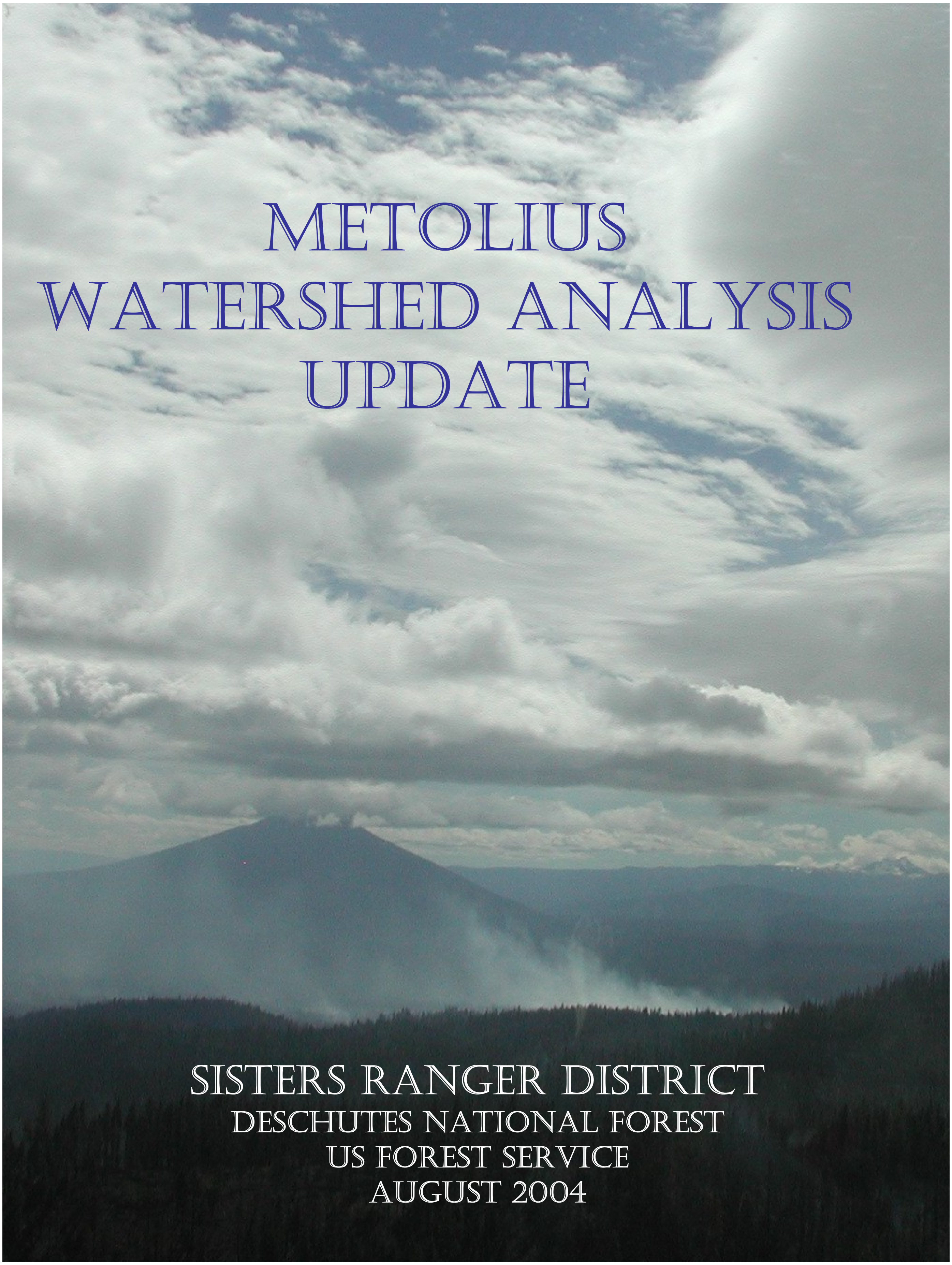

METOLIUS WATERSHED ANALYSIS UPDATE

SISTERS RANGER DISTRICT

DESCHUTES NATIONAL FOREST

US FOREST SERVICE

AUGUST 2004

METOLIUS WATERSHED ANALYSIS UPDATE

AUGUST 2004

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- **Kris Martinson, Community Relations Lead**

INDEX OF REPORTS

METOLIUS WATERSHED ANALYSIS UPDATE 2004

EXECUTIVE SUMMARY

Fireweed in bloom, Metolius Basin, July 2004

PURPOSE AND SCOPE OF THIS DOCUMENT

- **Updates the Sisters Ranger District 1996 Metolius Watershed Analysis**
- **Analyzes effects of recent wildfires and changes in the watershed since 1996**
- **Identifies trends of concern**
- **Prioritizes areas to guide future management**
- **Provides recommendations**
- **Identifies data gaps and monitoring needs**
- **Provides basis for cumulative effects analysis**

MAJOR CHANGES IN THE METOLIUS WATERSHED SINCE 1996 INCLUDE:

- **The B&B Wildfire-** The largest wildfire in Deschutes National Forest history.
- **Seven other large wildfires-** Including the Cache Mountain, Link, and Eyerly Wildfires. In total, 54% (80,419 acres) of watershed has been affected by wildfires since 1996.
- **New data** for many resource areas, including new Fire Regime Science.
- **New regulatory information**, i.e. Clean Water Act 303-D listings.
- **Evolving social and management issues**

Overview

What is Watershed Analysis?

"Watershed Analysis is a systematic procedure to characterize the aquatic, riparian, and terrestrial features within a watershed. Managers use information gathered during watershed analysis to refine riparian reserve boundaries, prescribe land management activities, including watershed restoration, and develop monitoring programs (NWFP, ROD, 1994, pg. 10).

This information helps guide future management and suggest future projects. It serves as a foundation for future project level analysis and decision-making. The analysis helps to ensure that activities are consistent with ecosystem management objectives as described in the *Deschutes National Forest Land and Resource Management Plan* (LRMP) as amended by the *Record of Decision for Standards and Guidelines for Management of Habitat for Late-Successional and Old-Growth Forest Related Species Within the Range of the Northern Spotted Owl*.

Watershed Analysis process is based on the six step analysis process outlined in the *Federal Guide for Ecosystem Analysis at the Watershed Scale* (version 2.2) and associated modules. This analysis is not a decision making process. Project level recommendations for federal lands must be further analyzed according to the National Environmental Policy Act (NEPA) process.

Why was this Watershed Analysis Update Done?

The Federal Guide states: "Federal Agencies will conduct multiple analysis iterations of watersheds as new information becomes available, or as ecological conditions, management needs, or social issues change." The need for an update may be triggered by major disturbance events, or if existing analyses do not adequately support informed decision making for particular projects or issues. As analysis updates are conducted, new information is to be added to existing analyses.

The Sisters Ranger District consulted with Forest and Regional Forest Service specialists in September 2003 during the aftermath of the B&B Wildfire. It was recommended that because more than half the watershed had burned since the previous analysis completed in 1996, a focused update should be completed. This update serves to support changed condition analysis for the Metolius Basin Forest Management Project which was partially burned, and identifies recommendations for future management activities. This document provides important new information but **does not** update and rewrite all aspects of the original 1996 Metolius Watershed Analysis. Both documents are useful summaries.

How was this Watershed Analysis Update Prepared?

This update is based on an interdisciplinary analysis done by a team of Forest Service specialists between November 2003 and March 2004. The analysis was used as a basis for the Metolius Basin Forest Management Project EIS Changed Condition Report. This compilation of the analysis was completed in August of 2004. This is a dynamic document that may be updated and modified as needed.

CHRONOLOGY:

1994	The Record of Decision for the Northwest Forest Plan amended local Forest Plans and required Watershed Analysis be completed in Key Watersheds before management actions take place.
1996	The original Metolius Watershed Analysis is completed. The Metolius is one of seven Key Watersheds designated on the Deschutes National Forest.
1996-2003	Projects are planned and completed guided by watershed analysis priorities and recommendations for fuels reduction and restoration, and other management.
July 2003	A major project, the Metolius Basin Forest Management Project EIS, is completed and a record of Decision is issued. Approximately, 12,500 acres of forest tree thinning, mowing, and burning are included in the landscape level project.
August 2003	The B&B Complex Fires are reported on August 19, 2003. The 2 fires eventually join together to encompass about 92,000 acres across multiple ownerships (Willamette NF, Deschutes NF, State of Oregon, Confederated Tribes of Warm Springs, and private lands). The fire is contained in October of 2003. Approximately 1350 acres of the Metolius Basin Forest Management Project area were burned.
September 2003	The Metolius Basin Project is appealed in September of 2003. Part of the appeal claims that a supplemental EIS must be completed for the project as a result of the wildfires. The Decision is affirmed by the Regional Forester in October. In the decision, the Regional Forester informs the plaintiff that the Forest will conduct an assessment of changed conditions resulting from the B&B Fires in accordance with 40 CFR 1502.9 and implementation will not occur until that analysis is completed consistent with regulations.
December 2003-March 2004	An interdisciplinary analysis is conducted to update the 1996 Watershed Analysis to reflect conditions and changes resulting from the B&B Fires and other important changes within the watershed.
March 2004	A lawsuit is filed in US District Court on the Metolius Basin Forest Management Project. Claims include: The FEIS is legally inadequate and violates NEPA, cumulative effects of Eyerly and Cache Mtn Fires, Eyerly Fire Salvage, and McCache Project are inadequately addressed and that a supplemental EIS is required as a result of the Link and B&B fires.
July 2004	The interdisciplinary review of the Metolius Basin Project in relation to the B&B Fires is completed. The Ranger and Forest Supervisor decide to make minor adjustments including: dropping treatments in 170 acres of spotted owl habitat and in 750 acres of forests affected by the fire, and adjusting mitigations to address aquatic and noxious weed concerns. They conclude that a Supplemental EIS is not necessary and implementation on the project should go forward.
August 2004	The Metolius Watershed Analysis is compiled into this document.

Public Involvement

Ranger Bill Anthony leads public tour to Mollie's Rock, near Corbett Snopark

December 2003 – The Metolius Watershed Analysis Update Newsletter is sent to 600 people.

- The newsletter describes watershed analysis process
- It provides preliminary comparison of the watershed in 1996 and 2004
- It describes accomplishments of 1996 recommendations
- It asks for new information
- Six people and/or agencies respond

December 2003 - July 2004- Presentation and Talks

- Summary of analysis is presented to: Region 6, Deschutes and Ochoco National Forest Line Officers and Resource Specialists, Deschutes Provincial Advisory Committee (PAC), Metolius Working Group, and public groups such as Kiwanis, Rotary, and Homeowners associations.

December 2003 - July 2004- Field Trips

- More than a dozen field trips are done in the B&B Fire area to discuss findings, view fire effects, and discuss options for the future. Groups included: Forest Service Chief and Line Officers, Congressional Staff, Forest Industry, State and Private Foresters, Small Woodland Owners, Native Plant Society, College classes, Burned Area Emergency Rehabilitation Coordinators, and public. Several hundred people attend tours.

Public Issues and Questions

FIRE

- **Where were fires within the historic range (characteristic) and outside historic range (uncharacteristic)?**
- **Which areas would naturally experience stand replacement fire (i.e. Fire Regime 4 & 5)?**

SALVAGE

- **Need more information on salvage effects**
- **Concern regarding size of trees salvaged- retain large dead and live trees**
- **Prefer investments in proactive thinning versus salvage**
- **Timeliness of salvage affects economics**

SOILS

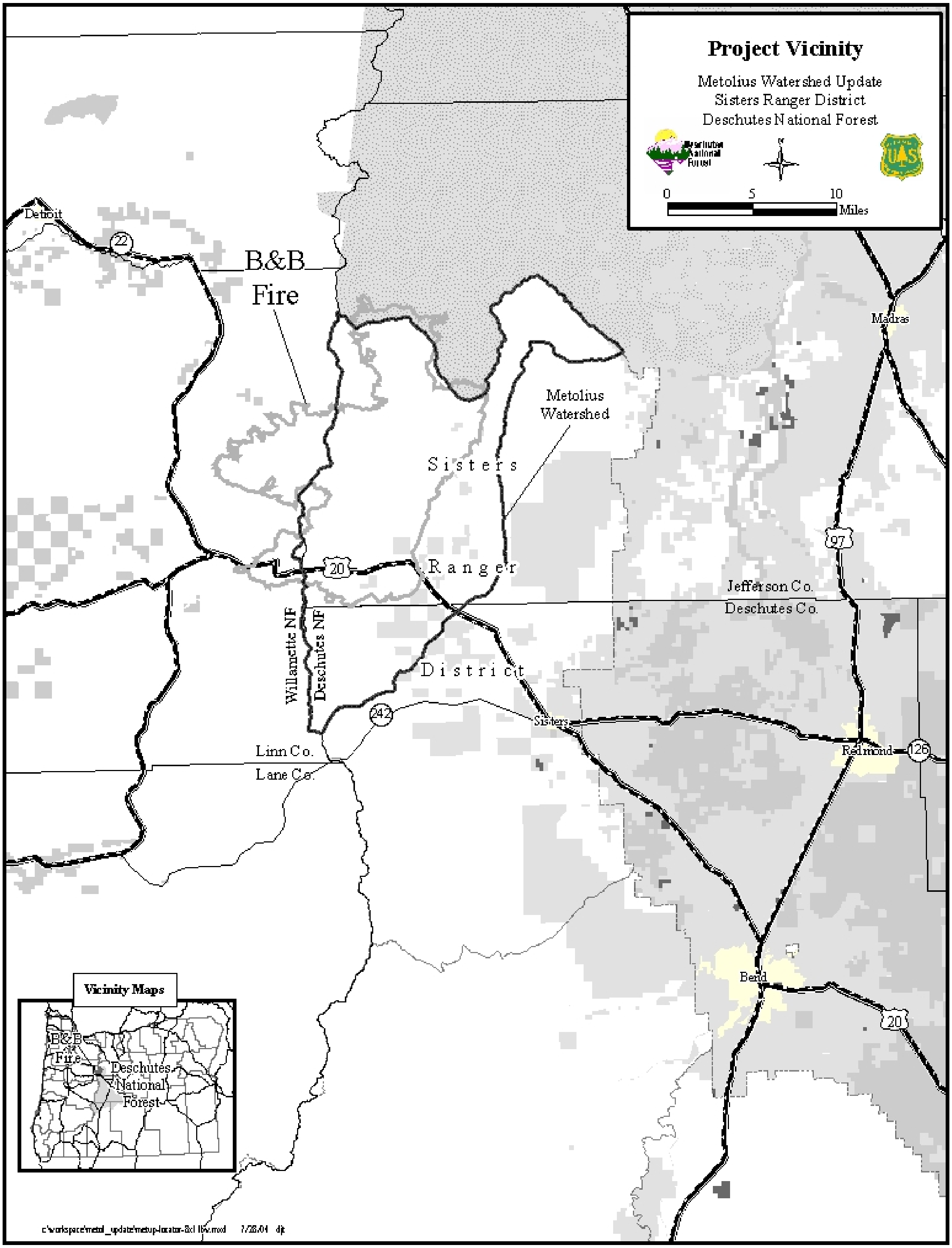
- **Improve soil analysis in watershed analysis document**

WILDLIFE

- **Reevaluate goals for spotted owl habitat.**
- **Consider big game needs/road closures.**

ROADS

- **Use new data on Off Road vehicles and roads.**



Project Vicinity
Metolius Watershed Update
Sisters Ranger District
Deschutes National Forest
0
5
10
Miles
Detroit
22
B&B
Fire
Metolius
Watershed
Sisters
Ranger
District
Madras
97
20
Jefferson Co.
Deschutes Co.
Willamette NF
Deschutes NF
242
Sisters
Redmond
126
Linn Co.
Lane Co.
Bend
20
Vicinity Maps
B&B
Fire
Deschutes
National
Forest

METOLIUS WATERSHED ANALYSIS AREA
DISTINGUISHING FEATURES

SETTING

- **The Metolius Watershed Analysis Area is northwest of Sisters, Oregon.** It is located in the northern half of the Sisters Ranger District, Deschutes National Forest, and is within Jefferson and Deschutes Counties. It lies approximately 30 miles west of Bend, Oregon along Highway 20, which bisects the southern third of the analysis area

PHYSICAL

- **Key Watershed- Metolius River**
- **Cascade Mountain backdrop**- Mt Jefferson, Three Finger Jack
- **Unique geology-** Creates springs and highly permeable outwash plains of sand and gravel left by glaciers
- **Subwatersheds:** Covers 14 subwatersheds, including: Headwaters, Upper and Middle Metolius River, Dry Creek, Cache Creek, Upper Lake Creek, Lower Lake Creek, First Creek, Jack Creek, Canyon Creek, Abbot Creek, Candle Creek, and Jefferson Creek.
- **Part of Columbia River Basin-** The Metolius is within the Upper Deschutes River Basin and in a larger context the Columbia River Basin. The Metolius River enters the Deschutes River above Pelton and Round Butte Dams, the Deschutes flows into the Columbia River, which flows into the Pacific Ocean.
- **The Metolius River is spring fed, stable, sensitive to sediment-** One of the most stable rivers in the world for its size, vulnerable to sediment because of the lack of flood events to flush gravels clean.
- **Precipitation:** The area is located on a steep rain gradient on the eastern slope of the Cascade Mountain range.
- **Elevations :** Range from 10,358 feet at the top of South Sister to 2900 feet near the community of Camp Sherman.

BIOLOGICAL

- **Important Fishery-** The Metolius River once supported large sockeye and spring chinook runs**.** One of the healthiest Bull Trout populations in the state. Reintroduction of Salmon is planned under the relicensing of Pelton/Round Butte Dams.
- **Trademark Ponderosa Pine Forests-** The Metolius Basin is known for large ponderosa pine trees and scenic forest views.
- **Diversity of Fire Regimes and Vegetation-** All five Fire Regimes are present, although much of the area historically experienced frequent low intensity fire. Higher elevations and moisture gradient areas support diverse subalpine, moist, and dry mixed conifer forests.
- **Diversity of Wildlife-** Typical westside species, such as the Northern Spotted owl, survive here at the edge of their range. Supports a diversity of wildlife including pine forest species such as goshawks and white headed woodpeckers. Bald eagle Management Area and known bald eagle nests
- **Rare endemic wildflower, Peck's penstemon and rare fungi and lichens-** Epicenter of the global population of the endemic wildflower Peck's Penstemon. Habitats support a high

diversity of wildflowers and native plants.

- **Sub-alpine and alpine habitats**
- **Expanding noxious weed populations associated with roads, urban areas, and past management**

SOCIAL

- **Ownership- 95% Public lands, 5% Private lands**
- **State Highway 20- Oregon's busiest route over the Cascade Mountains**
- **Important Recreation and Residential Area-** The community of Camp Sherman, resorts, and campgrounds are within the analysis area. The Metolius is a popular recreation area for camping, fishing, hiking, and other activities.
- **Growing population and new developments**
- **Large areas of forest/ urban interface**
- **Long history of Native American use and early European settlement**
- **Wild and Scenic-** The Metolius is a Wild and Scenic River managed under a plan completed in 1996.
- **Valued scenic vistas-** Head of Metolius, Black Butte, Wilderness Trails,Camp Sherman Area.

LAND ALLOCATIONS

The following tables illustrate the land allocations within the watershed.

The public land in the watershed is managed under the Northwest Forest Plan and the Deschutes National Forest Land and Resource Management Plan. Table 1 describes allocations that have been designated by the Northwest Forest Plan while Table 2 shows the Deschutes National Forest land allocations.

OV Table 1. Land Allocations as described by the Northwest Forest Plan for the Metolius watershed.

NORTHWEST FOREST PLAN (NWFP)			
MANAGEMENT ALLOCATION	ACRES	% OF TOTAL NWFP ACRES	% OF WATERSHED
Late-successional Reserves	74,344	50%	50%
Congressionally Withdrawn	42,340	28%	28%
Matrix	19,419	13%	13%
Other Ownership	7,939	5%	5%
Administratively Withdrawn	3,218	2%	2%
Area Outside NWFP	1,436		1%
TOTAL	148,696	100%	100%

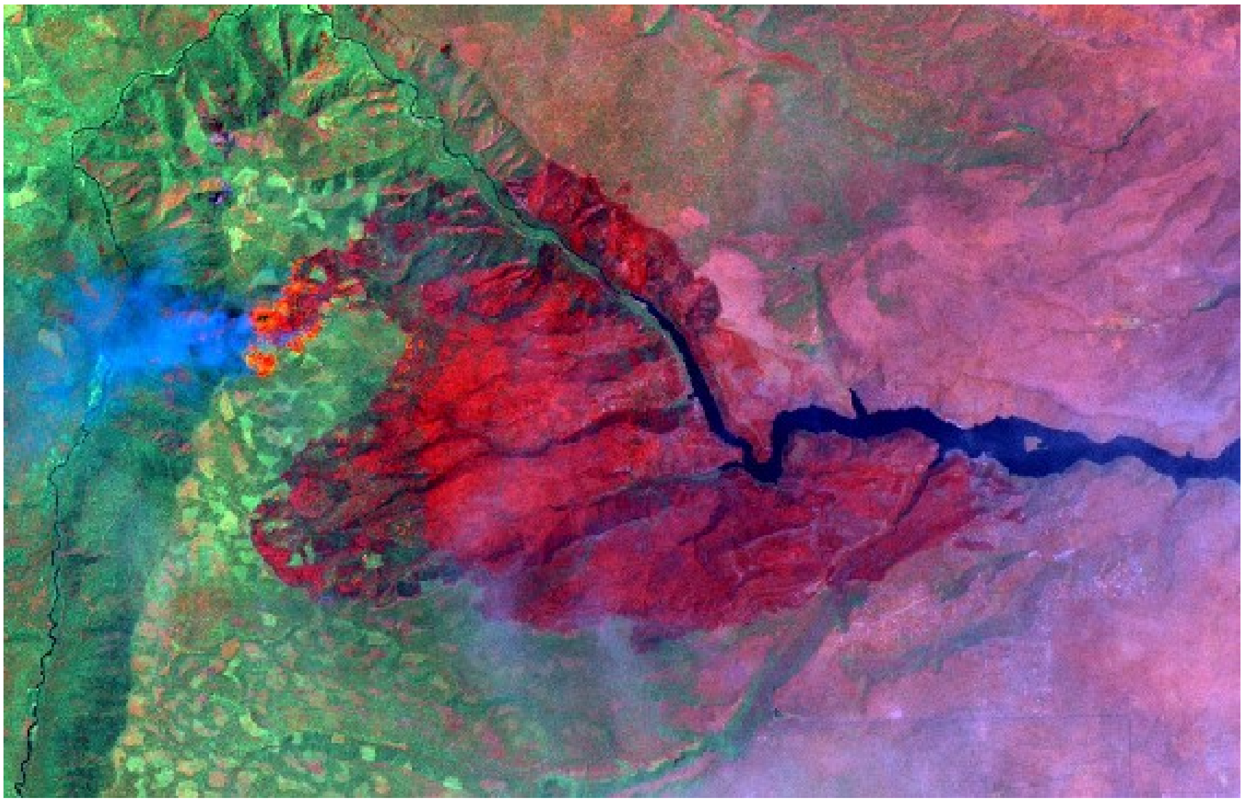
OV Table 2. Land Allocations as described by the Deschutes National Forest Land and Resource Management Plan (LRMP) for the Metolius watershed.

DESCHUTES FOREST PLAN		
LRMP MANAGEMENT ALLOCATION	ACRES	% OF WATERSHED
Wilderness	42,340	28%
Metolius Special Forest	19,933	13%
Metolius Heritage	17,722	12%
General Forest	14,467	10%
Metolius Wildlife/Primitive	9,807	7%
Other Ownership	8,138	5%
Metolius Scenic - Retention Midground	7,537	5%
Metolius Black Butte Scenic	6,187	4%
Metolius Wild & Scenic River, Recreation Segment	4,920	3%
Metolius Wild & Scenic River, Scenic Segment	3,132	2%
Winter Recreation	2,853	2%
Scenic Views - Retention Foreground	1,717	1%
Cache Mtn Research Natural Area	1,602	1%
Intensive Recreation	1,492	1%
Scenic Views - Retention Midground	1,345	1%
Metolius Research Natural Area	1,335	1%
Metolius Scenic - Retention Foreground	1,157	1%
Eagle	808	1%
Metolius Special msi	749	1%
Metolius Special msj	634	<1%
Metolius Scenic - Partial Retention Midground	285	<1%
Scenic Views - Partial Retention Midground	259	<1%
Scenic Views - Partial Retention Foreground	179	<1%
Metolius Old Growth	98	<1%
TOTAL	148,696	100%

KEY QUESTIONS – FOCUS OF ANALYSIS:

1. HOW HAVE THE WILDFIRES AFFECTED THE WATERSHED AND ITS PROCESSES?

2. WHAT IMPORTANT NEW INFORMATION HAS EMERGED IN THE PAST 8 YEARS?



The lower Metolius Watershed and the Eyerly Fire burning on Green Ridge towards the Metolius River. A rain storm helped stop the fire's westward spread, but also started the Cache Mountain Fire. 2002. IR photo.

Key Findings- By Resource Area

The following is a synopsis of resource reports and team synthesis.
For more detail, see the attached Resource Reports.

Fire

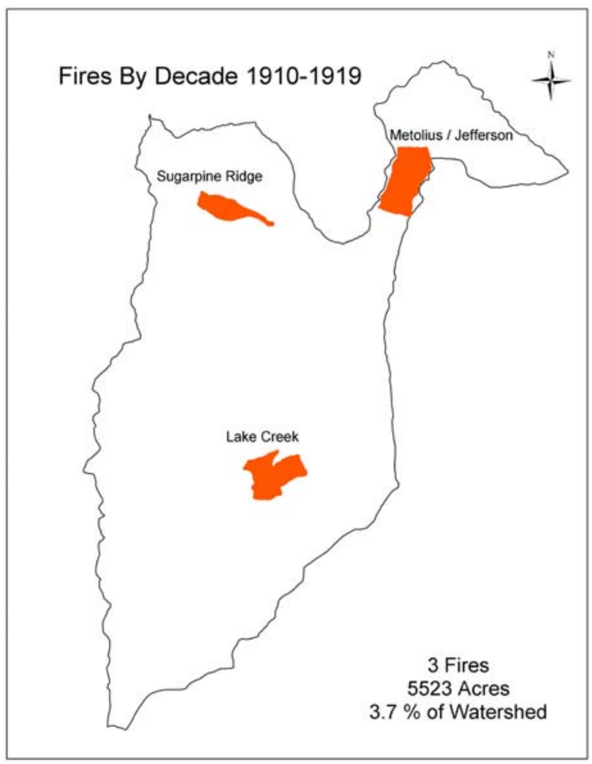
- **The Metolius Basin has been changed by wildfire**

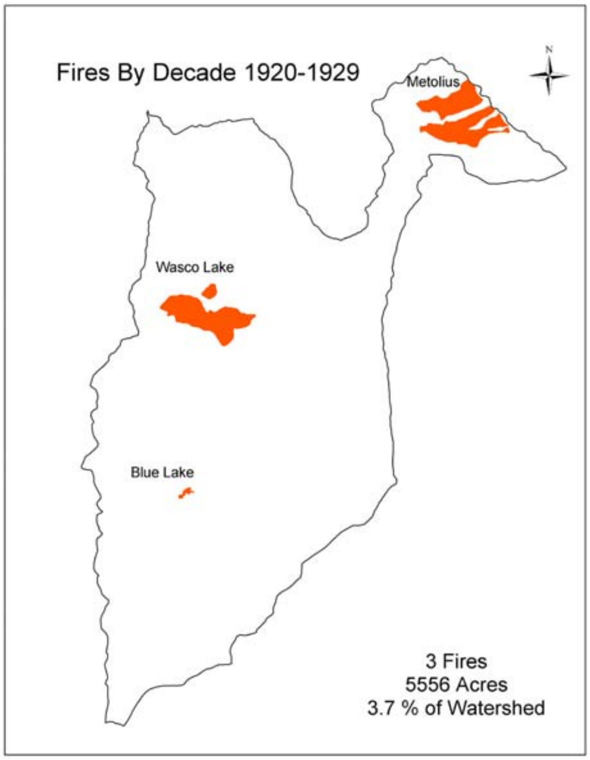
- **Between 1996 and 2003, eight large wildfires have burned in the Metolius Basin**

2003- B&B Fire- 91,902 acres	2002- Metolius RNA- 167 acres
2003- Link Fire- 3,589 acres	1999- Cache Creek- 382 acres
2002- Cache Mountain-3,858 acres	1998- Square Lake- 113 acres
2002- Eyerly- 23,135 acres	1996- Jefferson- 3,689 acres

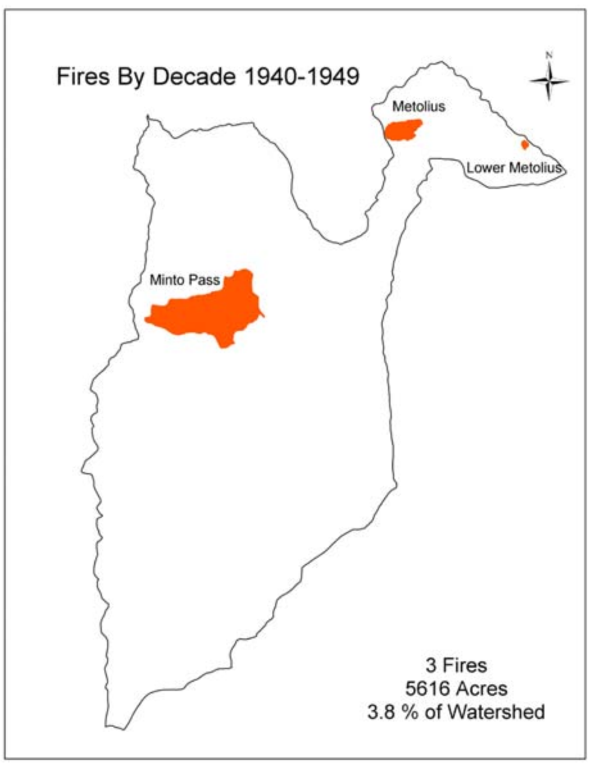
- **The B&B and Eyerly wildfires of 2002 and 2003 are unprecedented in size compared to the fires in the past century.**

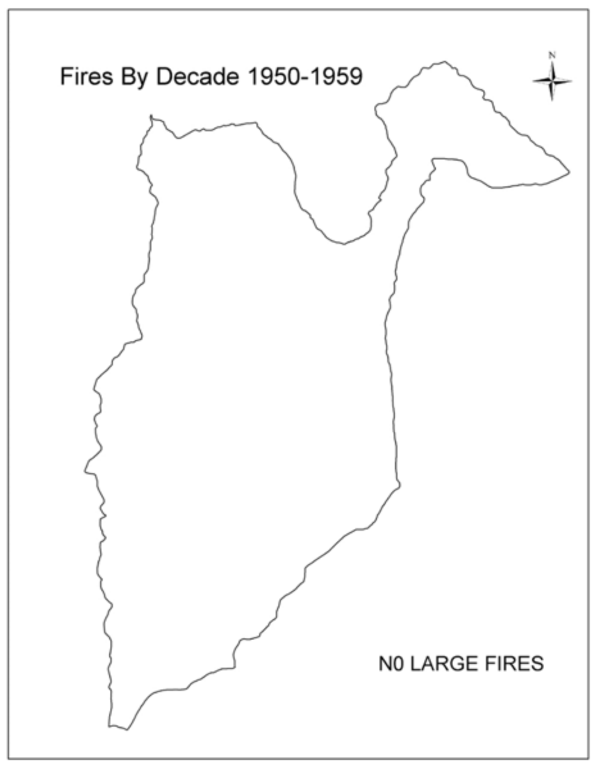
- **This is displayed in the "Fires By Decade" Analysis below, which shows historic fires in the watershed from 1900- 2003.**

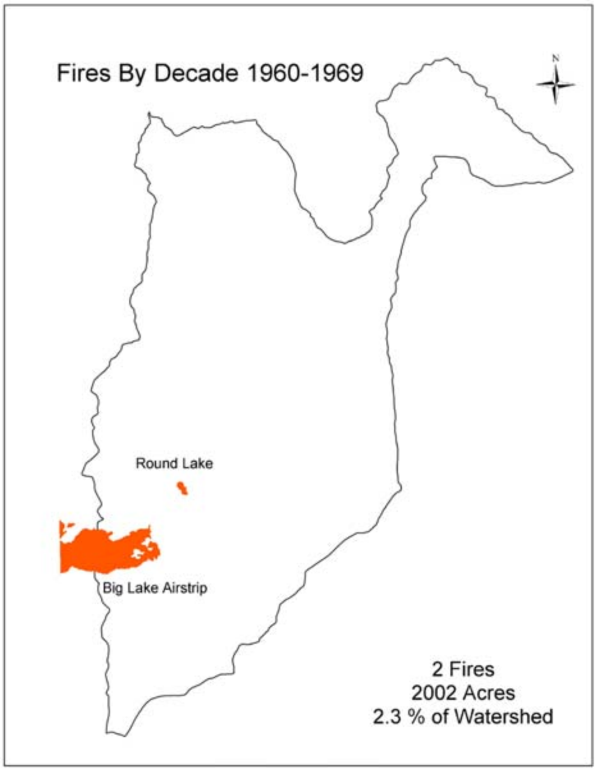


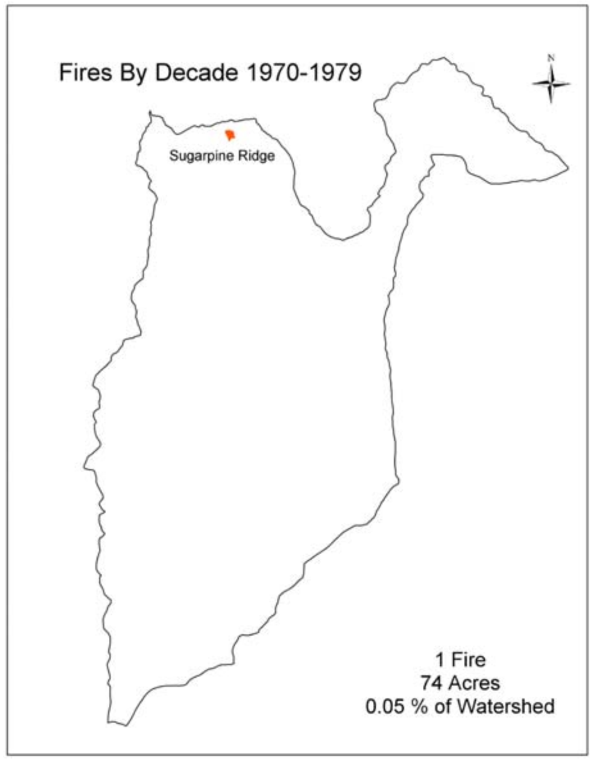

Fires By Decade 1920-1929
N
Metolius
Wasco Lake
Blue Lake
3 Fires
5556 Acres
3.7 % of Watershed

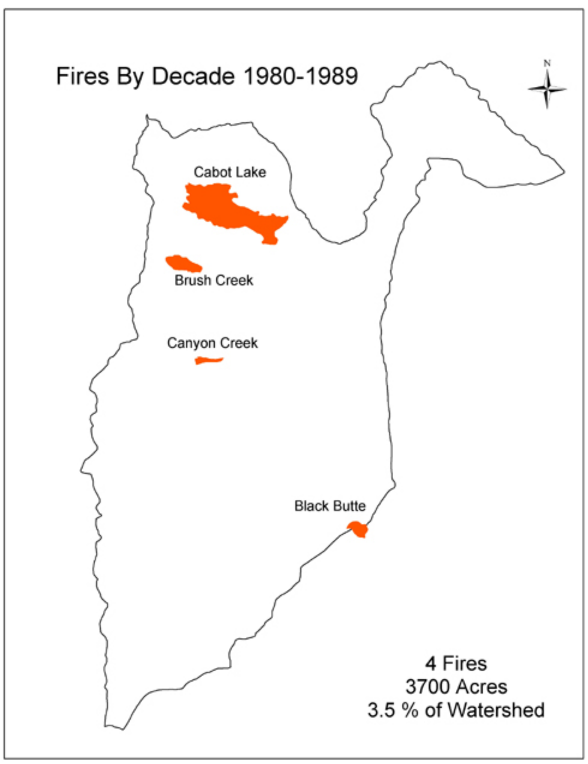

Fires By Decade 1930-1939
N
Dugout Lake
1 Fire
636 Acres
0.4 % of Watershed

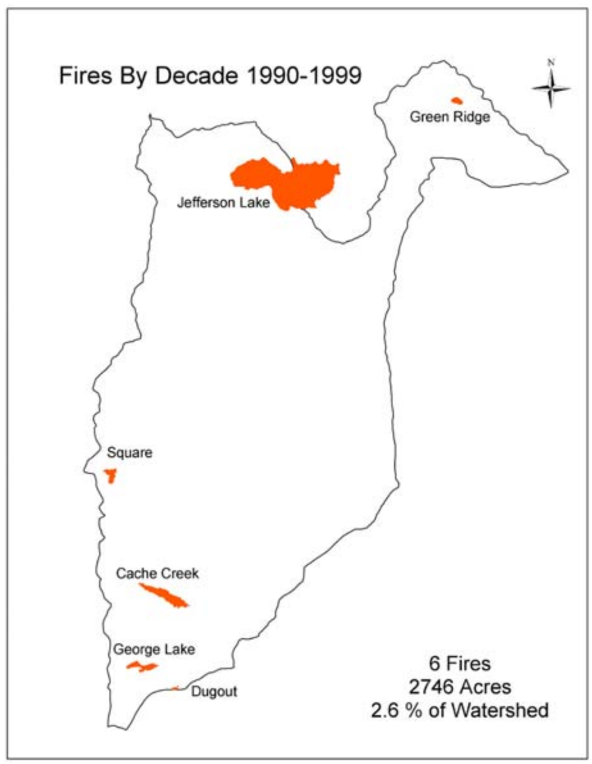

Fires By Decade 1940-1949
N
Metolius
Lower Metolius
Minto Pass
3 Fires
5616 Acres
3.8 % of Watershed

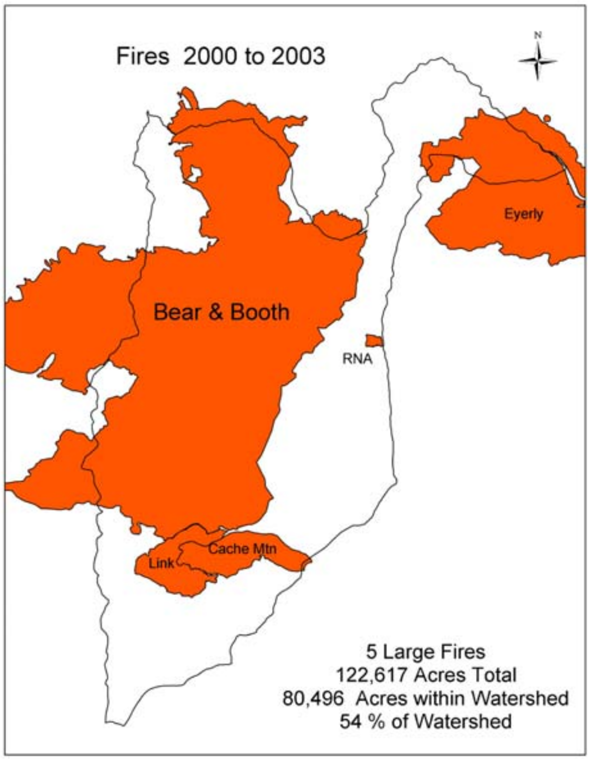

Fires By Decade 1950-1959
N
N0 LARGE FIRES

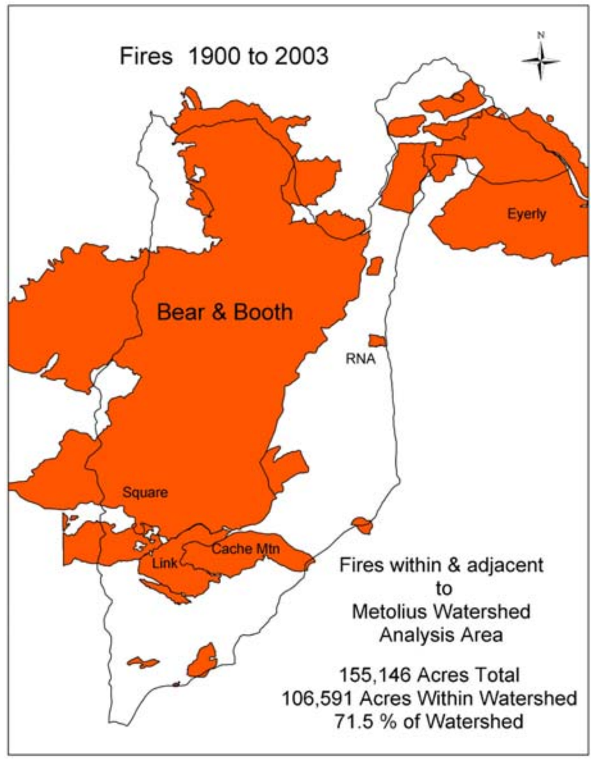

Fires By Decade 1960-1969
N
Round Lake
Big Lake Airstrip
2 Fires
2002 Acres
2.3 % of Watershed


Fires By Decade 1970-1979
N
Sugarpine Ridge
1 Fire
74 Acres
0.05 % of Watershed

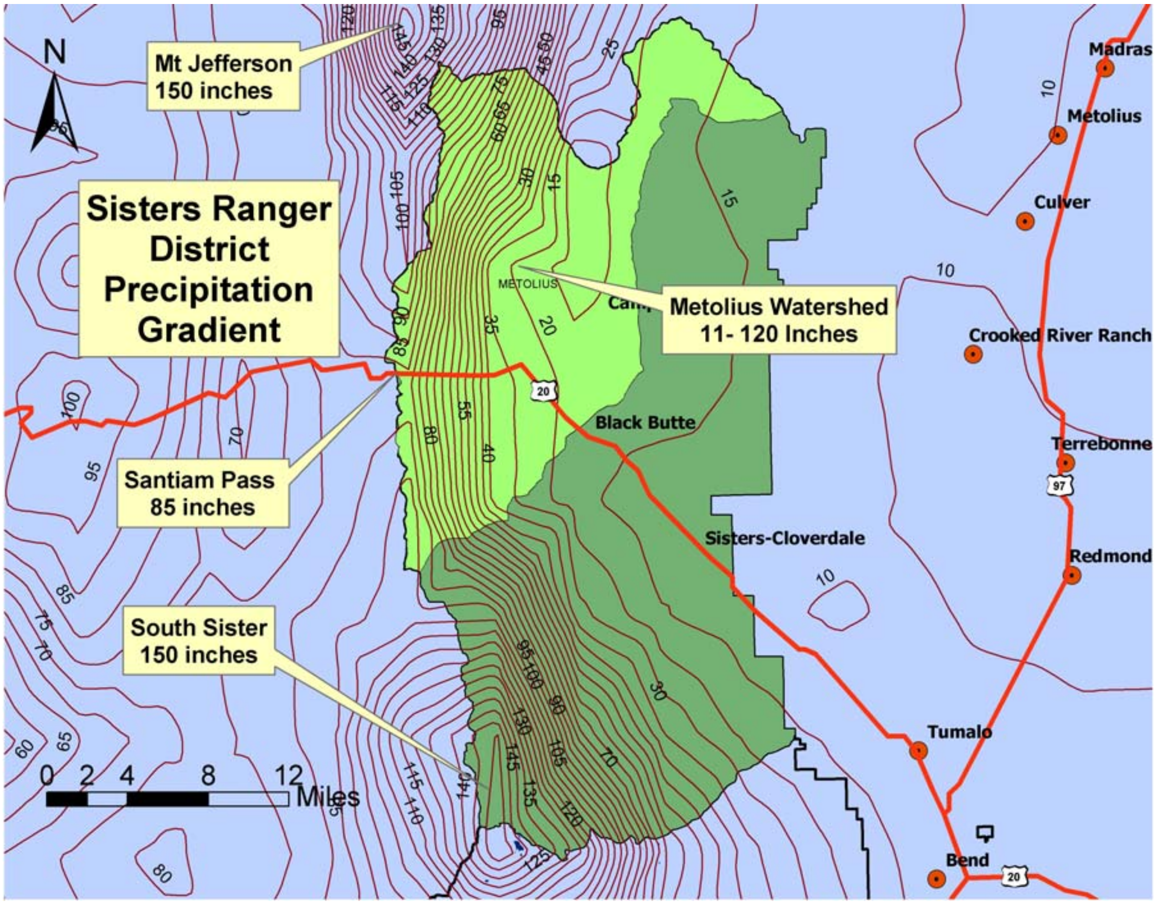

Fires By Decade 1980-1989
N
Cabot Lake
Brush Creek
Canyon Creek
Black Butte
4 Fires
3700 Acres
3.5 % of Watershed


Fires By Decade 1990-1999
N
Green Ridge
Jefferson Lake
Square
Cache Creek
George Lake
Dugout
6 Fires
2746 Acres
2.6 % of Watershed





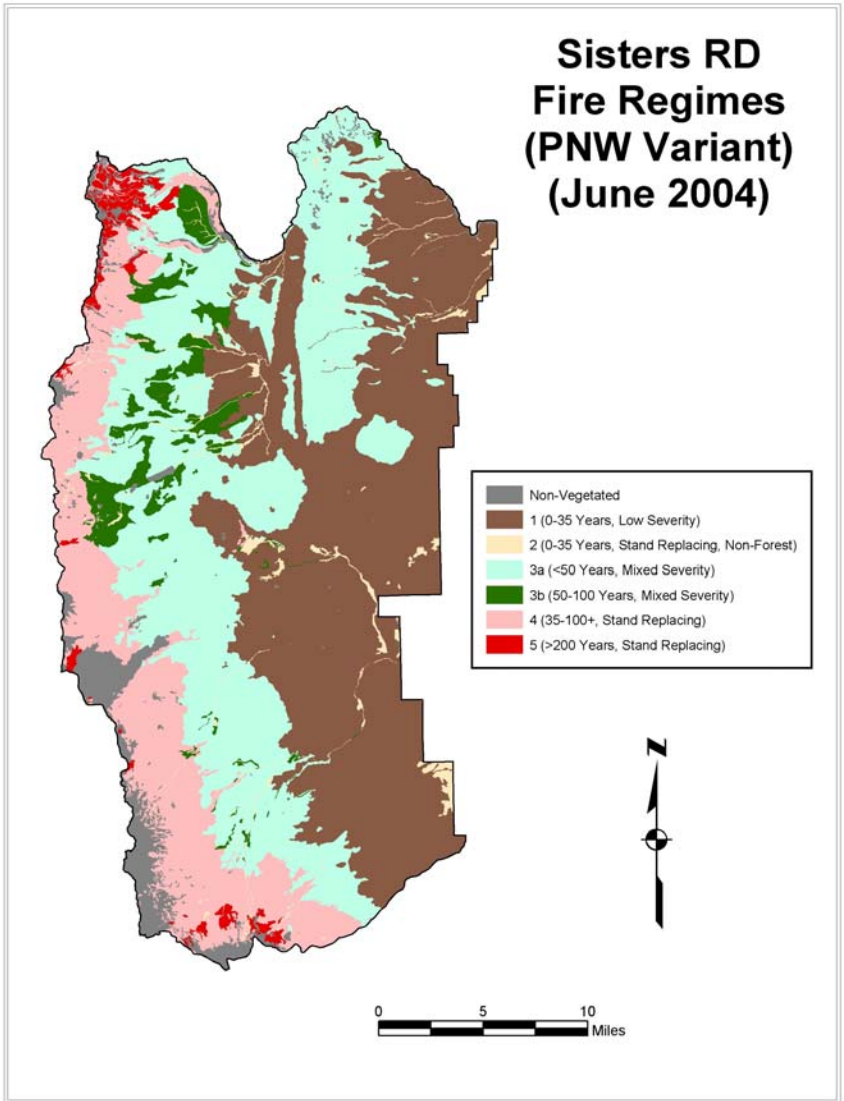
- **In 2 years, four times as many acres have burned than burned in the previous 100 years.**
  - From 1900-1999, 29,449 acres burned.
  - In 2002 and 2003, 122,450 acres burned.



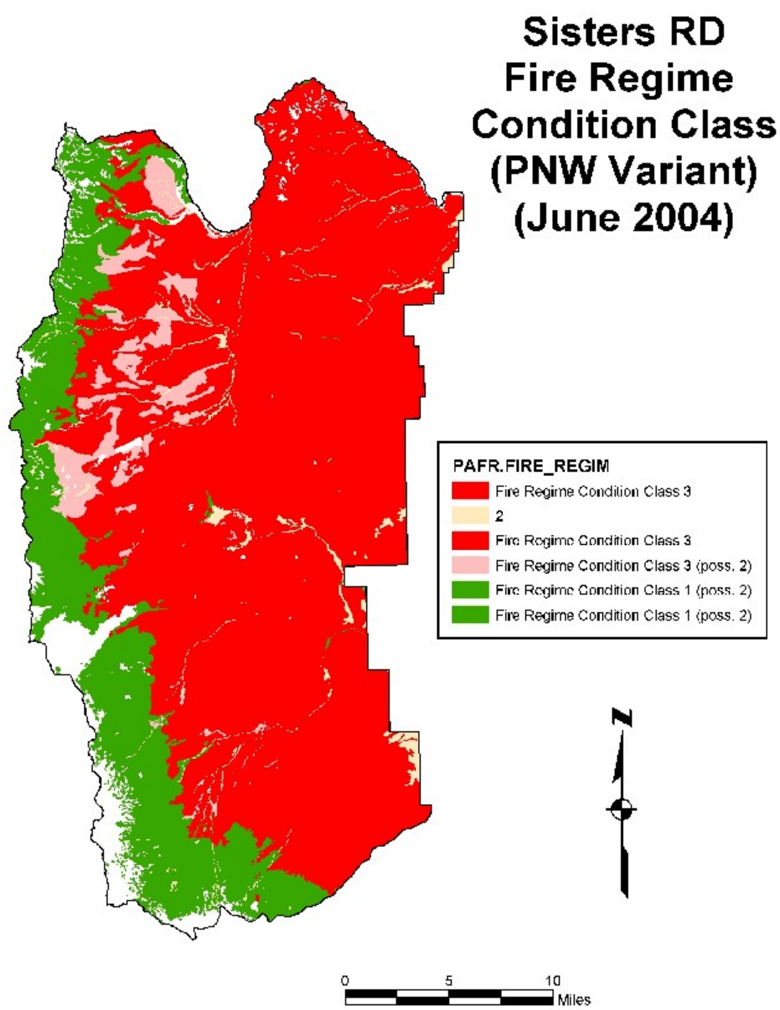
- ❖ **A steep rain gradient influences Metolius Basin vegetation and fire regimes**

- ❖ **This rain gradient creates a diversity of forest types, fire regimes, and influences fire behavior**

    - o ***Fire Regime (FR)*** = A general classification of the role fire would play across a natural landscape in the absence of modern human mechanical intervention, but including the influence of aboriginal burning (Agee 1993, Brown 1995).



- ❖ **Fire regimes in the Metolius Watershed vary with elevation and moisture**
- ❖ **Five different Fire Regimes are present**
- ❖ **Historically, Fire intensity was different at different elevations**
  - High elevation fires (FR 4 & 5) burn at high intensities and reset forest stands (i.e. similar to lodgepole pine stands in Yellowstone)
  - Middle elevation fires (FR 3) burn at mixed intensities creating diversity (i.e. Mixed Conifer forests)
  - Low elevation fires (FR 1) burn at low intensities and forests survive and thrive (ie. Ponderosa pine forests near Metolius River)



❖ **Condition Class** = Is the degree of departure from the natural (historic) range of variability within a fire regime.

❖ **The exclusion of fire has altered most of the mid-low elevation Metolius Basin Forests from their historic structure, composition, and diversity.** Fire regimes in ponderosa pine and mixed conifer forests have been significantly altered from their historic fire return interval, and the risk of losing key ecosystem components is high. These areas were most affected by the B&B Fire.

❖ **High elevation forests are for the most part, within their historical ranges for fire return and fire regimes.** The risk of losing key ecosystem components is low. These areas will recover naturally from the B&B Fire.

SUMMARY OF FIRE FINDINGS:

- **Some portions of lower elevation mixed conifer and ponderosa pine forest areas experienced fires in the past eight years that were uncharacteristic in size and intensity and unprecedented in the fire history of the past 100 years.**

- **High elevation fires in the past eight years were within historic range of intensity but size was likely outside the historic range. They will recover through normal successional patterns.**

- **The departure from historic patterns of fire, past management, and weather patterns have changed fire regimes and increased risk of larger fires at higher intensities. This is a reason for the recent uncharacteristic wildfires.**

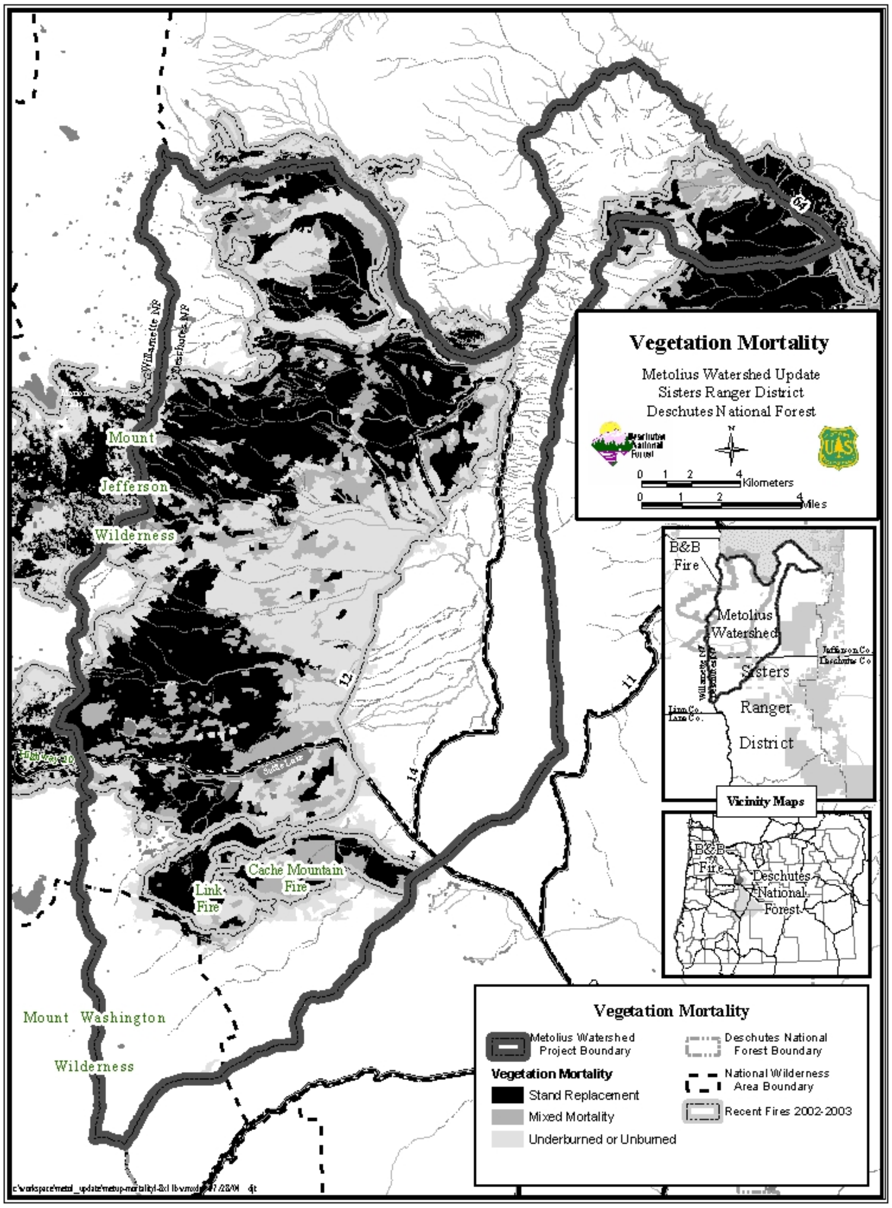
KEY FIRE AND FUELS TRENDS

♨ **New-** Expect decreased fire risk for 5 years due to reduction of fine fuels and brush.

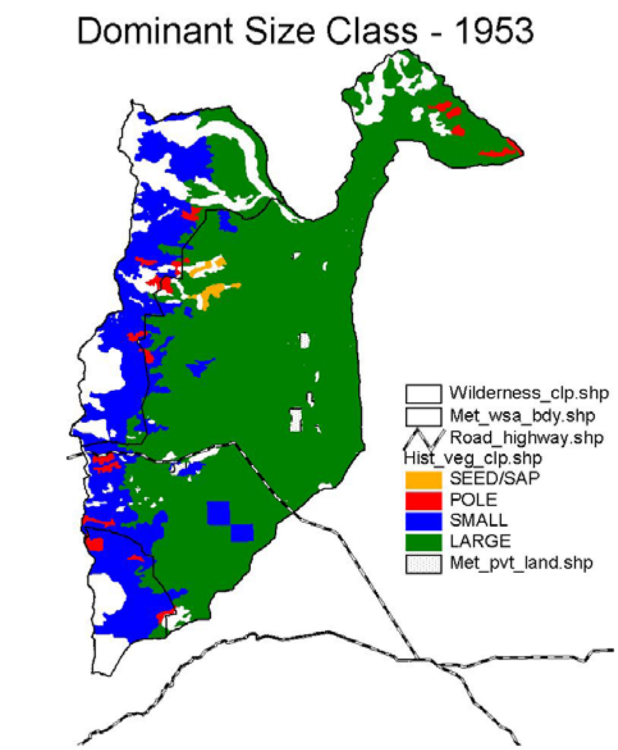
♨ **New-** Expect increased fuel loading over the next 5-60 years from falling snags. Large amounts of wood on the ground creates resistance to fire suppression, difficulties with fire reintroduction, safety issues, and risks of reburn to developing forest.

