above

ground litter biomass at a forested site, they represent as much as 30-90% of the total inputs of phosphorus, calcium, potassium, magnesium, and nitrogen (Kimmins, 1987). Powers (1990) cited research from eastern Germany, regarding litter raking - the regular removal of freshly fallen conifer needles, practiced in central European conifer forests for centuries to obtain bedding straw for farm animals. Powers reports that Wiedemann and others found that several decades worth of litter raking on sandy soils led to higher soil densities(compaction), growth declines of about 12 percent, appreciable declines in soil nutrients, and lower fertility. Powers also noted that Sands (1983) concluded that desirable soil physical properties depended largely on the maintenance of soil organic matter.

Coarse material is generally defined as >1" diameter. For purposes of this analysis, anything over 12" diameter was considered large coarse woody debris. This material may reach the forest floor as a result of stem breakage, deadfall, windthrow, and managed salvage operations. On the ground, a complex set of interactions begins, including colonization by fungi and nitrogen fixing bacteria, which combine to enrich the decaying wood they inhabit with nutrients. In addition, rotting logs intercept and absorb nutrient-rich water(through fall) and litterfall from the canopy. Maser, et.al states that "Decaying wood thus serves as a savings account of soil organic materials and nutrients in forest ecosystems."(Maser et al., 1984)

The thick, well decomposed organic layer is an indication of the productivity of a site. It is dependent on the recruitment and retention of downed material on-site, the proper temperature and moisture regimes that allow for the soil biotic community to decompose the litter and coarse organic matter. A site's decomposing coarse organic matter can retain nearly 300 percent of its weight in water, making it capable of absorbing and releasing water slowly, minimizing the risk of rapid runoff and surface soil erosion risks. Sites which are deficient in decaying coarse woody debris may experience soil moisture limitations to growth, particularly in well drained soils such as those in the Kachess Campground. In addition, retaining the fine organics of needle and branch litter in and around the perimeter of campsites, along with the smaller sizes of coarse wood, acts to buffer the effects of foot traffic by distributing the ground pressure that can negatively affect soil porosity.

Mineral soil development rates take on the order of decades to several centuries to occur. Water and nutrients accumulate and cycle in the organic and volcanic ash layers in the upper 40 cm.of soil. The incorporation of organic matter into these upper soil layers, which decreases rapidly with depth, makes the upper horizons disproportionately more important to the site's productivity. This makes soil loss both a short and long term threat to soil productivity. Powers (1990) reported research in which the loss of a thin layers of organic top soil during site preparation, following logging, was responsible for 30% loss in volume growth by mid-rotations. Small losses of the surface soil can affect productivity. Topsoil losses can occur through displacement, compaction and erosion.

Background Conditions

Landtype Association
The landtype association on which the campground is located is a glacial outwash/alluvial fan deposit (map unit Ou6). These are gently sloping landforms, formed by fluvial deposits from two perennial streams and a river. Glacial outwash and fluvial deposits provide a mixed, unconsolidated mass of various sized rock, soil and woody materials ranging from very large boulders and logs to fine sediments. Soils have weathered in place over top of this material, overlayed with periodic deliveries of flood debris and volcanic ash deposits. They provided deep soil deposits, generally well drained conditions, and the possibility of perched water tables on compacted till. While not as dynamic as in glacial times, streams continue to respond dynamically under flood conditions. This landtype, along with its generalized interpretations is described in "Landtype Associations of North Central Washington" (Davis et.al, 2000).

- warm, moist, maritime climatic influence by 50 inches of annual precipitation
- moderate soil moisture potential
- dense multi-storied closed forest canopy w/understories of mid to tall level woody shrubs
- stand replacing fire interval of 200+ years
- downed woody debris is abundant (20-30 tons/acre)
- 1-3 inches of organic duff, with 50% decayed wood.
- high site productivity for wood fiber - contributes to high downed wood
- low to moderate productivity for herbacious plants - makes disturbance even more critical
- revegetation potential when disturbed is low to moderate.
- low surface soil erosion hazard due to high rock fragment content and gentle slopes
- high aquifer recharge - high storage capacity for near surface ground water,
- small areas of poorly drained soils in depressional areas
- areas with cemented till between 20-40 inches deep

Soil Survey Data
The entire campground is mapped as a single soil map unit (map unit #254), under the Kittitas County Soil Survey. The Natural Resource Conservation Service labeled it Kachess Gravelly Sandy Loam. Additional information:

- Parent materials are glacial till overlying coarse glaciofluvial deposits
- Thick deposits (7-13 inches) of volcanic ash from Mt. Mazama.
- Thick well decayed layer of organic material over ash, ranging from 1 to 3 inches
- 30-80% hard rock fragments in upper mineral soil layer (pebbles and cobbles)
- Well drained, gravelly loamy sand surface horizon texture
- High water holding capacity in the upper layer, but extremely cobbly below the top few inches, with possible restrictive layer at 37 inches (compacted till) which may restrict water movement.

- Soil compaction hazard is high
- Puddling hazard is high (sealing of surface pores)
- Rooting depth of 60 or more inches.

The temperature and moisture regimes of these soils make them productive sites with high basal areas and volume growth (Lillybridge et.al., 1995). Harvey et al., (1995) identified soil fertility, in Eastside forest ecosystem, as critical to productivity. Soils are young and exhibit highly variabile fertility. "Water and nutrients tend to accumulate and cycle in surface layers, primarily organics and volcanics...' 'Most critical soil processes are at soil depths ranging from 5 to 40 or more cm." The low bulk density (high macropore porosity) of the volcanic ash layer, gives it an exceptionally high water holding capacity (Harvey et.al., 1995). Generally soils are well-drained though the water table can be fairly high when the reservoir is full.

Disturbances Affecting the Key Processes

Severity of soil productivity disturbance throughout the Kachess Campground ranged from severe to low. Disturbance varies considerably throughout the campground (see Table 2). Overall detrimental soil compaction exceeds the Forest Plan Standard of 20% of activity area. In some areas, such as the day use areas, detrimental compaction is 50-60% of the activity area. This includes Box Canyon Loop and day use, Gale Creek Loop and day use, and portions of Beargrass and Thetis Loops. The soil in the campsites themselves is generally moderately to severely compacted from years of foot traffic within and between campsites, bicycle travel throughout the campground and mechanical impacts from past timber sales, salvage logging, and annual hazard tree removal. In many areas, soil has been eroded or compacted around the bases of trees to the point that tree roots are exposed. Years of repeated foot traffic has displaced the organic layer that should function to buffer the ground pressure of the human use. Some areas are deficient in total volume of downed wood in various stages of decay, while in others it is a deficiency of specific size classes. Soil organic horizon thickness (duff layer) is absent or extremely thin and reduced from 1-3"depth potential. The volcanic ash layer is absent or noticeably shallow in areas of heavy use around the campsites.

Trampling of plants and compaction of soils by foot traffic, wheeled vehicles and selection of tent sites are conditions contributing to the low density of ground cover vegetation throughout much of the campground. This, in turn, contributes to reduced biomass accumulations on the forest floor, soil compaction and soil loss. Factors that directly influence travel and areas of use include the height, density and species composition of the understory plant community, as well as the complex accumulations of large diameter (>24" dbh), preferably >30”dbh, on the forest floor. The taller more dense communities with perceived barriers appear to discourage the public from traveling into or expanding camping activities into the forest adjacent to a campsite.

Certain recreation activities, including firewood collection, result in the camper traveling outward in multiple direction from a campsite. With each trip into surrounding vegetation, over time, understory vegetation becomes beaten down, less dense, and the

forest floor becomes more visible. Multiple trails develop. Increased visibility increases the comfort level of the next visitor to penetrate the vegetation, expanding outward with tent locations, firewood searches or travels to adjacent campsites. Variability in herbacious and woody plant cover around campsites ranges from dense cover in portions of some loops, to a complete absence of species with the exception of small clumps at the base of overstory trees. The frequency of use for certain sites, in highly desireable locations along shorelines, appears to have resulted in soil and vegetation loss around the perimeter of these sites. This repeated use allows little time during the growing season for vegetation recovery. While Thetis Creek loop remains closed, it is apparent that coarse woody debris is still being removed, and the trails and campsites are being utilized by recreationist, not as overnight sites but for day use. While small herbs, shrubs and conifer seedlings are beginning to encroach into the abandoned sites. In 7 years, a band of approximately 10-12 feet wide, of what was originally a severely disturbed 60 foot diameter area, has now been colonized by plants. These are generally under 12" height. Soil organic matter has seen only minor improvements where it currently ranges in depth from only a thin layer of needles, to approximately 5/8 " of undecayed duff overlaying compacted soils. Conifer seedlings which find a seed bed in this thin organic layer would become stressed as the roots pass through the thin organic layer and come in contact with the compacted mineral soil.

Coarse downed woody debris and fine organic matter is deficient due to past salvage logging, hazard tree removal, and campground firewood collecting. Firewood collection is contributing to this deficiency. The largest deficiency is in material less than 12 inch diameter, and materials over 24-30” diameter. The potential coarse woody debris loads for these forest habitat types is 20-30 tons/acre (Davis, 2000)

Thetis Creek Loop, after 7 years of rest from camping was documented to have 400-550 linear feet/acre of downed wood most of which was in the 14 to 24 inch diameter (21 tons/acre), in a solid decay class (class 1, 2). Much of this material appears to be recent accumulations. Lodge Creek Loop had nearly 900 linear feet/acre of wood with 75% in the 20-24” diameter class and 25% in the 10-20” class (32 tons/acre). Box Canyon Loop (interior) had 800 linear feet/acre, in the 14-20” diameter class (37 tons/acre) all of which appeared to be from recent hazard tree management. Beargrass loop had nearly 800 linear feet/acre in the 18-24” diameter (37 tons/acre). Box Canyon Loop (shoreline), Gale Creek Loop, and Box and Gale Creek day use areas all had less than 100 liner feet/acre. (4 tons/acre). These tons/acre were based on using an average 20” diameter log, with a 50% density index (USDA, 1977). Over 90 percent of this material is in decay classes 1 and 2, which is solid. While the tonnage in all but the last group are within the habitat type range, the lack of material approaching 30” diameter and lack of material in the advanced decay classes are concerns from both a short term water holding capacity and long-term organic and nutrient availability.

For campers traveling throughout the campground or attempting to access the Shoreline Trail, a lack of designated trails, signed to encourage their use, has led to each camper picking their own route out of their campsite. Currently, the most heavily impacted areas have an average of 3 to 4 well established trails per campsite radiating outward through

the vegetation. The less frequently used sites have 1 to 2 trails leading away from them. Off-road bicycle riding(mountain bike) throughout the campground is another activity which has contributed to the development of an expansive network of trails. This disturbance was summarize as part of the cumulative soil compaction in Table 1.

Soil Compaction

Detrimental soil compaction throughout the Kachess Campground exceeds the Forest Plan standard of <20% of the activity area. Campground detrimental soil disturbance was analyzed by evaluating and summarizing the acres of detrimental compaction occurring in each disturbance category throughout the campground. For purposes of analysis, road lengths were scaled from the project map, and widths were measured. Parking area width and lengths were estimated on-site. Trail lengths were estimated based on observed trails per campsite, estimated lengths, 2 ft.widths, and 100% compacted. Campsite disturbances were classified into one of three disturbance area size classes. These include high (60 ft.x90 ft.), moderate (60 ft.x 60 ft.) and low (40 ft. x 40 ft.). Day use areas disturbances were based on paced distances, and estimates of percentage of area in severe disturbance.

Table 1. Summary of Soil Compaction Cumulative Effects

Disturbance Categories	Acres	% Total Compaction
roads	6.1	20.7%
parking	4.6	15.6 %
campsites and day use	15.6	52.9%
trails	2.1	7.1%
Total estimated acres of soil compaction	29.5	100%

Total area of campground, without the big tree area = 94 acres

These numbers do not reflect campground entrance station, restroom facilities, trailer dump facilities, trailhead, ground disturbance at two group sites, and associated peripheral soil disturbance.

The numbers indicate that nearly 60% of the 29.5 acres are attributable to campsites, dayuse areas and trail disturbances. Of the 29.5 acres, 10.6 acres are attributed to the cumulative effect of only the “high” severity class for campsites and day use areas. If management could reduce the disturbance footprint on these 10 acres by 33%, which means an average site would be shrunk from an area of 60 ft. x 90 ft., to 60 ft. x 60 ft., an additional 3.7 acres of soil productivity could be restored. In some cases, it may be possible to see further gains in productivity. There is the potential for a 50% reduction in trail density leading from each campsite, would contribute another 1 acre gain, and we could conservatively gain approximately 4.7 acres of soil recovery, without closing any campsites. This would be dependent on effective traffic control for 5-10 years following soil restoration work, for vegetation to become sufficiently tall to discourage travel.

Table 2. Ranking of areas, in terms of existing severity of soil productivity loss, from most severely impacted (1) to least severe (11)

Ranking	Acres of Severe Compaction
1. Box Canyon Day Use	3.9 ac.
2. Gale Creek Day Use	3.8 ac.
3. Box Canyon loop	4.7 ac.
4. Gale Creek loop	3.5 ac.
5. Beargrass loop	5.3 ac.
6. Thetis Creek loop - north side along reservoir shoreline	2.5 ac
7. Mineral Creek loop	2.4 ac
8. Thetis Creek loop - east end near reservoir	0.5 ac
9. Mineral Creek loop - east end near reservoir	0.5 ac
10. Thetis Creek loop - west end	0.4 ac
11. Lodge Creek loop	1.5 ac
Total	29.0 ac

Soil Development

Evidence of soil loss can be seen by comparing soil horizons in high traffic areas with those found in relatively undisturbed areas. Displacement or removal of the plant cover and organic horizon by foot traffic or mechanical damage occurs first, which exposes the volcanic ash deposits to erosion. Once the organics are removed, a very rapid loss of the volcanic ash layer may be experienced. On the Kachess Gravelly Sandy Loam soils, the losses of one or both of these layers may account for a total loss of between 3.5 and 6.5 inches of the most productive soil layers, around the most severely degraded campsites and trails.

Where large diameter downed coarse wood exists, in some places it is not functioning to limit foot travel or contributing to plant protection and succession. This is due to the wood's position and to the frequency and intensity of human use, and so additional input of coarse wood may be effective as vegetation refugia only if it is arranged in raised structures or clumps. The openness of the understory invites outward expansion of soil disturbance and vegetation damage and diminishes the effectiveness of large coarse wood as a barrier to protect vegetation. The visibility of the wood through the understory appears in some cases to have had the opposite effect of making the wood an attractant as climbing and playground equipment, actually increasing plant and soil damage adjacent to the wood.

Soil Productivity Restoration and Protection

Restoration and protection of soil productivity is accomplished by focusing on the soil physical conditions and processes recognized as necessary for soil development and nutrient cycling. This analysis includes a number of actions intended to work toward restored soil productivity, and to learn from these actions in the interest of adaptive management. These actions are included in the "Measures common to alternatives 2-5 and 7" beginning on page 10. A full discussion of soil restoration and protection is included in appendix D.

ENVIRONMENTAL CONSEQUENCES

Potential direct and cumulative environmental effects are associated with:

felling trees,
yarding logs,
slash removal,
soil compaction reduction
tree and shrub planting,
traffic control structures and exclosures

Potential indirect and cumulative effects would be associated with:

soil compaction reduction techniques
tree/shrub/forb planting and revegetation
traffic control structures and exclosures
firewood gathering closures,
campground loop closures, rest-rotation and campground administration.

Alternative 1

Summary

Soil productivity would continue to degrade where 75 hazard trees are cut and removed annually, including areas around campsites and day use areas, where foot traffic and recreation activities expand the area of soil compaction into the new openings. Where trees are removed, canopies would be opened up, ground cover would be trampled and lost. Compacted soils would have reduced shade and are expected to experience increased surface temperatures and reduced soil moisture during the growing season. The continued loss of site organics, changes in microsite climates and increasing soil compaction would continue to affect the soil and site's ability to produce an understory consistent with the AMA objectives of managing for late-successional habitat. This alternative lacks the soil productivity mitigation measures which are necessary to protect the existing conditions or restore the degraded soil conditions. This alternative has no provision for an adaptive approach to a revegetation/restoration plan to achieve soil

restoration objectives. As such, it represents the alternative that provides the least benefits and protection to soil productivity.

Soil Compaction

Annual felling and ground based skidding of salvage logs, out of campground and day-use areas, would result in a direct environmental effect of incrementally increasing soil compaction by 5 to 15% in the areas where trees are removed. This is based on observations in logging operations where designated skid trails were effectively used. The cumulative impact, in percent of area experiencing detrimental soil compaction, would be increased by this amount. In campgrounds and heavily used recreation areas, the removal of trees would create a more open environment for campers and recreationists. The indirect and cumulative effect is that, in a heavily used campground area, these trees and their associated shrub community represent vertical forest structure which discourages, interrupts and redirects human travel. In less heavily used areas, they provide microsite protection to plants that occupy the soils around the perimeter of their base. Removal of these trees results in altered patterns of human movement, exposing understory plants and soils to increased trampling and damage. Indirect and cumulative effects would include increased extent of soil compaction and shrub vegetation damage around campsites, resulting from expansion of trails, campsites and day-use areas. This alternative has no revegetation or soil restoration plan to restore degraded areas.

Compaction is likely reducing the size and distribution of the population of the mychorrizal fungi, which are necessary to increase the root surface area of desireable plants and enhance their nutrient uptake, utilization and growth rates.

Soil Development

The direct effects on mineral soil erosion would be negligible. However, in areas where ground cover vegetation still exists, the removal of trees would lead to the additional expansion of soil and plant disturbance due to foot travel and equipment use movement outward around campsites. Soil development is closely linked to ground cover and overstory vegetation condition, as they provide the inputs of organic matter to the soil surface. Reduced plant density yields reduction in ground cover. This may result in indirect and cumulative effects in the displacement of surface organic soil horizons, with a subsequent displacement of underlying volcanic ash deposits. This effect can reduce water holding capacities and water availability to plants, resulting in either reduced seedling establishment, reduced growth, or decreased survival. These conditions already exist in many of the more heavily used and severely impacted sites and are expected to expand further with additional tree removal.

Indirectly, the microsite conditions of soil temperature and moisture may be changed incrementally with each tree removed. Cumulatively, the effect of continued removal of trees would be warmer and drier surface soil conditions over the long-term. This is especially problematic and persistent when combined with problems of poor natural re-generation, decreased plant survival and diminished growth rates associated with plants colonizing on severely compacted soils.

Slash cleanup by campers would continue to adversely affect the accumulation of new organic matter on the forest floor. Firewood collection is expected to continue contributing to the absence of fine and coarse organic matter as campers burn material for campfires or displace the fine material with their foot traffic. With disturbance expanding, expect a continued decline in available organic matter necessary for nutrient cycling, soil structure, and water holding capacity.

Herbacious and Woody Understory Plants
Logging results in direct effects to both herbaceous and woody plant species of the understory, as trees fall upon and then are moved across and over these plants. This may damage plants sufficiently to cause stress that ultimately effects the plant's survival. The most severely disturbed campsites would see continued degradation in density and diversity of species. With no understory revegetation plan, the shrub and forb plant communities would continue to degrade, reducing the available inputs of fine leaf litter and root development which are important in soil development. This would continue to feed the cycle where a loss of plants and ground cover contribute to increased areas of soil compaction. Natural revegetation recovery would be largely unsuccessful due to compaction problems and continued heavy recreation impacts.

In the closed Thetis loop and other closed sites, recovery of the seral plant community would continue at a slow rate, proceeding under the current disturbance pattern with density improving over the next decade.

Tree regeneration in compacted soils with insufficient nutrients, associated with low organic matter and increased soil moisture stress would be slow and would susceptible to attack by fungus and disease.

Indirect and cumulative effects would include increased extent of shrub and ground cover vegetation loss around campsites, resulting from expansion of trails, campsites and day-use areas.

Alternative 2

Summary
This alternative involves 97 acres harvested with approximately 3000 trees removed. In addition to the use of helicopter logging, there are several additional mitigation measures that provide an adaptive management approach to restoring soil productivity. Since these measures are "common" to alternatives 2, 3, 5 and 7, this alternative differs from the others on three points of implementation: 1) it proposes the largest number of total acres of soil affected, with the greatest number of campsites treated in a single entry; 2) it proposes no new permanent site closures, for even the most severely degraded sites; 3) it provides no process for managing campsites on a rest/recovery cycle following treatment.

The size of the area treated, the number of trees removed around each site, the density of campsites in an area and the severity of the existing conditions all affect the success of the mitigation measures. Since trees function as natural barriers to human travel through the forest, the more trees that can be retained, especially within a close proximity to the campsite, the less mitigation work has to be artificially created by using logging debris to prevent ground disturbance in and around the new openings, and the more effective the log traffic control structures would be.

Four of the most severely impacted areas – Beargrass, Gale Creek, Box Canyon, and Thetis loops - account for 21 of the total of 29.5 acres of severely impacted soil, and would have no permanent or long-term campsite or day-use area closures other than the five sites in Gale Creek loop already permanently closed. Without resting these specific areas from public use, allowing for the soil recovery and vegetation establishment, this alternative has the lowest probability (other than alternative 1) that these areas would respond to the mitigation measures or achieve the scale of soil recovery or understory revegetation necessary.

The long-term protection of the restoration work is expected to be difficult as campsites and day use areas would continue to be heavily used by the public. Trails to access shorelines, travel between adjacent campsites, or campers avoiding the use of existing soil disturbance and instead setting camp on vegetated ground cover, are all conditions that would prevent effective soil recovery. While fencing has been identified as mitigation, linear fencing has been ineffective in the most heavily used areas of Box and Gale Creek where the public was determined to go around them. Fenced exclosures, however, in combination with jackstrawed wood as described in section II-C, *Alternatives Considered*, are expected to be more effective in providing protection.

Soil Compaction

Helicopter yarding to a landing in the reservoir draw down zone would minimize any additional direct effects on soil compaction from yarding. Slash removal, construction of log human traffic control structures, loosening of compacted soils and digging holes for planting trees may require the use of a tracked excavator. It would be assumed that this equipment would generally operate either on disturbed ground, from a campsite parking pad or campground road and not contribute either directly or cumulatively to increased soil compaction.

The use of hand crews and, if necessary, cable winch line equipment from roads and parking pads, would minimize any additional soil disturbance.

Loosening of compacted soils with equipment would produce a direct effect of reducing the area of detrimental compaction associated with areas around campsites. Treatments may initially reduce the cumulative area of compaction by 1-4% (based on a total of 1 to 3 acres treated in approximately 80 acres of area), however, the long-term reduction in soil compaction would depend on what we learn from these initial efforts.

Managing campsites for an acceptable level of soil and vegetation disturbance (footprint), would result in indirect and cumulative effects of reducing localized areas of soil compaction, as plants become established in previously degraded soil and their roots contribute to improve soil porosity. Placement of downed large woody debris, in various decay classes, arranged around the perimeter of each campsite, to delineate the "foot print", could be effective in achieving reductions in cumulative soil compaction. However, several log barrier structures would be needed at each site, using large diameter logs bridged upon each other, to nearly 3 feet tall, to form a complex structure that would deter travel within the structure

Planting of trees that are 4-8 feet in height, with heavy equipment, must be done simultaneously with soil restoration work to limit the number of equipment intrusions onto the soils. If equipment is kept on degraded soil, and the soils are then scarified by equipment as it pulls out, there should be no direct or cumulative effects on soil compaction. Short term direct and indirect effects would be a very limited reduction in site-specific soil compaction, due to the limited number of trees planted. The digging of the hole would loosen the soils in that location and, once planted, the tree would present a small barrier to foot travel. Furthermore, root development and expansion should loosen soils around the base of the tree. Long-term, the soils around the base would recover in the heavily used sites only with the appropriate sized protection structures and maintenance.

Eliminating "redundant trails" with effective trail relocations, barrier work, signing, and administration help from concessionaires should result in a short term, indirect and cumulative effect of reducing soil compaction. The combination of log barriers and designated trails would improve soil porosity, shrinking the area of soil compaction, limiting the extent of campsite and trail expansion, and allowing the indirect effects of plant root expansion to further reduce soil compaction. However, by reopening all previously closed campsites and day use areas following logging, the most severely degraded conditions would not be allowed adequate recovery time and restoration work is at risk of being ineffective.

Creating exclosures in the Box Canyon, Gale Creek, and penninsula areas, if maintained, would provide indirect improvements in soil compaction over the long-term, as human use is removed from the areas, and vegetation is allowed to recover.

The combination of the immediate opening of campsites to the public use, the large extent of area affected by the tree removal, and the limited effectiveness of the barrier work over such a large an area, are all expected to contribute to a relatively high risk of re-disturbance. As a result of this, the most severely degraded campsite soils may not experience a long-term reduction in cumulative compaction percentages. Where the public use is of low to moderate frequency and intensity, where conditions are less degraded, and where there is sufficient space between campsites to effectively manage the human use and protect the restoration areas with fencing or woody debris, expect cumulative reductions in soil compaction around campsites.

This alternative offers more protection and less direct effects than alternatives 1 or 7, due to the single entry and helicopter yarding. However, its indirect and cumulative effects of exposing more ground to human disturbance, and having no rest-recovery or permanent closures of the most degraded soils would contribute to mitigation measures being less effective, than Alternative 3 or 5, over the long-term.

Soil Development

The three most important factors influencing effects to soil development/recovery would be 1) effects on the microsite climate of the forest floor, including temperature and moisture, 2) effects on the accumulation of organic material in various decay classes, which affects the development of an organic soil horizon (layer), and 3) effects of human use on ground cover and vegetation establishment, immediately following the hazard tree removal.

This alternative opens up the canopy, over the greatest number of acres, to solar radiation and wind. With tree canopies opened up, soils would have reduced shade and are expected to experience increased surface temperatures and reduced available soil moisture. These factors increase the time required to break down organic material and slow the rate of decomposition of organic duff into humus and usable nutrients.

Large downed coarse wood, retained during slash disposal, would increase the amount of humus and organic material on-site for soil development including:

- increased soil-water holding capacity and low shade
- prevention of further soil loss, particularly of soil organic layers
- provision of sites for colonizing bacteria and fungi, which would accelerate decay of woody debris.

Eliminating firewood collecting would directly improve the short term accumulation of woody materials in a variety of size and decay classes. While firewood collection would be prohibited, expect some ongoing removal of organic matter <6" diameter for campfires, until public contact becomes effective. The larger material would help mitigate some of the temperature and moisture concerns of removing the canopy. Downed woody material indirectly minimizes human disturbance to the surface soil horizons in localized areas.

Placement of downed large woody debris structures, in various decay classes, arranged to delineate a "disturbance footprint" at each campsite would be effective in providing organic matter as well as moisture retention for accelerating biological decay processes and improving plant growing conditions. However, as previously noted, it would be difficult to regulate foot travel effectively in the most popular sites and so this alternative carries a lower probability than alternatives 3-7 that long-term ground cover protection would be effective.

This alternative does not remove the use from the immediate area but attempts to reroute and discourage travel with fencing and log barriers. Immediately opening of presently-

closed campsites to human use would displace groundcover, and expose the site to trampling and retard the site's ability to establish a diverse, understory vegetation community. Areas which have a basically healthy understory community, in which plants have simply been beaten back are expected to recover more quickly than the more severely impacted sites. Lack of shrubs and forbs in these sites would retard accumulation of fine organic litter fall. Cumulative improvement is expected to be slow at best on the most disturbed sites found in Box Canyon, Gale Creek, and Beargrass loops and portions of Thetis loop.

Creating human exclosures in the Box Canyon, Gale Creek, and peninsula areas would provide localized direct and cumulative effects of increasing accumulations and retention of organics. Localized improvements in soil moisture and nutrient cycling, for tree and plant growth, would be achieved by preventing displacement and removal of organics by campers and day users.

Herbaceous and Woody Understory Plants

This alternative would result in the greatest short term, direct effects to both herbaceous and woody plant species of the understory, from felling and helicopter yarding of trees. A 20% damage to residual vegetation would result in direct reduction in density of groundcover vegetation. In stands where trees and shrub vegetation is currently degraded, the direct and indirect effects would be the greatest. Indirectly, standing trees act as natural obstacles to human travel, breaking up patterns of movement. With trees removed, the most heavily used and degraded areas would experience the indirect and cumulative effects of further reductions in density and diversity of ground cover plant species from increased human trampling. With such a large area affected by the tree removal, a limited ability to treat a large enough area of degraded soil, the reopening of all campsites, and the difficulty of modifying human movement throughout the area, this alternative has a lower probability than alternatives 3-7 of achieving vegetation restoration for soil productivity objectives.

Restoration of understory vegetation, and its soil productivity function, is dependent on reducing soil compaction, and being able to manage for a long term reduction in the level of future disturbance around campsites. Indirect effects of mechanical soil compaction reduction treatments would be improvements in localized growing conditions. The long-term effects would again vary by frequency and intensity of campsite use, and effectiveness of protection measures.

With no permanent campsite closures or rest-rotation cycles, vegetation recovery would be difficult and uncertain in areas with severe site degradation and frequent public use. In these sites, with multiple trails leading away from each campsite, and the close proximity of campsites to each other, it is expected that camper foot traffic around and through revegetated soil areas would likely retard its establishment and survival. In severely disturbed and/or heavily used sites, log structures without limbs may attract use, as climbing apparatus, and retard the establishment and survival of plants. Localized successes are expected to occur in low to moderate use areas, but may not achieve the full

soil productivity objectives at the landscape scale. Log foot travel barrier structures would work in moderate to low use areas, around plantings or to protect healthy residual clumps of vegetation. Structures may allow the expansion in the size of these clumps vegetation.

While attempts would be made to protect plantings from being trampled, this would be a high maintenance and long term effort. Under this "full treatment" alternative there is a large area affected by tree removal, making it difficult to effectively implement these kinds of protection while all campsites are maintained open. Site degradation could make shrub and young conifer plantings survival success poor, and growth slow due to moisture stress, low nutrients, soil temperature increases and continued camper disturbance. Contributions of organic debris from shrub communities established on poor growing sites may be insufficient to contribute appreciably to soil recovery. An unsuccessful attempt at developing a dense vegetation community would not only affect the production and accumulation of biomass for nutrient cycling, but it would also leave the area around the campsite sparsely vegetated and perpetuate a cycle of outward expanding foot travel from the campsites, furthering cumulative impacts to plants and soils.

Alternative 3

Summary

This alternative is nearly identical in effects to Alternative 2, with the major exception being in the effects associated with the 39 acres to be treated at the end of 20 years, and the 5-year rest-rotation and permanent closure areas. In areas where soil disturbance is low to moderate severity, the removal of the disturbance is often all that is necessary to effectively restore plant cover and initiate soil productivity recovery processes. In these cases, removing the disturbance is the most effective means of restoring compacted and denuded soils.

Alternative 3 - Actions Different than Alternative 2:

- 20-year rest period for 39 acres, or ½ of the area in 5 of the campground loops.
- At end of 20 years, loops are treated, and begin 5-year rest-rotation for all loops, where each loop would be rested for a minimum of five (5) years, with option to extend if vegetation/soil recovery is slower than expected.
- Permanent closure of most severely degraded sites along shoreline in Box Canyon and Thetis loops, and closed sites in Lodge loop
- Group Site and Gale Creek Day Use area would be treated with routine hazard tree treatment instead of "full treatment".

Alternative 3 has the same adaptive management plan for slash treatment and revegetation and soil restoration as in Alternatives 2, 5 and 7. However, where Alternative 2 falls short in achieving effective reductions in compacted soils and vegetation recovery, Alternative 3 is expected to demonstrate indirect and cumulative improvement in the residual vegetation and soil compaction restoration over 39 acres.

This is due to the 20 year rest/recovery period, and absence of human disturbance that the soil and vegetation would have had experienced, prior to hazard tree removal. Following the tree removal, the taller and more dense vegetation, established during the rest period, would be more effective than in Alternative 2 in controlling vegetation trampling and soil compaction once the sites are reopened. The recovered vegetation would be more effective in redefining and reducing the campsite's disturbance footprint, reducing stresses on the residual and planted trees and shrubs, than simply using log barriers.

The 5-year rest-rotation cycle would provide an adaptive management component that is missing in alternatives 2 and 5. It provides the manager a scheduled period of time where site disturbance would be removed and adjustments can be made to revegetate or restore soils. While this technique is common to Alternatives 3 and 7, Alternative 3 is the only alternative that combines the extended 20-year rest period with the rest-rotation cycle. These two techniques, in combination, provide the most effective combination of techniques to achieve improvements in soil productivity.

Removing the human use during this period would reduce direct impacts at each campsite, and cumulatively reduce detrimental compaction across portions of the approximately 39 acres.
The areas treated at the end of the 20 year period would contribute to improvements in soil porosity, soil development and vegetation at the proper landscape scale, and recognize the temporal needs for soil recovery over portions of 5 loops. Of the alternatives that provide for campground use, this alternative would move the greatest number of acres furthest toward achieving the soil productivity objectives and standards.

Soil Compaction
Those portions of the campground loops to be treated in the first 20 years would have the same effects as described in Alternative 2. However, resting 39 acres prior to treatment at the end of 20 years, added to the effects of the 5-year closure/rest recovery evaluation period every 20 years, and the permanent closure areas in Box Canyon and Thetis Loops make Alternative 3 an improvement in soil compaction over Alternatives 2, 5 and 7.