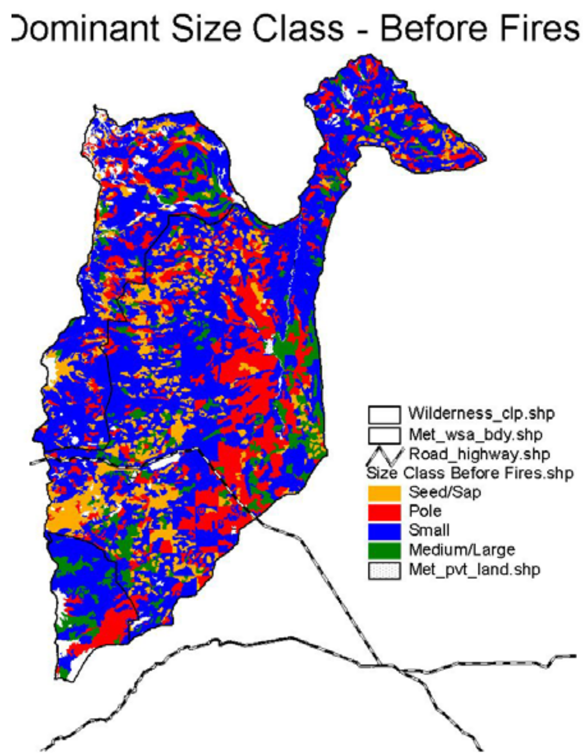
♨ **New-** Wildfires have created new landscape patterns which in some ways resemble historic landscape patterns with complex edges, some gradual edges, and live stand remnants and legacies. Conversely, more trees in lower elevation forests are dead than would have likely occurred historically and patch sizes of dead trees are larger than historic patch sizes.

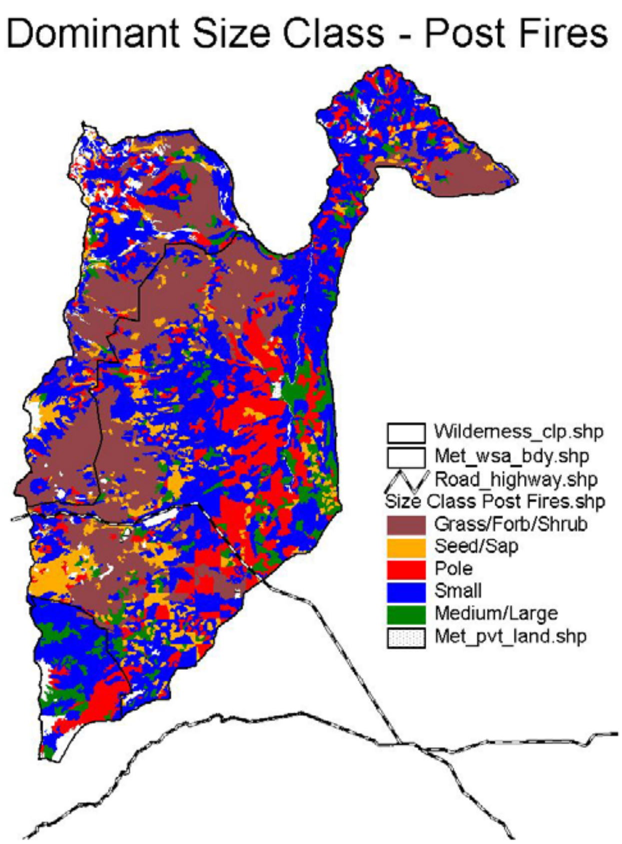
FOREST VEGETATION



- **About 54% of watershed has been affected by wildfires since 1996**
  - Approximately 26% of watershed has experienced stand replacement fire (more than 75% of the trees are dead)
  - Approximately 11% has experienced mixed severity fire (25-75% of the trees are dead)
  - There are now 5 times more early stage forests than in 1996 (grass/forb /shrub class has increased from 6% to 31%)







- **There has been a continual loss of large trees since 1953.**
- **In 1953 large trees dominated the landscape.**
- **Large trees were less prevalent in 1996, before the fires, because of logging which removed large trees and fire exclusion which allowed many small trees to grow and dominate the landscape.**
- **There are even less large trees in 2004 due to fire caused mortality.**
- **About 113,000 or 17% of the large trees over 21" in diameter in the watershed were lost in fires since 1996.**

SUMMARY OF FOREST VEGETATION FINDINGS:

- **Forest vegetation structure and tree size have been pushed even farther outside the historic range due to fire. This continues a trend of more early seral vegetation and fewer older, large trees over 21” in diameter.**
  - 1953 - 64% of the watershed dominated by large trees
  - 1996 - 9% of the watershed dominated by large trees
  - 2004 – 7% of the watershed dominated by large trees

- **The greatest percentage of moderate to high severity fire (where more than 25% of the overstory trees are dead) is found is found in 3 plant association groups:**
  - Lodgepole pine- 56% of fire was moderate to high severity
  - Mixed conifer wet- 50% of fire was moderate to high severity
  - Mixed conifer dry- 43% of fire was moderate to high severity

- **31% of Riparian forest areas burned at moderate to high severity**

- **Landscape patch structure has changed. There are four large, early seral patches in the areas of:**
  1. Cache Mountain and Round Lake
  2. Abbot Butte
  3. Sugar Pine Ridge
  4. North end of Green Ridge

KEY FOREST VEGETATION TRENDS

♨ **1996 Trend** (still valid outside wildfire areas)– Greatly increased stand densities are putting all trees sizes at risk. Large tree mortality, insect and disease, and catastrophic fire risk are increasing. Species composition shift from early to late seral species. Outside wilderness, stand structure has been shifting from larger to smaller trees and from single or two canopy layers to multiple canopies. Large tree development is slowed.

♨ **1996 Trend**-(modified, but still valid outside fire areas)- Some Wilderness areas are in late stages of successional development and despite fire exclusion, vegetative disturbance patterns and successional trends will continue within the range of historic variability.

♨ **1996 Trend**-(Still valid outside wildfire area) **–** In mixed conifer, the horizontal landscape structure is fragmented with higher edge contrast and landscape patches are smaller and more numerous than occurred historically.

♨ **1996 Trend and New**- Continued loss of large trees, interior habitats, and connectivity for some wildlife species.

- ♨ **New-** Large areas of early seral vegetation due to wildfire created mortality in forest vegetation, increasing amounts of grass, shrubs, and seedlings.

- ♨ **New** - Continued mortality of fire damaged trees is expected from secondary agents such as insects and disease, especially bark beetles and root disease.

Soils

Summary of Soil Findings:

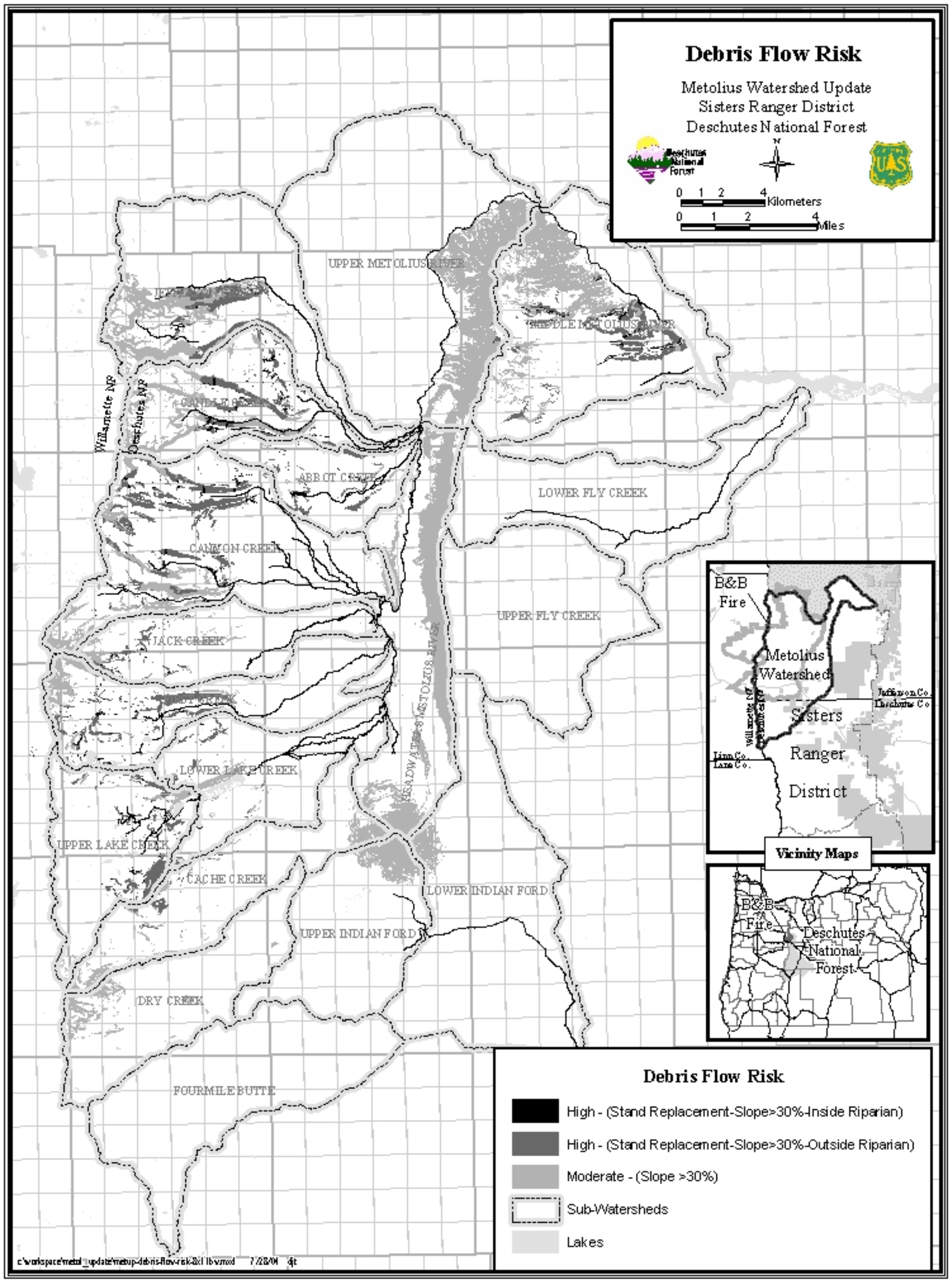
- **Despite extreme fire behavior and stand replacement tree mortality, the wildfires within the watershed had minimal effects to soil productivity.**
  - Negative changes were isolated and localized to areas where stumps or down wood burned for extended periods of time.
  - Less than 4% of the area showed negative changes in terms of altered mineral composition or nutrient volatization.

- **There are elevated erosion risks associated with severely burned areas**. Risk is tempered and lowered by high infiltration rates of soils in the area and relatively gentle slopes. Highest risk areas are headwater areas of:
  1. First Creek
  2. Jack Creek
  3. Canyon Creek
  4. Brush Creek

- **Ten debris flows (landslides) occurred in the Metolius Basin during an intense winter storm in 1996**
  - Nine of the ten debris flows in 1996 were associated with managed areas where vegetation had been manipulated in varying degrees.
  - Five older debris flows were discovered in the Highway 20 corridor and appear to be associated with a similar intense winter storm in 1964.

- **Slopes exceeding 25% in areas of stand replacement fire have an elevated risk of debris flows within 3 years of the fire as tree roots decay and lose soil holding strength**.

  - Slope stability in these areas is not likely to return to pre-fire levels within the next 20 years, although returning shrubs and trees will help stabilize soil.



KEY SOIL TRENDS

- **New-** Increased risk of debris flows (landslides) after 5 years up to 20 years due to loss of stabilizing tree roots in wildfire areas.
- **New-** Increased risk of erosion due to wildfire effects, channeling fine sediment into aquatic habitats, threats to road structures, and lowered soil productivity.
- **1996 Trend** (less concern/ improvements/new information) - Lowered soil quality due to altered nutrient cycling, compaction related to ground based harvest systems, roads, trails, and recreation activities.

Aquatic Systems

Summary of Aquatic Findings:

- **There are more 303D Listed Streams (**Brush, Canyon, First, & Lake Creek and Lake Billy Chinook), largely due to changes in standards, rather than to changes in water quality since 1996.

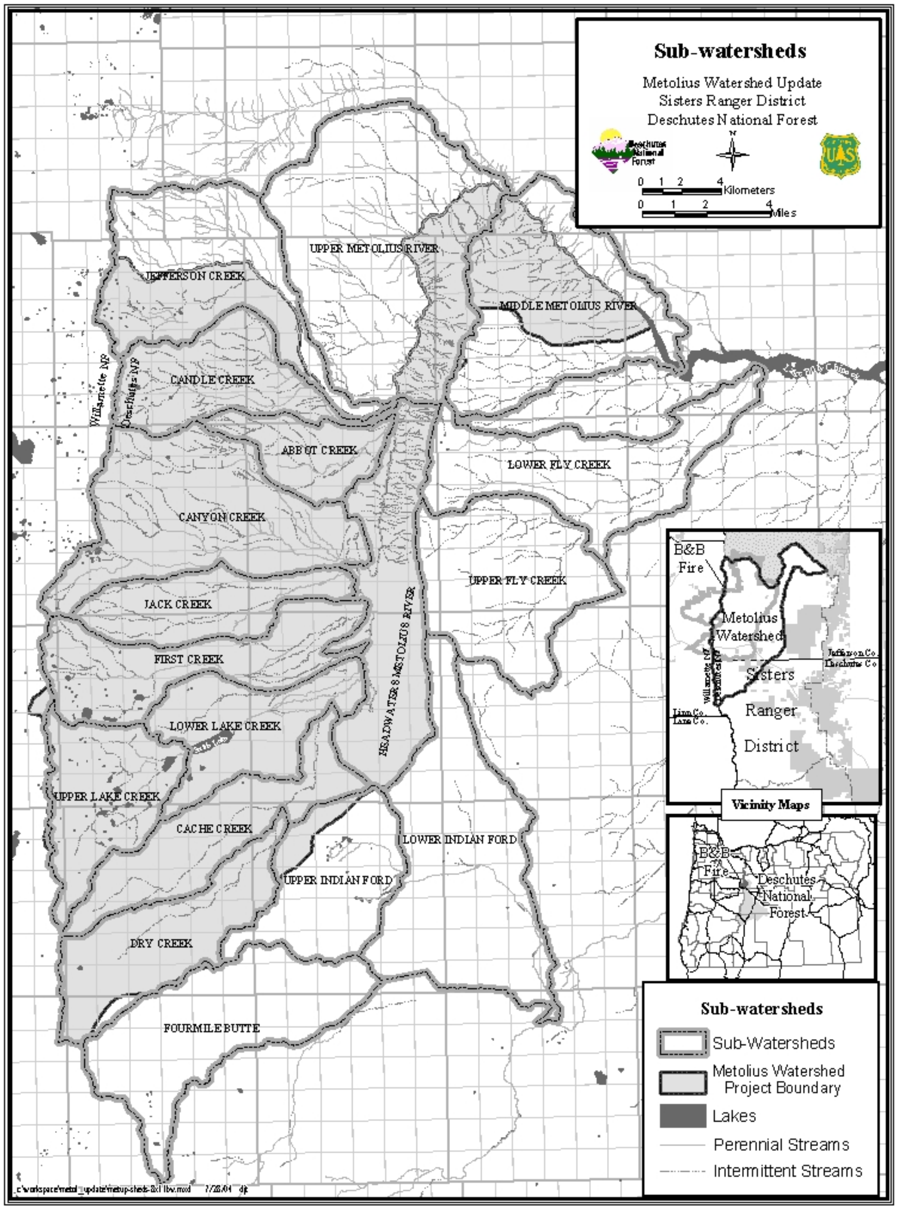
- **There are threats to water quality associated with wildfire**:
  - Sediment from upland erosion
  - Channel instability and erosion
  - Debris slides in the upper watersheds
  - Storm runoff can stress the road drainage network and wash out roads, including roads at stream crossings

- **About 43% of the watershed falls within the rain-on snow elevation zone** (3500-5000 feet), where openings from harvest or fire could increase peak flows in streams downstream. Approximately 4,400 acres of harvest in this zone since 1994 could elevate the risk of increased peak flows.

- **Risks to Aquatic habitat are tempered by**: topography, infiltration rates, and stream characteristics.

- **Six Subwatersheds are at higher risk after the wildfires**. Factors include: sediment deposition into important fish spawning areas, morphological changes to stream channels, or temperatures increases.

  1. Abbot Creek
  2. Candle Creek
  3. Canyon Creek
  4. First Creek
  5. Lower Lake Creek
  6. Middle Metolius Subwatershed- Street Creek
  7. Headwaters of the Metolius



KEY AQUATIC TRENDS

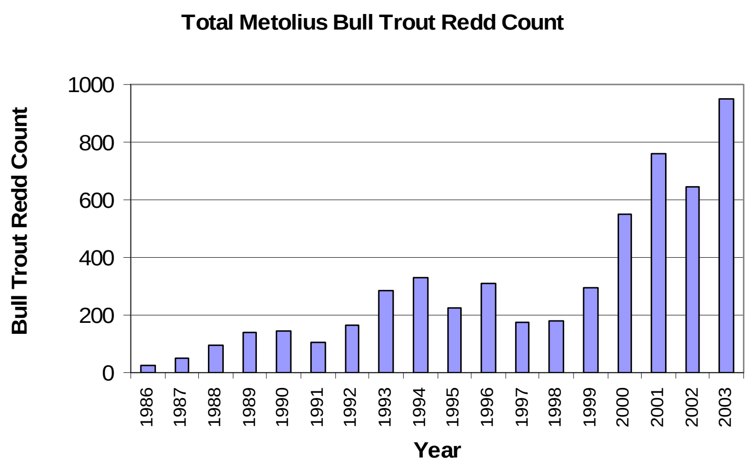
- **New** -Potential for increased peak flows that threaten stream bank stability and loss of soil cover which increases erosion.
- **New**- Increased risk of higher stream temperatures due to loss of stream shade, especially in small streams (Brush, First, and Abbot Creek).
- **New-** Increased risk of short term nutrient increases in water for 4-6 years due to nutrients released by the wildfire.
- **New** and **1996 Trend (has improved but still valid)** – Decrease in water quality and clarity due to algae and possible nutrients from development around Suttle and Blue Lakes.
- **1996 Trend** (some improvements) - Increased sediment delivery and changes in flow regimes from road density, soil compaction, and road/stream interactions.

FISHERIES

SUMMARY OF FISHERIES FINDINGS:

- **There will be a return of anadromous fish (chinook and sockeye salmon) to the Metolius watershed within 6-10 years. The Pelton Round Butte Dam settlement agreement for relicensing specifies restoration of fish passage over the dams.**

- **Bull Trout and Redband Trout populations are currently doing well but sediment is a concern**.
    - Fine sediment in fish spawning habitats can reduce spawning and rearing success of trout and salmon by reducing waterflows through spawning gravel, filling hiding places for young fish and the aquatic invertebrates on which they feed.



KEY FISHERIES TRENDS

♨ **New and 1996 Trend**-(improving)– Reduced density of instream wood and subsequent loss of habitat complexity in the Metolius River. Trend has improved due to active management and will improve from falling trees in wildfire areas. After a spike in recruitment as fire killed trees fall there will be a gap in new recruitment of wood.

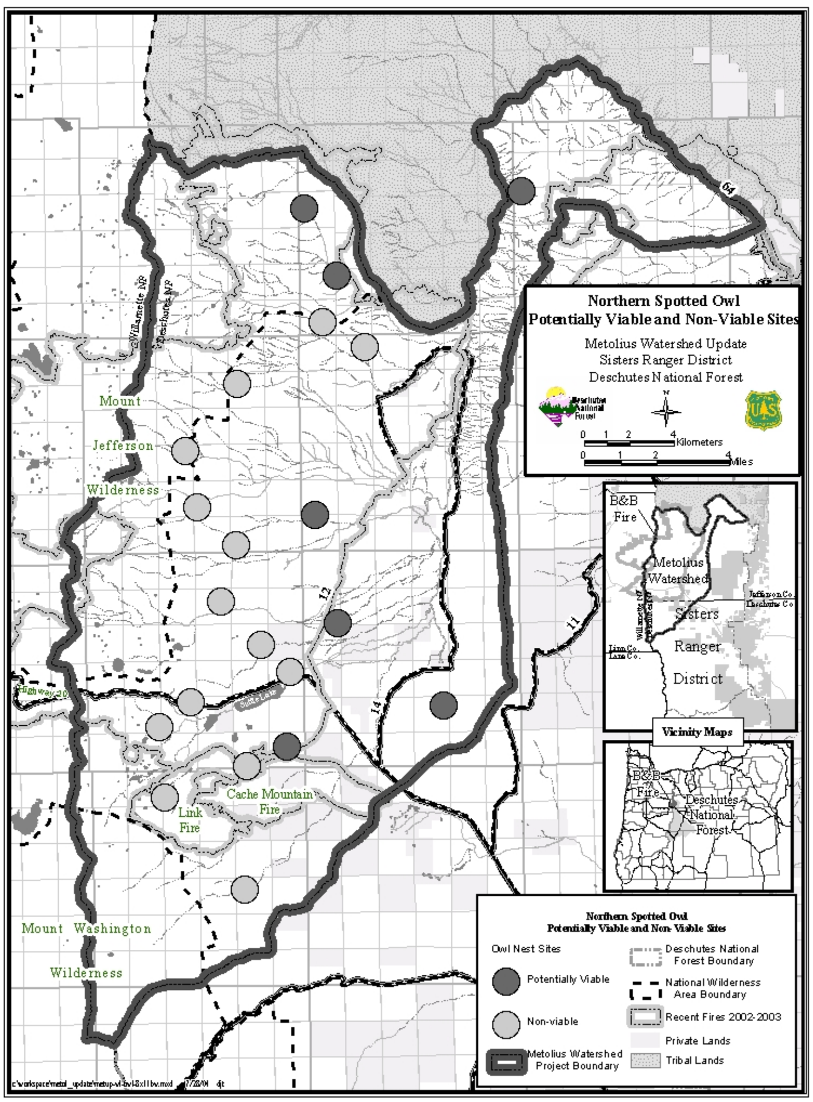
♨ **New and 1996 Trend**-(modified, less concern, but still valid)- Interaction of native and non-native fish species because of non-native fish introduction. Less of a concern in high lakes because stocking has been reduced.

WILDLIFE

SUMMARY OF WILDLIFE FINDINGS:

- **There has been a loss of large tree habitats and snags.** This especially affects: owls, white-headed woodpecker, pileated woodpecker, marten, bald eagle, osprey, and bats.

- **Wildfires have accelerated the loss of spotted owl habitat in the watershed, which was already in decline before the fires due to drought, insects and disease.**
    - Over 11,000 acres of NRF (Nesting, Roosting, Foraging Owl Habitat) was lost
    - Of 21 known owl sites only 7 are still potentially viable due to loss of habitat
    - 66% of the Metolius watershed owl sites were lost
    - 59% of the district owl sites lost



KEY WILDLIFE TRENDS

♨ **1996 Trend and New**- Continued loss of large trees, interior habitats, and connectivity for some wildlife species.

♨ **New-** The need to remove hazard trees and firewood cutting in high use areas and recreation sites will reduce snag habitats. Of special concern are areas around lakes (Meadow Lakes) and streams for wildlife perches (i.e. eagles).

♨ **New**- Risk of increase of non-native wildlife species (Starlings, Barred owls) and natives (Great Grey owls and cowbirds). Expanssion of their range due to wildfire changes to habitats.

BOTANY

SUMMARY OF BOTANY FINDINGS:

- **Rare plants such as Peck's penstemon and Tall Agoseris will benefit from the wildfires due to fire stimulated flowering and increase in habitat with bare mineral soil.**
- **Noxious weeds will also expand into burned areas and can degrade native habitats.**

It's pretty but… The noxious weed St Johns Wort near Corbett Snopark is displacing native plants. Knapweed is also rapidly expanding in burned areas.

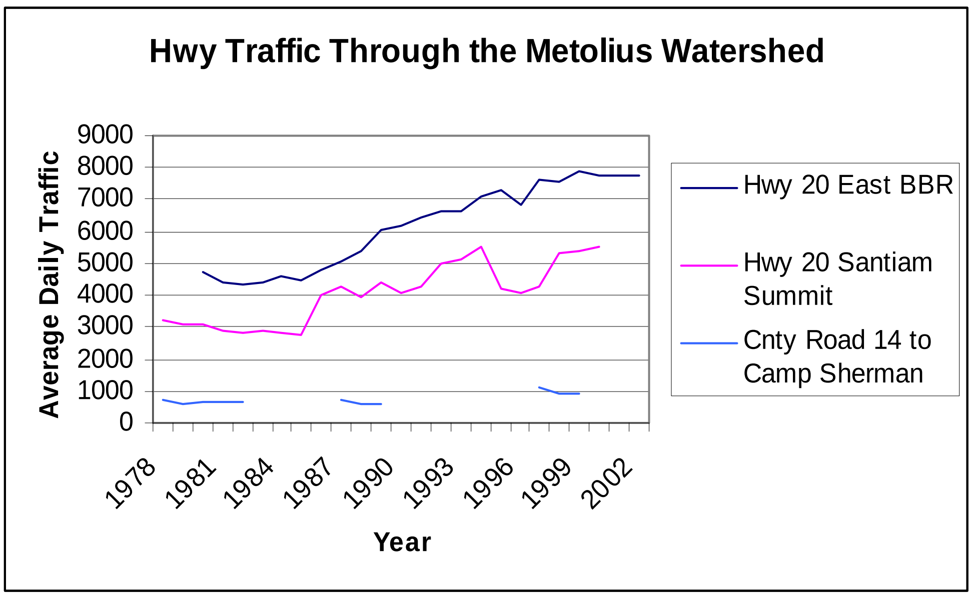
KEY BOTANY TRENDS

♨ **New**- Risk of expansion and spread of noxious weeds due to wildfire changes to habitats and vectors for spread (roads, OHV's, wildlife, streams).

ROADS

SUMMARY OF ROADS FINDINGS:

- **Traffic on Highway 20 and Road 14 (the road to Camp Sherman) has continued to increase.**
  - There has been an 80 % increase in traffic on Highway 20 in 20 years (1982 to 2002), from 4300 to 7800 vehicles per day east of the Black Butte Ranch entrance.
  - There has been a 54 % increase in traffic on Road 14 into Camp Sherman in 20 years (1979 to 1999), from 600 to 950 vehicles per day



- **Road densities still exceed Forest Plan standards although there has been a slight drop due to road closures.**
  - 1996 open and closed road densities for the watershed were 3.9 miles/sq.mile
  - 2004 open and closed road densities are 3.7 miles /sq.mile
  - Open roads only density is 2.8 miles/sq.mile
  - If wilderness acres are excluded, this density is considerably increased

- **Only 12% of the watershed roads receive routine maintenance each year, the remaining roads receive little or no maintenance.**

- **In many areas low use roads are closing themselves without being assessed to see if they are hydrologically stable, due to blow down, and shrub growth.** This will increase in fire areas due to dead trees falling in roadways.

Key Road Trends

- ♨ **New**- Shift in road users from Forest management use to forest visitors. About 95% of forest road traffic is now associated with recreation and forest users rather than timber production. Road maintenance funding, traditionally supplied by forest management activities is decreasing.

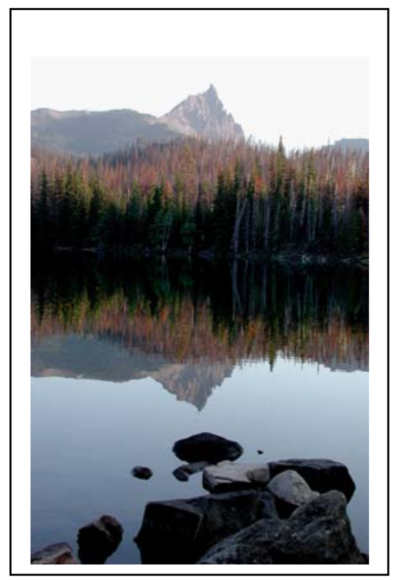
- ♨ **New**- Increased controversy over road closures.

- ♨ **New**- Increasing use and economic importance of Highway 20.

- ♨ **New and 1996 Trend** (Modified but still valid)- Human use of the watershed is increasing, especially diversity and intensity of activities, traffic, access on roads, and demand for day use recreation. Wildfire effects are likely to result in an increase in OHV use and increase traffic temporarily.

Social, Including Recreation & Scenery

Summary of Social Findings:



- **There will be a shift in sense of place expectations. There are changes to scenery. Burned areas have a distinctive character and will have short term low scenic integrity for many people for up to 5 years.** Wildflower displays will be prevalent for several years

- **There will be long term scenic quality recovery after about 5 years as understory plants recover and new trees grow.**

- **The fires and subsequent highway closures and evacuations had a tremendous impact on Central Oregon economy**. There is an increasing economic importance of Highway 20 and adjacent public lands to local business.

- **Salvage and other forest management (including road closures) remains controversial.**

Key Social Trends

Paul Engstrom surveys Round Lake Christian Camp after the B&B Fire, several structures and vehicles were destroyed

- **New and 1996 Trend** (Modified but still valid) - Human use of the watershed is increasing, especially diversity and intensity of activities, traffic, access on roads, and demand for day use recreation. Wildfire effects are likely to result in an increase in OHV use, mushroom picking (especially commercial), hunting, and increase traffic temporarily.

- **New**- Shifts in type and location of recreation. Some unburned areas may receive a great increase in use.

- **New**- Increased risks to visitor and employee safety from falling snags, down trees, and falling rock.

- **New**- Increasing sense of risk for forest/urban interface residents and increasing tolerance/desire for urban interface fuels reduction.

- **New**- Off road travel is increasing and affecting resources.

- **New**- Shift in sense of place expectations for some users, especially those off the beaten path (hunters, mushroom pickers, fisherman, hikers).

- **New**- Perceptions of what is natural can be in conflict with restoration of ecosystem process and function. Tradeoff and costs are not clearly understood by all members of the public.

- **New**- Continued interest in economic uses, including timber and recreation as well as research use of the watershed.

HERITAGE RESOURCES

SUMMARY OF HERITAGE RESOURCES FINDINGS

- **Wildfires have exposed and damaged historic and prehistoric sites.**

- **There are opportunities to continue to improve coordination with the Confederated Tribes of Warm Springs concerning ceded lands and tribal resources.** The entire Metolius watershed and the entire Sisters Ranger District are ceded lands with protected treaty rights, managed in trust for the Tribes by the Forest Service**.**

KEY HERITAGE RESOURCES TRENDS

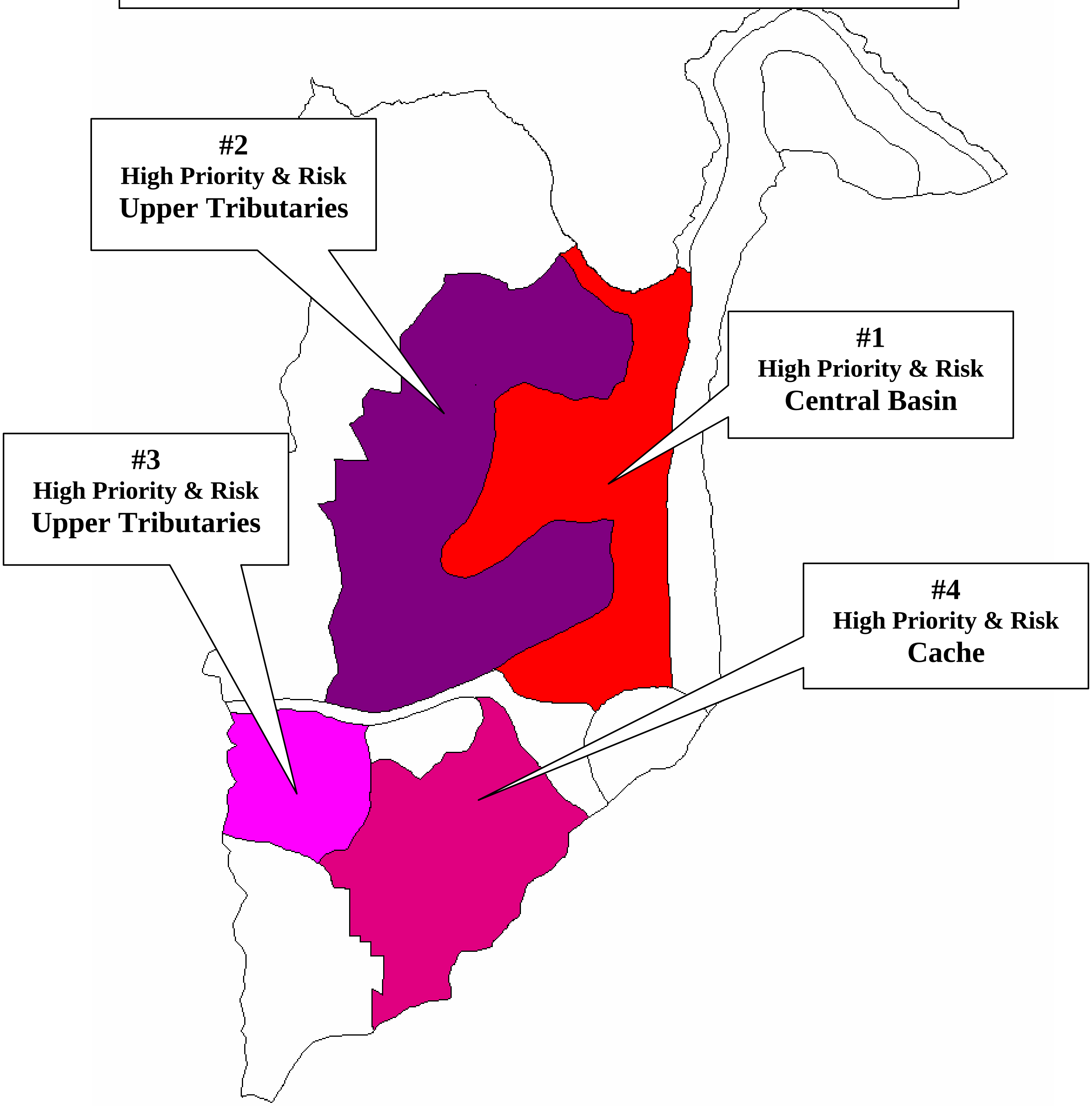
♨ **New- Increased vulnerability of heritage resources due to exposure and loss of some historic structures in wildfire**.

♨ **New- Communication and information sharing between the Forest Service and the Tribes has improved in the last decade**. Continuing efforts to understand and address Tribal concerns is needed. Several projects have brought Tribal elders and resource specialists together with Forest Service specialists. Information sharing and cooperation is at unprecedented levels, but still need improvement. Information about resources of Tribal interest remains fragmentary and incidental. There are no systematic methods in place to locate, identify, and communicate to Warm Springs about such resources.

♨ **New- Increased human use and disturbance have increased the probability that undiscovered and known sites of cultural importance are being impacted**. Inventory and protection of culturally significant sites needs to continue at a more rapid pace to match growth pressures.

PRIORITY AREAS

FOR FUTURE MANAGEMENT ACTIVITIES



PRIORITY AREAS FOR MANAGEMENT ACTIVITIES

Landscape Areas Priorities						
High Priority RED	**8-Upper Tributaries**	**2-Central Basin**	**4- Meadow Lakes**	**6-Cache**		
Medium Priority YELLOW	9-Green Ridge	7-Suttle	3-Hwy 20	1-Wilderness	10-Scarp	
Low Priority GREEN	11-Lower River	5- Black Butte				

COMPARISON BETWEEN 1996 & 2004-

- **Upper Tributaries and Central Basin** were the top high priorities in 1996 and 2004.
- **Meadow Lakes and Cache** have become high priorities, largely due to fire effects and increasing uncontrolled Off Road Vehicle use.
- **Suttle** has decreased in priority due to management intervention.
- **Green Ridge, the Wilderness, and Scarp** have risen to medium priority largely due to fire effects

Landscape Area	Red Flag Trends	Yelllow Flag Trends
Upper Tributaries	**16**	**9**
Central Basin	**13**	**11**
Meadow Lakes	**11**	**11**
Cache	**10**	**11**
Highway 20	10	5
Wilderness	9	7
Suttle	8	12
Green Ridge	9	11
Scarp	7	7
Lower River	4	11
Black Butte	3	5

TRENDS WITH MOST RED FLAGS:

- ❖ Social conflicts affecting management
- ❖ Increase in noxious weeds
- ❖ Loss of large trees & connectivity
- ❖ Increase in insects & disease
- ❖ Increase in human use
- ❖ Increase in off road travel

General Recommendations

Specific detailed recommendations follow in Recommendations Report

Protect Aquatic Systems and Fish Habitats

1) Reduce road densities, especially riparian road densities and stream crossings. Focus on high and moderate risk sub-watersheds.

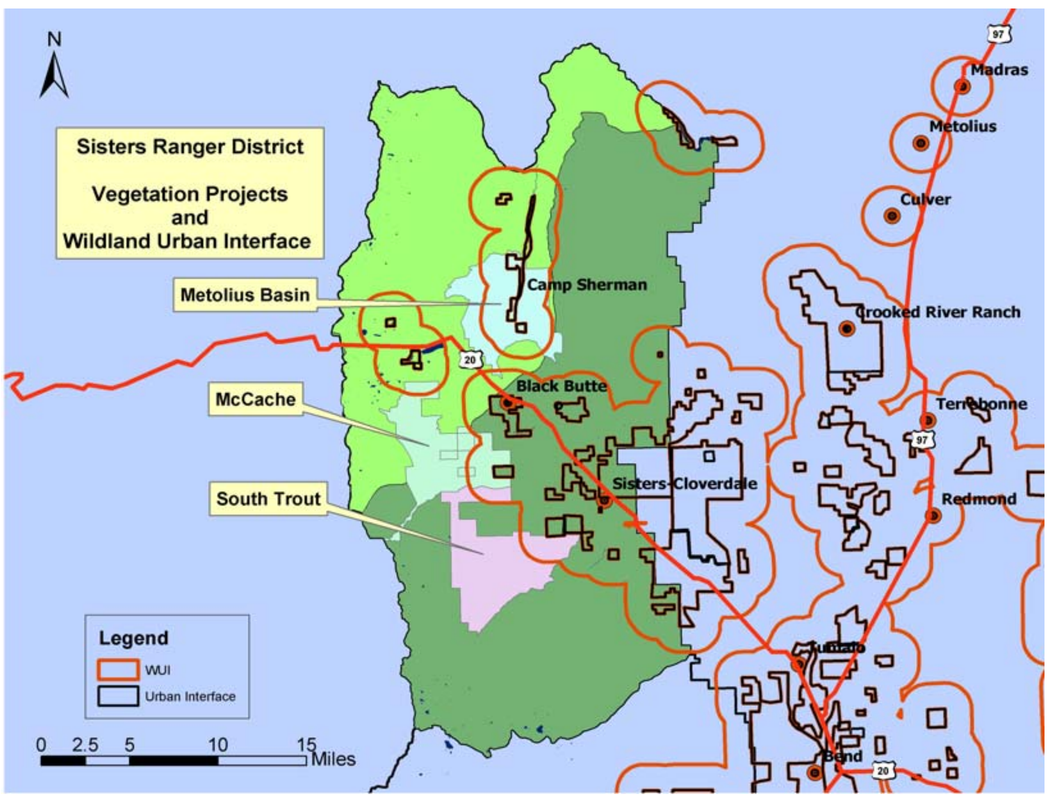
2) Consider expanded buffers for activities in burned and unburned riparian reserves.

3) Increase capacity of culverts to accommodate increased flows and debris.

4) Increase recovery of riparian shade and large wood by planting in high risk sub-watersheds.

5) Prepare for the return of salmon to the Metolius River and Suttle Lake.

Restore Forest Habitats and Continue to Reduce Risks



6) Continue thinning around Wildland Urban Interface- Camp Sherman and other areas where stand densities are high to protect large trees, the Metolius River, and people. Proceed with Metolius Basin Forest Management Project EIS

7) Consider salvage of burned trees for ecological benefit in Fire Regimes 1 and 3 to reduce fuels toward historic levels to improve the ability to re-introduce fire and to make fires easier to control in the future.

8) Manage strategically to maintain and restore dense forest areas, such as northern spotted owl habitat in forest types which are likely to sustain habitat over time.

9) Continue forest management which promotes large trees and restores fire process to this fire dependent ecosystem.

10) Allow some areas to recover naturally. When replanting trees, increase variability and reduce edges in plantations.

11) Prevent spread and introduction of noxious weeds to protect forest habitats and biological diversity.

12) Ensure consideration of big game needs including: cover, forage, security, mobility across landscape. Increase road closures.

Address Social Concerns

13) Reduce risks to public health and safety in burned areas. Education and awareness are an important part of this because the post fire environment will have more risks and not all can be controlled.

14) Consider salvage of burned trees for economic benefit to produce wood products and provide jobs.

15) Continue planning to reduce conflicts and resource damage form uncontrolled off road vehicle use.

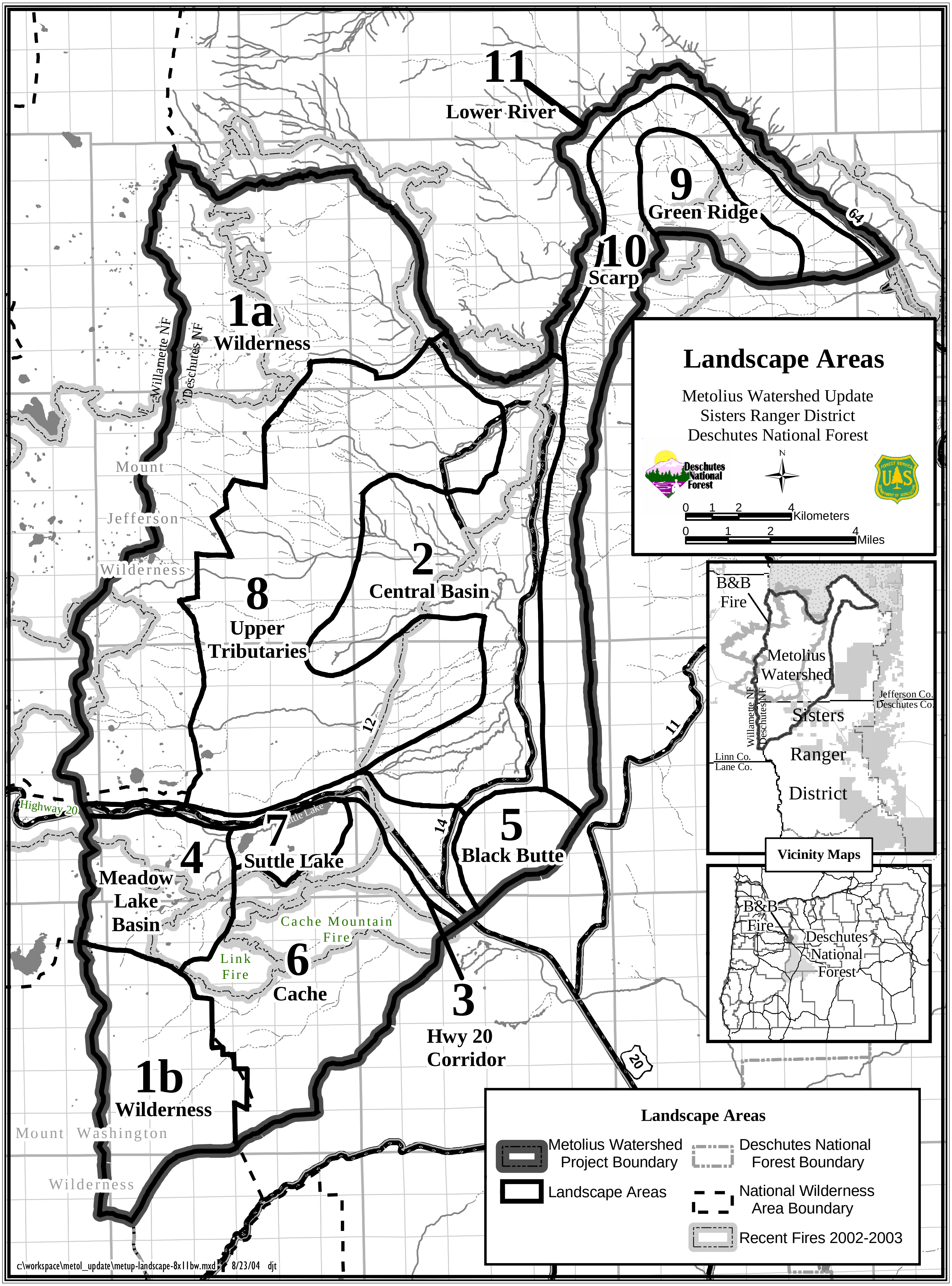
16) Expand heritage inventories, evaluate and manage historic sites.

17) Continue to work with the Confederated Tribes of Warm Springs on resources of interest.

18) Continue outreach and learning opportunities, especially regarding Fire Ecology.

19) Continue monitoring and research. Some topics of concern:

- Long term salvage studies
- Modeling reburn potential
- Tree mortality in mixed severity
- Fall rates of snags
- Historic research on fire, forests, and people of the Metolius Basin
- Monitor natural regeneration
- Monitor use- Off Road vehicles and mushroom harvest



Landscape Areas
Metolius Watershed Update
Sisters Ranger District
Deschutes National Forest
Deschutes National Forest
N
0 1 2 4 Kilometers
0 1 2 4 Miles
11
Lower River
9
Green Ridge
10
Scarp
1a
Wilderness
2
Central Basin
8
Upper Tributaries
7
Suttle Lake
4
Meadow Lake Basin
5
Black Butte
6
Cache
3
Hwy 20 Corridor
1b
Wilderness
Mount Jefferson Wilderness
Mount Washington Wilderness
Willamette NF
Deschutes NF
Highway 20
Cache Mountain Fire
Link Fire
64
12
14
11
20
B&B Fire
Metolius Watershed
Jefferson Co.
Deschutes Co.
Sisters Ranger District
Linn Co.
Lane Co.
Willamette NF
Deschutes NF
Vicinity Maps
B&B Fire
Deschutes National Forest
Landscape Areas
Metolius Watershed Project Boundary
Deschutes National Forest Boundary
Landscape Areas
National Wilderness Area Boundary
Recent Fires 2002-2003
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RECOMMENDATIONS

Common to All Landscape Areas

Soils

- **Protect soils** during management activities by project design.

- **Restore hydrologic function and bulk densities of detrimentally compacted areas within the watershed**. De-compacting soil profile conditions allows for nutrient cycling processes associated with biotic and chemical components of the soil resource to function under conditions in which root growth and water infiltration are not inhibited by high bulk densities.
  - Continue use of a winged subsoiling implement to restore detrimentally compacted soils within Soil Condition Class C and D areas. Priority should be given to subwatersheds in which high overall levels of detrimental compaction have been identified or where hydrologic function or site productivity is of concern.
  - Subsoil decommissioned road beds in all subwatersheds where subsurface conditions allow for unimpeded travel of the subsoiling implement.

- **Stabilize Slopes**- Plant trees on slopes greater than 30% in stand replacing burn areas to expedite the return of conifer root networks capable of stabilizing slopes during periods of super-saturation.

Aquatic Resources-Hydrology

All subwatersheds

- **Consider expanded buffers** for activities in burned and unburned riparian reserves.

- **Replace undersized Culverts**- Monitor stream crossings and road drainage within and downstream of the fire area; remove or improve undersized culverts and design to allow fish migration

- **Road closures**- Officially inactivate[1], in the next 10 years (2004-2014), level 2 roads that had been undrivable prior to the fire due to vegetation

- **Monitor long-term in-stream large woody debris** (LWD) in all subwatersheds affected by the recent fires

- **Monitor morphological changes in streams** mostly affected by the fire

- **Protect Streams from recreational impacts**.
  - Eliminate and prevent future establishment of dispersed campsites within 100 feet of bankfull stream channels within the fire area
  - Do not reestablish lost campgrounds within 100 feet of bankfull stream channels within the fire area

Abbot Creek

- Reduce riparian road miles through inactivation[1]
- Remove or improve road-stream crossings
- Monitor bank stability in C4 redband spawning reach
- Plant conifers in riparian reserves for long term shade and wood recruitment.
- Monitor vegetation recovery adjacent to perennial stream reaches in stand replacing burn areas; plant if necessary

Candle Creek

- Reduce riparian road miles, including user-created roads, through decommissioning[2]
- Monitor bank stability in C4 bulltrout spawning reach

[1] Inactivation – convert to a level 1 closed road, remove culverts, and repair drainage problems
[2] Decommission – remove the road from the system, remove culverts, subsoil, and, in some cases, recontour slopes

- Plant conifers in riparian reserves for long term shade and wood recruitment.

Canyon Creek

- Reduce riparian road miles, including user-created roads, through decommissioning[2]
- Reduce road densities through decomissioning[2]
- Reduce acres with greater than 20% detrimental soil condition by subsoiling
- Restore channel and function in Brush Creek tributary (1.5 mile reach along 1200-830 road)
- Remove or improve road-stream crossings, including (but not limited to) 1260 road at Roaring Springs Creek, and 1230-500 road at Bear Valley Creek
- Install culvert at crossing of Roaring Springs tributary and 1230 road – spring-fed tributary is current running down the ditch because the crossing was blocked by 1996 road repair work
- Monitor bank stability in C3/C4 reach of Canyon Creek, E4 reach of Brush Creek, and in stand replacing fire areas upstream
- Plant riparian vegetation along Brush Creek, Bear Valley Creek, and Upper Canyon Creek in stand replacing burn areas
- Assess riparian condition (vegetation) to determine risk of sedimentation in B4/C4 bulltrout spawning reach of Roaring Spring Creek
- Assess riparian condition (vegetation and bank stability) to determine risk of sedimentation and bank erosion in E4 bulltrout and redband rearing reach of Brush Creek

First Creek

- Remove or improve road-stream crossings on Davis Creek at roads 1210 (private land), 1200 (north), and 1200 (south)
- Work with landowner to fix 5 ft. headcut immediately downstream of culvert on 1210 road and Davis Creek
- Reduce riparian road miles through decommissioning[2]
- Reduce road densities through decomissioning[2]
- Reduce acres with greater than 20% detrimental soil condition by subsoiling
- Monitor vegetation recovery adjacent to perennial stream reaches in stand replacing burn areas; plant if necessary

Jack Creek

- Reduce acres with greater than 20% detrimental soil condition by subsoiling

Lower Lake Creek

- Reduce riparian road miles, including user-created roads, through decomissioning[2]

Vegetation

General

- The recommendations related to vegetation management from the original watershed analysis were reviewed and found to still be valid, especially in areas not involved in recent fires or, if involved, the areas that burned at low intensity or were unburned.

- In areas outside of the recent wildfires and in the low intensive wildfire areas, implement the recommendations from the original watershed analysis to:
  1. Reduce fire hazard in fire regimes 1 and 3
  2. Maintain and enhance the early seral large tree (21"+ DBH) component.
  3. In mixed conifer stands, shift species composition from primarily late seral to primarily early seral.
  4. Reduce stand densities to more sustainable levels.
  5. Maintain, enhance and move toward desired wildlife habitat objectives
  6. Minimize potential negative environmental effects of vegetation treatments

Salvage

- Incorporate the research community and new findings into any restoration or salvage activities to:
  - Integrate the latest scientific knowledge into project planning.
  - Assist in developing appropriate research/project monitoring protocols.

- Incorporate fire patch variability into treatment design.
  - Consider larger treatment areas.

- Maintain convoluted edges.
- Retain stand legacies.
- Protect streams and soils through logging system design.
- Rebuild connectivity in potential habitats.

➢ Salvage to reduce hazards in areas where human safety may be threatened (e.g., along roads, within campgrounds, etc.).

➢ Outside of wilderness areas consider salvage in fire regimes 1 and 3 (i.e., ponderosa pine and mixed conifer plant association groups). This would meet the following objectives:
  1. Reduce future fuel loads to those that are more in line with the historic range of variability.
  2. Help protect developing stands from future near-term stand replacement events to meet long-term resource management objective.
  3. Allow the reintroduction of low and mixed severity prescribed fire and wildfire.

➢ Salvage is very time sensitive related to value and should be accomplished within the first year to maximize value and within the first 2 to 3 years to have any value to offset the cost of the treatments and perhaps provide funding for other restoration objectives.

➢ Salvage should be designed and conducted in such a manner to minimize any potential adverse environmental effects. Beshta, et al. (1995) and (Fitzgerald, (2002), describe approaches to help avoid or reduce negative environmental effects during salvage.

Reforestation

➢ Monitor natural regeneration and do not plant where adequate regeneration of desired species is occurring. The level of natural regeneration will not be completely evident for 2 to 5 years post fire.

➢ When replanting trees, increase variability and reduce edges in plantations.

➢ In the absence of natural regeneration, reforest areas in the following order of priority:
  1. Previous regeneration harvest units.
  2. Areas with no salvage potential but with sensitive resource concerns
  3. Areas with salvage potential and sensitive resource concerns that are not likely to be salvaged.
  4. Areas with no salvage potential and no sensitive resource concerns.
  5. Areas with salvage potential that are ultimately salvaged.

6. Areas with salvage potential and no sensitive resource concerns that are not salvaged.

- Since funding is limited, consider not reforesting areas without sensitive resource concerns that are not salvaged.

- LSR:
  - Since timber production is not an objective of LSR's plant at lower densities such as 100 to 200 trees per acre to reduce the number of future entries needed to meet long-term management objectives.
  - Design in variability in reforestation densities (e.g., limit animal damage control, incorporate natural regeneration, etc.) to mimic historic patterns of variability of reforestation that might have been found in post-wildfire stand replacement events.

- Matrix:
  - Since timber production is one objective of matrix lands, plant at higher densities than LSR's such as (200 to 300 trees/acre) to ensure this management objective can be met over most acres.

Insects and Disease

- Even though the manager has limited ability to avoid outbreak populations of bark beetles (the greatest forest insect-related concern that arises after a wildfire), there are some opportunities.
  - The removal of infested trees and soon-to-be-infested host material helps to limit bark beetles populations to a certain degree. The greatest gains are with the largest infested trees; removal of small infested trees, or trees colonized two years previously have no relevance to reducing bark beetle populations from within the fire area.
  - The more aggressive the salvage alternative is, regarding the removal of currently infested or soon-to-be-infested trees, the greater will be the potential benefit to live surrounding stands. Can you prove this?
  - Formal monitoring should be done to determine tree survival with various levels of fire damage.

Botany

Mushroom harvest

- Prepare for large influx of mushroom pickers in wildfire areas.
- Consider additional enforcement and limits on mushroom harvest in LSR.

- Implement consistent mushroom policies regarding LSR mushroom harvesting.
- Evaluate whether extensive fire related mushroom harvest may have adverse effects on LSR objectives: Restrictions should apply if: (1) unacceptable resource damage from gathering activities or (2)perceived decline in fruiting body abundance over a specified period of time

Rare Plants

- Follow Conservation Guide Recommendations for designation of additional protected populations of Peck's penstemon in underrepresented subwatersheds.

- Follow Conservation Guide Recommendations and set up management monitoring treatment studies if extensive salvage is planned in Peck's penstemon population areas.

- Monitor response of Water Lobelia to fire and recreation impacts.

- Promote research opportunities to study rare plants, fungi, and fire response.

Special Habitats

- Promote and protect hardwoods, including:
    - Aspen, cottonwood and other distinctive species such as pacific yew, Douglas maple, dogwood, willow for their value as habitat and contribution to biological diversity.

- Avoid siltation in lakes and streams-Habitats for water lobelia and other rare species.

- Protect meadows from mechanical disturbance and noxious weed invasion.

New Common to All: Integrated Weed Management Plan

- Continue aggressive weed surveys and manual control in the wildfire areas as a high priority to avoid detrimental effects of weed spread into native plant habitats. Approval for more effective weed control in some large populations is needed. i.e. herbicides.

- All projects should incorporate guidelines from the USDA Forest Service 2001 Guide to Noxious Weed Prevention Practices. All practical and feasible precautions to prevent noxious weed introduction and spread should be undertaken.

- Recommend weed-free order for the Metolius Basin Project Area in concert with the Willamette National Forest

- **Utilize Required Practices by Forest Service Policy for weed prevention:**
  (1) For forested vegetation management operations, use equipment cleaning contract provisions, USDA Forest Service 2001 Guide to Noxious Weed Prevention Practices. WO-CT 6.36 p.21
    (a) Highlights:
      (i) Prior to operations, all off road equipment free of soil, seeds, debris that could contain or hold seeds. Certified in writing prior to each start up or move.
      (ii) New infestations of weeds should be reported promptly and treated.

Fire and Fuels

- **Refine Fire Regime Mapping**. Some suggestions on how these fire regimes may be improved include the following:

  - Many of the improvements to this effort would likely result from consideration of topographic position/features such as aspect, elevation, slope position and landform rather than exclusively plant association. For example, the boundary between fire regimes 1 and IIIa may be further to the west than currently mapped using plant associations and there may be more fire regime IIIb within the larger/broader fire regime IIIa based on aspect and slope position and at the higher elevations adjacent to fire regime IV.
  - Fire regime V that as mapped under this effort was limited to plant associations and is the result of trying to identify plant associations found associated with topographic positions/features that may have been likely to experience fire with an average fire return interval of greater than 200 years. The high elevation zone likely contains more fire regime V than is mapped under this effort and is likely related more to topographic position on the landscape rather than plant association.
  - Fire regime II, as mapped, contains the juniper, meadow (except alpine meadow), and the xeric and mesic shrub plant associations. All of these plant associations are inclusions within much larger/broader fire regimes and should probably be considered within those larger/broader fire regimes. They should still be considered as stand replacing-non-forest types, but within the time-frames of the larger/broader fire regimes they are found within and not necessarily the 0-35 years as specified by fire regime II.
  - Further refinements of these broad natural/historic fire regimes may not result in new fire regimes being identified so much as an identification of the variation within or “inclusions” within, and that define, the broader/larger fire regimes. For example, fire regime IIIb within the broader fire regime IIIa, or

fire regime V within the broader fire regime IV or fire regime II in all other fire regimes.

- **Refine Condition Class mapping**. Some suggestions on how condition class determination may be improved include the following:
  - Reference conditions and data sets specific to the Sisters Ranger District need to be developed in a manner in which they are compatible with the methods described in the "Interagency Fire Regime Condition Class Guide book", version 1.0.5 – March 2004.
  - Refinement of the fire regimes may influence condition class determination.

- **Assess Future Fire Risk**: An assessment of hazard by fire regime and severity needs to be completed to assess future risks. Forest Vegetation Simulator with the Fire and Fuels Extension would be optimal to assess the fuel loading, fire intensity, flame length, scorch height and mortality using that would be expected in the future.

Specific to Fire Regime IV and V

- **Promote research opportunities**: A majority of the watershed classified as fire regime IV and V is in the Mount Jefferson wilderness area.
  - Wilderness areas provide a unique opportunity to study the effects of natural processes across the landscape and serve as a biological benchmark for natural processes.
  - Identify opportunities to work with universities to study the effects of fire and recovery in the plant association groups represented by fire regime IV and V.

- **Develop opportunities to create landscape level fuels treatment zones** along roads ridged and other natural features outside of wilderness that could assist in managing future fires to protect life, ecosystems and habitat.

Specific to Fire Regime III

- **Reduce fuel loading and canopy structure** where appropriate so that fire can be re-introduced into the area to help restore and maintain habitat within the historic range of variability in fire regime III at condition class I.

- **Manage stands adjacent to the Wilderness** so fires originating in the Wilderness can be controlled before they can spread.

Specific to Fire Regime I

- Reintroduce fire in the Metolius Basin at intervals that represent the historic range of variability.
- Proceed with the implementation of Metolius Basin Vegetation Management project.
- Implement fuels reduction treatments around the Wildland Urban Interface and other areas where stand densities are high.
- Reduce the canopy structure (Crown Bulk Density) and surface fuel configurations in Fire Regimes 1 & 3, Condition Class 2&3 to levels that can accommodate fire.
- Reduce fuels towards HRV and improve ability to re-introduce of fire

Wildlife

Survey

- **Eagles-** Survey annually for bald eagles
- **Owls**- Survey the watershed in its entirety to determine if sites are still viable, if site locations have changed, and to gain more knowledge on habitat needs, responses to large scale events, etc.
- **Buffleheads-** Survey to determine if and where nesting is occurring.
- **Wolverine**- Coordinate with State and Federal agencies to continue to survey remote areas to determine areas of wolverine use for protection.
- **Goshawk**- Survey potential habitat to determine the approximate population size within the watershed and to gather more information on habitat requirements.
- **Great Gray Owl-** Conduct landscape level surveys to determine great gray owl presence and habitat preferences as related to large scale disturbances.
- **Waterfowl-** Conduct surveys to determine areas of importance for waterfowl.
- **Osprey**- Survey along highly potential habitat to determine population levels in the watershed.

Improve Habitat

- **Spotted owls**- Refine a long term strategy to manage for sustainable owl habitat in wetter plant association groups.

- **Buffleheads**- Provide nest boxes around potential habitat to account for snag/cavity loss due to hazard trees, fire, etc.

- **Wolverine-** Continue to close roads to reduce road densities, primarily in stand replacement areas where little cover is remaining. Consider seasonal road closures to reduce disturbance to big game populations and to enhance wolverine foraging success.

- **Goshawk-**
  - Manage for goshawks primarily in mixed conifer and ponderosa pine PAGs within the Metolius watershed. Managing small (30-50 acres) patches in appropriate PAGs may allow goshawks to reoccupy the watershed over time.
  - Consider following the draft Regional guidance for goshawk management.
  - Protect at least 30 acres of the most suitable nesting habitat around active sites.
  - Consider establishing a 400 acre Post-Fledgling Area (PFA) around each active site.
  - Treatment of remaining areas may be appropriate to reduce risk of loss.

- **White Headed Woodpeckers-**
  - Manage for late-successional fire climax ponderosa pine stands with open understories by adopting the white-headed woodpecker habitat strategy for the watershed.
  - Limit large snag removal in green stands.
  - In stands impacted by fire, keep shrub densities low to accelerate growth of the new stand.
  - Consider continuing the ongoing research project. This project has established important baseline data and can be used as a long term study to gain additional knowledge of the white-headed woodpecker.
  - Continue effectiveness monitoring and incorporate findings into future projects.

- **Great Gray Owl-**
  - Consider the installation of platforms if nesting structure is found deficient and management of this species is warranted.
  - Continue to enhance existing habitat, especially around natural meadows, by thinning or other appropriate vegetation treatments.

- **Waterfowl-** Place boxes around areas heavily impacted by both hazard tree removal and fire to provide nesting sites.

- **Osprey**- Retain large snags along major water bodies to provide for potential nest structures.

- **Flammulated owls-**

- Manage for late-successional fire climax ponderosa pine stands with open understories and occasional dense thicket habitat.
- Limit large snag removal in green stands.

➢ **Neotropical migrant birds**

- Re-establish, promote, and/or enhance important habitats for identified declining bird species.
- Map hardwood stands and develop a strategy for treatment to determine priorities for restoration.
- Work with local groups, state and federal agencies to develop a strategy for the development and promotion of local birding locations along the Cascades Birding Trail.
- Enhance birding locations not identified on the Cascades Birding Trail (i.e. Moyer Springs).
- Work with local schools and groups to establish educational programs and projects.

➢ **Bats**

- Protect large snags near riparian areas.
- Protect unique habitat features (i.e. caves, hollow trees, etc.).
- Retain large snags across the landscape to provide roost and hibernacula sites.
- Reduce the risk to remaining habitat by reducing stand densities.
- Place boxes around areas heavily impacted by both hazard tree removal and fire to provide roosting and hibernaculum sites.

➢ **Big Game (Deer and elk)-**

- Ensure consideration of big game needs including: cover, forage, security, mobility across the landscape. Increase road closures to improve security.
- Update the Metolius Mule Deer Winter Range Plan with more site-specific information.
- Coordinate with ODFW to refine the Mule Deer Habitat Model if applicable and possibly refine winter range boundaries using information collected over the last decade.
- Strive to meet proposed road density levels outlined in the Deschutes LRMP and associated plans.
- Coordinate with ODFW on a forage strategy for the fire areas.
- Look for options to partner with local organizations and agencies on the repair and reconstruction of existing water sources. Also look for opportunities to develop new sites (i.e. Moyer spring).

- **American Marten-**
  - Implement the spotted owl habitat enhancement strategy to accelerate the development of suitable habitat which would equate to similar habitat needs for marten.
  - Re-establish camera set surveys to determine level of use by marten.

- **Wolverine (R6 Sensitive, Threatened in State of Oregon)-**
  - Enforce wilderness policies and guidelines to reduce the potential for wilderness encroachment by motorized equipment.

- **Crater Lake Tightcoil-** Management recommendations were developed for several mollusk species including *Pristiloma arcticum crateris*. The following objectives were designed to assist in maintaining the viability of the species:

  At known sites:
  - Minimize disturbance of the forest floor litter, duff, and woody debris within the extent of the riparian vegetative habitat.
  - Maintain a component of riparian vegetation, including hardwood trees and shrubs where they exist, to provide a constant supply of logs, leaves, and leaf mold.
  - Maintain or enhance naturally occurring diversity of plant species in Habitat Areas. Maintain natural understory vegetation and a layer of uncompacted organic litter and debris on the ground within the riparian vegetation zone.
  - Avoid activities that would cause soil compaction within 33’ of the stream edge.
  - Maintain existing logs and other woody debris within the extent of riparian vegetation.
  - Avoid prescribed burning in Habitat Areas and protect them from wildfire by fuels management in adjacent areas.
  - Avoid activities that would lower the water table.

- **Snags, Down Woody Material, and cavity nesters-**
  - Use the DecAID stratification as a basis for dead wood retention and refine retention levels based on specific species requirements.
  - Maintain large structure on the landscape

Heritage Resources-Tribal and Archaeology

- **Complete Inventories**- Most developed recreation sites have heritage resources evaluated, several to finish up. Highest needs are the historic resources in Camp Sherman including the summer homes, the CCC structures, and one prehistoric site not yet evaluated

- **Improve Heritage Resource Management Guidelines**- Need to develop better guidelines on how to manage these heritage resources where recreation use and management is ongoing and occasional needs for utility development or improvement are needed in campgrounds, summer homes, resorts, and group camps. This is of highest concern with historic structures in developed locations.

- **Recreation Management**- Continue integrating heritage resources in dispersed recreation management and trails in the watershed.

- **Cultural Use plants**- Inventory huckleberry patches and manage for continued vigor. Share information with the Confederated Tribes of the Warm Springs Reservation of Oregon

- **Maintain and improve water quality** throughout the Metolius Basin.

- **Promote Research**- Continue to recruit and encourage archaeology research with university professors and graduate students in the Metolius Basin.
    - Specifically look for opportunities to research the prehistoric use of aquatic resources such as anadromous fish on the Metolius River, Lake Creek, and Suttle Lake.
    - Continue to collect more in depth information about sites in the watershed utilizing PIT projects and local volunteers.

- **Develop interpretive opportunities** to tell the history and prehistory of the basin at such places as Black Butte, Suttle Lake, and the Santiam Wagon Road.

Scenic Resources/Social

These recommendations are designed to **protect short-term scenic quality and promote long-term scenic viability** within the Metolius Watershed Analysis area, particularly along the primary and secondary travel corridors, within the Foreground and Middleground landscape.

- Rehabilitate impacted areas, such as soil displacement or disturbance (erosion and land slide) areas.
- Actively manage and monitor travel corridors, especially within the areas impacted by wildfires to meet Highway Safety Act standards.
- Actively manage and monitor dispersed recreation and special uses, such as mushroom harvesting, within the Metolius Watershed Analysis area.
- Salvage dead and down trees within the high severity areas and plant in stand replacement burn areas to help facilitate and perpetuate landscape components (line, form, color, and texture) to meet the desired future scenic conditions.
- Salvage dead and down trees within the mixed severity areas and allow natural regeneration to take hold to help facilitate and perpetuate landscape components (line, form, color, and texture) to meet the desired future scenic conditions.
- Thin from below (0-12" dbh) along primary and secondary travel corridors, including within areas that have been lightly impacted by wildfires to help facilitate and perpetuate landscape components (line, form, color, and texture) to meet the desired future scenic conditions.
- Design treatment activities to minimize additional impact to the existing forest and landscape character by keeping tree stumps low to the ground, disposing associated slash in a timely manner, and protecting healthy trees with live crown.

Recreation

- Assess and remove fire related hazards where necessary to protect visitors.

Roads-(See Roads Analysis for more detailed information)

- **Continue to reduce road densities** toward Forest Plan Standards.

- **Seek funding to increase road maintenance to reduce adverse hydrologic effects.**

- **Rd 1490** has been identified in the Deschutes NF Road Rules as "unsuitable for haul". This road needs additional drainage work including additional structures. This road has no remaining surfacing on it and is left with an extremely rough, unmaintainable, subgrade only. It is not an immediate threat to the environment for its current use but if used for commercial haul would need to be reconstructed.

- **Rd 1216185** in Sec. 16 (may be identified as 1216179). Log stringer bridge across the N. Fork of Lake Creek has been closed to vehicle traffic and is probably at the end of its usefulness as a foot bridge. Originally (2001) it was recommended by the district ATM committee that this bridge be removed at such time or replaced with a trail bridge to maintain foot traffic. However since that time an adjacent parcel of property has been acquired by the Deschutes Basin Land Trust. No rights to access the southwest corner of section 16 were retained and the DBLT are most likely going to remove the roads across their lands leaving that piece inaccessible by vehicle. This needs to be addressed whenever the next management activity on this piece occurs. Perhaps either acquire R/W across DBLT lands or construct a bridge across one of two branches of Lake Creek either the North Fork from the north side or the South Fork from the south.

Integrated Opportunities by Landscape Area

Landscape Area 1 – Wilderness

- **Wilderness Fire Plan**: The recommendation to develop a Wilderness Fire Plan was based on the premise that fires in the wilderness would be generally small in size and intensity (Metolius WA 1996, pg.151). While recognizing that fires in Fire Regime IV and V would result in stand replacement intensities. No action has been taken on this recommendation because of the risk of managing fires in adjacent to WUI.
- **Develop a Wilderness Fire Plan:** There may be an opportunity to reevaluate the development of a Wilderness Fire Plan in the aftermath of the B&B fire because of the changed fuel conditions.

- **Huckleberry Management-** Identify Huckleberry patches and share information and discuss management with Warm Springs Culture and Heritage Committee.

- **Protect wilderness lakes from uncontrolled use**. Consider re-designating campsites around high-use lakes such as Square and Wasco. This would require extensive snag falling to ensure safety.

- **Develop partnerships with trail user groups** to increase the amount of trail clearing and maintenance that can be done.

- **Encourage or require weed-free hay to be used by horse packers.**

- **Increase monitoring and enforcement of wilderness trespass**.

Landscape Area 2 – Central Basin

- **Water Quality** - Continue to monitoring water quality in the Metolius River. Identify sources of bacteria, if possible.

- **Continue Public Education regarding fuels treatments:** The Heritage Demonstration Project in the heart of the Metolius Basin along the 1419 road applied a variety of vegetative treatments and burning on 63 acres to demonstrate what different treatments would look like. The Friends of the Metolius worked in conjunction with the USFS to provide public meetings and tours of the project to educate the public about potential impacts, consequences and benefits of applying sound silvilculture management and the reintroduction of fire to the landscape.

- **Assess the Wizard Falls bald eagle area** for potential treatment to lessen the risk of loss and for the perpetuation of large tree habitat.

- **Protect large snags outside campgrounds and recreation sites** along the Metolius River.

- **Evaluate historic resources in Camp Sherman**, especially summer homes, CCC structures, and prehistoric site

- **Maintain character of the Head of Jack Creek** and maintain access for traditional uses

- **Complete interpretive and educational signs should be completed at the Head of Jack Creek Trailhead as decided in the EA and decision for that project**.

- **Continue monitoring use along Canyon Creek.** Determine where displaced campers have moved to as a result of closed dispersed sites.

Landscape Area 3 – Highway 20 Corridor

- **Increase efforts to control highway weeds**
- **Add fire and recovery interpretation to the information panels at the Mt Washington overlook.**
- **Work with ODOT to develop a highway traffic safety plan to manage hazard trees and land slides.**

Landscape Area 4 – Meadow Lake Basin

- Continue to manage off road travel and dispersed recreation to reduce impacts to streams and lakes.

- Coordinate fish stocking with ODFW.
- **Eagles-** Assess the Meadow Lakes area as an additional area in which to manage for bald eagle habitat. Promotion of large tree habitat, large snags, and long-lived species are desired.

- **Buffleheads-** Limit the use of some lakes in Meadow Lakes area to provide an undisturbed setting or limit vehicle use there. Designated campsites may also be an option to reduce disturbance in important areas.

- **Bats-** Survey Meadow Lakes area and compare with findings along First Creek to further define habitat in the watershed.

- **Implement an interpretive plan for the Santiam Wagon Road and Cache Creek Toll Station though these areas for the recreating public**.

- **Complete Meadow lakes OHV Strategy Plan**- A dispersed recreation management planning process was initiated in 2003 in conjunction with the Willamette NF, but not completed due to other priorities. This plan should be completed as soon as possible. OHV use in the area should be managed consistent with the new USFS policy, taking into account traditional use patterns and the LSR and Cache RNA management objectives.

- **Monitor huckleberry regrowth and vigor**. Prior to the fires, this area was a popular and productive huckleberry area. An opportunity exists to restore enhance huckleberry habitat which is an important subsistence and spiritual food to the Confederated Tribes of Warm Springs, as well as a popular recreational activity.

Landscape Area 5 – Black Butte

- **Consider opportunities to reintroduce fire on Black Butte**
  - **Note**: The north and northwest side of Black Butte are in Fire Regimes III (Mixed Conifer) and V (Fir-Hemlock). When the Fire Regime V portion burns it will likely result in a stand replacement event like the fire in 1981. The portion of the Butte that is occupied by Fire Regime III is in Condition Class 3 and has missed multiple fire cycles. What this means is when a fire starts during a period of high fire danger (90% percentile weather) there is a very high probability it will result in a stand replacement fire

- **Protect and or Salvage Historic Structures**- Continue rehabilitation of historic structures and resources present and develop a plan for continued maintenance of these resources. Develop a plan to incorporate historic interpretation into the recreation experience on the butte top. Make salvaged tower parts available to other historic reconstruction projects or museums.

Landscape Area 6 – Cache

- **Complete McCache Project** to reduce fuels and accelerate forest recovery.
- **Implement an interpretive plan** for the Santiam Wagon Road and Cache Creek Toll Station though these areas for the recreating public.
- **This area should be a priority for implementing the new OHV rules**.
- **Promote research opportunities to study fire effects in the Cache Mountain RNA.** Of special interest is postfire lake data collection to compare to prefire data.
- **Protect the Cache RNA from OHV impacts and trespass.**
- **Cache Mountain provides a huckleberry management opportunity.**
- **Monitor and follow up on BAER and fireline rehabilitation.**

Landscape Area 7 – Suttle Lake

- **Monitor build-out of Suttle Lake Resort** and follow through on monitoring and education tasks.
- **Lower Lake Creek** Continue to improve waste water disposal methods along to meet EPA standards and improve watershed health.
- **Water quality-** Monitor Suttle Lake at intervals to track changes in water quality and the algae bloom, and to assess degree of recovery.
- **Bald eagles**- Manage the area around Suttle Lake to develop bald eagle habitat. This will include the restoration of large tree habitat with large limb structure to support nesting structures. Ponderosa pine and Douglas fir are preferred tree species.
- **Assist and monitor re-vegetation of the resort area in partnership with Suttle Lake Resort.**

- **Follow up and continue riparian restoration around the lake and in the campgrounds**.

- **Work with Camp Tamarack to develop a vegetation restoration and management Plan around Dark Lake.**

Landscape Area 8 – Upper Tributaries

- **Culturally Significant Cedar Stand-** Maintain health and vigor of red cedar stand for cultural significance
- **Monitor dispersed camping for increases as a result of changes in use around the Metolius tributaries.**
- **Implement the new OHV management direction.**

Landscape Area 9 – Green Ridge

- **Reopen discussion (and previous recommendation)on the development of a Fire Management Plan for the natural use of fire.**

Landscape Area 10 – Scarp

- **Reconsider development of a Fire Management Plan** for the natural use of fire.

- **Maintain Green Ridge Lookout** to serve as a backup for Back Butte and provide additional detection coverage for the Metolius Basin. An active volunteer program at GREEN RIDGE Lookout provides additional detection during the summer. Green Ridge Lookout is managed as a rental pre and post fire season.

- **Maintain access for tribe** for traditional uses.

Landscape Area 11 – Lower River

- **Reconsider development of a Fire Management Plan for the natural use of fire.** Goals include allowing natural disturbances to influence the character of the landscape and develop a Fire Management Plan that provides guidelines for the use of natural fire. The reintroduction of fire will benefit many species which have evolved with low intensity recurring fire. (Pg 170).

- **Continue to implement Metolius WSR recommendations for managing the primitive area, especially dispersed camping monitoring below Bridge 99.**

- **Improve Monty campground via the Pelton hydro relicensing agreement**. Continue early season closure as a way to manage the traditional party use and reduce resource damage

Opportunities Adjacent/Outside of Landscape Areas

Lower Fly Creek

- Reduce riparian road miles through inactivation[1]

Upper Metolius

- Partner with Warm Springs Reservation to assess sedimentation from roads in face drainages and in the mainstem Metolius River

Middle Metolius River – Street Creek drainage

- Officially inactivate[1], in the next 10 years (2004-2014), level 2 roads that had been undrivable prior to the fire due to vegetation
- Monitor stream crossings and road drainage within and downstream of the fire area; remove or improve undersized culverts and design to allow fish migration
- Monitor long-term in-stream large woody debris (LWD) Reduce riparian road miles through decommissioning[2]
- Reduce road densities through decomissioning[2]
- Assess bank instability and opportunities for restoration
- Monitor native vegetation recovery and effectiveness of BAER planting adjacent to perennial stream reaches in stand replacing burn areas; plant if necessary

Lower Metolius River – Spring Creek drainage

- Officially inactivate[1], in the next 10 years (2004-2014), level 2 roads that had been undrivable prior to the fire due to vegetation
- Monitor stream crossings and road drainage within and downstream of the fire area; remove or improve undersized culverts and design to allow fish migration
- Monitor long-term in-stream large woody debris (LWD)
- Reduce riparian road miles through decommissioning[2]
- Reduce road densities through decomissioning[2]
- Assess bank instability and opportunities for restoration

Data Gaps and Research Opportunities

The following potential studies were identified by the Sisters Ranger District Metolius Watershed Analysis Team during post-wildfire landscape analysis.

These are opportunities to further develop our knowledge of local conditions, augment existing science, and improve our understanding of post-fire ecology to aid in future ecosystem management. Many agencies and groups are available as collaborative partners and can assist with funding for these studies.

Aquatic Ecology, Hydrology and Fish Biology

- **Instream Wood**- Monitor long term recruitment of instream wood in burned subwatersheds
- **Stream Morphology**- Track morphological changes such as streambank stability and riparian recovery in burned subwatersheds
- **Effects to Bull Trout and Redbands-** Determine risk of sediment to bull trout and redband spawning reaches. Identify restoration opportunities
- **Lake Ecology**- Study the effects of the Link Fire on lakes in the Cache Mountain Research Natural Area
- **Water Quality**- Study Suttle Lake water quality and algae blooms
- **Roads and Streams**- Investigate the question of "hydrologic connectivity" of roads, ditches, and streams. May require a range of options from studying existing data to detailed road surveys
- **Sedimentation-** Effects of salvage logging on sediment reaching streams
- **Nutrient effects-** Study the effects of nutrient release from fire and salvage logging
- **Peak flow changes from Salvage Logging**

Silviculture and Forest Ecology

- **Old Growth-** Improve mapping and assessment of old growth forests in the watershed. The numbers of acres of old growth in the watershed are only estimates. Old growth stands should be identified and mapped using all the variables in the Region 6 Interim Definitions of Old Growth
- **Tree Mortality-** Track and study tree mortality in mixed severity wildfire areas.
- **Salvage-** Design retrospective and long term studies on the effects of salvage
- **Salvage-** Determine effects of salvage on tree growth, i.e. Does salvage aid in acceleration of tree growth, particularly ability to grow big trees faster?
- **Down Wood and Snags-** Inventory down wood and snag levels. Study fall rates of snags by species and size and decomposition of down wood by burn severity

- **Plant Associations**- Improve and refine Plant Association mapping and estimates of site potential. This would allow managers and decision makers to more confidently determine current stand conditions/site potential and weigh the tradeoffs of different management scenarios.

- **Historic Information**- Transfer and preserve historical vegetation information into GIS databases from historic maps and studies (i.e. Samuel Johnson Foundation Maps and the 1903 Cascade Forest Reserve Report).

Botany and Noxious Weeds

- **Peck's Penstemon and fire**- Study effects of wildfire, and fall versus spring prescribed burns on Peck's penstemon
- **Noxious Weeds**- Determine strategies to prevent noxious weed invasion of burned areas
- **Competing with Noxious Weeds** Identify native plant species which can compete with noxious weeds and develop propagation techniques

Soils

- **Subsoiling**- Assess the effect of past subsoiling operations on residual tree health and growth, planted or natural regeneration tree rooting and growth, and biotic and ecologic soil processes within the profile
- **Compaction and Displacement**- Assess the effect of detrimental soil conditions and disturbance on site productivity and other ecologically measurable factors, such as tree growth, vegetative biomass, and soil biota
- **Fire, Salvage, and Soil Productivity-** Investigate the long term effects of fire and salvage on soil nutrients and long-term productivity, including coarse wood relationships with mycorrhizae

Fire Ecology

- **Wildfire effects in unmanaged stands**- Study wildfire effects and recovery in the Mt Jefferson Wilderness areas and Cache Mountain Research Natural Area
- **Wildfire effects in managed stands** Complete retrospective studies of wildfire behavior in created fuel breaks, and managed stands
- **Reburn Potential**- Model reburn potential in burned areas by forest type
- **Reburn Implications**- Determine implications/effects of reburn in various forest types
- **Fire Regime Science**- Refine Fire Regime and Condition Class mapping through field studies. The use of fire regimes and fire hazard condition class is relatively new.

- **Fire History**- Compile and interpret information on historic fire sizes and intensities

Wildlife

- **Fire effects on wildlife**- Study how the occurrence of fire affect wildlife species shifts on landscapes and the use of remaining habitats.
- **Fire effects on Late Successional Species**- Investigate how large scale habitat changes affect interior and late-successional species (spotted owl, bats, great gray owl, flammulated owl, etc)
- **Snags and Down Wood (also see Silviculture)** Inventory and study fall down rates, decomposition, and wildlife use of snags and down wood related to burn severity.
- **DecAid-** Determine the appropriate use of this model in regards to salvage and validate assumptions.
- **Fire Salvage Effects**- Assess relative effects of salvage on various wildlife species and determine implications for those species.
- **Shifts in Wildlife use over time-** Determine how wildlife use in burned areas will shift and change over time as stands recover.
- **Eastside Spotted Owls**- Study and refine eastside Spotted owl habitat definitions
- **Barred Owls**- Develop a strategy for documenting occupation of the watershed by barred owls and a management plan to reduce impacts to native species.
- **Carnivores-** Assess effects of wildfire, especially within forested wilderness areas, on connectivity related to large ranging carnivores (i.e. wolverine)
- **Amphiphians**- Study fire effects to montane amphibian species, especially spotted frogs
- **Turkeys-** Investigate Turkey competition with native gallinaceous birds and land birds
    - Does salvaging aid in the acceleration of habitat primarily growing big trees faster?
    - Does salvaging impact certain species over others and is it important?
    - Reburn potential - what are the implications?
    - How do we address use by wildlife over time since shifts in use will occur?
    - How do we address population viability?
    - Use of burned snags/down wood? Not much documented here?
    - What is the most appropriate use of DecAid with regards to salvage?

- **Waterfowl and Neotropical Migratory Birds** -Survey for Waterfowl and Neotropical migratory birds in the watershed, study effects of fire on these species, and determine important habitats for protection and restoration
- **Mule Deer**- Refine and update Mule Deer Habitat Models and Metolius Winter Range Boundaries.
- **Population Viability**- Determine how best to address population viability of various species of concern.

Heritage

- **Survey Needs** -Approximately 2/3 of the watershed has never been inventoried for heritage resources. As a result, there is a high probability of significant sites being present that are unknown.

- **Evaluation and Analysis Needs**- Of the sites recorded and known in the watershed, only 1/3 have been evaluated for significance. The remainder may or may not contain important information about our knowledge of the historic and prehistoric past of the watershed. Only a few of the approximately 200 sites recorded have any in depth analysis that can allow us to determine prehistoric time periods of occupation, specific associations with activities conducted at the site or other locations. As a result, very little is known about the overall patterns of prehistoric land use in the Metolius or how that use may have changed over time.

- **Basic Research questions**: **When were people in what parts of the basin?** (Address through: Excavations in multicomponent prehistoric sites to look for stratigraphic context integrity and conduct dating analysis by examining point typologies, conducting obsidian sourcing and hydration analysis and radiocarbon dating of cultural organic remains such as charcoal, bone, or shell) .

- **Prehistoric/Historic Harvest of Anadramous fish**--Paleoenvironmental reconstruction through lake bed core studies and developing a research design to examine whether harvesting of andramous fish was utilized extensively at any period of the prehistoric past.

- **Historic Research-** Archival research in the early phases with some archaeological work to see if we can confirm historic accounts on Santiam Wagon road use, specific time periods and activities for specific stops along the route in the Metolius Basin. Cache Creek Toll station -what facilities did they have there? What range of activities occurred at Graham Corral? Were there other popular stops along the route? How much utilization was by cattle and sheep verses private travel to visit relatives in Prineville vs commercial travel to move goods and services?

Social/Recreation

- **Recreation-** Assess types and extent of recreational uses in the watershed and identify trends

- **Mushroom Harvest-** Assess post-fire mushroom harvest clientele, and how to better manage the mushroom program

- **Social-** Perception of post-fire environment along scenic corridors and middle and background landscape

Soils

The categorization of detrimental soil classes assumes a degree of effect to soil productivity as a result of changes in physical and biotic conditions. The extent and duration of these effects remains unclear across the soil types present in the Metolius watershed.

Monitoring

Silviculture and Forest Ecology Monitoring

Monitoring of the post-wildfire landscape would be beneficial to learn how the landscape responds to both passive and active management.

Soils Monitoring

The categorization of detrimental soil classes assumes a degree of effect to soil productivity as a result of changes in physical and biotic conditions. The extent and duration of these effects remains unclear across the soil types present in the Metolius watershed.

- 1). Assess the effect of past subsoiling operations on residual tree health and growth, planted or natural regeneration tree rooting and growth, and biotic and ecologic soil processes within the profile.
- 2). Gather tree growth and biomass production data within comparable sites containing Condition Class B, C and D soils to assess the effect of detrimental soil conditions on site productivity and other ecologically measurable factors.

Aquatic Monitoring

- **Continue water quality monitoring.**
- **Monitor long-term in-stream large woody debris** (LWD) in all subwatersheds affected by the recent fires
- **Monitor morphological changes in streams** mostly affected by the fire

Wildlife Monitoring

- Surveys should occur for focal wildlife species to determine population trends, essential habitat, and impacts of recent events.
- Snag densities are needed to validate the DecAID analysis.
- Monitor open road densities to ensure meeting forest plan standards.
- Map and develop a strategy for treatment of hardwood stands (i.e. aspen).

Botany Monitoring

- Revisit all rare plant sites and revise population condition descriptions after the fire. Identify any management needs such as weed control or access management.

Archaeology Monitoring

- Monitor at least 50% of unevaluated and significant heritage resources annually that are located where ongoing management occurs such as in campgrounds, on roads with management of 2 or above, in summer home tracts, and at resorts or group camps.
- Monitor 20% of other significant and unevaluated sites in the watershed annually on a rotational basis so that each site is visited at least every five years.
- **Tribal Resources Coordination-** Monitor health of huckleberry patches, western red cedars, and water quality. Share monitoring information with appropriate tribal officials.

SOILS

Soil Resource Characteristics

Changes to the soil resource within the Metolius watershed since 1994 have primarily occurred as the result of silvicultural management activities and wildfire.

1) Operational efficiency and the effective implementation of logging systems have generally reduced detrimental impacts to the soil resource through the use of designated skid trails, boom-mounted harvest machinery, and winter logging. Silvicultural prescriptions during this period have generally removed moderate to low volumes under thinning operations and subsoiling has been used to rectify detrimental compaction incurred on skid trails and landings.

2) The four major wildfires that have occurred within the watershed have minimally affected the productivity of the soil resource. Although fire behavior in some areas was extreme and tree mortality was classified as stand replacement in many areas, the direct effects to the soil resource in terms of altered mineral composition or nutrient volatilization were not observed to be of great extent. Negative changes to the productivity of the soil resource are isolated to areas where stumps or down woody debris were completely combusted and contributed extended durations of elevated temperatures to the soil surface. These areas are not contiguous enough across the landscape to map and are estimated to be less than 4% of the total fire areas.

3) Erosion risks associated with the loss of live vegetative and organic surface cover are elevated in areas of stand replacement mortality. Although some subwatersheds experienced these conditions on up to 52% of their area (Abbott Creek 52%, Middle Metolius 39%, and Canyon Creek 36% were the highest), the high infiltration rates of the soils present and the relatively gentle slopes throughout much of these areas contribute to a lowered overall risk of erosion losses and associated sediment delivery to stream channels.

4) Headwater areas of First Creek, Jack Creek, Canyon Creek and Brush Creek are the most susceptible to erosion losses within the B&B Complex fire. The return of vegetation within stand replacement areas of fires that burned during the 2003 season is expected to

occur at rates comparable to those observed in the Eyerly and Cache Mountain fires of 2002. This growth should contribute to reducing erosion loss rates and sediment delivery to stream channels with a steady increase in cover capable of reducing raindrop impacts and providing surface roughness to lower the energy of overland flows.

5) Debris flows are a naturally occurring mechanism within the watershed. Post-fire risks of debris flows associated with the loss of root strength in areas of stand replacement fire on slopes exceeding 25% are elevated between 3 and 20 years following the fire event. The planting of conifers on these slopes is highly recommended in order to expedite the return of root systems within the soil profiles.

Landslide/Debris flows associated with 1964 and 1996 Storm Events

Geologic Processes of the 1964 and 1996 Storm Events

The occurrence of debris flows within the Metolius Basin was not known during the previous watershed analysis. Since that analysis, ten debris flows have swept down slopes in the Metolius Basin during an intense storm that developed over much of Oregon and Washington in early February of 1996. Five older debris flows have been recognized in the Highway 20 corridor area and appear to be associated with a similarly intense storm event during the early winter of 1964.

The 1996 storm event dropped record rainfall on a snowpack ranging from three to four feet in depth. This event resulted in significant overland flow contributions to stream drainages, localized flooding, and debris flows that emanated along valley hillsides above a number of drainages. The rain and melted snow caused floods in all tributaries of the Metolius River and produced a record-breaking peak discharge of the Metolius River into Lake Billy Chinook measuring 8,430 cubic feet per second.

Of the ten debris flows documented during the 1996 event, two cascaded down steep draws on Green Ridge above the Metolius River (river miles 21 and 29), a group of seven developed on the south canyon wall of Canyon Creek and another flowed down the steep south canyon wall above Cabot Creek. All of these flows except the Metolius River mile 21 and Cabot Creek flows occurred in managed areas where vegetation had been manipulated to varying degrees. The Metolius River mile 21 flow emanated from an unroaded area on the Horn of the Metolius and the Cabot Creek flow occurred within the Mt. Jefferson Wilderness, although directly below a hiking trail. Details of all flows resulting from the 1996 event were documented in a white paper report written by the Forest Geologist (Chitwood, 1996).

Management Influences vs. Natural Occurrence

Metolius River/Green Ridge Debris Flows

Although debris flows had not been identified prior to the 1996 event, field and photo reconnaissance revealed that alluvial fans were present at numerous locations along the Metolius River, including the areas directly below the mile 21 and 29 failures. These fans are now known to have developed from dozens of debris flows that have swept into the Metolius River from the Green Ridge fault scarp at multi-century intervals. The presence of alluvial fans formed by earlier debris flows indicates that the 1996 flows were representative of events that have previously occurred within the Metolius Basin.

The influence of land management activities on these two flows is likely minimal. The mile 29 flow failed on a geologic substrate (mostly tuffs and tuffaceous siltsones) that is less pervious to water than the loose soils above it. The soil at the initial point of failure is a cohesionless, silty sand with high potential for erosion and liquefaction. When saturated, these soils are poised to fail along this geologic boundary on the relatively steep slopes present in this area. Although a system of primitive logging roads used to remove a moderate amount of timber during the late 1960s was present in the area containing the release point of this flow, a considerable amount of trees and other vegetation had regenerated in and around the failure point. A cursory reconnaissance of this site determined a low likelihood that past management practices played a significant role in the location and occurrence of this flow (Chitwood, 1996).

The mile 21 flow has not been field visited but appears to have released from a similar elevation and geologic environment as the mile 29 flow. No roads have ever been constructed and no timber has ever been harvested on the slopes of the drainage containing the point of failure of this flow
.

Canyon and Cabot Creek Debris Flows

Seven debris flows developed side-by-side on the south wall of a glacial valley containing the east-flowing Canyon Creek. Another flow occurred on a similar aspect within the Cabot Creek drainage approximately five miles to the north. The Canyon Creek valley was deepened in the area of the recent debris flows by glacial erosion, while the rim of the valley was raised by deposition of tall lateral moraines along the valley sides.

The most recent glacial retreat in this area left a mantle of unconsolidated and cohesionless till on the sides and floor of the Canyon Creek valley. Underlying this till is an older, consolidated and nearly impervious till that is more resistant to the downward movement of percolating ground water. Above these glacial deposits is a two-foot layer of sandy, basaltic ash deposited from volcanic vents to the east. All of the debris flows in this valley originated in the unconsolidated and cohesionless glacial till or the overlying basaltic ash within a short distance below the crest of the canyon wall.

The Canyon Creek debris flows were likely enhanced to varying degrees by the loss of vegetative rooting systems provided by trees and brush. The debris flows occurred in three different vegetative environments resulting from management activities during 1989 and 1990, including a wildfire burn and partial salvage, a clear-cut, and a partial cut with dead and dying trees invaded by bugs. The location and size of these debris flows appear to be related to the density of fine roots present at the time of slope failure. None of the debris flows reached Canyon Creek, either losing their energy on the wide valley bottom floor or at the toe of the slope on which they traveled. Some of the flows began to flow over the surface of frozen snow and soil as they reached the lower extent of the slopes on which they failed.

Preliminary reconnaissance following the events show that the fine-root density was least in the largest (easternmost) of the seven flows where the wildfire had killed standing trees and limited underbrush had re-established itself. This flow is also the largest of the 1996 debris flows in the Metolius Basin. The smallest debris flows occurred in a clear cut area where snowbrush had subsequently grown profusely and developed a large mass of new fine roots capable of affecting the size of the releases. A few other flows, including the second largest of those in the Canyon Creek valley, occurred within a partial cut fir stand that had approximately 90% mortality of the remaining trees and very little ground cover.

Although all of the Canyon Creek flows occurred on managed lands on which either green harvest and/or wildfire salvage had been implemented, one of the Canyon Creek flows followed a well-developed drainage that is likely the result of prehistoric debris flows and the Cabot Creek debris flow occurred on slopes within a wilderness area. Although little visual evidence of historic debris flows was found on the ground or on aerial photographs for these areas, the likelihood of previous debris flows on these slopes is relatively high. Regular fire interval records in this area support a historic fire disturbance of the vegetation that would have resulted in the loss of root holding capacities from direct mortality from wildfire or bug infestations.

Highway 20 Hill slopes

Field reconnaissance following the B&B Complex wildfire of 2003 revealed a number of slope failures on south facing slopes along Highway 20 above the Mt. Washington overlook (B&B Complex BAER report). Approximately five failures were identified that are likely associated with the 1964 storm event recorded as a similar recurrence interval as the 1996 event. Trees growing within these failures were measured between 30 and 40 years of age. Anecdotal information indicates that some of these flows blocked the highway during this event and the lobe of material on which the Mt. Washington overlook is constructed is likely derived of material from an event of this type.

The vegetation along this stretch does not appear to have been significantly managed prior to this event. No skid trails or harvest activities were evident from this reconnaissance. The slopes above the failures appear to be associated with a droughty soil type of slightly lower productivity that limits stand density and tree size to some degree along the upper third of the slope. The area also appears to have been burned in a stand replacement manor sometime prior to 1933, based on landscape photographs taken from the Cache Mountain Lookout.

Post-fire Debris Flow Risks

Forest root systems contribute in several ways to reinforcing slope stability, including bonding unstable soil mantles to stable subsoils or substrata through deep root penetration or by providing a reinforced network of roots in the upper soil horizons capable of holding the underlying soil in place. The loss of vegetative cover and live conifer root holding capacities following clear felling operations has been shown to accelerate incidences of landsliding on steep forest slopes throughout the world between 3 and 10 years following removal, primarily due to the change in root strength resulting from the deterioration of dead roots (O'Loughlin, 1982).

Slopes exceeding 25% in areas of stand replacement fire within the Metolius watershed are likely to have an elevated risk of debris flow failures within three years of the fire event. Although the fire has not altered the geologic reality of failures along subsurface geologic interfaces such as consolidated glacial till or tuffaceous bedrock, it has killed the primary vegetative components that provide root-holding strength within the soil profiles above these failure interfaces. Slopes burned by a stand replacing fire have lost nearly all of the surface duff and brush cover and had more than 75% of the conifers killed.

The roots of the standing dead trees in stand replacement areas will continue to provide shear strength within the soil profile after the fire, with documented reductions in this strength of 50% within three years (O'Loughlin, 1982). Root strength is not likely to return to pre-fire levels for up to twenty years following the fire event, although the growth of brush and naturally regenerated conifers will begin to offset the loss of soil strength during this period. Heavy summer thunderstorm precipitation events may be able to saturate the soil profile sooner due to the presence of higher soil moistures from the reduction in evapotranspiration rates on these sites. Winter rain on snow events will likely carry the similar saturation rates as before the fire but could result in an increased number and size of failures due to the loss of shear strength in the soil profiles.

Slope stability in these areas is not likely to return to pre-fire levels within the next 20 years, although the importance of shrub and early seral conifer root systems in reducing these risks during this period are not insignificant. Areas of infrastructure or natural resource values below such slopes should be identified and monitored for the risk of loss or damage from a debris flow event.

Updated Soils existing condition

Management Activities since 1994

Harvest activity layers were compiled and queried for the update analysis in order to quantify management activities since 1994 within the Metolius watershed. Soil Table 1 summarizes these harvest activities by prescription for the 6th field subwatersheds in the

Metolius system. Recent harvest activities have incurred comparatively lower detrimental disturbance levels than prescriptions implemented prior to the 1994 analysis, primarily due to improved logging system design, lower volume prescriptions and specific soil resource mitigations intended to reduce compaction levels from ground-based harvest operations. These include the use of boom mounted harvest machinery and winter season harvest and yarding operations over snow and/or frozen ground.

Soil Table 1. Harvest Prescriptions since 1994 within 6th field subwatersheds of the Metolius.

	6th Field subwatershed								
Harvest Rx	**Abbot**	**Cache**	**Canyon**	**Dry**	**First**	**Jack**	**L.Fly**	**L.Lake**	**U. Lake**
HTH	36	6	444		298	420		735	41
HSL				45			33	4	
HSG				57					
HSV									
HSH		142	327			379		546	570
HTHP		97							94
HSVP								47	
acres treated	36	239	771	102	298	799	33	1,372	705
Total acres	6,391	11,867	21,068	12,497	13,177	9,207	16,227	10,965	11,136
% of sub_shed	<1%	2%	3.6%	<1%	2%	8.6%	<1%	12.5%	6.3%

Figures from Soil Table1 indicate that Jack Creek, Lower Lake and Upper Lake subwatersheds have received the greatest amount of harvest activity since 1994, primarily as thinning and salvage prescriptions that removed low to moderate volumes from within activity units. Santiam Corridor restoration units within the Upper Lake subwatershed included helicopter and ground-based operations, with some harvest and yarding over snow. Detrimental impacts from a few of these activities were monitored following activities and generally complied with Regional Standards and Guidelines for detrimental soil disturbance (Deschutes Soil Monitoring, 1996-2001). The highest subwatershed acreages entered for harvest activities since 1994 include 12.5% of Lower Lake Creek, 8.6% of Jack Creek and 6.3% of Upper Lake Creek subwatersheds, respectively.

Changes to soil quality and condition class

Soil Disturbance Condition classes were developed in the 1994 analysis to describe existing detrimental soil disturbance across the watershed area. Soil condition classes A (less than 10% detrimental soil disturbance), B (11-20%), C (21-40%), and D (>40%) were estimated across the watershed utilizing queries of harvest activity prescriptions to infer levels of impact from ground-based harvest systems and any other ground disturbing management activities. (Bennett, 1994). Aerial photo interpretation was also used to help classify some areas based on the presence and density of skid trails and landings visible on the ground. The level of accuracy of this method for quantifying the extent of detrimental soil disturbance is considered reasonable at the watershed scale and has been correlated in some cases to field monitoring of detrimental soil conditions (Deschutes Soil Monitoring, 1996-2000).

The Soil Condition Classes primarily describe the extent soil disturbance in the form of compaction on skid trails and landings. In general, areas of multiple entries and/or high volume removals correlate directly to higher levels of detrimental soil disturbance within an activity area. Some areas with high volume removal during bare ground operating seasons that had narrow spacing of skid trails or unrestrained machine harvester traffic are also likely to have additional disturbance between skid trails on areas of multiple machine passes. Harvest activities between 1960 and 1990 often exceeded 30% detrimental soil disturbance as a result of high volume clearcut or shelterwood prescriptions. Activities since 1990 have generally incurred detrimental impacts near or below 20% due to lower volume removal, winter season harvesting and yarding, designated skid trails and off trail traffic of machine harvesters limited to two or fewer passes.

Approximately 50% of the 4,996 harvest activity acres since 1994 have occurred within areas mapped previously as condition class A and 50% are within areas mapped as soil condition class B. A subset of harvest units from the various sales during this period have been monitored following their implementation and show compliance to regional 20% standards and guidelines for soil disturbance either prior to or after subsoiling mitigations (Deschutes Soil Monitoring, 1996-1999). Under this analysis, all units implemented during this period are assumed to have met these standards and are now considered to be in the B soil condition class.

Summaries of current soil condition class acres indicate that the Lower Lake, Abbot, Cache, Jack, and Headwaters of the Metolius subwatersheds have the highest levels of detrimental soil disturbance as a result of past management activities. A summary of the current soil condition class acres by subwatershed, acres changed from class A to class B, total detrimental acres, and percent of subwatershed considered detrimental is included in Soil Table 2.

Estimated overall detrimental soil disturbance within the 5th field Metolius watershed is approximately 7% of the land base. Increases in disturbance since 1994 have been less than 1% within any 6th field subwatershed. Additional land base committed to the road system within the watershed also contributes to the total amount of detrimental surface area that does not support vegetation or infiltrate water. Road densities included in the hydrology report tables can be used to infer relative amounts of road surface within any subwatershed and additional acres considered to be detrimental. Road densities within Cache Creek and Lower Lake Creek subwatersheds are the highest reported, while First Creek, Jack Creek and Abbott Creek are also relatively high.

Soil Table 2. Soil Condition Class and detrimental acres by subwatershed

Sub_watershed	A	B	C+D	A to B	Acres detrimental[1]	% of watershed	
ABBOT CREEK	1836	1350	3067	11	1282	20	
CACHE CREEK	4902	2269	4627	235	2087	18	
CANDLE CREEK	10587	4	336	0	631	6	
CANYON CREEK	13304	1134	5739	323	2614	12	
DRY CREEK	8070	1028	2785	0	1445	12	
FIRST CREEK	8093	1387	3608	2	1764	13	
HEADWATERS METOLIUS RIVER	5959	3197	6208	0	2800	18	
JACK CREEK	3926	2028	3098	230	1531	17	
JEFFERSON CREEK	8136	0	11	0	410	2	
LOWER FLY CREEK	10	4	10	0	4	0	
LOWER INDIAN FORD	12	28	13	0	10		
LOWER LAKE CREEK	2972	2386	5506	592	2278	21	
MIDDLE METOLIUS RIVER	6789	528	1790	0	982	5	
UPPER FLY CREEK	5	6	12	0	5	0	
UPPER INDIAN FORD	34	592	1060	0	438		
UPPER LAKE CREEK	7724	1707	1552	603	1193	11	
UPPER METOLIUS RIVER	6584	442	188	0	474	2	
Metolius 5th Field	88943	18090	39610	1996	19948	7	286308

Suppression Activities from wildfires

Suppression activities during the B&B, Link, Eyerly and Cache Mountain fires incurred soil disturbance on firelines and safety zones created by machine dozers. Impacts include the displacement of mineral A horizon soil and surface cover provided by litter and duff, and variable compaction from multiple passes of large equipment. Total length of dozer line created by these activities is unknown. However, the overall percentage of any individual subwatershed affected by this disturbance is likely to be less than 1%.

Rehabilitation of suppression impacts on dozer lines included re-spreading of bermed soil from the edges, the placement of large woody debris on the surface and drain dips and waterbars to limit overland flow distances and energies during runoff producing rain events. Although still altered from their pre-fire condition, the majority of dozer trails after rehabilitation are in a condition capable of limiting overland flow concentrations and energies, supporting vegetation, and allowing soil processes to function to some level of productivity.

[1] Detrimental acres are tabulated as 5%, 20% and 30% of Condition Class A, B and C+D acres, respectively.

Burn Severities resulting from wildfires

Burn severity resulting from wildfire can be described for soil productivity and hydrologic function within the physical soil domain.

1) Severity as it relates to soil productivity is associated with the effects of heat generated during the fire event. This is specifically related to the physical alteration of mineral soil or the volatilization of soil nutrients and organic matter that may alter short or long-term productivity of the soil resource.

2) Severity as it relates to hydrologic function and an associated increased risk of erosion correlates directly to the loss of cover provided by live vegetation, 1,000 hr fuels and surface litter and duff. It can also be affected by the development of hydrophobic characteristics within the soil profile resulting from the distillation and deposition of organics combusted or heated during the fire.

Burn severity and soil productivity

Severity for soil productivity relates to the condition of the physical and chemical components of the mineral soil resource from heat generated and pulsed by the fire event. Mineral soil discoloration is the primary indicator of whether extended durations of elevated temperatures occurred during the fire. These conditions are capable of volatilizing soil nutrients to the extent that nutrient availability and plant growth could be reduced in the short and long term on site.

Field observations during BAER assessments of the four major fires since 1994 within the watershed revealed that a very low percentage of the burned areas met criteria for high burn severity described in BAER manuals (BAER website, 2003). Observations of the burned areas found that mineral soil discoloration was only present underneath downed logs and in stump holes where the woody material was entirely consumed. These areas were found to be less than 5% of the surface area of the original high severity mapped by BAER resource specialists on the 2002 Eyerly fire and not contiguous enough across the landscape to be spatially mapped. Conditions on the Link fire were found to be the least severe of the four major fires in the Metolius watershed while the B&B Complex and Cache Mt. fires generally had total amounts of high severity conditions between the other fires.

Since areas of discoloration were primarily found within Stand Replacement mortality mapped for this project, high severity for soil productivity was conservatively calculated as 5% of the Stand Replacement acres mapped for all four fires. Soil Table 3 summarizes burn severity by subwatershed as it relates to soil productivity according to this assumption. Since the total amount of high burn severity is less than 3% of any subwatershed, alteration of soil productivity from the volatilization of nutrients is not of extensive concern as a result of these fires. Some localized areas may have limited or reduced growth in the short term until pioneer species are able to colonize and contribute organic matter to the mineral A horizon. In many cases, soil productivity may have been enhanced in the short term from the flush of available nitrogen that wildfires often create in the first two growing seasons after the event. This flush is apparent on the Eyerly fire from observations of the extent and growth rates of native annuals and seeded rye and winter wheat during the 2003 growing season.

Soil Table 3. Soil Productivity Burn Severity by Subwatershed

		Soil Productivity Burn Severity		
2003 SWS	**Percent Burned**	**High[2]**	**Moderate**	**Low**
		Acres	Acres	Acres
Abbot Creek	100	167 (3%)	4686 (73%)	1524 (24%)
Cache Creek	47	69 (<1%)	4392 (37%)	1057 (9%)
Dry Creek	2	5 (<1%)	237 (2%)	45 (<1%)
Candle Creek	65	122 (1%)	4202 (38%)	2831 (26%)
Jefferson Creek	50	99 (<1%)	3910 (22%)	5094 (28%)
Canyon Creek	92	375 (2%)	11717 (56%)	7191 (34%)
First Creek	70	136 (1%)	5626 (43%)	3415 (26%)
Jack Creek	88	67 (<1%)	2959 (32%)	5033 (55%)
Headwaters Metolius River	6	10 (<1%)	298 (2%)	592 (4%)
Upper Lake Creek	60	128 (1%)	5167 (46%)	1338 (12%)
Lower Lake Creek	64	100 (1%)	4175 (38%)	2719 (25%)
Upper Fly Creek	0			
Lower Fly Creek	14	87 (<1%)	2127 (13%)	5
Upper Metolius River	7	16 (<1%)	513 (2%)	1712 (5%)
Middle Metolius River	60	415 (2%)	10544 (50%)	1682 (8%)
Lower Metolius River	26	208 (1%)	4492 (18%)	83 (<1%)
Juniper Creek	0	0	0	0
Whitewater River	0	0	0	0

[2] High burn severity is calculated as 5% of the acres mapped as Stand Replacement on the Mortality Layer developed for this project.

Natural erosion risks and runoff rates

Assessing the extent to which fires within the Metolius watershed have altered the hydrologic function and erosion risks of the soil resource requires a comparison to natural runoff rates inherent to the soils present. Natural hydrologic function and runoff rates of exposed mineral soil can be assessed from the hydrologic group attribute for each soil type present (Larsen, Soil Resource Inventory, 1976). The hydrologic group rating is an indicator of the runoff potential of exposed mineral soil conditions during storm events.

In general, the majority of the soils mapped within the watershed have low runoff potentials in the A and B categories. Soil types mapped as hydrologic group B-C have the highest runoff potential within the watershed. Acres of this group are not extensive within the watershed, especially within the boundaries of the B&B Complex fire. Soils in this group are primarily present in valley bottom locations within Riparian Reserves on floodplains of perennial stream reaches. The Brush Creek, Bear Valley Creek and Middle Canyon Creek drainage areas of the Canyon Creek subwatershed have the highest concentrations of these hydrologic soil groups.

Burn severity and erosion risks

Changes to runoff rates and erosion risks resulting from the fire are primarily related to the consumption of surface cover capable of reducing raindrop impacts and overland flow energies. Negligible changes to the physical properties of the mineral soil as a result of the fire were identified by BAER field reconnaissance. Burn severity relating to hydrologic function and associated erosion risks thus corresponds directly to the vegetative and surface cover conditions reflected in the Stand Replacement, Mixed Mortality and Underburned or Unburned categories mapped as the Mortality Class layer during this update.

Acres mapped on the mortality layer were converted directly to high, moderate and low severity to reflect the loss of surface cover for this analysis. Soil Table 4 summarizes burn severity as it relates to hydrologic function and erosion risks for the subwatersheds in which the fires occurred.

Soil Table 4. Hydrologic and erosion risk burn severity by subwatershed

		Hydrologic Burn Severity[3] (%of sub_shed)		
2003 SWS	**Percent Burned**	**High**	**Moderate**	**Low**
		Acres	Acres	Acres
Abbot Creek	100	3336 (52%)	1517 (24%)	1524 (24%)
Cache Creek	47	1385 (12%)	3076 (26%)	1057 (9%)
Dry Creek	2	93 (1%)	144 (1%)	45
Candle Creek	65	2438 (22%)	1886 (17%)	2831 (26%)
Jefferson Creek	50	1973 (11%)	2036 (11%)	5094 (28%)
Canyon Creek	92	7502 (36%)	4590 (22%)	7191 (34%)
First Creek	70	2715 (21%)	3047 (23%)	3415 (26%)
Jack Creek	88	1335 (15%)	1691 (18%)	5033 (55%)
Headwaters Metolius River	6	199 (1%)	109 (1%)	592 (4%)
Upper Lake Creek	60	2555 (23%)	2740 (25%)	1338 (12%)
Lower Lake Creek	64	2006 (18%)	2269 (21%)	2719 (25%)
Upper Fly Creek	0			
Lower Fly Creek	14	1740 (11%)	474 (3%)	5 (<1%)
Upper Metolius River	7	323 (1%)	206 (1%)	1712 (5%)
Middle Metolius River	60	8306 (39%)	2653 (13%)	1682 (8%)
Lower Metolius River	26	4150 (17%)	550 (2%)	83 (<1%)
Juniper Creek	0	0	0	0
Whitewater River	0	0	0	0

Abbot Creek (52%), Middle Metolius (39%), and Canyon Creek (36%) subwatersheds had the highest percentage of their total area burned as Stand Replacement acres. These

[3] The categories of high, moderate and low describe gradients in the amount of mineral soil exposed after the combustion of above ground organics. High severity describes >80% exposed mineral soil and near complete consumption of crown needles that precludes a measurable needlefall to the soil surface after the fire. Approximately 20% of the Stand Replacement acres are considered to have needles available for litter fall. Mixed mortality acres generally have >80% exposed mineral soil but have a live and dead needle source remaining on trees capable of providing immediate inputs to surface cover. Underburned and Unburned acres have litter and duff remaining on the surface and a live needle source to continue to provide input to the soil surface.

acres are considered to have a high severity rating reflecting an elevated risk of runoff due to the loss of surface cover and roughness. Rill and gully erosion associated with overland flows is more likely to occur on these areas, especially on soils with a higher inherent risk of runoff mapped as hydrologic soil group B-C.