Portions of the loops to be closed for 20 years prior to treatment would experience indirect and cumulative reductions in compacted soils. Low to moderately impacted areas would respond with the most recovery, as the health of the vegetation would have 20 years of growth in the general absence of human disturbance. Natural recovery would consist of the growth and expansion of plant roots, and colonization of new plants into areas sparsely vegetated. The more severely impacted sites within the 20 year rest period would see more improvement in compaction reduction than the same areas in Alternatives 2 ,5 or 7.

By using the 20-year rest period, managers would give the site time to naturally recover, prior to utilizing expensive mechanical means for soil compaction reduction and tree planting. These mechanical methods, while expensive, also are limited in their effectiveness. This alternative would require less additional soil disturbance from

mechanically treating soil compaction and tree planting, require fewer constructed log barriers to limit trampling and protect vegetation, and is expected to produce greater reductions in areas compacted and denuded of vegetation and groundcover. In addition, the foot traffic barriers that are installed would be more effective on the 39 acre area than the they would be on the same area under Alternative 2.

One example of the scale of improvement that can be realized is in the nine (9) of the 20 acres of the most severely degraded soils throughout the campground, contained in the Beargrass and Thetis loops. By temporarily closing ½ of each of these loops, or a total of 4.5 acres of the 105 acres, a reduction in detrimental soil disturbance of approximately 4%, from the cumulative total of 29.5% of area, could be realized. Further compaction reduction area would be accomplished at each campsite by reducing the trail density around and between sites (trails). These reductions in conjunction with the other 3 loops would approach attainment of the Forest Plan standards of 20%.

Alternative 3 reduces soil compaction, and provides a process for managing for reduced campground soil disturbance, over the greatest number of acres.

Soil Development

Alternative 3 provides soil development improvements over Alternatives 2, 5 and 7 in the 39 acres associated with the 20-year rest-rotation portions of the campground loops. In addition, it exceeds Alternatives 2 and 5 in reducing soil compaction, through the use of the 5-year rest-rotation plan for reopening closed campsites.

In addition, the permanent closure areas in Box Canyon and Thetis loops would show indirect and cumulative improvements in soil development over Alternative 2. Effects listed below for the temporary closure areas would be the same for these permanent closures, with exception that at the end of the 20-year period, some minor reversals of these effects would occur upon treatment and reopening of the campsites.

Expected indirect and cumulative effects on the 39 acres managed with the 20-year rest-rotation period include:

- Improved accumulations, distributions, and retention of coarse woody debris.
- Improved accumulation of fine organic matter from shrubs, needle fall and fine woody materials at the duff layer. Materials would be retained on-site and utilized in the short term by decomposers, incorporating nutrients in the upper soil horizons, accelerating plant growth
- Reduced displacement of fine organic matter from foot travel and camping equipment use.
- Increased water holding capacity of soils. The size class of trees available in the overstory, for future recruitment to the forest floor is rarely over 24". Once on the forest floor, tree boles would expect to have over 40% of its biomass consumed by fungi over the 20-year period. At that decay stage, water holding capacity on site could potentially increase by 100-300% in locations occupied by the decaying wood.

Firewood gathering closures would be more effective than in Alternative 2, as the campsite closures would result in greater compliance around the areas that are closed to use and yield greater retention of fine organic material at each closed campsite. The effect would be more rapid rebuilding of the soil organic horizons.

Upon reopening the campsites to use, and implementation of the 5-year rest-rotation, these 39 acres would show improved soil productivity conditions, over areas not experiencing the 20 year recovery period. In addition, the acres not rested for 20 years would receive the benefit of human disturbance removal for 5 years, every 20. This would increase organic matter accumulations with the benefits mentioned above.

Herbacious and Woody Understory Plants

Of the alternatives that keep the campground open, Alternative 3 provides the most improvement in the understory plant community over the greatest number of acres. These improvements are associated with the 39 acres affected by the 20-year rest period, the permanent closure areas, and the campsites of low to moderate severity of disturbance that would experience the 5-year rest-rotation plan. Treatment areas outside these areas are expected to experience effects similar to Alterative 2.

A 20-year temporary closure followed by rest-rotation is the most effective means of achieving an increasing density and diversity of understory plant species. With removal of human disturbance, expect indirect improvements in soil porosity, increased survival of shrubs, forbs and conifer seedlings, increased density of understory vegetation, with encroachment into campsite disturbance zones. The establishment of a more dense seral understory would indirectly affect the productivity through increased contributions of litterfall and fine woody debris, increased nutrient inputs to soils, and increased root mychorrizal action. The accumulation and retention of downed coarse woody debris, with its moisture and nutrients, would provide improved microsite habitat for plant colonization. Permanent closure areas in Box Canyon and Thetis Loops would see indirect and cumulative effects similar to those of the 20-year temporary closures.

Portions of the loops that are treated first and are outside of the 39 acre rest blocks, would receive at least a 5 year rest period every 20 years under this alternative. It is in the areas of low to moderate human disturbance where the indirect effects on improved vegetation heath and density would occur. These campsites would have plants establishing and growing in the absence of human disturbance. It is expected that the more severely degraded individual campsites would need to remain closed beyond 5 years, under this alternative, to allow for vegetation and soil recovery.

Alternative 5

Summary

Same treatment area as Alternative 2, with approximately 50% fewer trees removed. By removing fewer trees, this alternative would provide indirect improvements in reducing long-term soil compaction, indirect improvements in soil temperature and moisture, improved residual vegetation health and increased ground cover over Alternatives 2 and 7. This alternative provides no rest-rotation cycle for campground loops, but like Alternative 3 it does provide for permanent closure of two (2) small areas, one in Thetis and one in Box Canyon Loop. This alternative has the same adaptive management plan for slash treatment, and revegetation and soil rehabilitation as in Alternatives 2, 3 and 7.

Soil Compaction

A single entry with helicopter yarding and 50% fewer trees removed would result in less direct effects on increased soil compaction than Alternatives 2 and 1. Indirectly, standing trees act as natural obstacles to human travel, breaking up patterns of movement and reducing the areas of exposure to trampling. Retention of trees would contribute to the indirect effect of limiting soil compaction associated with foot travel and camping use.

A reduction of soil compaction, by mechanical treatments would occur around the campsites, similar to Alternative 2, 3 and 7. Expect short term reductions in the cumulative percentage of compacted soil, improve planting survival success. Long term, soil compaction around campsites is expected to return, as campsites are reopened without a rest-rotation option. The use of log barriers to protect soil restoration work from trampling would be more effective than in Alternative 2, as the increased number of trees retained over the same acreage would contribute to the effectiveness of the traffic control structures. Expect localized improvements in shrinking the extent of detrimental soil compaction within the campsite footprint.

Closure areas in Box and Thetis loops make the effects from Alternative 5 an improvement over conditions expected in Alternative 2.

In the most severely disturbed sites, expect less benefit to soil compaction recovery, than in Alternative 3 and 7.

Soil Development

Retaining 50% more standing trees than Alternative 2 would have the indirect effect of:

1. increased shade and soil moisture levels for the soils and understory plants,
2. increased numbers of standing trees which would affect the movement of recreationist around and through campgrounds, helping to minimize the area of organic soil displacement and groundcover loss, by foot trampling.

Permanent site closures would have same effect as in Alternative 3

The lack of a rest-rotation scheme would result in continued frequency and intensity of human disturbance. While firewood collection would be prohibited, expect ongoing removal of organic matter <6" diameter for campfires, until public contact becomes effective.

Herbacious and Woody Understory Plants
Short term direct effects on residual vegetation damage, with fewer trees felled, should be less under this alternative than under Alternative 2.

This alternative provides no rest-rotation cycle for campground loops, and so would not alleviate the human use disturbance, including the physical damage to understory vegetation, and indirect effects of retarding plant recovery, which would be realized under Alternative 3 and 7. Restoration of soil productivity and understory vegetation is dependent on achieving a reduction in soil compaction to achieve Forest Plan Standards. Expect localized improvements in soil compaction and growing conditions. Without long term soil compaction reduction, or removal of use from campsites, the more severely disturbed sites would not experience the desired vegetation recovery to meet soil objectives. Fewer trees removed would result in less damage to understory plant communities. By removing fewer trees, canopies maintain a higher percentage of canopy closure. This provides temperature and soil moisture buffering to the understory, which would aid in revegetation. Residual soil compaction, lack of decomposed organics and absence of shrub communities would make sites less productive, until the soil organic layer can rebuild. Site degradation may make plant establishment difficult, survival poor, and growth slow due to moist stress, low nutrients and soil temperature increases.

Log barrier work is expected to be more effective than under Alternative 2, as they can be incorporated into the residual stand of trees, to protect islands of plantings or natural vegetation, and fewer of them would be needed. As such, visual resources would be less compromised with fewer structures, and may allow for the barriers to be constructed at the appropriate height ensuring their effectiveness at restricting travel.

Alternative 6

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Summary
No hazard tree removal or slash treatment would occur. All campsites would be closed and roads and campsite facilities would be removed. Day use areas remain open. There would be no revegetation and soil mitigation measures or exclosures. The day use areas would remain in a severely degraded condition, eventually being unable to produce either an understory or overstory conifer stand. The remainder of the campground would likely see spotty success at revegetation. Sites that continue to be popular for dispersed walk-in camping would likely remain in a degraded state or possibly get worse. Other sites that are not as popular would gradually recover. Overall, this alternative would be the most effective in restoring soil productivity over the most acres of the original campground.

Soil Compaction
This alternative would result in the most direct, indirect and cumulative reduction in detrimental soil compaction in areas of the campground that are well removed from either water or existing roads, and would therefore be likely to see little dispersed camping. Campsite human disturbance would be removed. Without soil rehabilitation, degraded soils would be abandoned and soil compaction recovery would occur by natural processes. The biological activity which incorporates organic detritus into the surface soil layers, along with plant root development, and freeze-thaw action would contribute to gains in porosity over time. The process would begin immediately with the removal of the roads and campsite facilities, as well as the chronic human disturbance. However, recovery would require 10 to 20 years for the more moderately impacted sites, and 20 years or more for severely degraded soils. Thetis Creek loop, which was a severely impacted site that has been rested for 7 years without any mechanical soil treatments, is showing only the very beginnings of plant colonization by a very limited number of species. Increases in retention of downed woody debris would assist the recovery of the site by increasing the water holding capacity of the area and improve near surface aquifer storage. Small localized areas with good soil porosity adjacent to areas which are more severely impacted would allow for well developed root masses to extend into degraded areas and assist in loosening soil compaction.

Day use areas which currently have detrimental soil compaction in excess of 50% of activity areas would continue to expand the area of compacted soil under this alternative, and not achieve Forest Plan standards. In addition, areas of the campground that are close to roads, streams, or the lake would likely experience heavy dispersed camping use. Experience elsewhere has shown that this use can often increase the soil compaction and vegetation loss in localized areas. Down woody debris would become scarce in these areas, as campers remove firewood.

Removal of roads and campsites would contribute to reducing compacted soil acres. Although recovery would be uneven across the landscape, this alternative would result in the greatest overall percentage of soil porosity recovery over the largest area, improving water holding capacity and gaseous exchanges between roots and atmosphere, improving soil productivity.

Soil Development
Day use areas, and areas of heavy dispersed camping would only continue to see further soil loss through erosion by foot traffic and action of waves on the lake. The climate and temperature regime, as well as the presence of fungi and bacteria and other decomposers, would contribute to a rather rapid rate of decay across many of the closed campsites. Soil development recovery would be variable, depending on degree of site degradation, amount of dispersed use, local physical environments, and plant species that occupy the sites. Mineral soil development is an extremely slow process, but the process of organic material decomposition and incorporation into a humus soil layer can begin immediately with removal of disturbance.

Comparisons of recovery at two of the more severely impacted campsites in the Thetis Creek loop, after 7 years of recovery, yielded a very thin organic layer of needles at one site and over 5/8 inch thick layer of moderately decomposed humus at the other. Both areas were without coarse woody debris influence and a sparse shrub component. The development of a forb/shrub community would provide the finer organic matter and nutrients needed to sustain productivity in the short term until the coarse wood can be accumulated and broken down by decomposers. Solid coarse woody material in the <24" dbh size class may take 3-5 years to be colonized by bacteria and fungus, and another 15-20 years to become decayed into humus. This highlights the importance of the seral understory plant community over the short term.

Herbacious and Woody Understory Plants
Further degradation of seral plant communities is expected in the day use areas and areas experiencing heavy dispersed recreation, and without mitigation measures, the direct effects would be increased acres of ground cover loss. This alternative would not achieve the Forest Plan standards for percentage of soil ground cover in the day use areas and in sites that remain popular for dispersed camping.

A slow recovery in many of the closed campsite areas is expected. Around the perimeter of the abandoned campsites, soil porosity would undergo natural recovery. The density and distribution of successional species is expected to make slow, steady improvement, as they fill into the most suitable growing sites. The biomass they produce would eventually accumulate on the forest floor contribute to a nutrient reserve, and seed bed. A diversity of soil organisms would be responsible for decomposing the materials into useable forms. Large woody debris softened by bacteria and fungi would trap finer organic matter and become nurse sites for shrubs and small trees. Some sites may experience early colonization by young conifers in the accumulated fine organic duff layers, only to develop unhealthy growth, or high mortality as their root encounter compacted nutrient poor layers in the surface mineral soil horizons. Long-term indirect and cumulative effects include meeting the Forest Plan standards for percentage of ground cover in areas that do not experience high levels of dispersed recreation.

Alternative 7

Summary
Like alternatives 2, 3 and 5, this alternative includes mitigation measures addressing slash treatment and vegetation and soil rehabilitation.

Features that make this alternative unique from other alternatives include permanent closures of 2 more campsites in the Gale Creek riparian reserve, representing approximately 5 acres, and the Thetis Creek loop, representing 8.5 acres. In total, these permanent closures represent improvement in productivity in about 12.8 % of the total campground area. These closures could indirectly and cumulatively contribute to meeting Forest Plan standards for detrimental soil compaction and ground cover in these riparian reserves. However, the effectiveness of the Gale Creek campsite closure, in achieving these standards, would be lower than at Thetis due to Gale's proximity to a

heavy day use area. This may prevent it from meeting Forest Plan standards for soil productivity.

The rest-rotation cycle of 5 years is similar to Alternative 3, however this alternative is implemented in conjunction with a routine, annual hazard tree removal. When compared to alternatives that provide for continued camping, Alternative 7 provides less improvement to soil productivity than Alternative 3, or 5, but more than Alternatives 1 and 2.

Soil Compaction

The continued removal of 150-200 trees per year with helicopter yarding in the Gale, Beargrass, Box Canyon, Mineral and Lodge Creek Loops would contribute only slight increases in detrimental soil compaction to those areas. Of these loops, Beargrass, Box Canyon and Mineral are all currently in exceedance of the Forest Plan standard for detrimental compaction.

The permanent closure areas of half of Gale Creek loop and the entire Thetis Creek loops would see very different effects on soil compaction. Proximity of the Gale Creek closure area to the Gale Creek day use area would result in continued demand by day users to occupy the closure area, making it difficult to administer effectively. Several campsites in the closure area were closed to camping in 1996 and a fence constructed in 1997 to restore plant and soil conditions. The fence has been ineffective in improving conditions along Gale Creek streambanks, as it has provided very little appreciable improvement in plant community diversity or density. Under this alternative, this area would be subject to a more stringent exclosure as described in Section II-C, *Alternatives Considered,* and this is expected to be more effective at allowing soils and vegetation to begin recovering.

The Thetis loop, while currently temporarily closed to overnight camping and not as accessible to day use, is still being used as a destination day use area. A network of foot trails, bicycle paths and garbage in the fire rings indicate it currently is receiving day use. Permanently closing this area and removing roads and facilities would mean it would still receive day use. Recovery would proceed more slowly that it would in other less popular areas, but diligent administration would ultimately bring the area into compliance with Forest Plan soil standards for area of detrimental compaction and percentage of soil ground cover.

The effects of a rest-rotation cycle can be examined in the Thetis Creek loop, a severely disturbed loop. The compaction recovery observed there after 7 years rest, indicates a 5-year rest-recovery period is too brief a period to accomplish much gain in soil porosity in the most severely disturbed sites. In areas where sites exhibited low to moderate areas of soil compaction, the 5 years may be adequate to provide sufficient plant root growth to initiate improvements in soil porosity around the campsite perimeter. In addition, the 5 years of growth would help develop an understory plant community that would work in conjunction with the log travel barrier devices to discourage travel between sites and minimize increased compaction.

Natural recovery of soil porosity is a function of a freeze/thaw cycles, burrowing mammals, root development and decay, soil invertebrate and fungal and microbial action. These processes are slow, with plant diversity and density representing an early indicator of recovery. In areas void of organic duff and productive mineral soil, the process must begin with the development of these soil horizons.

Soil Development

Removal of 100 to 200 trees per year may minimize the short-term changes in canopy openings that would expose the forest floor to direct short wave solar radiation. As a result, expect less short-term indirect increases in soil temperatures and decreases in moistures than Alternative 2, 3 and 5. However, over the long-term, the cumulative effects may be the same, as total trees removed would eventually match those of Alternative 2. It is unknown how much understory plant growth would have occurred over this time period, but where it does occur there would be a buffering effect on soil temperatures and moisture. The additional ground disturbance associated with the multiple stand entries, and its frequency of occurrence would contribute to ground cover displacement, which would detrimentally affect soil development.

Soil recovery is dependent on minimizing additional disturbances, establishing or protecting a dense and diverse residual understory plant community, and retaining coarse wood. The greater the vegetation density, the higher the biomass production and accumulation of organic matter at the soil surface. Soil development in the five treated campground loops is expected to be spatially variable and improve only in small isolated areas in the less severely disturbed sites. This is because a 5 year rest period every 20 years, when considered in conjunction with more frequent stand entries than with other alternatives, is not expected to be a sufficient amount of time to yield measurable improvements in organic matter accumulations

Soil development would continue to be degraded in the Beargrass, Box Canyon and Gale loops with entries for hazard tree removals. Additional soil organic layer displacement and vegetation damage is expected during logging, followed by continued heavy recreation use. The percentage of soil organic cover is low, soil compaction is high and organic mineral soil horizons have been lost. Shrub and forb densities are sparse and would contribute very small amounts of fine litter to the soil surface. Coarse wood appears to be either in a late stage of decay or relatively solid. Water holding capacities would improve as recently fallen wood can be retained on-site, and allowed to decompose. Multiple entries would provide the opportunity for the forest soils to receive periodic pulses in coarse woody debris.

Some improvement in soil development is expected in the Gale Creek closure area due to extensive exclosures intended to restrict foot travel from accessing the area. The structural components necessary for soil development, including both fine and coarse inputs of organics are missing from this area. Prohibiting firewood collection should help in the long-term, but short-term it is expected that the public would continue to collect the finer woody debris for campfire use until behaviors can be changed.

At Thetis Creek loop, in 7 years, annual litter fall of mostly fine organic material accumulated around the perimeter of the campsite, with decreasing amounts moving inward to the center of the campsite. Organic material consisted of a thin mat of decomposed leaf litter, and only mildly decomposed needles, small twigs, and branches. Decomposition into humus and incorporation into the surface soil horizon had not yet begun. The permanent closure of the Thetis Creek loop would contribute toward continued improvements in soil development as recreation use is reduced and coarse woody debris is allowed to decompose into humus layer. Percent ground cover is high and shrub communities are on the rebound. Soil loss would be negligible, nutrient reserves would be developed and organics would be incorporated into the mineral soil horizon. Water holding capacities in the organic materials may increase by as much as 100 to 300 % over the next 20 years.

Herbacious and Woody Understory Plants

Alternative 7's effects on vegetation would be similar to Alternative 1, with approximately twice as many trees removed per year. Thetis Loop remains closed as in Alternative 1. It differs from Alternative 1 in that it expands the permanent campsite closures in the Gale Creek to include the entire riparian reserve, and it would have slash treatment and vegetation and soil rehabilitation plans. Items expected to improve the effects over those of Alternative 1 include use of helicopter yarding, prohibited firewood collection, utilization of coarse woody debris for soil productivity and foot traffic control, exclosures in the Box Canyon and Gale Creek day-use areas, reduced campsite disturbance footprint, soil compaction restoration, tree and shrub plantings, and riparian reserve treatment areas. Maintenance and recovery of understory vegetation would vary by severity of site conditions, frequency of use by the public, and effectiveness of mitigation measures. While it provides improvements over Alternative 1, it does not achieve the improvements expected in Alternative 3 or 5, even though 5 provides no rest-rotation.

On the less disturbed campsites, a five (5) year recovery period may be adequate to allow shrubs enough growth to accomplish ground cover revegetation objectives, and provide increased nutrient inputs (litterfall) to build a humus layers. Vegetation recovery at Thetis loop indicated few plant species have encroached into the 60 ft. by 80 ft. campsite in a 7-year rest period, with occupation mainly around the outer 8 –10 feet band of the site's outer perimeter. Downed large wood is just beginning to experience decay, and much of the wood still has its bark intact. Five years is not considered sufficient time to establish a height or density of vegetation to discourage trail development, and provide a barrier to campsite use area expansion (reduction of disturbance footprint). It is expected individual campsites would need to remain closed, beyond 5 years, under this alternative, to allow for vegetation and soil recovery.

In the Beargrass, Box Canyon, and Gale Creek loops fine organic matter accumulations from understory vegetation would remain low, given the low existing percentage of ground cover in the area.

G. AQUATIC RESOURCES AND WATERSHED

AFFECTED ENVIRONMENT

The proposed action is located in the Kachess Lake (1703000111E), Box Canyon (1703000111K) and Gale Creek (17030001111) subwatersheds of the Yakima 5th field watershed. The project area is located in Kachess Campground between Box Canyon Creek and Thetis Creek on the western shoreline of Kachess Lake. Kachess subwatershed is 19,478 acres in size and includes all of Kachess Lake. Approximately 138 acres of this subwatershed is within the Kachess Campground Administrative Area based on available Wenatchee National Forest corporate GIS data. Approximately 9.7 acres of the 7,765 acre Box Canyon subwatershed are within the Campground. Aproximately 17.5 acres of the 5,591 acre Gale Creek subwatershed are within the Campground.

Riparian Reserves

Riparian reserves and wetland areas are the vegetative zones bordering lakes, ponds, springs and seeps, wet meadows, ephemeral, intermittent and perennial streams. Riparian areas provide the link between terrestrial habitats and aquatic habitats. These areas are important to maintaining aquatic habitat. Riparian areas also can provide refugia and dispersal habitat for many terrestrial species.

Riparian Reserves were established as a key element of the Aquatic Conservation Strategy (ACS) in the Northwest Forest Plan (NFP), which amended the Wenatchee National Forest Plan in 1994. Riparian Reserves were established as a land allocation to maintain and restore riparian structure and function of intermittent streams, confer benefits to riparian-dependent and associated species other than fish, enhance habitat conservation for organisms that are dependent on the transition zone between upslope and riparian areas, improve travel and dispersal corridors for many terrestrial animals and plants and provide for greater conductivity of the watershed. Riparian Reserves also serve as connectivity corridors between Late-Successional Reserves.

Riparian Reserves as defined by the NFP include those portions of a watershed required for maintaining hydrologic, geomorphic, and ecological processes that directly affect standing and flowing water bodies such as lakes and ponds, wetlands, streams, stream processes, and fish habitats. Riparian Reserves are primary source areas for wood and sediment such as unstable and potentially unstable areas in headwater areas and along streams. Riparian Reserves occur at the margins of standing and flowing water, intermittent stream channels, ephemeral ponds, and wetlands. Riparian Reserves generally parallel stream networks but also include other areas necessary for maintaining hydrologic, geomorphic and ecological processes.

The project area includes the riparian reserves along the banks of Box Canyon Creek for approximately 1,025 feet (based on available Wenatchee National Forest corporate GIS data) to the confluence with Kachess Lake. The riparian reserve for Kachess Lake within the project area runs from Box Canyon Creek along the western shoreline south to just north of Thetis Creek for approximately 8,375 feet. Also included within the project area are the riparian reserves along Gale Creek for approximately 1,100 feet to the confluence with Kachess Lake. The functioning riparian reserve was determined to average 60 feet in width along the lakeshore and 200 feet along Box Canyon and Gale Creeks.

The majority of riparian reserves within the project area have been altered from their natural condition due to the long term management of this area as a developed campground. The campground is generally filled to capacity on weekends during the summer months. It is also a popular area for snowmobile riding during the winter season. Over years a variety of management activities have occurred within the riparian reserves including campsite creation, hazard tree removal and erosion control. Total length of disturbance within the riparian reserves is approximately 7,660 feet based on GIS mapping.

In the 1970's in an attempt to stop bank erosion and the loss of facilities along Box Canyon Creek, a bulldozer was used to push boulders out of the channel and up onto the streambank to act as riprap (personal communication Lin Cole 1993). The legacy of this activity can still be seen in this section of the creek. The lower streambank is now armored with large boulder substrate that was originally in the channel. The upper banks are largely devoid of any vegetation with the exception of a couple of small conifers and pole size cottonwoods mainly due to the heavy foot traffic this area sustains. Herbaceous ground cover for 600 feet along the east side of the stream in about a 30 foot wide strip is approximately 10%. From 30 feet out to 60 feet there are a few scattered conifers, willow, cottonwood and alder. Ground cover is 50% crisscrossed with numerous footpaths.

In 1996 high flows melting from a record snowpack resulted in a streambank mass wasting event in Gale Creek adjacent to the lower spur of the Gale Creek Loop. As a result of the mass wasting, several large trees on both sides of Gale Creek fell into the creek. For purposes of public safety five campsites adjacent to the creek were closed and some of the trees removed from the creek. Because this section of stream was deficient in large downed wood several of the trees were left in place, however the tops and limbs were removed for safety reasons.

Restoration of the riparian reserves (approximately 200 feet) in Gale Creek in the area that was disturbed in the 1996 flood and along the 600 foot section of Box Canyon Creek within the campground was implemented in 1997 and 1998. Pole fencing, along with gravel trails and interpretive signing was placed adjacent to the two creeks in an attempt to reduce foot traffic on the stream banks. The five temporarily closed campsites in the Gale Creek Loop were permanently closed with the parking pads removed, woody debris scattered and compacted ground roughed up. Native vegetation was replanted along the stream banks in the fall of 1998 and 1999. Success of the restoration has been limited.

Gale Creek has had the most success. The amount of foot traffic on the streambank has been reduced. Grasses have covered much of the bank exposed in the mass wasting event. The replanted native vegetation has been slow to take hold. There is some minor encroachment of herbaceous plants into the closed campsites, but this area still receives foot traffic. Box Canyon has not seen any real improvement. There is still a tremendous amount of foot traffic along the banks and in the riparian reserve. This area is a very popular swimming area with the campground users. The replanted vegetation has a tenuous toe hold at best at this site. Most of these plants, even though some are several years old now are just a few inches in height.

Log structures were placed along the shoreline of Kachess Lake from the eastern end of the Box Canyon Loop down to the southeastern end side of the Thetis Loop in 1990 in an effort to control shoreline erosion. Basalt riprap was also dumped along the shoreline in the day use and boat launch area in the 1980's in an effort to protect the shoreline.

The shoreline riparian reserves from the upper boat launch along the Box Canyon day use area along the north and eastern side of the Box Canyon Loop, along the north and eastern portions of Thetis Loop and along the swimming beach/picnic area down to the lower boat launch have been compacted and lost most of the understory/ground cover component. In these three areas from the high water zone to a width of 60 feet or more the ground cover averages from 5 to 30%. Also in these three areas with the exception of the north side of the Thetis Loop the willow and cottonwood vegetation that makes up the upper vegetated portion of the lake drawdown zone has been lost. The drawdown zone north and east of the upper boat launch has been getting motorized vehicle traffic which may account for some of this loss. This area and the swimming/picnic area also may be sustaining damage from the use of snowmobiles as snowmobile tracks were evident in the soils at both locations. Bicycle tracks were also seen weaving through the drawdown vegetation adjacent to the Lakeshore Trail on the east side of the peninsula. Understory vegetation in the riparian reserves on the Thetis Loop is slowly recovering in the campsites with the encroachment of herbaceous plants such as twinflower and bunchberry dogwood. However, even though the area is closed to camping, it appears to be attracting day use. The shoreline, especially around the eastern portion of the peninsula, appears to be receiving heavy foot and bicycle use and there is very little to any vegetation recovery in this area.

Aquatic Species and Habitat

Fish Species and Distribution

At least 12 species of fish are known to exist or have existed in the past in the Kachess subwatershed (see Table 1). These species include anadromous salmonids, resident salmonids and other fish.

Table 1. Fish species known to exist or to have existed in the Kachess subwatershed.

SCIENTIFC NAME	COMMON NAME
Oncorhynchus kisutch	Coho salmon*
Oncorhynchus tshawytscha	Chinook salmon*
Oncorhynchus nerka	Sockeye salmon*
Oncorhynchus nerka	Kokanee
Oncorhynchus mykiss	Steelhead trout*
Oncorhynchus clarki lewisi	Westslope cutthroat trout
Oncorhynchus mykiss gairdneri	Rainbow/redband trout
Salvelinus fontinalis	Brook trout (introduced)
Salvelinus confluentus	Bull trout
Prosopium coulteri	Pygmy whitefish
Lota lota	Burbot
Ptychocheilus oregonensis	Northern pikeminnow
Cottus sp.	Sculpin (unknown species)

*Anadromous species extirpated from the subwatershed due to the construction of Kachess dam..

The Yakima River once produced an extremely abundant number of anadromous salmonids. Up until about the turn of the 19th Century, anadromous fish were said to abound in the Upper Yakima River (Gilbert and Evermann 1894). No actual fish numbers were recorded but it has been estimated that the Yakima could have supported at a minimum 500,000 spawning chinook salmon (Davidson 1953). One reason suggested for the rapid decline in the fishery was the tremendous commercial fishery ongoing in the lower Columbia River (McDonald 1895). Gilbert and Evermann (1894) reported on the rapid development of cropland in the Yakima Basin and an extensive irrigation system. The development of irrigation systems was outgrowing the ability of the Yakima to supply water and it was thought that soon the entire flow would be withdrawn from the river. Finally, construction of dams in the upper Yakima, (Cle Elum, Kachess, Easton and Keechelus) in the early 1900's contributed to the decline of the anadromous fishery in the basin.

Fish populations occupying Kachess Lake and its tributaries have been isolated from the rest of the Yakima basin since the construction of a crib dam on the lake in 1904 and with the completion of the current dam in 1911. With the completion of the dam, steelhead trout and other anadromous species have been extirpated from the watershed. The dam has also blocked passage of fluvial bull trout from the Yakima River into Kachess Lake, resulting in a remnant adfluvial population in the lake. Other salmonid species found in the lake and fish-bearing tributary streams include cutthroat trout, rainbow trout, brook trout, Kokanee, and pygmy whitefish.

Burbot is a native resident fish also found in Kachess Lake. Burbot are unique in that they are the only freshwater species of the cod family. Burbot have a northern circumpolar distribution and are found generally in large lakes, reservoirs and rivers.

Spawning occurs at night when water temperatures are around 35 degrees Farenheit from January to April. Adults aggregate into large spawning balls in shallow inlets over sandy or gravel bottoms. Eggs hatch after about four to five weeks of incubation (Wydoski et al 1979). Little information is available on the population status of burbot in Washington State. However the Kootenai River population in Idaho has recently been petitioned for listing under the Endangered Species Act. A brief search on the internet also revealed concern for declining populations in other states and countries.

Pygmy whitefish are a small (4.7 to 5.9 in) member of the Salmonid family. In North America they are distributed across the northern tier of the US, throughout Canada and north into southeast Alaska. The fish spawn in late summer to early winter scattering their eggs over coarse gravel in streams and lake shallows. Food items consumed by pygmy whitefish include crustaceans, aquatic insects larvae, fish eggs and small mollusks. Pygmy whitefish are also thought be an important prey species for bull trout.

Pygmy whitefish are generally found in cool lakes and streams of mountainous regions. Washington State is at the extreme southern edge of the pygmy whitefish's range. Once found in 15 or more lakes, pygmy whitefish have been eliminated from at least six waters due to fish management activities and declining water quality. The population status in the remaining nine lakes (including Kachess) is unknown. In light of this WDFW recommends that watersheds and lakes containing pygmy whitefish populations have adequate protection from accelerated eutrophication. This includes practices which protect riparian reserves and limit erosion to prevent siltation of spawning areas and warming of water temperatures (Hallock et al 1998).

Box Canyon Creek within the project area was snorkel surveyed in early September 2000 for fish presence. No fish were seen at that time. Most likely because of the high human use in this segment, fish are using it only for migration access between the creek above the campground and the lake.

Gale Creek has not been surveyed but kokanee have been seen spawning in the segment within the project area.

Threatened, Endangered and Sensitive Species

The following Threatened, Endangered and Sensitive species occur or are suspected to occur in the Kachess Lake, Box Canyon and Gale Creek subwatersheds. Proposed species are those species that the U.S. Fish and Wildlife Service (USFWS) or National Marine Fisheries Service (NMFS) has determined warrant listing as threatened or endangered. Candidate Species are those which the USFWS or NMFS are reviewing information to determine if that species warrants listing. Species of Concern are those species whose conservation standing is of concern to USFWS or NMFS, but for which further status information is needed. Forest Service Sensitive Species are those recognized by the Regional Forester as a species for which population viability is a concern.

Bull Trout (*Salvelinus confluentus*) – The Columbia Basin Distinct Population Segment (DPS) of bull trout was listed as Threatened by the USFWS June 1, 1998. The bull trout inhabitating the Yakima River drainage are included in this population segment.