Soils within areas of Stand Replacement mortality are primarily located on uplands and are in hydrologic group B or A-B. Although there is a slightly elevated risk for increased runoff as a result of the consumption of surface litter and duff in these areas, the associated risk of erosion from overland flow energies is minimized due to predominantly low slope gradients and surface roughness provided by partially consumed 1,000 hr fuels. Many of the bottomland locations with soils in the B-C hydrologic group had variable vegetative mortality and are likely to experience extensive re-sprouting of riparian species during the 2004 growing season.

The Abbot Creek and First Creek subwatersheds also have a component of B-C hydrologic soil group map units in the valley bottoms. Changes in runoff rates or erosion risks is also moderated in these subwatersheds due to shallower slopes in Abbot Creek or the presence of coarser Blue Lake cinders on the surface of upland soils located on the valley walls of First Creek.

Trends associated with soil productivity

Status of 1994 Metolius Watershed Soil Recommendations

All Landscape Areas, Soil Resources page 145.

1). Develop a long term logging system in areas of ground-based harvest to minimize the use of subsoiling as a mitigation measure. This recommendation is addressed on a sale by sale basis and factors in harvest prescriptions to locate and dedicate skid trail and landing infrastructure in the design of activity units.

2). Subsoiling as a restoration measure has been accomplished within the Metolius Basin, specifically within the North Shackle Sale area. Approximately 5 miles of roads and skid trails in a 450 acre area were subsoiled to return hydrologic function to these areas and allow soil processes to progress in an uncompacted soil profile.

3). Areas of stream/road intersections where runoff has been concentrated and a high risk of sediment delivery to streams is present have been identified and corrected in a number of subwatershed areas of the Metolius Basin. Methods included the modification or improvement of road drainage systems, replacement and upsizing of culverts, removal of culverts, and road decommissions or closures.

Three primary areas of implementation have occurred since 1994.

a). ERFO projects after the 1996 flood event; seven primary road culverts had vented fords constructed or armored to conduct flows in excess of culvert capacity across the road beds and back into the stream channel.

b). District road closures under Non-ERFO road closure and maintenance EA's after the 1996 flood and individual KV projects associated with Sale EA's; approximately 30 miles of road surfaces were decommissioned (8.5 mi. in LA-2 and 22.1 mi. in LA-8), 9.5 miles of road were inactivated with improvements of drainage systems (4.6 mi. in LA-2 and 4.9 mi. in LA-8) and 46 miles of open road had drainage systems restored or reconstructed (19.2 mi. in LA-2, 4.5 mi. in LA-7 and 22.2 mi. in LA-8). One major culvert was replaced across Candle Creek with a bridge.

c). BAER culvert replacements after the B&B Complex fire; seven major culverts are being upsized and redesigned, or replaced with a bridge in 2004. Eight culverts on smaller arterial roads have been pulled. Six culverts have been upsized and two crossings have had dips or cross drains constructed to address drainage issues.

Soil recommendations from Watershed Analysis Update 2004

Recommendations in the 1994 Watershed Analysis for the soil resource revolved around the use of subsoiling to restore hydrologic function and bulk densities of detrimentally compacted areas within the watershed. De-compacting soil profile conditions allows for nutrient cycling processes associated with biotic and chemical components of the soil resource to function under conditions in which root growth and water infiltration are not inhibited by high bulk densities.

1) Continue use of a winged subsoiling implement to restore detrimentally compacted soils within Soil Condition Class C and D areas. Priority should be given to subwatersheds in which high overall levels of detrimental compaction have been identified or where hydrologic function or site productivity is of concern.
2) Subsoil decommissioned road beds in all subwatersheds where subsurface conditions allow for unimpeded travel of the subsoiling implement.
3) Plant trees on slopes greater than 30% in stand replacing burn areas to expedite the return of conifer root networks capable of stabilizing slopes during periods of super-saturation.

Data Gaps/Monitoring needs

The categorization of detrimental soil classes assumes a degree of effect to soil productivity as a result of changes in physical and biotic conditions. The extent and duration of these effects remains unclear across the soil types present in the Metolius watershed.

1). Assess the effect of past subsoiling operations on residual tree health and growth, planted or natural regeneration tree rooting and growth, and biotic and ecologic soil processes within the profile.

2). Gather tree growth and biomass production data within comparable sites containing Condition Class B, C and D soils to assess the effect of detrimental soil conditions on site productivity and other ecologically measurable factors.

AQUATIC / FISHERIES

Hydrologic Characteristics

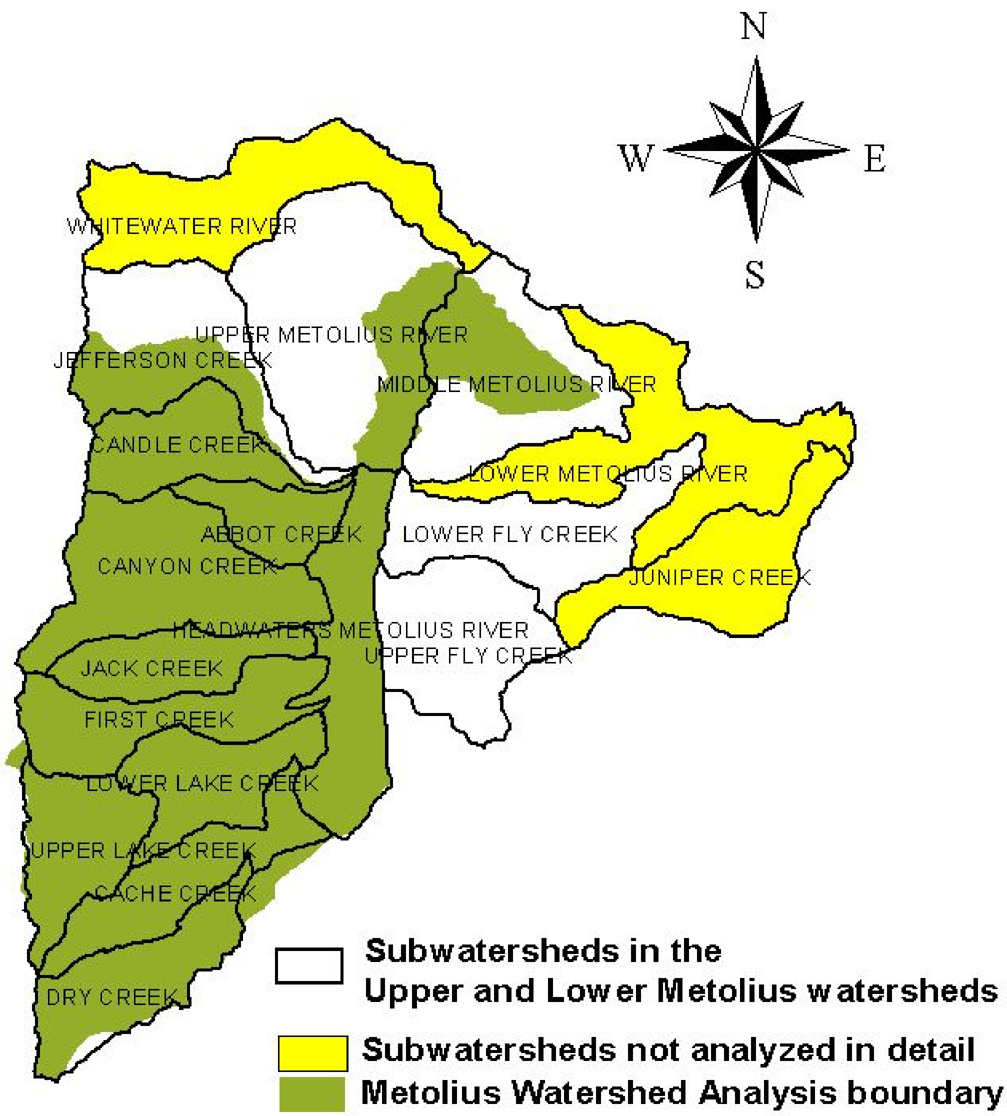
Watershed and subwatershed (SWS) boundaries have changed since the 1994 Metolius Watershed Analysis[1] (WA) due to a regional effort to standardize the delineation procedure (Aq. Table 1). The updated Metolius Watershed Analysis area covers the subwatersheds originally analyzed in the former Metolius Watershed, all of which are "key watersheds" under the Northwest Forest Plan, except the former Cache subwatershed. The original analysis area covers approximately 50 % of the 2003 Upper Metolius watershed (HUC 1707030109; total acres: 140,812) and the Lower Metolius watershed (HUC#1707030110; total acres: 145,498). Lower Metolius, Whitewater River, and Juniper Creek subwatersheds are within the 2003 Upper and Lower Metolius watersheds but are not "key watersheds", do not touch the Metolius Watershed Analysis boundary, and were not affected by recent fires (except for the Spring Creek drainage within the Lower Metolius SWS); therefore, they are not analyzed in-depth (Aq. Figure 1, Pg. Aq-3). Many old subwatersheds were split into two subwatersheds such as Cache, Candle, Jack, Suttle, and Fly subwatersheds. From this point forward the new subwatersheds will be used for analysis in the Metolius Watershed Analysis.

[1] work began in 1994 and was not completed until 1996

Aq. Table 1. Cross-walk between 2003 and 1994 (original Metolius WA) subwatershed (SWS) boundaries.

1994 SWS	2003 SWS	2003 Watershed	Acres
Abbot	Abbot Creek	Upper Metolius River	6391
Cache	Cache Creek	Upper Metolius River	11867
Cache	Dry Creek	Upper Metolius River	12497
Candle	Candle Creek	Upper Metolius River	10957
Candle and non-delineated	Jefferson Creek	Upper Metolius River	18045
Canyon	Canyon Creek	Upper Metolius River	21068
Jack	First Creek	Upper Metolius River	13177
Jack	Jack Creek	Upper Metolius River	9207
Scarp	Headwaters Metolius River	Upper Metolius River	15501
Suttle	Upper Lake Creek	Upper Metolius River	11136
Suttle	Lower Lake Creek	Upper Metolius River	10965
Fly	Upper Fly Creek	Lower Metolius River	16406
Fly	Lower Fly Creek	Lower Metolius River	16227
Metolius Horn and non-delineated	Upper Metolius River	Lower Metolius River	31553
Street and Metolius Horn	Middle Metolius River	Lower Metolius River	21208
Street and non-delineated	Lower Metolius River	Lower Metolius River	24300
Non-delineated	Juniper Creek	Lower Metolius River	15088
Non-delineated	Whitewater River	Lower Metolius River	20715
Total Acres in Upper and Lower Metolius Watersheds			**286308**

Aq. Figure 1. Metolius Watershed Analysis area and 2003 subwatersheds analyzed in the aquatics section.



The Water Resource

Since the 1994 Metolius Watershed Analysis, the GIS stream layer has been updated (Aq. Table 2). Also, since 1994, four large-scale fires (Cache Mountain Fire, Eyerly Fire, Link Fire, and B & B Complex Fire) and a few smaller fires have occurred which cover approximately 35 % of the Upper and Lower Metolius Watersheds (approximately 60% of the former analysis area) (Aq. Figure 2;Aq. Table 3). Approximately, 41% of the watershed area that drains into the Metolius River (verses Lake Billy Chinook (LBC) reservoir) was burned, and of that, 11 percent was by a stand replacing fire. On a subwatershed scale, more than 50% of Abbot, Candle, Jefferson, Canyon, First, Jack, Upper Lake, Lower Lake, and Middle Metolius subwatersheds burned. Within the Middle Metolius and Lower Metolius subwatersheds, more than 91% of Spring Creek and 67% of Street Creek drainages were burned. Also, more than 50% of Abbot Creek subwatershed and Spring Creek drainage were burned by a stand replacing fire.

Aq. Table 2. Miles of stream by stream class in each subwatershed (SWS). Update of Table 5 in 1996 Metolius WA.

2003 SWS	Class 1 & 2[2]	Class 3	Class 4	Total Stream Miles
Abbot Creek	5.9		21.6	27.5
Cache Creek	0.0		14.0	14.0
Dry Creek	0.0		10.5	10.5
Candle Creek	9.8	2.8	40.8	53.5
Jefferson Creek	21.5	32.2	9.1	62.7
Canyon Creek	27.3	3.9	50.1	81.2
First Creek	10.2	0.9	30.7	27.8
Jack Creek	6.6	0.0	22.0	26.7
Headwaters Metolius River	20.4		39.4	59.9
Upper Lake Creek	4.8	1.3	11.8	17.8
Lower Lake Creek	13.7	0.0	12.0	16.3
Upper Fly Creek	0.0	0.2	37.6	37.8
Lower Fly Creek	12.4	3.7	26.0	42.1
Upper Metolius River	11.5	35.3	77.5	124.3
Middle Metolius River	7.8	13.6	58.9	80.2
Lower Metolius River	0.2	6.7	39.0	45.9
Juniper Creek	0.0		28.0	28.0
Whitewater River	22.6	51.5	5.8	79.8
Total Watershed	**174.7**	**152.1**	**534.8**	**836.0**

[2] Class 1 = fish bearing, anadromous or public water supply; Class 2 = fish bearing; Class 3 = perennial fish bearing; Class 4 = intermittent

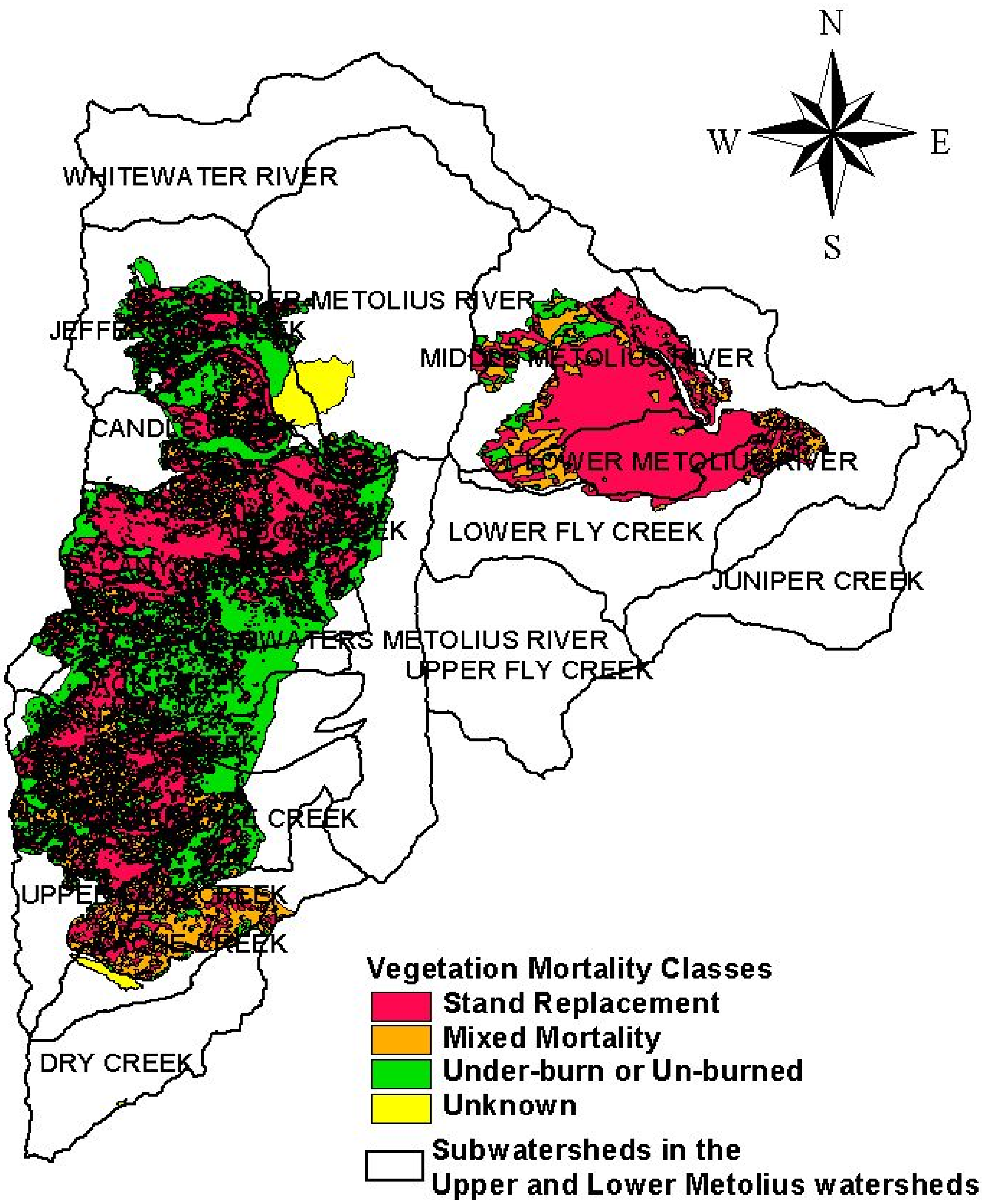
Aq. Table 3. Total acres and percent of subwatersheds burned since 1994.

2003 SWS	Total Burned	SR[3]		M		UB		UK	
	%	Acres	%	Acres	%	Acres	%	Acres	%
Abbot Creek	100	3336	52	1517	24	1524	24		0
Cache Creek	47	1385	12	3076	26	731	6	326	3
Dry Creek	2	93	1	144	1	45	0		0
Candle Creek	65	2438	22	1886	17	2814	26	17	0
Jefferson Creek	50	1973	11	2036	11	4232	23	862	5
Canyon Creek	92	7502	36	4590	22	7191	34		0
First Creek	70	2715	21	3047	23	3415	26		0
Jack Creek	88	1335	15	1691	18	5033	55		0
Headwaters Metolius River	6	199	1	109	1	592	4		0
Upper Lake Creek	60	2555	23	2740	25	1326	12	12	0
Lower Lake Creek	64	2006	18	2269	21	2719	25		0
Upper Fly Creek	0		0		0		0		0
Lower Fly Creek	14	1740	11	474	3	5	0		0
Upper Metolius River	7	323	1	206	1	576	2	1136	4
Middle Metolius River	60	8306	39	2653	13	1682	8		0
Street Creek[4]	67	3216	44	1096	15	585	8	0	0
Metolius face[5]	55	4876	36	1490	11	1084	8	0	0
Lower Metolius River[6]	26	4150	17	550	2	83	<1	0	0
Spring Creek[7]	91	5419	80	677	10	68	1	0	0
Juniper Creek	0	0	0	0	0	0	0	0	0
Whitewater River	0	0	0	0	0	0	0	0	0
Total Watershed	**35**	**40056**	**14**	**26988**	**9**	**31968**	**11**	**2353**	**1**

Notes:
Acres in the mortality classes refer to fires since 2002.
Mortality was not classified before 2001, therefore, the unknown mortality class refers to fires between 1994 and 2001.
SR = stand replacement; M = mixed mortality; UB = underburned or unburned; UK = unknown mortality

[3] The stand burn mortality classes are: stand replacing (> 75% stand mortality), mixed mortality (between 25% and 74% stand mortality), and underburned/unburned (< 24% stand mortality). No needles or duff remain in stand replacing burn areas and only 1000 hour fuels are left. In mixed mortality areas, the duff is mostly consumed but needles and 1000 and 100 hour fuels remain. In underburned areas, most of the duff remains and needles and branches cover the ground.
[4] 7th field HUC within 6th field HUC Middle Metolius subwatershed
[5] 7th field HUC including Bean Ck., Middle Metolius R., and face drainages within 6th field HUC Middle Metolius subwatershed
[6] estimate
[7] 7th field HUC within 6th field HUC Lower Metolius subwatershed

Aq. Figure 2. Map of subwatersheds burned since 1994 by vegetation mortality class (unknown mortality class for fires before 2002).

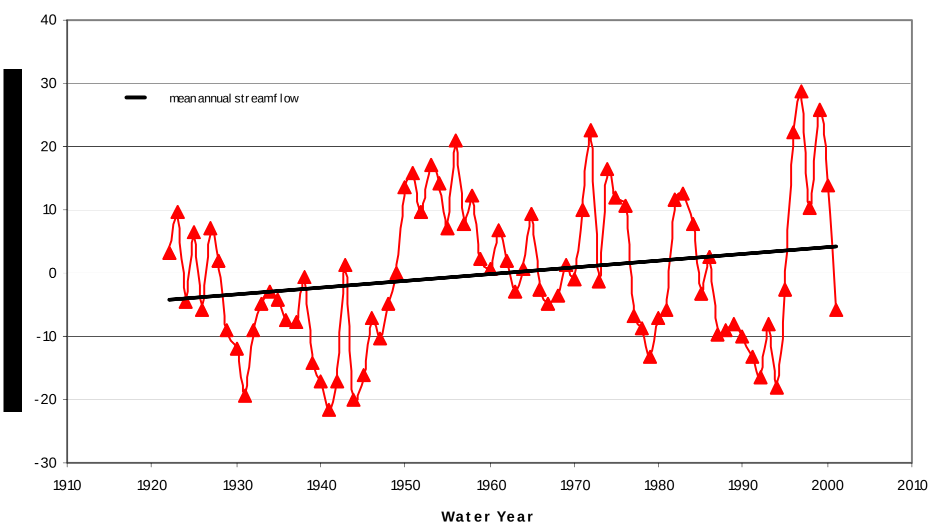


Streamflow[8]

The U.S. Geological Survey measures stream flows on the Metolius River near Grandview, one mile upsteam of LBC Reservoir at river mile 13.6 (Gage #14091500). Drainage area at this gage is 316 mi^2 and the period of record is from 1922 to the present. The Metolius River is a spring dominated system with a generally flat hydrograph (annual mean daily flows only fluctuate 330 cfs). Average daily flow ranges from 1337 cfs in October to 1667 cfs in June. The 90-year gage record shows that 1994 and 1995 were low water years, 1996-2000 were high water years, and 2001-2003 were low water years (Aq. Figure 3).

Peakflow on the Metolius River occurs between May and June with an instantaneous peak flow mean of 2046 cfs. Stormflow, rain-on-snow, or extreme snow-melt peaks on the Metolius River occur mainly between November and February and have a mean of 3051 cfs and range between 1490 and 8430 cfs. Mean annual discharge is 1497 cfs and the maximum instantaneous peak discharge ever recorded is 8430 (Feb. 7, 1996). The largest peak flows on record for the Metolius River are the 1964 flood (7530 cfs) and the 1996 flood (8430 cfs). More than 70% of the peak discharge of the 1964 and 1996 floods entered downstream of the Pelton Round Butte Dam due to the vast extent of young and permeable volcanic rocks (O'Connor et al. 2003). The gage record for the Deschutes River near Moody, OR shows that the 1996 event was approximately a 65-year flood; however, the paleoflood record shows that it was approximately a 30-year flood (Hossman et al. 2003). The Metolius River streamflow data show no trend due to management; however, detecting a trend would be difficult due to the porous geology in the Metolius watersheds.

Aq. Figure 3. Percent difference from mean annual streamflow in the Metolius River near Grandview, OR (USGS # 14091500).



Many streams in the analysis area have a large spring influence starting in their intermediate reaches (Aq. Table 4). The Jefferson Creek hydrograph generally represents the flow regime in these snow-melt/spring dominated systems. Peak flows usually occur during snow-melt between May and early July or

[8] In 1994 Metolius WA the heading was "Changes in flow regime."

occasionally during rain-on-snow events that mostly occur between November and February. The spring-dominate streams are generally more stable with minimal bank erosion. Flashier systems tend to be less stable with more bank erosion.

On February 7, 1996, the largest recorded peak flow on the Metolius River occurred. A region-wide storm caused record-breaking rainfall, flooding, and numerous debris flows over much of Oregon and Washington; however, on the Deschutes National Forest only the Metolius watersheds were affected (Chitwood and Jensen 1996; Chitwood et al. 1996). This rain-on-snow event caused floods in all tributaries of the Metolius River and caused a record breaking discharge of 8430 cfs at the mouth of the Metolius River.

Approximately 34% of the Upper and Lower Metolius watersheds were burned since 2002, thereby, significantly reducing vegetation and evapotranspiration (Aq. Table 3). The relationship between loss or removal of vegetation (fire and timber harvest) and increases in water yield are well established (USDA 1976; Troendle and King 1985; Helvey 1980; Farnes 2000). The majority of the increase in water yield occurs during spring runoff (King 1989). If increases in water yield are concentrated during peakflows then they can affect channel stability.

Climate primarily determines the magnitude of large flood events (Dunne and Leopold 1978); however, land use practices have been shown to increase peak flows in some cases (Troendle and Kaufmann 1987). The reduction in tree density (i.e. canopy cover) results in a reduction in the amount of transpiration and canopy interception of rainfall/snowfall, thereby, increasing the amount of the precipitation available for runoff as stream flow.

In addition, studies have shown that snow-water-equivalent and the snow melt rates are higher in open areas (both burned and natural) than in forested areas (McCaughey and Farnes 2001; Skidmore et al. 1994). The amount of water yield declines as leaf-area-index recovers. Studies in Colorado have shown that full vegetative-hydrologic recovery after logging may take up to 80 years (Troendle and King 1985; USDA 1976).

Aq. Table 4. Miles of stream by flow regime.

2003 SWS	Named streams	Perennial	Intermittent	Spring-fed	Flashy
Abbot Creek	Abbot Creek	5.9	21.6	Intermediate and lower reaches	
Cache Creek	Cache Creek	0.0	14.0		
Dry Creek	Dry Creek	0.0	10.5		
Candle Creek	Candle and Cabot Creeks	12.2	41.2	Candle and Cabot Creeks	
Jefferson Creek	Jefferson and Parker Creeks	53.7	9.1	Jefferson and Parker Creeks	
Canyon Creek	Canyon, Bear Valley, Roaring, and Brush Creeks	25.6	55.6	Roaring Ck. and intermediate and lower reaches of Brush Ck.	Upper Brush Creek
First Creek	First Creek	6.5	35.2		All
Jack Creek	Jack Creek	6.6	22.0	Intermediate and lower reaches	
Headwaters Metolius River	Metolius River	16.2	43.6	Large spring at headwaters	
Upper Lake Creek	Link Creek	3.3	14.5	Lake controlled and spring-fed	
Lower Lake Creek	Lake and Davis Creeks	13.2	12.4	Lake Creek is controlled by Suttle Lake	
Upper Fly Creek	Fly and Meadow Creeks	0.2	37.6		Fly Creek
Lower Fly Creek	Fly, Prairie Farm, and Six Creeks	8.7	33.4		Fly Creek
Upper Metolius River	Metolius River and Mariel, Walker, Sheep, Code, Camp, Racing, and Rainy Creeks	46.8	77.5	?	?
Middle Metolius River	Metolius River and Street and Bean Creeks	20.9	59.3		Street Creek
Lower Metolius River	Lake Billy Chinook reservoir and Spring Creek	6.9	39.0		Spring Creek
Juniper Creek	Juniper Creek	0.0	28.0		?
Whitewater River	Whitewater River and Cache, Lionshead, and Milk Creeks	74.1	5.8	?	?
Total Watershed		**300.8**	**560.3**		

Notes:
Estimates of hydrologic response (i.e. spring-fed or flashy) were made from field observations.
If a stream is not categorized as spring-fed or flashy then it does not have a dominate flow regime.
A "?" means observations for these streams were not available.

Watersheds exhibit great natural variability in flow, and can accommodate some increase in peak flows without damage to stream channels and aquatic organisms. However, shifts in the frequency of channel-forming flows will result in physical adjustment of the channel such as increases in channel width, depth, erosion, and sediment deposition. Hydrologic risk, generally, related to channel erosion, should then be evaluated based on specific watershed characteristics such as precipitation and channel stability (discussed in the Hydrologic Response section).

The existing evapotranspiration condition, due to the loss or removal of vegetation from fires and past timber management, was estimated for the Metolius Watershed (combined Upper and Lower Metolius watersheds) using the Canopy Evapotranspiration (CET) model. The canopy evapotranspiration (CET) model was used to estimate the percent change in evapotranspiration from historic conditions both before and after the 2002 and 2003 fires. Percent CET is only a surrogate for evapotranspiration because it does not include variables such as climate, wind and vegetation type. The CET model is best used to represent relative differences in percent canopy evapotranspiration between subwatersheds, project alternatives, or events that significantly alter vegetation.

The CET model uses a 2000 satellite image to determine vegetative condition prior to the 2002-2003 fires. Raster data of percent canopy and vegetation size class from this image were used to estimate the percent of the canopy evapotranspiring at it's potential (referred to as percent CET). To estimate post-fire vegetative condition (2003 percent CET), the 2000 canopy data was adjusted by multiplying it by a mortality coefficient based on the fire layer. Very little timber was harvested between 2000 and 2003; therefore, no other adjustments were made to the 2000 image.

Historic percent CET was estimated for each subwatershed by determining historic percent canopy by plant association group (PAG) (Volland 1988) (Aq. Table 5). The Forest silviculturist (Jo Boosier) and the District silviculturists (Rob Schantz and Brian Tandy) provided historic ranges and means based on Bill Hopkins Region 6 Old Growth definition for ponderosa pine, CVS plots, representative stands, and professional judgment. These values took into account natural disturbance such as bug infestations and fire. Both the 2000 and 2003 CET mean estimates were subtracted from the historic CET mean estimates to determine the pre-fire change in % CET from historic conditions and the post-fire change in % CET from historic conditions (Aq. Table 6).

Aq. Table 5. Historic means and ranges for percent canopy in the Metolius watersheds.

PAG	Mean % canopy	Range (%)
Juniper, White Bark Pine	15	10-25
Ponderosa Pine	25	10-40
Mixed Conifer	35	10-60
Mountain Hemlock	48	0-90
Cascade Lodgepole Pine	70	0-80

A negative change in % CET from historic mean conditions represents the percent of that subwatershed that was historically vegetated with mature trees on average but is no longer (i.e. openings) due to management or disturbance. A positive change in % CET from historic mean conditions represents overstocked (on average) vegetative conditions.

Canopy evapotranspiration in all the subwatesheds evaluated was within the historic range of variability both before and after the fires; although, post-fire % CET in some subwatersheds was close to the upper and lower boundaries of the range (i.e. Abbot and Middle Metolius are at the low end of the historic vegetative condition and Headwaters of the Metolius is at the upper historic range) (Aq. Table 6).

Not surprisingly, subwatersheds significantly burned by the fire had a large reduction in canopy evapotranspiration due to the fire (i.e. Abbot, Canyon, and Middle Metolius subwatersheds). Subwatersheds that experienced substantial reductions in %CET (i.e. Abbott Creek and Canyon Creek) from recent fires have a higher risk of increased peak flows and morphological change.

The existing % CET for the area draining into the Metolius River is 27. This is less than the historic mean of 36 % but within the historic range of variability (7 to 61%). Recent fires have reduced % CET in the watersheds from 34% to 27%. Although CET does not directly translate into streamflow due to watershed characteristics such as infiltration and precipitation, overall streamflow in the Metolius watersheds is predicted to increase but be within the range of historic water yields and peaks.

Aq. Table 6. Change in percent canopy evapotranspiration (CET) in each subwatershed (SWS) in the Metolius Watershed Analysis area before and after the 2002 and 2003 fires.

2003 SWS	Historic Mean % CET (range)	%2000 CET	%2003 CET	Pre-fire change in% CET from historic mean	Post-fire change in% CET from historic mean	Change in% CET from fires
Abbot Creek	33 (10-56)	35	13	1	- 21	-22
Cache Creek	35 (8-60)	32	26	- 3	- 9	-6
Dry Creek	42 (6-66)	31	31	- 11	- 11	0
Candle Creek	41 (7-69)	33	23	- 9	- 19	-10
Jefferson Creek	45 (3-81)	34	27	- 10	- 18	-7
Canyon Creek	41 (6-67)	39	20	- 3	- 22	-19
First Creek	42 (7-65)	34	23	- 8	- 19	-11
Jack Creek	39 (8-61)	34	24	- 4	- 15	-11
Headwaters Metolius River	30 (10-48)	41	40	11	11	-1
Upper Lake Creek	43 (5-75)	33	22	- 10	- 20	-11
Lower Lake Creek	35 (10-59)	34	24	- 1	- 11	-10
Upper Metolius River	38 (7-68)	38	38	0	0	-1
Middle Metolius River	31 (10-51)	31	18	0	- 13	-13
* Whitewater River	42 (3-77)	40	40	2	2	0
* Area draining into Metolius River	36 (7–61)	34	27	2	9	-7

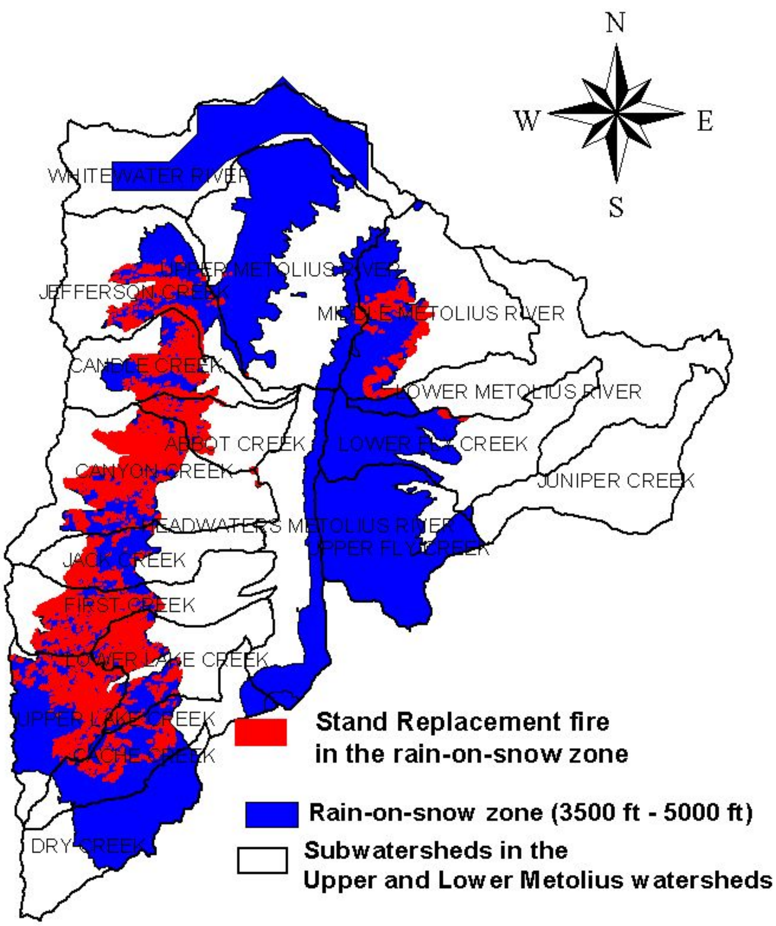
Notes:
A negative value represents a decrease in % CET and a positive value an increase in % CET. A value in bold indicated that pre- or post-fire CET is outside the historic range of variability.
*estimate

Openings from fire or harvest in areas subject to rain-on-snow could increase peak flows in stream reaches downstream due to increased snow accumulation and melting.

Approximately, 43 % of the Metolius watersheds fall within the rain-on-snow zone (3500 to 5000 ft) (Aq. Figure 4). In 1996 and 2001 many of the streams in the analysis area were affected by a rain-on-snow event and numerous road-stream crossings were repaired under ERFO. Thirty-nine percent of the Upper and Lower Metolius watersheds 2002 and 2003 burn area falls within the rain-on-snow zone, and 14 % of that area experienced a stand replacing fire (Aq. Table 7).

Likewise, approximately 4400 acres of harvest since 1994 are also within this zone and could elevate the risk of increased peak flows.

Aq. Figure 4. Rain-on-snow event risk.



Aq. Table 7. Amount of subwatersheds in the rain-on-snow (ROS) zone of 3500 to 5000 feet and percent of ROS zone affected by the fires since 2002.

2003 SWS	Acres in ROS zone	% of SWS in ROS zone	Acres of ROS zone burned by a stand replacing fire	% of ROS zone burned by a stand replacing fire
Abbot Creek	1856	29	932	50
Cache Creek	7193	61	966	13
Dry Creek	7235	58	0	0
Candle Creek	5011	46	1704	34
Jefferson Creek	6647	37	1161	17
Canyon Creek	8216	39	4027	49
First Creek	5087	39	2004	39
Jack Creek	3657	40	841	23
Headwaters Metolius River	5647	36	10	0
Upper Lake Creek	9573	86	2397	25
Lower Lake Creek	4881	45	1856	38
Upper Fly Creek	14840	90	0	0
Lower Fly Creek	7082	44	86	1
Upper Metolius River	15369	49	158	1
Middle Metolius River	7766	37	1415	18
Street Creek[4]	4179	57	66	16
Metolius face[5]	3488	26	736	21
Lower Metolius River[6]	1215	5	12	1
Spring Creek[7]	1613	24	608	38
Juniper Creek[6]	0	0	0	0
Whitewater River[6]	12429	60	0	0
Total Watershed	**123705**	**43**	**17569**	**14**

The upper portions of the streams in the fire perimeter are dominated by rain and snow-melt and have a flashier flow regime (Aq. Table 4). As a result these reaches have higher bank erosion and move larger bedloads. The upper and intermediate reaches of Abbot Creek, Canyon Creek, Jack Creek, and First Creek subwatersheds experienced a stand replacing fire (Aq. Table 3) and 50%, 49%, 39%, and 23% of it was in the rain-on-snow zone (Aq. Table 7). Within Canyon Creek, over 4000 acres in the rain-on-snow zone were burned by a stand replacing fire. Although, infiltration rates are high in the pumacious ash and cinders and have not been significantly altered by the fire in these subwatersheds (Sussmann 2003), peak flows are still predicted to increase. Evapotranspiration in these areas will decrease and snow pack will increase, leading, most likely, to higher peak flows.

Watersheds exhibit great natural variability in flow, and can accommodate some increase in peak flows without damage to stream channels and aquatic organisms. However, shifts in the frequency of channel-forming flows will result in physical adjustment of the channel such as increases in channel width, depth, erosion, and sediment deposition. To understand the risk of potential adverse effects to the aquatic resource, natural and anthropogenic variables that affect aquatic health must be evaluated.

In general, the Upper and Lower Metolius watersheds (5th fields) are not very sensitive to storm/melt events because spring influence. In order to better understand which subwatersheds are naturally the most hydrologically responsive, the parameters discussed in the aquatics sections were summarized and then subwatersheds were ranked with the most responsive as "1" (Aq. Table 8). Not surprisingly, subwatersheds with the largest drainage networks are the most responsive to storm/melt events. The risk of adverse water quantity due to anthropogenic inputs and wildfire were determined for each subwatershed and for the Metolius watersheds (Aq. Table 8). Based on the risk of adverse water quantity and water quality, fish habitat (Aq. Figure 11) and channel morphology effects were assessed.

Aq. Table 8. Summary of variables affecting natural hydrologic response the subwatersheds of the Metolius River. Values in italics are estimates.

SWS	% of SWS in ROS zone	Acres in ROS zone	% of SWS with Slopes > 30%	Spring/ Lake controlled	Infiltration rate (relative difference)	Miles of perennial stream	Natural Sensitivity Rank
Abbot	29	932	10		R	5.9	**10**
Cache	61	966	12		R	0	**14**
Dry	58	0	8	x	R	0	**15**
Candle	46	1704	31		R	12.2	**6**
Jefferson	37	1161	45	x	R	53.7	**12**
Canyon	39	4027	22		R	25.6	**4**
First	39	2004	16		VR	6.5	**8**
Jack	40	841	9		R	6.6	**9**
Head of Metolius	36	10	33	x	R	16.2	**13**
Upper Lake	86	2397	13	x	VR	3.3	**16**
Lower Lake	45	1856	6	x	VR	13.2	**17**
Upper Fly	90	0	4		M	0.2	**7**
Lower Fly	44	86	17		M	8.7	**5**
Upper Metolius	49	158	32		M	46.8	**2**
Middle Metolius	37	1415	41		M	20.9	**3**
Lower Metolius	*5*	*12*	*21*		M	6.9	**11**
Juniper	0	0	*2*		M	0	**18**
Whitewater	*60*	0	*53*		M	*74.1*	**1**
Total Watershed	43	17569	24	-----	-----	301	**------**

Aq. Table 9. Variables evaluated for determining water quantity effects from wildfire and anthropogenic inputs.

SWS	% SWS in SR fire	Acres in ROS zone	Acres of SR fire in ROS zone	Road density excluding	% SWS in detri-mental	pre-fire change in %CET	Change in% CET from fires	Infiltration rate	spring/ lake con-trolled	Stream-flow Risk Factor
Abbot Creek	52	1856	932	5.71	20	4	-22	R		2
Cache Creek	12	7193	966	7.32	18	-9	-6	R		1
Dry Creek	1	7235	0	6.33	12	-26	0	R	X	1
Candle Creek	22	5011	1704	5.45	6	-22	-10	R		5
Jefferson Creek	11	6647	1161	1.06	?	-23	-7	R	X	2
Canyon Creek	36	8216	4027	4.87	12	-7	-19	R		5
First Creek	21	5087	2004	6.17	13	-19	-11	VR		4
Jack Creek	15	3657	841	5.56	17	-11	-11	R		3
Headwaters Metolius River	1	5647	10	5.05	18	39	-1	R	X	5
Upper Lake Creek	23	9573	2397	3.04	11	-23	-11	VR	X	1
Lower Lake Creek	18	4881	1856	7.12	21	-3	-10	VR	X	1
Upper Metolius River	1	15369	158	2.96	?	1	-1	M		5
Middle Metolius River	39	7766	1415	3.14	?	-1	-13	M		5
Street Creek[4]	44	1827	665	4.9	10	?	?	M		5
Metolius face[5]	36	1490	745	1.4	3	?	?	M		2
Whitewater River	0	*12429*	0	*1*	?	?	0	M		0
Area draining into Metolius River	**11**	**123705**	**17569**	**4.01**	**?**	**-2**	**-7**			

Notes:
Values in italics are estimates.
Streamflow risk factor is on a scale of 1-5, with 5 being the highest risk of an increase in peakflows.

Based on these variables the risk of increased stormflows was assessed (Appendix Aq1) and the risk ranking is listed by subwatershed in the Fish Habitat/Channel Morphology section of the Aquatics section. Only 35 % of the Upper and Lower Metolius Watersheds has been burned since 1994 and only 41% of the area draining into the river. In addition, only 11 percent of the area draining into the Metolius River was burned by a stand replacing fire. Percent canopy evapotranspiration was only reduced by 7 units by the recent fires. In addition, the Metolius watersheds are within the historic range of variability for evapotranspiration based on the fact that all the subwatersheds are within the range. Although the Metolius River is primarily spring-fed and not overly responsive to storm/melt events, increases in stormflows due to inputs from tributaries are still predicted.

Streamflow Trends

- Streamflow in the Metolius River is very stable with mean daily flow ranging from 1337 cfs in October to 1667 cfs in June.
- The 82-year old Metolius River streamflow record shows no trend due to management; however, detecting a trend would be difficult due to the porous geology in the Metolius watersheds.

- Peakflow on the Metolius River occurs between May and June with an instantaneous peak flow mean of 2046 cfs.
- Stormflow, rain-on-snow, or extreme snow-melt peaks on the Metolius River occur mainly between November and February and have a mean of 3051 cfs and range between 1490 and 8430 cfs.
- The largest peakflow recorded on the Metolius River occurred on February 7, 1996.
- % CET has decreased in all subwatersheds affected by the recent fires and has decreased by 7 in the combined Metolius watersheds.

Water Quality[9]

Water quality is an important feature of the Metolius Watershed because the watershed was designated a Key Watershed based on the water quality contribution to the Deschutes River and because of the healthy population of bull trout, which depends on the high water quality of the system. Water quality of the Metolius Basin is some of the highest recorded in Oregon. Metolius River has such a unique character of cold, clear and clean water to prompt the Wild and Scenic Plan (1997) to call for the development of specific water quality standards for the Metolius River based on the baseline conditions. With most ODEQ criteria, the Metolius River far exceeded the water quality standards established by the state.

Fish habitat is protected through management of physical and biological characteristics of water quality including sediment, temperature, nutrients, pH, and nuisance algae in lakes. Fecal bacteria or E. coli bacteria, are measured to determine the degree of pollution that may threaten the safety of waters to humans. Bacteria can also serve to measure the degree of organic population in a stream or lake.

Sediment, particularly fine grained sediment, can reduce the spawning and early rearing success of trout and salmon by reducing the flow of water through the gravel spawning areas. Fine sediment can fill in the hiding places in the cobbles and gravel that are used by juvenile salmonids, and the aquatic invertebrate on which they feed. Bull trout require low stream temperatures near 50 ^{o}F for successful spawning and early rearing of fry. Redband trout, kokanee and chinook salmon require moderate water temperature for optimal growth and survival. Nutrients can increase microbial and algal production that can decrease dissolved oxygen levels that can harm fish. In lakes, pH is a measure of hydrogen ion concentration that increases with increased algal production that is usually associated with organic enrichment. In the Cascade Lakes, high pH in lakes is usually associated with low dissolved oxygen caused by algal blooms.

Water quality parameters potentially most changed since the 1994 Metolius Watershed Analysis are/would be sedimentation and water temperature. As mentioned earlier, approximately 34 % of the Upper and Lower Metolius watersheds have been burned since 1994 and much of the riparian areas. Threats to water quality are associated with: 1) storm runoff stressing the road drainage network; 2) sedimentation from upland erosion; 3) channel erosion; 4) storm runoff threatening roads at stream crossings; 5) debris slides in the upper watersheds; and 6) the loss of steam-side shade. Some sediment transported to the streams will initially be ash from the fire and could slightly increase water nutrient levels; however, most of the ash has already absorbed into the soil during the light rain following the fire or has been transported off site by water and wind.

[9] New heading

Management Direction

Clean Water Act: Beneficial uses and the associated water quality parameters as defined by the State of Oregon for the Metolius River and it's subwatersheds are shown in Aq. Table . The State is required by the Clean Water Act (CWA), Section 303(d), to identify water quality impaired streams. The waterbodies in Aq. Table 11 are listed on the Oregon 2002 303(d) list for water quality exceedences above the State standards (ODEQ 2003). Monitoring data on the various parameters are not available for many of the streams; therefore, it is possible that some of the streams exceed state water quality standards and are not listed on the 303(d) list.

Aq. Table 10. Beneficial uses and associated water quality parameters for Deschutes River Basin (ODEQ 2003).

Beneficial Use	Associated Water Quality Parameter
Public Domestic Water Supply	Turbidity, Chlorophyll *a*
Private Domestic Water Supply	Turbidity, Chlorophyll *a*
Industrial Water Supply	Turbidity, Chlorophyll *a*
Irrigation	None
Livestock Watering	None
Anadromous Fish Passage	Biological Criteria, Dissolved Oxygen, pH, Sedimentation, Temperature, Total Dissolved Gas, Toxics, Turbidity
Salmonid Fish Rearing	Dissolved Oxygen, Sedimentation, Temperature
Salmonid Fish Spawning	Same as Salmonid Fish Rearing
Resident Fish and Aquatic Life	Same as Anadromous Fish Passage
Wildlife and Hunting	None
Fishing	Aquatic Weeds or Algae, Chlorophyll *a* , Nutrients
Boating	None
Water Contact Recreation	Aquatic Weeds or Algae, Bacteria, Chlorophyll *a* , Nutrients, pH
Aesthetic Quality	Aquatic Weeds or Algae, Chlorophyll *a*, Nutrients, Turbidity

Aq. Table 11. Waterbodies listed on the 2002 State of Oregon 303(d) list for water quality exceedences.

Waterbodies	SWS	Parameter	Standard*
Brush Creek	Canyon Creek	Temperature	Bull trout; 50° F
Canyon Creek	Canyon Creek	Temperature	Bull trout; 50° F
First Creek	First Creek	Temperature	Spawning; 55° F
Lake Creek	Lower Lake Creek	Temperature	Rearing; 64° F
Lake Billy Chinook	All Upper and Lower Metolius Watersheds	pH	6.5 to 8.5
Lake Billy Chinook	All Upper and Lower Metolius Watersheds	Chlorophyll a	0.01 mg/L

* The water temperature standard in this table is the standard used for the 2002 303(d) temperature listings and is different from the 2004 temperature standard in the 2003 Oregon Administrative Rules (OAR 340-041-0028).

Total Maximum Daily Loads and Water Quality Management Plans: The Deschutes National Forest relies on current laws, management plans, and Best Management Practices (BMPs) to provide the basis for improving water quality in the forested landscape. All federal land management activities must follow standards and guidelines (S&Gs) listed in the Deschutes National Forest Plan, as amended by the Northwest Forest Plan (NWFP) (USDA Forest Service and USDI Bureau of Land Management 1994), INFISH (USDA Forest Service 1995a), and BMPs (USDA Forest Service 1998a). NWFP and INFISH provides management direction in the form of Riparian Reserves (RRs) and interim Riparian Habitat Conservation Areas (RHCAs), and S&Gs for Key Watersheds. The National Forest lands in the Metoius watersheds fall under NWFP and INFISH direction.

Temperature, sediment, pH, and chlorophyll *a* are the primary concerns in meeting water quality standards on forested lands. Strategies to improve water temperature conditions include providing shade and allowing the development of natural channel morphologies, which are generally narrower and less easily heated than management affected channels. Current policies, regulations, BMPs, and adaptive management techniques are expected to minimize unwanted sedimentation from forestry related activities, and likewise, reduce the amount of nutrients that affect pH and chlorophyll *a*. Habitat conditions are expected to be improved through implementation of BMPs, which promote riparian conditions that improve channel stability and reduce erosion and promote the protection and recovery of channel morphology to the most stable forms.

The Clean Water Act requires States to develop Total Maximum Daily Load allocations and Water Quality Management Plans in basins where water bodies are listed as water quality impaired, that is, do not meet State Water Quality Standards. The Upper Deschutes River Sub-Basin Total Maximum Daily Load (TMDL) and Water Quality Management Plan (WQMP) is scheduled for completion in 2006 and covers all the subwatersheds in the Metolius Watershed Analysis area. The TMDL and WQMP document establishes water quality goals for waterbodies and lays out steps toward meeting them by establishing numeric goals for allowable levels of pollution (loads) by sub-basin within the larger basin. A Memorandum of Understanding (MOU), signed May 2002, between Oregon Department of Environmental Quality and the USDA Forest Service, designates the Forest Service as the management agency for the State on Nation Forest Service lands. To meet CWA responsibilities defined in the MOU, the Forest Service is responsible for developing a Water Quality Restoration Plan (WQRP). The Upper Deschutes Basin WQRP is under development and scheduled for completion in 2004.

Section 401 of the federal Clean Water Act (CWA) authorizes state water quality programs to certify that federal actions involving the award of licenses or permits will not violate applicable state water quality requirements. The Confederate Tribes of the Warm Spring Reservation (CTWSR) and Portland General Electric (PGE) received the Findings and Evaluation Report applied for the relicensing of the Pelton Round Butte Dam in June 2002. The CTWSR and PGE developed a Water Quality Management and Monitoring Plan (WQMMP) for the Pelton Round Butter Project (i.e.LBC Reservoir) as a requirement of the relicensing of the dam (CTWSR and PGE 2002).

Standards for parameters of concern (ODEQ 2003)

Temperature (OAR 340-041-0028): The purpose of the temperature criteria in this rule is to protect designated temperature-sensitive, beneficial uses, including specific salmonid life cycle stages in waters of the State. The following sections of the temperature rule apply to the Metolius watersheds:

4) Biologically Based Numeric Criteria: Unless superseded by the natural conditions criteria described in section (8) of this rule, or by subsequently adopted site-specific criteria approved by EPA, the temperature criteria for State waters supporting salmonid fishes are as follows:

- The seven-day-average maximum temperature of a stream identified as having salmon and steelhead spawning use on subbasin maps and tables set out in OAR 340-041-0101 to OAR 340-041-0340 may not exceed 13.0 degrees Celsius (55.4 degrees Fahrenheit) at the times indicated on these maps and tables;
- The seven-day-average maximum temperature of a stream identified as having core cold water habitat use on subbasin maps set out in OAR 340-041-101 to OAR 340-041-340 may not exceed 16.0 degrees Celsius (60.8 degrees Fahrenheit);
- The seven-day-average maximum temperature of a stream identified as having salmon and trout rearing and migration use on subbasin maps set out at OAR 340-041-0101 to OAR 340-041-0340, may not exceed 18.0 degrees Celsius (64.4 degrees Fahrenheit);
- The seven-day-average maximum temperature of a stream identified as having a migration corridor use on subbasin maps and tables OAR 340-041-0101 to OAR 340-041-0340, may not exceed 20.0 degrees Celsius (68.0 degrees Fahrenheit). In addition, these water bodies must have coldwater refugia that's sufficiently distributed so as to allow salmon and steelhead migration without significant adverse effects from higher water temperatures elsewhere in the water body. Finally, the seasonal thermal pattern in Columbia and Snake Rivers must reflect the natural seasonal thermal pattern;
- The seven-day-average maximum temperature of a stream identified as having Lahontan cutthroat trout or redband trout use on subbasin maps and tables set out in OAR 340-041-0101 to OAR 340-041-0340, may not exceed 20.0 degrees Celsius (68.0 degrees Fahrenheit);
- The seven-day-average maximum temperature of a stream identified as having bull trout spawning and juvenile rearing use on subbasin maps set out at OAR 340-041-0101 to OAR 340-041-0340, may not exceed 12.0 degrees Celsius (53.6 degrees Fahrenheit).

5) Unidentified Tributaries: For waters that are not identified on the fish use maps and tables referenced in section (4) of this rule, the applicable criteria for these waters are the same criteria as is applicable to the nearest downstream water body depicted on the applicable map.

6) Natural Lakes: Natural lakes may not be warmed by more than 0.3 degrees Celsius (0.5 degrees Fahrenheit) above the ambient condition unless a greater increase would not reasonably be expected to adversely affect fish or other aquatic life.

8) Natural Conditions Criteria: Where the department determines that the natural thermal potential of all or a portion of a water body exceeds the biologically-based criteria in section (4) of this rule, the natural thermal potential temperatures supersede the biologically-based criteria, and are deemed to be the applicable temperature criteria for that water body.

9) Cool Water Species: Waters that support cool water species may not be warmed by more than 0.3 degrees Celsius (0.5 degrees Fahrenheit) above the ambient condition unless a greater increase would not reasonably

be expected to adversely affect fish or other aquatic life. Cool waters of the State are described on subbasin tables set out in OAR 340-041-0101 to OAR 340-041-0340.

11) Protecting Cold Water:

- Except as described in subsection (c) of this rule, waters of the State that have summer seven-day-average maximum ambient temperatures that are colder than the biologically based criteria in section (4) of this rule, may not be warmed by more than 0.3 degrees Celsius (0.5 degrees Fahrenheit) above the colder water ambient temperature. This provision applies to all sources taken together at the point of maximum impact where salmon, steelhead or bull trout are present.
- A point source that discharges into or above salmon & steelhead spawning waters that are colder than the spawning criterion, may not cause the water temperature in the spawning reach where the physical habitat for spawning exists during the time spawning through emergence use occurs, to increase more than amounts listed in Section 11 (ODEQ 2003) after complete mixing of the effluent with the river.
- The cold water protection narrative criteria in subsection (a) does not apply if:
  - There are no threatened or endangered salmonids currently inhabiting the water body;
  - The water body has not been designated as critical habitat; and
  - The colder water is not necessary to ensure that downstream temperatures achieve and maintain compliance with the applicable temperature criteria.

In addition Section 12 discusses implementation of the temperature criteria, and Section 13 allows ODEQ to establish alternative site-specific criteria for all or a portion of a water body that fully protects the designated use.

Turbidity (Nephelometric Turbidity Units, NTU) (OAR 340-041-0336): The State of Oregon and the Tribe state that no more than a ten percent cumulative increase in natural stream turbidities shall be allowed, as measured relative to a control point immediately upstream of the turbidity causing activity. However, limited duration activities necessary to address an emergency or to accommodate essential dredging, construction or other legitimate activities and which cause the standard to be exceeded may be authorized provided all practicable turbidity control techniques have been applied and approval granted.

Total Dissolved Solids (OAR 340-041-0032): The guide concentrations of 0.5 ug/L shall not be exceeded unless otherwise specifically authorized by DEQ upon such conditions as it may deem necessary to carry out the general intent of this plan and to protect the beneficial uses.

pH Standard(OAR 340-041-0021): The State of Oregon pH (hydrogen ion concentration) standard states that pH values shall not fall outside the range of 6.5 – 8.5. The following exception applies: Waters impounded by dams existing on January 1, 1996, which have pHs that exceed the criteria shall not be considered in violation of the standard if the Department determines that the exceedance would not occur without the impoundment and that all practicable measures have been taken to bring the pH in the impounded waters into compliance with the criteria. Tribal standards are very similar.

Chlorophyll a Standard (OAR 340-041-0019): The applicable State of Oregon standard for nuisance phytoplankton shall be applied to lakes, reservoirs, estuaries and streams, except for ponds and reservoir less than 10 acres in surface area, marshes and saline lakes. Average Chlorophyll *a* value of 15 ug/L shall be used to identify waterbodies where phytoplankton may impair the recognized beneficial uses of natural lakes that do not thermally stratify, reservoirs, rivers and estuaries. For natural lakes that thermally stratify and where phytoplankton may impair the recognized beneficial uses of natural lakes, the chlorphyll *a* standard is 10 ug/L. Upon determination by the Department that the values in OAR 340-041-0019 are exceeded, the Department shall, in accordance with a schedule approved by the Commission, conduct such studies as are necessary to describe present water quality; determine the impacts on beneficial uses; determine the probable causes of the exceedance and beneficial use impact; and develop a proposed control strategy for attaining compliance where technically and economically practicable. Proposed strategies could include standards for additional pollutant parameters, pollutant discharge load limitations, and other such provisions as may be appropriate. Where natural conditions are responsible for exceedance of the values in OAR 340-041-0019 or beneficial uses are not impaired, the values in OAR 340-041-0019 may be modified to an appropriate value for that water body. The applicable Tribal standard for nuisance phytoplankton growth is substantively the same as that of the State's.