Bull trout are found in a variety of habitats ranging from small headwater streams and large rivers to lakes. Some fish may remain in headwater streams, migrating short distances to spawning sites. Other fish may migrate relatively long distances into small streams to spawn from rivers or lakes. These fish may spend two to four years in their natal streams before migrating into larger rivers or lakes.

Within the Kachess Lake subwatershed the bull trout stock status is identified as critical based on chronically low spawning escapement for the past 13 years (WDFW 1997). Box Canyon is considered to be the primary spawning area for Kachess Lake. The highest redd count in Box Canyon for the resent past was 17 in 1999. There have been fewer than ten redds in any given year for 10 of the last 17 years.

The presences of bull trout in upper Kachess River and Mineral Creek has been known for several years but the timing of the migration run was until the fall of 2000 unknown. Field investigation conducted by the Washington Depatment of Fish and Wildlife (WDFW) documented adult adfluvial bull trout moving from Kachess Lake into the upper Kachess River in early to mid-October. Spawning activity was subsequently documented in late October through early November. The upper Kachess River usually goes subsurface from the mouth (confluence with Kachess Lake) to upstream for a distance of approximately one mile during late summer. Movement of adult bull trout into the upper Kachess River is obviously triggered by late fall rains. Periodic de-watering of the river channel occurred during the spawning season causing stranding and mortality of a few adult bull trout (Anderson 2000). A total of 15 redds were found in the upper Kachess River and Mineral Creek in 2000.

Westslope Cutthroat Trout (*Oncorhynchus clarki lewisi*) – Westslope cutthroat trout are listed on the Regional Forester's Sensitive Species List. It is also a USFWS species of concern.

Westslope cutthroat trout can exhibit several life histories. They can migrate between lakes and streams, between small tributaries and main rivers, or remain non-migrating residents of tributary streams. Spawning generally occurs in spring through summer.

Westslope cutthroat trout occur in the Kachess Lake, Box Canyon and Gale Creek subwatersheds and are found in all of the fish-bearing streams in the project analysis area. Kachess Lake has been stocked with westslope cutthroat by the WDFW since the 1980's. Genetic testing has not be done to evaluate the impact stocked fish may be having on the native cutthroat population.

Redband Trout (*Oncorhynchus mykiss gairdneri*) – This species is on the USDA-Forest Service Regional Forester's sensitive species list.

Redband trout are a variant of rainbow trout that have been found east of the Cascades in the Columbia River Basin. Redband trout are suspected to occur wherever wild trout populations exist. Redband and rainbow trout exhibit a life history similar to steelhead trout, except they are not anadromous.

Redband trout occur in the Yakima River Basin. While not a listed or proposed species, the presence of the redband population may be important to steelhead populations. The anadromous steelhead and resident redband populations are thought to be one population in the Upper Columbia (Chapman et. al. 1994). If the same situation exists in the Mid-Columbia, the redband in the Kachess subwatershed may be a genetic reservoir important for the recovery of steelhead populations. Currently, however, access between Kachess watershed and the Yakima is disrupted by the dam at Kachess Lake.

Rainbow trout are found through out the analysis area in all the fish-bearing streams. Rainbow trout were planted in Kachess Lake for about 50 years. They are no longer being planted. As with the cutthroat trout, it is not known what influence if any the planted fish may have had on the native rainbow population.

Aquatic Habitat

Aquatic habitat for Gale and Box Canyon creeks within the project area makes up a small fraction of the available habitat for both creeks. Approximately 1,100 feet of habitat out of 5.4 miles of available habitat in Gale Creek is located within the project area. Approximately 1,025 feet of habitat out of 10 miles of available habitat in Box Canyon Creek is located within the project area.

Salmonids are coldwater fish with definite temperature requirements. Water temperature can influence the metabolism, behavior, and mortality of trout along with other aquatic organisms. Standards and guidelines in the Wenatchee National Forest Land and Resource Management Plan as modified by the Northwest Forest Plan for stream temperatures are as follows:

- The maximum temperature would be less than or equal to 61 F on any day and/or the average 7 day maximum temperature would be less than or equal to 58 F.
- Where streams naturally exceed the above standards, management activities would not cause further measurable temperature increase.

Gale Creek is the only water body in the project area that is listed on the Clean Water Act 303(d) list for non-compliance. Water temperature data for Gale Creek was collect for 1996, 1999, 2000 and 2001. In all four years water temperatures exceeded the Wenatchee Forest Plan standards. Water temperature for Box Canyon Creek was collected for 1996, 1998, 1999 and 2001. The 1997 and 2000 data for Box Canyon and

the 1997 and 1998 data for Gale Creek were lost (the recording devices were washed away or stolen). Water temperature exceeded standards in Box Canyon during the 1996, 1998, and 2001 seasons for the average seven day maximum temperature perimeter. See Tables 2 and 3 for a summary of water temperature data.

Table 2. Annual water temperature summary for Gale Creek.

	Maximum Daily Temp. (F)	Number Days >61 F	Maximum 7 Day Average Temp. (F)	Number Days >58 F
1996	65.5	18	64.3	35
1997	Thermograph Lost, No Data Available			
1998	Thermograph Lost, No Data Available			
1999	61.9	1	59.4	18
2000	63.1	5	61.5	21
2001	61.8	1	69.6	9

Table 2. Annual water temperature summary for Box Canyon.

	Maximum Daily Temp. (F)	Number Days >61 F	Maximum 7 Day Average Temp. (F)	Number Days >58 F
1996	60.9	0	58.7	5
1997	Thermograph Lost, No Data Available			
1998	63.2	10	62	28
1999	56.7	0	55.8	0
2000	Thermograph Lost, No Data Available			
2001	60.2	0	59.6	9

Only a limited amount of sediment data has been collected on streams in the project analysis area. Box Canyon Creek was sampled once in 1990. McNeil gravel core samples found fine sediment levels averaging 8.2% by volume (Watson 1991). Gale Creek was surveyed in 1991 for aquatic condition. Stream channel substrate was found to be at least 30% embedded by fine sediments.

Woody debris numbers in Box Canyon Creek ranges from 25 pieces per mile to 70 pieces per mile. The lower ranged counts are in reaches that have had past timber harvest in the

riparian reserves. Based on land type and vegetation potential a range of 50 to 80 pieces per mile is probably what should be expected for this creek. The segment within the project area currently has no functioning large wood. A Bureau of Reclamation project implemented 1997 placed short segments of wood in this segment of channel, but the wood was washed out by high water after one season. Woody debris in Gale Creek ranges from 4 pieces per mile to 28 pieces per mile. However, Gale Creek upstream from the campground has been heavily harvested by private landowners and the Forest Service. Wood recruitment within the project area of Gale Creek is within standards. Much of the wood currently in the channel in this segment has resulted from the mass wasting event in 1996 and from recent dropping of hazard trees in the Big tree area on the north side of the creek. Gale Creek is similar to Box Canyon Creek and should have about the same potential for wood recruitment.

ENVIRONMENTAL CONSEQUENCES

Alternative 1. *No Change*

Under this alternative management of hazard trees within Kachess Campground would continue on as it has in the past including annual hazard tree removals. The rules for hazard tree evaluation would remain the same. Total removal would average about 75 trees per year.

Direct Effects – Under this alternative within riparian reserves, only trees determined to be hazardous and having the potential to strike a stationary target would be felled. Trees felled in the riparian reserve are to remain in place. In the past, if the area was available to public access, the trees, once down would be limbed, cut into smaller sections or removed for safety reasons. It is assumed for the purposes of this analysis this practice would continue. Since the implementation of the Aquatic Conservation Strategy Objectives via the amended Wenatchee National Forest Land and Resource Management Plan, a relatively small number of trees have been felled within the riparian reserves. The direct impacts of felling the occasional tree within the riparian reserve should be very minimal to aquatic species and habitat. Felling a tree into the water may cause a short term increase in turbidity of the water resulting from the disturbance of the substrate. However this increase should last only a matter of minutes before clearing up. Limbing and/or cutting the tree in smaller sections should have the same minimal impact. Removal of a tree felled in the riparian reserve may result in soil displacement which could have the potential to be routed into a stream or the lake resulting in an increase in water turbidity and in-stream fine sediment levels. Because generally only one or two trees every couple of years is required to be removed, any increase would not be detectable above background levels.

Indirect and Cumulative Effects – The continued felling of trees and opening of the overstory canopy over a long period of time without the continuous maturing of trees to replace those felled could potentially impact resident fish populations by exposing the streams channel to more solar radiation and increase water temperatures during the

critical summer months. This would be a greater potential problem along the southern streambank of Gale Creek in the Gale Creek Loop. Gale Creek is chronically out of compliance with Forest Plan Standards in regards to water temperature. The upper watershed of Gale Creek, upstream of the campground, has been heavily harvested in the recent past which is likely one contributing factor in the seasonally high water temperatures for this creek.

Riparian vegetation also provides bank stability by holding soil in place with root mass. The continual reduction in vegetation within the riparian reserves could result in an increase of fine sediment that could fill in pools where fish rest and find escape cover while migrating. An increase in fine sediment levels could impact the shallow gravel lakebed by filling in the interstitial spaces between the gravel substrate adjacent to the campground which could be spawning habitat of pygmy whitefish and burbot.

Currently the public has uncontrolled access to the majority of streambanks and lake shoreline throughout the campground. Felling trees in the riparian reserves along the streams and lakeshore would further open up understory vegetation and ground cover and is likely to further encourage more recreation use leading to increased bank erosion in these areas. Of the approximate 10,500 foot length of streambanks and shoreline within the campground approximately 7,660 feet have varying degrees of disturbance. Areas of greatest disturbance are approximately 600 feet along Box Canyon Creek, which currently has about 10% ground cover even after several years with an ongoing revegetation project. About 300 feet of the 1,100 foot length of Gale Creek within the project area is exhibiting bank erosion and a decrease in vegetative ground cover. A 200 foot portion is slowly recovering after a restoration project was implemented in 1997. However recovery appears to be somewhat impeded by high recreation usage. The highest disturbed areas along the lake shoreline include 2800 feet along the north side of the Box Canyon Day Use area and camping loop that averages from 5 to 30% groundcover. The willow and cottonwood vegetative component within the upper drawdown zone also appears to be suppressed by motorized and foot traffic in this area. A second area of high disturbance is approximately 1,900 feet adjacent to the north and east sides of the Thetis Loop on the peninsula. Even with the current closure of this loop to camping, the area is still receiving high levels of day use along the shoreline. Vegetative ground cover ranges from 20 to 50%. The final highly impacted areas are in the lower day use area and boat launch. This area is approximately 1,100 feet in length and has about 5% groundcover. The draw down zone vegetation appears to be similarly impacted as in the Box Canyon Loop area.

Previous attempts at streambank revegetation have been met with mixed success. If the area is attractive for accessing the lake or streams, people would be there. No amount of signing, barrier placement or closure seems to discourage use by the public. This is evident along Box Canyon Creek and along the shoreline in Thetis Loop. With no stronger deterrence to prevent the public from utilizing these areas aquatic and riparian habitat conditions would remain stagnant or continue to slowly decline over time.

Alternative 2. *Full Treatment*

Direct Effects – Under this alternative within riparian reserves, only trees determined to be hazardous and having the potential to strike a stationary target would be felled. Trees felled in the riparian reserve are to remain in place unless determined by the district fisheries biologist to be in excess of what is needed to meet Forest Plan standards and guidelines for downed woody debris. Any excess wood would be relocated to areas within the campground deemed deficient in woody debris. Wood remaining or relocated would be placed so as to provide effective barriers for the protection of streambanks and the lake shoreline from further degradation and provide for the vegetative recovery of these areas. Vegetation would be replanted with conifers averaging four to eight feet in height, and other appropriate native grasses/forbs and shrubs. Exclosure areas from visitor use are to be created in the heaviest impacts areas along the Box Canyon Day Use area, the shoreline along the eastern edge of the Peninsula in Thetis Loop and along the shoreline near the Gale Creek boat launch between the parking area and the swimming beach. Firewood gathering is to be prohibited from the campground.

Implementation of this alternative would have similar direct impacts to aquatic species and habitat as Alternative 1. The occasional felling of a tree within the riparian reserves should only result in a short term increase in turbidity if the tree was dropped into the water causing a disturbance of the substrate. The direct impacts of felling the occasional tree within the riparian reserve should be very minimal to aquatic species and habitat. Felling a tree into the water may cause a short term increase in turbidity of the water resulting from the disturbance of the substrate. However this increase should last only a matter of minutes before clearing up. Limbing and/or cutting the tree in smaller sections should have the same minimal impact. Removal of a tree felled in the riparian reserve may result in soil displacement which could have the potential to be routed into a stream or the lake resulting in an increase in water turbidity and in-stream fine sediment levels. Because generally only one or two trees every couple of years is required to be removed, any increase would not be detectable above background levels. Relocating woody debris to the exclosure areas along Box Canyon, Thetis Loop and Gale Creek boat launch area may result in soil displacement within the reserves as material is placed. The resulting soil displacement could have the potential to be routed into a stream or the lake causing a short term increase in water turbidity and fine sediment levels. The replanting of vegetation should stabilize the soils and reduce the potential for routing of fine sediments to the streams and lake.

Indirect and Cumulative Effects – Under this alternative uncontrolled public access to the lake shore and streambanks would be restricted to delineated, hardened access points. This should allow for the recovery of vegetation, providing a source for the replacement of trees felled for safety concerns. With the full implementation and enforcement of these conservation measures the area should experience a recovery of riparian and aquatic habitat over the long term. However for these conservation measures to be successful, the willingness and full diligence of district personnel and the campground concessionaire would be necessary. History has shown this requires considerable

attention to be effective and this is sometimes difficult to provide. With full support this alternative should result in a long-term improvement in aquatic and riparian habitat.

Alternative 3. *Treat about half of each loop.*

Direct Effects – Under this alternative within riparian reserves, only trees determined to be hazardous and having the potential to strike a stationary target would be felled. Trees felled in the riparian reserve are to remain in place unless determined by the district fisheries biologist to be in excess of what is needed to meet Forest Plan standards and guidelines for downed woody debris. Any excess wood would be relocated to areas within the campground deemed deficient in woody debris. Wood remaining or relocated would be placed so as to provide effective barriers for the protection of streambanks and the lake shoreline from further degradation and provide for the vegetative recovery of these areas. Vegetation would be replanted with conifers averaging four to eight feet in height, and other appropriate native grasses/forbs and shrubs. Exclusion areas from visitor use are to be created in the heaviest impacts areas along the Box Canyon Day Use area, the shoreline along the eastern edge of the Peninsula in Thetis Loop and along the shoreline near the Gale Creek boat launch between the parking area and the swimming beach. Firewood gathering is to be prohibited from the campground.

Implementation of this alternative would have similar direct impacts to aquatic species and habitat as Alternative 2, except that three campsites in the Box Canyon Loop and three sites in the Thetis Loop within the riparian reserves with the most severe compaction and vegetation loss would be permanently closed and rehabilitated. The occasional felling of a tree within the riparian reserves should only result in a short term increase in turbidity if the tree was dropped into the water causing a disturbance of the substrate. The direct impacts of felling the occasional tree within the riparian reserve should be very minimal to aquatic species and habitat. Felling a tree into the water may cause a short term increase in turbidity of the water resulting from the disturbance of the substrate. However this increase should last only a matter of minutes before clearing up. Limbing and/or cutting the tree in smaller sections should have the same minimal impact. Removal of a tree felled in the riparian reserve may result in soil displacement which could have the potential to be routed into a stream or the lake resulting in an increase in water turbidity and in-stream fine sediment levels. Because generally only one or two trees every couple of years is required to be removed, any increase would not be detectable above background levels. Relocating woody debris to the exclosure areas along Box Canyon, Thetis Loop and Gale Creek boat launch area may result in soil displacement within the reserves as material is placed. The resulting soil displacement could have the potential to be routed into a stream or the lake causing a short term increase in water turbidity and fine sediment levels. The replanting of vegetation should stabilize the soils and reduce the potential for routing of fine sediments to the streams and lake. Impacts to aquatic resources should be similar for the rehabilitation of the campsites in the Box Canyon and Thetis Loops.

Indirect and Cumulative Effects – Under this alternative uncontrolled public access to the lake shore and streambanks would be restricted to delineated, hardened access points. This should allow for the recovery of vegetation, providing a source for the replacement of trees felled for safety concerns. Also the most degraded riparian campsites would be permanently closed and rehabilitated. The effects of this alternative should be similar to those identified in alternative 2.

As with alternative 2 for these conservation measures to be successful, the willingness and full diligence of district personnel and the campground concessionaire would be necessary. History has shown this requires considerable attention to be effective and this is sometimes difficult to provide. With full support this alternative should result in a long-term improvement in aquatic and riparian habitat that should be incrementally better than alternative 2 due to the permanent closure of seven sites in Box Canyon and Thetis loops within the riparian reserves.

Alternative 5. *Partial treatment across the campground*

Under this alternative approximately 1/3 to 1/2 of the trees recommended for removal in Alternative 2 would be cut. All portions of the camping loops would remain open and the public would be informed via signs that some hazard may remain in the campground. This alternative would remove approximately 800 to 1000 trees.

Direct Effects – Under this alternative within riparian reserves, only trees determined to be hazardous and having the potential to strike a stationary target would be felled. Trees felled in the riparian reserve are to remain in place unless determined by the district fisheries biologist to be in excess of what is needed to meet Forest Plan standards and guidelines for downed woody debris. Any excess wood would be relocated to areas within the campground deemed deficient in woody debris. Wood remaining or relocated would be placed so as to provide effective barriers for the protection of streambanks and the lake shoreline from further degradation and provide for the vegetative recovery of these areas. Vegetation would be replanted with conifers averaging four to eight feet in height, and other appropriate native grasses/forbs and shrubs. Exclusion areas from visitor use are to be created in the heaviest impacts areas along the Box Canyon Day Use area, the shoreline along the eastern edge of the peninsula in Thetis Loop and along the shoreline near the Gale Creek boat launch between the parking area and the swimming beach. Firewood gathering is to be prohibited from the campground. Four campsites in the Box Canyon Loop and three sites in the Thetis Loop within the riparian reserves with the most severe compaction and vegetation loss would be permanently closed and rehabilitated.

Implementation of this alternative would have similar direct impacts to aquatic species and habitat as Alternative 3. The occasional felling of a tree within the riparian reserves should only result in a short term increase in turbidity if the tree was dropped into the water causing a disturbance of the substrate. The direct impacts of felling the occasional tree within the riparian reserve should be very minimal to aquatic species and habitat.

Felling a tree into the water may cause a short term increase in turbidity of the water resulting from the disturbance of the substrate. However this increase should last only a matter of minutes before clearing up. Limbing and/or cutting the tree in smaller sections should have the same minimal impact. Removal of a tree felled in the riparian reserve may result in soil displacement which could have the potential to be routed into a stream or the lake resulting in an increase in water turbidity and in-stream fine sediment levels. Because generally only one or two trees every couple of years is required to be removed, any increase would not be detectable above background levels. Relocating woody debris to the exclosure areas along Box Canyon, Thetis Loop and Gale Creek boat launch area may result in soil displacement within the reserves as material is placed. The resulting soil displacement could have the potential to be routed into a stream or the lake causing a short term increase in water turbidity and fine sediment levels. The replanting of vegetation should stabilize the soils and reduce the potential for routing of fine sediments to the streams and lake. Impacts to aquatic resources should be similar for the rehabilitation of the campsites in the Box Canyon and Thetis Loops.

Indirect and Cumulative Effects – Under this alternative uncontrolled public access to the lake shore and streambanks would be restricted to delineated, hardened access points. This should allow for the recovery of vegetation, providing a source for the replacement of trees felled for safety concerns. Also the most degraded riparian campsites would be permanently closed and rehabilitated. The effects of this alternative should be similar to those identified in alternative 3.

As with the previous alternatives for these conservation measures to be successful, the willingness and full diligence of district personnel and the campground concessionaire would be necessary. History has shown this requires considerable attention to be effective and this is sometimes difficult to provide. With full support this alternative should result in a long-term improvement in aquatic and riparian habitat that should be incrementally better than alternative 2 and similar to alternative 3 due to the permanent closure of seven sites in Box Canyon and Thetis loops within the riparian reserves.

Alternative 6. *Close most of the campground, except day-use areas*

Under this alternative overnight camping facilities would be removed and loops closed. Day use areas in Box Canyon Creek and Gale Creek would remain open. The area would be available for dispersed walk-in camping.

Direct, Indirect and Cumulative Effects –Under this alternative, effects would be similar to Alternative 1 but to a smaller degree because only the two day use areas would remain open as developed facilities and the number of users would be reduced. However, these areas are two of the areas with the most concerns for impacts to aquatic and riparian resources. In addition, dispersed walk-in use would likely cause some popular sites to remain in a degraded condition.

Alternative 7. *Close sites in the most critical riparian areas, continue annual hazard tree removal in remainder of the campground*

Under this alternative, the Thetis Loop would remain closed and portions of Gale Creek loop and Box Canyon loop would be closed. The other loops would be managed on a five year rest rotation basis. The hazard trees would be treated on an annual basis. Approximately 150-200 trees would be removed per year.

Direct Effects – Under this alternative within riparian reserves, only trees determined to be hazardous and having the potential to strike a stationary target would be felled. Trees felled in the riparian reserve are to remain in place unless determined by the district fisheries biologist to be in excess of what is needed to meet Forest Plan standards and guidelines for downed woody debris. Any excess wood would be relocated to areas within the campground deemed deficient in woody debris. Wood remaining or relocated would be placed so as to provide effective barriers for the protection of streambanks and the lake shoreline from further degradation and provide for the vegetative recovery of these areas. Vegetation would be replanted with conifers averaging four to eight feet in height, and other appropriate native grasses/forbs and shrubs. Exclusion areas from visitor use are to be created in the heaviest impacts areas along the Box Canyon Day Use area, the shoreline along the eastern edge of the Peninsula in Thetis Loop and along the shoreline near the Gale Creek boat launch between the parking area and the swimming beach. Firewood gathering is to be prohibited from the campground. Four campsites in the Box Canyon Loop and three sites in the Thetis Loop within the riparian reserves with the most severe compaction and vegetation loss would be permanently closed and rehabilitated.

Implementation of this alternative would have similar direct impacts to aquatic species and habitat as Alternative 3. The occasional felling of a tree within the riparian reserves should only result in a short term increase in turbidity if the tree was dropped into the water causing a disturbance of the substrate. The direct impacts of felling the occasional tree within the riparian reserve should be very minimal to aquatic species and habitat. Felling a tree into the water may cause a short term increase in turbidity of the water resulting from the disturbance of the substrate. However this increase should last only a matter of minutes before clearing up. Limbing and/or cutting the tree in smaller sections should have the same minimal impact. Removal of a tree felled in the riparian reserve may result in soil displacement which could have the potential to be routed into a stream or the lake resulting in an increase in water turbidity and in-stream fine sediment levels. Because generally only one or two trees every couple of years is required to be removed, any increase would not be detectable above background levels. Relocating woody debris to the exclosure areas along Box Canyon, Thetis Loop and Gale Creek boat launch area may result in soil displacement within the reserves as material is placed. The resulting soil displacement could have the potential to be routed into a stream or the lake causing a short term increase in water turbidity and fine sediment levels. The replanting of vegetation should stabilize the soils and reduce the potential for routing of fine sediments to the streams and lake. Impacts to aquatic resources should be similar for the rehabilitation of the campsites in the Box Canyon and Thetis Loops.

Indirect and Cumulative Effects – Under this alternative uncontrolled public access to the lake shore and streambanks would be restricted to delineated, hardened access points. This should allow for the recovery of vegetation, providing a source for the replacement of trees felled for safety concerns. Also the most degraded riparian campsites would be permanently closed and rehabilitated. The effects of this alternative should be similar to those identified in alternative 3.

As described in alternatives 2, 3, and 5 for these conservation measures to be successful, the willingness and full diligence of district personnel and the campground concessionaire would be necessary. History has shown this requires considerable attention to be effective and this is sometimes difficult to provide. With full support this alternative should result in a long term improvement in aquatic and riparian habitat that should be incrementally better than alternative 2 and similar to alternative 3 due to the permanent closure of seven sites in Box Canyon and Thetis loops within the riparian reserves.

Essential Fish Habitat Determination

This project is located adjacent to Kachess Lake. The dam is a total barrier to any anadromous fish migration. Therefore, none of the alternatives would adversely affect Essential Fish Habitat for Mid-Columbia steelhead trout.

Consistency with Aquatic Conservation Strategy Objectives

Conditions in the campground are currently inconsistent with several Aquatic Conservation Strategy objectives. Streambank, shoreline and in-channel conditions are in poor physical shape due to past management practices such as ripraping and high numbers of people concentrating along the streambanks and shorelines (#3, 5)*. The loss of riparian vegetation has most likely influenced water quality by raising water temperatures and increasing sediment levels (#4, 5)*. The diversity of riparian vegetation species has been altered by past management practices and the large numbers of visitors congregating next to the water (#8, 9)*. All alternatives, except #1, would begin to improve conditions and are therefore consistent with the aquatic conservtion strategy.

* Refers to the number of the individual aquatic conservation strategy objective. See Appendix C for details.

H. WETLANDS, FLOODPLAINS, AND PRIME FARMLANDS

There area none in the project area.

I. WILDLIFE

AFFECTED ENVIRONMENT

1. Current Direction for Management of Wildlife Habitats in and around Kachess Campground

1.a. Forest Connectivity under the Snoqualmie Pass AMA Plan

Kachess Campground is located within the Snoqualmie Pass Adaptive Management Area, where emphasis is on maintaining and enhancing connectivity of late successional forest habitats across the "checkerboard lands" surrounding Interstate 90. This area is a critical link in the north-south movement of organisms in the Cascade Range (U.S. For. Serv., 1994).

Under the Management Plan for the Snoqualmie Pass Adaptive Management Area (1997), Kachess Campground is located on the perimeter of a "Connectivity Emphasis Area" (CEA). This 4X10-mile corridor between Lake Kachess and Lake Keechelus is generally managed under standards and guidelines accorded to Late Successional Reserves (LSRs). Existing developed campgrounds such as Kachess, however, are the exception (FEIS pp. 2-8 and 2-10). In established recreational developments within the CEA, "minor adjustments" are used to bring facilities into compliance with amended land and resource management plans, to effect watershed restoration, and to meet AMA goals and objectives.

1.b. Aquatic Conservation Strategy as it Relates to Terrestrial Wildlife

The Aquatic Conservation Strategy (ACS) is intended to maintain and restore aquatic ecosystems across broad landscapes, as opposed to individual project areas or small watersheds. All proposed activities in riparian reserve, however, must either meet or not prevent attainment of larger ACS objectives.

When operation of existing developments such as Kachess Campground is not compatible with ACS objectives, then minor adjustments and mitigation are the preferred methods for resolving conflicts. Where impacts from recreational activities cannot be effectively mitigated, however, and those impacts prevent the attainment of larger ACS objectives, then the activity will be eliminated within the riparian reserve.

Kachess is a large campground spanning the lowest reaches of 2 streams—Box Canyon and Gale creeks. A third stream, Thetis Creek, empties into the lake just outside the campground. A high percentage of the campground is either lakeshore or within riparian reserve areas along streams, and is therefore subject to ACS objectives.

Two ACS objectives relate specifically to terrestrial wildlife and the reliance of most wildlife on riparian systems. They are:

- *Maintain and restore habitat to support well-distributed populations of native plant, invertebrate, and vertebrate riparian-dependent species.*

- *Maintain and restore spatial and temporal connectivity within and between watershed.*

In this project area, maintaining and connecting riparian forest corridors is especially important for movement of animals in and between the Thetis, Gale, and Box Canyon Creek subbasins. The forested lakeshore may also provide important resting cover and foraging opportunities for birds migrating seasonally along the 10-mile length of Lake Kachess[1].

1.c. Decaying Wood Habitat Structure in Developed Campgrounds

There are no Forest Plan standards and guidelines dealing specifically with snag and log retention in developed campgrounds. Under the Snoqualmie Pass AMA plan, LSR standards apply outside, but not in Kachess Campground.

Under the Northwest Forest Plan, however, snag management in adaptive management areas must at least meet the intent behind measures prescribed for matrix (ROD pp. C-41). Those requirements are to:

> Retain at least 15% of the area associated with each cutting unit (stand), with 70% of the total area retained in aggregates 0.2 to >1 ha in size, and the remainder as dispersed trees or clumps <0.2 ha in size. Larger aggregates are particularly important where adjacent areas have little late successional habitat. To the extent possible, patches and dispersed retention should include the largest, oldest live trees, decadent or leaning trees, and hard snags occurring in the unit. Patches should be retained indefinitely.

In addition, to meet both distribution and viability requirements under the National Forest Management Act, cavity excavators must be minimally maintained at 40% of their potential population capacity across subbasins, with required snags per acre met on average areas no larger than 40 acres[2].

Rose et al (2001) assert that the most appropriate scale for predicting the effects of management for decaying wood structure is minimally at a watershed, rather than stand or project scale, given the highly variable needs among species, populations, and even individual animals, and constantly changing conditions on the ground, both human-

[1] Some species are known to migrate northward in spring along mountain ranges and valleys that are oriented north-south, such as the Kachess valley. This pattern is typical of Townsend's warbler and MacGillivray's warbler, for example (*National Audubon Society: Sibley Guide to Bird Life and Behavior, 2001*).

[2] (ROD pp. C-41, C-42.)

caused and natural. Decaying wood habitats may be most effective for wildlife, however, when they are well distributed across landscapes and also when they occur in locally dense clumps.

Provision of snags may not be prescribed in this project area, but is desirable here for the following reasons:

- The campground fully occupies an area of low relief that physically links three subbasins; therefore, habitat connectivity is particularly advantageous here.

- The Gale-Thetis subwatershed is heavily cutover, and remaining "snag-rich" late successional forest habitat is highly fragmented. Therefore, options for retention of snags in that subbasin are already greatly reduced and are at or near a level where the viability of the cavity excavator population is a concern.

- The presence of decaying wood structure may enhance the recovery of denuded and compacted soils and the growth of understory vegetation and trees, through profound influences on nutrient cycling, nutrient uptake, and soil moisture retention.

- The presence of snags and logs may facilitate certain wildlife presence in or near the campground, even during periods of heavy human use. The opportunity to observe wildlife enhances the recreational experience for many campground users. Excited visitors often report seeing pileated woodpeckers here-—a species whose presence hinges largely on the dwindling availability of large trees, snags, and decaying logs across the campground.

Although providing snags randomly throughout a campground can be a safety hazard, there are certain actions that can be taken to provide at least some measure of snag habitat. These include designating "snag retention areas" in locations removed from fixed "targets", topping of hazard trees rather than felling, and even leaving tall stumps.

2. Overview of past and present habitat conditions for terrestrial wildlife in and around the campground.

Kachess Campground is comprised of plant associations of the western hemlock and Pacific silver fir series. Most of the project area is late seral or climax forest (Hessburg 1993) with vegetative structure that has been heavily modified by decades of heavy human use. The project area would be classified as (moist) eastside mixed conifer forest habitat, transitioning into a montane mixed conifer habitat type dominated by silver fir (Chappell et al. 2001).

2a. Camping, Day-use, and Boat Launch Areas:

Today, denuded and compacted soils characterize many high use areas, including the lakeshore, stream banks of Gale and Box Canyon Creeks, most campsites, and day use areas. In many places, there is little or no understory vegetation. Snags and large dying and defective trees are virtually absent across most of the campground. Down logs are few and scattered, and firewood is in short supply in many areas.

As recently as 20–30 years ago, large old trees were found in most parts of the campground, and dense canopy cover (>60%) characterized all areas except the Box Canyon boat launch (an open stand of lodgepole pine). Today, most if not all "giant" trees[3] are confined to the big tree area and the outer fringes of the Thetis loop. Dense closed canopy conditions now persist only in the Gale camping loop and big tree area.

The apparent change in overstory structure across most of the campground is the result of repeated annual removal of hazard trees in response to root disease problems and also natural tree mortality. In the 1990s, an average of 75 hazard trees were removed annually from this campground[4]. Hazard trees were also removed throughout the 1970s and 1980s, but numbers could not be estimated. There were 2 commercial salvage operations here prior to 1990, apparently because routine hazard tree operations were not keeping pace with the development of hazard trees in expanding root disease pockets.

2b. The Big Tree Area

The 16-acre big tree area stands in sharp contrast to the rest of the campground. This relatively undisturbed patch of old forest is located between Gale Creek and the Lodge camping loop, and extends east from the main campground road to the shoreline of Lake Kachess.

This big tree are is not pristine, but has been spared the intensive hazard tree management, salvage treatments, trampling, and firewood collection that have occurred in other parts of the campground. It provides superior old forest habitat structure for wildlife (Franklin et al. 1981), although its small size and growing isolation in the campground may reduce its utility to some wide-ranging species.

The big tree area is still characterized by complex vertical and horizontal vegetative structure. Douglas-fir, western hemlock, and western red cedar trees (4-7 feet in diameter at breast height) are overstory dominants. Pacific silver fir, western hemlock, and

[3] "Giant trees" are defined as >30 in. dbh, in *Wildlife-habitat relationships in Oregon and Washington, 2001*, D.H. Johnson and T. A. O'Neil.

[4] Since 1994, district records indicate that almost 500 hazard trees [7-60 in dbh] were removed from Kachess Campground. Two hundred trees (est'd) were removed in 1991 and 1992 (Cle Elum RD, unpub. data).

western red cedar trees (2-4 ft in diameter) occupy codominant and intermediate canopy positions. Understory trees and shrubs are scant except in gaps created by the fall of single large trees or small groups of trees. There is also vigorous shrub growth around the southern and eastern edges of the big tree area (along Gale Creek and the lakeshore). There, tall shrubs (*Salix* spp., *Alnus* spp., *Acer circinatum*) form dense thickets that are utilized in spring and summer by snowshoe hare, ruffed grouse, black-tailed deer[5], and migratory songbirds.

In the big tree area, snags and logs are prevalent in a wide array of diameter, height, and decay classes, and many cavities are evident in living trees and snags. Large hollow trees and logs are present. Indicators of decay in living trees, such as broken tops and branches, conks, cracks, cankers, cavities, and dwarf mistletoe deformity (in hemlocks) are common (pers. observ., this writer).

There are no campsites or permanent structures here—only a network of foot-trails (including some user-built) and some wooden benches that have not been maintained in recent years. In the past, sections of large logs (3-5 ft. in diameter) that fell across trails were cut out to provide for trail passage, but otherwise, the only recent vegetation management that has taken place in the big tree area is hazard tree felling around its perimeter.

During the last 5 years, at least 7 large hazard trees (3-5 ft dbh, 100–170 ft in height) were felled[6] along the southern edge of the big tree area (north shore of Gale Creek), in order to protect the Gale Creek Bridge and campsites on the opposite side of the creek. The felled trees, including a Douglas -fir that was 450 years old at the time it was felled (*stump diameter=6', tree height = 168')*, were left on site to meet the objective for retention of down wood along streams, under the Aquatic Conservation Strategy.

The largest and presumably oldest trees in the campground are Douglas-fir trees (6-7'in diameter @ breast height) located on the north side of the big tree area, hereafter referred to as the "big tree area buffer". Five campsites on the south side of the Lodge loop were temporarily closed in 1994, pending completion of a long-term vegetation management plan that would decide the fate of these potentially hazardous trees.

2c.Riparian Forest

Intense human use has substantially altered vegetative structure (and riparian habitat effectiveness) in portions of the riparian reserves within this campground. Declining vegetation, denuded soil, and eroding banks characterize approximately 69% of the campground shoreline area, 58% of the riparian corridor along Box Canyon Creek, and 27% of the riparian corridor along Gale Creek (see environmental baseline under fisheries section of this document). The north side of Gale Creek, however, has not been

[5] Most deer residing in this watershed are black-tailed, but mule deer and hybrids between the two have also been observed in the Kachess area.

[6] One of the Gale Creek hazard trees was successfully high-topped in 2001.

heavily used and still supports decaying wood habitat structure, dense overstory canopy, and vigorous understory growth. This area still provides hiding and nesting cover and foraging opportunities for wildlife. It also provides cover that facilitates wildlife movement within the stream corridor—-even when the campground is open. Therefore, this area meets both habitat and connectivity objectives under the Aquatic Conservation Strategy.

Elsewhere, opportunities for wildlife movement along streams are limited by the absence or reduction of undergrowth and decaying wood habitat structure on one or both sides of streams, and by close proximity to campsites and other high use areas. Even these areas, however, may serve as corridors for wildlife movement when the campground is getting little or no human use.

3. Overview of Habitat Conditions on Lands Surrounding the Project Area

3.a. Late Successional Forest Habitat

Approximately 60% of the Gale-Thetis subwatershed, and 30% of the Box Canyon Creek subwatershed have been harvested (primarily as clearcuts) in the last 20-30 years, according to the Yakima Watershed Analysis (USDA, 1997). In Gale-Thetis, most of the harvest occurred in late successional forest habitat on private industrial forestlands. Most of the habitat that remains is located on National Forest, with the largest and most contiguous patches occurring at lower elevations near Kachess Lake

Across the lake from the campground (in the area between Lake Kachess and Lake Cle Elum), recent land exchange has brought most of the private industrial forestlands under National Forest management. The exchange consolidated a corridor several miles wide and more than 10 miles long that will be managed primarily for connectivity and restoration of late successional forest habitats.

Currently, this corridor retains a higher percentage of late successional forest habitat than the lands west of Lake Kachess. Therefore, even though connectivity is a major concern west of the project area, the corridor across the lake provides better north-south connectivity at this time. Habitat connectivity will continue to improve there as newly acquired clearcuts mature.

Kachess Campground is located at the narrowest east-west crossing on Lake Kachess (600 ft across), and highly mobile species potentially move across the lake here with greater ease or frequency than at other locations on the lake. Therefore, this campground is uniquely situated to provide connectivity between remnant patches of late successional forest habitat to the west, and larger, more contiguous habitats to the east.

3.b. Decaying wood habitat structure.

The Gale-Thetis subwatershed encompasses 18 acres within the Kachess Administrative complex, and an estimated 8 acres within this project area (= 0.1% of the subwatershed). In the Gale-Thetis subwatershed, "snag rich" late successional forest habitat comprises approximately 40% of landscape. Recent timber harvest has greatly reduced or eliminated snag habitat (i.e., dead, dying, and defective trees) across 60% of the area. There have been no field surveys to determine snag and log densities outside this project area, but down logs appeared to be well represented (even in harvest areas) during general field reconnaissance.

Based on a widely used model by Thomas (1979), the Gale-Thetis landscape would be capable of maintaining cavity excavator populations at only 40% of maximum—a level considered adequate for population viability. Over the last 15 years, however, research has shown that more snags and large down wood are needed to provide for the needs of fish, wildlife, and ecosystem function than was previously recognized in the works of Thomas (1979) and Brown (1985), and that even a goal of 40% habitat capability may be insufficient for maintaining viable populations of cavity excavators (Rose et al. 2001). Various studies have shown that previous models underestimated the numbers of snags required to support nesting pairs of cavity excavators, and also underestimated the densities and sizes of snags used by cavity dependent wildlife. This concern provides even more impetus for retaining and/or restoring snag habitat to the extent practicable in the managed campground area.

There has been less regeneration harvest in the Box Canyon Creek subbasin, which encompasses approximately 10acres of the campground. Although the campground acreage provides little or no decaying wood habitat structure, snags and logs are well represented elsewhere in this subwatershed. Proportionately more of the landscape is undisturbed National Forest and will be managed under standards and guidelines accorded to LSRs. The subwatershed also encompasses a substantial amount of snag-rich old and mature forest in designated wilderness. Therefore, viability of cavity excavator populations is less of a concern here than in Gale-Thetis.

3.c. Riparian forest habitat.

The condition of riparian forest habitats across the larger landscape is mixed. Recent watershed analysis revealed that respectively 25% (1400/5600 ac) and 30% (2300/7800 ac) of lands in the Gale-Thetis and Box Canyon Creek subwatersheds are within prescribed riparian reserve buffers. All of the riparian acres in Box Canyon Creek are on National Forest, but in Gale-Thetis, only 51% (710/1400 ac) of riparian acres are located on National Forest land. Much of the riparian habitat on private land has been harvested.

On National Forest lands in the Gale-Thetis subwatershed, the total area of mapped recreation sites within riparian reserve is 37 ac (5% of all riparian reserve acres)[7]. For Box Canyon Creek, the total area is 13 ac (0.6% of all riparian acres)[8]. Thus the percentage of riparian reserve that is subject to recreational use is relatively low. Some of these areas are experiencing the same kinds of degradation observed in Kachess, but the acreage affected is too small to prevent the attainment of larger ACS objectives for the watershed.

When areas used for recreation are combined with acreage that has also been removed or degraded through timber harvest and through hazard tree management along roads, the cumulative impacts to riparian forest habitats are much larger, particularly in Gale-Thetis.

4. Wildlife In and Near the Project Area

The list of wildlife that uses or potentially uses this project area includes species closely associated with late seral forest conditions (i.e., large and giant trees with multi-layered stand structure and closed canopies), as well as species that are capable of exploiting a broad range of forest conditions (including stands with smaller trees and moderate canopy structure).
The presence of the big tree area and stretches of relatively intact riparian forest accounts for much of the potential and documented wildlife presence in the campground. These areas retain key habitat structure that as been reduced or eliminated in other parts of this campground (Table 1). They also provide hiding cover and forage for many habitat "generalists", such as deer.

Deer and elk occupy this entire watershed during summer and fall, and many may pass through this project area prior to and after campground closing. A few deer remain in or near the campground throughout summer and fall, in spite of the heavy human use that occurs here. Since the Thetis loop was closed to public use in 1994, deer have been observed regularly on the peninsula. The interior big tree area provides both hiding and thermal cover for deer, and abundant browse near the lakeshore.

The campground may be an important area for neotropical migratory birds and bats, due to the high percentage of riparian forest here, and its position on the landscape (midway up a long lake, in a broad low-lying area that retains at least some superior old forest habitat structure).

[7] Developed campgrounds encompass 12 acres, dispersed recreation sites and summer homes each encompass 12 acres.
[8] Developed campgrounds encompass 8 acres, and dispersed recreation sites encompass 8 acres.

Table 1. Key late seral forest habitat structure within Kachess Campground.

Key Habitat Structure	Current Distribution In Project Area	Associated Wildlife Use
Tall conifers with dense crowns	Throughout	Nesting cover/foraging opportunity for Townsend's warbler, golden-crowned kinglet
"Soft" snags (i.e., dead trees in advanced stages of decay)	big tree area	Nesting habitat for chestnut-backed chickadee, foraging opportunities for cavity excavators.
Stumps and logs in advanced stages of decay	Mostly big tree area	Cover for salamanders, frogs, rubber boa; foraging opportunities for pileated woodpeckers.
Hollow trees and logs	big tree area	Potential roost/nest sites for Vaux's swift, pileated woodpecker, no. flying squirrel, bats; bushy-tailed woodrat; hiding cover for snowshoe hare; potential den sites for black bear, marten, fisher, etc…)
Large old trees with deeply furrowed bark	big tree area	Foraging substrate for brown creeper; supports important lichen food sources for flying squirrel (McComb 2001).
Large trees with large limbs (>8" in diameter)	big tree area	Potential nesting structure for marbled murrelet.
Logs near dense riparian shrub cover	big tree area, Box Canyon Creek (north side), Gale Cr (north)	Drumming sites and nesting cover for ruffed grouse, cover for herps and small mammals, hiding cover for fawns,
Logs partially submerged in fast-moving streams	Gale,Thetis, Box Canyon Creeks	Resting sites for harlequin duck, subsurface feeding sites for dipper
Large, broken-topped trees with stovepipe cavities	big tree area	Potential cavity-nest sites for spotted owl.

5. Species Addressed in this Assessment

Effects of the various alternatives on terrestrial wildlife will be addressed for selected management indicator species, all "PETS" (federally Proposed, Endangered, and Threatened species, and species classified as sensitive by the Pacific Northwest Regional Forester), and other species of concern, including land birds.

5.a. Management Indicator Species

Management Indicators are species that may be affected by land management decisions, and that also represent a larger group of species with similar habitat requirements and sensitivity. The indicator species selected for this analysis are *pileated woodpecker* (representing fauna dependent on large diameter snags and trees with cavities), and *primary cavity excavators* (representing fauna that rely on dead and dying trees in general, including *bats* and *amphibians*).

American marten, an indicator species for late successional forest habitat, was not selected for this analysis because suitable habitat is now largely confined to the big tree area. Only a small portion of the suitable marten habitat would be treated under alternatives 2, 3, 5, and 7. Habitat effects will be similar to those described for spotted owl, and the significance of the effects will be comparable to the discussion for other wide-ranging carnivores. A 16-acre remnant patch of habitat in the campground would only sustain marten for a brief period of time, and any use would also hinge on connectivity with other suitable habitat areas outside the project area. The riparian forest corridor along Gale Creek is a potential travel corridor for marten and a link to habitat outside the campground. Under all alternatives, the riparian reserve would be managed to meet connectivity objectives under the Aquatic Conservation Strategy. Therefore further evaluation for marten would not be meaningful.

On this National Forest, *ruffed grouse* is used as an indicator species for riparian forest habitat. They are associated with mixed hardwood and conifer stands at lower elevations, typically occurring as riparian forest. They nest on the ground near cover provided by trees, stumps, logs, shrubs, and even rocks. Large logs with overhanging cover are used for territorial drumming. Their diverse diet includes insects, seeds, berries, nuts, tree buds, blossoms, and herbaceous plants, and occasionally small amphibians—all readily available in and around healthy streamside vegetation. Dense understory shrubs may be most important for their persistence in summer (providing protection for broods from predators as well as diverse foraging opportunities). Dense conifer foliage may provide protection from predators and the elements in winter (unpub. report, Wenatchee National Forest, 1999).

At least one breeding pair of ruffed grouse resides in this campground. Their presence can be largely attributed to the presence of the big tree area and dense shrubs along the north side of Gale Creek and the adjacent shoreline area. Proposed intermediate treatments under alternatives 2, 3, 5, and 7 would encompass 1-2 acres in the Gale Creek

riparian reserve, but the expected level of hazard tree removal is so small that habitat structure and function are not expected to change to any noticeable degree. ACS objectives would also provide for retention and/or improvement of riparian forest habitat structure under all alternatives. Therefore, further evaluation of effects on ruffed grouse would not be meaningful.

Pileated woodpeckers require large expanses of forest habitat with large trees (in excess of 20 inches in diameter) for nesting (SAT Report, Thomas et al, 1993). They forage on trees and logs that harbor insects in their heartwood. They frequently forage in the decaying wood at the base of living trees, where carpenter ants form galleries. They roost in hollow trees, excavating their own entrances to internal chambers that may later be used by marten, Vaux's swift, flying squirrels, bushy-tailed woodrats, and bats (Bull et al., 1997, Bull et al., 1992).

A pair of pileated woodpeckers is known to forage in Kachess Campground and reportedly nests there, but active nest trees have not been located. Outside the big tree area they have been seen foraging on decaying trees, logs, and stumps. Large, rectangular cavities excavated by pileateds are encountered thoughout the big tree area.

Primary cavity excavators (PCEs) are birds that drill cavities in trees. The PCEs known to use Kachess Campground include hairy, downy, and pileated woodpeckers, red-naped sapsucker, northern flicker, and red-breasted nuthatch. Three-toed and black-backed woodpeckers potentially use the area, but were not seen during limited field reconnaissance by this writer.

5.b. Proposed, Endangered, Threatened, and Sensitive Species

There are 8 *PETS* species that potentially use Kachess campground for all or part of the year. Federally listed species include the northern spotted owl, bald eagle, marbled murrelet, gray wolf, and grizzly bear. Sensitive species include the California wolverine, Pacific fisher, and peregrine falcon.

There is no critical habitat for any listed species in the project area.

Spotted owl (Federal Status: threatened).

A portion of Kachess Campground is located within the breeding radius (0.7 mi) of a nesting pair of spotted owls (pair 340, also known as the Kachess Lake East pair). Within that radius, there is currently no nesting, roosting, and foraging (NRF) habitat within the campground. Total available NRF habitat within the breeding radius is currently below 500 acres--the prescribed threshold for incidental take. Therefore, further reduction of

owl habitat within this radius would constitute an adverse effect and require authorization for incidental take from the U.S. Fish and Wildlife Service.

The entire campground (110 ac) falls within the larger home range radius (1.8 mi) of pair 340. As little as 10 years ago, much of this campground was believed to provide NRF habitat (albeit marginal) for spotted owls, but the cumulative loss of overstory trees from annual hazard tree operations and natural tree mortality (since 1994) has made the campground too open to support sustained use by breeding owls. Outside of the big tree area and big tree area buffer, the campground now provides only dispersal opportunity for spotted owls.

Pair 340 has been the subject of radiotelemetry study, and both male and female owls have been detected at locations near (but not in) the campground (L. Hicks, unpub. data, 1994). They potentially use habitat within the big tree area, and/or move through the campground to access habitat outside the project area.

Marbled Murrelet (Federal Status: Threatened)

Murrelets have been known to nest in campgrounds in Oregon and California. There are no known murrelet records on the Wenatchee National Forest or for that matter east of the Cascade crest in Washington; however, Kachess Campground is located 50.7 miles from saltwater in Marbled Murrelet Zone 2, and murrelets have flown as far as 59 miles inland to nest in Washington (unpub. data, U.S.F.S. 2001). They forage in marine waters.

These seabirds nest high in old trees on large moss-covered limbs or flat surfaces formed by limb deformities or the juncture of branches. The diameters of nest trees observed in Washington ranged from 38 to 210 inches (@ 4.5 ft). Mean dbh was 80" (unpub. data., U.S.F.S. 2001). Nest trees tend to be located in the interior of stands--away from "edge" conditions that favor corvids (jays, crows, and ravens-- potential predators of murrelet chicks and eggs) (W. Ritchie, pers. commun.).

In Washington, murrelets nest more commonly in old and mature stands greater than 500 ac, but they also nest in remnant old trees or groves surrounded by younger forest. Most nests have been on landscapes comprised of at least 30% old and mature forest.

At Kachess, superior nesting structure for marbled murrelet is available in the big tree area (W. Ritchie, pers. commun.). A few decades ago the Thetis loop may also have provided suitable nest trees for marbled murrelet, but heavy recreational use, root disease, and hazard tree operations on the peninsula have substantially altered that area's forest structure. The few large trees that remain there lack the large horizontal limb structure seen on trees in the big tree area.

Wide Ranging Carnivores:

Grizzly Bear (Federal Status: Threatened)
Gray Wolf (Federal Status: Endangered)
California Wolverine (Federal Status: Sensitive in R6)
Pacific Fisher (Federal Status: Sensitive in R6)

Kachess Campground is located on the southern end of the North Cascades Grizzly Bear Recovery Zone, in the Cle Elum Bear Management Unit (*BMU*).

There is no core area[9] for grizzly bears in or near Kachess campground. The nearest core area is approximately 2 miles to the north, on Box Ridge. Road densities in the surrounding subwatersheds range from 2.0 mi/sq. mi. in the Mineral/Kachess basin, to 4.0 mi/sq mi in Gale-Thetis. They exceed 3.0 mi/sq mi in the immediate campground area.

Grizzly bears have not been reported in the Kachess area, although a class I (highly reliable) grizzly bear sighting occurred in the late 1980s approximately 10 mi from this project area in designated wilderness. Grizzlies potentially use the general area in summer and fall when huckleberries are abundant.

Currently, there is no recovery plan for gray wolves in the North Cascades—only interim direction addressing the protection of known den and rendezvous sites. There are no known wolf dens or rendezvous sites on the Cle Elum Ranger District, but wolf sightings have been reported in Box Canyon Creek during recent years. There is ample ungulate prey base (mountain goats, mule deer, and elk) here for wolves and they potentially use the entire watershed during snow-free months. The high density of roads and human disturbance in the vicinity of this campground, however, may deter them from using this project area. Incidental use is always possible.

There are few reports of wolverine on this district, but they potentially occur here. The presence of ungulates in general, and fawns and calves in particular may attract them to an area. This wide-ranging carnivore is usually associated with large expanses of remote, pristine forest but may also use areas near human habitation. A variety of habitats are used, but little is known about habitat factors essential to their persistence. The availability of large mammal prey may be most critical. Smaller prey such as marmot and snowshoe hare, salmon-spawning streams, and berry patches may be seasonally important. Activities that reduce habitat diversity, increase fragmentation of habitat, and/or result in increased human access, appear to be detrimental to wolverines (Bianci 1994).

Fisher are closely associated with late successional forest habitat in the Pacific Northwest, where large trees, snags, and decayed logs provide denning opportunities, and

[9] Areas more than 0.3 mi from open roads and trails with motorized use.

light gaps produce pockets of dense understory vegetation that support abundant prey. They prey on small and medium-sized mammals and birds, with snowshoe hare as one of the most frequently reported prey items across their range. They have extremely large home ranges that include multiple subdrainages, and use forested drainage bottoms and ridgelines for travel corridors. They avoid open areas, and fragmentation of late successional forest habitat may limit their ability to exploit remnant forest patches (Powell and Zielinski 1994, Washington Department of Fish and Wildlife 1991).

Due to prolonged and intense human disturbance, use of the Kachess Campground project area by all of these wide-ranging carnivores is expected to be incidental, and probably limited to brief periods in early spring and late fall when few people use the area.

Bald Eagle (Federal Status: Threatened)

The Wenatchee National Forest participates in recovery efforts for bald eagle, through implementation of the Pacific Bald Eagle Recovery Plan (1986).

A pair of bald eagles nests several miles from Kachess Campground, on Lake Cle Elum. In recent years, at least one bald eagle has been observed numerous times foraging on upper Lake Kachess. It is not known whether this bird is one of the Lake Cle Elum pair, or a different bird altogether.

Bald eagles may potentially nest or roost in old and mature forest around Lake Kachess—including the big tree area. No eagle use has been documented in this project area, however, to date.

Because bald eagles historically nested on the southern end of Lake Kachess (S. Roberson, pers. commun.), a 300-acre area bald eagle management area has been proposed for that end of the lake. The proposal is consistent with provisions of the Pacific Bald Eagle Recovery Plan.

Peregrine Falcon (Federal Status: Sensitive in R6)

Peregrine falcons nest on sheer cliffs ranging in height from 75 – 2000 feet, and often located near riparian, lacustrine, or marine environments with abundant avian prey (Pagel, unpub. rep.). There are no cliffs suitable for nesting in or near this project area. There is potential cliff nesting habitat (unrated) in upper Box Canyon Creek, and across Kachess Lake in the upper French Cabin Creek and Silver Creek basins.

Peregrines potentially forage in the general area around Lake Kachess. There has been one report of peregrine falcon in the area—a single bird observed in fall during the late 1980s, near the south end of the lake.

Wooded areas near water attract diverse avifauna. Large bodies of water provide open areas where avian prey (such as waterfowl) cannot easily escape a peregrine falcon. Peregrines are potentially impacted by activities that remove or degrade riparian vegetation and reduce avian prey populations (U.S. Fish and Wildlife Service, 1982).

5.c. Other Species of Concern

Vaux's swift (Status: Washington State Species of Concern)

Vaux's swift are seen regularly in Kachess Campground, foraging high above the creeks and big tree area. They are closely associated with old forests that provide hollow snags and hollow broken tops of live trees for nesting and night roosting. Hollow trees result from heart rot in living trees (Bull et al. 1997), therefore, retention of large defective trees, especially those with signs of decay (butt rot, broken tops, conks, dead branch stubs.) is important when managing younger stands (Washington Department of Fish and Wildlife 1991).

In this analysis, the needs of pileated woodpecker are used to indicate the needs of Vaux's swift as well, based on their common reliance on large decaying trees and large hollow trees for roosting.

Land birds

Recent, widespread concern over regional and local declines in non-game land bird populations culminated in Partners In flight Bird Conservation Planning. This is an ongoing nation-wide collaborative effort among multiple agencies and organizations, with the intent of ensuring long-term maintenance of healthy native land bird populations across multiple geographic scales. The planning entails a 4-step process, as follows:

- Identifying habitats and habitat attributes important to land birds;
- Identifying desired habitat conditions across the *landscape*, based on the habitat relationships of select group of priority species;
- Identifying biological objectives or management targets that will move the landscape into the desired condition;
- Identifying conservation strategies that can be implemented at various scales to achieve the biological objectives.

This process emphasizes ecosystems, habitats, and habitat conditions, rather than species. (Individual species provide a means of monitoring progress towards desired landscape condition). It is a dynamic process that recognizes and even hinges on a shifting mosaic

of conditions on the landscape as the means of conserving birds with diverse habitat needs.

Kachess Campground is located on the east slope of the Washington Cascades, but it is near the crest and primarily comprised of a moist forest type resembling forests of the Southern Pacific Rainforest province (encompassing western Washington, Oregon, and northern California). In the coniferous forests of western Washington and Oregon, the habitat requirements of 20 "focal species" are the basis for conservation planning. Each species exhibits a close association with a certain habitat attribute and forest condition. The requirements of 6 of these focal species encompass forest conditions and habitat attributes present in Kachess Campground, and all 6 species reside in the campground (Table2).

This campground, however, is also an ecotone of the moist forests of western Washington and the drier mixed conifer forests of eastern Washington (where conservation of forest in late successional condition is considered a priority in the Partners in Flight bird conservation plan). The campground's dual character is reflected in the assemblage of birds that occurs here. In the late successional mixed conifer forest of eastern Washington, multi-layered/dense canopy structure is an important attribute, with hermit thrush as a focal species. It too resides in Kachess campground, and is included in this analysis.

Table 2. Forest conditions, key habitat attributes and focal species occurring within Kachess Campground.

Forest Condition	**Habitat Attribute**	**Focal Species**
Old-growth	large snags	Vaux's swift
Old-growth/ mature	large trees	Brown creeper
Old-growth	conifer cones	red crossbill
Mature	large snags	pileated woodpecker
Mature	mid-story layers	varied thrush
Mature/young	forest floor complexity	winter wren
Late successional multi-layered	dense canopy	hermit thrush

Biological Objectives for Landbirds at Various Geographic Scales:
(Partners in Flight, 2001)

In the western Washington and Oregon region, the biological objectives for forest conditions represented in Kachess campground are as follows:

- Old growth forest: Maintain existing old-growth forest, and where there is <15% of the landscape within a subprovince, initiate action to develop old-growth forest to provide >15% across the subprovince.

- Mature Forest/multi-layered: Maintain existing mature forest, and where there is <15% of the landscape within a subprovince, initiate action to provide >15%.

Conservation plans provide objectives for management of focal species populations and for management of habitat at the stand and landscape scales within regions. Habitat objectives applicable to Kachess campground are summarized in Table 3.

TABLE 3

Forest conditions and key habitat attributes of Kachess Campground, with associated habitat objectives and information needs from state and regional plans for the conservation of landbirds*.

Forest Condition	Habitat Attribute	Focal Species	Habitat Objectives		Conservation Considerations	Information needs that may be addressed through monitoring in Kachess CG
			Stand or Project Scale	Landscape Scale		
Old-growth forest	large snags	Vaux's swift	provide roost trees >21" dbh and >82' tall, in different stages of decay, some hollow, in stands with mosaic canopy closure >60%. Provide 6 acre no-harvest buffer around known nest trees and roosts etc.	provide an average of 6 potential nest/roost structure per square mile at any given time, with 30% of structure having broken tops, up to 20% as snags, and up to 70% as live trees with defect (i.e., broken tops, large cavity excavation).	optimal sites for conservation of this spp are in proximity to aquatic/riparian habitats, and shared with closed woodpecker. In harvest units and riparian buffer zones, retain the largest live trees (particularly dying and defective). Unroads (for recreation). Existing is documented in logged stands).	In managed forest, do riparian buffer zones or logged stands provide nesting habitat if suitable large trees are maintained? Are there limiting factors (buffer width, patch size, or tree density)? Will birds recolonize areas where suitable snags are created? What variables may influence recolonization (proximity to riparian, to other nesting areas)?
	large trees	Brown creeper	provide late-successional forest in blocks of 75 ac. In managed forests, retain the largest live trees, preferably Douglas fir, including an average of 7 trees per ac that are >18in dbh, and at least 2 trees >24in dbh. Retain large live trees for recruitment; leave trees needing to decay to begin young managed stands.	Provide an average of 2 contiguous blocks of late-successional forest >75 ac, or one block >150 ac per square mile, across the watershed.	Optimal sites for conservation are above 1000 ft in elevation, and have a high percentage or potential for Douglas-fir, and if available, white pine.	In managed forest, do riparian buffer zones or logged stands provide nesting habitat if suitable large trees are maintained? Are there limiting factors (buffer width, patch size, or tree density).
	conifer cones	red crossbill	In managed forests, retain the largest live trees, particularly western hemlock and Douglas-fir, including an average of 7 green trees/ac >18" dbh, with 2 trees >24".	Provide habitat patches with diverse species composition, particularly western hemlock and Douglas-fir, amongst many elevation and climatological regions to provide for avoid synchronous cone failures.	In harvest units, retained trees should be mature and clumped (common aggregations) to facilitate cross pollination.	What is the best pattern for green-tree retention in harvest units, dispersed or clumped?
mature forest/multi-layered	large snags	pileated woodpecker	In managed stands >60 years old, provide 70% canopy closure and 70% conifer canopy cover, + an average of 2 nest snags/6 ac >30"dbh, + an average of 12 foraging snags/ac (mix of hard and soft) in the following size classes: 7/ac - 10-20"dbh, 2/ac -20-30"dbh, 3/ac - >30"dbh (may include nest snags). Maintain 500 no harvest bc for around known nests or roosts.	Provide an average of 60% of landscape as suitable habitat (early successional with adequate snags, young forest (40-80yrs) with adequate snags, and late-successional forest). and >40% of suitable should be as late successional forest.	During harvest retain large logs and snags in various stages of decay for foraging sites.	Can breeding populations be sustained in managed stands 60-80 yrs old with residual snags from previous rotations?
	multi-story tree layers	varied thrush	Provide late successional forest on blocks of 75 ac. In managed stands, provide multiple tree layers w/ mixed spp composition, high canopy closure (>70%), and 30% shrub/moss/vegetative cover in the sub-canopy and understory for a dense leaf litter layer. Riparian buffer zones within harvest areas should be >70m wide, w/ habitat conditions described above. Harvest activities in these zones not in those stands	Provide an average of 2 contiguous blocks of late successional forest >75 ac, or one block >150 ac per square mile, across the watershed.	Maintain habitat/large roots to reduce the amount of edge and fragmentation. Optimal sites for this spp > 2000 ft in elevation, w/ high canopy closure and stem density, and multiple layers of subcanopy trees, often w/ wet site spp (western red cedar, western hemlock, and deciduous trees).	Data are needed on all aspects of varied thrush nesting ecology since there have been no species-specific studies. Are riparian management zones within harvest units suitable habitat to support successfully reproducing populations?
mature/young	forest floor complexity	Wilson's warbler	Provide late successional forest in blocks of 75 ac. In managed forests w/ rotation age >80 yrs, provide an average of 4 down logs/ac w/ dbh >24" and >50' long (USFS 1993), provide shrub cover (woody or forb) >80% with 0m of ground, and the forb surface cover by foraging w/ mean cb h<10". Riparian buffer zones with harvest units should be more than >40m wide and meet described stand-level conditions.	Provide an average of 2 contiguous blocks of late-successional forest >75 ac, or one block >150 ac per square mile, across the watershed.	Retain tracts of forest as unmanaged or lightly managed to ensure structural diversity. The primary species to benefit from this strategy in east-side forests are varied thrush, chestnut-backed chickadee, blue grouse, winter wren, and Townsend's warbler.	Are riparian management zones within harvest units suitable habitat to support successfully reproducing populations? What size area is necessary?
late successional/ multi-layered	dense canopy/ vertical cover	hermit thrush	provide patches of forest w/ multi layered structure and dense understory shrub layer.	By 2025, initial actions to establish/maintain 6 blocks of forest >500 ac (in Westside Cascades), that are moving towards dominance by mid canopy late-successional forest conditions. Maintain and sustain existing areas of moderate to high quality habitat.		Data are needed on all aspects of hermit thrush nesting ecology and habitat relationships.

*from the Partners in Flight Plan for the Conservation of Landbirds in the coniferous forests of western Oregon and Washington (2002), and the Partners in Flight Plan for the Conservation of Landbirds in the east-slope Cascades of eastern Washington and Oregon (2001).

ENVIRONMENTAL CONSEQUENCES

EFFECTS COMMON TO ALL OR MOST OF THE ALTERNATIVES

Effects on migratory land birds:

Potential to remove nests: All alternatives entail some level of annual tree removal (or tree-topping) in April or May. This activity may remove nests of migratory land birds that use old and mature forest, including those which nest in large trees, dense vertical canopy structure, mid-story tree layers, and understory shrubs, as well as on the forest floor. Most cavity nest trees are probably already confined to the big tree area, big tree area buffer, and shoreline areas. Shoreline cavity nest trees likely to be felled (as hazard trees) under alternatives 2, 3, and 5. Cavity nest trees in or near the big tree area buffer area are likely to be felled under alternative 2.

Impacts to land bird habitat at the stand scale*:* Only Alternative 2 (maximum modification) would impact *intact* late successional forest habitat (due to annual hazard tree removal on 3 out of 19 acres, all in the big tree area buffer. Less frequent hazard tree removal on the south side of the big tree area would degrade but not eliminate habitat there). Habitat effectiveness for land birds that forage or nest in large trees or dense vertical canopy cover, or for birds associated with conifer cones for foraging, would be slightly reduced. With the big tree area still intact, however, many birds are likely to continue using the central part of this campground.

Under all the alternatives except no. 6., sustained hazard tree removal may reduce or eliminate residual large tree structure along the shoreline. Removal of both at risk trees and hazard trees may reduce or eliminate key late successional habitat structure in full treatment and intermediate treatment areas, including large trees, dense vertical canopy cover, and cone-producing conifers.

Impacts to land bird habitat at a landscape scale: At a watershed scale, impacts to land bird habitat from vegetation management in this campground would be insignificant under all alternatives. Late successional forest habitat still comprises 40 and 70% of the 2 surrounding sub basins, and because most of this habitat is on National Forest land in the Snoqualmie Pass AMA, almost all that remains will be managed under standards and guidelines accorded to late successional reserves. The surrounding acreage affords multiple options for meeting Partners in Flight bird conservation objectives at the watershed scale, and contributes to regional objectives as well.

Effects from noise disturbance:

Under alternatives 2, 3, and 5, planned use of chainsaws, helicopters, and heavy equipment during removal of at risk trees would produce noise above ambient levels for this campground, commencing after September 15 and persisting until winter snow precludes access. At this time of year, however, such noise poses little or no risk of disturbance to nesting birds, including spotted owl and marbled murrelet.