Sedimentation / Erosion

Since the 1994 Metolius Watershed Analysis, the largest flood on record occurred in the Metolius watersheds in 1996. The storm trigger 10 debris flows in the Metolius Basin, which are the only storm-related debris flows ever reported in this area. Two debris flows were on the steep slopes of Green Ridge, seven were on the steep south canyon wall of Canyon Creek, and one was on the south canyon wall of Cabot Creek. It appears that the debris flows in Canyon Creek were related to timber harvest activities from 1989. In addition, the flooding and debris flows caused significant road damage. Although, sedimentation and bank erosion occurred, fish habitat appears unaffected or improved (Chitwood et al. 1996).

Fine sediment in spawning gravel has been measured in many important fish habitats of the Metolius Basin since 1988. Ten sites, including the Metolius River, have been monitored using modified McNeil core sampling techniques at the same locations. Generally ten samples were collected in the field and a water sample was taken to estimate suspended sediments in the core sampler. For year 1988 to 1997, two samples were collected at each riffle where possible. For years 2002 and 2003, one sample was taken per riffle. Samples were dried in lab ovens and sieved using standard screen sizes (Houslet and Riehle 1998). Suspended sediment from the water in the core sampler were also dried, sieved and added to the bulk sample by size category. In later years after 1993, the wet volume of suspended sediment was converted to dry weight and apportioned to the various size categories based on the early year sieve size proportions.

An arc-sine transformation of the data were used for statistical analysis to correct for error associated with testing percentages. Significant trends were based on analysis of variance, and individual relative differences were tested using Tukeys HSD tests ($\alpha < 0.05$). Sites with only two years of data were tested using t-tests ($\alpha < 0.05$).

The percent of fine sediments in bull trout and redband trout spawning habitats were assessed before and after the 1996 flood (Houslet and Riehle 1998). Fine sediment was the highest in the 1988 and 1989 samples for most streams. Candle Creek, Brush Creek and Canyon Creek. remained the least changed between 1988 to 1997. Roaring Creek, Jefferson Creek, Abbot Creek and Jack Creek had the most decrease in fine sediment from 1988 to post-1996 flood (Aq. Table 12; Aq. Table 13).

Since 1996-1997, fine sediment increased slightly in Canyon Creek and the Metolius River upstream of Lake Creek (Aq. Table 12). The South Fork Lake Creek declined in fine sediment after the 1996 flood, but is now similar to pre-flood conditions.

Fine sediment in spawning habitat remains a concern for the Metolius Watershed. Although the flushing effects of the of the 1996 flood remains in many streams, some recovery of fine sediment is occurring in Canyon and Lake Creek. The flushing effect of the 1996 flood on Jefferson Creek may have also moved spawning sized gravel from the stream, reducing available spawning habitat. The Metolius River upstream of Lake Creek may have had too high of sampling variability to provide an adequate test.

Fine sediment (< 6.4 mm) on average in all tributary spawning sites is approximately 29% (range from 17 to 44%), and approximately 28% in the Metolius River above Lake Creek. US Fish and Wildlife Service recommends fines <20% in spawning gravels for a properly functioning bull trout habitat (USFWS 1998). Although, these sediment levels are slightly above the USFWS recommendation, the Metolius Watersheds support a robust spawning population of both redband trout and bull trout (refer to Fisheries Report). Levels of fine sediment in the Metolius watershed streams were found to be similar to that of the chinook salmon and bull trout spawning habitat of the upper Warm Springs River (personal communication, Mike Weldon, Fishery Biologist, Bureau of Natural Resources, Warm Springs).

These results are supported by a study of sediments accumulated in the Metolius Arm of Lake Billy Chinook reservoir from 1964 to 1998 (O'Connor et al. 2003). The report states that there is no detectable delta and that sediment yields for the 34-year period between 1964 and 1998 are remarkably low and possibly the lowest in the region. This is especially notable because the 34-year period includes the two largest flow events in the last 140 years. Therefore, sedimentation from past management is assumed to be within the historic range.

Wildfires have the potential to impact the soil to the limits of natural variability, including reduced soil aggregate stability, reduced permeability, increased runoff and erosion, and reduced organic matter/nutrient status. These combined effects can cause the runoff following a rain event to increase significantly, thus increasing the overland flow available to initiate soil erosion, either as sheet or rill erosion. The potential for erosion is highest on the steeper slopes that burned with a high burn severity[10]**.** As a result peak flow timing and magnitude could be altered and could result in increased bank erosion. An increase in sedimentation and a reduction in stream complexity due to channel erosion would threaten critical fish habitat in these drainages. In addition, severe channel erosion could impair hydrologic function by disconnecting the channel from the floodplain through channel incision and/or over widening. Increasing the channel width-to-depth ratio would also reduce riparian vegetation and increase solar exposure to the water, thus potentially increasing water temperature.

Since the 2002 and 2003 wildfires, the risk of sedimentation has increased in subwatersheds with substantial stand replacement burn areas. Although soil infiltration rates are high within the fire area, the reduction in ground cover in areas classified stand replacing or mixed mortality increases the risk of upland erosion due to rainsplash and rilling during a convective storm. The buffering effect of riparian vegetation has been significantly reduced in these areas (Aq. Table 14), but downed wood and shrub skeletons, which are abundant in these drainages, reduce the erosive effects of rainfall and help trap sediment. However, a significant increase in sedimentation would threaten critical fish habitat in the tributaries and the mainstem Metolius River. Although, recent fires are predicted to significantly increase sedimentation in tributaries and possibly in the Metolius River, the effect to Lake Billy Chinook reservoir would most likely be minimal because the 1964 and the 1996 floods did not even have a detectable effect on the Metolius Arm delta (O'Connor et al. 2003).

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[10] Burn severity describes the effects of the fire on the soil hydrologic function (amount of surface litter, erodibility, infiltration rate, runoff response) and productivity.

Studies of other large fires have shown a significant increase in erosion and sedimentation in the first five years following the fires (Beaty 1994; Ewing 1996; Helvey 1980; Minshall et. al 1997). After the large fires in Yellowstone National Park during 1988, research was done on sediment increases following the fire. The largest post-fire sediment increases (load/volume runoff) occurred during the snowmelt period (April, May, June); the post-fire sediment increase ranged from 156% in April to 42% in June on the Yellowstone River. The spring runoff total suspended sediment (TSS) increase, averaged 60% for a four-year period. There was one reported 100% increase in August (thunderstorm event) on a load per unit runoff basis. The summer season sediment increase, averaged 30% for the rising streamflow period in the summer, and 7% for the falling streamflow period (Ewing 1996).

Ewing (1996) also reported a statistically significant increase in the measured total sediment discharge and the measured sediment concentration in the Yellowstone River. He also concluded that increased suspended sediment loads during snowmelt were small in comparison to post-fire summer events. Ewing stated, “the largest portion of the fire-related sediment is transported out of the burned watersheds during the highest runoff of the year. As burned sites revegetate and erosion diminishes, fine sediment may thus be progressively transported downriver by spring runoffs.”

Other studies have also reported increases in sediment following a fire. In the Entiat Experimental Forest of central Washington State, there were sediment increases of 8 to 10 times the pre-fire levels in three small watersheds (approx. 2 mi^2) (Helvey 1980). The spring following the 1988 Red Bench Fire in the North Fork of the Flathead River in Montana, TSS experienced 2 to 3 fold increases on Flathead National forest system lands and 5 to 10 fold increases on the Glacier National Park lands. In the burned watersheds, the TSS decreased after the first year but remained slightly higher throughout the five-year duration of the study (Hauer and Spenser 1998).

In contrast, monitoring of fine sediment in Jefferson Creek (a spring-fed stream in the Upper Metolius watershed) before the Jefferson Fire (burned approximately 10% of the Jefferson Creek subwatershed in the summer of 1996) and for 2 years after the fire found that there was no significant change in fine sediment in spawning gravels due to the fire (Houslet and others, 1999). Approximately 6 months after the Jefferson Fire, a small flood occurred (approx. 5 yr flood). Fine sediment collected after the fire, but both before and after this small flood, did not show a significant change in percent fines; however, the invertebrate community moved more toward grazers in the more open post fire canopy. In addition, results showed that the February 1996 flood (prior to the fire), approximately a 20 year flood, significantly reduced fine sediment.

This suggests that although a large rain/melt event after a fire can contribute large amounts of sediment, the associated flood may also flush the sediments out of the system. This would depend on the depositional character of the stream, percent of the subwatershed burned (Jefferson Fire only burned 10% of the subwatershed), amount/intensity of rainfall, and extent of landslide activity after the storm/melt event.

Aq. Table 12. Mean percentage of fine sediment less than 0.85mm in trout spawning gravel of streams in the Metolius Watershed.

Stream	1988	1989	1991	1992	1993	1996	1997	2002	2003	Homogeneity Significance	df	stat	P value
Abbot	-	9.5	-	-	-	3.5	-	-	-	0.12	18	4.86	<0.01*
Brush	-	5.8	-	-	9.4	-	5.3	-	5.4	0.058	3,34	2.472	0.078
Candle	7.8	-	-	-	-	7.3	-	-	-	0.03*	10	0.59	0.28
Canyon	4.3	-	5.3	-	-	2.2[a]	-	-	5.8[a]	0.164	3,27	3.365	0.033*
Lower Jefferson	10.6[a,b]	-	9.4	-	-	5.8[a]	6[b]	-	-	0.720	3,33	4.644	0.008*
Jack	12.4[a,b]	-	9.4	-	-	6.5[a]	-	7.0[b]	-	0.001*	3.31	3.866	0.019*
Roaring	11.1[a,b]	-	10.9[a,b]	6.3	-	5[a]	-	-	4.3[b]	0.743	4,41	5.807	0.001*
S.F.Lake	-	8.5[a]	-	-	-	-	4.7[a]	7.2[a]	-	0.759	2,25	3.702	0.039*
Metolius at Lake Cr	-	-	-	-	-	-	5.1	7.4	-	0.138	17	-2.113	0.025*
Metolius at Gorge	-	-	-	-	-	-	7.8	-	-	-	-	-	-

* A significant difference between all of the previous years (analysis of variance, p<0.05).
The lettered superscript denotes a significant difference between years with a similar letter (Tukey HSD, p<0.05).

Aq. Table 13. Mean percentage of fine sediment less than 6.4mm in trout spawning gravel of streams in the Metolius Watershed.

Stream	1988	1989	1991	1992	1993	1996	1997	2002	2003	Homogeneity Significance	df	stat	P value
Abbot	-	36.0 [a]	-	-	-	17.0 [a]	-	-	-	0.15	18	5.28	<0.01*
Brush	-	30.0	-	-	28.9	-	19.0	-	20.5	0.468	3,34	2.520	0.074
Candle	35.3	-	-	-	-	28.9	-	-	-	0.06	11	1.12	0.14
Canyon	24.9	-	21.1	-	-	-	-	-	26.8	0.107	2,22	0.848	0.442
Lower Jefferson	33.2[a]	-	24.3	-	-	23.0	20.3[a]	-	-	0.153	3,33	3.899	0.017*
Jack	43.8[a,b]	-	32.0	-	-	29.9[a]	-	26.4[b]	-	0.519	3,31	5.623	0.003*
Roaring	41.8[a,b]	-	33.8	22.1[a]	-	-	-	-	24.5[b]	0.241	3,32	7.264	0.001*
S.F.Lake	-	39.0	-	-	-	-	29.9	38.2	-	0.244	2,25	2.760	0.083
Metolius at Lake Cr	-	-	-	-	-	-	24.7[a]	31.0 [a]	-	0.062	17	-1.769	0.047*
Metolius at Gorge	-	-	-	-	-	-	29.9	-	-	-	-	-	-

* A significant difference between all of the previous years (analysis of variance, p<0.05).
The lettered superscript denotes a significant difference between years with a similar letter (Tukey HSD, p<0.05).
Two sample test were performed using t-tests.

Aq. Table 14. Percent of riparian reserves (RRs) within the Lower and Upper Metolius watersheds that were burned since 1994 by mortality class and subwatershed.

2003 SWS	% of RR Burned	% of RR burned by mortality class			
		SR	M	UB	UK
Abbot Creek	100	54	25	20	0
Cache Creek	37	7	19	5	6
Dry Creek	9	1	7	1	0
Candle Creek	68	23	20	25	0
Jefferson Creek	49	8	11	26	4
Canyon Creek	92	35	25	32	0
First Creek	67	22	23	22	0
Jack Creek	87	13	19	55	0
Headwaters Metolius River	4	0	0	4	0
Upper Lake Creek	67	30	26	12	0
Lower Lake Creek	40	11	12	17	0
Upper Fly Creek	0	0	0	0	0
Lower Fly Creek	14	11	3	0	0
Upper Metolius River	3	0	0	1	2
Middle Metolius River	55	32	12	11	0
Street Creek[4]	64	37	20	7	0
Metolius face[5]	53	31	10	12	0
Lower Metolius River[6]	29	25	3	1	0
Spring Creek[7]	93	79	13	1	0
Juniper Creek	0	0	0	0	0
Whitewater River	0	0	0	0	0
Total Watershed	**39**	**15**	**10**	**13**	**0**

Notes:
Percents by mortality class refer to fires between 2002 and 2003. Unknown mortality refers to fires between 1994 and 2002.
SR = stand replacement; M = mixed mortality; UB = underburned or unburned; UK = unknown mortality.

The fire effects to peak flow timing and magnitude can be exacerbated by roads, skid trails, landings, and firelines (Lotspeich et al 1970, DeByle and Packer 1972). Roads can alter surface hydrology through several mechanisms including interception of subsurface runoff (through compaction), concentrating surface runoff, and extending channel networks which increases watershed efficiency. Roads also reduce infiltration, reduce vegetative cover in streamside areas, and accelerate erosion and sedimentation into streams (Megahan 1983). Roads in riparian areas pose the greatest threat to water quality and channel morphology because of their proximity to streams. Roads on slopes adjacent to streams are more likely to be transported to the stream. In addition, past harvest or fire suppression equipment (usually in skid trails, bulldozer lines, and landings) can cause compaction (detrimental soil condition) and associated hydrologic impacts. However, compaction in skid trails is considerable less than roads and compaction in bulldozer lines is even less than skid trails because there are fewer passes by heavy equipment. Continued reduction of roads that increase runoff and sedimentation will remain a key priority for the Metolius Watershed in the post fire period.

Road densities in the subwatersheds affected by the 2002 and 2003 fires, especially in the non-wilderness portions, are high (Aq. Table 17; Aq. Table 18; Aq. Table 19; Aq. Table 20). Surface runoff during rain storms and snow-melt will accelerate following the fire, especially in drainages classified as stand replacing mortality (i.e. Abbot Creek, Brush Creek, upper Jack Creek, First Creek, Link Creek, Street Creek, and Spring Creek). This will put additional pressure on the road drainage network. Shallow or blocked ditches, plugged relief culverts, and inadequate water bar frequency or design could increase the risk of water running down the roads and associated sedimentation. Higher peak flows could threaten existing roadways at stream crossings primarily in the mid- and lower segments of Abbot Creek, Canyon Canyon Creek (primarily Brush and Bear Valley Creek), and First Creek, Middle Metolius River, and Lower Metolius River subwatersheds (Strohm and Fisher 2003; Wilcox et al. 2002). Many of these crossings had or have drainage structures that were undersized (assuming a 100 year event) prior to the fire. Given a predicted increase in peak flow and an increased risk of plugging culverts with debris, many of the structures are not sized or designed to handle the higher peak flows. Drainage failure would lead to road wash-out, which would significantly increase sedimentation and channel erosion and threaten critical fish habitat.

Many of the culverts were evaluated by the Burned Area Emergency Response (BAER) team and were upsized or replaced with bridges within the first year following the fire (McCown 2003). However, there was not enough time (constraints of BAER funding) or money to evaluate the entire area or to fund all the culvert and drainage projects. The crossings identified to date as potential hydrologic risks are listed in Aq. Table 15. Stream crossings should continue to be evaluated in and downstream of the fire area.

Aq. Table 15. Culverts or fords in the Upper and Lower Metolius watersheds that are undersized or at risk of failing.

Road	MP	Stream Crossing	Predicted 100-yr discharge (cfs) prior to fire	Discharge capacity of culvert	Bankfull width	Pre-fire culvert span
1230-500	1.2	Bear Valley Ck.	213	75	17	5
1210	0.5	Davis Ck. (Private)		22	11	4
1200	north	Davis Ck.		57	11	4.7
1200	south	Davis Ck.		57	11	4.7
1200		Lake Ck.		410	22	12.5
1260	1.2	Roaring Ck.		150	17	10.5

Approximately 33 miles of system trails, used by both hikers and horses that are within stand replacing burn areas. These trails intercept a fair amount of surface runoff. After the fire, many drainage structures, which once diverted water off the trails, were completely or partially destroyed. The loss of log drainage structures will cause more of the earthen structures to fail resulting in accelerated erosion and down cutting of trail tread. The loss of trail drainage will increase the risk of sediment transport to the streams by routing water down the trails, thus creating gullies. In addition, sedimentation will increase at stream crossings where trail bridges have been destroyed if trail use continues.

Road densities and stream crossings have changed since the 1994 Metolius Watershed Analysis because 33.10 miles roads have been decommissioned[15] and subwatershed boundaries have changed (Aq. Table 16). Within the Metolius watersheds road densities have decreased since 1994 by 33 miles due to decommissioning, but are still considered a high risk to the aquatic system according to the document, "Determining Risk of Cumulative Watershed Effects Resulting from Multiple Activities" (USDA Forest Service 1993) (

Aq. Table 17). Road densities in the Spring Creek and Street Creek drainages are approximately 4.7 and 4.9 but will be reduced to 3.4 and 4.0 after proposed road decommissions. There are many stream crossings throughout the Metolius watersheds, and more than 100 in Canyon Ck., Headwaters of the Metolius, Upper Fly Creek, Upper Metolius, and Lower Metolius subwatersheds (Aq. Table 18).

Aq. Table 16. Decommissioned roads in the Metolius subwatersheds.

SUBWATERSHEDS	Decommissioned Road Miles						
	Closed Level 1	Open Level 2	Open Level 3	Open Level 4	Open Level 5	Other Roads	Total Miles
ABBOT CREEK						10.41	10.41
CANYON CREEK						7.44	7.44
FIRST CREEK						5.41	5.41
HEADWATERS METOLIUS RIVER						1.29	1.29
JACK CREEK						6.35	6.35
LOWER LAKE CREEK		0.12				2.09	2.21
Total Watershed		**0.12**				**32.98**	**33.10**

Aq. Table 17. Road densities for subwatesheds within analysis area.

2003 SWS	SWS mi^2	% burned since 1994	Miles of road	Road density including wilderness	Road density excluding wilderness
Abbot Creek	**10.0**	**100**	**56.6**	**5.66**	**5.71**
Cache Creek	18.5	47	112.3	6.06	7.32
Dry Creek	19.5	2	59.6	3.05	6.33
Candle Creek	**17.1**	**65**	**10.7**	**0.63**	**5.45**
Jefferson Creek	**28.2**	**50**	**16.5**	**0.59**	**1.06**
Canyon Creek	**32.9**	**92**	**101.3**	**3.08**	**4.87**
First Creek	**20.6**	**70**	**79.2**	**3.84**	**6.17**
Jack Creek	**14.4**	**88**	**65.6**	**4.56**	**5.56**
Headwaters Metolius River	24.2	6	122.3	5.05	5.05
Upper Lake Creek	**17.4**	**60**	**52.9**	**3.04**	**3.04**

2003 SWS	SWS mi^2	% burned since 1994	Miles of road	Road density including wilderness	Road density excluding wilderness
Lower Lake Creek	**17.1**	**64**	**121.9**	**7.12**	**7.12**
Upper Fly Creek	25.6	0	160.7	6.27	6.27
Lower Fly Creek	25.3	14	112.4	4.43	4.43
Upper Metolius River	49.3	7	145.8	2.96	2.96
Middle Metolius River	**33.1**	**60**	**104.1**	**3.14**	**3.14**
Street Creek[4]	**11.4**	**67**	**56.0**	**4.9**	**4.9**
Metolius face[5]	**21.2**	**55**	**29.7**	**1.4**	**1.4**
Lower Metolius River[6]	38.0	26	114	3.0	3.0
Spring Creek[7]	**10.6**	**91**	**49.7**	**4.7**	**4.7**
Juniper Creek[6]	23.6	0	71	3.0	3.0
Whitewater River[6]	32.4	0	32	1.0	1.0
Total Watershed	447.5	35	1539.1	3.44	4.01

Notes:
More than 50% of the area of the subwatersheds in bold was burned in the fire.
Revision of Table 6 in 1994 Metolius Watershed Analysis.

Aq. Table 18. Road-stream crossings for subwatesheds within analysis area.

2003 SWS	Number of stream crossings					
	Perennial	Intermittent	Class 1 & 2	Class 3	Class 4	Total
Abbot Creek	8	63	8		63	71
Cache Creek		26	0		26	26
Dry Creek		15	0		15	15
Candle Creek	1	19	1		19	20
Jefferson Creek	4		1	3		4
Canyon Creek	17	109	17	1	108	126
First Creek	6	51	12		45	57
Jack Creek	6	41	6		41	47
Headwaters Metolius River	9	106	13		102	115
Upper Lake Creek	7	19	8	3	15	26
Lower Lake Creek	18	35	19		34	53
Upper Fly Creek		123	0		123	123
Lower Fly Creek	7	48	5	7	43	55
Upper Metolius River	53	91	0	53	91	144
Middle Metolius River	3	100	2	1	100	103
Street Creek[4]	?	?	2	0	67	69
Metolius face[5]	?	?	1	0	33	34
Lower Metolius River	1	30	1		30	31
Spring Creek[7]	?	?	0	0	47	47
Juniper Creek		5			5	5
Whitewater River	3	5	1	2	5	8
Total Watershed	**143**	**886**	**94**	**70**	**865**	**1029**

Note:
Update of Table 7 in 1994 Metolius Watershed Analysis.

Aq. Table 19. Road miles within riparian reserves (RR) in the subwatersheds of the Metolius Watershed Analysis.

2003 SWS SUB-WATERSHED	ROAD SURFACE TYPE	RR ROAD MILES CLASS 1 & 2	RR ROAD MILES CLASS 3	RR ROAD MILES CLASS 4	RR ROAD MILES in wetland buffer	TOTAL RR ROAD SURFACE MILES	TOTAL STREAM MILES	TOTAL RR ROAD SURFACE MILES/ STREAM MILES
ABBOT CREEK	PAVED	0.35		0.16		0.51	27.5	0.02
	GRAVEL OR NATIVE	3.11		3.72	0.24	7.07	27.5	0.26
ABBOT CREEK TOTAL MILES		**3.46**	**0.00**	**3.88**	**0.24**	**7.58**	**27.5**	**0.28**
CACHE CREEK	PAVED			0.04		0.04	14	0.00
	GRAVEL OR NATIVE			2.64	0.34	2.98	14	0.21
CACHE CREEK TOTAL MILES		**0.00**	**0.00**	**2.68**	**0.34**	**3.02**	**14**	**0.22**
DRY CREEK	PAVED					0.00	19.5	0.00
	GRAVEL OR NATIVE			1.24	0.56	1.80	19.5	0.09
DRY CREEK TOTAL MILES		**0.00**	**0.00**	**1.24**	**0.56**	**1.80**	**19.5**	**0.09**
CANDLE CREEK	PAVED			0.06		0.06	53.5	0.00
	GRAVEL OR NATIVE	3.04		1.14	0.24	4.42	53.5	0.08
CANDLE CREEK TOTAL MILES		**3.04**	**0.00**	**1.20**	**0.24**	**4.48**	**53.5**	**0.08**
JEFFERSON CREEK	PAVED					0.00	62.7	0.00
	GRAVEL OR NATIVE	2.17	0.55			2.72	62.7	0.04
JEFFERSON CREEK TOTAL MILES		**2.17**	**0.55**	**0.00**	**0.00**	**2.72**	**62.7**	**0.04**
CANYON CREEK	PAVED	0.33			0.03	0.36	81.2	0.00
	GRAVEL OR NATIVE	8.99	0.40		1.35	10.74	81.2	0.13
CANYON CREEK TOTAL MILES		**9.32**	**0.40**	**0.00**	**1.38**	**11.10**	**81.2**	**0.14**
FIRST CREEK	PAVED	0.20		0.38	0.07	0.65	27.8	0.02
	GRAVEL OR NATIVE	6.49		2.31	2.12	10.92	27.8	0.39
FIRST CREEK TOTAL MILES		**6.69**	**0.00**	**2.69**	**2.19**	**11.57**	**27.8**	**0.42**
JACK CREEK	PAVED	0.10			0.15	0.25	26.7	0.01
	GRAVEL OR NATIVE	2.47		2.02	0.43	4.92	26.7	0.18
JACK CREEK TOTAL MILES		**2.57**	**0.00**	**2.02**	**0.58**	**5.17**	**26.7**	**0.19**
HEADWATERS METOLIUS RIVER	PAVED	2.10		1.05	0.02	3.17	59.9	0.05
	GRAVEL OR NATIVE	6.51		3.60	0.10	10.21	59.9	0.17
HEADWATERS METOLIUS RIVER TOTAL MILES		**8.61**	**0.00**	**4.65**	**0.12**	**13.38**	**59.9**	**0.22**
UPPER LAKE CREEK	PAVED	0.63		0.04	0.64	1.31	17.8	0.07
	GRAVEL OR NATIVE	1.81		0.81	5.96	8.58	17.8	0.48
UPPER LAKE CREEK TOTAL MILES		**2.44**	**0.00**	**0.85**	**6.60**	**9.89**	**17.8**	**0.56**
LOWER LAKE CREEK	PAVED	0.49		0.20	1.12	1.81	16.3	0.11
	GRAVEL OR NATIVE	4.17	0.20	2.29	2.90	9.56	16.3	0.59
LOWER LAKE CREEK TOTAL MILES		**4.66**	**0.20**	**2.49**	**4.02**	**11.37**	**16.3**	**0.70**
UPPER FLY CREEK	PAVED					0.00	37.8	0.00
	GRAVEL OR NATIVE		1.34	12.26	0.84	14.44	37.8	0.38
UPPER FLY CREEK TOTAL MILES		**0.00**	**1.34**	**12.26**	**0.84**	**14.44**	**37.8**	**0.38**
LOWER FLY CREEK	PAVED					0.00	42.1	0.00
	GRAVEL OR NATIVE	6.71		3.86	1.15	11.72	42.1	0.28
LOWER FLY CREEK TOTAL MILES		**6.71**	**0.00**	**3.86**	**1.15**	**11.72**	**42.1**	**0.28**

2003 SWS SUB-WATERSHED	ROAD SURFACE TYPE	RR ROAD MILES CLASS 1 & 2	RR ROAD MILES CLASS 3	RR ROAD MILES CLASS 4	RR ROAD MILES in wetland buffer	TOTAL RR ROAD SURFACE MILES	TOTAL STREAM MILES	TOTAL RR ROAD SURFACE MILES/ STREAM MILES
UPPER METOLIUS RIVER	PAVED					0.00	124.3	0.00
	GRAVEL OR NATIVE	7.32	7.57	2.32	2.32	19.53	124.3	0.16
UPPER METOLIUS RIVER TOTAL MILES		**7.32**	**7.57**	**2.32**	**2.32**	**19.53**	**124.3**	**0.16**
MIDDLE METOLIUS RIVER	PAVED					0.00	80.2	0.00
	GRAVEL OR NATIVE	1.90	0.06	6.05	0.06	8.07	80.2	0.10
MIDDLE METOLIUS RIVER TOTAL MILES		**1.90**	**0.06**	**6.05**	**0.06**	**8.07**	**80.2**	**0.10**
STREET CREEK[4]						**6.6**	**25**	**0.24**
METOLIUS FACE[5]						**4.1**	**55**	**0.07**
LOWER METOLIUS RIVER TOTAL MILES				**2.1**	**1.0**	**3.1**	**45.9**	**0.7**
SPRING CREEK[7]						**8.4**	**21**	**0.33**
JUNIPER CREEK				**0.2**		**0.2**	**28.0**	**<0.1**
WHITEWATER RIVER		**0.1**		**0.2**		**0.3**	**79.8**	**<0.1**
TOTAL WATERSHED		**59**	**10.12**	**48.69**	**21.64**	**139.45**	**836**	**0.17**

Aq. Table 20. Miles of road on slopes greater than 30% within riparian reserves (RR) or riparian habitation conservation areas (RHCAs).

SUBWATERSHEDS	Miles of road on slopes >30% in RRs
ABBOT CREEK	2.27
CACHE CREEK	0.34
DRY CREEK	0.14
CANDLE CREEK	0.49
JEFFERSON CREEK	1.14
CANYON CREEK	6.34
FIRST CREEK	2.09
JACK CREEK	0.78
HEADWATERS METOLIUS RIVER	4.60
UPPER LAKE CREEK	1.95
LOWER LAKE CREEK	1.99
UPPER FLY CREEK	3.80
LOWER FLY CREEK	6.15
UPPER METOLIUS RIVER	8.21
MIDDLE METOLIUS RIVER	5.71
LOWER METOLIUS RIVER	?
JUNIPER CREEK	?
WHITEWATER RIVER	?
Note: More than 50% of the subwatersheds in bold were burned in the 2002 and 2003 fires.	

Based on past harvest, Abbot Creek and Lower Lake subwatershed are at the 20% detrimental soil condition threshold stated in the Deschutes Nation Forest Plan (Aq. Table 21). A few subwatersheds have stands with greater than 20% of their soils in detrimental condition; but this number has not increased since 1994 (Class C&D).

Also, since 1994 harvest has occurred in Abbot, Cache, Canyon, Jack, Upper Lake, and Lower Lake subwatersheds. At least 2000 acres in the Metolius watersheds have increased detrimental soil damage (changed from class A to class B) since 1994; however, they are still below the Forest Plan standard of 20% detrimental condition.

Aq. Table 21. Detrimental soil condition in subwatersheds of the Metolius River.

2003 SWS	% of SWS in detrimental soil condition	%C&D	Change in A to B acres since 1994
Abbot Creek	20	48	11
Cache Creek	18	39	235
Dry Creek	12	22	0
Candle Creek	6	3	0
Jefferson Creek	?	?	?
Canyon Creek	12	27	323
First Creek	13	27	2
Jack Creek	17	34	230
Headwaters Metolius River	18	40	0
Upper Lake Creek	11	14	603
Lower Lake Creek	21	50	592
Upper Fly Creek	?	0	0
Lower Fly Creek	*10*	0	0
Upper Metolius River	?	?	?
Middle Metolius River	?	?	?
Street Creek[4]	10		
Metolius face[5]	3		
Lower Metolius River	?	?	?
Spring Creek[7]	13		
Juniper Creek	0	?	?
Whitewater River	?		
Total Watershed	**?**		> 1994
Note: Values in italic are estimates.			

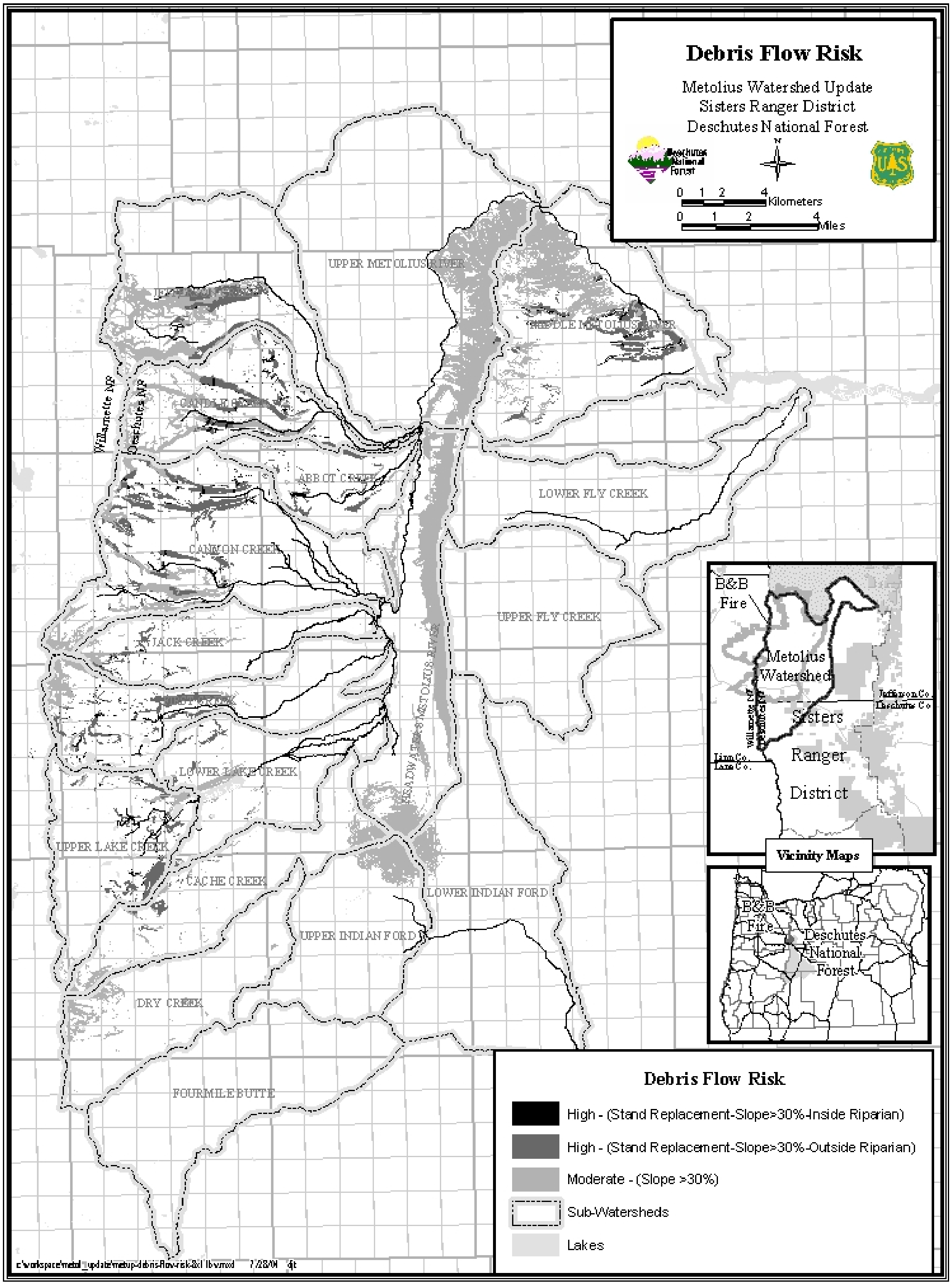
Since the 2002 and 2003 fires, areas stand replacing fire mortality classes and on steep slopes (greater than 30%) are at risk of sliding due to the loss of vegetation and root strength (Aq. Figure 5; Aq. Table 22). Likewise, areas on steep slopes with minimal tree cover due to timber harvest, roads, or other management are also at risk of sliding, albeit somewhat less because of slope stabilization from shrubs and grasses. The risk of debris slides in the Street Creek, Spring Creek, and Bean Creek drainages and the upper and mid-drainages of Abbot Creek, First Creek, and Brush Creek have been severely elevated since the fire and will remain for many years. Although, slopes along the south side of Canyon Creek slid during the 1996 rain-on-snow event, this area was essentially underburned (low severity burn) and is not at an elevated risk for sliding.

Debris slides can contribute large amounts of sediment to streams, significantly altering water quality and channel morphology and threatening critical fish habitat. Approximately 7 to 10 skid trails in the headwaters of Jack Creek off the 1220-700 road are at risk of eroding and some gullies have already formed. However, there is only a minimal risk of sediment reaching the intermittent channel due to the broad flat terrain at the bottom of the slope. It appears that the debris flows in Canyon Creek were related to timber harvest activities from 1989. In addition, the flooding and debris flows caused significant road damage. Although, sedimentation and bank erosion occurred, fish habitat appears unaffected or improved (Chitwood et al. 1996).

The risk of adverse water quality effects due to anthropogenic inputs and wildfire were determined for each subwatershed and for the Metolius watersheds (Aq. Table 23). On a subwatershed scale, fire effects and anthropogenic effects are high but on a watershed scale some of the effects are muted.

Overall road densities in the Metolius watersheds (5^{th} fields) are high and there are over 130 native surface road miles in the riparian reserves and over 1000 stream crossings. In addition, approximately 1200 acres of stand replacing fire occurred on slopes greater than 30 percent withn the Riparian Reserves. The mainstem Metolius River is designated a Wild and Scenic River with exceptionable water quality. It provides bull trout, redband trout, and kokanee salmon spawning habitat and bull trout, redband trout, sockeye salmon, and chinook salmon rearing habitat. In some spawning areas in the Metolius River, increases in sedimentation are predicted due to sediment inputs from tributaries. Based on the variables in the risk of increased sedimentation was assessed (Appendix Aq1) and the risk ranking is listed by subwatershed in the Fish Habitat/Channel Morphology section of the Aquatics section.

Aq. Figure 5. Debris slide risk areas in the Metolius watersheds.



Aq. Table 22. Risk of debris slides occurring and reaching streams based on acres burned, stand replacement acres burned, and acres with canopy cover less than 15% within subwatersheds in the Metolius Basin and within their riparian reserves on slopes greater than 15% and 30%.

2003 SWS	Acres burned on slopes >30%	SR acres burned on slopes >30%	SR Acres on slopes >15% within RRs	SR Acres on slopes >30% within RRs	Risk of debris slide reaching streams
Abbot Creek	559	380	204	51	Mod
Cache Creek	388	164	5	0	Very Low
Dry Creek	0	0	0	0	Very Low
Candle Creek	1927	857	370	137	High
Jefferson Creek	3404	1302	142	84	Mod
Canyon Creek	3778	1749	594	143	High
First Creek	1538	635	193	41	Mod
Jack Creek	674	254	79	14	Low
Headwaters Metolius River	121	6	5	1	Very Low
Upper Lake Creek	1235	610	176	68	Mod
Lower Lake Creek	599	252	50	17	Low
Upper Fly Creek	0	0	0	0	Very Low
Lower Fly Creek	51	47	5	1	Very Low
Upper Metolius River	167	47	13	1	Low
Middle Metolius River	5022	3179	728	422	High
Lower Metolius River[6]	250	1000	150	190	High
Juniper Creek	0	0	0	0	Very Low
Whitewater River	0	0	0	0	Very Low
Total Acres	19713	10482	2714	1170	
Total % of Metolius Watersheds	**7**	**3**	**1**	**0.4**	

Aq. Table 23. Variables evaluated for determining water quality effects from wildfire and anthropogenic inputs. Values in italics are estimates.

SWS	**road density excluding wilderness**	**RR road miles on slopes >30%**	**# stream crossings/ stream mi**	**RR native surface/ gravel road miles**	**SR acres on slopes >30% in RRs**	**% RR in SR**	**% RR burned**	**SR Acres on slopes >30% within RRs**	**Sediment-ation Risk Factor**
Abbot Creek	5.71	2.27	2.58	7.07	51	54	100	51	5
Cache Creek	7.32	0.34	1.86	2.98	0	7	37	0	1
Dry Creek	6.33	0.14	1.43	1.8	0	1	9	0	1
Candle Creek	5.45	0.49	0.37	4.42	137	23	68	137	4
Jefferson Creek	1.06	1.14	0.06	2.72	84	8	49	84	1
Canyon Creek	4.87	6.34	1.55	10.74	143	35	92	143	5
First Creek	6.17	2.09	2.05	10.92	41	22	67	41	5
Jack Creek	5.56	0.78	1.76	4.92	14	13	87	14	1
Headwaters Metolius River	5.05	4.6	1.92	10.21	1	0	4	1	4
Upper Lake Creek	3.04	1.95	1.46	8.58	68	30	67	68	4
Lower Lake Creek	7.12	1.99	3.25	9.56	17	11	40	17	5
Upper Fly Creek	6.27	3.8	3.25	14.44	0	0	0	0	4
Lower Fly Creek	4.43	6.15	1.31	11.72	1	11	14	1	4
Upper Metolius River	2.96	8.21	1.16	19.53	1	0	3	1	2
Middle Metolius River	3.14	5.71	1.28	8.07	422	32	55	422	
Street Creek[4]	4.9	?	2.80	*6.0*	?	37	64	?	5
Metolius face[5]	1.4	?	0.60	*3.5*	?	31	53	?	2
Lower Metolius River	*3*	?	0.68	*2.5*	*190*	*25*	*29*	190	
Spring Creek[7]	4.7	?	2.20	*7.0*	?	79	93	?	5
Juniper Creek	*3*	?	*0.18*	*0.2*	0	0	0	0	1
Whitewater River	*1*	?	*0.10*	*0.3*	0	0	0	0	1
Total Watershed	**4.01**	**?**	**1.23**	**130.7**	**1170**	**15**	**39**	**1170**	

Note:
The sedimentation risk factor is on a scale of 1 to 5, with 5 being the subwatershed with the greatest risk of increased sedimentation.

Water Chemistry

Water quality protection is a key interest in the Metolius Watershed because of the high quality of the Metolius River and because of concerns of organic pollution from septic systems around Suttle Lake and/or the recreation residences along the Metolius River. Additional concern exists as a result of the listing of Lake Billy Chinook (LBC) reservoir on the Oregon 303(d) list for pH and chlorophyll *a* exceedences, both of which are affected by nutrients (ODEQ 2002).

Since the completion of the Metolius Wild and Scenic River Plan (USDA 1997), nutrients and bacteria have been monitored in a partnership with the Friends of the Metolius to establish a baseline condition for the Metolius River and detect any sources of pollution that might be occurring. The Wild and Scenic River Plan outlined Limits of Acceptable Change as a method of monitoring conditions and setting standards. For E. coli bacteria, the limit is half of the ODEQ criteria (64 colonies/100ml) due to the already outstanding water quality in the Metolius River. Other limits are set using the baseline conditions at the time of the plan development. Measurements of nitrates and phosphorous are used to establish this level for a baseline, and future monitoring will be compared against these baseline conditions. In addition, extensive nutrient monitoring was conducted by Portland General Electric and the Confederate Tribes of the Warm Springs Reservation for the relicensing of the Pelton Round Butte Dam (CTWSR and PGE 2002).

Nitrates and phosphorous were selected for monitoring as part of the Friends of the Metolius partnership because of concerns of pollution from nearby septic drainfields into the groundwater and into the springs feeding the streams and lakes of the Metolius Watershed. There was concern raised in the 1980s for the health of Suttle Lake and some researchers suggested that the algae bloom was becoming more intense and water clarity was decreasing (Aquatic Analyst, 1990). It was thought that phosphorous was naturally occurring due to the composition of the weathered volcanic bedrock. Nitrogen is considered the limiting nutrient controlling plant and algae growth in Suttle Lake and the Metolius River. The balance of these nutrients is important in measuring the water quality and aquatic ecology of the watershed. E. coli bacteria was selected as a good indicator of pollution from domestic waste water, and one indicator that would address concerns for public health.

Bacteria

Monitoring of E. coli bacteria since 1995 has generally found low levels of this fecal bacteria in the Metolius River and Suttle Lake/Lake Creek (Aq. Table 24). Average counts (1 to 12 colonies per 100 ml) of E. coli bacteria were well below the standard set in the Wild and Scenic River Plan (60 colonies/100ml). However, bacteria counts were highly variable and spikes of higher counts were found at some sites to over 60 colonies/100ml. In two instances, counts over 64 colonies/100ml were found. These sites recovered to normal levels in the next sample period, however. A recent spike was detected in the river above the confluence with Lake Creek, setting the 2003 year apart from other years. In general, no significant concern was identified from the bacteria monitoring, since levels for the Metolius River were low compared to most nearby streams. As monitoring continues, future spikes in bacteria counts should be followed up with more targeted repeat sampling to determine the source. Bacteria is unlikely to be affected by the wildfires in the watershed.

Nitrates

Nitrate monitoring reveals a distinct trend of the headwater spring of the Metolius River being the source of nitrogen, with a decreasing trend downstream as nutrients are absorbed by algae and bacteria in the river (Aq. Table 25). The year 1997 was a high year for nitrate values measured, but recent years have showed no trend (Aq. Table 24). There was no trend to nitrogen levels by month (Aq. Table 25), as would be expected due to the source originating primarily from the headwater springs. Levels were below the 0.1 mg/L reporting level at all sites except for the Metolius River springs, where levels averaged 0.108 mg/L. There are no national standards for nitrate concentrations but a concentration < 0.3 mg/L would likely prevent eutrophication (MacDonald et al. 1991). Results indicate that the Metolius River is still nitrogen limited. It appears that nitrogen decreases downstream as algae and bacteria absorb it (Codder and Riehle 2001).

Phosphorous

Orthophosphorous measurements were lowest in 1996, when the monitoring began. Since then no changes have occurred (Aq. Table 24). May is the month with the highest values recorded for total phosphorous (Aq. Table 25). Various differences between sites were significant. Orthophosphorous concentrations at all the sites were significantly less than concentrations at the Metolius Springs, as a result of the natural phosphorous-rich volcanic rock in the Metolius Basin (
Aq. Table 26). The most important finding was that orthophosporous concentrations are highest at the Metolius Springs (same trend as nitrates) and lowest at the mouth of Link Creek and the outlet of Suttle Lake. In addition, orthophosporous concentrations at the Lake Creek outlet are significantly less than the other Metolius River sites; therefore, suggesting that algae growth in Suttle Lake and Blue Lake may be processing the nutrients.

Water quality monitoring results from the 1996-2003 in the Upper Metolius River show that orthophosphorus levels continue to be high in the Metolius basin, ranging from 0.05 to 0.08 mg/L (Aq. Table 24). Although no standards are established for phosphorus, MacDonald et al. (1991) suggests streams entering lakes or reservoirs should not exceed 0.05 mg PO_4-P/L in order to prevent eutrophication. High phosphorus concentration is natural in the Metolius basin due to the interaction of phosphorus rich volcanic rock and ground water (CTWSR and PGE 2002). Chitwood (1997) found natural amounts as high as 2.3 mg/L total phosphorus discharging from the Metolius River springs. Once these waters enter the reservoir concentrations drop to 0.03 to 0.06 mg/L (Johnson 1985), within the range suggested by MacDonald and others (1991).

pH

As mentioned earlier, State and Tribal standards for pH are exceeded in LBC Reservoir. According to monitoring data reported in the Pelton Round Butte Project Water Quality Management and Monitoring Plan (WQMMP), high pH values in the reservoirs are limited to the surface waters (CTWSR and PGE 2002a). In the deeper water, pH remains within the standard at all times. These exceedances are the result of high levels of photosynthetic activity promoted by the high concentration of nutrients, principally phosphorus, in the waters above the Pelton Round Butte Dam. The phosphorus enters the reservoir in the tributary streams and appears to be largely of natural origin. Of the tributaries, the Metolius River has the lowest pH, not exceeding a pH of 8.3. No nutrients are contributed to the water by the reservoir. With regard to the pH of the reservoir discharge, data collected from 1994 through 2001 indicate that pH, maximum pH in particular, is higher in tributary inflows to LBC reservoir than in water released at the Reregulating Dam.

Based on this data, it appears that there is no measurable increase in pH through the reservoir area and that the reservoir is reducing the pH of the inflow (CTWSR and PGE 2002a). As part of the WQMMP, CTWSR and PGE are proposing a Selective Water Withdrawal facility to improve water quality and surface currents in LBC reservoir (CTWSR and PGE 2002). ODEQ is reasonably assured that operation of the Project will comply with the pH standard provided that CTWSR and PGE meet monitoring, maintenance, and policy conditions outlined in the Findings document (ODEQ 2002b).

Chlorophyll a

In addition, the state and tribial nuisance phytoplankton growth standard of 15 ug/L of Chlorophyll *a* is exceeded during the summer within LBC Reservoir. High summertime concentrations of Chlorophyll *a* are the result of input of nutrients from the tributary rivers and natural processes of seasonal stratification in the reservoirs. The concentration of phosphorus in the Metolius River is the result of the abundance of phosphorus in the basaltic bedrock of the basin. Likewise, much of the phosphorus in the reservoirs appears to be of natural origin. Blooms of blue-green algae in LBC Reservoir are the result of excess phosphorus and relatively low nitrogen. The artificial impoundments created by the dams provide a suitable environment for this high level of primary production to take place (CTWSR and PGE 2002).

CTWSR and PGE have conducted extensive studies describing present reservoir water quality; assessed impacts on beneficial uses; assessed probable cause of the trigger exceedance and beneficial use impact; and developed a proposed control strategy for attaining compliance where technically and economically practicable (2002). These actions are consistent with an action process lined-out in the standard as OAR 340-041-0150(2)(a). ODEQ concurs with the PGE and CTWSR's position that while the trigger value is exceeded in the reservoirs during the summers, beneficial uses of the dam impoundments are not adversely affected by nuisance phytoplankton growth. In addition, the Selective Water Withdrawal facility should help reduce phytoplankton growth in the reservoir. ODEQ is reasonably assured that operation of the Project will comply with the nuisance phytoplankton growth standard provided that CTWSR and PGE meet monitoring, maintenance, and policy conditions outlined in the Findings document (ODEQ 2002b).

Suttle Lake

Suttle Lake water quality has been monitored since the previous watershed analysis. Repeated water testing at various depths was conducted by the Sisters Ranger District in the years of 1995 and 2001. Although trends in water clarity were noted by previous investigators (Aquatic Analyst, 1990), recent conditions in water clarity have remained similar or improved slightly since the early 1970s (Aq. Figure 6). Change in the water clarity, as measured by the depth of water at which the secchi disk is visible, has not recovered to the earliest measurements from 1940 (Newcomb 1940).

Measurements of pH in Suttle Lake were compared to those of previous research. A recent trend in pH was not apparent since the early 1970s (Aq. Figure 7). Algae blooms continue to occur and appear to be more pronounced during years of drought or low summer precipitation. Grab samples taken by the Sisters Ranger

District during the bloom of September 26, 2003, showed surface water with a average pH of 9.2. Although turbidity levels can rise in streams downstream of Suttle Lake (i.e. Lake Creek and the Metolius River) during a bloom such as the September 2003 event, this bloom does not appear to have intensified in the last 30 years. Algae diversity and dominance of bluegreen algae species did not show a trend toward eutrophication from the 1980s through the 2001 samples (Sweet 2002). However, recent monitoring of bluegreen algae (July 2004) has revealed levels over the World Health Organization's warning level of 15,000 cells/mL. Monitoring is on-going and currently algae levels have not reached the level recommended by the World Health Organization for lake closure of 100,000 cells/mL (pers. comm. Wilcox, 2004).

Improvements to nearby septic systems include the Forest Service Waterski Day Use Area, Suttle Lake Resort, and Camp Caldera (formerly known as Blue Lake Resort). These upgrades may have curbed the trend in bluegreen algae production, water clarity and pH in Suttle Lake.

Post fire conditions of Suttle Lake may not be significantly altered. Lake productivity post fire was not found to increase in lakes in northern Minnesota, even though streams feeding the lakes had elevated nutrients from the effect of the fire (Gresswell 1999, Wright 1976, Taraochak and Wright 1986). Little research on the effects of watershed scale fire is available on lake ecosystems. Due to the limited drainage area and inlet streams to Suttle Lake, the risk is low that changes will occur to the water quality of the lake after the fires.

Wildfire

Within the Fire areas, the primary nutrients of concern, in relationship to timber harvest and fire activities, are phosphorus and nitrogen. In the Metolius Watershed area the primary concern with any nutrient increase in the streams, is a potential for increasing the nutrient levels in the Metolius River and ultimately, Lake Billy Chinook Reservoir, which could lead to increased algae growth in the reservoir.

During the burning process, some nutrients in the grass and duff are released into the atmosphere; however, most remain in the ash and are rapidly reabsorbed into the topsoil (DeByle 1981). Nutrients can remain ionically attached to soil particles until utilized by newly established vegetation after a fire. Before vegetation reestablishes, nutrient leaching could occur but the risk is significantly reduced significantly in soils with high cation exchange capacity and moderately well drained soil permeability characteristics. It is hard to predict if these increases in nutrients will be taken up by plant growth or bacteria before entering Lake Billy Chinook. However, little effect was noted is lake ecology after fires in lakes in northern Minnesota (Write 1976, Tarapchak and Wright 1986) and Yellowstone Lake (Gresswell 1999).

Both nitrate and phosphorous concentrations are expected to be higher in the surface waters after there is wildfire in the watershed. Hauer and Spenser (1998) reported the highest levels of nutrient increase correlated to those areas with high burn severity. Robinson and Minshall (1996) reported nitrate concentrations were directly related to the proportion of the watershed burned. Although relatively small proportions of the entire Metolius Watershed burned with high severity, some increases in nutrients may occur. Studies have shown that water chemistry is most often altered during the first few storms following fire and typically returns to pre-burn levels within one to five years (Spencer and Hauer 1991; Debano et al. 1998; Gresswell 1999).

Aq. Table 24. Mean values and tests of significance of water quality measurements between years for all Metolius River sites.

Nutrient/ Bacteria	1996	1997	1998	1999	2000	2001	2002	2003	Equality of variance	df	F-stat	P value
e. coli (colonies/100ml)	-	3.3^{a}	1.14^{b}	5.46	5.50	4.86	7.84	11.9^{ab}	<0.001*	6	3.044	0.008*
nitrate (mg/l)	0.088	0.093^{ab}	0.044^{a}	0.043^{b}	-	0.108	0.064	0.072	<0.001*	6	2.872	0.011*
Orthophosphoros (mg/l)	0.052^{abc}	0.079	0.081^{a}	0.071	-	0.076	0.080^{b}	0.079^{c}	0.012*	6	2.970	0.008*
total phosphorous (mg/l)	0.095	0.231	0.094	0.089	-	-	-	-	<0.001*	3	2.690	0.050

Note:
Values which were not similar (Tukey HSD, P<0.05) were given like-lettered superscript.
* A significance at the P<0.05 level.

Aq. Table 25.Mean values and tests of significance of water quality measurements between months for all sites.

Nutrient/ Bacteria	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Equality of variance	df	F-stat	P value
e. coli (colonies/100ml)	2.1^{a}	1.9^{b}	2.90	3.30	2.4^{c}	5.50	10.5^{abcd}	6.70	5.10	10.60	3.60	1.9^{d}	<0.001*	11	2.617	0.004*
nitrate (mg/l)	0.089	0.054	0.06	0.055	0.085	0.056	0.064	0.055	0.057	0.063	0.050	0.050	0.001*	11	0.907	0.535
orthophosphorou (mg/l)	0.061	0.060	0.058	0.056	0.065	0.064	0.061	0.073	0.066	0.072	0.066	0.070	0.100	11	1.040	0.411
total phosphorous (mg/l)	0.076^{a}	0.093	0.118	0.070	0.334^{abcde}	0.081	0.093	0.075^{b}	0.082^{c}	0.087^{d}	0.082	0.072^{e}	<0.001*	11	2.080	0.025*

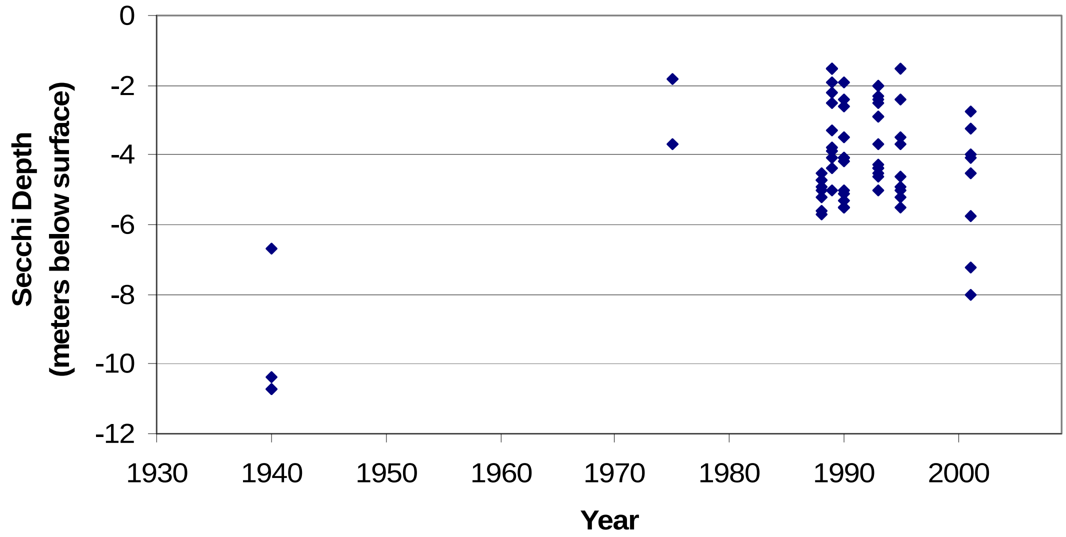
Note:
The interaction of month and site was not significant at the P<0.05 level.
Values which were not similar (Tukey HSD, P<0.05) were given like lettered superscript.
* A significance at the P<0.05 level.

Aq. Table 26.Tests of significance of water quality measurements between sites. Symbol denotes a significance at the P<0.05 level.