All alternatives entail spring tree removal requiring use of chainsaws and heavy equipment for periods ranging annually from a day or two (alternative 6) to 10-15 days (alternative 7). The resulting noise would be above ambient levels for this campground at that time of year. Alternatives 2, 3, and 5 also entail prolonged use of chainsaws and heavy equipment for spring slash treatment in year one, and for alternatives 3 in year 20 as well. Resulting noise would persist for 20-30 days. All of these activities have a potential to disturb nesting birds in or near the campground, including migratory land birds, spotted owls nesting within ¼ mile of the campground, and marbled murrelet that may be nesting in the big tree area.

There is little or no risk of noise disturbance to nesting spotted owls as long as they continue to use the nearest known nest location across Lake Kachess. These particular spotted owls have utilized nests that are more than ½ mile apart, however, and if they were to move closer to the campground their susceptibility to noise disturbance may increase under all alternatives. In the absence of a provisional timing restriction that would be implemented when they are nesting within ¼ mile of the campground (or when there is uncertainty as to nesting status due to lack of field survey), all alternatives carry a potential for disturbance to nesting spotted owls. As planned, all alternatives may adversely affect spotted owls and may result in incidental take from noise disturbance, as defined under the Endangered Species Act.

There were no marbled murrelet detections in Kachess campground and other suitable habitat in Box Canyon, during protocol surveys in 1995. Since then, more extensive surveys for marbled murrelet have been conducted in the I-90 corridor (in conjunction with recent land exchange), but there were no detections east of the Cascade crest in Kittitas County. The survey data for the campground is no longer current, therefore, the presence of undetected pairs cannot be ruled out.

In April and May, noise from chainsaw use and heavy equipment within ¼ mile of potential nest sites in the big tree area may disrupt nesting by undetected pairs. All alternatives entail tree felling within ¼ mile of the big tree area; these alternatives may adversely affect marbled murrelet. The disturbance would also constitute incidental take under the Endangered Species Act.

Effects on Wide-ranging Carnivores (grizzly bear, gray wolf, California wolverine, and Pacific fisher)

None of the alternatives would affect core habitat for grizzly bears in the Cle Elum Bear Management Unit, or security habitat for gray wolves, California wolverine, or Pacific fisher. This campground and the surrounding area are heavily roaded, and heavy traffic and concentrated and prolonged human use here probably deters use of the area by most ungulate prey and wide-ranging carnivores.

Incidental use of the project area by wide-ranging carnivores, however, is possible, particularly in early spring when human presence is low and ungulates are moving through the project area. The noise resulting from planned tree removals and slash treatments in early spring is likely to displace any ungulates and wide-ranging carnivores from the area, but the imminent influx of people, vehicles, and boats would have the same impact. There is little or no difference among the alternatives as far as their potential to affect wide-ranging carnivores through disturbance, and that effect is inconsequential for all.

Planned tree removals under alternatives 1, 2, 3, 5, and 7 would ultimately reduce overstory canopy across much of this campground. Alternative 2 would do so at once (by removing at risk trees), whereas alternative 1 would do so at a much slower rate over a much longer period of time (by removing hazard trees as they develop). But all of these alternatives eventually result in a more open stand comprised of small-to medium-sized trees as the predominant condition in the campground.

To the extent that soil conditions and human trampling allow, the removal of overstory trees may stimulate the growth of understory trees, shrubs, and ground cover, improving both hiding cover and forage for deer and small mammal prey species, and improving predaceous foraging opportunity for wide-ranging carnivores. Even with full soil and vegetation recovery, however, the benefits of improved cover and forage for prey would not be realized in such a heavily used developed setting—at least not during periods of human use. In this campground, predaceous foraging opportunities for wide-ranging carnivores would continue to be incidental, at most. Therefore, all these alternatives may affect but would not likely adverse affect both grizzly bears and gray wolves. All of the alternatives may impact wolverine and fisher, but would not likely adversely impact these species or cause a downward trend towards federal listing under the Endangered Species Act.

Effects on Bald Eagle

This project area is outside of this district's two designated bald eagle management areas.

Although no bald eagle use has been documented in this project area, the presence of large trees near water may attract bald eagles to the area for nesting, roosting, and perching while foraging. Under all alternatives, large trees suitable for nesting and roosting would persist in the big tree area. The alternatives differ, however, in the amount of shoreline tree structure that may be removed, and whether or not the largest and oldest trees in the campground are likely to persist.

Under alternative 2, the planned reopening of campsites and subsequent need for annual hazard tree removal on the south side of Lodge loop would eventually result in removal of some of the largest and oldest trees in the campground—tree structure that may be used by eagles. Reopening of the Thetis loop campsites and subsequent annual hazard

tree operations along the peninsula shoreline (under alternatives 2, 3, and 5) would also reduce potential roosts and perches for eagles near water.

Because all of the alternatives entail some removal of potential roost trees, but are still consistent with planned recovery efforts, all of the alternatives may affect, but would not likely adversely affect bald eagle.

Effects on Management Indicator Species

Pileated woodpecker and cavity excavators:

Snag Densities and Population Capacity: Currently snags exist only in the big tree area, big tree area buffer, and Thetis loop (30 ac, total, or 27% of the project area). Snags and green trees for snag recruitment would persist in these areas under alternatives 1 and 7. The percentage of the campground that would provide snags and green trees for snag recruitment ranges from 16% (under alternative 2) to 86% (under alternative 6) (Table 4). All alternatives meet the minimum 15% green tree retention standard prescribed for matrix lands (and recommended for adaptive managemnt areas)—primarily due to presence of the big tree area and unmanaged old forest immediately adjacent to the campground.

Long-term Snag Recruitment: The sustained removal of hazard trees in intermediate treatment areas, and the removal of at risk trees in full treatment areas, would greatly reduce or eliminate opportunities for recruitment of large snags in the future. Large green trees would persist only in the locations described under each alternative in Table 4.

Green trees for recruitment of smaller snags would persist throughout the campground under all alternatives, but it is unlikely that any would be permitted to stand when they start to die, outside of retention areas.

Table 4. Acres of late successional habitat that would be retained indefinitely under each alternative, providing both snags and green trees for future snag recruitment.

	Alternative					
	1	**2**	**3**	**5**	**6**	**7**
Location in Campground						
big tree area	16	16	16	16	16	16
big tree area buffer	3	-	3	3	3	3
Thetis peninsula	11	-	-	-	11	11
Shoreline patches along Box Canyon and/or Thetis loops	NA	-	3	2	NA	NA
Planned snag retention Area	-	2	-	2	NA	1
Remainder of Campground	-	-	-	-	65	1
Total acres	30	18	26	23	95	32
Percent of project area where snags would persist	**27**	**16**	**24**	**22**	**86**	**29**

Potential population capacity of cavity excavators at the subbasin level:

Portions of Kachess campground comprise 0.1% of both the Gale-Thetis and Box Canyon Creek subbasins, and 0.4% of the Kachess subwatershed. All 30 campground acres that currently support snags are tallied as Kachess subbasin acreage, which includes all lands draining directly into Lake Kachess.

When the acreage of old and mature forest habitat with snags is tallied across the entire Gale-Thetis and Box Canyon Creek subbasins, it appears that woodpecker populations would be maintained at 40% and 70% of their maximum potential (respectively), based on the availability of unmanaged old and mature forest outside this campground.

An estimated 60-70% of the Kachess subbasin is unmanaged old and mature forest (based on Yakima Watershed analysis, and 1999 aerial photography), capable of supporting cavity excavator populations at 60-70% of maximum. The campground acreage with snags comprises 0.1% of the total subbasin. Even the maximum reduction of acreages with snags (a loss of 12 acres under alternative 2) is not expected to reduce overall population levels of cavity excavators at the subbasin level.

There is an inherent assumption in this analysis that snag densities in the surrounding unmanaged old and mature forest would be sufficient to maintain woodpeckers at 100% of their maximum potential.

Snag Distribution:

The Northwest Forest Plan requires that minimally (in matrix), snags would be retained within a harvest unit at levels sufficient to support cavity excavators at 40% of potential population levels based on published guidelines and models. The objective is to meet the 40% minimum population standard throughout matrix, with per-acre requirements met on average areas no larger than 40 acres. In this project area, an average of 3 snags per acre would be needed to support woodpeckers at 40% of maximum. Under current conditions, that average is met campground-wide and across 40-acre subunits based on high densities of snags in the big tree area (assuming a minimum snag density of 10 per acre, which is far below the range described for this type of forest association), in adjacent unmanaged old and mature forest on the west side of the campground, and also based on low but increasing density of snags on the Thetis peninsula. Average snag density is lowest in the northeast quadrant of the campground (the 40-acre subunit encompassing the Thetis, Mineral, and Box Canyon loops), because there is no unmanaged forest to offset the absence of snags in the managed campground area.

Alternatives that retain late successional habitat on the peninsula (1, 6, and 7) would meet the minimum objective for distribution of snags across the entire campground area. Alterntives 2, 3, and 5 fail to retain and/or restore sufficient snags in the northeast quadrant of the campground to achieve an average of 3 snags per acre there. The planned retention areas would, however, provide some decaying wood habitat structure that may serve as a "stepping stones" across the managed campground area.

The high density of snags in the big tree area would persist under all alternatives, and would partially mitigate the poor distribution and low density of snags that would result in the northeast part of the campground under Alternatives 2, 3, and 5. Alternative 2 is the only alternative that would also reduce snag density in the big tree area buffer, thus reducing the degree to which the general big tree area can compensate for absence of snags elsewhere in this campground.

Under all but alternative 6, habitat values for woodpeckers would decline in the managed campground area. Alternatives that reopen the Thetis camping loop would have the most impact. Provisions for retention of existing stumps in advanced stages of decay, and for retention of both sound and cull logs, would maintain and/or increase foraging opportunities for pileated woodpeckers and other cavity excavators in the managed campground area. Nesting structure, however, would be confined to the big tree area and larger retention areas.

EFFECTS OF THE INDIVIDUAL ALTERNATIVES

Alternative 1

General: Under the current management strategy, habitat values for wildlife associated with closed canopy forest and multi-layered stand structure would continue to decline slowly and unevenly across the managed campground area, due to sustained annual removal of hazard trees. Experience in this campground has shown that the recruitment and removal of hazard trees would outpace the growth of residual trees, resulting in more open and less diverse forest structure across the managed campground area.

Large defective trees and snags would persist only within the big tree area (16 ac), the big tree area buffer area (3 ac), and planned snag retention areas (1-2 ac). Snag and log densities would increase on the Thetis camping loop (approx 11 ac). In the managed campground area, snag-rich forest habitat would eventually comprise approximately 29% of the project area (32 out of 110 ac), with few if any snags or defective trees on remaining acres.

Snag density in unmanaged forests of this type typically ranges from 21 to 40 total snags per acre (comprised of 13-26 snags in the 10-14" dbh class, 3-6 snags in the 15-19" dbh

class, 2-4 snags in the 20-24" dbh class, 2-4 snags >25" dbh[10]). No snag density surveys were conducted outside of proposed treatment areas, but preliminary reconnaissance in the big tree area verified that snag abundance is high there, and that the snag density figures are reasonable estimates for the unmanaged refugium within this campground and within adjacent late successional habitats.

Spotted Owl

Under sustained annual hazard tree operations, overstory canopy cover would continue to decline slowly and unevenly across the managed campground area. In time, most of the areas that now provide dispersal habitat for owls would become unsuitable, and may persist in that condition because of denuded and compacted soils, and a lack of green tree recruitment. The big tree area and big tree area buffer, however, would continue to provide NRF habitat for spotted owls. Dispersal habitat conditions are expected to persist on the Thetis peninsula and may even improve if the growth of intermediate trees offsets mortality of older trees infected with root disease. Improved snag recruitment and retention of logs may enhance predaceous foraging opportunity there for spotted owls, and may improve the connectivity of the peninsula area with habitat in the big tree area.

Planned removal of hazard trees would not reduce the availability of nesting, roosting, and foraging habitat within the home range and breeding radii of resident owls across Lake Kachess.

Alternative 1 may adversely affect spotted owls, and may result in incidental take, based on the potential for noise disturbance discussed previously.

Marbled Murrelet

Planned hazard tree removal under alternative 1 may eliminate potential nesting structure for marbled murrelet on the south side of the Big tree area. There, large trees in excess of 150 feet tall occasionally pose a hazard to camping facilities in the Gale loop and the bridge over Gale Creek. The need for hazard tree removal north of the creek would be infrequent, however, due to recent closure of campsites on the opposite side of the Gale Creek (to better meet ACS objectives)..

The sustained removal of hazard trees in the Gale, Lodge and Mineral loops would slowly reduce overstory canopy cover in these areas, and may slightly increase edge effects on both sides of the big tree area. As a result, the risk of predation by jays, crows, and ravens on murrelet chicks and eggs in the big tree area, may rise slightly.

Determination of Effect: Alternative 1 may adversely affect marbled murrelet, and may result in incidental take, based on the potential for noise disturbance discussed

[10] *From* Forest-wide assessment of late successional reserves and managed late successional areas, Wenatchee National Forest, 1997.

previously, and also the potential to remove active murrelet nests and/or potential nesting structure on the south side of the big tree area. The majority of potential nest trees, however, would persist in the big tree area.

Alternative 2

General

Alternative 2 is the "full treatment" alternative. Planned removal of at risk trees in full treatment areas would immediately reduce overstory canopy cover to the 10-20% range across most of the campground, including the Thetis loop. The sustained removal of hazard trees would also reduce overstory canopy cover in the intermediate treatment areas, but more slowly and unevenly. The largest and oldest trees in the big tree area buffer would eventually be removed as hazard trees, to protect 5 reopened campsites in the Lodge loop.

Under planned measures for soil and vegetation recovery, including reforestation with disease resistant species, a multi-aged stand of disease resistant trees with about 40 – 50% canopy closure would eventually characterize most parts of the campground. The largest trees outside the big tree area would be silver fir and western hemlock up to 14 inches in diameter, and the occasional large cedar. Snags would persist only in the big tree area and 3 planned snag retention areas in the north half of the campground (a total of 18 ac).

Spotted Owl

The reduction of overstory canopy cover to the 10-20% range would result in an unsuitable habitat condition for spotted owls across the full treatment acreage. Sixty-eight acres currently mapped as dispersal habitat would be downgraded to unsuitable. Planned measures for soil restoration, improved retention of down wood, and planned revegetation with disease resistant species would facilitate re-establishment of trees in these areas. In the long-term (>50 years), stand structure comprised of small-to-medium sized overstory trees and 40-60% canopy cover is expected to develop. These conditions would provide dispersal habitat for spotted owls, but would not support sustained use by resident breeding pairs. Planned measures for soil and vegetation recovery, however, would also accelerate the development of dispersal habitat structure on the 13 acres that are currently mapped as unsuitable.

Proposed annual removal of hazard trees in intermediate treatment areas would entail removal (or in the case of planned snag retention areas, high-topping) of an estimated 8-15 trees per year across 18 acres that are largely in linear or small patch configurations. This activity would reduce overstory canopy cover, but the extent to which it would affect habitat suitability for spotted owls varies across the campground. Existing owl habitat adjacent to Gale Creek may be slightly degraded by infrequent hazard tree

removal there, while habitat in the big tree area buffer is likely to be downgraded to a dispersal condition, due to the disproportionate loss of overstory canopy cover with the removal of large old Douglas-fir trees, and sustained hazard tree removals around campsites.

Remaining riparian areas have been more heavily modified by long-term campground use and previous hazard tree operations that already reduced overstory canopy structure and eliminated snags and many of the larger trees. Understory seedlings, saplings, and intermediate trees are largely lacking in these areas. They currently provide dispersal habitat for spotted owls, but experience has shown that sustained hazard tree removal would eventually reduce overstory canopy in these areas to below 40%, an unsuitable condition for spotted owls.

Over the long term, 40-60% canopy cover would be restored in these intermediate treatment areas, due to the growth of disease resistant trees and planned measures for soil and vegetation recovery. In the interim, these intermediate treatment areas would contribute structural diversity to the developing stand, and would support key elements of owl habitat (overstory tree cover and abundant down wood habitat structure for prey) while the rest of the campground recovers.

Nesting, roosting, and foraging habitat for owls would persist only in the big tree area (16 ac).

Planned vegetation management would not reduce the availability of NRF habitat within the breeding radius (0.7 mi) of resident spotted owls across Lake Kachess. Planned intermediate treatment in the big tree area buffer, however, would reduce habitat within this pair's home range radius (1.8 mi) by 3 ac, leaving them with a total of 2398 ac of available NRF habitat. The current level of habitat is already below the threshold for incidental take, and the additional loss of 3 acres under this alternative would constitute an incidental take.

Determination of Effect on Spotted Owls: Alternative 2 may adversely affect spotted owls in the following ways:

- Proposed hazard tree management in the big tree area buffer area would reduce NRF habitat to a dispersal condition, reducing available habitat within the breeding radius of owl pair 340 from 2398 to 2395 acres (an incidental take due to removal of habitat).
- In the absence of timing restrictions, there is a *potential* for disturbance to a nesting pair of spotted owls during planned spring slash treatments and/or future annual hazard tree operations in spring (constituting incidental take from disturbance). As long as the resident pair (#340) continues to use traditional nest trees across Lake Kachess, however, the risk of disturbance is minimal and no incidental take would result.

Marbled Murrelet

Planned hazard tree removal under alternative 2 may eliminate potential nesting structure for marbled murrelet on the north and south sides of the big tree area. Large diameter trees in excess of 150 feet tall adjacent to Gale Creek occasionally pose a hazard to camping facilities in the Gale camping loop, and/or the bridge over Gale Creek. The need for hazard tree removal north of the creek would be infrequent, however, due to recent closure of campsites on the opposite side of the creek.

In the big tree area buffer, the eventual removal (in spring) of large old Douglas-fir trees would eliminate potential marbled murrelet nesting structure--in this case, giant trees with large horizontal limb structure. It may also remove undetected nests (resulting in incidental take). The resulting loss of overstory canopy structure may slightly increase edge effect on the north side of the big tree area. The risk of predation by crows, jays, and ravens on murrelet eggs and chicks within the big tree area may increase slightly.

Determination of Effect on Marbled Murrelet: Alternative 2 may adversely affect marbled murrelet and may result in incidental take, based on the potential for spring noise disturbance discussed previously, and the potential to remove occupied (undetected nests) and/or potential nest trees in the on the north and side sides of the big tree area.

Alternative 3

General

Under this alternative, the long-term effects on habitat structure are the same as those described under alternative 2, with one exception: existing closed campsites in the Lodge loop and part of the Thetis loop would remain closed, and 3 more sites in the Box Canyon loop would be permanently closed to use. These closures would reduce the acreage subject to intermediate treatment from 18 acres under alternative 2, to 14 (10 acres now, 4 acres in 20 years). As a result, there would be no need for hazard tree removal in the big tree area buffer. Hazard tree management would also cease temporarily in part of the Gale Creek riparian reserve, but would resume again in 20 years.

Short-term effects are also the same as alternative 2, except that initial removal of at risk trees would impact about half as much acreage. Remaining areas would be closed to public use for 20 years to facilitate soil and vegetation recovery. At that time, the remaining at risk trees would be removed and sites would be reopened. Loops would then be put on a rest-rotation system, with brief periods of nonuse where needed to facilitate soil and vegetation recovery.

Under this alternative, overstory canopy cover may still decline slowly and unevenly in some temporarily closed areas, due to natural tree mortality in root disease centers. In other places, however, overstory canopy cover may stabilize or increase due to the

persistence of at-risk trees and hazard trees. The 20-year closure would temporarily enhance snag recruitment and improve the distribution of snags across the managed campground area. That benefit would be lost, however, when these areas are treated and reopened in year 20.

Spotted Owls

Improved retention of overstory trees and recruitment of snags and logs on untreated areas may temporarily improve dispersal habitat conditions for spotted owls in this campground, offsetting some of the impacts from removal of at risk trees (and downgrading of dispersal habitat to an unsuitable condition) on 40 acres. NRF habitat would not be reduced or eliminated under this alternative in the short or long-term. After 20 years, the planned resumption of hazard tree management along Gale Creek may degrade, but would not eliminate habitat on the north side of the creek.

Planned vegetation management would not eliminate habitat within the home range or breeding radii of resident spotted owls across the lake. The alternative may adversely affect spotted owls and may result in incidental take, based on the potential for disturbance to nesting pairs, discussed previously.

Marbled Murrelet

Under this alternative, there would be no removal of hazard trees in the big tree area buffer, and potential nest trees for marbled murrelet would persist in that area as well as the big tree area. After 20 years, the resumption of hazard tree management along Gale Creek may result in infrequent hazard tree removals there, and may eliminate potential nesting structure and/or undetected nests on the south side of the big tree area. The removal of undetected nests would constitute incidental take.

Under this alternative, the removal of at risk trees in the Gale loop in year 20 would reduce overstory canopy cover there, resulting in slightly increased edge effect between the big tree area and Lodge loop. The risk of corvid predation on murrelet chicks and eggs in the big tree area, may increase slightly after year 20.

Determination of Effect: Based on the potential for disturbance to nesting pairs constituting incidental take (discussed previously), and the potential to remove active nests and/or potential nesting structure on the south side of the big tree area (after year 20), alternative 3 may adversely affect marbled murrelet.

Alternative 5

General

This alternative would regenerate small patches of even-aged trees, in a matrix of mixed-age trees that would be still subject to sustained annual hazard tree removal. Permanent closure of selected campsites in the Lodge, Thetis, and Box Canyon loops would eliminate any need for hazard tree removal in the big tree area buffer area, and some shoreline areas. The acreage subject to intermediate treatment would be 14 acres. Otherwise, the effects of sustained hazard tree removal in intermediate treatment areas are the same as alternative 2.

Spotted Owl

The creation of many small openings in areas currently mapped as dispersal habitat would further reduce overall canopy closure and render these areas unsuitable for owl use. No NRF habitat, however, would be eliminated under this alternative, and available habitat for the resident pair across the lake would not change for either the breeding or home range radii.

Sustained annual hazard tree removal within the shoreline riparian buffer and within half of the riparian reserves along Gale and Box Canyon Creek would downgrade dispersal habitat there to an unsuitable condition.

This alternative is likely to adversely affect spotted owls, based on the potential for disturbance to nesting pairs, discussed previously.

Marbled Murrelet

The permanent closure of campsites in the Lodge loop negates the need for hazard tree removal in the big tree area buffer area. Therefore, all potential nest trees for marbled murrelet would persist in that area and most of the adjacent big tree area.

On the south side of the big tree area, large diameter trees in excess of 150 feet tall occasionally pose a hazard to camping facilities in the Gale camping loop and the bridge over Gale Creek. The need for hazard tree removal on the north side of the creek was recently reduced by permanent closure of several campsites on the opposite side of the creek. Even though infrequent, hazard tree removal here may eliminate potential nesting structure and/or undetected nests of marbled murrelet. The removal of nests would constitute incidental take.

Determination of Effect: Based on the potential for disturbance to nesting pairs constituting incidental take (discussed previously), and the potential for infrequent hazard tree removal along Gale Creek to eliminate potential nest trees and/or undetected nests (also constituting incidental take), alternative 5 may adversely affect marbled murrelet.

Alternative 6

General

This alternative would benefit wildlife that use or potentially use this campground on more than an incidental basis, because overall human disturbance would be reduced across much of the campground. Shoreline areas, and areas close to open roads, however, would probably attract more use as dispersed campsites by boaters and people who walk in from the main campground road.

In areas where use is curtailed, improved soil and vegetation recovery may improve the availability and quality of cover and forage for wildlife. The presence of summer homes, dispersed camping, and heavy traffic to and from day use are, however, may still deter use of the area by larger, wider-ranging wildlife,.

In places, openings in canopy would still develop and/or enlarge due to natural tree mortality in root disease pockets. With retention of both at risk and hazard trees, however, canopy cover may also stabilize and even increase in places. Snag and log recruitment would resume in parts of the campground that experience reduced human use, enhancing the connectivity of late successional habitat structure across the area, and enhancing dispersal habitat structure for spotted owls. In the portions of the campground that experience high levels of dispersed camping, however, recruitment of downed logs would likely decline, due to firewood removal. This alternative may adversely affect spotted owls, however, based on the small potential for disturbance to nesting pairs resulting from brief hazard tree operations in day use areas, in spring. Dispersal habitat in day use areas may be slightly degraded by light hazard tree removals, but would not be reduced or eliminated.

The likelihood of adverse effect and incidental take due to noise is lower for alternative 6 than the other alternatives, due to the relatively brief duration of expected noise disturbance in spring (1-2 days), and the fact that hazard tree operations under that alternative would be confined to the far ends of the campground, more than ¼ mile away from suitable nesting structure for spotted owls in the big tree area.
The brief period of disturbance and confinement of noise to the far ends of the campground under alternative 6 would pose little or no risk of disturbance to murrelets nesting in the big tree area, and would not result in incidental take. In this case, noise disturbance may affect but would not likely adversely affect marbled murrelet.
Under this alternative, potential nesting structure for marbled murrelet would not be removed. This alternative would not affect marbled murrelet.

Under alternative 6 (closure of all camping facilities and roads, except those needed to access day use areas), the intensity of human use would decline across parts of the campground. Reduced trampling of vegetation, curtailment of hazard tree operations, and increased retention of down wood would enhance soil and vegetation recovery in parts of this campground, albeit slowly. Areas that become popular with dispersed campers may

actually see some decline in soil and vegetation recovery. Cover and forage for potential prey species would improve. Predaceous foraging opportunities for wide-ranging carnivores may increase, particularly on the peninsula and north side of the big tree area. The presence of summer homes, dispersed camping, and the flow of heavy traffic to and from day use areas, however, would probably continue to limit overall use of this area by deer and wide-ranging carnivores. Therefore this alternative may affect but would not likely adversely affect both grizzly bear and gray wolves. It may impact, but would not likely adversely impact both fisher and wolverine.

Alternative 7

General

Under alternative 7, all of the existing closures in the campground would become permanent, and about ½ of the Gale Creek loop would also be permanently closed to facilitate vegetative recovery in the riparian reserve. The rest of the campground would be subject to annual hazard tree removal that is more intense than alternative 1, but still well below the levels of tree removal that would result under alternative 2. There is also a provision for periodically closing loops using a rest rotation system, to facilitate soil and vegetation recovery.

Sustained hazard tree removal would eventually reduce overstory canopy cover in full treatment areas to a 10-20% range—in less time than alternative 1. Late successional habitat structure would remain available in the Big Tree area, big tree area buffer, and remaining large trees would persist along the shoreline of the Thetis loop. The need for infrequent hazard tree removal on the south side of the big tree area would be eliminated, due to planned closures in the Gale Creek loop.

Reduced human use and improved retention of coarse wood would facilitate vegetative recovery in closed portions of the campground. Snag recruitment would resume in these areas, and the distribution of snags across this campground would improve.

Spotted Owl

Due to sustained removal of hazard trees over time and the resulting loss of canopy cover, most areas that now provide dispersal habitat for spotted owls would eventually become unsuitable, and would persist in that condition until residual trees and disease resistant species can provide 40% canopy cover (see alternative 1). No NRF habitat for spotted owls would be affected under this alternative, and available habitat would not change for the resident pair across the Lake.

This alternative may adversely affect spotted owls and would result in incidental take, based on the potential for disturbance to nesting pairs discussed previously.

Marbled Murrelet

Continued opening of forest canopy in the Lodge/Mineral loop areas may slightly increase edge effects on the north side of the Big tree area, and thus the risk of predation by jays, crows, and ravens on chicks and eggs.

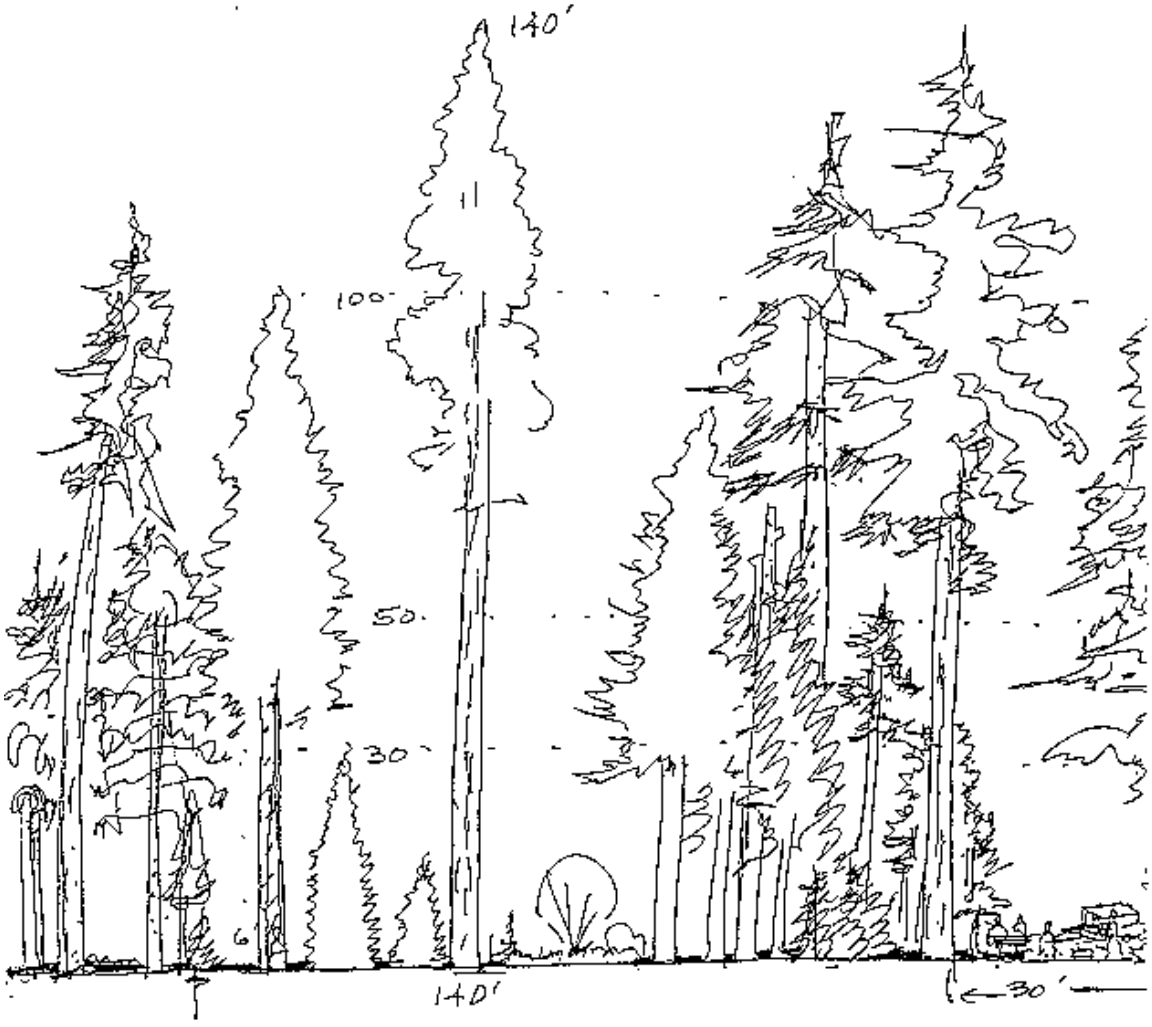
The planned closure of campsites in Gale Creek would eliminate the need for hazard tree removal on the north side of the Creek. Potential nest trees in that area would no longer be subject to removal as hazard trees. All potential nest trees in the big tree area and big tree area buffer would persist under this alternative.

Determination of Effect: Based on the potential for disturbance to nesting pairs constituting incidental take (discussed previously), this alternative may adversely affect marbled murrelet.

J. SCENIC QUALITY

AFFECTED ENVIRONMENT

1. SETTING: The unique scenic quality of Kachess campground is situated in dense, large multi-story evergreen trees on an alluvial fan surrounded by Kachess Lake and a forested landscape with a high mountain backdrop with Gale Creek and Box Canyon Creek flowing through the area. The shoreline adjacent to Kachess Lake fluctuates seasonally with most of the high water during the summer use season. The shoreline is limited to approximately 5 feet of beach during high water. Shoreline area increases as the water drops during the rest of the season to approximately 30 feet. Gale Creek and Box Canyon Creek fluctuate with high flow during the spring and lower during the end of summer. The facilities blend with the forest setting and the impression is a natural appearing landscape from within the campground, from the main loops, and from Lake Kachess. Scenic beauty is a main attribute of the campground. The Forest Plan land allocation for Kachess Campground is RE-1, Developed Recreation with Scenic Quality Objective of Retention. The vegetation can be altered for public safety, to protect the campground trees from spreading disease, and to enhance or accommodate recreation sites. Maintaining a variety of tree structures, the enclosed character and diversity of vegetation types, and screening between units and between loops are important elements



No Change Alt. 1

Typical Existing Vegetation Condition.

Richess Campground
sketch by H. Markewitz 3/94

1"=20'

FIGURE 9

to maintaining and perpetuating for the scenic resource. The visual characteristics of individual, groupings, and masses of large and medium overstory and small understory tree species dominate the wooded scenic setting. The site has strong dominant line characteristics of tree boles, lake shoreline and river corridors. Color is apparent in evergreen hues, some yellow fall color of deciduous species and some ground cover. Texture is reflected in a variety of needle patterns, bark characteristics, and layering boughs from crown to ground of varying size trees and species. The textural pattern is rich in diversity.