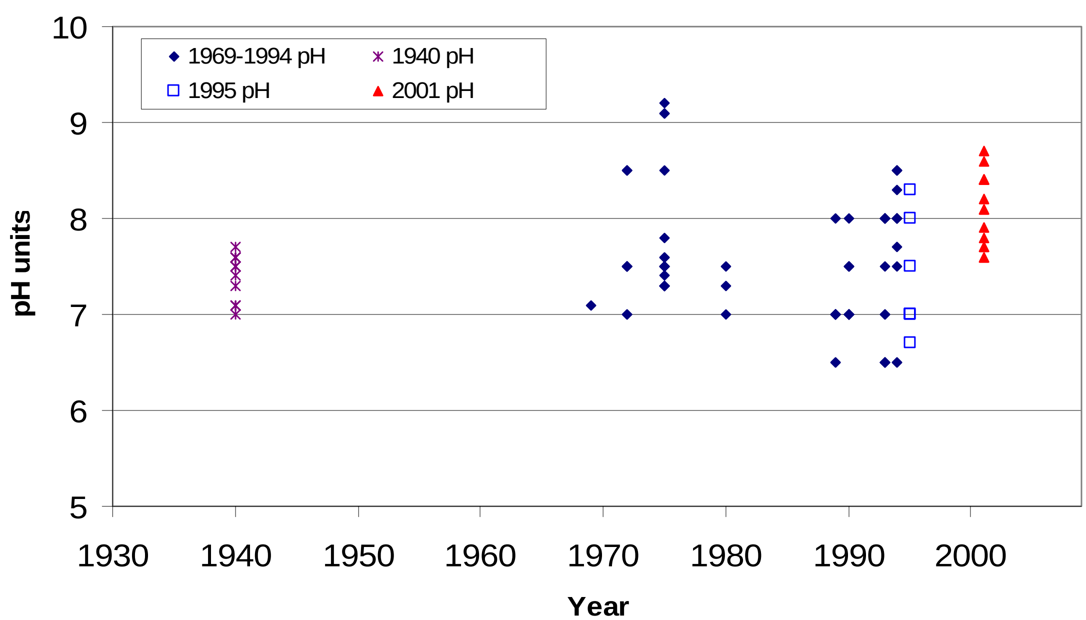
Nutrient/Bacteria	Link Cr at mouth	Suttle Lake Outlet	Lake Cr at mouth	Metolius Springs	Metolius u/s Lake Cr	Metolius at Camp Sherman	Metolius at Allingham	Metolius at Gorge	Jack Creek	Canyon Creek	Equality of variances	df	F-stat	P value
e. coli (colonies/100ml)	5.9	2.6	5.1	1.1	7.9	4.7	13.5	4.6	3.70	4.20	0.004*	9	1.468	0.162
nitrate (mg/l)	0.021	-	0.047	0.114@	0.046	0.053	0.06	0.047	-	-	0.106	6	10.759	<0.001*
orthophosphorous (mg/l)	0.027	0.01#	0.042^	0.09@	0.074	0.073	0.074	0.073	0.070	0.05	<0.001*	9	77.433	<0.001*
total phosphorous (mg/l)	0.050	-	0.061	0.172	0.081	0.120	-	0.132	-	-	0.151	5	1.210	0.307

Notes:
^ - significantly lower than all Metolius River sites from
# - significantly lower than all sites except Link Creek at the mouth
@ - significantly different from all sites

Aq. Figure 6. Water clarity, as measured by the depth at which a secchi disk is visible, of Suttle Lake. Historic data from Newcomb (1940) and Aquatic Analyst (1990).



Aq. Figure 7. Water pH concentration in Suttle Lake. The 1995 and 2001 data were from lab tests of water samples collected at various depths. Historic data from Newcomb (1940) and Aquatic Analyst (1990).



Stream Temperature

Stream shade has been significantly to completely denuded in riparian areas classified as stand replacing burn (Aq. Table 14). Riparian areas in Abbot Creek, Candle Creek, Cabot Creek, First Creek, Brush Creek, upper Link Creek, Street Creek, Spring Creek, and Bean Creek are the most severely impacted. Increased solar energy will elevate surface water temperatures. Sources of cooler water from adjacent springs will help to buffer stream temperature increases. The riparian shrubs along these drainages are expected to rapidly recover over the next few years and provide some cover especially on the smaller drainages. The fire killed trees will provide little shade and large tree recovery is not expected for another 50 to 100 years. Lower Brush Creek, Canyon Creek (part of which is downstream from Brush Creek), First Creek, and Lake Creek subwatershed were listed prior to the fire on the 2002 303(d) list as "Water Quality Limited" by the State of Oregon for water temperature exceedances over the standard (ODEQ 2002) (
Aq. Table 11).

The long term analysis of water temperature has showed no significant trends over time of any streams in the Metolius Watershed (Aq. Figure 8; Aq. Figure 9). Some variation could be attributed to water years and drought cycles, although water discharge data were not available for comparison.

Bull trout spawning streams had consistently lower maximum water temperature in July than bull trout streams with bull trout rearing alone. Abbot Creek and Brush Creek (rearing only streams) had slightly higher maximum water temperatures that did the main spawning streams. The Metolius River at Bridge 99 had consistently cooler water temperature than the Metolius at Gorge Campground.

Brush Creek and upper Canyon Creek have been listed for 7-day average maximum temperatures exceeding 10 ^{o}C (50^{o}F[11]) on the 2002 303(d) list by ODEQ. Juvenile bull trout have been found in these streams but no evidence of spawning bull trout have been recorded in these stream segments. Brush Creek exceeded the criteria 10 to 20 days on some years (Aq. Figure 10). South Fork of Lake Creek is listed for temperature for salmonid rearing criteria of exceeding 64 ^{o}F[11]. Because of its source as the outlet of Suttle Lake, water temperatures were consistantly higher than the criteria for all years of record (Aq. Figure 9).

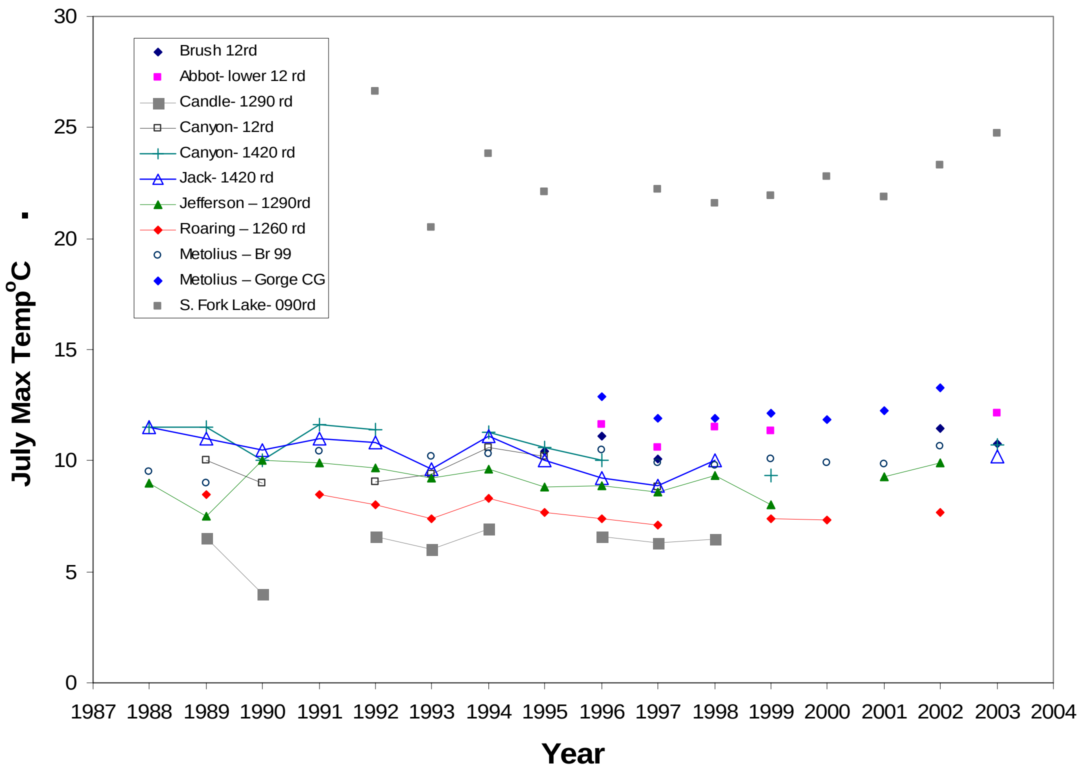
First Creek is an intermittent stream with short perennial segments. Water temperatures in the record exceeded the 55^{o}F[11] criteria for salmonid spawning habitat. At the time these temperatures are recorded, much if not all of the flow of First Creek had diminished at the mouth of the creek. Any spawning occurring in the reach near the 12 road crossing would be of resident brook trout and low densities of redband trout. There is no long-term data set of temperature for this location. Upper First Creek, upstream of the 1210 rd, is perennial but may only have non-native brook trout present, no redband trout. Because upper First Creek was burned high severity, increases in water temperatures in upper First Creek could be expected near the 1210 crossing. Because of the intermittent natural of flow in the summer, the effect of the fire mortality and loss of shade may not translate downstream to the 12 road crossing, an area of low riparian tree mortality.

The effect of over story tree mortality from the wildfires may have an effect on Brush Creek due to its small width, low summer flow and the intensity of the burn along the channel in the upper reach. Spring-fed inputs along the length of the stream may offset the effects of the fire. If water temperatures do increase in this stream, it may provide an increased niche for brook trout, which has been found to be a non-native competitor of bull trout in some locations.

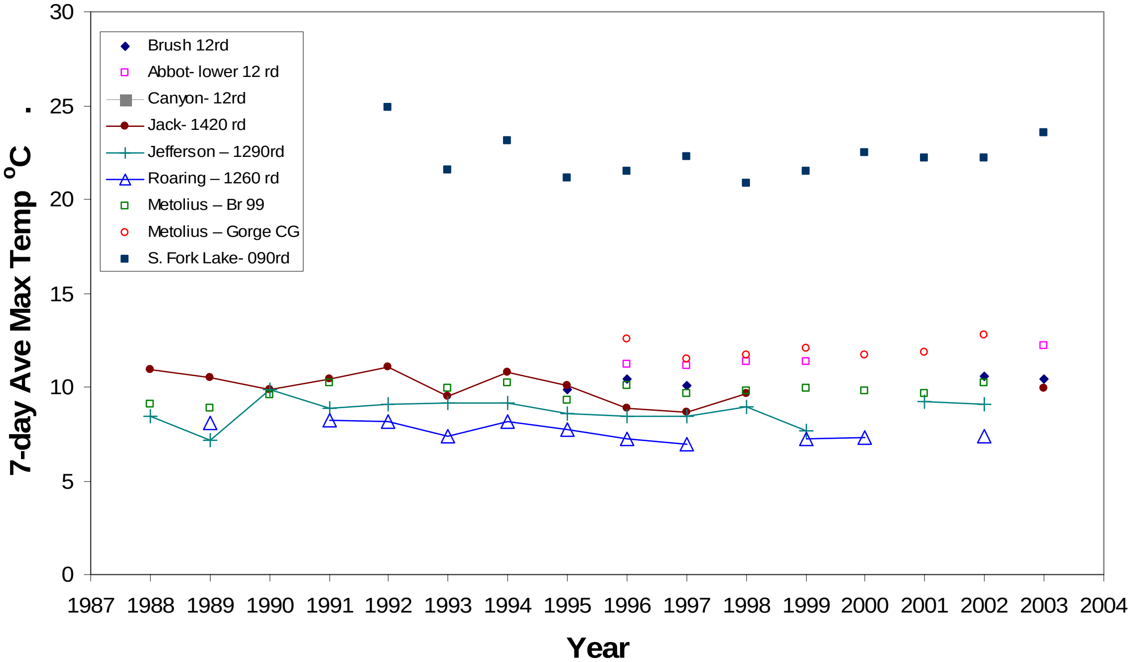
[11] This was the 2002 standard but temperature standards changed in 2004 (refer to Standards of Parameters of Concern section under Water Quality).

Lake Creek water temperatures may be little affected by the burn area because of the light under burn along the stream downstream of Suttle Lake. The water temperatures in the lake will not be impacted, which largely determines the temperature of the stream. The upper Link Creek watershed had mixed mortality along the stream but summer flows do not reach Blue Lake to influence Lake Creek downstream. Similarly, there is no connection of Cache Creek, flowing through the Cache Mountain Fire, to Lake Creek in the summer.

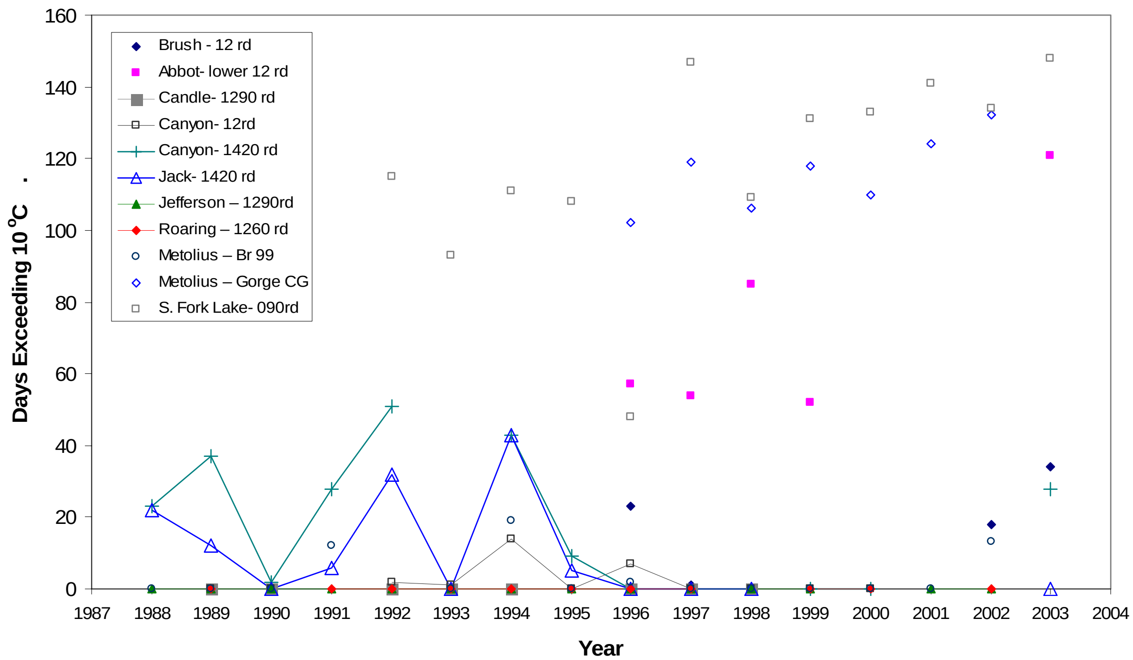
Aq. Figure 8.Maximum July water temperatures (°C) in long term monitoring sites in streams of the Metolius Watershed. Data connected with lines are bull trout spawning streams.



Aq. Figure 9. Maximum 7-day average maximum water temperatures (ºC) for long term monitoring sites in streams of the Metolius Watershed. Data connected with lines are bull trout spawning streams.



Aq. **Figure 10. Number of days exceeding 10ºC water temperatures at long term monitoring sites in streams of the Metolius Watershed.**



Note: Data connected with lines are bull trout spawning streams.

Post-fire monitoring in Jefferson Creek following the Jefferson fire in 1996 showed no change in water temperature after nearly 2 miles of stream were burned. The limited length of stream burned, moderate discharge and the inputs of groundwater springs above and below the fire area combine to offset the effect of the fire on Jefferson Creek. Post fire monitoring of Street Creek following the Eyerly Fire showed similar results. Canyon shading, headwater springs and reduced tree mortality in the perennial reach may combine to reduce the effect of the burn on temperatures of that stream. Some investigators found little change in water temperatures of streams burned in large wildfires (Amaranthus and others 1989); however, most investigators found stream temperature increases (Gresswell 1999). Variations in annual discharge and weather can cause variability and make direct pre-and post-wildfire comparisons difficult.

The loss of canopy closure in riparian reserves was assessed using pre-fire satellite imagery and adjusting the change in canopy after the wildfires based on stand mortality data. Significant loss of riparian canopy occurred in the Abbot, Cache, Candle, Canyon, Jefferson and Upper Lake Creek subwatersheds (Aq. Table 27; Aq. Table 28). These subwatershed have nearly 1000 acres or greater of riparian reserves in the very low (0-19%) canopy class. Canyon Creek has 2567 acres of riparian reserve in the very low canopy class. This watershed has many important bull trout streams, including Canyon Creek, Roaring Creek and Brush Creek. The effect of reduced canopy on Canyon Creek is restricted to the upper reaches, upstream of the mouth of Roaring Creek.

Reduced canopy may have the most effect on streams with low discharge and high width to depth ratios. Upper Brush Creek may increase in temperatures but spring inputs may off-set the effects of the fire in the lower reaches. Abbot Creek may have a similar off-set to water temperature increases from the springs just upstream of the upper 12 road crossing. Candle Creek, the coldest stream of the Metolous Watershed, gains nearly 70 percent of its flow from a large complex of springs near the trailhead. Jefferson Creek has a similar spring influence, where groundwater springs from the lava flow at several places along its length. These groundwater springs may reduce the effects on water temperature in the watershed as a whole and not impact the Metolius River to any large degree.

Upper Lake Creek subwatershed consists primarily of Link Creek and its tributaries. Riparian reserves along this subwatershed experienced a mixed mortality burn from the B and B Fire; however, very little of this subwatershed is perennial and it only supports a isolated population of brook trout. Upper Link Creek flows into a meadow in the spring, and usually sinks into the moraine of the Blue Lake Crater. Surface water flowing into Blue Lake from Upper Link Creek does not occur some years. Another unnamed tributary enters Blue Lake at the north end. This small stream may increase in temperature slightly but because of it outlet being intermittent, may have little influence on Blue Lake or waters downstream.

Recovery of stream shade will be first provided by rapidly growing shrubs such as Vine Maple, Pacific Ninebark and Mountain Alder. These shrubs were growing densely along these streams before the fires and may recover from roots not damaged by the fire. In October, sprouting of leaves was observed in cottonwood along First Creek and from various riparian shrubs along Jefferson Creek. These streambank deciduous shrubs can provide some shade in a relatively short time, in comparison to conifers. Long-term shade may take perhaps 30 years to recover after the fire if regeneration is successful. Competition from snowbrush and mazanita may slow the regeneration of conifers in some streamside locations.

Aq. Table 27. Acres of riparian reserves by canopy closure class prior to recent wildfires fires. Data was calculated using canopy from satellite imagery.

	0 to 19 percent	20 to 39 percent	40 to 59 percent	60 to 79 percent	80 to 100 percent
Subwatershed Name	**very low**	**low**	**moderate**	**high**	**very high**
ABBOT CREEK	248	558	393	33	0
CACHE CREEK	110	349	129	0	0
CANDLE CREEK	823	915	804	224	12
CANYON CREEK	582	1783	1790	480	0
DRY CREEK	126	245	77	26	0
FIRST CREEK	189	1694	684	153	0
FOURMILE BUTTE	14	25	14	73	4
HEADWATERS METOLIUS	198	1040	966	249	0
JACK CREEK	172	724	381	68	0
JEFFERSON CREEK	251	2558	629	103	0
LOWER FLY CREEK	554	727	251	89	0
LOWER INDIAN FORD	612	290	18	0	0
LOWER LAKE CREEK	318	876	511	22	0
MIDDLE METOLIUS RIVER	1055	920	773	277	15
UPPER FLY CREEK	273	522	91	0	0
UPPER INDIAN FORD	651	307	124	1	0
UPPER LAKE CREEK	415	1067	402	39	0
UPPER METOLIUS RIVER	83	2502	982	570	17

Aq. Table 28. Acres of riparian reserves by canopy closure class after recent wildfires. Data was calculated using canopy closure from satellite imagery and mortality classes determined post-fire.

	0 to 19 percent	20 to 39 percent	40 to 59 percent	50 to 79 percent	80 to 100 percent
Subwatershed	**very low**	**low**	**moderate**	**high**	**very high**
ABBOT CREEK	992	208	31	0	0
CACHE CREEK	224	248	116	0	0
CANDLE CREEK	1472	745	477	85	0
CANYON CREEK	2567	1369	694	6	0
DRY CREEK	146	230	72	26	0
FIRST CREEK	1350	864	399	107	0
FOURMILE BUTTE	14	25	14	73	4
HEADWATERS METOLIUS	216	1038	950	249	0
JACK CREEK	472	678	193	0	0
JEFFERSON CREEK	942	2166	372	60	0
LOWER FLY CREEK	563	718	251	89	0
LOWER INDIAN FORD	612	290	18	0	0
LOWER LAKE CREEK	586	751	381	10	0
MIDDLE METOLIUS RIVER	1808	689	436	98	8
UPPER FLY CREEK	273	522	91	0	0
UPPER INDIAN FORD	651	307	124	1	0
UPPER LAKE CREEK	1136	662	111	14	0
UPPER METOLIUS RIVER	191	2393	982	570	17

Groundwater

Groundwater quality has been a concern in the earlier watershed analysis and during the development of the Metolius Wild and Scenic Plan. Concerns included the risk of pollution of the springs feeding the Metolius River from nearby septic drainfields along the river corridor. High water quality was identified in the Wild and Scenic River Plan as an outstandingly remarkable value to be protected. In addition, several water systems had tested positive for fecal bacteria and there were isolated reports of people becoming ill from their drinking water. Several new wells were drilled deeper to avoid the problem of drawing domestic water from shallow wells. Some of the older wells were as shallow as 10 to 18 ft. Several septic systems were being replaced at the same time due to age and malfunction. Some systems were old and did not met modern standards. Some old systems were draining into a simple open bottom barrel filled with gravel.

As part of the river management plan, recreation residence owners along the river were asked to voluntarily test their water systems and report on the type of septic system. The Forest Service was designated to compile these data and will be reported in this analysis. Since the program was voluntary, only a subset of lots reported testing each of the three years data were collected. There is a complete accounting for the current knowledge of septic systems. Water source information for each lot was not complied. If a water system was found to be positive for fecal bacteria, we did not know if the system was a shallow well, deep well, spring source or from the river.

The survey of septic systems yielded 26 lots of 108 along the river that had good documentation of the type and location of their system. Although some information was gathered from a portion of the remaining lots, little other documentation or description of the system was provided. There were five outhouses found in the survey.

One measure of the risk of a system for failure is the age and type of septic holding tank. In the survey, 22 of the lots had metal tanks older than 20 years (Aq. Table 29). Metal tanks, especially older ones, may be more prone to rusting and leakage over time. There were 26 lots which had no record of the type of system, tank or age of the system. The risk of these unknown systems being older and not meeting codes is high.

Aq. Table 29. Summary of a septic tank survey of the type of tank and the system age for recreation residences along the Metolius River.

	pre 1984	post 1983	unknown	total
metal tanks	22	2	15	39
concrete	12	23	8	43
unknown	-	-	26	26
total	34	25	49	108

Water system tests were reported for the previous three years. These tests are valuable to assess the location of the lots with any high values for bacteria or nitrates, in relation to the location of old septic systems, failed septic systems or outhouses.

Nitrate tests were relatively low in most water systems reported. Only three lots in Tract C, from different locations, had nitrates reported over 1 mg/L nitrate. The Metolius River spring tested higher for nitrate (Aq. Table 30) and these sources of water, either from the river or groundwater, may be the reason for these higher values in Tract C. Data of the source of water for the lots would help to determine the source of the nitrates. Most levels reported are considered good water quality for drinking under the ODEQ criteria.

Aq. Table 30. Nitrate test results for recreation residence water systems for the year 2001 through 2003.

Tract	<0.1 mg/L	<1.0 mg/L	2.3 mg/L	5.5 mg/L	7.2 mg/L	Not tested	Total
C	8	31	1	1	1	90	132
E	1	1				14	16
F		1				11	12
H	7	2				33	42
I	4	3				26	33
O	7	24				61	92
Total	**27**	**62**	**1**	**1**	**1**	**235**	**327**

Tests for fecal coliform bacteria, E. coli, were reported 130 times over the three year period. Of those tests, 20 tested positive for E. coli bacteria, with 16 of those positive tests located in Tract C and 4 positives in Tract O. There were 5, 6 and 7 lots that tested positive for E. coli bacteria in the years 2001 through 2003, respectively (Aq. Table 31). Additional testing was done on two lots that continued to find positive results.

There may be many reasons for positive tests for bacteria in a water system, including a surface water source such as the river or tributary spring, a shallow well or an unsealed well. Shallow wells may be prone to drawing improperly filtered water or may leak surface water along the well casing if not properly sealed. Fecal bacteria occurs in surface water and the soil naturally, since the source of these bacteria is from any warm blooded animal. Although relatively low levels are found in the Metolius River, E. coli bacteria is always present and may increase in concentration during rain events or periods of increase wildlife or domestic stock use. For this reason, unfiltered surface water from the river should not be used for drinking.

Aq. Table 31. Fecal coliform bacteria test results from recreation residence water systems for the years 2001 through 2003.

	2001		2002		2003		additional tests	
tract	positive	number tested	positive	number tested	positive	number tested	positive	number tested
C	5	8	5	7	5	13	1	1
E		0		0		3		0
F		1		0		0		0
H		2		1		7		0
I		1		2		4		0
O		6	1	3	2	13	1	1
Total	5	18	6	13	7	40	2	2

The wildfires would not likely have an effect on groundwater quality. It is possible that with less vegetative cover there will be increased soil moisture and groundwater in the watershed. Any increased level of groundwater could increase water tables and could affect the proper function of drainfields in near shallow water tables. The significance of this effect is expected to be minor, and local variations in how groundwater is affected by fractured basaltic bedrock would likely overshadow any effect from the fire becoming apparent along the Metolius River.

Water Quality Trends

- Sediment yield contributed to LBC reservoir by the Metolius River is remarkable low and appears to be the lowest in the region.
- Fine sediment in fish spawning habitats continues to be a concern because there is a trend that fine sediment has been increasing since the 1996 flood. The fire may exacerbate this trend especially in subwatersheds that were significantly burned by a stand replacement fire
- Road densities have decreased since 1994 due to decommissioning.
- Since 1994, approximately 2000 acres in the Metolius watersheds have increased detrimental soil damage (i.e. a change from soil class A to B); however, the Metolius watersheds are still below the Forest Plan detrimental soil condition standard of 20%.
- Metolius Springs are a source of phosphorous and nitrogen to the river and levels decrease as the water flows downstream. Lake Creek is not a significant source of nutrients to the Metolius River.
- Nitrate and phosphorous will likely increase after the fires in streams. There is not an expected change in lakes after the fires.
- Suttle Lake water quality has not changed significantly since the 1970s. Algae blooms do not appear to be changing. Water clarity remains less than 1940 and pH remains higher than 1940.
- Water temperature has not changed significantly since previous watershed analysis. There is an expected increase in water temperature in some streams with loss of riparian canopy and stream shade. Groundwater springs will offset some of these changes.
- Groundwater well testing has showed some areas prone to bacteria in water systems of recreation residences along the river. Nitrate values generally do not raise concern. More work is needed to determine source of water systems to relate to failed water tests. Age of septic systems continues to be a concern and need for upgrading.

Channel Morphology

Large wood creates habitat for fish by providing overhead cover and slow water areas for rearing juvenile bull trout and redband trout. Bull trout were found to use wood most frequently as cover in streams of the Metolius watershed (Goetz 1994). Chinook are closely associated with slow water habitats most often found in pools (Hillman and others 1987, Hillman 1992, Roper 1994). Redband trout have been found to use wood and pockets of slow water in the streambank more than open water areas in the Metolius River (Houslet 2004). Wood creates slow velocity habitat in the Metolius River and tributary streams, where fish can hide and gain refuge from faster water.

Instream wood densities of streams inventoried within the Metolius Watershed were generally above the INFISH standard of 20 logs/mile (Aq. Table 32). Wood densities were greatest in mixed conifer plant associations and meadow riparian areas with mixed vegetation types. Channels flowing along lava were generally in mixed conifer stands but had reduced wood densities due to the narrow riparian forests. Ponderosa pine forests had lower average densities and averages just above the INFISH standard of 20 logs/mile (Aq. Table 32). Two reaches in the upper Metolius River in ponderosa pine wet forest type, did not meet the INFISH standard.

Part of the reason for the high wood densities in the mixed conifer forest types may be from the high densities of trees and the high mortality of trees after the insect and disease outbreaks of the mid 1990s. Much of this tree mortality added a pulse of insteam wood to those channels. Due to the size, complexity and stable flow regimes, these channels were able to retain much of the wood after the 1996 flood. Channels more prone to moving wood during the 1996 flood were primarily in the ponderosa pine dominated forest types which have a low rate of natural recruitment of wood. These stands of riparian forest also have less mortality associated with drought related insects and root disease. The reaches most likely affected by the 1996 flood and in the ponderosa pine forest types include lower Jefferson Creek, lower Canyon Creek and the Upper Metolius River.

Riparian reserves dominated by medium and large trees before the fires where Candle Creek, Canyon Creek, First Creek, Jefferson Creek, Lower Lake Creek, and the Headwaters of the Metolius River (Aq. Table 33). Lower Lake Creek and the Headwaters of the Metolius River were minimally affected by the fires and the influence of large trees should continue to maintain habitat for fish. Lower First Creek and Lower Canyon Creek were also minimally affected by the fire but the upper portion of the First Creek drainage was mostly stand replacement. The loss of large trees in the upper First Creek drainage was significant. Upper Canyon Creek burned more mixed and the loss of large trees was primarily in the middle reaches between the wilderness and the 1230 road.

The middle reaches of Candle Creek and Jefferson Creek were burned stand replacement and the loss of older riparian forest along these important bull trout streams was significant. Approximately 4 miles of Candle Creek and approximately 7 miles of Jefferson Creek burned stand replacement. In most of the riparian reserves, the trees were killed but much of the wood remains. Only the smaller diameter material was consumed. The downfall of wood into these stream is expected to be significant in the next 10 to 15 years. Channel changes may occur in Jefferson Creek as log jams develop and overflow. Jefferson Creek is more prone to these processes due to the portion of the watershed that is more snowmelt dominated, draining the southwestern slopes of Mt. Jefferson. Examples of these log jams and changes in channel orientation were observed following the 1996 flood. Other observers have documented changes in channel morphology due to debris dams In the long term these changes may create more complex habitat of side channels and flooded riparian areas with pools. Over the short term, there may be sediment trapping and release as these jams develop and break up during floods.

Similar channel changes were observed on a smaller scale on Brush Creek after the tree mortality following the spruce budworm outbreak of the early 1990s. Debris from the white fir mortality caused debris jams and at times impounded the main channel and redirected the flow into the forest. In some cases the new flow channel interacted with existing roads causing gullies in the road and sedimentation when it rejoined the creek.

Aq. Table 32. Average density of wood surveyed in stream channels within various plant association groups. Large and medium sized wood is defined as >12 inches in diameter and greater than 35 ft in length. Small wood is defined as 6 to <12 inches in diameter and >20 ft long.

Plant Association Group	Average Large and Medium Wood per mile (>12in, 35 ft)	Standard deviation	Average Small Wood per mile	Standard deviation
HWD- hardwood	17	1.98	37	6.51
LAVA	37	3.67	45	1.13
MCD-mixed conifer Dry	44	43.19	60	86.84
MCW-mixed conifer wet	44	45.22	119	202.04
MDW- meadow	117	62.18	389	267.15
MSHB- mixed shrub	28	29.59	43	57.80
PPD- ponderosa dry	24	19.34	34	29.97
PPW- ponderosa wet	17		15	
RIP- riparian	70	39.82	74	32.43
WATER	35	18.95	51	25.58
XSHB- xeric shrub	12		19	

Aq. Table 33. Acres of riparian reserve by vegetation size classes along streams within the Metolius subwatersheds. Data classifies using Landsat imagery per-fire. Size classes based on diameter at breast height are defined as follows: seep/sap/pole- <10inch, small- 10 to14 inch, medium- 15 to 20 inch, and large >20 inch.

Subwatershed Name	Not classified	Sparce	Grass shrub	Seed sap pole	Small	Medium	Large
ABBOT CREEK	0	0	69	364	341	457	0
CACHE CREEK	0	4	25	279	70	198	12
CANDLE CREEK	1	236	367	356	501	1242	75
CANYON CREEK	2	48	139	788	1532	2031	96
DRY CREEK	1		48	144	110	161	10
FIRST CREEK	3	20	41	543	816	1216	82
HEADWATERS METOLIUS RIVER	4	5	96	61	1001	1275	12
JACK CREEK	1		78	213	521	525	7
JEFFERSON CREEK	2	181	52	159	577	2568	1
LOWER FLY CREEK	2	2	158	248	771	431	9
LOWER LAKE CREEK	2	3	147	296	375	814	90
MIDDLE METOLIUS RIVER	5	25	101	315	1773	820	0
UPPER FLY CREEK	1		21	347	278	226	13
UPPER LAKE CREEK	3	8	214	625	380	611	80
UPPER METOLIUS RIVER	2	43	21	21	3012	1052	2

Pools per mile were more linked to channel type than the density of large wood (Aq. Table 34; Aq. Table 35). Steep channels with large substrates of the Rosgen Channel Types A and B had more frequent pools due to there step-pool morphology than those C and E type channels with more gentle slopes. Plots of pools per mile or percent pool versus large wood densities were not well correlated. The regression of the number of large wood pieces of all classes and the number of pools for Rosgen C Type channels had an $R^2 = -0.3453$, and test of slope not equal to zero had a significance of $P < 0.0001$ (intercept = 0). Only a third of the relationship of large wood and the number of pools was explained.

In most stream channels observed, instream wood was not reduced significantly due to the consumption by the fire. In some cases, log jams have become unstable due to the anchor along the stream bank being consumed by the fire. This process was most prevalent along smaller stream channels with low summer flows during the fire. These streams include upper Brush Creek, Bear Valley Creek, upper First Creek and Upper Link Creek. Spring fed bull trout streams generally retained instream wood and log jams remain in place.

Aq. Table 34. Average large wood above 6 inches in diameter and 20ft long, average pools per mile and percent pools by stream channel type in the Metolius Watershed. Rosgen channel type were defined by Rosgen (1994).

Rosgen Channel Type	LWD/mile	Pools/mile	Percent pool
A	109	32	46
A2	238	21	5
A3	39	54	36
A4	202	5	2
A5	193	24	33
B	40	18	27
B2	180	12	9
B3	174	26	22
B3a	86	21	24
B4	151	18	18
B4a	52	34	34
B4c	45	4	2
B5	376	9	12
C	235	34	27
C3	189	15	19
C4	170	7	8
C5	68	2	69
E5	153	2	1
F	57	5	23
F4	59	8	18

Aq. Table 35. Average large wood per mile, pools/mile and percent pools for streams in the Metolius Watershed.

STREAM	Average large wood per mile	Pools/mile	Percent pool
Abbott Creek	253	1	2
Bear Valley Creek	183	34	26
Brush Creek	177	5	2
Cabot Creek	94	18	23
Candle Creek	135	27	22
Canyon Creek	378	19	24
First Creek	150	18	51
Fly Creek	32	54	37
Heising Spring Creek	15	0	13
Jack Creek	577	24	24
Jefferson Creek	153	7	11
Lake Creek	199	9	8
Link Creek	45	20	15
Metolius River	50	4	11
Roaring Creek	226	7	2
Six Creek	53	41	38
South Fork Link Creek	47	50	7
Spring Creek	59	8	18
Street Creek	22	53	47
Upper Link Creek	54	40	18
Grand Total	163	18	19

Streambank instability was low and generally less than 3 percent on most streams in the watershed (Aq. Table 36). The exceptions were those streams with intermittent flow and more snow melt dominated flow regimes. Street Creek had a reach with 18.8 percent bank instability and Fly Creek (Lake Billy Chinook tributary) had a reach with 12 percent instability. These two streams were located in the Eyerly Fire of 2002. Follow-up surveys of Street Creek one year after the fire found that immediate post-fire increases in percent fines measured with pebble counts were attributed to the lost of streambank vegetation and downwood along streambanks or slopes adjacent to the streambank (Dachtler 2003). Dry ravel of soil into the creek channel was occurring on Street Creek the same season of the fire. The steep valley hill slope and dry soil conditions increased this effect. Long term slope stability and sediment inputs that may lead to channel migration may not occur until root structure decays along streambanks or hill slopes, thought to occur 5 to 10 years after the fire.

General valley form and soil types are less prone to this dry ravel and streambank collapse in the Band B and Link Fire . Reaches of upper Brush Creek, upper First Creek, upper Link Creek and portions of Abbot Creek will be a concern for bank stability after the B and B Fire. Little if any effect from the fire will result in channel change on the Metolius River, since the majority of flow is from spring sources and only 2 mile of the river was burn with low intensity. Street Creek had nearly half of the 1.6 miles of fish habitat burn high severity.

Aq. Table 36. Average streambank stability of surveyed streams in the Metolius Watershed from stream surveys from 1996 to 2001.

STREAM	Average percent of channel with bank instability
Cabot Creek	0.2
Candle Creek	0.1
Fly Creek	4.7
Heising Spring Creek	0.0
Jack Creek	0.0
Jefferson Creek	0.5
Link Creek	1.6
Metolius River	1.3
Six Creek	0.0
South Fork Link Creek	0.9
Spring Creek	0.0
Street Creek	11.0
Upper Link Creek	0.1
Grand Total	1.6

Outside of the Eyerly Fire, few miles of fish habitat burned with high severity (Aq. Table 37). High severity wildfire rating is based on soil conditions, with little surface organic matter remaining in the soils. These soil conditions lead to increased risk of erosion, soil movement and streambank instability. Stream channels with this type of burn severity were most commonly intermittent, where dry conditions lead to increased fire effects. First Creek had the only perennial streams within high burn severity in the B and B Fire or the Link Fire.

Aq. Table 37. Miles of stream by type within areas of high burn severity of the soil within the B and B, Cache and Link fires.

Stream Type	Canyon	Jack	First	Total
perennial with fish				
perennial without fish			1	1
intermittent with fish				
intermittent without fish	4	3	10	17
Total	4	3	10	18

Stream channels with the most risk of changes to the channels may be those with more watershed scale effects (Aq. Table 9; Aq. Table 23). All the riparian reserves along Abbot Creek were burned, of which 54% was burned stand replacement. Although this stream is primarily spring fed, the watershed has an older, more weathered soil type with a slightly higher percentage of clay. Runoff is more likely in this watershed, given the entire watershed is burned. As a result of increased runoff and debris falling into the channel from dead trees, debris jams and side channel may form.Other investigators found channel changes after wildfires due to debris jams (Bozeck and Young 1994, Minshall 1990). These processes may create increased fish habitat and fish densities in the long term (Rieman and others 1997). Over the short term, these changes may lead to increased pulses from sediment storage and transport.

Candle Creek had over 23 percent of the riparian reserve burned stand replacement. Although debris accumulations will increase from the tree mortality, the confinement of the channel along the lava flow and the terrace may limit the amount of channel chance in this stream. The spring dominated flow regime will also serve to minimize the amount of channel change.

Canyon Creek had much of the riparian reserves burned (92 percent), most was in the upper portion of the watershed. Of those reserve acres burned, 35 percent were stand replacement. Canyon Creek is a moderate size watershed and includes tributaries, such as Bear Valley, Brush Creek and Roaring Creek. Much of upper Canyon Creek and Bear Valley Creek are B-Type channels with larger substrate and may be less vulnerable than channel such as Brush Creek.

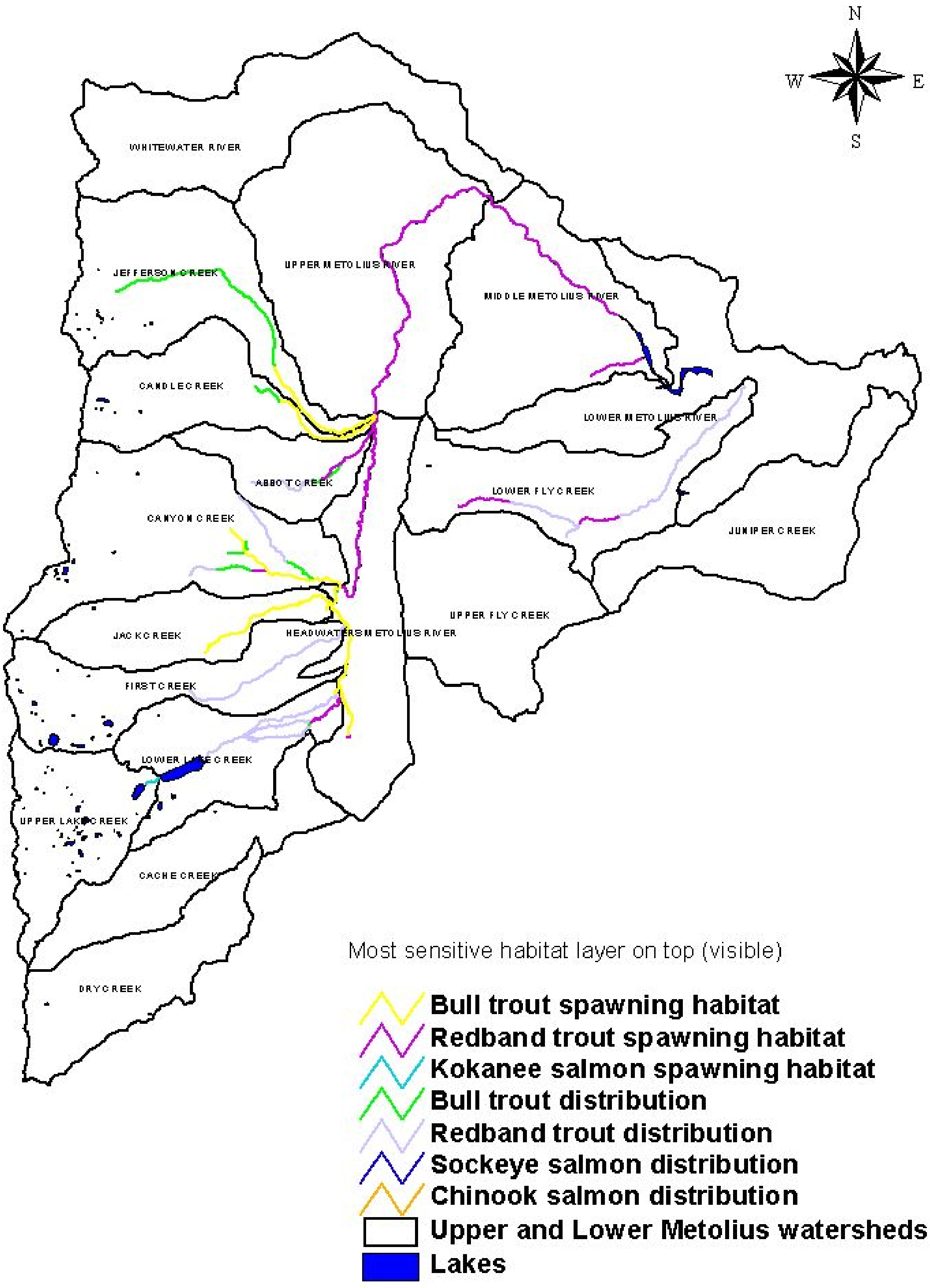
In Upper First Creek subwatershed, 22 percent of the riparian reserves burned stand replacement. A total of 67 percent of all the riparian reserves were burned in the subwatershed. Since this watershed is more snowmelt dominated, with a more flashy flow regime, the risk of channel change in this subwatershed is greater than most others in the analysis area.

Upper Lake Creek subwatershed had 67 percent of the riparian reserves burned and 30 percent of the reserves burn stand replacement. This subwatershed is located upstream of Blue Lake and is the upper Link Creek drainage. The cinder dominated soil of the stream banks may loose its cohesion in more intensely burned areas and channel changes may results. More fine sediment transport may occur and some channel widening may result. Infall of large wood may offset some of the sediment influx through storage from debris jams.

Channel Morphology Trends

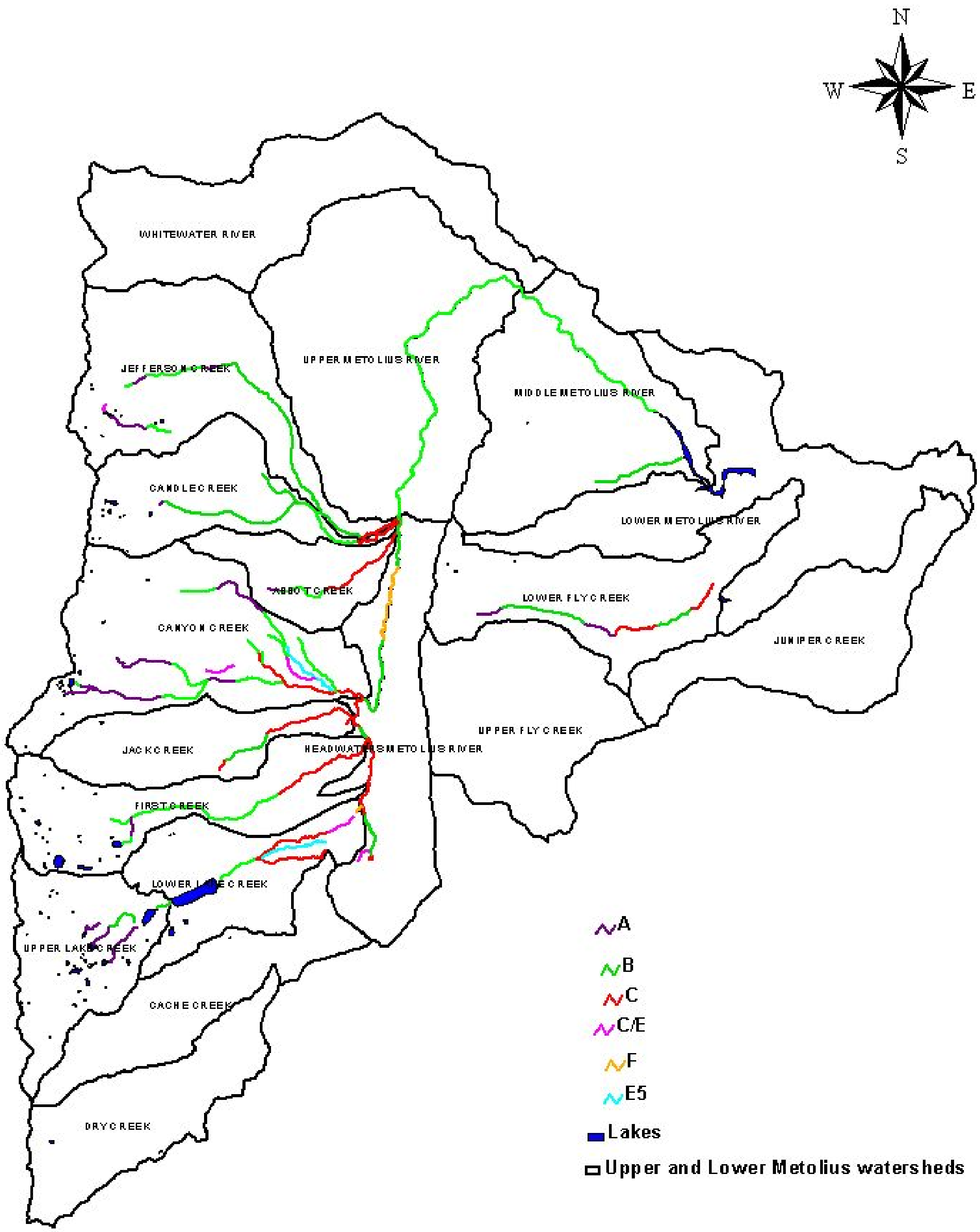
- Large wood is highest in mixed conifer and ponderosa wet plant associations.
- Large wood in the upper Metolius River along ponderosa stands has been slow to recover from removal in the early 1900s. Restoration efforts have been slow to recover wood for fish habitat.
- Large wood has significantly increased from tree mortality in the mid- 1990's.
- Instream wood, in the short-term, is predicted to increase after the fire.
- Stream stability is predicted to decrease downstream of high severity wildfire
- Log jams and pools are predicted to increase over the long-term after the fires.
- Long term habitat complexity is predicted to increase for fish.

Aq. Figure 11. Map of fish distribution and habitat in the Metolius River subwatersheds.



Note: Refer to Appendix Aq1 for more detailed fish distribution maps.

Aq. Figure 12. Map of Rosgen stream types in the Metolius River subwatersheds.



Riparian/Aquatic PAG

Size and Structure

Prior to the fire, the wet mixed conifer stands in the Metolius Basin had the highest density of instream wood. These stands also had the highest number of pools per mile in streams, although only about a third of that relationship was explained by instream wood density alone.

Riparian vegetation has changed significantly since the 2002 and 2003 wildfires. Approximately 40% of the riparian reserves in the Metolius watersheds were burned by the 2002 and 2003 fires (Aq. Table 14). One hundred percent of the riparian reserves in Abbot Creek subwatershed were burned. Approximately, 68% of the riparian reserves in Candle Creek were burned, 92% in Canyon Creek, 67% in First Creek, and 87% in Jack Creek. Riparian reserves that experienced a stand replacement wildfire over one-third of their area occurred in Abbot Creek, Canyon Creek, and Middle Metolius subwatersheds, and in the Spring Creek drainage of the Lower Metolius subwatershed.

There was a significant loss of old tree (large tree) forests from the B&B Complex Fire (2003) along Jefferson Creek, Candle Creek, Canyon Creek and First Creek. Canopy closure was reduced significantly in Abbot Creek, Cache Creek, Candle Creek, Canyon Creek, Jefferson Creek, and Upper Lake Creek (Upper Link Creek).

Approximately 15 % of the riparian reserves in the Metolius watersheds were burned by a stand replaced wildfire (Aq. Table 14). Riparian reserves burned with stand replacement intensity at a similar rate as the subwatersheds overall ($R^2 = 0.9336$). However, the intensity of the burn did vary slightly in the riparian reserve based on plant association group (Aq. Table 38). Mixed conifer dry and mixed conifer wet plant association groups in riparian reserves burned stand replacement at nearly half the rate of upland areas in the watershed. A similar trend was noted for the ponderosa pine wet plant association. Little difference was noted in other plant association groups with the intensity of wildfire.

Stream channel flow regime had little influence on the percentage of stand replacement wildfire within riparian reserves (Aq. Table 39). In riparian reserves, the riparian plant associations were burned by stand replacement fires at similar intensities and magnitudes as the mixed conifer plant associations. Also in the riparian reserves, the ponderosa pine plant association had the most area classified as stand replacement.

The 1994 watershed analysis predicted that vegetation in riparian reserves would have a lower risk of experiencing a stand replacement wildfire due to high relative humidity and wetter vegetation. This may only have been the case in the wetter plant associations. In more xeric plant associations, riparian reserves burned similarly as uplands, with burn intensity depending on the site conditions of fuel loads, topography and burning conditions.

Aq. Table 38.Percent of the plant association group (PAG) in the watershed and in the riparian reserves burned by a stand replacement wildfire.

	Percent of PAG in Stand Replacement	
PAG	**Watershed**	**Riparian Reserve**
AMDW	0.0	0.0
CINDER	1.2	0.0
LAVA	13.0	9.4
LPD	0.0	0.0
MCD	10.5	5.5
MCW	23.8	13.8
MHD	9.9	7.5
MSHB	32.4	32.0
PPD	66.3	53.5
PPW	30.8	15.9
RIP	14.1	14.1
ROCK	2.4	0.5
WATER	6.9	15.5
WBPD	0.2	0.0
XSHB	26.3	35.0
XXXX	0.0	0.0
Areas not in a PAG	10.9	10.5
Grand Total	15.6	12.5

Aq. Table 39. Percent stand replacement wildfire in riparian reserves by stream type and plant association group.

	Plant Association Group				
Reserve Type	**MCD**	**MCW**	**PPD**	**PPW**	**RIP**
Perennial Streams	43	57	77	-	54
Intermittent Streams	31	24	57	56	0
Wetlands	42	55	64	-	20
Not Riparian Reserve	28	40	76	61	-

Wildlife

Aquatic Riparian Threatened, Endangered, and Sensitive Species

Fish Existing Condition[12]

Bull trout populations have continued to make a dramatic recovery since the previous watershed analysis, with a all time peak in redd counts in the year 2003 (Aq. Figure 13; Appendix Aq1). Continued protection of the spawning population made through protective angling regulations in the entire watershed has resulted in a strong recovery.

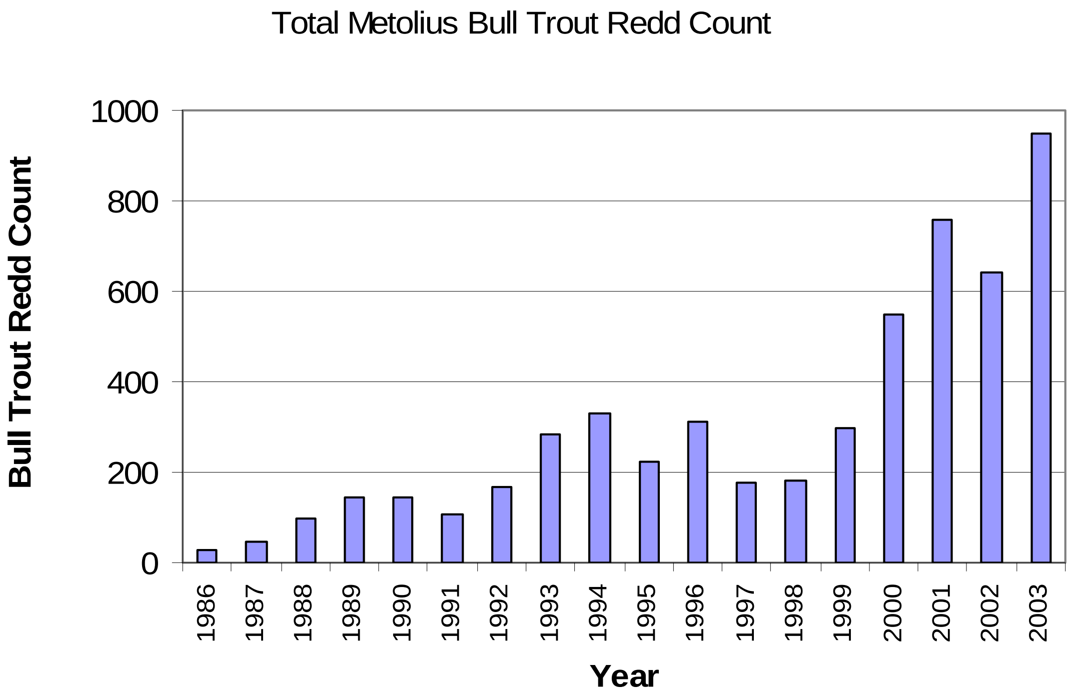
Significant increases in bull trout spawning counts were made in Jefferson Creek and Candle Creek (Aq. Figure 14; Appendix Aq1). There was concern for the population after the Jefferson Fire of 1996, where 2 miles of Jefferson Creek and 2 miles of upper Candle Creek were burned. Bull trout in these streams were actually observed spawning during the B and B Fire.

The same scale of increases were not observed in Heising Spring or the Metolius River. Although steady levels of spawning were found, these areas may not have the capacity for increased spawning. Heising Creek is a short ½ mile spring and has a large population of spawning kokanee salmon. Accurate bull trout redd counts are difficult in this stream due to redd superimposition from the kokanee salmon.

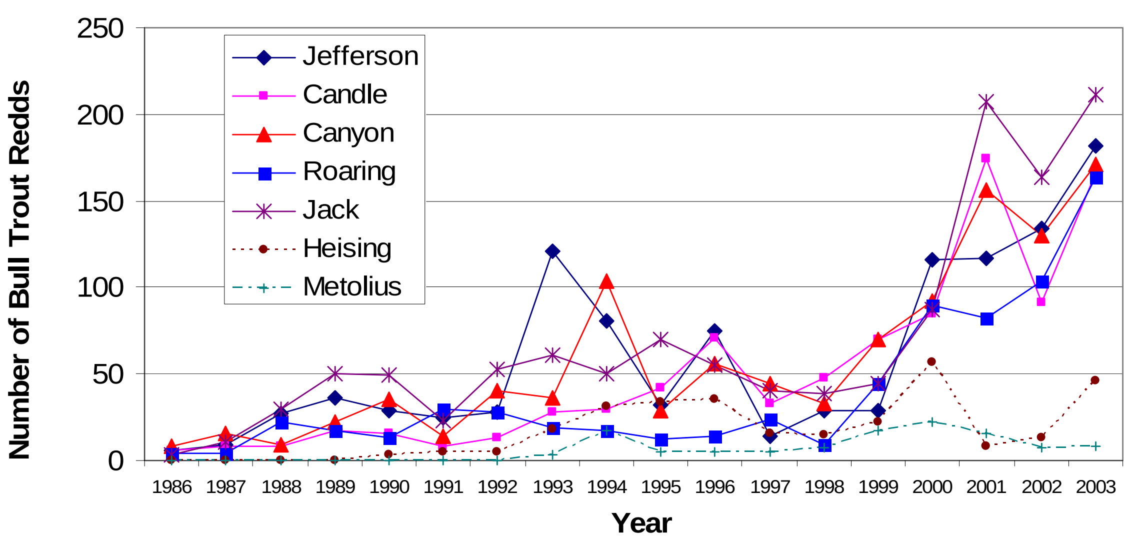
The known spawning areas in the Metolius River are confined to a ½ mile reach near the mouth of Jack Creek, where there is significant groundwater upwelling in the channel and from various spring along the riverbank. Some increases in know spawning locations have indicated an expansion of the spawning habitat. New documented spawning areas have been found in Spring Creek, and in the Metolius upstream of Lake Creek. Juvenile bull trout have been found in Lower Lake Creek, near the springs.