2. OVERALL CHARACTER: The overall vegetative condition of the area is wooded, multi-storied coniferous forested landscape. It is mostly natural-appearing to slightly altered with a variety of openings throughout the area that have resulted from hazard tree removal of large conifers throughout the campground. Campground loops are separated by a forest of large to medium sized conifers and mixed vegetation. The atmosphere of the area is medium and large size trees in a heavy to moderately heavy wooded forest. A variety of understory species are present depending on the degree of light penetrating to the forest floor. Parts of the area are heavily forested and dark, while other parts are moderately open and sunny, with less than a 50% canopy cover. Gale Creek and Box Canyon Creek flow through the campground. Both provide a picturesque setting of wooded riparian vegetation with crystal clear water. Both creeks are heavily used by the campers of the area. A lake shore trail surrounds the campground and provides views toward lake Kachess and distant landscapes and peaks.

3. EXISTING CONDITION: For the purpose of describing the existing scenic condition of the campground six management units of varying scenic character and settings are described. The six areas are: Area 1 Thetis loop, Area 2 Lodge Creek loop, Area 3 Mineral loop, Area 4 Box Canyon, Area 5 Beargrass, Area 6 Gale Creek, Area 7 Views from Kachess lake. Figure 9 shows a typical existing situation.

<u>Area 1, Thetis loop</u>
Scenic Condition:
- Large trees towering above with medium trees and a variety of dense small trees scattered throughout the campground loop.
- Wooded atmosphere with medium shade; some light penetrates to the campground floor.
- Evidence of past hazard tree removal and some views of Lake Kachess.
- Variable winds and breezes blowing through the area.
- Variable density of tree screening between units.
- An atmosphere of being out in a peninsula in a conifer forest surrounded by Lake Kachess.

The vegetation condition is slightly altered as compared to a natural forest. Facilities are worn and rustic with large diameter logs in places. Air movement to disperse smoke is moderate to high through the campground. Views include intermittent glimpses of the lake, middle ground views of distant peaks, and the immediate campground loop.

Area 2, Lodge Creek loop
Scenic condition:
- Large trees, dense to moderately dense canopy.
- Some units are lined with sparse trees with heavy understory vegetation.
- Vegetation throughout the loop appears altered to natural.
Screening varies from heavy to very little between some units. Air movement to disperse smoke is moderate. Facilities are worn and rustic. Wooded atmosphere and enclosed landscapes are found in most units. Views are limited to the immediate campground loop. A very forested setting.

Area 3, Mineral Loop
Scenic Condition:
- Large trees exist around the outside of the campground loop.
- Medium-size trees scattered in variable clumps throughout the inner loop.
- Multi storied dense vegetation on the edges of the outside campground loop throughout the area.
- Moderately wooded atmosphere with moderately heavy understory vegetation. Air movement to disperse smoke is moderate. The scenery is altered within the loop to natural appearing vegetation on the outside loop. Screening varies from slight to moderately heavy throughout campground. Views are limited to the immediate loop. A wooded forest setting throughout the loop.

Area 4, Box Canyon
Scenic Condition:
- Moderately large trees throughout loop.
- Some scattered large trees.
- Variety of conifers, multi level stands with dense to moderately dense trees throughout the area.
- Moderate to heavy wooded atmosphere with little understory vegetation. The vegetation is natural appearing to slightly altered. Screening varies from moderate to heavy. Views vary from immediate loop to Lake Kachess to distant peaks. Air movement to disperse smoke in campground is moderate to high. This loop is screened from the other parts of the campground with landform and wooded forested vegetation.

Area 5, Beargrass Flat
Scenic Condition:
- Large multi-storied stand composition.
- Scattered large trees with heavy crowns.
- Conifers vary from moderately heavy to sparse canopy.
- Moderately wooded atmosphere with moderate screening between units.
The area's vegetation appears natural to slightly altered in some places. Air movement to disperse smoke is low to moderate. Views from within the loop varies from adjacent units to the immediate loop. This loop has a steep wooded slope on the northwest side of the loop.

Area 6, Gale Creek loop
Scenic Condition:
- Multi-level vegetative structure.
- Large trees, medium to small trees, variety of conifers.
- Wooded atmosphere with heavy shade, dark, the sound of Gale creek, views towards Gale creek and a cool feeling.
- Natural appearing vegetation.
Screening of trees between units is dense. Facilities are worn and rustic. Air movement around campground to disperse smoke is low to moderate. Views are limited from the campground loop towards Gale creek. The banks of Gale Creek are worn from past recreation uses.

Area 7, Views from Kachess Lake.
The campground as viewed from Lake Kachess appears as a slightly altered landscape. The multi-story stand composition is dense and appears heavily wooded in most of the area. The entire area appears as a coniferous forested landscape. The day use area is altered with a parking area and boat launch. The area north and up lake from the Box Canyon area is slightly altered due to the evidence of the launch area and parking. The immediate adjacent landform frames the campground and provides a natural appearing setting. Evidence of some camping units and people along the shoreline trails and on the beach give evidence of a campground.

4. VISUAL QUALITY OBJECTIVES: The Wenatchee Forest Plan provides several visual quality objectives as a tool for measuring the effect of a particular activity on scenery. The objectives are:

Retention: *Areas in which changes in the landscape are not visually evident to the average person unless pointed out.*
Partial Retention: *Areas in which changes in the landscape may be noticed by the average forest visitor but they do not attract attention. The natural appearance of the landscape still remains dominant.*
Modification: *Areas in which changes in the landscape are easily noticed by the average forest visitor and may attract some attention.*
Maximum Modification: *Areas in which changes in the landscape are strong and would be obvious to the average forest visitor.*

ENVIRONMENTAL CONSEQUENCES

Alternative 1
This alternative would, at first, maintain a multi-storied wooded setting with large trees, provide enclosure and screening and buffer, and the area would maintain a natural appearing to slightly altered vegetative condition through-out the campground with some sites being altered. The positive elements of form, line, color and texture of the area would be maintained for the next several years. At present rates of removal, however, most of the large trees would be gone in 20 years. Areas throughout the campground

would be altered at random due to removal of trees from disease. Views from Kachess Lake would appear natural. Thetis loop, Lodge Creek loop, Mineral loop, and parts of Box Canyon and Beargrass would be altered the most due to the amount of potential disease in the area. Gale Creek loop would have a smaller scale change.

Desired disease-free trees for long-term management (pines, larch, cedars, and other mixed conifers and deciduous trees) would not be introduced to the site. Vegetative changes and visual quality impacts to the entire campground would be gradual. This alternative would meet the Retention Visual Quality Objective.

Alternative 2 (Figure 10)
The Full Treatment alternative would retain most trees twelve inches in diameter or less, as well as scattered large cedars, some pines, and any tree that would not reach a "target" if it fell. The scenic wooded setting would be drastically changed. The enclosed character of the campground would not be maintained. The general appearance of the campground would be heavily altered and some campground settings would be unrecognizable from the existing scenic quality condition. Understory vegetation between loops would be retained in most areas, as well as scattered clumps of smaller to medium sized trees. Some large tree boles would be retained as snags, but most would not remain between campground units. Patches and clumps of old trees would be left in areas that would not fall in the campground units. The positive elements of form, line, color and texture of the existing vegetation would not remain. Views from Kachess Lake would appear altered, with part of the area appearing heavily altered. Long term vegetation of planted pines, larch, cedar, mixed conifers, deciduous trees and ground covers would eventually dominate the site in 30 years to provide a wooded setting

The Thetis loop would be heavily altered both from within the campground and the view from Lake Kachess. Thetis loop, Mineral loop, Lodge Creek loop, and Beargrass Flat would have the largest changes. Box Canyon and Gale Creek loops would be altered. Vegetative alterations would negatively change the setting between units, loops and cumulatively the entire campground. The vegetation and the visual quality impacts would be extremely high. This alternative would not meet the Retention Visual Quality Objective. The general appearance would be heavily altered to drastically contrasting depending on the amount of smaller trees left after removal of large trees. The Visual Quality Objective of Maximum Modification to Modification would be the norm.

Alternative 3 (Figure 11)
This alternative would retain most of the trees twelve inches in diameter or less, as well as scattered large cedars, some pines, and any tree that would not reach a camping area if it fell. Since the amount of area treated is reduced by 50%, the vegetation that surrounds the campground units would provide a strong wooded enclosure between the loops. Even though the wooded setting in the treated area would be removed, the scale of the changes would retain some of the forested character. Depending on the design configuration of the treatment, this alternative would partially maintain large tree character, some wooded settings, patches, and groves of old trees. Reducing the scale of the vegetative changes is

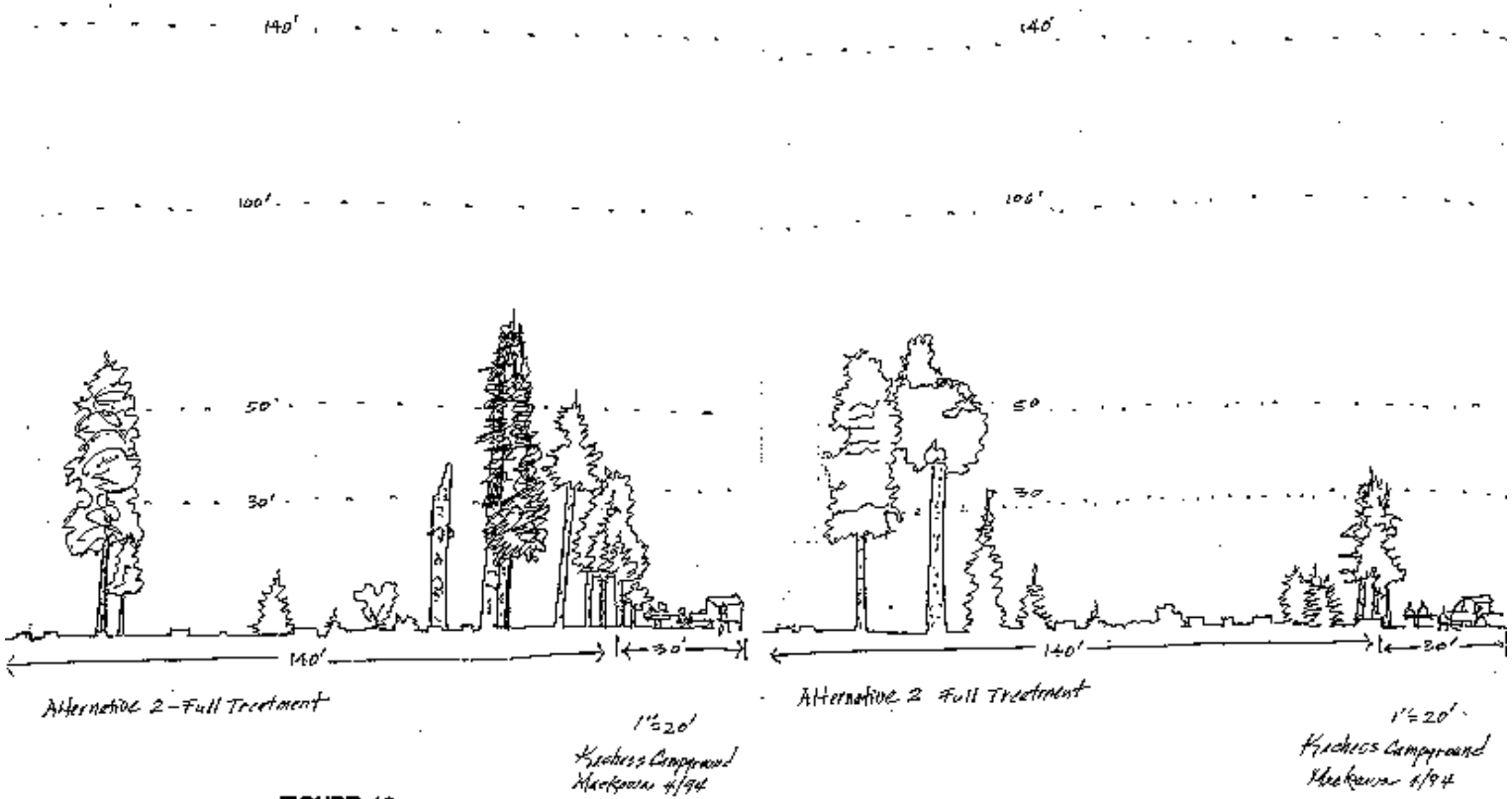

140'
100'
50'
30'
140'
30'
Alternative 2 – Full Treatment
1"=20'
Kirchner Campground
MacKenzie 4/94
140'
100'
50'
30'
140'
30'
Alternative 2 Full Treatment
1"=20'
Kirchner Campground
MacKenzie 4/94

FIGURE 10

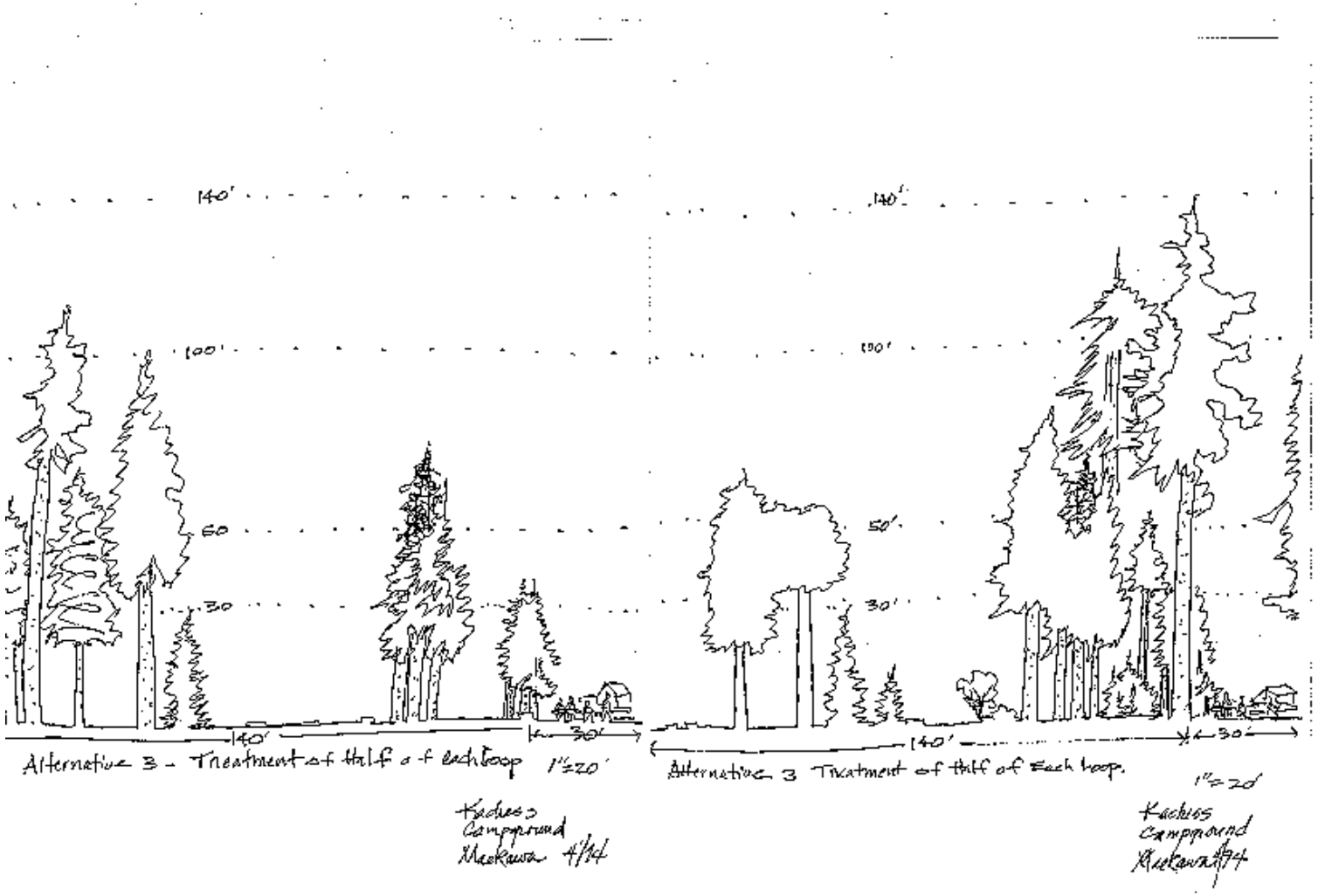

140'
100'
60
30
140'
30'
Alternative 3 - Treatment of half of each loop 1"=20'
Kachess Campground Mackaway 4/14
140'
130'
50'
30'
140'
30'
Alternative 3 Treatment of half of Each loop.
1"=20'
Kachess campground Mackaway 4/94

FIGURE 11

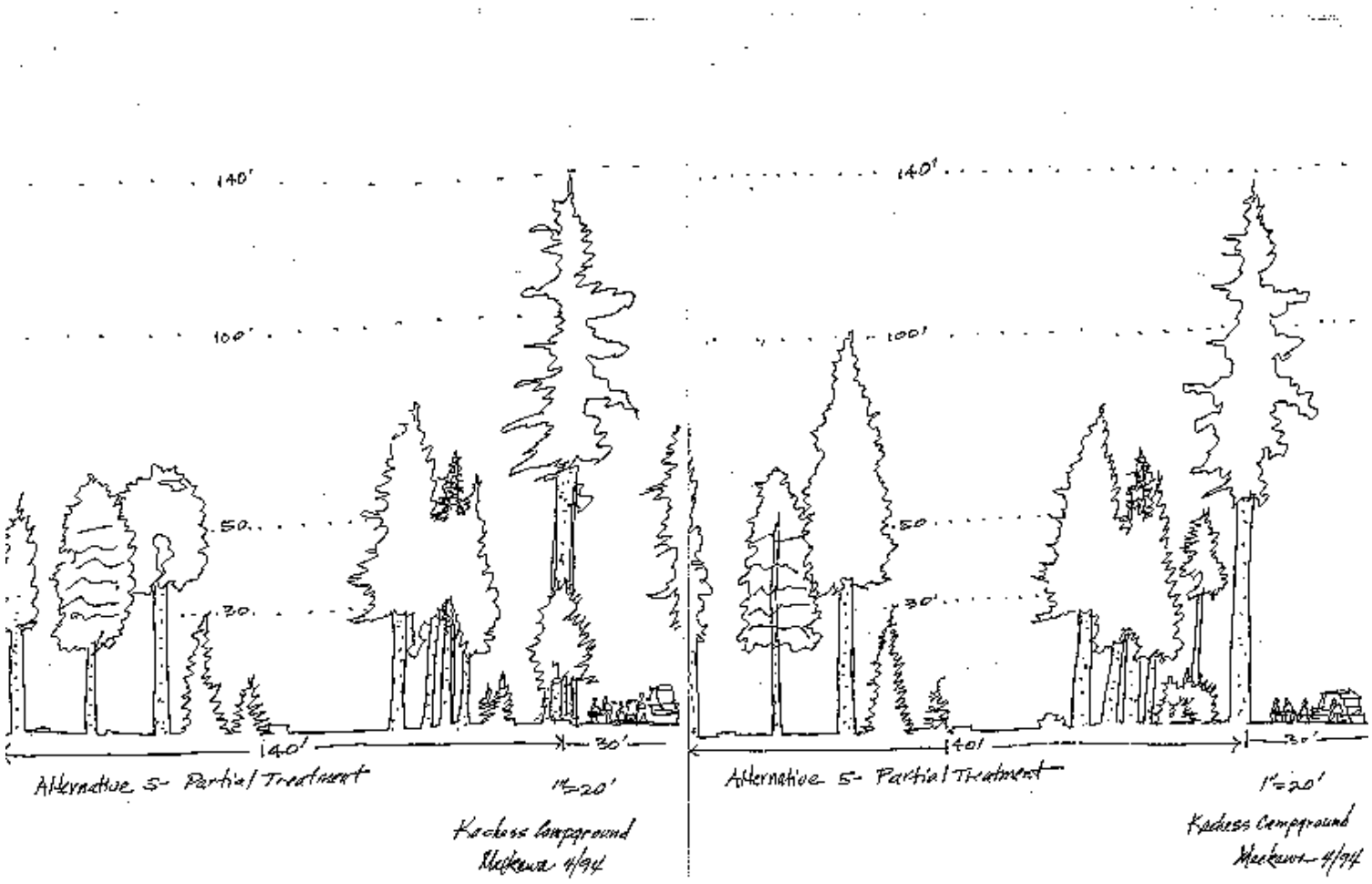

140'
100'
50'
30'
140'
30'
Alternative 5- Partial Treatment
1"=20'
Kachess Campground
Mackenzie 4/94
140'
100'
50'
30'
140'
30'
Alternative 5- Partial Treatment
1"=20'
Kachess Campground
Mackenzie 4/94

FIGURE 13

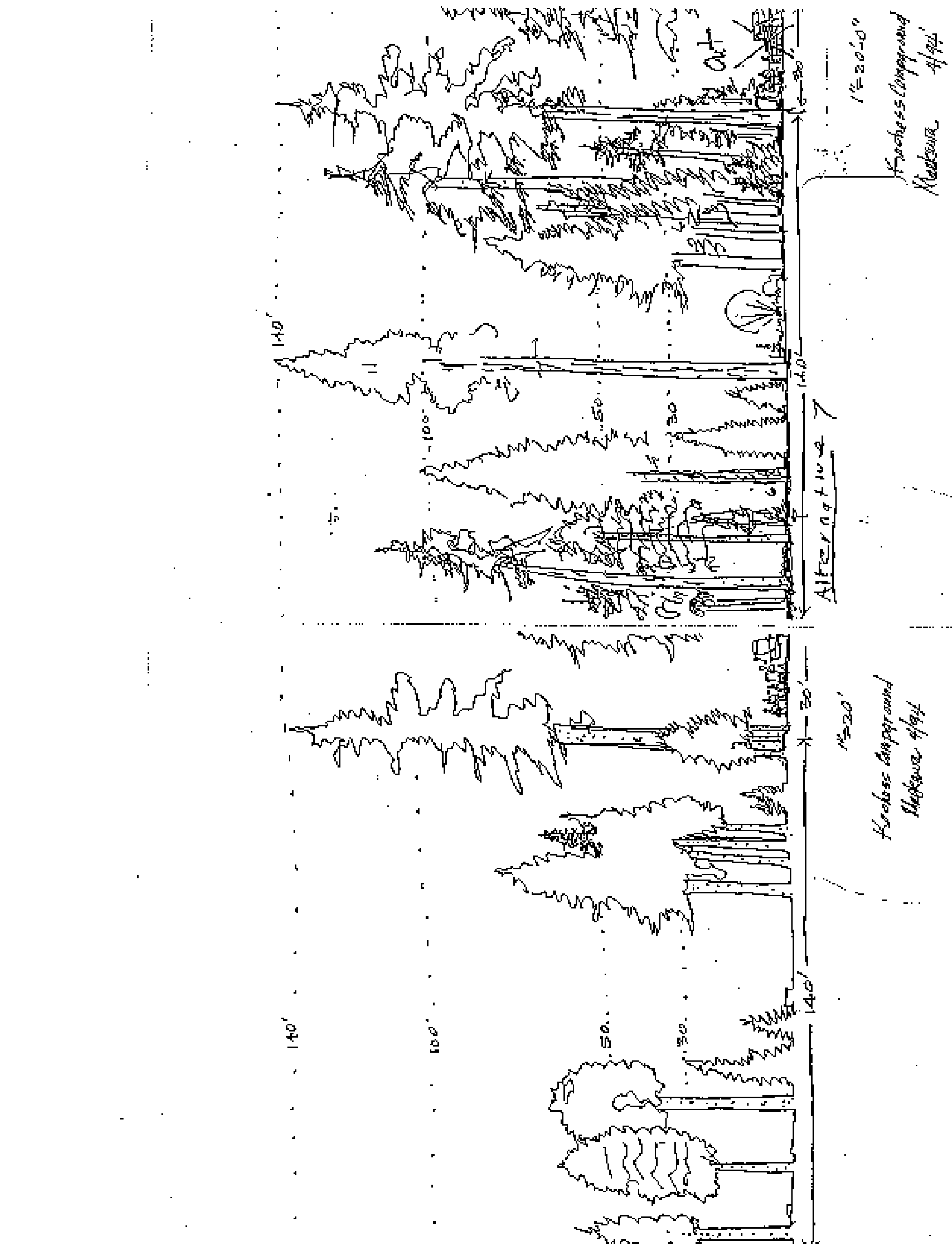


FIGURE 15

the main positive attribute of this alternative. The treated area (approximately 50% of each loop) would look the same as Alternative 2. The desired vegetation of pines, larch, cedar, mixed conifers with deciduous trees and vine maples would co-exist with the existing old trees in a variety of patches and change over the next 30 years.

The view from Lake Kachess would appear slightly altered to altered. The scale of the vegetative changes would favor visual quality. The scenic atmosphere of the campground would be partially retained. All the loops would appear altered, but the amount of contiguous changes would be reduced and screened between campground loops. Thetis loop, Lodge Creek, Mineral and Beargrass Flat would have the greatest contrasting changes. Box Canyon and Gale Creek loops would be less altered. One half of the area would have gradual vegetative and visual quality changes and the other half very high visual impacts. This alternative would not meet Retention Visual Quality Objectives. The treated area would appear altered to heavily altered. Adjacent untreated areas would provide a wooded atmosphere and thus appear natural. The Visual Quality Objective of Modification to areas of Maximum Modification would be the general norm for the campground.

Alternative 5 (Figure 13)
This alternative would partially maintain some multi story wooded setting. Trees would provide a variety of enclosures and screening. The area would maintain a range of natural appearing, slightly altered to altered vegetative condition throughout the campground. The positive elements of form, line, color and textures would be partially maintained. Areas throughout the campground would be changed by the tree removal at random, in patches, or in groves in a variety of patterns to promote maintaining some large to moderate sized trees and providing for the introduction of the desired variety of disease-free trees for the future (30 years). The desired trees for the future would start to add variety and diversity of vegetation to the area. Thetis loop would be altered the most. Mineral and Lodge Creek loops would be altered. Box Canyon and Beargrass would have some alteration. Gale Creek would be the least altered. Views from Kachess Lake would be natural appearing to slightly altered. Vegetative changes and visual quality impacts to the campground would appear in a range of gradual to moderate. This alternative would meet Partial Retention Visual Quality Objectives. Some areas would meet Retention Visual Quality Objectives.

Alternative 6
Closing most of the campground except the day use areas would retain the existing wooded multi-story setting. The enclosed landscape character of mostly natural appearance would dominate the site. The recreational setting would be retained, but would be experienced by people in a dispersed setting, rather than a developed setting. This alternative would meet Retention Visual Quality Objectives from within the site and as viewed from Kachess Lake. The vegetative changes and visual impact to this area would be gradual to nonexistent.

Alternative 7(Figure 15)
This alternative would maintain a multi-story wooded setting, large tree structure, provide enclosure and screening and buffer, and the area would maintain a slightly altered vegetative condition throughout the campground with some sites being altered. The positive elements of form, line, color and texture of the area would be maintained for the next decade. At present rates of removal, most of the large trees would be gone in 12-15 years. Areas throughout the campground would be altered at random due to removal of trees from disease. Views from Kachess Lake would appear natural. Lodge Creek loop, Mineral loop, and parts of Box Canyon and Beargrass would be altered the most due to the amount of potential disease in the area. Gale Creek loop would have a smaller scale change, and Thetis loop would remain natural.

Desired disease-free trees for long-term management (pines, larch, cedars, and other mixed conifers and deciduous trees) would be only sporadically introduced to the site. Vegetative changes and visual quality impacts to the entire campground would be gradual. This alternative would meet the Retention Visual Quality Objective.

K. SPECIAL USES

CONCESSION OPERATION

AFFECTED ENVIRONMENT
Kachess is one of eleven campgrounds on the Cle Elum Ranger District operated by Thousand Trails Management Services Inc. under a Special Use Permit, which expires December 31, 2005 and provides for a possible 5 year extension to December 31, 2010. Due to the popularity of Kachess Campground, capacity, level of development, complexity of operation, and revenues generated, it is the "flagship" of the concession operation on the district. Kachess alone generates almost half of the annual gross revenues from concession operated campgrounds on the district.

ENVIRONMENTAL CONSEQUENCES

Alternative 1
Under this alternative, the concessionairre and Forest Service would continue to incur above-average costs (above what it normally costs for a campground this size) for the annual hazard analysis and felling operation

Alternatives 2-5 and 7
All these alternatives would have effects impacting campground operation and maintenance, profitability, and permit administration. Any treatment other than that of Alternative 1 would necessitate closing the site earlier than "normal" in order for the treatment to take place that fall and early winter. This would result in a loss of gross revenues for that season. Depending on the extent of treatment, the campground would need to remain closed most if not all of the next season for slash cleanup, facility repair,

and initial rehabilitation. Closing of Kachess campground for a season would result in a loss of nearly half the annual gross revenues to the campground concessionaire, which in turn would significantly impact the profitability of that year. Hopefully any damage to facilities would be repaired that season and therefore have no negative impacts upon reopening the campground the following year. Depending on the extent of treatment, full rehabilitation of the site would most likely take place over several subsequent seasons. These projects would most likely result in temporary closures of portions of the campground with corresponding loss of revenues and additional non-routine administrative responsibilities for the permittee as well as increased complexities in permit administration. Alternatives 3,5 and 7 all result in a loss of additional campsites (revenue) with no corresponding reduction of overhead.

Alternative 6

Permanent loss of the camping revenues from Kachess campground, even with the corresponding reduction of overhead, could have a significant impact on the profitability of the concession operation on the Cle Elum Ranger District.

All costs associated with maintenance and enforcement activities of a dispersed area would be borne by the Forest Service. In the event operation and maintenance of the remaining day use facilities proved to be not economically viable for concession operation, the Forest Service would have to reassume those costs and responsibilities as well.

SUMMER HOMES

As shown on figure 3 at the beginning of this document, there are ten summer homes adjacent to the campground. These summer homes are on National Forest Land, and are covered under a special-use permit. At one point in the 1970's the intent had been to phase out these homes and expand the campground into this area. Since that time, Forest Service policy and philosophy have both changed, and this is no longer planned.

The summer home area was not included in the survey, nor is it part of this analysis. None of the alternatives would directly affect the summer homes, though the effects on their scenery would be as described above.

L. CULTURAL RESOURCES

AFFECTED ENVIRONMENT

Cultural resources are the material remains of human history. In many cases, these remains are our only link to the past activities of both American Indians and Euro-American settlers. The physical evidence from prehistoric and historic sites sometimes provides the only information about how people used the land and its resources to survive

and create unique ways of life. Other sites and places on the landscape have religious and cultural significance to American Indians and other groups.

The full extent of prehistoric and historic use within the Kachess Vegetation Management Planning Area has yet to be determined. Previous surveys within portions of the project area resulted in valuable information. Those survey results would appear to indicate a high prehistoric and moderate historic site density. Ethnographic information for the Kachess Lake area reveals extensive use of the area for hunting, gathering, fishing and travel. With this in mind, it is conceivable that potential sites exist within the project area.

Prehistoric:

Studies have shown that the Cascade Mountains of central Washington have likely seen human utilization since the end of the Pleistocene. At the time of historical contact, this area was inhabited by the Kittitas Indians, a subgroup of the Yakamas. Their recognized territory included all of the Yakima and Kittitas Valleys and the surrounding mountains to the Cascade crest. These large mountain lakes were still part of the seasonal round of these peoples into the early 20th century. Ethnographic accounts record the use of the area as a base camp for fishing, berry harvesting and mountain hunting activities on a seasonal basis.

Historic:

Employment Relief Administration, Work Progress Administration, and Civilian Conservation Corps: According to local residents, a fish trap was established on Box Canyon Creek in 1929 by the County Game Department. The purpose was to rid the lake of Dolly Varden, which were considered to be an undesireable predator. Shortly thereafter, the ERA or WPA occupied a camp at Box Canyon Creek while the men cut cedar that had been killed by the raising of the lake level. The camp was later used as a CCC spike camp during the construction of the Lake Kachess Campground. Some CCC-built fireplaces are still present throughout the campground.

Logging: Logging first occurred in the campground when it was being built in 1933/34. The next documented logging took place in 1957 when the Box Canyon portion was built. Logging occurred again in 1964-67 when the Kachess Campground complex was under construction including the road system and loops. Cutting again took place with the Kachess Campground Timber Sale in 1985/1986. Periodic entries have been made on a much smaller scale throughout the years to clean up blowdown or remove hazard trees.

Other: Records have shown that early trappers used the area and it was a portal to uplake mining activites. The reservoir dam and logging of the shoreline below the highwater line were completed around 1912. The early campground established by the Forest Service included sites on the Gale Creek and Box Canyon ends of the area. In the mid 1960s additional and better roads were developed between the existing campgrounds and the Peninsula and Beargrass loops were completed.

Cultural Resource Inventory Strategy:

The project area was surveyed in 1985 and portions again in 1991, and 1997. Many surveys have been conducted immediately outside the boundaries of the project area and have been referenced.

Two sites and one isolate occur within or on the outer boundary of the project area and would be protected/avoided during project implementation.

Important Interactions

While most heritage resources are discovered before a project is implemented, there is always the possibility that a site could be impacted before it is found. The greater the amount of ground that is disturbed increases the potential to disturb a site. An area's potential to contain heritage resources is generally divided into areas of low, medium and high heritage sensitivity.

Logging activity, including the development of landings and skidtrails all have potential to disturb buried deposits; cultural material not easily located by surface survey. Standard contract provisions would be included in the timber sale contract or service contract to addresses this issue. These provisions allow the Forest Service to automatically modify or cancel portions of the contract to protect an area or a heritage resource site if an additional site is discovered while the project is underway.