[12] refer to Appendix 5 for fish distribution maps

Aq. Figure 13. Redd counts for bull trout spawning areas in the Metolius Watershed from 1986 to 2003.

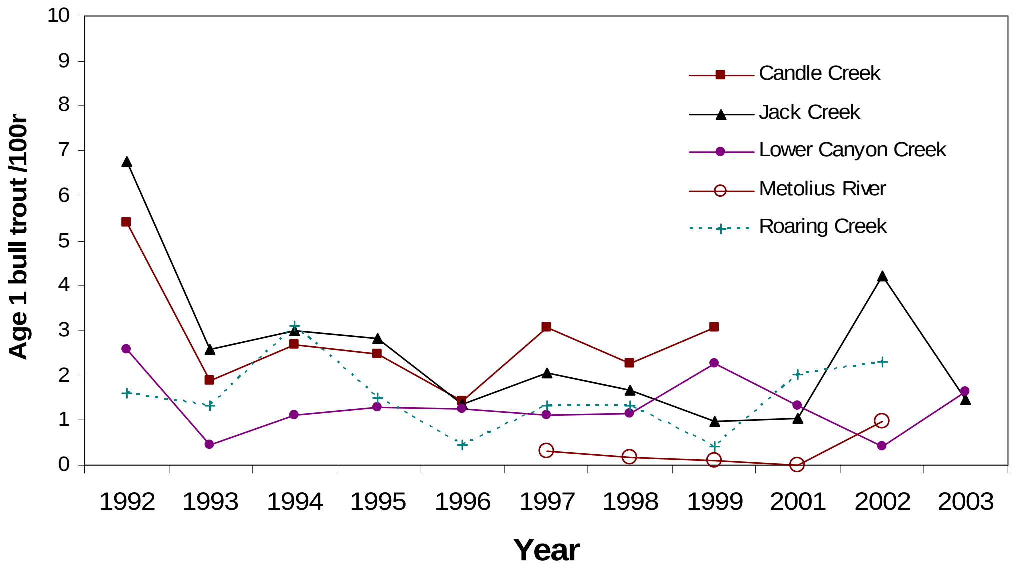


Aq. Figure 14. Number of bull trout redds counted in streams within the Metolius Watershed.

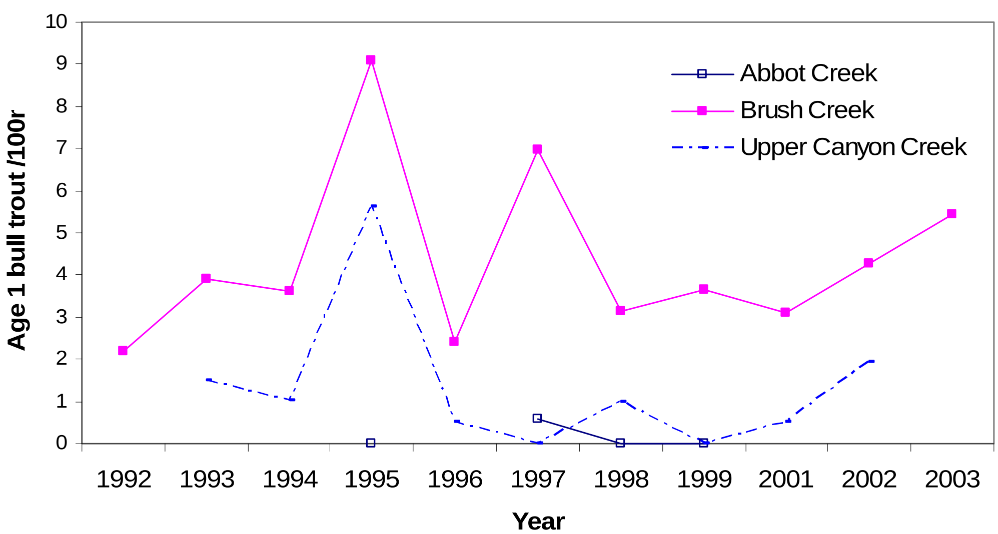


Juvenile bull trout densities in the tributaries and in the upper Metolius River monitoring sites have remained relatively unchanged (Aq. Figure 15). The most change in juvenile densities was noted from a high in 1995 and an decrease after the 1996 flood (Aq. Table 40**Error! Reference source not found.**). Juvenile densities recovered within a short period after the flood. Densities of bull trout in the streams in which rearing but no spawning occurs have been more variable (Aq. Table 15). The year 1995 was a significantly high year for Brush Creek and Upper Canyon Creek.

Aq. Figure 15. Juvenile bull trout densities for spawning streams in the Metolius Watershed.



Aq. Figure 16. Juvenile bull trout densities in rearing habitats of the Metolius Watershed.



The US Fish and Wildlife Service has proposed Critical Habitat Designation for Suttle Lake, Blue Lake, Link Creek, Lake Creek, the Metolius River, Abbot Creek, Brush Creek, Candle Creek, Jefferson Creek and tributary, Canyon Creek and tributary, Heising Spring, Jack Creek, and Roaring Creek. The draft recovery plan for bull trout within the Columbia River Distinct Population Segment is under review and will be completed within the next year.

Aq. Table 40. Average juvenile bull trout density (Age 1-3+/100m^2) for selected pool and run habitats from 1992 to 2003.

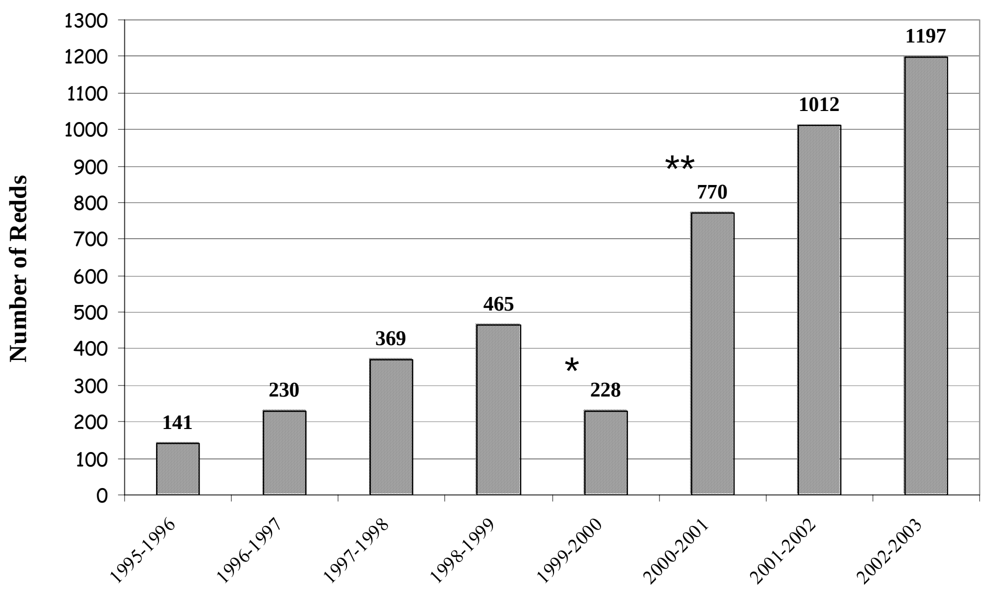
Stream	1992	1993	1994	1995	1996	1997	1998	1999	2001	2002	2003	Homogeneity Significance	df	ANOVA F-stat	P value
Upper Canyon Creek	-	2.48	1.02[a]	7.74[a,b]	0.5[b]	1.33	2.59	3.89	2.19	3.67	-	0.173	8,16	2.73	0.041*
Roaring Creek	-	2.52	3.84	2.25	2.21	2.34	4.74	1.61	4.09	3.86	-	0.023*	8,31	0.39	0.917
Lower Canyon Creek	3.95	1.68	-	3.24	2.93	3.01	2.35	3.49	1.88	2.02	3.21	0.520	9,52	0.97	0.472
Jack Creek	9.85[a,b]	5.50	4.90	6.09	2.9[b]	6.11	5.94	3.30	3.3[a]	5.04	3.60	0.014*	10,63	2.01	0.470*
Metolius River	-	-	-	-	-	0.04	0.03	0.28	0.54	1.73	-	<0.001*	4,21	1.59	0.214
Candle Creek	10.24	6.26	5.69	6.59	3.32	6.79	3.80	5.77	-	-	-	0.321	7,26	1.00	0.451
Brush Creek	5.70	6.74	6.73	14.91[a,b]	5.48	9.14	6.00	4.85[a]	3.92[b]	4.26	6.42	0.198	10,56	2.06	0.044*
Abbot Creek	-	-	-	-	-	0.97	0.00	0.37	-	-	-	0.002*	2,15	1.316	0.297

Note:
Year 2000 was not sampled and year 2003 was partially sampled due to closures caused by the wildfire.
* A significant difference between years (analysis of variance, alpha=0.05).
Values with the same lettered superscript denote a significant difference between those years (Tukey HSD test, alpha=0.05).

Redband trout populations have recovered dramatically since the early 1990s (Aq. Figure 17). Listed as a 'depressed population' by ODFW in the Metolius Basin Fish Management Plan, the Metolius population has increased from 141 redds in 1995 to 1197 redds in the upper Metolius River in 2003. In 2004 the population dropped slightly to 881 redds; however, it is too early to determine if this is a trend. Much of this increase may be attributed to the elimination of hatchery rainbow releases in 1995, increase of instream wood from habitat projects or recovery of low flow from the drought.

Chinook salmon and sockeye salmon have been released on an experimental basis into the Metolius River and selected tributaries. The upper Deschutes and Crooked River basins have been identified as Essential Fish Habitat under the Maguson-Stevens Act. This act protects habitat important to commercial ocean fisheries. The Listing included the upper Deschutes Basin with the likelihood that anadromous fish will be passed through the dams on the Deschutes River in the future. Under the proposed new license for Pelton Round Butte Dams, fish passage will be a part of the new operation at the dam complex on the Deschutes River. This proposed reintroduction marks a return to anadromy to the watershed. Sockeye salmon would use the Metolius River for spawning and Lake Billy Chinook for rearing. The chinook salmon would use the Metolius River and lower Lake Creek for spawning and rearing in the river and lower reaches of the tributaries.

Aq. Figure 17. Metolius River Redband Redd Counts 1995 through 2003 (Sections 0 through 7).



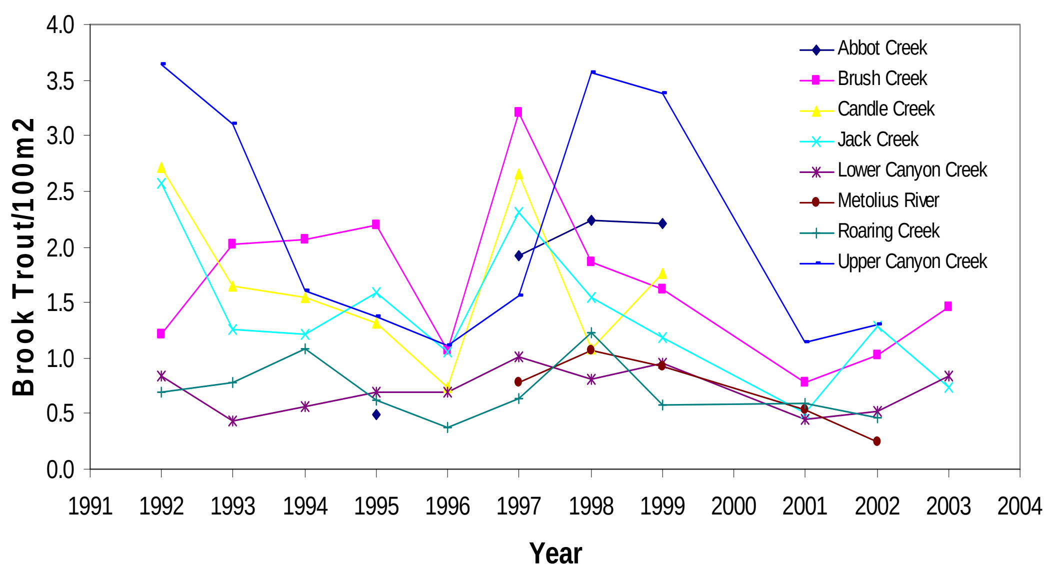
Notes:
* Sections 6-7 were not surveyed in 1999-2000 and sections 0-5 were not surveyed as frequently as other years.
** Sections 6-7 were sampled less frequently in 2000-2001 than in other years.

Brook Trout populations have been monitored since 1992 in habitat were they overlap with bull trout rearing areas. Identified as potential competitor with bull trout, brook trout were targeted for monitoring in habitats that were warmer and considered marginal bull trout habitat and more favorable for brook trout. In all habitats monitored, brook trout populations have been low and variable. However, densities of brook trout are low in recent years compared to other years monitored. There appears to be a low period in response to the 1996 flood, similar to bull trout (Aq. Figure 18).

Brook trout were identified as a species of concern in the original watershed analysis due to the introduction in high mountain lakes, primarily in the wilderness areas. Fish introduced to the lake were thought to reduce native amphibian populations. These introduced brook trout populations were also distributing downstream in the watersheds that contained native bull trout. Since then, high lakes within bull trout watersheds are not stocked with brook trout. Naturalized populations of brook trout remain in some high lakes were streams provide adequate late season spawning habitat.

Brown trout populations are not monitored in the watershed. Brown trout are found in Suttle Lake, Lake Creek and in the Metolius River and in Lake Billy Chinook. Introduced in the 1930's, brown trout are found in low number throughout the length of the Metolius River. Recent monitoring of fish in Street Creek showed an increase in the percentage of brown trout relative to native redband trout from zero to 9 % (Dachtler 2002). Spring Creek, an adjacent tributary, is now 50% brown trout.

Aq. Figure 18. Brook trout density in bull trout monitoring locations from 1992 to 2002.



Fish habitats have been changed by the wildfires but the degree to which these changes will impact existing fish populations is uncertain. Habitats in some subwatersheds will likely be altered by increased peak flows and short-term sedimentation. Subwatersheds more prone to these changes are Abbot Creek, Candle Creek, Canyon Creek, First Creek, Lower Lake Creek, and the Street Creek drainage of the Middle Metolius subwatershed.

Stream shade has been reduced in many streams and the impact to stream temperature for important fish habitat will be variable depending on groundwater contribution and amount of exposed channel. Streams with increased risk of thermal loading from the fire include Abbot Creek, Brush Creek, Canyon Creek, First Creek, and Street Creek.

Instream wood will increase post fire and will account for high densities of wood for the next 10 to 15 years or more. This pulse of wood to stream habitats will set the stage for the next 50 to 80 years, until large trees are once again growing along the streams. Log jams and debris jams will create complex habitats that bull trout and juvenile Chinook could use. Some debris jams will cause channel migration and side channel development. This instability will create habitat in the long-term but some sediment pulses and accumulations will result in the process. Channel instability and side-channel development is predicted to occur in Abbot Creek, Brush Creek, First Creek and Jefferson Creek. Roads in riparian reserves and stream crossing may increase the risk of sedimentation from these channel changes.

Predicted Future Fish Habitat Condition

Analysis of future fish habitat and channel morphological condition was conducted by rating existing key fish habitat and comparing it to the predicted watershed response ratings. This exercise is not intended to be used as a prescription for habitat restoration work; rather, it is a tool for summarizing aquatic risk primarily related to the 2002 and 2003 fires. The predicted watershed response ratings were taken directly from the tables in the Physical Domain section of this document (Aq. Table 9; Aq. Table 23). Fish habitat variables that were rated include percent unstable stream banks, water temperature, percent pools, large woody debris per mile, and percent fine sediment. In addition, the miles of current bull trout and redband spawning and bull trout rearing habitat were considered when assigning the fish habitat value factors (Aq. Table 41). All these variables describe the existing fish habitat condition.

The fish habitat value factor was determined by summing the number of variables meeting or exceeding the criteria for each stream. The criteria used to evaluate the existing fish habitat was general and should only be used as a tool to evaluate relative risk differences between streams. The predicted risk to fish habitat and channel morphology by stream was rated by summing the fish habitat value factor, the streamflow risk factor and the sedimentation risk factor (Aq. Table 41).

Based on this exercise and data from the water quantity and quality tables (Aq. Table 9; Aq. Table 23), fish habitat and channel morphology risk was summarized by subwatershed (list is below Aq. Table 41 and in Appendix Aq1). Subwatersheds with the highest aquatic risk are Candle SWS (including both Candle Creek and Cabot Creek drainages), Canyon SWS (specifically Canyon Creek and Brush Creek drainages), Headwaters of the Metolius SWS (primarily due to tributary input), Middle Metolius SWS (specifically Street Creek drainage), and Lower Metolius SWS (specifically Spring Creek drainage).

Aq. Table 41. Comparison of fish habitat values and risk of stream morphological change based on increased peakflow and sedimentation risk.

Bull trout, Redband, or Salmon Stream	Percent of channel with unstable streambanks	Water Temperature (°C)	% of stream in pool habitat	Large Wood per mile	Fine Sediment <6.4 mm	Miles Bull Trout Spawning Habitat	Miles Bull Trout Rearing Habitat	Miles Redband Trout Spawning Habitat	Fish Habitat Value Factors (1 – 8)	Streamflow Risk Factors (1- 5) (Aq. Table 9)	Sedimentation Risk Factors (1- 5) (Aq. Table 23)	Predicted risk to fish habitat and channel morphology
Abbot Creek	?	12.6	2	253	17.0	0	2.9	2.4	4	2	5	11
Brush Creek*	?	10.7	2	177	20.5	0	2.6	0	2	5	5	12
Cabot Creek	0.2	<10*	23	94	?	0	0	0	3	5	4	12
Candle Creek	0.1	6.5	22	135	28.9	4	4	0	6	5	4	15
Canyon Creek	?	10.7	24	378	26.8	2.7	4.6	3.1	5	5	5	15
First Creek	?	?	51	150	?	0	0	0	2	4	5	11
Fly Creek	4.7	>10*	37	32	?	0	0	3.0	3	2	4	9
Jack Creek	0	9.2	24	577	26.4	5.8	5.4	0	6	3	1	10
Jefferson Creek	0.5	9.9	11	153	20.3	4.5	8.7	0	5	2	1	8
Lake Creek	?	24.7	8	199	?	0	0.3	2.2	3	1	4	8
Link Creek	1.6	?	15	45	?	0	0	0	2	1	4	7
Metolius River - Upper	1.3	13.2	11	50	30.0	5.7	28	28	4	5	4	13
Metolius River - Middle	1.3	10.6	11	50	?	0	28	28	3	5	2	10
Metolius River - Lower	<10*	10.6	11	50	?	0	28	28	3	5	3	11
Roaring Creek	<10*	7.7	2	226	24.5	1.8	1.8	0	5	3	3	11
Spring Creek	0.0	>10*	18	59	?	0	0	0	2	5	5	12
Street Creek	11.0	18	47	22	?	0	1.2	1.7	3	5	5	13
Criteria	**<10**	**<10**	**>15**	**>100**	**<20**	**>0**	**>0**	**>0**				

* estimate

Summary of Fish Habitat/Channel Morphology Risk[13]

Abbot Creek SWS

- High risk sediment deposition in C4 redband spawning areas
- Low/Moderate risk of morphological change in C4 reach of Abbot Creek
- Moderate risk of temperature increase

Cache Creek SWS

- Negligible sedimentation risk to redband spawning habitat in S.F. Lake Creek
- Low risk of morphological changes in Cache Creek

Dry Creek SWS

- Negligible sedimentation risk to redband spawning habitat in S.F. Lake Creek
- Low risk of morphological changes in Dry Creek

Candle Creek SWS

- High risk sediment deposition in C4 bulltrout spawning reaches
- Moderate risk of morphological changes in C4 reach of Candle Creekdue to high increases in stormflow from fire effects

Jefferson Creek SWS

- Low risk sediment deposition in C4 bulltrout spawning areas
- Low risk of morphological changes in C4 reach

Canyon Creek SWS

- High risk sediment deposition in C3 and C4 bulltrout spawning areas on Canyon Ck.
- Moderate risk of sediment deposition in B3 redband spawning area of Canyon Creek due to inputs from upper Canyon Ck. and Bear Valley Ck.
- High risk of sediment deposition in Brush Creek E4 redband and bulltrout rearing reaches from upper subwateshed contribution
- Moderate risk of morphological changes in C3/C4 reaches of Canyon Creek and E4 reach of Brush Creek due to high increases in stormflow from fire effects
- High risk of morphological change in B3 reach of Canyon Creek due to existing bank instability and predicted increases in stormflow
- High risk of temperature increases in Brush Creek, moderate temperature increases in Canyon Creek (inputs from Bear Valley Creek, Brush Ck, and Upper Canyon Creek), and moderate temperature increases in Roaring Creek (spring influence and minimal RR burn)
- Moderate risk of sedimentation in B4/C4 bulltrout spawning reach of Roaring Spring Creek
- Moderate risk of sedimentation and bank erosion in E4 bulltrout and redband rearing reach of Brush Creek

[13] These conclusions are based on Aq. Table 41. Refer to Appendix 5 for a more thorough explanation of the parameter ratings.

First Creek SWS

- High risk sediment deposition in C5 redband rearing areas on First Ck.
- Moderate risk of morphological changes in B2 and in redband rearing B3 and C5 reaches of First Creek
- Moderate risk to stream temperature in redband rearing reach

Jack Creek SWS

- Low risk of sediment deposition in B4 and C4 bulltrout spawing areas in Jack Ck.
- Moderate risk of morphological changes in C4 bulltrout spawning reach
- Low risk of temperature increases in bulltrout spawning reach

Headwaters of the Metolius River SWS

- Moderate risk of sedimentation in redband spawning reaches in the upper mainstem Metolius R. due to inputs from Abbot, Canyon, Candle, and First Creeks.
- Low risk of morphological change in the upper mainstem Metolius River because riparian vegetation is still intact and banks are stable
- Negligible temperature affect in upper mainstem Metolius River because of cold spring influence and dilution of tributary inputs.

Upper Lake Creek SWS

- Low risk of sediment deposition in B4 redband and kokanee spawning reach of Link Ck below Blue Lake.
- Negligible risk of morphological changes in B4 reach between Blue and Suttle Lakes
- Negligible temperature affect in Link Creek

Lower Lake Creek SWS

- High risk of sediment deposition in C3, C4, and E5 redband rearing reaches in S.F., M.F., and N.F. of Lake Creek and in C3 redband spawning reach in S.F. Lake Ck.
- Low risk of morphological changes in C3/C4 reaches of S.F, M.F., N.F., and mainstem reaches of Lake Creek
- Low risk of stream temperature increases because minimal riparian vegetation was lost and the limiting factor on stream temperature is Suttle Lake

Upper Fly Creek SWS

- Low risk of sedimentation to redband rearing reaches in Lower Fly Creek
- Negligible risk of morphological changes in Upper Fly Creek

Lower Fly Creek SWS

- Moderate/High risk of sedimentation to Rosgen “C” redband spawning reaches in Lower Fly Creek from roads
- Low risk of morphological changes in Rosgen “C” redband spawning reaches in Fly Creek

Upper Metolius River SWS

- Potential risk of sedimentation in face drainages and the middle mainstem of the Metolius River due to roads on the Warm Springs Reservation
- Low risk of morphological change in the middle mainstem Metolius River because riparian vegetation is still intact and banks are stable
- Negligible temperature affect in middle mainstem Metolius River because of cold spring influence and dilution of tributary inputs.

Middle Metolius River SWS

- Street Creek
  - High risk of sedimentation to redband spawning reach in Street Creek
  - High risk of morphological change in unstable, perennial Rosgen B3/B4 reaches
  - High risk of stream temperature increases in perennial, redband spawning reach of Street Creek

- Face drainages, Bean Ck. and the lower mainstem Metolius R.
  - Low risk of sedimentation in steep, intermittent face drainages
  - Low/moderate risk of sedimentation in lower mainstem Metolius River
  - Low risk of morphological change in the lower mainstem Metolius River because riparian vegetation is still intact and banks are stable
  - Negligible temperature affect in lower mainstem Metolius River because of cold spring influence and dilution of tributary inputs.

Lower Metolius River SWS

- Spring Creek
  - Moderate risk of sedimentation to redband and kokanee spawning reach in the perennial section of Street Creek
  - Low risk of morphological change in perennial reach of Street Creek
  - Negligible risk of stream temperature increases in perennial, redband/kokanee spawning reach of Spring Creek

- Face drainages and Lake Billy Chinook Reservoir
  - Low risk of sedimentation in steep, intermittent face drainages
  - Low/Moderate risk of sedimentation in LBC reservoir due to inputs from Street Creek, Spring Creek, and some face drainages within the fire area
  - Negligible long-term risk of nutrient, pH, or chlorophyll *a* increases due to short-term flushing and dilution

Juniper Creek SWS

- Negligible sedimentation risk to Juniper Creek or LBC reservoir
- Negligible risk of morphological changes in Juniper Creek

Whitewater Creek SWS
- Negligible sedimentation risk to Whitewater Creek or it's tributaries
- Negligible risk of morphological changes in Whitewater Creek or it's tributaries

Landscape Goals, Recommendations, and Opportunities

Integrated Opportunities by Landscape Area

Landscape Area 2 – Central Basin

All subwatersheds

- Monitor stream crossings and road drainage within and downstream of the fire area; remove or improve undersized culverts and design to allow fish migration
- Monitor long-term in-stream large woody debris (LWD) in all subwatersheds affected by the recent fires
- Monitor morphological changes in streams mostly affected by the fire
- Eliminate and prevent future establishment of dispersed campsites within 100 feet of bankfull stream channels within the fire area
- Do not reestablish lost campgrounds within 100 feet of bankfull stream channels within the fire area
- Plant trees on slopes greater than 30% in stand replacing burn areas to help stabilize slopes.
- Continue to monitoring water quality in the Metolius River. Identify sources of bacteria, if possible.

Abbot Creek SWS

- Reduce riparian road miles through inactivation[14] and/or decommissioning[15]
- Remove or improve road-stream crossings
- Monitor bank stability in C4 redband spawning reach
- Plant conifers in riparian reserves for long term shade and wood recruitment.

Candle Creek SWS

- Reduce riparian road miles, including user-created roads, through decommissioning[15]
- Monitor bank stability in C4 bulltrout spawning reach
- Plant conifers in riparian reserves for long term shade and wood recruitment.

[14] Inactivation – convert to a level 1 closed road and repair drainage problems
[15] Decommission – remove the road from the system, remove culverts, subsoil, and, in some cases, recontour slopes

Canyon Creek SWS

- Reduce riparian road miles, including user-created roads, through inactivation[14] and/or decommissioning[15]
- Remove or improve road-stream crossings, including (but not limited to) 1260 road at Roaring Springs Creek
- Install culvert at crossing of Roaring Springs tributary and 1230 road – spring-fed tributary is current running down the ditch because the crossing was blocked by 1996 road repair work
- Monitor bank stability in C3/C4 reach of Canyon Creek, E4 reach of Brush Creek, and in stand replacing fire areas upstream
- Plant riparian vegetation along Brush Creek in stand replacing burn areas
- Assess riparian condition (vegetation) to determine risk of sedimentation in B4/C4 bulltrout spawning reach of Roaring Spring Creek
- Assess riparian condition (vegetation and bank stability) to determine risk of sedimentation and bank erosion in E4 bulltrout and redband rearing reach of Brush Creek
- Upland planting in areas where natural regeneration is difficult

First Creek SWS

- Remove or improve road-stream crossings on Davis Creek at roads 1210 (private land), 1200 (north), and 1200 (south)
- Work with landowner to fix 5 ft. headcut immediately downstream of culvert on 1210 road and Davis Creek

Lower Lake Creek SWS

- Reduce riparian road miles, including user-created roads, through inactivation[14] and/or decommissioning[15]

Landscape Area 4 – Meadow Lake Basin

Upper Lake Creek SWS

- Continue to manage off road travel and dispersed recreation to reduce impacts to streams and lakes.
- Coordinate fish stocking with ODFW.

Landscape Area 7 – Suttle Lake

Lower Lake Creek SWS

- Continue to improve waste water disposal methods to meet EPA standards and improve watershed health.
- Monitor Suttle Lake at intervals to track changes in water quality and the algae bloom, and to assess degree of recovery.

Landscape Area 8 – Upper Tributaries

All Subwatersheds

- Officially inactivate[14], in the next 10 years (2004-2014), level 2 roads that had been undrivable prior to the fire due to vegetation
- Monitor stream crossings and road drainage within and downstream of the fire area; remove or improve undersized culverts and design to allow fish migration
- Monitor long-term in-stream large woody debris (LWD) in all subwatersheds affected by the recent fires
- Monitor morphological changes in streams mostly affected by the fire
- Plant trees on slopes greater than 30% in stand replacing burn areas to help stabilize slopes.

Abbot Creek SWS

- Reduce riparian road miles through inactivation[14] and/or decommissioning[15]
- Remove or improve road-stream crossings
- Monitor bank stability in C4 redband spawning reach
- Monitor vegetation recovery adjacent to perennial stream reaches in stand replacing burn areas; plant if necessary

Canyon Creek SWS

- Reduce riparian road miles through decommissioning[15]
- Reduce road densities through decomissioning[15]
- Reduce acres with greater than 20% detrimental soil condition by subsoiling
- Remove or improve road-stream crossings, including (but not limited to) 1230-500 road at Bear Valley Creek
- Restore channel and function in Brush Creek tributary (1.5 mile reach along 1200-830 road)
- Plant riparian vegetation along Brush Creek, Bear Valley Creek, and Upper Canyon Creek in stand replacing burn areas

First Creek SWS

- Reduce riparian road miles through decommissioning[15]
- Reduce road densities through decomissioning[15]
- Reduce acres with greater than 20% detrimental soil condition by subsoiling
- Monitor vegetation recovery adjacent to perennial stream reaches in stand replacing burn areas; plant if necessary

Jack Creek SWS

- Reduce acres with greater than 20% detrimental soil condition by subsoiling

Outside of Landscape Areas

Lower Fly Creek SWS

- Reduce riparian road miles through inactivation[14] and/or decommissioing[15]

Upper Metolius SWS

- Partner with Warm Springs Reservation to assess sedimentation from roads in face drainages and in the mainstem Metolius River

Middle Metolius River SWS– Street Creek drainage

- Officially inactivate[14], in the next 10 years (2004-2014), level 2 roads that had been undrivable prior to the fire due to vegetation
- Monitor stream crossings and road drainage within and downstream of the fire area; remove or improve undersized culverts and design to allow fish migration
- Monitor long-term in-stream large woody debris (LWD) Reduce riparian road miles through decommissioning[15]
- Reduce road densities through decomissioning[15]
- Assess bank instability and opportunities for restoration
- Monitor native vegetation recovery and effectiveness of BAER planting adjacent to perennial stream reaches in stand replacing burn areas; plant if necessary

Lower Metolius River SWS – Spring Creek drainage

- Officially inactivate[14], in the next 10 years (2004-2014), level 2 roads that had been undrivable prior to the fire due to vegetation
- Monitor stream crossings and road drainage within and downstream of the fire area; remove or improve undersized culverts and design to allow fish migration
- Monitor long-term in-stream large woody debris (LWD)
- Reduce riparian road miles through decommissioning[15]
- Reduce road densities through decomissioning[15]
- Assess bank instability and opportunities for restoration

APPENDIX AQ1 – SOILS, GEOLOGY, HYDROLOGY AND AQUATIC HABITAT

Table 5-1. Summary of variables affecting water quality and water quantity in the Metolius River subwatersheds and watersheds.

Variable	Abbot	Cache	Dry	Candle	Jefferson	Canyon	First	Jack	Head of Metolius	U. Lake	L. Lake
% of SWS in ROS zone	29	61	58	46	37	39	39	40	36	86	45
Acres in ROS zone	932	966	0	1704	1161	4027	2004	841	10	2397	1856
% of SWS w/ Slopes > 30%	10	12	8	31	45	22	16	9	33	13	6
Spring/Lake controlled			x		x				x	x	x
Infiltration rate (relative diff.)	R	R	R	R	R	R	VR	R	R	VR	VR
Miles of perennial stream	5.9	0	0	12.2	53.7	25.6	6.5	6.6	16.2	3.3	13.2
Natural Sensitivity Rank	**10**	**14**	**15**	**6**	**12**	**4**	**8**	**9**	**13**	**16**	**17**
% SWS in SR	52	12	1	22	11	36	21	15	1	23	18
Road density ex wilderness	5.7	7.3	6.3	5.4	1.1	4.9	6.2	5.6	5.1	3	7.1
# of stream crossings	71	26	15	20	4	126	57	47	115	26	53
# stream crossings/stream mi.	2.6	1.9	1.4	0.4	0.1	1.6	2.1	1.8	1.9	1.5	3.3
Miles of road on slopes > 30%	2.27	0.34	0.14	0.49	1.14	6.34	2.09	0.78	4.6	1.95	1.99
RR native surface/gravel road mi	7.07	2.98	1.8	4.42	2.72	10.74	10.92	4.92	10.21	8.58	9.56
Debris Slide Risk to Stream	M	VL	VL	H	M	H	M	L	VL	M	L
location of fire	all	M	L	M,L	M,L	All	U,M	U,M		M,L	U
Acres of SR in ROS zone	932	966	0	1704	1161	4027	2004	841	10	2397	1856
% RR burned	100	37	9	68	49	92	67	87	4	67	40
% RR burned as SR	54	7	1	23	8	35	22	13	0	30	11
RR acres burned as SR on slopes > 30%	51	0	0	137	84	143	41	14	1	68	17
% of SWS in detrimental soil condition	20	18	12	6	?	12	13	17	18	11	21
% pre-fire change in ET from historic mean	4	-9	-26	-22	-23	-7	-19	-11	39	-23	-3
% change in ET from fire	-64	-20	-1	-31	-21	-49	-34	-31	-2	-33	-29

Variable	L. Fly	U. Metol	M. Metol	Metolius (7th field)	Street Ck (7th field)	L. Metol	Spring Ck (7th field)	Juniper	White-water	Total W-shed
% of SWS in ROS zone	44	49	37	11	25	*5*	15	0	*60*	43
Acres in ROS zone	86	158	1415	1490	1827	*12*	1016	0	0	17569
% of SWS w/ Slopes > 30%	17	32	41			*21*		*2*	*53*	24
Spring/Lake controlled										
Infiltration rate (relative diff.)	M	M	M	M	M	M	M	M	M	
Miles of perennial stream	8.7	46.8	20.9			6.9		0	*74.1*	301
Natural Sensitivity Rank	**5**	**2**	**3**			**11**		**18**	***1***	
% SWS in SR	11	1	39	36	44	*17*	80	0	0	14
Road density ex wilderness	4.4	3	3.1	1.4	4.9	*3*	4.7	*3*	*1*	4
# of stream crossings	55	144	103	34	69	*31*	47	*5*	*8*	1029
# stream crossings/stream mi.	1.3	1.2	1.3	0.6	2.8	*0.7*	2.2	*0.2*	*0.1*	1.2
Miles of road on slopes > 30%	6.15	8.21	5.71							
RR native surface/gravel road mi	11.72	19.53	8.07					0.2	0.3	139.45
Debris Slide Risk to Stream	VL	L	H			H		N	N	
location of fire	L	U	M,L			U,M				
Acres of SR in ROS zone	86	158	1415	745	665	*12*	609	0	0	17569
% RR burned	14	3	55	53	64	*29*	93	0	0	39
% RR burned as SR	11	0	32	31	37	*25*	79	0	0	15
RR acres burned as SR on slopes > 30%	1	1	422			*190*		0	0	1170
% of SWS in detrimental soil condition	*10*			3	10		13	0		
% pre-fire change in ET from historic mean	-6	1	-1	?	?	?	?	?	?	?
% change in ET from fire	-6	-1	-41	?	?	-5	?	0	0	-21

Summary of Fish Habitat/Channel Morphology Risk and Evaluation Procedure

Abbot Creek SWS

- High overall road densities and number of stream crossings
- Moderate native surface/gravel road miles in RR
- Moderate % of subwatershed in determental soil condition and high number of acres > 20% detrimental condition (C & D classes)
- High risk of sedimentation from fire effects and roads
- A reduction of 22 units in %CET in the subwatershed from the fires
- Low/moderate increase in stormflows due to large reduction in ET from fire and harvest tempered by flat slopes, low acres in ROS zone, and high infiltration
- Channel appears to have handle 1996 flood without significant morphological change
- Loss of RR vegetation in upper perennial section of Abbot Creek but not in lower C4 reach
- Many road drainage structures in lower SWS were improved after the fire
- Riparian vegetation in the majority of the Rosgen "C" reach was unburned or underburned; thereby, not affecting bank stability
- High fish habitat value factor for redband trout in Abbot Creek

Fish Habitat/Channel Morphology Risk:

- High risk sediment deposition in C4 redband spawning areas
- Low/Moderate risk of morphological change in C4 reach
- Moderate risk of temperature increase

Cache Creek SWS

- Highest road density in the Metolius watersheds but low riparian road miles
- Moderate % of subwatershed in determental soil condition and high number of acres > 20% detrimental condition (C & D classes)
- Although 37% of the RR burned, temperature effects would be negligible because the stream is intermittent
- No fish habitat in Cache Creek but during storm/melt events Cache Creek contributes to redband spawning habitat in S.F. Lake Creek
- Low risk of sedimentation in Cache Creek
- Moderate amount of acres in the ROS zone
- Low increase in stormflows despite high road densities due to flat slopes, high linfiltration, no to little perennial water, low predicted increases from Dry Creek, and minimal fire effects

Fish Habitat/Channel Morphology Risk:

- Negligible sedimentation risk to redband spawning habitat in S.F. Lake Creek
- Low risk of morphological changes

Dry Creek SWS

- High road density but low riparian road miles
- Moderate % of subwatershed in determental soil condition and high number of acres > 20% detrimental condition (C & D classes)
- Very few fire effects
- No fish habitat in Dry Creek or Cache Creek but during storm/melt events Dry Creek contributes to redband spawning habitat in S.F. Lake Creek
- Low risk of sedimentation in Dry Creek
- Low increase in stormflows despite high road densities due to flat slopes, high infiltration, no perennial water, and minimalw fire effects

Fish Habitat/Channel Morphology Risk:

- Negligible sedimentation risk to redband spawning habitat in S.F. Lake Creek
- Low risk of morphological changes

Candle Creek SWS

- Low overall road density but high road density concentrated at the bottom of the subwatershed with moderate amount of roads in RR
- Moderate/High risk of sedimentation from fire effects and native surface roads (including user-created roads) in RR
- Some user-created roads in riparian but mainly in underburned area
- Moderate acres in the ROS zone, naturally sensitive to storms/melt events
- A reduction of 10 units in %CET in the subwatershed from the fires
- High predicted increase in stormflow due to fire effects and natural sensitivity
- Low risk of stream temperature increase because minimal RR mortality in perennial sections and spring influence in Candle and Cabot Creeks
- High fish habitat value factor in Candle Creek and moderate value factor in Cabot Creek

Fish Habitat/Channel Morphology Risk:

- High risk sediment deposition in C4 bulltrout spawning areas
- Moderate risk of morphological changes in C4 reach in Candle Creek due to high increases in stormflow from fire effects

Jefferson Creek SWS

- Low road densities overall and within RRs
- Low risk of sedimentation due to fire effects (mixed and stand replacing)
- Low/Moderate increase in stormflows due to fire effects and natural sensitivity
- Low risk of stream temperature increase because minimal RR mortality in perennial sections and spring influence in Jefferson Creeks
- High fish habitat value factor for bull trout in Jefferson Creek
- Primarily wilderness

Fish Habitat/Channel Morphology Risk:

- Low risk sediment deposition in C4 bulltrout spawning areas
- Low risk of morphological changes in C4 reach due to low/moderate predicted increases in stormflow from fire effects

Canyon Creek SWS

- High riparian native surface road miles (including additional user-created roads) and riparian roads on steep slopes but moderate number of stream crossings
- Moderate % of subwatershed in determental soil condition and high number of acres > 20% detrimental condition (C & D classes)
- Large reduction in stream shade in perennial reaches that could affect stream temperature
- Canyon Creek and Brush Creek are listed on the Oregon 2002 303(d) list for water temperature exceedence above the bulltrout standard of 50°F.
- High risk of sedimentation due to riparian roads and fire effects
- A reduction of 19 units in %CET in the subwatershed from the fires
- High predicted increase in stormflows due to fire effects, natural sensitivity, harvest, and roads
- High bank instability in Canyon Creek B3 reach just above the Roaring Springs confluence
- Many road drainage structures in middle SWS were improved after the fire
- Riparian vegetation in the Rosgen "C" reach was unburned or underburned; thereby, not affecting bank stability
- High fish habitat value factors in Canyon and Roaring Creeks, low value factor in Brush Creek

Fish Habitat/Channel Morphology Risk:

- High risk of sediment deposition in C3 and C4 bulltrout spawning areas on Canyon Ck.
- Moderate risk of sediment deposition in B3 redband spawning area of Canyon Creek due to inputs from upper Canyon Ck. and Bear Valley Ck.
- High risk of sediment deposition in Brush Creek E4 redband and bulltrout rearing reaches from upper subwateshed contribution
- Moderate risk of morphological changes in C3/C4 reaches of Canyon Creek and E4 reach of Brush Creek due to high increases in stormflow from fire effects
- High risk of morphological change in B3 reach of Canyon Creek due to existing bank instability and predicted increases in stormflow
- High risk of temperature increases in Brush Creek, moderate temperature increases in Canyon Creek (inputs from Bear Valley Creek, Brush Ck, and Upper Canyon Creek), and moderate temperature increases in Roaring Creek (spring influence and minimal RR burn)
- Moderate risk of sedimentation in B4/C4 bulltrout spawning reach of Roaring Spring Creek
- Moderate risk of sedimentation and bank erosion in E4 bulltrout and redband rearing reach of Brush Creek

First Creek SWS

- High road densities, native surface/gravel road miles, and number of stream crossings in RRs
- Moderate % of subwatershed in determental soil condition and high number of acres > 20% detrimental condition (C & D classes)
- High sedimentation risk due to roads
- A reduction of 11 units in %CET in the subwatershed from the fires
- High predicted increase in stormflows due to fire effects, natural sensitivity, harvest, and roads
- Riparian vegetation in the Rosgen "C" reach was unburned or underburned; thereby, not affecting bank stability
- Moderate risk of stream temperature increase because RR vegetation in middle perennial reach was lost but lower C reach was underburned or unburned
- Listed on the Oregon 2002 303(d) list for temperature exceedences above the salmonid spawning standard of 55°F
- Low fish habitat factor for First Creek

Fish Habitat/Channel Morphology Risk:

- High risk sediment deposition in C5 redband rearing areas on First Ck.
- Moderate risk of morphological changes in B2 and in redband rearing B3 and C5 reaches of First Creek
- Moderate risk to stream temperature in redband rearing reach

Jack Creek SWS

- High overall road densities but low/moderate road miles in RRs
- Moderate % of subwatershed in determental soil condition and high number of acres > 20% detrimental condition (C & D classes)
- High percentage of RR burned but mostly low and mixed severity
- Low risk of sedimentation and temperature effects
- Riparian vegetation in the Rosgen "C" reach was unburned or underburned; thereby, not affecting bank stability
- A reduction of 11 units in %CET in the subwatershed from the fires
- Moderate predicted increase in stormflows due to fire effects, roads and harvest
- High fish habitat value factor in Jack Creek

Fish Habitat/Channel Morphology Risk:

- Low risk of sediment deposition in B4 and C4 bulltrout spawing areas in Jack Ck.
- Moderate risk of morphological changes in C4 bulltrout spawning reach
- Low risk of temperature increases in bulltrout spawning reach

Headwaters of the Metolius River SWS

- High overall road densities and moderate RR road miles
- Moderate/High risk of sedimentation from roads
- Moderate % of subwatershed in determental soil condition and high number of acres > 20% detrimental condition (C & D classes)
- High predicted increase in stormflows due to predicted increases in the following tributaries: Lake Creek, Jack Creek, First Creek, Canyon Creek, Abbot Creek, Candle Creek, and Jefferson Creek.
- No fire effects on the mainstem Metolius River
- No/Low effects from past harvest because it occurred in areas without drainage density
- High fish habitat value factor in the upper mainstem Metolius River

Fish Habitat/Channel Morphology Risk:

- Moderate risk of sedimentation in redband spawning reaches in the mainstem Metolius R. due to inputs from Abbot, Canyon, Candle, and First Creeks.
- Low risk of morphological change in the mainstem Metolius River because riparian vegetation is still intact and banks are stable
- Negligible temperature affect in mainstem Metolius River because of cold spring influence and dilution of tributary inputs.

Upper Lake Creek SWS

- Moderate risk of sedimentation from roads and fire; however, area drains into Blue Lake and Suttle Lake which reduces the overall risk to Link and Lake Creeks
- Moderate reduction in stream shade but will have a negligible effect on stream temperature because the lakes are the limiting factor.
- Low fish habitat value factor in Link Creek. No fish habitat above the lakes.
- A reduction of 11 units in %CET in the subwatershed from the fires
- Low predicted increase in stormflows due to lake control, very high/high infiltration, and low/moderate road density

Fish Habitat/Channel Morphology Risk:

- Low risk of sediment deposition in B4 redband and kokanee spawning reach of Link Ck below Blue Lake.
- Negligible risk of morphological changes in B4 reach between Blue and Suttle Lakes
- Negligible temperature affect in Link Creek

Lower Lake Creek SWS

- One of the highest road densities, the highest number of stream crossings, and moderate/high RR road miles
- High risk of sedimentation from roads
- Moderate % of subwatershed in determental soil condition and high number of acres > 20% detrimental condition (C & D classes)

- Listed on the Oregon 2002 303(d) list for water temperature exceedences above the salmonid rearing standard of 64° F
- High fish habitat value factor for redband trout
- Important bulltrout spawning habitat on the Metolius just downstream of Lake Creek
- A reduction of 10 units in %CET in the subwatershed from the fires
- Low predicted increase in stormflows due to lake control (fire and ROS zone concentrated around lake), very high infiltration, and low predicted increases from Cache Creek.
- Minimal effect on stormflows from roads because roads on steep slopes are above Suttle Lake and roads near stream are on the flats.

Fish Habitat/Channel Morphology Risk:

- ➢ High risk of sediment deposition in C3, C4, and E5 redband rearing reaches in S.F., M.F., and N.F. of Lake Creek and in C3 redband spawning reach in S.F. Lake Ck.
- ➢ Low risk of morphological changes in C3/C4 reaches of S.F, M.F., N.F., and mainstem reaches of Lake Creek
- ➢ Low risk of stream temperature increases because minimal riparian vegetation was lost and the limiting factor on stream temperature is Suttle Lake

Upper Fly Creek SWS

- High road density, riparian road miles, and number of stream crossings
- Not burned by recent fires
- Negligible/Low predicted increase in stormflows due to compaction from roads
- High risk of sedimentation from roads
- No fish habitat in Upper Fly Creek SWS but drains into Lower Fly Creek which provides habitat for redband rearing

Fish Habitat/Channel Morphology Risk:

- ➢ Low risk of sedimentation to redband rearing reaches in Lower Fly Creek
- ➢ Negligible risk of morphological changes in Upper Fly Creek

Lower Fly Creek SWS

- High riparian road miles but low number of stream crossings
- Moderate/High sedimentation from roads in both Upper Fly and Lower Fly
- Low predicted increase in stormflows due to minimal fire effects
- Moderate fish habitat value factor for redband trout.

Fish Habitat/Channel Morphology Risk:

- ➢ Moderate/High risk of sedimentation to Rosgen “C” redband spawning reaches in Lower Fly Creek from roads

- Low risk of morphological changes in Rosgen "C" redband spawning reaches in Fly Creek

Upper Metolius River SWS

- High riparian road miles mainly comprised of USFS road 1499
- High road density on the Warm Springs Reservation
- Negligible fire effects
- No predicted increase in stormflows in the tributaries within the Upper Metolius SWS
- High predicted increase in stormflows in the mainstem of the Upper Metolius River due to predicted increases from the Headwaters of the Metolius SWS and it's tributaries (Jefferson, Candle, Abbot, Jack, etc…).
- Moderate fish habitat value factor in the middle mainstem Metolius River

Fish Habitat/Channel Morphology Risk:

- Potential risk of sedimentation in face drainages and the mainstem of the Metolius River due to roads on the Warm Springs Reservation
- Low risk of morphological change in the mainstem Metolius River because riparian vegetation is still intact and banks are stable
- Negligible temperature affect in mainstem Metolius River because of cold spring influence and dilution of tributary inputs.

Middle Metolius River SWS

- A reduction of 13 units in %CET in the subwatershed from the fires
- More than 400 acres of slopes >30% in RR with stand replacing burn

- Street Creek
  - High road densities, riparian road miles, and number of stream crossings
  - Large % of SWS in SR burn
  - High risk of sedimentation from roads and fire effects
  - Approximately 1700 lineal feet of bank erosion (including both banks) in perennial reach (Dachtler 2003).
  - High predicted increase in stormflows due to fire effects, roads, and natural sensitivity
  - Large reduction in stream shade in perennial reach that could affect stream temperature
  - Moderate fish habitat value factor

  Fish Habitat/Channel Morphology Risk:

  - High risk of sedimentation to redband spawning reach in Street Creek
  - High risk of morphological change in unstable, perennial Rosgen B3/B4 reaches
  - High risk of stream temperature increases in perennial, redband spawning reach of Street Creek

- Face drainages, Bean Ck. and the lower mainstem Metolius R.
  - Majority of this area is within Metolius Breaks Roadless Area
  - Large % of SWS in SR burn
  - SR burn along approximately 2.5 miles of the mainstem Metolius River just above Lake Billy Chinook reservoir
  - Low/Moderate predicted increases in stormflows in face drainages
  - High predicted increase in stormflows in the mainstem Metolius River due to predicted increases in the following tributaries: Lake Creek, Jack Creek, First Creek, Canyon Creek, Abbot Creek, Candle Creek, and Jefferson Creek.
  - All face drainages are intermittent or ephemeral
  - Most of the sediment from upstream will deposit on point bars and behind debris
  - Moderate fish habitat value factor in the lower mainstem Metolius River

  Fish Habitat/Channel Morphology Risk:
    - Low risk of sedimentation in steep, intermittent face drainages
    - Low risk of morphological change in the mainstem Metolius River because riparian vegetation is still intact and banks are stable
    - Negligible temperature affect in mainstem Metolius River because of cold spring influence and dilution of tributary inputs.

Lower Metolius River SWS

- Spring Creek
  - High road densities, riparian road miles, and number of stream crossings
  - Large % of SWS and riparian area in SR burn
  - High risk of sedimentation from roads and fire effects
  - High predicted increase in stormflows due to fire effects and roads
  - Large reduction in stream shade in intermittent reaches but not in perennial reach
  - Low fish habitat value factor
  - Spring Creek feds into Lake Billy Chinook reservoir

  Fish Habitat/Channel Morphology Risk:
    - Moderate risk of sedimentation to redband and kokanee spawning reach in the perennial section of Street Creek
    - Low risk of morphological change in perennial reach of Street Creek
    - Negligible risk of stream temperature increases in perennial, redband/kokanee spawning reach of Spring Creek

- Face drainages and Lake Billy Chinook Reservoir
  - All of this area drains in the LBC reservoir
  - LBC is listed on the Oregon 303(d) list for pH and chlorophyll *a*
  - Approximately, 2 miles of SR burn along the southern edge of LBC reservoir
  - Very low road density
  - Negligible predicted increases in stormflows in face drainages

- High predicted increase in stormflows in the mainstem Metolius River due to predicted increases in the following tributaries: Lake Creek, Jack Creek, First Creek, Canyon Creek, Abbot Creek, Candle Creek, Jefferson Creek, Street, Spring Creek.
- All face drainages are intermittent or ephemeral
- Most of the sediment from upstream will deposit on point bars and behind debris
- Low risk of short-term nutrient spikes in the reservoir following the Eyerly fire
- High fish habitat value factor for LBC reservoir for bull trout rearing and winter habitat and kokanee salmon rearing

Fish Habitat/Channel Morphology Risk:

- Low risk of sedimentation in steep, intermittent face drainages
- Low/Moderate risk of sedimentation in LBC reservoir due to inputs from Street Creek, Spring Creek, and some face drainages within the fire area
- Negligible long-term risk of nutrient, pH, or chlorophyll *a* increases due to short-term flushing and dilution

Juniper Creek SWS

- Moderate road density but very low riparian road miles and number of stream crossings
- Not burned by recent fires
- Negligible predicted increase in stormflows due to compaction from roads
- No fish habitat in Juniper Creek (intermittent) but it drains into LBC reservoir

Fish Habitat/Channel Morphology Risk:

- Negligible sedimentation risk to Juniper Creek or LBC reservoir
- Negligible risk of morphological changes in Juniper Creek

Whitewater Creek SWS

- Low road density and very low riparian road miles and number of stream crossings
- Not burned by recent fires
- No predicted increase in stormflows

Fish Habitat/Channel Morphology Risk:

- Negligible sedimentation risk to Whitewater Creek or it's tributaries
- Negligible risk of morphological changes in Whitewater Creek or it's tributaries

Aq. Table 5-2. Average density of age 1 bull trout/100m2 in pools and run of selected streams in the Metolius Watersheds.

Average of Density/ 100m2	**year**											
Stream Name	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2001**	**2002**	**2003**	**Grand Total**
Abbot Creek				0.5		1.9	2.2	2.2				2.0
Brush Creek	1.2	2.0	2.1	2.2	1.1	3.2	1.9	1.6	0.8	1.0	1.5	1.6
Candle Creek	2.7	1.6	1.5	1.3	0.7	2.7	1.1	1.8				1.7
Jack Creek	2.6	1.3	1.2	1.6	1.1	2.3	1.5	1.2	0.5	1.3	0.7	1.3
Lower Canyon Creek	0.8	0.4	0.6	0.7	0.7	1.0	0.8	0.9	0.5	0.5	0.8	0.7
Metolius River						0.8	1.1	0.9	0.5	0.2		0.7
Roaring Creek	0.7	0.8	1.1	0.6	0.4	0.6	1.2	0.6	0.6	0.5		0.7
Upper Canyon Creek	3.6	3.1	1.6	1.4	1.1	1.6	3.6	3.4	1.1	1.3		1.9
Grand Total	1.8	1.5	1.3	1.3	0.9	1.7	1.7	1.6	0.6	0.8	1.1	1.3

Aq. Table 5-3. Pools per mile from stream survey of stream reaches in the Metolius Watersheds.

STREAM	REACH	1989	1990	1992	1995	1996	1997	1998	1999	2000	2001
Abbott Creek	1	6									
	2	0									
Abbott Creek Total		1									
Bear Valley Creek	1		44								
	2		24								
Bear Valley Creek Total			34								
Brush Creek	1	4									
	4	5									
Brush Creek Total		5									
Cabot Creek	1					18					
Cabot Creek Total						18					
Candle Creek	1				8						
	2				12						
	3				39						
	4					41					
	5					36					
Candle Creek Total					19	38					
Canyon Creek	1	21									
	2	24									
	3	2									
	4	37									
	5	10									
Canyon Creek Total		19									
First Creek	1	0									
	2	31									
	3	22									
First Creek Total		18									
Fly Creek	2							49			
	3							60			
	4							59			
Fly Creek Total								54			
Heising Spring Creek	1							0			
Heising Spring Creek Total								0			
Jack Creek	1				27						20
	2	0									36
Jack Creek Total		0			27						31
Jefferson Creek	1	7				16					
	2					6					
	3					5					
	4					7					
	5					3					

STREAM	REACH	1989	1990	1992	1995	1996	1997	1998	1999	2000	2001
Jefferson Creek Total		7				8					
Lake Creek	1	17									
	2	17									
	3	0									
	4	1									
Lake Creek Total		9									
Link Creek	1						20				
Link Creek Total							20				
Metolius River	1								8	4	
	2	2							4	5	
	3	1								5	
	4									4	
	5	1								6	
Metolius River Total		1							5	5	
Roaring Creek	1				8						
	2				6						
Roaring Creek Total					7						
Six Creek	1						61				
	2						30				
	3						32				
Six Creek Total							41				
South Fork Link Creek	1					50					
South Fork Link Creek Total						50					
Spring Creek	1							8			
Spring Creek Total								8			
Street Creek	1								71		
	2								36		
Street Creek Total									53		
Upper Link Creek	1					33					
	2					47					
Upper Link Creek Total						39.9					

Aq. Table 5-4. Large wood per mile (all size classes) for stream survey reaches in the Metolius Watershed.