In the unlikely event that subsurface cultural deposits are exposed by project activity, all work within the vicinity of the buried and disturbed site would cease. This halting of work is necessary in order to fully assess the cultural resource property. Assessment could involve site documentation through testing, consultation with the State Historic Preservation Office, and development of a site mitigation plan. The report on the findings, as well as mitigation measures would be submitted to the proper agencies for review before any further management activity could continue.

Logging:

The only type of logging prescribed within the planning area is helicopter logging and using a self-loading log truck on existing roads. Helicopter logging has the least impacts of any method.

Revegetation:

Revegetation activities can have both positive and negative effects on heritage resources. Planting trees by auger methods or drilling for ground cover seeding is a direct negative effect if it takes place on a site. But stabilization of soil and ground cover around a site aids in its preservation.

Slash Treatment:

Many larger logs left on the ground following logging would be untreated. This would aid in discouraging campers from creating user-built trails. Some of the slash would be treated by non-mechanical means.

ENVIRONMENTAL CONSEQUENCES

Alternative 1

Direct Effects: None are anticipated.

Indirect Effects:
Indirect effects to documented historic properties are limited to natural occurrences associated with weathering and erosional processes. Metal artifacts would continue to rust and corrode. Weathering and erosional processes would lead to further deterioration of all sites.

Under the no action alternative, there would be minimal risk to cultural resources. Sites would not be exposed to any potential impacts from project activities.

Alternatives 2-7

Direct Effects:
The remaining alternatives range from treating all areas to only portions. Helicopter harvest method would be used in all alternatives. All logging activity takes place on terrain considered to be at moderate to high risk for containing heritage resources, and as the number of treated acres increases, so does the potential for disturbing a site not yet discovered. Usually developing landing sites poses the greatest potential risk to heritage resources, due to the extensive ground disturbance. This potential would be minimized by placing the landing in a location approved by the District Heritage Manager.

Indirect effects: Same as Alternative 1

M. CIVIL RIGHTS

There are no known specific uses of this area by any specific ethnic group. Management activity in this area would generate opportunities for minority employment and contracting. None of the alternatives would have an adverse effect on women, Native Americans, or any other minority group.

N. CONSUMERS

None of the alternatives would have any effect on consumers. Although each alternative would yield different administrative costs, the net effect would be significantly small.

O. IRREVERSIBLE AND IRRETRIEVABLE COMMITMENT OF RESOURCES

None of the alternatives would produce any irreversible or irretrievable commitment of resources, except for fuel used in operations.

P. ENVIRONMENTAL JUSTICE

Executive Order 12898, dated February 11, 1994, requires agencies to incorporate environmental justice into their missions by identifying and addressing disproportionately high adverse human health or environmental effects of their programs and policies on minorities and low income populations and communities. We have found through both internal and external scoping that there are no minorities or low income people who would be adversely or disproportionately affected by the actions proposed in this analysis.

CHAPTER IV - CONSULTATION WITH OTHERS

People writing, calling, or attending meetings and abbreviated comments:

Dino Jurdich(property owner near Crystal Springs) - Wants to buy logs.
Esther Faudree - Wants to be on mailing list.
Mrs. J. Davison - Wants to be on mailing list.
Enid Roebury - Wants to be on mailing list.
Ruth Apffel - Concerned that increased opening of canopy would increase blowdown, and that heavy cutting would destroy the reason for going.
Betty Howe - Wants to be on mailing list.
Ralph Cornwall - Don't close campground. Cut trees if necessary to keep open.
Mr./Ms. West - Cut the most hazardous trees and replant.
Mr./Mrs. Jones - Remove all diseased trees and plant new ones. Owls would move to new trees.
Roland and Betty Davis - Love Kachess. Don't cut trees or change campground.
Niel Duncanson (nearby property owner) - Alts 3 or 5 most reasonable. Closure would affect their property value.

Morris Jenkins (longtime resident and forester) - Fell all trees in root disease pocket are a hazard and recommended removal. Should take action regardless of owl habitat because of popularity of the site.
Dan Farrel -(Forest Service employee with 20+ years experience in recreation) Wind events in the Summer blow down healthy and unhealthy trees randomly. Recommends expansion of current annual hazard tree removal program.
Mrs. Lois Smith (nearby landowner) - Wouldn't mater if trees were cut.
Vern Lang - Do what's necessary to keep the campground open.
Fabian Ruchin - Cut what's necessary to keep the campground open.
Tag and Merit Christianson (nearby landowners) - Remove trees in stages to preserve habitat. Ban jet skis, motorcycles, and snowmobiles.
Susan Reiley - Investigate all forms of treatment. Cut trees only as an extreme last resort.
Un-named in Bellevue: DON'T cut trees! Close sites if necessary.
Un-named (phone call) - Wait until 1 camper gets killed before considering cutting.
L. McCoy - Selectively thin over time. Would be hot and ugly if trees cut.
Washington Dept. of Fisheries - Utilize trees cut from this campground for fisheries enhancement projects elsewhere in upper Yakima basin.
Janet Nelson - Hates to see trees cut, but OK if we have to.
Bill Coates - Wants to be on mailing list. Keep campground primitive.
K. E. Cottingham - Believed the whole campground was to be closed. Vehemently against it. Feels trees are not a hazard.
Liz Tanke - Do the minimum needed for safety. Plant only native species. Restrict snowmobile and random foot travel. Consider buying back timber sales or Plum Creek land to replace lost habitat. Urged protection of old-growth and riparian areas.
Bruce and Cheryl Whitemarsh (cabin owners) - Do what is necessary to correct the problem.
Mearl and Mary Winkle (cabin owners) - Do what's necessary to correct the problem.
Craig Magnuson - Log carefully, plant back disease-resistant trees.
Ellensburg Hilltoppers (Jeep club). - Remove hazard trees ASAP. May injure spotted owls as well as campers.
Tom Baker (nearby landowner) - Program has worked well in the past. Maybe inspect more closely in spring.
Un-Named in Seattle - "Cut the trees down."
Mary Pat Larson - Prohibit any kind of logging. If safety is a problem, close the campground and let the forest heal itself.
Brian Murphy (nearby landowner) - If campground closed, don't move it near them.
Donna Criscione (representing Kachess Ridge landowners) - Concerned that if campground closes, people would camp on their land.
Ann and Brian Lewis - Preserve the Forest. Close campground if that's what's necessary.
Ron Nelson - Scale down campground, save some old growth. Keep boat launch open.
Kieth Baldwin - Wants to be on mailing list.
Kirk Cresto - Wants to be on mailing list.
Gwilym Plouse. - Loves the trees, but said do what we need to do for safety.
Bernie Larson - Would hate to see the trees cut, but do what's necessary.
Becky Price - Camps there often and concerned about campground closure.
Mike Mitchell - Can help with logging and land exchange.

Gene Gilbert - Wants to stay informed. Concerned that root disease may be in cabin area, too.
Margaret Kelly - Sell the trees and put the money back into the campground.
Gary Walk (Boeing Recreation Manager) - Can we treat root disease? Wants to be sure Boeing recreation site (across lake) is not closed.
K. W. Jeffers - Remove known hazard trees or close the site.
Mr. and Mrs. Chauncey Deschenes - Do what is necessary.
Mr. and Mrs. Stan Pasin - Do what's necessary to keep the area safe.
Dick and Bernadette Harris - Remove trees if no treatment available.
Andrew Magnuson - Safety must come first. Suggests removing trees in stages over several years.
Bill Burwell - Remove diseased trees if that's what's necessary.
Linda Levar - Would hate to see the area closed. Remove diseased trees if that's what's necessary.
Dan Papineau - Use qualified personnel. Be aware of increasing blowdown hazard. Remove hazard trees and monitor future problems. Feels campground is too dark.
Andy Roben - Wants to be on mailing list.
Ken Roben - Wants to be on mailing list.
Eric Espenhorst (Friends of the Earth) – Consider no-commercial-harvest alternative. Use prescribed burning, natural fire, and manual release.
E.M. Sterling – Listed a number of issueS to consider in the process.

ATTENDEES AT PUBLIC MEETING
Jack Chase
Scott Montgomery
Robert Cernick
Bill Lowery
Brian Cole
Augie Anderson
Janice Cole

COMMENTS FROM PUBLIC MEETING:
- Closing campground would be a large revenue loss and denial of camping experience to thousands.
- Sanitize loops where needed. Develop additional camping in group site and summer home site.
- Closing campground is completely out of the question.
- Retain some old-growth feel, even it means a smaller campground.
- Favor family camping over large groups.
- Treat in a way so it doesn't look like a clearcut.

Environmental Assessment Prepared by:

Tim Foss, Project Team Leader

Acronym List

ACS - Aquatic Conservation Strategy

DBH – Diameter at Breast Height

GPS – Global Positioning Unit

LSR – Late Successional Reserve

NRF – Nesting/Roosting/Foraging (spotted owl habitat)

PETS – Proposed, Endangered, Threatened, and Sensitive (species)

ROD – Record of Decision (for Amendments to Forest Service and Bureau of Land Management Planning Documents within the range of the Northern Spotted Owl [aka Northwest Forest Plan]).

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APPENDIX A

Chapter 3

Components of Tree Hazard Analysis

Hazard rating consists of inspecting potentially hazardous trees and estimating the probability of failure and striking targets during the time between examinations, then ranking by risk, from high to low, and prioritizing for treatment. Since it is not reasonable to eliminate all hazards (i.e. all trees) from a recreation site, line officers must decide what constitutes an acceptable level of risk, then treat or mitigate as necessary to achieve that level while minimizing disturbances and impacts on aesthetics and recreation enjoyment. This not only requires inspecting each tree in the context of its location in the unit, it also suggests some level of documentation or tracking is needed to maintain an ongoing record of tree condition and date of examination or re-evaluation. Tracking maximizes the economic efficiency of hazard monitoring programs in the long run since only those trees needing re-evaluation in a given year are evaluated. A systematic tracking system also minimizes program disruptions or discontinuities in the event of personnel changes.

The degree to which a tree is hazardous hinges on four factors:

(1) its potential for failure;

(2) its potential for striking a target in the event of failure;

(3) the potential that serious damage will result; and

(4) the value of the potential target(s).

Minimum value for any factor results in significantly reduced risk.

Potential for Failure

The job of estimating the potential for tree failure (the likelihood of failure) is difficult because of the many interacting variables that come into play, but it can be done and with reasonable assurance. Tree size, age, form, species, condition, and location must all be considered along with plant association, successional stage, stand structure, stand species composition, climatic and soil conditions, and presence and extent of defect. Failure potential is estimated by examining a tree, determining the factors and conditions that contribute to failure or weakening, and estimating the likelihood that these factors and conditions will simultaneously occur before the next inspection period. Variables that are evaluated include:

1) the lean of a tree and factors that contributed to the lean;

2) whether a tree has recently been root-sprung (lateral root anchorage has been compromised);

3) whether trees that leaned over some time ago have righted their tops subsequently and have acceptable lateral anchorage;

4) the presence of forked tops or a recent weakening of a forked top;

5) the presence and extent of lethal or weakening root, stem, or branch disease or insect infestation;

6) the season of the year when high winds are likely and its relationship to the visitor-use season;

7) the direction of prevailing winds and the potential for wind eddies.

8) the presence of damage caused by recreationists, roadbuilding or maintenance activities, installation of septic systems and drainage fields, tree poisoning by effluent from waste disposal stations or restrooms;

9) the presence of dead, broken, or hanging branches.

10) the presence of basal scars, trunk injuries, lightning strikes, wind shake, frost cracks, cankering, dead tops, broken tops, V-shaped branch crotches, stem swellings, bear damage, undermined roots, excessive soil compaction, slime flux, basal resinosis, mechanical injury, crooked stem (old snow break), and;

11) evidence of root disease infection and mortality, species composition of adjacent trees, opportunities for lateral spread of the disease, presence of natural barriers to disease spread.

There are many others, but this abridged list reveals the types of variables considered in the evaluation of tree failure potential.

Potential for Striking a Target

The potential that a tree or tree part will strike a target is determined by evaluating where trees or their parts will likely land in the event of a failure, and whether those places of impact will be occupied by targets at the time. This determination is more straightforward for sites with characteristic high and steady occupancy than where intermediate or low occupancy occurs. Variables that are evaluated include:

1) the location of designated parking areas and other undesignated areas where people are prone to park their vehicles;

2) the location of tent pads, fire rings, barbeque pits, water pumps, waste disposal stations, restrooms, historic buildings, information boards, interpretive stations, trailside rest stops, scenic viewing areas where hikers are prone to/invited to pause and view, children's play areas;

3) seasonal use patterns including timing of use, type of use (weekend car camping vs. established elk camps vs. off-season use for motor homes by retired couples), and extent of use; and

4) the location of all potential targets or target areas to identified tree hazards.

Potential that Serious Damage will Result

The amount of damage resulting from partial or complete failure of a tree is dependent upon the size of the failed portion. Damage potential is estimated by rating the size of the tree part that will strike a target. In total, damage potential incorporates evaluation of the likelihood that a partial or complete tree failure will impact a target, the likelihood and amount of damage, and the value of the potential target.

Value of Potential Target(s)

The value of a potential target is estimated by determining the maximum extent of loss in the event that it is struck by a failed tree or tree part. Financial and emotional losses resulting from the death, injury, or dismemberment of a person are far greater than for the loss of picnic tables, buildings, or vehicles. Values are expressed in relative terms (low, moderate, and high) and are factors considered in evaluating damage potential. For example, if the target is a person or their parked vehicle, the value would be high. A target of moderate value may be a building or other developed structure or convenience such as a water pump or waste disposal station. Garbage cans, dumpsters, and information boards may be examples of lower value targets.

A Standard for Rating

The standard system suggested here incorporates two important components. The first component addresses the potential for tree failure within a specified time period. Failure potential is rated on a scale of 1 to 4 in order of increasing potential:

1 = VERY LOW FAILURE POTENTIAL

Sound trees that will not likely be exposed to extremes of weather.

2 = LOW FAILURE POTENTIAL.

Trees with only minor defects (stem decay with more than an acceptable rind of sound wood), in areas sheltered from weather extremes, or sound trees that will likely be exposed to weather extremes (wind, snow loads).

3 = MEDIUM FAILURE POTENTIAL.

Trees with moderate defects (at or near the threshold of acceptable rind thickness), or that are growing in shallow soil, are shallow-rooted, or are exposed to high water table, and that will likely be exposed to strong winds and snow, (extent of defect alone does not justify removal or hazard mitigation); or highly defective trees in areas well-sheltered from weather extremes; or highly defective trees exposed to weather extremes which only occur in the off season.

4 = HIGH FAILURE POTENTIAL.

Highly defective trees in unsheltered areas, or trees with root anchorage limited by erosion, excavation, undermining, or adverse soil conditions; dead trees, or those with root disease.

The second component of hazard rating addresses damage potential in the event of a failure. This portion of the rating must incorporate the likelihood that a failed tree or tree part will strike a target, the likelihood of damage, and an estimate of target value. Damage potential is rated on a scale of 1 to 4 in order of increasing potential:

1 = NO DAMAGE.

Target impact will involve only very small tree parts; or there is no chance that failed parts will cause damage when they impact a target.

2 = MINOR DAMAGE.

Failure of only small tree parts and impacts in occupied areas are indirect; or failures will likely occur when area is unoccupied; damage when it occurs, is to low value target(s).

3 = MEDIUM DAMAGE.

Failure involves small trees or medium-sized tree parts, and impacts will likely occur in areas with targets; impacts will be direct, and damage will likely be moderate, and target value is moderate.

4 = EXTENSIVE DAMAGE.

Failure involves medium to large tree parts or entire trees, and impacts will be direct in areas with targets; target value is high, and damage to property will likely be severe; or serious personal injury or death is the likely result.

The hazard classification for each individual tree is determined by combining the values from the two parts of the rating system. Seven risk classes ranging from 2 to 8 are possible. Treatment priorities by risk class are as follows:

Risk Class	Treatment Priority
8	very high
7	high
6	moderate
2-5	low

Annual Site Examinations

Timing and frequency of examinations may vary, but all developed sites should be reconnoitered for new evidence of hazardous trees at least annually. Sites should be examined once the severe weather season(s) have passed. This translates to spring in many parts of the country because severe weather is most often associated with winter storms. When that is the case, examinations should be completed in the spring, after the snow is off and before new foliage emerges, to improve the sighting of branch, bole, and root defects. Winter storms often bring attention to the most severely defective trees or limbs, and the portions of stands with severe root disease or stem decay.

Annual site exams should be done systematically. They normally consist of a walk-through examination, where each tree and all areas of the developed site are observed for new evidence of hazard or defect. All trees within striking range of a target, either fixed or transitory, should be examined. Evaluations should begin at known or established reference points, and all trees in the near vicinity of those points systematically examined with pertinent observations recorded for each tree. Ideally, a benchmark or baseline hazard tree evaluation should already be completed for the site and notes from the walk-through examination can be used to modify or upgrade that information. If no such baseline evaluation exists for a site, one should be conducted.

Establishing a Baseline Hazard Tree Evaluation

The development of a baseline evaluation requires a systematic approach that should be organized in planning sessions before going to the woods. The approach that follows is one we have used and modified over the years. We divide it into four stages:

1) identify and gather the necessary equipment;

2) determine the data needs and gather those data;

3) record the data and develop a permanent database; and

4) manage the unacceptable hazards.

Equipment Needed for Baseline Hazard Tree Evaluations

Equipment	Intended Use
Pulaski	Exposing roots and checking for decay, signs and symptoms
Cruisers axe	Sounding boles, inspecting stems for saprot, heartrot, evidence of insect attack
Binoculars	Examining stems for conks, punk knots, swollen knots and other indicators of stem decay, and for examining tree crowns for hazardous branches, dead or forked tops, other defects
Diameter tape	Measuring tree diameter
Chain (trailer)	Measuring distances for stem mapping
Compass	Recording azimuths for stem mapping, and relationships to reference points
Relaskop/ Clinometer	Measuring tree heights
Cordless drill, batteries, drill bits	Estimating the rind thickness of sound wood in the bole, evaluating root soundness (drill bits are flexible steel, 11-12 inches long X 1/8" wide, 9-10" flute, drill is heavy duty, battery packs are rechargeable)
Hand lens (10X)	Examining advanced decay, other indicators
Field Ident. Guides	Aids for identification of defects by their indicators (timber cruiser and stand exam guides, this guide)
Data forms/pencils	Recording data
Tree tags	Provide a semi-permanent numbering system for trees that will be re-evaluated annually (Tags are aluminum, numbered in series)
Aluminum nails	To secure tree tags in trees
Tree paint or tree flagging	To identify trees that must be removed

This equipment list can be modified to suit budgets and individual needs. We have routinely used these items to do a thorough job of recording a baseline evaluation to which subsequent annual evaluations and monitoring

exams could be tiered. The portable drill replaces the increment corer of past evaluations. It improves the ease of non-destructive sampling of defect and annual monitoring of its progress.

Where and How to Collect Data

Where to survey. Trees should be evaluated adjacent to all roads, including the roads entering and exiting the site and all travel loops within the developed portion of the site. All trees of a height that if fallen would reach the road should be examined. The width of the survey area adjacent to roads is equivalent to the height of the tallest trees. Concurrently, all trees adjacent to structures, parking areas, restrooms, waste disposal stations, and water pumps must be evaluated. The width of the survey area around these developments is equal to the height of the tallest trees.

Within developed sites, all trees that can reach to tent pads, picnic tables, motor home parking areas, commonly used streamside or lakeside fishing spots, fire rings, barbecue pits and all other recognized gathering places or focal points of human activity should be carefully evaluated. If these are not known, they should be observed during periods of high use prior to establishing the baseline evaluation. At all times, examiners should be aware of the tree hazards that have some potential to impact human targets. These are most important to identify and mitigate to protect the safety of visitors.

Generally, only trees greater than 6 inches diameter at breast height (DBH) should be examined. Smaller trees cause little damage and are considerably less prone to failure under most conditions. Under certain circumstances, trees less than 6 inches in diameter may require periodic inspection if their proximity to a particularly sensitive target (a target that likely would be damaged by impact) suggests unacceptable hazard, but this is exceptional.

How to survey. To start, a system of reference points should be established. Permanent reference points are essential for generating maps and for documentation and relocation of individual trees. Since roads are a relatively permanent fixture on the landscape, they are an excellent location for placement of initial points. Spikes driven into the road centerline at regular intervals (nailheads highlighted with colored flagging) can be referenced to one another using azimuth and distance to each other point and the nearest main road junction or some other permanent landmark. Subsequently, a grid of points can then be established throughout the site, referenced to one another and the spikes in the road. We have found that a reference grid of a 2 or 3 chain interval, depending upon the density of vegetation and sighting distances, is sufficient. These within-site reference points should also be established as permanent references; capped, steel pipes (1 to 2" diameter X 2 to 3' length) work well. These can be driven into the ground with the cap exposed above the litter layer. Reference numbers should be visibly stamped on the pipe caps. Reference points should be numbered in series to avoid future confusion, starting at one end of the site and running to the opposite end.

Beginning with reference point #1 and continuing in order to the last, trees should be evaluated and observations recorded. A blank data form (TRF1-91) is provided in Appendix A. Another is provided (Appendix D) displaying several tree records as they might occur. One method of evaluating

Individual trees that has worked well involves an initial examination from a distance to allow comparison of the vigor and overall appearance of a tree to its nearest neighbors. This is followed by close-up inspection and examination of each individual tree (≥ 6" DBH). The view from a distance allows the examiner to detect symptoms of root disease which can include reduced lateral branch and terminal growth, thinning crowns, chlorosis (yellowing), distress cone crops (abundant small cones), dead tops and branches. Evidence of defoliator activity, dwarf mistletoe infection, and bark beetle attack is often initially detected from a distance. Verification of the causal agents, assessment of tree damage and weakening, and potential for failure occurs with careful root, stem, and upper crown inspection. Individual tree and stand-level clues should be used to make accurate diagnoses for each tree.

Each tree that is examined should be tagged with a numbered aluminum tree tag fixed to the tree with an aluminum nail. Nails should be driven through the tag leaving 3/4 to 1" of the nail sticking out to allow for new radial growth. Tags should be placed 1 or 2 inches below the surface of the litter layer so they are hidden from view yet easily found. Normally a cardinal compass direction should be selected and all tags should be placed facing in that direction. This will simplify the process of future tag relocation.

Recreation site records covering a 10-year period in the Pacific Northwest revealed the frequency of tree failure by position of the defect on the tree. Table 1 displays the tree data by species. Nearly two-thirds of all recorded failures occurred as a result of root or butt defects. Limb failures occurred more frequently in hardwoods than in conifers.

Table 1 - Distribution of failures by position of defect and tree species on Pacific Northwest recreation sites.

Tree species	Up bole (%)	Low bole (%)	Butt (%)	Limb (%)	Root (%)	Total Number
Alder	23	11	30	1	35	154
Douglas-fir	17	11	15	3	54	404
Engelmann spruce	0	3	34	0	63	38
Grand fir	12	16	18	0	53	34
Incense cedar	14	29	8	4	44	111
Larch	8	26	4	4	58	26
Lodgepole pine	13	8	7	3	69	637
Madrone	10	2	28	42	18	321
Maple	13	4	30	9	47	47
Mountain hemlock	12	77	0	0	12	43
Noble fir	37	11	0	0	53	19
Pacific silver fir	5	48	5	0	43	21
Ponderosa pine	42	6	5	0	47	283
Poplar	15	12	19	31	23	26
Red fir	16	30	13	1	40	87
Sitka spruce	18	27	18	0	36	11
Spruce, unident.	0	53	0	0	47	297
Subalpine fir	55	3	24	0	17	29
Sugar pine	14	25	17	8	36	36
Tanoak	13	24	18	16	28	1614
Western hemlock	4	18	18	1	58	113
Western red cedar	0	15	12	10	63	41
White fir	0	53	15	0	26	34
Average	15%	22%	15%	6%	42%	4423

Typically, there will be many readily available stand-level clues that will be overlooked if they are not brought to mind. Examiners should scout the area in the vicinity of each tree for obvious and subtle evidence of past and current pathogen and insect attack or other damaging agents. Nearby stumps and old root tubes should be examined for evidence of advanced decay and conks of root and butt pathogens. Broken-out tops that are lying on the ground, and windthrown or wind-sheltered trees should be examined to determine the causal agents. Conks, mushrooms, and other fruiting bodies on and around trees should be identified since these are primary indicators of decay (disease) and their identification often leads to detection and correct diagnosis of problems in adjacent apparently healthy trees.

When individual trees are evaluated, examiners should look for signs and symptoms of disease and evidence of insect attack (Figures 8-12). In the event that signs and symptoms indicate damage and a potential hazard, trees should be examined more thoroughly to determine the extent to which the damage has compromised structural integrity of the tree. Some defects

Figure 8

Figure 9

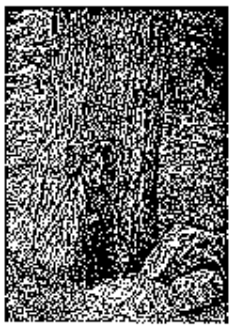

Figure 10

Figure 11

Figure 12

do not demand immediate hazard mitigation but suggest periodic re-examination. Such monitoring can range in frequency from one to three years depending on the degree of structural degradation. Systematic tree examination begins at the ground around the base of the tree, then proceeds to the butt, bole, limbs, and tree top. All sides of each tree should be examined. If basal resinosis, crown symptoms, conks, or evidence of decay indicates a root disease problem, examination of several roots via the pulaski will be necessary. Since many trees in recreation areas are tall and their tops are partially hidden from view by other tree crowns, binoculars may be necessary.

If root disease symptoms are evident, the root collar, butt, and major lateral roots should be inspected for signs of the causal agent(s) such as fruiting bodies, evidence of ectotrophic (surface) mycelium, signs of recent or old injuries. Some older injuries may be completely covered with callus tissue or bark. Evidence of older injury is often characterized by obvious fissures

in the bark or they may be nearly unrecognizable except for a subtle flattening of the bole. At this point, if evidence points to root disease, the pulaski can be used to uncover roots (out to a distance of one meter if needed) and to chop into them to examine them for incipient stain or advanced decay. At least 2 major roots should be checked for root disease if preliminary evidence suggests that it is present. The roots that are most likely infected should be checked first. These include those closest to infected (hollow) stumps, windthrown trees, or obvious root disease centers.

If a tree exhibits signs of older injury, the cordless drill can be used to check for presence and extent of decay behind old wounds. The first place to drill is directly into the scar or flattened area. If decay is found, at least 3 more drillings should be made to the opposite and adjacent sides, to estimate the extent of decay. Tree species that display buttressing or fluted butts (e.g., western hemlock, western redcedar) may require more sampling since the distal portions of fluted areas are often thicker. The thickness of the remaining rind of sound wood should be recorded by averaging all measurements. Refer to Table 2 for minimum safe shell thickness. When the thickness of the rind (shell) of sound wood is insufficient for a trees' diameter (DBH), the failure potential would be recorded as 'high'.

Table 2 - Minimum safe tree shell thickness at various DBH's1/.

Tree DBH (in.)	Minimum Shell Thickness2/ (in.)	Tree DBH (in.)	Minimum Shell Thickness (in.)
4	1.0	40	6.0
8	1.5	44	6.5
12	2.0	48	7.0
16	2.5	52	8.0
20	3.0	56	8.5
24	3.5	60	9.0
28	4.0	64	9.5
32	4.5	68	10.0
36	5.5		

1/ Modified from Wagener, 1963 by expanding the range of diameters covered.
2/ Minimum shell thickness for trees with open wounds is 25 percent greater than indicated in Table 2.

Drilling into all trees is not recommended since it is somewhat time consuming and is usually not warranted lacking other indicators of internal defect. Trees with substantial decay usually bear obvious indication of that defect.

Signs of significant pileated woodpecker activity (not to be confused with sapsucker work, or other woodpecker work after mass attack by bark beetles) such as partial cavity excavation, often indicates the presence of termites and/or carpenter ants. It might mean that insects are mining in the bark and are not affecting the integrity of the wood, or it may mean that the butt or the main stem has significant decay. Chopping the bark or drilling can confirm the presence and extent of defect. Be discrete with chopping so as not to suggest to visitors that it is an acceptable public activity.

The bole above the lower butt is the next logical section to examine. From this point upward, visual examination will be employed to estimate the extent of defect. Again, signs of past injury or fruiting bodies should be the target of observation.

Old-growth trees often exhibit fruiting bodies of stem decay fungi when decay levels are hazardous to personal safety. These fruiting bodies generally develop at the site of old branch stubs. Absence of conks, however, does not necessarily mean that a tree is free from defect. Record the presence of all signs of potential defect so that if treatment is not immediately warranted, the loss of a conk or misinterpretation of other signs will not lead future examiners to believe the stem is sound. If hazard evaluations are conducted on cloudy days, lighting conditions will be flat, and fruiting bodies of stem decay fungi will often be missed. Examinations are best done on sunny days when visibility and contrast are maximized.

While dead branches and dead tops are less hazardous to visitors than dead trees or those with root disease, tree tops should be examined thoroughly. Tree hanging and dead branches should be evaluated and dealt with as needed. Dead tops should be examined for decay and instability indicated by crumbling sapwood, woodpecker activity, and nesting cavities. Binoculars are useful in this assessment.

Recording an Evaluation

Individual tree examinations are complete at this stage. To provide evidence that a tree was examined, a tree record should be filled out (refer to Appendix D for an example record form). Recording results of recreation site evaluations is necessary from several vantages:

1) the assessment of current hazards and forest health provides orientation and framework for future vegetation management activities;

2) it shows the predominant defects in each campground making the job of future surveys easier;

3) it provides the database for future vegetation and hazard management and monitoring efforts;

4) it sets the baseline upon which to build other recreation opportunities, other vegetation structures and compositions, planning and investment horizons; and

5) it is the record of performance in the event of Tort Claims.

Monitoring Recognized Tree Hazards

A primary benefit of establishing a baseline survey and permanent database is that future site re-inspections and hazard monitoring are simplified. Hazard and monitoring information are readily entered into relational databases like Paradox, dBase IV, RBase and perhaps Oracle. Answer files may be generated annually, listing the trees indicated in prior inspections that are to be monitored in a given year. Files would provide the locations of specific trees relative to reference points, their species, size, and type of defect, their prior extent of defect, the appropriate monitoring interval, prior hazard and risk ratings, and recommended treatments. Stem maps can be generated using the reference points and

azimuth/distance information using AutoCAD or equivalent software and maps of virtually any specification can be generated; tree removal maps for contractors, annual tree visitation maps for defect monitoring and periodic re-evaluation, complete developed site maps for long-range planning and visual perspective projections. Over time, annual layers of information will be accumulated and available for trend analyses of vegetation, pathogen and insect populations, and management activities.

Establishing a Semi-Permanent Tree Record

Whether or not a tree has defect, a complete tree record should be developed at the time of the baseline survey and updated with each re-evaluation. The tree record should contain all the data needed to discover trends for individual trees. When observed in aggregate, stand level trends will become obvious. Each tree record form should have columns for each parameter that is to be measured or observed periodically, and rows to enter the observations for each examination. The following information should be recorded:

1) recreation site name;
2) tree identification number;
3) tree species;
4) date of baseline survey;
5) closest reference point (RP);
6) distance to RP;
7) azimuth (degrees true);
8) date of current examination;
9) tree diameter at breast height;
10) tree height;
11) symptoms of root problems (injury, loss of anchorage, disease);
12) cause of root problems;
13) cause of butt problems;
14) symptoms of stem problems;
15) cause of stem problems;
16) thickness of remaining sound wood (rind);
17) other problems, dead or hanging limbs, dead top;
18) risk rating/tree value rating;
19) recommended treatment;
20) date treatment accomplished;
21) date of next scheduled examination; and
22) name of examiner(s).

Some of these data need to be recorded only once (#1-#7), others at specified or regular intervals (#8-#22), and some may not be appropriate to a specific examination. All columns, in each row, for each examination, should be entered. This will insure that some data are not overlooked. If no alpha or numeric data are needed in a specific column for a particular inspection period, a "-" is an appropriate entry. Appendix A contains an example of a data sheet that includes all of the above categories as well as a section for additional remarks.

Decisions on the soundness of individual trees can be a matter of life or death to site visitors. Care should be taken to do a thorough job. Adequate time must be allowed to evaluate and record data for each tree. Evaluations should be conducted, whenever possible, during bright sunny weather when defects and their indicators are most easily observed. Trees in developed recreation sites have great aesthetic value and are difficult to replace. Removal decisions should be based on careful hazard evaluations, considering other hazard mitigation alternatives, such as seasonal closures, moving the location of potential targets, pruning, guying, bracing, topping and others.

APPENDIX B

Pacific Northwest Research Station
USDA Forest Service
Wenatchee Forestry Sciences Laboratory

JUN 14 1993

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Date: June 10, 1993

Subject: Evaluation of Kachess Campground, Cle Elum Ranger District, Wenatchee National Forest

To: Ms. Catherine Stephenson, District Ranger

From: Paul F. Hessburg, Area Pathologist and Research Plant Pathologist, WFSL

On the seventh of June, I met with Jim Trowbridge, silviculturist on the Cle Elum RD, to evaluate disease and insect conditions at the Kachess Campground. What follows are observations and recommendations resulting from that visit.

Plant associations of the western hemlock, Pacific silver fir, and grand fir series are represented in the campground. Most stands are successionally advanced and are either late-seral or climax. Fire return intervals in the campground area would typically be in excess of 100 years or more, and fires when occurring, would normally be stand-replacing. Three root diseases were found widely distributed throughout the campground: laminated root rot caused by the root pathogen *Phellinus weirii*; annosum root disease caused by *Heterobasidion annosum*; and brown cubical butt rot caused by *Phaeolus schweinitzii*. I would estimate that at least 50 to 60 percent of the campground area is affected by laminated root rot? Annosum root disease stump inoculum and butt rot can be found on virtually every acre where silver fir or western hemlock are growing. Brown cubical butt rot is common where overmature Douglas-fir overstories predominate.

Western hemlock dwarf mistletoe (*Arceuthobium tsugense*) is also widespread throughout the portion of the campground dominated by multistoried western hemlock. A sampling of hemlock breast height ages indicated that hemlock has seeded in and released somewhat continuously in response to ongoing root disease mortality, windthrow, and tree collapse, and the availability of small canopy gaps. I would assume that the same is true for those portions of the campground that are currently dominated by silver fir. Root disease is prevalent in some of these areas as well, and the age class structure appears to vary inversely with the abundance of overstory Douglas-fir.

Lodgepole pine is present in several small stands and tree density in some clumps is in excess of site potential. Some pockets currently support more than 200 $ft.^2$/ac basal area and should be thinned to about 80-100 $ft.^2$/ac. Trees in many cases are less than 60 years old, but diameters are large and if they were attacked by the mountain pine beetle (*Dendroctonus*

ponderosae) they might function as brood trees. Increment cores indicated that growth has slowed considerably in the last 10-15 years. Some lodgepole were attacked as saplings by terminal-feeding insects, and candelabra and forked-topped trees have resulted. These should be removed in the thinning because the forked tops are inherently weak and unstable, especially in wind.

Jim Trowbridge indicated that the District intended to survey vegetation conditions in the campground this summer to determine hazard tree and vegetation management needs. Apparently all vegetation management is to be completed prior to initiating a major capital investment project. Jim also indicated that funds available to campground survey were severely limited.

Ideally, all of the vegetation in the campground should be intensively surveyed, and individual trees mapped and hazard evaluated prior to developing a long-range vegetation management plan. Methods and rationale for this type of survey and site planning are described in detail in the recent publication: *Long-Range Planning for Developed Sites in the Pacific Northwest: The Context of Hazard Tree Management (1992), by R.D. Harvey and P.F. Hessburg*. Lacking adequate financial resources, an abbreviated version of this process can be implemented, but simplifying assumptions and conservative management decisions are warranted to eliminate potential tree hazards when needed individual tree hazard data cannot be purchased. To make informed vegetation management decisions concerning tree hazards and ongoing disease and insect dynamics, the following information should be gathered at Kachess CG as a minimum:

(1) The outer perimeter of the laminated root rot-affected area (infection center) should be identified on the ground. An outer buffer zone of 50 feet should be added to this perimeter to delimit the area of hidden infection. Survey crews should identify the perimeter of visible infection by identifying dead and dying trees with signs and symptoms of laminated root rot, and by examining the roots of adjacent asymptomatic trees for evidence of ectotrophic mycelia. Trees with ectotrophic mycelium should be considered as visibly infected. Methods for identifying infected trees and delimiting laminated root rot infection centers are described in the aforementioned hazard tree guide.

(2) The outer perimeter of the area infested by western hemlock dwarf mistletoe (infection center) should be identified on the ground. An outer buffer zone of 50 feet should be added to this perimeter to delimit the area of hidden infection. Western hemlock is an excellent species to be grown in many parts of the campground and it could be managed over long time frames in existing root rot centers according to a pathological rotation using unevenaged cutting methods. This would be ill-advised though where its dwarf mistletoe is prevalent because mistletoe would rapidly intensify and become especially damaging when young replacement trees were infected high in the crown.

(3) The age of all hemlock and silver fir larger than 6 inches d.b.h. should be determined by direct measurement or by random sampling and correlation of d.b.h. and age. Ann Camp, a doctoral student here at the Lab, is using a modified chainsaw with a special attachment to drive an increment borer. You might be able to apply this same technology to economically determine the ages of trees larger than 6 inches d.b.h. Western hemlock and Pacific silver fir are susceptible to infection by *H. annosum* and *P. weirii* at any age, but butt rot

develops when infected trees approach maturity, and overmature trees often have hazardous levels of butt defect. Accordingly, in the presence of annosum root disease and laminated root rot inoculum, western hemlock in developed sites should be managed to a pathological rotation age of no more than 140 years; silver fir no more than 120 years;

(4) Trees larger than 6 inches that are proposed for retention after vegetation management should be hazard evaluated to determine whether they are defective. Outside of the laminated root rot-affected area there are many large Douglas-fir, each of which should be evaluated for brown cubical butt rot. This butt rot is most damaging to the major lateral roots and root collar area and above-ground assessment may not reveal the extent of defect. Accordingly, the major lateral roots should be exposed within one-half meter of the stem and non-destructively drilled to assess defect. Methods are described in the hazard tree guide. Normally we would recommend that non-destructive assessment would be initiated when fruiting bodies were obvious, but this campground is so highly used that fruiting bodies are often trampled soon after they are produced.

Within the area of the laminated root rot infection center all Douglas-fir and grand fir should be removed that are larger than 6 inches d.b.h.; sapling and small pole-sized Douglas-fir and grand fir can be temporarily retained for screening and shading since they pose little hazard to human health and safety even when root diseased. Western hemlock and silver fir in these infection centers will also develop butt rot as they approach maturity. These species and others are susceptible to *P. weirii* but can be managed according to a pathological rotation in infection centers. Table 6 in the hazard tree guide provides the estimated pathological rotation ages for conifers susceptible to laminated root rot.

Western redcedar is quite resistant to laminated root rot and can be grown for up to 200 years in infection centers. Redcedar is susceptible to pencil rot *(Oligoporus sericomollis)* and cedar larger than 10 inches d.b.h. should be sounded with a cruiser's axe to determine whether defect is present. Where defect is present, the thickness of remaining sound wood should be assessed non-destructively using a portable drill. Table 2 in the hazard tree guide provides the minimum safe-tree shell thickness for a wide range of tree diameters. Non-destructive sampling methods and tool specifications are also identified in the guide. When portions of the laminated root rot center are to be regenerated, western redcedar, western larch, lodgepole pine, rust-resistant western white pine, western hemlock, and Pacific silver fir can all be included in the planting mix; Douglas-fir and grand fir should not be regenerated in this area, but should be encouraged outside of the root disease center and 50 foot buffer.

Within the area infested by dwarf mistletoe, hemlock with a Hawksworth mistletoe rating (DMR) of 5 or more should be removed and development of a hemlock understory discouraged. Severely infested overstories should be considered for regeneration. If small patches are regenerated, mistletoe will quickly reinvade from the perimeter. Regeneration patches should be several acres in size if hemlock is to be re-established and reinvasion by mistletoe is to be avoided. Non-host buffers on the outer edges of regeneration units might also be considered when replanting hemlock. While Pacific silver fir is a secondary host of this mistletoe, evidence of crossover was minimal in the campground and silver fir may be

encouraged under infested hemlock overstories. Western hemlock and silver fir are both highly susceptible to the Indian Paint Fungus *(Echinodontium tinctorium)*. Advance regeneration of either species suppressed 40 years or more should be destroyed rather than released to avoid high levels of this defect in the future stand. The infection biology and cull rules for this fungus are described in the hazard tree guide.

While evaluating the campground I noted that soils appeared to be highly compacted in many locations. Most of the soils were shallow often with no more than 12 inches of soil over glacial till. You might have Carl Davis or District soils personnel survey soil compaction at the campground to assess compaction and determine whether some sites should be treated or withdrawn from regular use to allow recovery.

One final management consideration I would voice concerns the windfirmness of residual vegetation after management. Winds are often strong down the lake and down the Gale Creek drainage. Ongoing removal of windthrow and dead or dying trees has opened stands up to further wind action. The District will need to carefully evaluate the wisdom of retaining large trees that are highly exposed to wind.

Jim gave me several western larch seedlings when I left asking if I would identify the lower stem damage and causal agent(s). I dissected the seedlings and microscopically evaluated them and found no evidence of fungal infection or any symptom or sign of disease. The basal swelling primarily affected the living secondary phloem tissues. I shared the specimens with Paul Flanagan and he concurred; the damage appeared to be insect feeding like that of a weevil (Coleoptera/Curculionidae) to the sieve cells and phloem parenchyma presumably to obtain photosynthate. Most of the damage was non-lethal, and it appeared that perhaps enzyme secretions associated with the feeding may have caused cell hypertrophy (distention) and hyperplasia (additional cell division). The damage in cross section was somewhat reminiscent of Eriophyid mite galling and cytoplasmic enrichment but I could find no evidence of mites, nor any mention in the literature of Eriophyid mite damage to larch seedlings, and the swellings themselves were not outwardly typical of such damage. I suspect that the damage will be inconsequential and most seedlings will survive outplanting. The specimens I had were opening bud when I received them.

Please let us know if we can assist you further with this or any other project.

cc: Jim Trowbridge, Cle Elum RD
Karl Davis, S.O.
Paul Flanagan, WFSL
Monty Heath, S.O.

APPENDIX C

Aquatic Conservation Strategy Objectives

Forest Service and BLM-administered lands within the range of the northern spotted owl will be managed to:

1. Maintain and restore the distribution, diversity, and complexity of watershed and landscape-scale features to ensure protection of the aquatic systems to which species, populations and communities are uniquely adapted.

2. Maintain and restore spatial and temporal connectivity within and between watersheds. Lateral, longitudinal, and drainage network connections include floodplains, wetlands, upslope areas, headwater tributaries, and intact refugia. These network connections must provide chemically and physically unobstructed routes to areas critical for fulfilling life history requirements of aquatic and riparian-dependent species.

3. Maintain and restore the physical integrity of the aquatic system, including shorelines, banks, and bottom configurations.

4. Maintain and restore water quality necessary to support healthy riparian, aquatic, and wetland ecosystems. Water quality must remain within the range that maintains the biological, physical, and chemical integrity of the system and benefits survival, growth, reproduction, and migration of individuals composing aquatic and riparian communities.

5. Maintain and restore the sediment regime under which aquatic ecosystems evolved. Elements of the sediment regime include the timing, volume, rate, and character of sediment input, storage, and transport.

6. Maintain and restore in-stream flows sufficient to create and sustain riparian, aquatic, and wetland habitats and to retain patterns of sediment, nutrient, and wood routing. The timing, magnitude, duration, and spatial distribution of peak, high, and low flows must be protected.

7. Maintain and restore the timing, variability, and duration of floodplain inundation and water table elevation in meadows and wetlands.

8. Maintain and restore the species composition and structural diversity of plant communities in riparian areas and wetlands to provide adequate summer and winter thermal regulation, nutrient filtering, appropriate rates of surface erosion, bank erosion, and channel migration and to supply amounts and distributions of coarse woody debris sufficient to sustain physical complexity and stability.

9. Maintain and restore habitat to support well-distributed populations of native plant, invertebrate, and vertebrate riparian-dependent species.

APPENDIX D

Soil Productivity Restoration and Protection

How to prevent further degradation?
There are a number of actions that can be taken in a campground setting to begin restoring soil productivity. These include:

Establish standards for acceptable levels of soil disturbance for concentrated activities within campsite, i.e. picnic tables, fire rings, tent pads, etc. for both single and double campsites w/o parking area. 40ft x 40ft (1600 ft sq.) for single, and 60 ft x 60 ft. (3600 ft. sq) for doubles.

Maximize density of seral shrub components around the perimeter of the acceptable activity area

Manage foot traffic paths, within and between campsites, to limit the area of severe soil disturbance between campsites.

Managing the frequency of human disturbance on a longer time cycle, by resting portions of campground.

Limit the number of entries into an area for removal of infected trees.

Plan a trail network that connects campground loops and desirable destinations, but reduces the overall density of soil disturbance.

Key components of soil productivity restoration and recovery under this project

Soil Compaction (Protect and Restore Soil Porosity)

- Prevent increases in soil compaction as a result of hazard tree removal
- Reduce area of soil compaction by restoring soil porosity using machinery to loosen soils, and revegetation to restore root mass.
- Reduce area impacted by adding natural ecosystem components that discourage expansion of activity areas around campsites, and contribute to soil productivity processes. This could include large woody debris clusters and dense shrub community regeneration
- Reduce area impacted by foot traffic through passive means, utilizing rest-rotation and site closures to increase plant diversity, increase biomass production and retention, increase fine and coarse woody debris retention, and increase below ground root mass.

Restore Soil Development Processes

- Prevent soil loss, particularly the displacement of the surface organic layer.
- Improve the accumulation and retention of both fine and coarse woody debris for soil structure, nutrient reserves, soil temperature-moisture regimes, and habitat for decomposers. Increasing density of shrub and herbaceous understory plant community is necessary to contribute leaf matter as detritus for re-building soil surface organic horizons.

Restore Herbacious and Woody Understory Plants

- Increase the density and diversity of plant species, by actively revegetating through plantings, and passively through rest-rotation management cycles.
- Managing human disturbance patterns to increase production and retention of biomass in the understory around campsites and throughout campground and day use areas.
- Increase coarse woody debris as habitat for plants

Plant communities are relatively easy to regenerate if soil compaction is avoided (Lillybridge, et.al, 1995). Avoiding additional compaction can be achieved by removing the disturbance that is contributing to the compaction. The effectiveness of a rest/recovery method of soil restoration is highly dependent on the type of soil (texture and rock content) and severity of damage from which you are trying to recover, and the plant community occupying the site. Simply taking use off of the most severely degraded sites and allowing time for recovery is not sufficient to restore their porosity and organic matter. However, moderate to low severity disturbance do respond favorably to removing the disturbances. Powers (1990) points out, freezing and thawing can promote natural recovery of compacted soils, and Sands (1983) found the effects of compaction were largely irreversible on coarse textured soils on warmer sites. Sands further points out that it is the maintenance of soil organic matter that would largely determine the recovery of desirable soil porosity. With soil types in the campground exhibiting coarse textures, and experiencing freeze-thaw cycles, it is expected that a rest/ recovery approach, in conjuction with the maintenance of the soil organic matter would yield a reduction in soil compaction.

On these sites, the time required for soils to incorporate woody debris is several decades, plants establishing in litter horizons which would encounter compacted soil at depth which would affect tree morphology, growth, stress and susceptibility to pathogens.

Restoration begins with the marking of hazard tree for removal, clearly marking coarse woody materials to be retained on-site and materials that needs to be relocated for use in the restoration stage. This step should make sure materials selected represent a wide range of decay classes. Sufficient downed wood volume and sizes would be necessary to provide wood on-site, through a period of time until the next tree growth rotation produces large downed wood. Staging of restoration material should be in a location that is accessible for heavy equipment placement following soil scarification.

Mechanical reduction of compaction and improved soil porosity can be accomplished through shallow tilling of upper 30 –40 cm. using a commercial tiller, or bucket excavator. A small track mounted excavator working from the parking pads, road surface or center of campsite, would be effective to pocket scarify the soils around the site perimeter to break up compaction, restore porosity and plant communities. Size of pockets should be 4-10 foot in diameter and located to avoid roots of overstory trees. Damage to roots can accelerate the movement of root rot pathogen.

Following scarification, use material generated from hazard tree removal to arrange large organic matter >20" dbh in clusters, with limbs, around the perimeter of the acceptable campsite disturbance footprint. Arrange it to achieve a height of 40+ inches, and maximize protection of established vegetation, building protection around these residual plant communities. Transplant shrubs and small trees densely around log clusters.

Use large coarse organic debris to block duplicate camper trails radiating out from center of campsites.

Organic litter from chipping of coarse organics and stumps, should be scattered around perimeter of designated campsite activity area to a depth no greater than 0.75 inches, *and incorporated into the surface soil horizon.* This would provide moisture retention and exchange of gases, but would not seal off the surface soil horizon.

APPENDIX E

MONITORING PLAN

Implementation Monitoring

During and after project activities, the members of the interdisciplinary team will periodically visit the site. The purpose of these visits, in addition to making decisions specified in the body of this document, will be to monitor the various activities and ensure that all required actions and measures are being properly implemented.

Effectiveness Monitoring

1. Monitor the population of *A. farlowii* yearly to ensure trampling of vegetation in the clump of trees that it is growing on is not occurring.

2. Monitor the campground and picnic areas yearly for the occurrence of noxious weeds and if found, treat populations, using the appropriate combination of hand and chemical methods, under the 1999 categorical exclusion for noxious weed control on designated administrative and recreation sites.

3. Each high-topped tree will be uniquely numbered and catalogued by GPS location in a snag retention database. These trees will be periodically monitored for longevity, rate of decay, cavity development, and use by wildlife.

4. Monitor progress toward meeting Forest Plan soil standards, including percent of area in a compacted condition, increase/decrease in plant cover, and increase/decrease in area of bare ground. Use standard transect soil monitoring protocols. Review results yearly with District and concessionaire personnel to determine if any "course corrections" are needed.

5.Monitor the health and soundness of remaining trees each year to insure they are not becoming hazards.

6. Monitor effectiveness of site footprints and designated trails. Are people staying within them and is vegetation coming back outside them?

7. Monitor effectiveness of exclosure areas. Are people avoiding them? Are there any developing safety hazards?

Validation Monitoring

Monitor the health and soundness of remaining trees each year. Examine trends over time to determine if the underlying strategy of removing trees and revegetating as specified in the "Hessburg letter" has indeed made the campground safer.

APPENDIX F

Conservation Plan for *Acanthophysium farlowii*

Kachess Picnic Area and Campground, Wenatchee National Forest
Prepared by Viva Worthington, Botanist
26 February 2001

Introduction

Kachess Picnic Area and Campground, located in Section 32, T22N, R13E on the Wenatchee National Forest currently supports 3 fungal root diseases: *Heterobasidion annosum* (annosum root disease), *Phellinus weirii* (laminated root rot) and *Phaeolus schweinitzii* (brown cubical butt rot). The stands are composed of plant associations of the western hemlock and Pacific silver fir series. Most stands are either late seral or climax. (Hessburg, 1993) The dead and dying trees pose a safety threat to campers in this high use area. The Cle Elum Ranger District is proposing to manage these diseases by removing selected trees and managing the vegetation in the Kachess Vegetation and Safety Environmental Assessment.

There is also a known site of a rare resupinate fungi, *Acanthophysium farlowii* (Burt) Ginns & Lefebvre, in the Kachess Picnic Area. *A. farlowii* is currently listed as a "Category B" species in the Survey and Manage Guidelines (USDA and USDI, 2001) and is listed as a sensitive taxon in a preliminary report on endangered, threatened and sensitive macrofungi of Washington State by Dr. Ammirati, Mycologist with the University of Washington, (Ammirati, 1994). Category B species are rare. The objective is to manage all known sites and reduce the inadvertent loss of undiscovered sites.

The goal of this conservation plan is to assure long term maintenance of *A. farlowii* as a viable species on the Wenatchee National Forest and to assure the maintenance of habitat for this taxon at this known site by retaining forest structure and soil conditions while managing root diseases.

Species and Habitat Information

A. farlowii (previously known as *Aleurodiscus farlowii)* is known from this one disjunct location in Washington, locations in several Canadian Provinces and the northeastern United States. *A. farlowii* occurs on recently dead twigs with bark intact of live *Abies spp.*, *Tsuga spp*. and *Pseudotsuga menziesii*. It is characterized by a white-spored, tiny crustose pale purplish-brown reflexed disc-shaped to cushion-shaped sporocarp with dark brown surfaces growing on twigs. The main body of the organism is approximately 1-4 mm in diameter and the fruiting body only 0.5-1.5 mm in diameter. It is presumed to be dependent on wind and animals for dispersal of spores. The best information available indicates that this fungus can fruit any time during the year (probably excluding winter), and that it cannot be positively identified in the field; it must be verified by microscopic

techniques. It is not known if the species is a saprophyte, parasite, or endophyte (Castellano et al, 1997).

Site Visits

Attempts were made to relocate the known site in July 1999 by the USFS Regional Mycology Team and USFS Botanists and in November 1999 by Dr. Ammirati, one of the scientists who originally found the site. Medium-sized conifer trees within reach of the ground were targeted in the survey. Many collections were made during both visits. *A. farlowii* was not found. Dr. Ammirati did identify *Aleurodiscus amorphous* within the stands.

Site Specific Management Recommendations

The Management Recommendations for this species (Castellano et al, 1997) state that there has not been any specific management of sites for this taxon. Since this taxon is a presumptive saprophyte on dead twigs on live trees, these habitats should be protected where populations exist. The single known site of this species on the Wenatchee National Forest should be managed to maintain the viability of this disjunct population. It is recommended that current habitat conditions and micro-climate conditions be maintained, impacts from soil disturbing activities minimized and damage or removal of host trees prevented, but also manage tree diseases in the area to minimize loss of host trees. This site should be managed to include an area that is large enough to maintain the habitat and associated micro-climate of this population. In July 1999 Dr. Thom Odell, USFS Regional Mycologist, recommended that the extent of the occurrence be found, the hosts be protected, and that it be buffered in a manner that makes sense on the ground. Dr. Ammirati recommended that given the fact that the species was not relocated, and that it would be impractical to survey every dead branch in the campground, the species should be assumed to be present, and conditions should be maintained under which it is currently known to exist. He recommended that maintaining a "reasonable component" of small and medium-size trees of all species would likely protect the viability of the species. He could not provide exact numbers, given the lack of knowledge about the species.

Under the silvicultural prescription for the maximum-treatment alternative in this Environmental Assessment (Alternative 2), the following trees would be left standing:

- All trees under 12 inches in diameter.
- All western redcedar and western white pines.
- All western hemlock under 140 years old.
- All Pacific silver fir under 120 years old.

- All trees in the big tree nature area, summer home area, and Gale Creek day use area.
- All trees that could not reach a campsite or facility if they were to fall.

By leaving this number of trees standing, conditions would be maintained under which *A. farlowii* is currently known to exist, thereby maintaining the population of the species in Kachess Picnic Area and Campground.

The Survey and Manage Standards and Guidelines (USDA, 2001) require strategic surveys or equivalent-effort surveys to be conducted for this species in the Eastern Washington Cascades physiographic province in 2006 and beyond before NEPA decisions are signed for habitat-disturbing activities in old-growth forest. The objective is to find additional new sites and to characterize the habitat, improving the ability to known where to survey and how to manage and conserve the species.

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APPENDIX G

Kachess Campground Plants

Abies amabilis
Abies grandis
Acer circinatum
Achillia millefolium
Achlys triphylla
Adenocaulon bicolor
Alectoria sarmentosa
Allotropa virgata
Alnus incana
Alnus sinuata
Amelanchier alnifolia
Anaphalis margaritacea
Anemone oregana
Antennaria sp
Apocynum androsaemifolium
Arctostaphylos nevadensis
Arenaria macrophylla
Arnica cordifolia
Asarum caudatum
Aster sp
Athyrium filix-femina
Berberis nervosa
Botrychium minganense
Botrychium multifidum
Bryoria fuscescens
Castilleja sp
Chimaphila umbellata
Cirsium sp
Clintonia uniflora
Corallorhiza mertensiana
Cornus canadensis
Dactylis glomerata
Disporum hookeri
Epilobium angustifolium
Equisetum sp
Fragaria vesca
Fragaria virginiana
Galium triflorum
Gaultheria ovatifolia
Geum macrophyllum
Goodyera oblongifolia
Hemitomes congestum
Herecleum lanatum
Hieracium albiflorum
Holodiscus discolor
Hypogymnia austerodes
Hypogymnia enteremorpha
Hypogymnia imshaugii
Hypogymnia physodes
Hypogymnia sp
Hypopitys monotropa
Juncus sp
Letharia vulpina
Lilium columbianum
Linnaea borealis longiflora
Listera cordata
Lonicera ciliosa
Luina nardosmia
Luzula hitchcockii
Lycopodium sp
Melanelia exasperatula
Menziesia ferruginea
Osmorhiza chilensis
Pachistima myrsinites
Pedicularis racemosa
Penstemon serralutus
Phleum pratense
Picea engelmannii
Pinus contorta
Pinus monticola
Platismatia glauca
Platismatia herrei
Polystichum munitum
Populus trichocarpa
Prunella vulgaris
Pseudotsuga menziesii
Pteridium aquilinum
Pterospora andromedea
Pyrola asarifolia
Pyrola picta
Pyrola secunda
Rhododendron albiflorum
Ribes sp
Rosa gymnocarpa
Rubes leucodermis
Rubus lasiococcus
Rubus parviflorus
Rubus spectabilis
Salix sp
Sambucus sp
Smilacina racemosa
Smilacina stellata
Sorbus scopulina
Sphaerophorus globosus
Spiraea betulifolia lucida
Symphoricarpos albus
Taxus brevifolia
Thuja plicata
Tiarella trifoliata unifoliata
Trifolium repens
Trillium ovatum
Tsuga heterophylla
Vaccinium membranaceum
Vaccinium myrtillus
Vaccinium ovalifolium
Vaccinium parviflorum
Vaccinium scoparium
Vicia sp
Viola orbiculata
Viola sp
Xerophyllum tenax

Appendix H. Terrestrial wildlife that use or potentially use Kachess Campground, based on limited field observations and habitat structure. Habitat associations are from *Wildlife-Habitat Relationships in Oregon and Washington, 2001, D. H. Johnson and T. A. O'Neil, managing directors.*

A lack of association does not indicate that a species cannot occur in the project area. It only indicates when no degree of association has been documented in published accounts. Therefore, this list of potential species should be considered preliminary, and in need of field validation.

Species (associated w/ forest hab)	Presence in Kachess Campground	Association with Key Habitat Structure Found in Kachess Campground			Other Factors Affecting Presence	
		Current Condition		post project (alt 2) condition in treated areas?		
		giant tree multi-story	large tree, multi-story, moderate canopy	small tree multi-story moderate canopy	use of forest structure tied to water	uses other landscape features
	d=documented p=possible	g=generally associated c=closely associated p=present *=low confidence			a=always o=often	
BIRDS						
great blue heron	d	g	g		a	
Canada goose	d	g	g		a	lakeshore
wood duck	d	c	c		a	
Barrow's goldeneye	p		g		a	
common merganser	d		g		a	
hooded merganser	p	c	c		a	
bufflehead	p		g		a	
harlequin duck	d	c			a	
turkey vulture	p	g	g	g		
osprey	p	g	g		a	
golden eagle	p	g	g			
bald eagle	p	g	g	g	a	
sharp-shinned hawk	p	c*	g	g		
Cooper's hawk	p	p*	g	p*		
northern goshawk	p	g	g	p		
red-tailed hawk	d	g	g	p		
American kestrel	p	p	p	p		
merlin	p	g*	g*	g*		
peregrine falcon	p	p	p	p		
ruffed grouse	d	p	p	g		
blue grouse	p	c	c	g		
spotted sandpiper	p				a	stream/lakeshore
common snipe	p					lakeshore
marbled murrelet	p	c	c			
barn owl	p	p	p			
long-eared owl	p					
western screech-owl	p	g	g	g		
great horned owl	p	g	g	p		
northern pygmy-owl	p	c	c	g		
spotted owl	d	c	c	p		
barred owl	p	c	c	p*		
northern saw-whet owl	p	g	g	g		

Species (associated w/ forest hab)	Presence in Kachess Campground	Association with Key Habitat Structure Found in Kachess Campground			Other Factors Affecting Presence	
		Current__ Condition		post project (alt 2) condition in treated areas?		
		giant tree multi-story	large tree, multi-story, moderate canopy	small tree multi-story moderate canopy	use of forest structure tied to water	uses other landscape features
	d=documented p=possible	g=generally associated c=closely associated p=present *=low confidence			a=always o=often	
common nighthawk	p	p	p	p		
Vaux's swift	d	c	c	p		
calliope hummingbird	p	g*	p*	p*		
rufous hummingbird	d	g	g	g		
belted kingfisher	d	g	g	g	a	
red-naped sapsucker	d	g	g	g		
red-breasted sapsucker	p	g	g	g		
downy woodpecker	p	g*	g*	g*		
hairy woodpecker	d	g	g	g		
three-toed woodpecker	d	g*	g	g		
black-backed woodpecker	p	g*	g	g		
northern flicker	d	g	g	g		
pileated woodpecker	d	c	c	p		
olive-sided flycatcher	p	g				
western wood-pewee	p	g				
Hammond's flycatcher	p	g	g			
Pacific-slope flycatcher	p	c				
warbling vireo	d	g	g	g		
red-eyed vireo	p	c	c	g		
gray jay	d	g	g	g		
Stellar's jay	p	c	c	g		
Clark's nutcracker	d		g			
black-billed magpie	p	g	g	g		
American crow	p	g	g	g		
common raven	d	g	g	g		
tree swallow	p	p			o	
violet green swallow	d	g				
black-capped chickadee	d	g	g	g		
mountain chickadee	d	g	g	g		
chestnut-backed chickadee	d	g	g	g		
red-breasted nuthatch		g	g	g		
brown creeper	d	g	g	p		
house wren	p	g	g	g		
winter wren	d	c	c	g		
American dipper	d	g	g	g		
golden-crowned kinglet	d	c	g	g		
ruby-crowned kinglet	d	g	g	g		
mountain bluebird	p	p	g	p		
Townsend's solitaire	d	g	g	g		
veery	p	p*	p*	p*	a	

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	d=documented p=possible	g=generally associated c=closely associated p=present *=low confidence			a=always o=often	
hermit thrush	d	g	g	g		
American robin	d	g	g	g		
varied thrush	d	c	c			
gray catbird	p		p*			
cedar waxwing	p	g	g	g	o	
Nashville warbler	p	g	g	g		
yellow warbler	d					
yellow-rumped warbler	d	g	g	g		
Townsend's warbler	d	c	g	p		
Orange-crowned warbler	p					
MacGillivray's warbler	d	g	g	g		
common yellowthroat	p		p			
Wilson's warbler	p	g	g	g		
western tanager	d	c	g	g		
spotted towhee	d	g	g	g		
chipping sparrow	d	g	g	g		
white-crowned sparrow	d		g			
song sparrow	d	g	g	g	o	
fox sparrow	p					
dark-eyed junco	d	g	g	g		
black-headed grosbeak	p	g	g	g		
brown-headed cowbird	p	g	g	g		
Bullock's oriole	p	c	g			
pine grosbeak	p	p*	g*	g		
house finch	p					
purple finch	p	g*	g*	g*		
Cassin's finch	p	p	p	g		
red crossbill	p	g	g	g		
pine siskin	d	g	g	g		
American goldfinch	p	p	g	g		
evening grosbeak	p	g*	g*	g*		
MAMMALS						
Masked shrew	p	c	c	c		
vagrant shrew	p	p	p	p		
shrew-mole	p	g	g	g		
California myotis	p	g	g	p*	o	
Yuma myotis	p	g	g		o	
Little brown myotis	p	g	g		o	
long-legged myotis	p	c	c	p*	o	
fringed myotis	p	g	g	g	o	
long-eared myotis	p	g	g		o	
silver-haired myotis	p	c	c	p	o	
big brown bat	p	c	c	p	o	

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		giant tree multi-story	large tree, multi-story, moderate canopy	small tree multi-story moderate canopy	use of forest structure tied to water	uses other landscape features
	d=documented p=possible	g=generally associated c=closely associated p=present *=low confidence			a=always o=often	
hoary bat	p	g	g	g	o	
snowshoe hare	d	c	c	c		
mountain beaver	p	p	p	g		
Townsend's chipmunk	d	c	c	c		
golden-mantled ground squirrel	d		g			
Douglas squirrel	d	c	c	g		
northern flying squirrel	p	c	c	g		
northern pocket gopher	p	p*	c*	c*		
American beaver	p	p	g	g	a	
deer mouse	p	g	g	g		
bushy-tailed woodrat	p	g	g	g		
western red-backed vole	p	c	c			
long-tailed vole	p	p	p	p	o	
western jumping mouse	p		p			
porcupine	p	g	c	c		
coyote	p	g	g	g		
gray wolf	p	g*	g	g*		
red fox	p	p	p	p		
gray fox	p		p	g		
black bear	p	g	g	g		
grizzly bear	p	g*	g*	g*		
raccoon	p	g	g	g		
American marten	p	g	g	g		
fisher	p	g	g	g		
ermine	p	g	g	g		
long-tailed weasel	p	g	g	g		
mink	p	p	p	p	o	
wolverine	p	g*	g*	g*		
western spotted skunk	p	g	g	g		
striped skunk	p	g	g	g		
northern river otter	p	p	p	p		
mountain lion	p	g	g	g		
bobcat	p	g	g	g		
elk	p	g	g	g		
black-tailed deer	d	g	g	g		
mule deer	p	g	g	g		
mountain goat	p		g*	g*		

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	d=documented p=possible	g=generally associated c=closely associated p=present *=low confidence			a=always o=often	
REPTILES						
northern alligator lizzard	p	g	g	g		
rubber boa	p	g	g	g		
western terrestrial garter snake	p	g		g		
sharp-tailed snake	p		g*	g*		
AMPHIBIANS						
northwestern salmander	p	c	c	c		
long-toed salamander	p	g	g	g		
Pacific giant salamander	p	g	g	g		
Van Dyke's salamander	p	g	g	g		
Tiger salamander	p	g	g	g		
w. red-backed salamander	p	g	g	g		
ensatina	p	g	g	g		
tailed frog	p	g	g	g		
western toad	p	g	g	g		
Pacific treefrog	p	g	g	g		
red-legged frog	p	g	g	g		
Cascades frog	p	g	g	g		