STREAM	REACH	1989	1990	1992	1995	1996	1997	1998	1999	2000	2001
Abbott Creek	1	153									
	2	286									
Abbott Creek Total		253									
Bear Valley Creek	1		173								
	2		193								
Bear Valley Creek Total			183								
Brush Creek	1	151									
	4	202									
Brush Creek Total		177									
Cabot Creek	1					94					
Cabot Creek Total						94					
Candle Creek	1				190						
	2				195						
	3				156						
	4					77					
	5					56					
Candle Creek Total					181	66					
Canyon Creek	1	140									
	2	439									
	3	344									
	4	646									
	5	323									
Canyon Creek Total		378									
First Creek	1	0									
	2	176									
	3	275									
First Creek Total		150									
Fly Creek	2							29			
	3							31			
	4							40			
Fly Creek Total								32			
Heising Spring Creek	1							15			
Heising Spring Creek Total								15			
Jack Creek	1				189						490
	2	725									739
Jack Creek Total		725			189						656
Jefferson Creek	1	277				162					
	2					85					
	3					84					
	4					221					
	5					88					
Jefferson Creek Total		277				128					

STREAM	REACH	1989	1990	1992	1995	1996	1997	1998	1999	2000	2001
Lake Creek	1	236									
	2	321									
	3	154									
	4	85									
Lake Creek Total		199									
Link Creek	1						45				
Link Creek Total							45				
Metolius River	1								45	76	
	2	54							45	57	
	3	75								40	
	4									21	
	5	65								11	
Metolius River Total		65							45	41	
Roaring Creek	1				270						
	2				182						
Roaring Creek Total					226						
Six Creek	1						18				
	2						32				
	3						109				
Six Creek Total							53				
South Fork Link Creek	1					47					
South Fork Link Creek Total						47					
Spring Creek	1							59			
Spring Creek Total								59			
Street Creek	1								28		
	2								17		
Street Creek Total									22		
Upper Link Creek	1					48					
	2					60					
Upper Link Creek Total						54					

Aq. Table 5-5. Days water temperature was exceeding 10 c on streams at long-term monitoring stations in the Metolius Watershed.

Station	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
Brush - 12 rd								0	23	1					18	34
Abbot- lower 12 rd									57	54	85	52				121
Candle- 1290 rd		0	0		0	0	0		0	0	0					
Canyon- 12rd	23	37	2	28	51		43	9	0			0	0			28
Canyon- 1420 rd		0	0		2	1	14	0	7	0	0	0				
Jack- 1420 rd	22	12	0	6	32	0	43	5	0	0	0					0
Jefferson – 1290rd	0	0	0	0	0	0	0	0	0	0	0	0		0	0	
Roaring – 1260 rd		0		0	0	0	0	0	0	0		0	0		0	
Metolius – Br 99	0	0	0	12		0	19	0	2	0	0	0	0	0	13	
Metolius – Gorge CG									102	119	106	118	110	124	132	
S. Fork Lake- 090rd					115	93	111	108	48	147	109	131	133	141	134	148

Aq. Table 5-6. July maximum water temperature for streams at long-term monitoring stations in the Metolius Watersheds.

Station	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
Brush 12rd								10.4	11.1	10.1					11.46	10.74
Abbot- lower 12 rd									11.6	10.6	11.48	11.36				12.16
Candle- 1290 rd		6.5	4		6.6	6	6.9		6.6	6.3	6.49					
Canyon- 12rd	11.5	11.5	10	11.6	11.4		11.3	10.6	10			9.31				10.73
Canyon- 1420 rd		10	9		9.0519	9.4	10.6	10.2	24.6	8.8						
Jack- 1420 rd	11.5	11	10.5	11	10.81	9.6	11.1	10	9.2	8.9	10.02					10.19
Jefferson – 1290rd	9	7.5	10	9.9	9.691	9.2	9.6	8.8	8.9	8.6	9.31	8.04		9.28	9.9	
Roaring – 1260 rd		8.5		8.5	8	7.4	8.3	7.7	7.4	7.1		7.41	7.31		7.67	
Metolius – Br 99	9.5	9		10.4		10.2	10.3		10.5	9.9	9.8	10.06	9.92	9.83	10.64	
Metolius – Gorge CG									12.9	11.9	11.9	12.11	11.85	12.23	13.28	
S. Fork Lake- 090rd					26.616	20.5	23.8	22.1		22.2	21.61	21.91	22.81	21.89	23.33	24.71

Aq. Table 5-7. Seven-day average maximum water temperature for streams at long-term monitoring stations in the Metolius Watersheds.

Station	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
Brush 12rd								9.9	10.4	10.0					10.6	10.5
Abbot- lower 12 rd									11.2	11.2	11.3	11.4				12.2
Candle- 1290 rd																
Canyon- 12rd	11.1	10.9	10.1	11.0	11.5		10.9	10.2	9.4			9.0	4.6			10.6
Canyon- 1420 rd																
Jack- 1420 rd	10.9	10.5	9.9	10.4	11.1	9.5	10.8	10.1	8.9	8.7	9.6					9.9
Jefferson – 1290rd	8.4	7.1	9.9	8.9	9.1	9.1	9.1	8.6	8.4	8.4	9.0	7.7		9.2	9.1	
Roaring – 1260 rd		8.1		8.2	8.1	7.3	8.1	7.7	7.2	6.9		7.3	7.3		7.4	
Metolius – Br 99	9.1	8.9	9.6	10.2		9.9	10.2	9.3	10.0	9.7	9.8	9.9	9.8	9.7	10.2	
Metolius – Gorge CG									12.6	11.5	11.7	12.0	11.7	11.9	12.8	
S. Fork Lake- 090rd					24.9	21.6	23.1	21.2	21.5	22.3	20.9	21.5	22.4	22.2	22.2	23.6

Aq. Table 5-8. Miles of stream by habitat type for bull trout.

	Spawning	Rearing	Migration_Forage
STREAM			
Abbott Creek		2.7	2.7
Abbott Side Chan		0.2	0.8
Brush Creek		1.1	1.1
Cabot Creek		0.0	0.0
Candle Creek	4.0	4.0	5.0
Canyon Creek	2.7	4.4	4.4
Heising Spring Creek	0.4	0.4	0.4
Jack Cr Side Chan	0.4	0.4	0.4
Jack Cr Trib	0.2	0.2	0.2
Jack Creek	5.2	5.2	5.2
Jefferson Creek	4.5	8.7	8.7
Lake Cr SF Side Chan			0.2
Lake Creek SF		0.3	2.1
Metolius R Side Chan		0.3	0.3
Metolius River	5.4	28.8	28.8
Roaring Cr Trib		1.3	1.3
Roaring Creek	1.8	1.8	1.8
Spring Creek	0.3	0.3	0.3
Street Creek			0.7

Aq. Table 5-9. Miles of stream by habitat type for brook trout.

STREAM	**Spawning**	**Rearing**	**Migration_Forage**
Abbott Creek	2.7	2.7	2.7
Bear Valley Creek	2.7	2.7	2.7
Cabot Creek	4.0	4.0	4.0
Canyon Creek	4.1	4.1	4.1
First Creek	7.8	7.8	7.8
Lake Cr NF Side Chan	0.1	0.1	0.1
Lake Cr SF Side Chan	0.7	0.7	0.7
Lake Creek	1.4	1.4	1.4
Lake Creek MF	5.9	5.9	5.9
Lake Creek NF	0.2	0.2	0.2
Lake Creek SF	4.7	4.7	4.7
Link Creek	0.6	0.6	0.6

Aq. Table 5-10. Miles of stream by habitat type for redband trout.

STREAM	Spawning	Rearing	Migration_Forage
Abbot Cr Side Chan			
Abbot Cr Trib			
Abbot Creek	2.4	2.7	2.7
Brush Creek		3.8	3.8
Canyon Creek	3.1	5.3	5.3
First Creek			6.3
Fly Creek	1.4	7.1	8.2
Jack Cr Side Chan		0.4	0.4
Jack Creek		2.6	2.6
Jefferson Creek			1.5
Lake Cr NF Side Chan			0.1
Lake Cr SF Side Chan	0.2	0.7	0.7
Lake Creek			1.4
Lake Creek MF			5.9
Lake Creek NF			0.2
Lake Creek SF	2.0	5.1	5.1
Link Creek			0.6
Metolius R Side Chan		0.3	0.3
Metolius R Trib		0.1	0.1
Metolius River	28.8	28.8	28.8
Metoloius R Side Cha	0.4	0.4	0.4
Roaring Creek		1.1	1.1
Six Creek	1.7	1.7	4.0
Spring Creek	0.3	0.3	0.3
Street Creek	1.7	1.7	1.7

Aq. Table 5-11. Miles of stream by habitat type for brown trout.

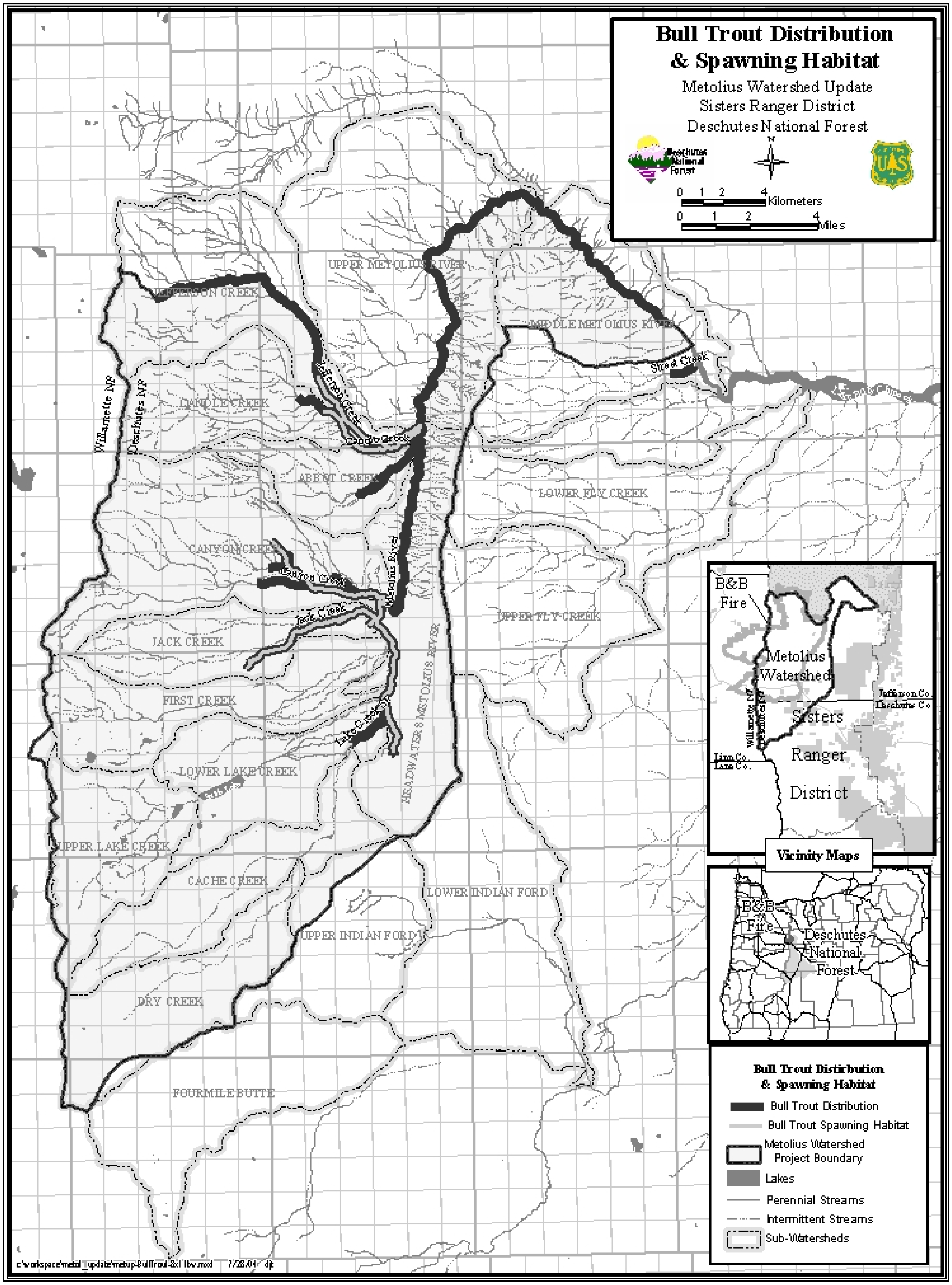
STREAM	Spawning	Rearing	Migration_Forage
Lake Cr NF Side Chan	0.1	0.1	0.1
Lake Cr SF Side Chan	0.7	0.7	0.7
Lake Creek	1.4	1.4	1.4
Lake Creek MF	5.9	5.9	5.9
Lake Creek NF	0.2	0.2	0.2
Lake Creek SF	4.7	4.7	4.7
Link Creek	0.6	0.6	0.6

Aq. Table 5-12. Miles of stream by habitat type for sockeye salmon.

STREAM	Spawning	Rearing	Migration_Forage
Abbot Creek	0.9	0.9	0.9
Candle Creek	3.0	3.0	3.0
Canyon Creek	4.1	4.1	4.1
Heising Sp Trib	0.1	0.1	0.1
Heising Spring Creek	0.3	0.3	0.3
Jack Cr Side Chan	0.4	0.4	0.4
Jack Creek	2.3	2.3	2.3
Jefferson Creek	1.3	1.3	1.3
Lake Cr NF Side Chan			0.1
Lake Cr SF Side Chan	0.1	0.1	0.7
Lake Creek			1.4
Lake Creek MF			2.4
Lake Creek NF			3.7
Lake Creek SF	0.3	0.3	4.7
Link Creek	0.6	0.6	0.6
Metolius R Side Chan	0.8	0.8	0.8
Metolius R Trib	0.2	0.2	0.2
Metolius River	28.6	28.6	28.6
Spring Creek	0.3	0.3	0.3

Aq. Table 5-13. Miles of stream by habitat type for spring chinook.

STREAM	Spawning	Rearing	Migration_Forage
Brush Creek			0
Canyon Creek			2.7
Heising Spring Creek			0.2
Jack Creek			0.1
Lake Creek SF			1.2
Metolius River			28.4
Spring Creek			0.3


Bull Trout Distribution
& Spawning Habitat
Metolius Watershed Update
Sisters Ranger District
Deschutes National Forest
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UPPER METOLIUS RIVER
JEFFERSON CREEK
MIDDLE METOLIUS RIVER
CANDLE CREEK
ABBOT CREEK
LOWER FLY CREEK
CANYON CREEK
UPPER FLY CREEK
JACK CREEK
FIRST CREEK
LOWER LAKE CREEK
HEADWATERS METOLIUS RIVER
UPPER LAKE CREEK
CACHE CREEK
LOWER INDIAN FORD
UPPER INDIAN FORD
DRY CREEK
FOURMILE BUTTE
Willamette NF
Deschutes NF
Metolius River
Canyon Creek
Jack Creek
Candle Creek
B&B Fire
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Jefferson Co.
Deschutes Co.
Linn Co.
Lane Co.
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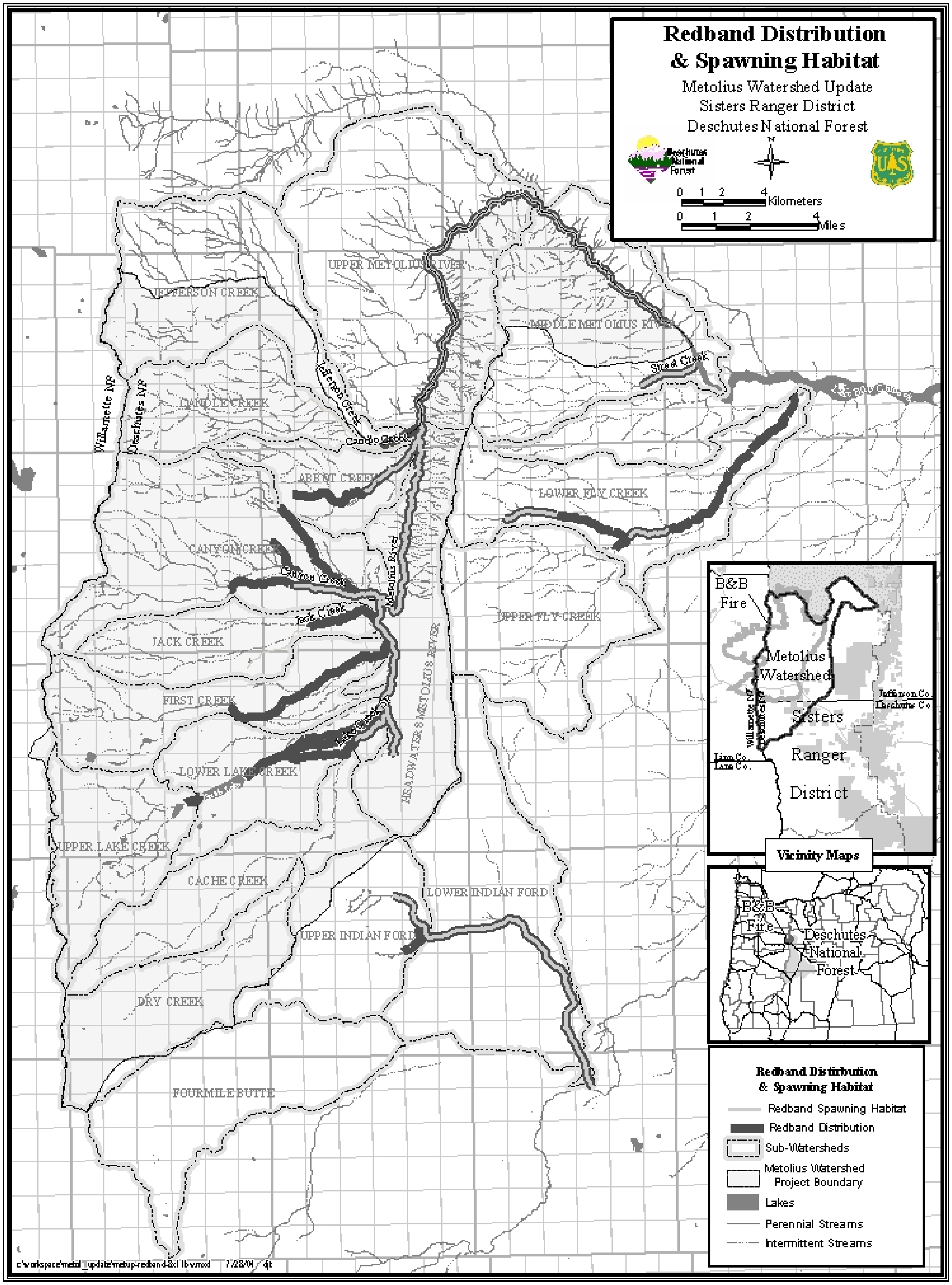
Bull Trout Distribution
Bull Trout Spawning Habitat
Metolius Watershed Project Boundary
Lakes
Perennial Streams
Intermittent Streams
Sub-Watersheds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& Spawning Habitat
Metolius Watershed Update
Sisters Ranger District
Deschutes National Forest
Kilometers
Miles
UPPER METOLIUS RIVER
JEFFERSON CREEK
MIDDLE METOLIUS RIVER
Street Creek
CANDLE CREEK
Candle Creek
ABBOT CREEK
LOWER FLY CREEK
CANYON CREEK
Canyon Creek
Metolius River
UPPER FLY CREEK
JACK CREEK
Jack Creek
FIRST CREEK
LOWER LAKE CREEK
HEADWATERS METOLIUS RIVER
UPPER LAKE CREEK
CACHE CREEK
LOWER INDIAN FORD
UPPER INDIAN FORD
DRY CREEK
FOURMILE BUTTE
Willamette NF
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Linn Co.
Lane Co.
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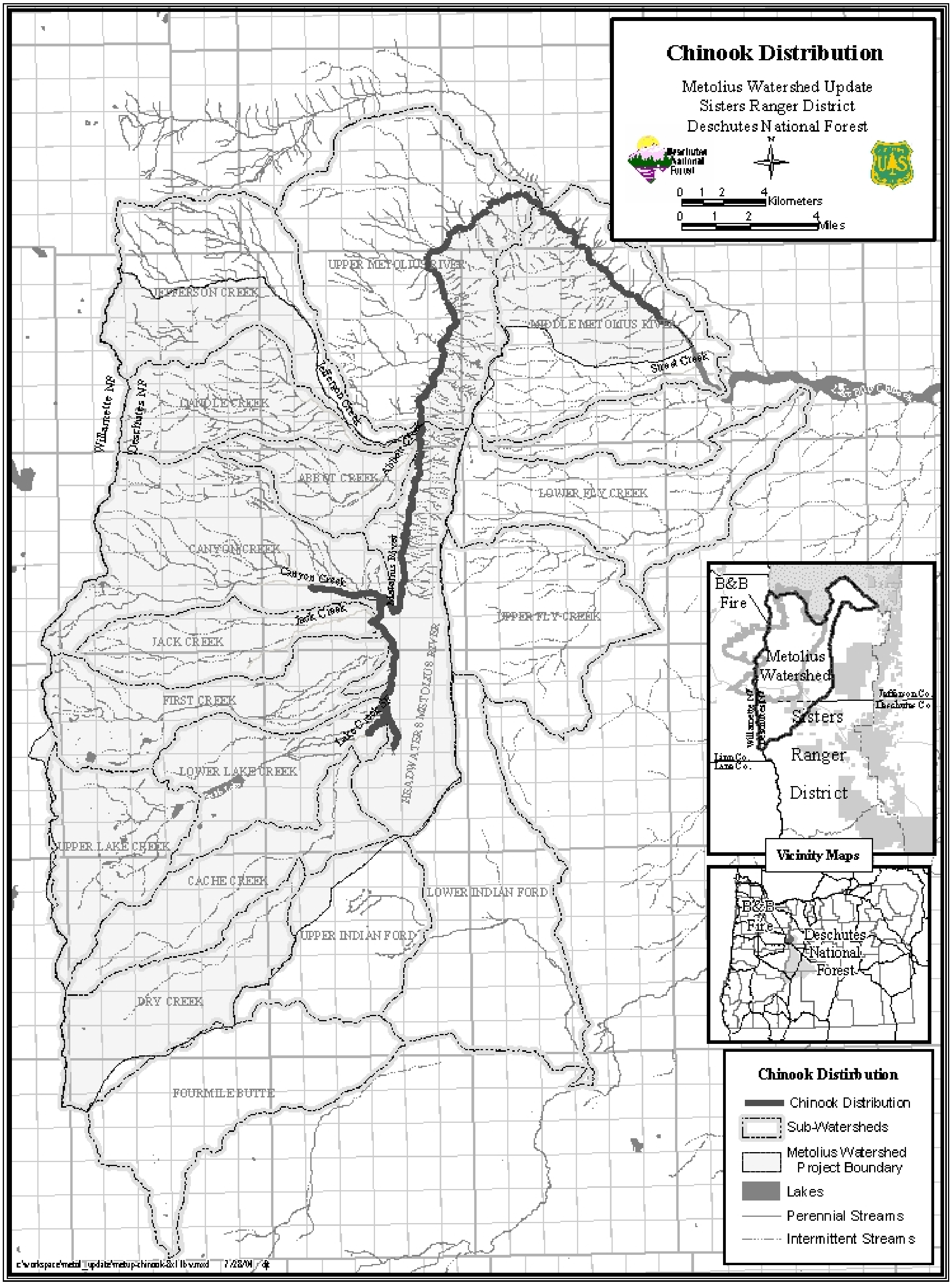
Redband Distribution
& Spawning Habitat
Redband Spawning Habitat
Redband Distribution
Sub-Watersheds
Metolius Watershed Project Boundary
Lakes
Perennial Streams
Intermittent Streams


Chinook Distribution
Metolius Watershed Update
Sisters Ranger District
Deschutes National Forest
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0 1 2 4 Miles
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JEFFERSON CREEK
MIDDLE METOLIUS RIVER
Street Creek
CANDLE CREEK
ABBOT CREEK
LOWER FLY CREEK
CANYON CREEK
Canyon Creek
Jack Creek
JACK CREEK
UPPER FLY CREEK
FIRST CREEK
Metolius River
HEADWATERS METOLIUS RIVER
LOWER LAKE CREEK
UPPER LAKE CREEK
CACHE CREEK
LOWER INDIAN FORD
UPPER INDIAN FORD
DRY CREEK
FOURMILE BUTTE
Willamette NF
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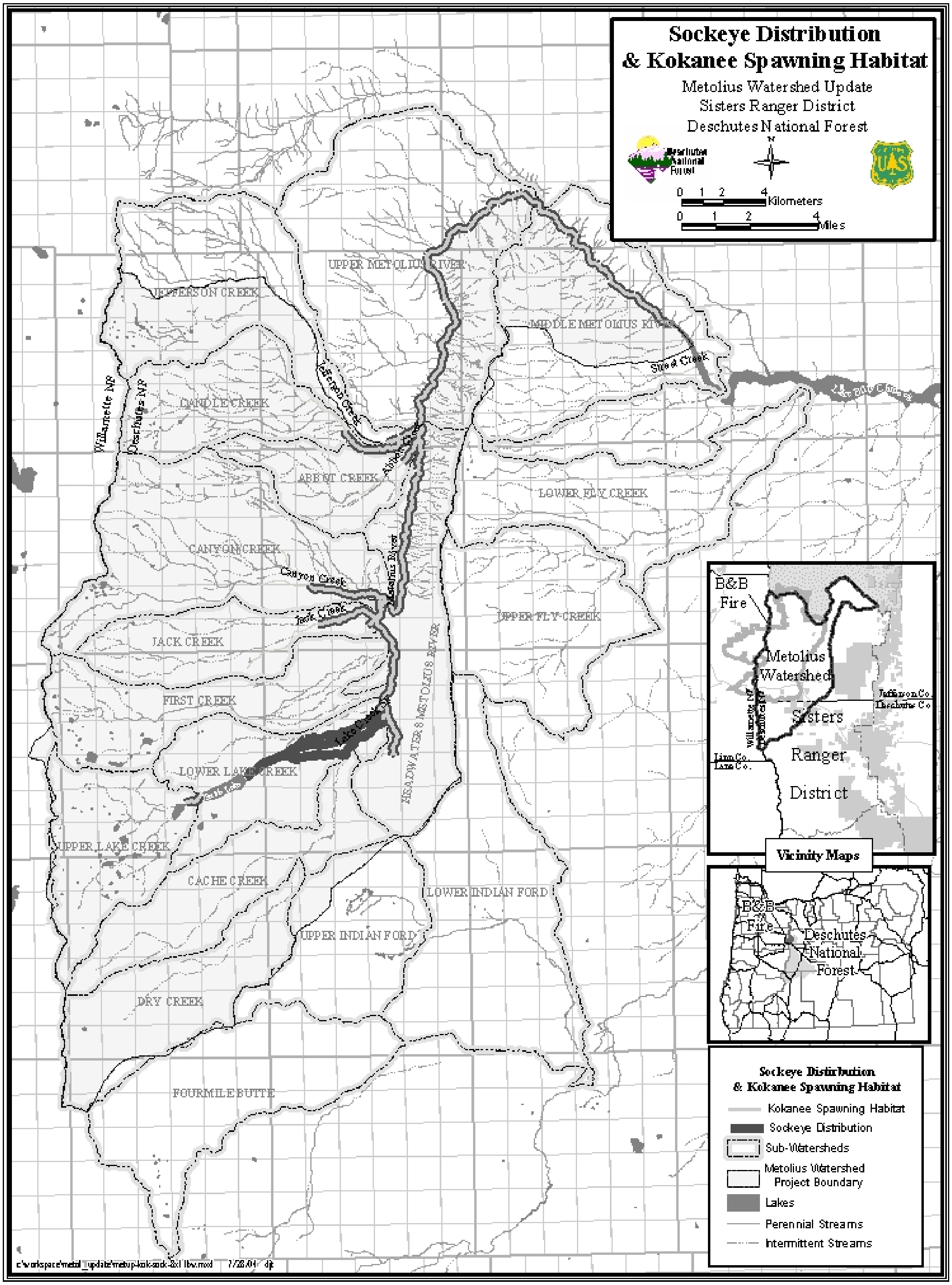
Vicinity Maps
Deschutes National Forest
Chinook Distribution
Chinook Distribution
Sub-Watersheds
Metolius Watershed Project Boundary
Lakes
Perennial Streams
Intermittent Streams


Sockeye Distribution
& Kokanee Spawning Habitat
Metolius Watershed Update
Sisters Ranger District
Deschutes National Forest
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JEFFERSON CREEK
MIDDLE METOLIUS RIVER
Street Creek
CANDLE CREEK
Willamette NF
Deschutes NF
Jefferson Creek
ABBOT CREEK
LOWER FLY CREEK
CANYON CREEK
Canyon Creek
Metolius River
Jack Creek
UPPER FLY CREEK
JACK CREEK
FIRST CREEK
HEADWATERS METOLIUS RIVER
Lake Creek
LOWER LAKE CREEK
UPPER LAKE CREEK
CACHE CREEK
LOWER INDIAN FORD
UPPER INDIAN FORD
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VEGETATION

Introduction

For both the 1996 watershed analysis and this update, current vegetation was analyzed on a stand/polygon basis utilizing photo interpreted data. However, the photo interpretation for the 1996 analysis was done by force account employees on 1991 aerial photos that were on a 1:15,580 scale and for this update the photo-interpretation was done by contract on 1995 aerial photos that were on a 1:12,000 scale. With these differences in the photos and the photo-interpreters, one can expect some differences in the outcomes from the different interpretations. Analysis utilizing other data sources such as continuous vegetation survey may also be utilized and where this is the case it will be noted.

Plant Associations and Plant Association Groups

In the original Metolius watershed analysis, potential natural vegetation was mapped to the plant association level based on the best information available at that time. This information was complied and mapped from field observations from a variety of sources including: silviculturists, soil scientists, ecologists and stand exam experts. Prior to this mapping effort it was recognized that the Forest did not have a good mapped plant association layer that was based on a consistent structured approach. Based on this finding, the Forest initiated a vegetation mapping contract to map plant associations across the Forest.

Between October 1993 and January 1996 a Vegetative Mapping Project was undertaken that mapped the plant associations for entire Deschutes National Forest. This mapping effort occurred concurrently with the original Metolius Watershed Analysis; however, the mapping project was not completed in time, nor was it far enough along at that time, to be used during the original watershed analysis. The basic document used for typing the plant associations was the September 1988 version of the Plant associations of the Central Oregon Pumice Zone. The mapping data generated by this effort has been used on all subsequent land management projects on the Sisters Ranger District and will be used for the update to the Metolius Watershed Analysis.

Under the newest mapping effort plant associations and plant association groups within the Metolius Watershed Analysis Project area are displayed in Veg. Table 1.

Veg. Table 1 - Plant Association Groups (PAGs) for the Why-Chus Watershed Analysis Area.

<table>
<tr><th colspan="6">PLANT ASSOCIATION GROUPS (PAGs)
SUMMARIZED FOR THE ENTIRE
METOLIU WATERSHED ANALYSIS AREA</th></tr>
<tr><th colspan="3">PLANT ASSOCIATION GROUPS
(PAGs)</th><th colspan="3">LUMPED PAGS FOR ANALYSIS
(LPAGs)</th></tr>
<tr><th>PAG</th><th>Code</th><th>ACRES</th><th>LPAG</th><th>ACRES</th><th>PERCENT OF THE WATERSHED</th></tr>
<tr><td>Mixed Conifer Dry</td><td>MCD</td><td>58,409</td><td>Mixed Conifer Dry</td><td>58,409</td><td>39%</td></tr>
<tr><td>Ponderosa Pine Dry</td><td>PPD</td><td>21,451</td><td rowspan="2">Ponderosa Pine</td><td rowspan="2">26,044</td><td rowspan="2">17%</td></tr>
<tr><td>Ponderosa Pine Wet</td><td>PPW</td><td>4,593</td></tr>
<tr><td>Mixed Conifer Wet</td><td>MCW</td><td>24,590</td><td>Mixed Conifer Wet</td><td>24,590</td><td>17%</td></tr>
<tr><td>Mountain Hemlock Dry</td><td>MHD</td><td>21,892</td><td rowspan="2">High Elevation</td><td rowspan="2">22,023</td><td rowspan="2">15%</td></tr>
<tr><td>White Bark Pine Dry</td><td>WBPD</td><td>131</td></tr>
<tr><td>Lodgepole Pine Dry</td><td>LPD</td><td>1,798</td><td rowspan="2">Lodgepole Pine</td><td rowspan="2">7,750</td><td rowspan="2">5%</td></tr>
<tr><td>Lodgepole Pine Wet</td><td>LPW</td><td>5,952</td></tr>
<tr><td>Cinder</td><td>CINDER</td><td>655</td><td rowspan="6">Special Habitats
(Non-Forest)</td><td rowspan="6">5,790</td><td rowspan="6">4%</td></tr>
<tr><td>Lava</td><td>LAVA</td><td>1,653</td></tr>
<tr><td>Rock</td><td>ROCK</td><td>3,254</td></tr>
<tr><td>Alpine Meadow</td><td>AMDW</td><td>27</td></tr>
<tr><td>Meadow</td><td>MDW</td><td>111</td></tr>
<tr><td>Xeric Shrub</td><td>XSHB</td><td>90</td></tr>
<tr><td>Mesic Shrub</td><td>MSHB</td><td>2,499</td><td rowspan="3">Riparian</td><td rowspan="3">3,291</td><td rowspan="3">2%</td></tr>
<tr><td>Riparian</td><td>RIP</td><td>581</td></tr>
<tr><td>Hardwood</td><td>HWD</td><td>211</td></tr>
<tr><td>Water</td><td>WATER</td><td>796</td><td>Aquatic
(Non-Forest)</td><td>796</td><td>1%</td></tr>
<tr><td>Not Classified</td><td>n/a</td><td>230</td><td>Not Classified</td><td>230</td><td><1%</td></tr>
<tr><td>GRAND TOTALS</td><td></td><td>148,923</td><td></td><td>148,923</td><td>100%</td></tr>
</table>

Changes to Forest Vegetation

Changes to vegetation within the watershed analysis project area since the original watershed analysis was completed in 1996 have occurred from two primary mechanisms, vegetation management activities and wildfire. These mechanisms have worked to change all aspects of vegetation from ground vegetation, fuels and snags to the species composition, density and structure of the standing live trees. One additional mechanism, a western spruce budworm outbreak, from the late 1980's through the early 1990's significantly affected the vegetation of the watershed, however, most of those effects where completed by the time of the original watershed analysis and as such were incorporated in that analysis and will not be incorporated in this update.

Vegetation Management Activities/Accomplishments

After the Watershed Analysis was completed in January of 1996 the District began projects to meet management direction in the Deschutes National Forest Land and Resource Management Plan as amended by the Northwest Forest Plan. The District completed 2 Late Successional Reserve (LSR) Assessments, one for the Metolius LSR and one for the Cache LSR and a number of vegetation management projects as displayed in Veg. Table 2.

Veg. Table 2. Vegetation Management Project initiated by the District since the 1996 Watershed Analysis.

Project	Analysis Acres	Proposed Treatment Acres	Actual Acres Treated to Date
Metolius Late Successional Reserve Assessment	75,762	n/a	n/a
Cache Late Successional Reserve Assessment	17,145	n/a	n/a
Forest Health DEMO	100	95	95
Northslope	7	7	7
Jack Canyon	14,750	3,440	2,258
Santiam Corridor	7,000	4,230	1,825
Santiam Restoration	9,500	3,539	1,038
McCache	15,350	5,295	0
Heritage DEMO	120	61	61
Metolius Basin	17,000	12,648	0
Small Tree Thinning in Plantations	6,021	6,021	1,723
	162,755	35,336	7,007

Virtually all vegetation management projects proposed for this watershed since January of 1996 have had similar management goals as stated in the purpose and need statements for those projects. In a broad sense, these goals have been related to the following: 1) reducing the risk/hazard of high intensity wildfire and 2) improving forest health to maintain, enhance and grow desired forest conditions to meet management objectives especially related to wildlife habitat. In addition to the primary vegetation management goals, other goals have included maintaining and/or enhancing scenic views and other non-vegetation management goals such as maintaining or improving soil condition and hydrologic function and reducing road densities.

The difference between proposed and treated acres in various projects in table 2 is due to several reasons. In the case of the McCache and Metolius Basin projects where no work has been completed to date, implementation has been delayed due to administrative process (i.e., appeals and litigation) and the occurrence of wildfires that either occurred within the project area or affected our ability to accomplish work. In the case of the other projects where treated acres is less than proposed, treatments have not been accomplished in some cases because of environmental concerns that surfaced during implementation and in other cases due to economic infeasibility and budgetary constraints.

Wildfire

Since the original Metolius Watershed analysis there have been a number of wildfires greater than 10 acres within the project area as displayed in Veg. Table 3.

Veg. Table 3. Fires greater than 10 in the Metolius WA project area since Jan. 1996.

Fire Name	Year	Total Size (acres)	Watershed Project Area (acres)
Jefferson	1996	3689 ??	1996
Square Lake	1998	113	113
Dugout	1999	17	14
Cache Creek	1999	382	382
Street Creek	2002	43	7
Eyerly	2002	22,634	5,420
Cache Mountain	2002	3,886	3,836
Link	2003	3,590	3,590
B and B	2003	90,696	67,325
Total		125,050	82,683

The Square Lake, Cache Creek and Link fires all burned entirely within the project boundary. However, the Jefferson, Dugout, Street Creek, Eyerly, Cache Mountain and B and B fires burned both within and outside of the project area boundary. In addition, some of these fires overlap other fires. For example, the Link fire burned into the perimeter of the Cache Mt. fire, the B and B fire completely burned over the Square Lake fire and burned over a portion of the Jefferson fire, and the Eyerly fire completely burned over the Street Creek fire.

The areas within the perimeters of these fires burned at varying intensities based on the current condition of the vegetation (species composition, structure and density), dead fuel loading (both vertical and horizontal), topography and weather conditions at the time of the fire. The effects of these fires have been classified into 3 categories based on the effect to the forested canopy as follows: low severity, moderate severity and high severity. The acres burned in each category are displayed in Veg. Table 4 and the categories are described below.

Veg. Table 4. Fire severity to vegetation for the Metolius Watershed.

Vegetation Severity	Acres	% of Watershed
Low	25,643	17%
Moderate	16,628	11%
High	38,148	26%
Outside of Fire	68,505	46%
Total	148,924	100%

<u>Low Severity</u>: These areas generally received a low to severe underburn that resulted in low mortality in the overstory trees (generally less than 25%) and 10% to 90% consumption and perhaps mortality of the ground vegetation and 25% to 75% consumption of the existing down woody debris.

Many of these acres appeared to have experienced a “nice underburn”. In some cases this is true, however, in other cases, the underburn was very severe and is likely to result in the loss of most of the white fir and other non-fire resistant components (e.g., lodgepole pine, western white pine, incense cedar, western red cedar and other true firs), if present. In the areas of severe underburning, it appears that most of the ponderosa pine and Douglas-fir will be able to survive this intense underburn, however, due to the intense heat of the fire at the base of the non-fire resistant components, primarily white fir, it can be expected that white fir and other similar components will continue to be lost over the next 3 to 5 years due to the deleterious effects of the fire. It is expected that the white fir that was killed by the fire, but the crowns have not yet turned brown, will turn brown by mid-summer and that trees that have not been killed outright but are under stress will continue to die from a variety of factors (fire effects, or insects, or diseases) over the course of the next 5 years.

Some areas within this category may actually be unburned but in general these are isolated areas and are the exception rather than the rule.

<u>Moderate Severity</u>: These areas experienced mixed severity burning where the over-story tree mortality ranges 25% to 75%. Many areas tend toward the high end of the mortality range with some scattered small patches of 100% mortality. The primary tree species to make it through the fire in these areas were the large overstory ponderosa pine and Douglas-fir. These areas also received a very severe underburn resulting in 90% to 100% consumption of the ground vegetation and near complete consumption of the existing down woody debris. A percentage of these acres may need reforestation.

<u>High Severity</u>: These areas received very high intensity fire that resulted in, for all practical purposes, a stand replacement event. In most areas, the over-story tree mortality is 100% but can be as low as 75%, especially on the edges of these areas. These acres will require reforestation.

Fire Severity by Lumped Plant Association Group

Fire severity by lumped plant association group is displayed in Veg. Table 5. The highest occurrence of fire was in the wet mixed conifer LPAG at 71%, followed by lodgepole pine at 68%, mixed conifer dry at 62%, riparian at 49% and high elevation at 41%. The lodgepole pine LPAG experience the highest level of moderate and high fire severity at 56%, followed by mixed conifer wet at 50%, mixed conifer dry at 43%, riparian at 31%, high elevation at 28% and ponderosa pine at 21%.

Veg. Table 5. Fire Severity by Lumped Plant Association Group.

LPAG	Total Acres	Outside Fire Perimeters	Fire Severity				Total
			Low	Moderate	High	Moderate + High	
Not Classified	230	100%	0%	0%	0%	0%	100%
Aquatic	796	n/a	n/a	n/a	n/a	n/a	100%
High Elevation	22,023	59%	13%	10%	18%	28%	100%
Lodgepole Pine	7,750	32%	12%	9%	47%	56%	100%
Mixed Conifer Dry	58,409	38%	19%	15%	28%	43%	100%
Mixed Conifer Wet	24,590	29%	21%	12%	38%	50%	100%
Ponderosa Pine	26,044	68%	12%	5%	16%	21%	100%
Riparian	3,291	51%	28%	4%	27%	31%	100%
Special Habitats	5,790	77%	19%	1%	2%	3%	100%
Total	148,923	46%	17%	11%	26%	37%	100%

Stand Structure and Tree Size

Veg. Table 6 displays the distribution of stand structure/size class across the watershed project area by reference year. There have been dramatic shifts in structure/size class. The primary shift has been a large increase in grass/forb/shrub resulting from the wildfires of 2002 and 2003. The grass/forb/shrub class increased approximately 38,285 acres or 26% of the entire watershed or 27% of the forested portion of the watershed. This also resulted in decreases in all other size classes, most notably the small size class which decreased by 16%, followed by the pole size class which decreased by 4% and the Medium/Large size class which decreased by 2%.

Veg. Table 6. Dominant stand structure/size class by reference year.

Dominant Size Class	1953	1995	2004	% Change from 1995
Non-forest/Grass/Forb/Shrub	10%	6%	31%	+416%
Seedling/Sapling (<5" DBH)	0%	9%	8%	-11%
Pole ("5 to 8.9" DBH)	2%	19%	15%	-21%
Small (9" to 20.9" DBH)	24%	54%	38%	-30%
Medium/Large (21"+ DBH)	64%	9%	7%	-22%
	100%	100%	100%	

Medium/Large Tree Component (21"+ DBH): Trees in this size class were analyzed utilizing continuous vegetation survey (CVS) plot data. There are 54 plots within the watershed area that have data. Of those 54, five are located in the wilderness and represent 8,475 acres in the wilderness and 49 are located on Forest Service land outside of wilderness and represent 2170 acres outside of wilderness. The plots in the wilderness were not used since each plot represented such a large portion of the wilderness. However, an analysis of the plots outside of wilderness show that approximately 113,000 trees 21"+ DBH or 17% of this size tree in the watershed, were involved in stand replacement wildfire and have consequently been lost. Additionally, another approximately 95,000 trees or 14% of this size class were involved in moderate/mixed severity wildfire with a portion of these trees also being lost. In summary, between 17% and 31% of the trees 21"+ DBH were lost in the watershed as a result of stand replacement and mixed severity wildfire over the last 2 years.

Potential Old Growth (POG)

Potential old growth (POG) for the watershed was estimated utilizing the photo interpretation data from the 1995 aerial photos. The Region 6 interim old growth definitions (USDA Forest Service, 1993) were used to classify potential old growth stands for the ponderosa pine series, grand fir/white fir (i.e., mixed conifer) series, mountain hemlock series and lodgepole pine series. There was not an old growth definition developed for the riparian vegetation series. Therefore, the old growth definition for the grand fir/white fir (i.e., mixed conifer) series was used to identify potential old growth in the riparian LPAG. For each series, the interim old growth definition contains 6 attributes that are used to assess and classify old growth. For this analysis, only 1 attribute, "number of large trees per acre", was utilized. Consequently, because only 1 of the 6 old growth attributes was used, stands that have the minimum number of large trees per acre to qualify as old growth are labeled ***potential*** old growth. Actual old growth should be specifically identified on a project by project basis. The numbers of large trees per acre were estimated for each stand using percent canopy cover as a surrogate for large trees per acre. Veg. Table 7 displays the attributes used to classify potential old growth.

Veg. Table 7. Attributes used, by LPAG, to estimate Potential Old Growth for the Watershed.

LUMPED PLANT ASSOCIATION GROUP (LPAG)	OLD GROWTH ATTRIBUTES		
	"Large" Tree Size	Approx. Number / Acre	Aerial Photo Percent Canopy Cover
High Elevation	21"+	10+	10%+
Lodgepole Pine	9"+	60+	15%+
Mixed Conifer Dry	21"+	15+	15%+
Mixed Conifer Wet	21"+	15+	15%+
Ponderosa Pine	21"+	10+	10%+
Riparian	21"+	15+	15%+

Veg. Table 8 displays the percent of the forested acres estimated to be potential old growth (POG) by LPAG prior to the recent fires and the % of the pre-fire POG acres involved and not involved in high or moderate severity fire. High severity fire is essentially a stand replacement fire, consequently, POG involved in high fire severity is no longer considered POG. Moderate severity fire is mix of stand replacement fire and non-stand replacement fire, consequently, the POG involved in this type of fire has been altered regarding most, if not all, stand attributes, however, the extent of those alterations is not explicitly known and will need to be verified on a project by project basis.

Veg. Table 8. Estimate of Potential Old Growth (POG) by LPAG

LUMPED PLANT ASSOCIATION GROUP (LPAG)	% POG of Total Forested Acres Before Fires	% of Current POG involved in High and Moderate Fire Severity		% POG not involved in High or Moderate Fire Severity
		High (Stand	Moderate (Mixed)	
High Elevation	21%	11%	5%	18%
Lodgepole Pine	63%	58%	9%	21%
Mixed Conifer Dry	11%	16%	11%	8%
Mixed Conifer Wet	13%	42%	14%	6%
Ponderosa Pine	24%	4%	0%	23%
Riparian	11%	32%	0%	8%
TOTALS	18%	23%	7%	13%

In summary, when considering only trees/acre over a minimum dbh, approximately 18% of the forested acres in the watershed were identified as potential old growth prior to the recent fires and 13% after the recent fires (that percentage is 14% if all of the POG involved in mixed severity fire can be still be considered POG post-fire). The largest decrease in POG as a result of the recent fires occurred in the logdepole pine LPAG with a 58% to 67% decrease, followed by mixed conifer wet with a 42% to 56% decrease, riparian with a 32% decrease, mixed conifer dry with a 16% to 27% decrease, high elevation with a 11% to 16% decrease and finally ponderosa pine LPAG with the smallest decrease in POG at 4%.

Species Composition

Vegetation Management Projects

In areas treated under vegetation management projects, long-lived early seral species (e.g., ponderosa pine and western larch) and fire resistant late seral trees (e.g., larger Douglas-fir) were favored for leave trees over late seral species (primarily white fir and smaller Douglas-fir). That does not mean that all late seral species were targeted for removal. Late seral species were retained in a number of different situations, for example, in no-treatment clumps and in areas where thinning was prescribed and there were no early seral choices. Consequently, stands treated in vegetation management projects saw a change in species composition that resulted in a higher ratio of early seral species to late seral species. In some areas, the ratio increased substantially, and in other areas only slightly or not at all.

Wildfire

In areas affected by wildfire, changes in species composition have been significant. In areas affected by high severity wildfire in which the result was classified as stand replacement (approximately 38,148 acres), species composition has been converted to early seral vegetation and has been classified as grass/forb/shrub.

In areas affected by moderate severity wildfire in which the result was mixed mortality where there is a mix of underburning and stand replacement and all possibilities in between, species composition was variably affected. In these areas, mortality can be expected to be between

25% and 75%, consequently, complete species conversion to early seral species composition can be expected on a portion of the acres, however, a majority of the acres will have some component of the pre-fire stand that will have survived.

In the mixed mortality and underburned areas, the species that were most likely to have survived the wildfires were the fire resistant early seral species such as ponderosa pine and western larch and also the larger more fire resistant late seral trees (e.g., larger Douglas-fir)

Stand Densities

Vegetation Management Projects

In areas treated under vegetation management projects, stand density reduction was a general goal for areas that were above sustainable levels from both a forest health stand point (i.e., upper management zone) and a fire hazard reduction standpoint (i.e., ladder fuels and crown bulk density). In some areas that were heavily affected by spruce budworm related mortality density reduction was not a specific goal because density reduction had already occurred. However, wherever thinning was prescribed, density reduction was one of the goals and was accomplished to varying levels depending on the management objectives.

Wildfire

In areas affected by wildfire, changes in stand densities have been significant. In areas affected by high severity wildfire in which the result was classified as stand replacement (approximately 38,148 acres), stand densities have been reduced to zero.

In areas affected by moderate severity wildfire in which the result was mixed mortality where there is a mix of underburning and stand replacement and all possibilities in between, stand density was variably affected. In these areas, mortality can be expected to be between 25% and 75%, consequently, stand density reduction will be variable across stands and in turn the landscape.

In areas affected by low intensity wildfire, some density reduction can be expected, especially in the smaller trees and in the least fire resistant trees (e.g., white fir). However, in most cases, density reduction as a result of low intensity wildfire was probably not significant because a majority of the low intensity fire was a result of burn-out/backburning operations that occurred under favorable burnout conditions such as during the night or high humidity/wet/rainy conditions. This type of low intensity burning left the densities in most stands approximately what it was prior to the fires, and for those stands that were at unsustainable densities relative to forest health and fire hazard prior to fire, will remain so post fire.

Updated Conditions and Trends by LPAG

The LPAG summaries in the following sections are updates to the original tables. These tables summarize size class, species composition and potential old growth for the following time frames, Historic Range of Variability (HRV), 1953/historic, 1995 (last watershed analysis) and 2004 (present/post-wildfires)

In the following tables, current size and structure was classified for each stand (acres) based on the size/structure class with the most (i.e., dominant) canopy cover regardless of the total canopy cover in the stand. Consequently, stands that qualify as potential old growth may fall into pole, small or medium/large size classes if they had the minimum number of trees/acre in the medium/large size class but the medium/large size class was not the dominant size class based on canopy cover (see also the section "Potential Old Growth" for additional information).

For the mixed conifer (dry and wet) and the riparian LPAG's, stands were classified as primarily pioneer species, climax species or mixed (pioneer and climax) species. Stands were classified as primarily pioneer or climax species if pioneer or climax species represented <25% of the canopy cover, respectively. Stands were classified as mixed species if both pioneer and climax species represented 25% or more of the canopy cover. Major pioneer species include ponderosa pine, western larch and lodgepole pine. Major climax species include white fir, Douglas-fir and other true fir.

MIXED CONIFER DRY (MCD) LPAG (39% of Total Acres)

The MCD PAG includes moderate and lower productivity CW Series plant associations. These plant associations are found on the slopes of the Cascades down to the flatter areas of pure pine stands. These associations have a moderate to high productivity and a mean annual precipitation of 20 to 45 inches per year (most sites are in the lower half of this range). Current tree vegetation consists of true firs (primarily white/grand fir), ponderosa pine, Douglas-fir and western larch and small amounts of other minor species.

Veg. Table 9 shows the distribution of size/structure, species composition and potential old growth in the MCD plant associations. Veg. Table 9 compares the distribution of size/structure, species composition and potential old growth between, the estimated historical range of variability (HRV), the known historical reference point (1953/Historic) and the present (1995 and 2004).

Trends Since 1995:

- There has been a significant shift in overall size/structure due to recent wildfires. This has resulted in a significant increase in the grass/forb/shrub size class and a decrease in all other size classes.
- The acres dominated (canopy cover) by the grass/forb/shrub class has increased by 27% of the total acres.
- The medium/large size class has decreased by 3%.
- The small class has decreased by 17%.
- The pole class has decreased by 5%.
- The seedling/sapling/pole class has decreased by 1%.
- The acres estimated to be potential old growth has decreased by 1% to 2% of the total acres.
- There has been a significant shift in overall species composition due to recent wildfires. The number of acres dominated by climax (i.e., late-seral species) and mixed species decrease 21% and 11% respectively and the acres dominated by early seral species (pioneer) increased by 34%.

Veg. Table 9. Mixed Conifer Dry -- Overall Comparison of Size/Structure, Species Composition and Potential Old Growth.

MIXED CONIFER DRY LPAG
(Total Acres = 58,409)

Vegetation Type	1995	Present
Not Classified or Non-Forest	3%	1%
Forested	97%	99%

Percent of Classified Forested Acres

Size / Structure	Year or Time-frame*	Species Composition: Pioneer (P)	Species Composition: Mixed (M)	Species Composition: Climax (C)	Totals	Potential Old Growth**
Grass / Forb / Shrub	HRV	1-7				
	1953/Historic	2	0	0	2	n/a
	1995	0	0	0	1	0
	2004	28	0	0	28	0
	Change	+28	0	0	+28	0
Seedling / Sapling (0-4.9”)	HRV	2-15	1-10	0-1		
	1953/Historic	1	0	0	1	n/a
	1995	4	5	1	10	0
	2004	6	3	1	9	0
	Change	+2	-2	0	-1	0
Pole (5-8.9”)	HRV	5-21	2-15	1-4		
	1953/Historic	0	0	0	0	n/a
	1995	6	7	5	18	2
	2004	6	5	2	13	2
	Change	0	-2	-3	-5	0
Small (9-20.9”)	HRV	12-40	6-30	3-5		
	1953/Historic	3	2	1	6	n/a
	1995	5	26	29	59	3
	2004	9	20	13	42	3
	Change	+4	-6	-16	-17	0
Medium / Large (21”+)	HRV	15-42	5-28	3-5		
	1953/Historic	46	45	0	91	90
	1995	2	4	3	10	6
	2004	2	3	1	7	4 to 5
	Change	0	-1	-2	-3	-1 to -2
TOTALS	HRV					
	1953/Historic	52	47	1	100	90
	1995	17	42	38	97	11
	2004	51	31	17	99	9-10
	Change	+34	-11	-21		-1 to -2

Notes:
* HRV equals estimated Historic Range of Variability. Percentages for the present are calculated on the entire LPAG acres. Change equals the change from 1995 to 2004.
** Acres were classified as ***potential*** old growth if it was estimated that they had at least 15% canopy cover (i.e., approximately TPA) in trees 21”+ dbh. Acres were classified as only ***potential*** because TPA was the only variable considered out of the 6 variables identified in Region 6 interim definition of old growth for the white/grand fir vegetation series.

MIXED CONIFER WET (MCW) LPAG (17% of Total Acres)

The MCW PAG includes the CD Series and the most productive sites in the CW series. The CD associations are climax to Douglas-fir and white fir. The major early seral species is ponderosa pine. The MCW plant associations occur on the mid to upper slopes of the Cascades and on more moist sites with a mean annual precipitation of 20 to 60 inches per year. The productivity is generally higher than in the MCD PAG. Current vegetation consists of true firs, ponderosa pine, Douglas-fir, western larch and lodgepole pine. Spruce can be found in the wetter bottomlands and riparian areas.

Veg. Table 10 was developed the same way and describes the same information for the mixed conifer wet (MCW) PAG as Veg. Table 9 does for the MCD PAG.

Trends Since 1995:

- There has been a significant shift in overall size/structure due to recent wildfires. This has resulted in a significant increase in the grass/forb/shrub size class and a decrease in all other size classes.
- The acres dominated (canopy cover) by the grass/forb/shrub class has increased by 38% of the total acres.
- The medium/large size class has decreased by 5%.
- The small class has decreased by 25%.
- The pole class has decreased by 6%.
- The seedling/sapling/pole class has increased by 1%.
- The acres estimated to be potential old growth has decreased by 7% to 8%.
- There has been a significant shift in overall species composition due to recent wildfires. The number of acres dominated by climax (i.e., late-seral species) and mixed species decrease 29% and 13% respectively and the acres dominated by early seral species (pioneer) increased by 44%.

Veg. Table 10. Mixed Conifer Wet -- Overall Comparison of Size/Structure, Species Composition and Potential Old Growth.

MIXED CONIFER WET LPAG
(Total Acres = 24,590)

Vegetation Type	1995	Present
Not Classified or Non-Forest	3%	<1%
Forested	98%	100%

Percent of Classified Forested Acres

Size / Structure	Year or Time-frame*	Species Composition: Pioneer (P)	Mixed (M)	Climax (C)	Totals	Potential Old Growth**
Grass / Forb / Shrub	HRV	0-20				
	1953/Historic	5	0	0	5	n/a
	1995	0	0	0	0	0
	2004	38	0	0	30	0
	Change	+38	0	0	+38	0
Seedling / Sapling (0-4.9")	HRV	3-20	0-25	0-9		
	1953/Historic	1	0	0	1	n/a
	1995	3	6	2	10	0
	2004	7	3	0	11	0
	Change	+4	-3	-2	+1	0
Pole (5-8.9")	HRV	1-11	5-30	1-10		
	1953/Historic	0	1	1	2	n/a
	1995	3	5	6	14	1
	2004	3	3	2		0
	Change	0	-2	-4	-6	-1
Small (9-20.9")	HRV	1-11	10-32	2-14		
	1953/Historic	1	8	18	27	n/a
	1995	3	22	37	63	4
	2004	6	15	17	38	2
	Change	+3	-7	-20	-25	-2
Medium / Large (21"+)	HRV	1-11	8-28	2-14		
	1953/Historic	19	40	3	62	85
	1995	0	4	7	11	8
	2004	1	3	2	6	3 to 4
	Change	+1	-1	-5	-5	-4 to -5
TOTALS	HRV					
	1953/Historic	26	49	22	97	85
	1995	10	37	51	98	13
	2004	54	24	22	100	5 to 6
	Change	+44	-13	-29		-7 to -8

Notes:
* HRV equals estimated Historic Range of Variability. Percentages for the present are calculated on the entire LPAG acres. Change equals the change from 1995 to 2004.
** Acres were classified as ***potential*** old growth if it was estimated that they had at least 15% canopy cover (i.e., approximately TPA) in trees 21"+ dbh. Acres were classified as only ***potential*** because TPA was the only variable considered out of the 6 variables identified in Region 6 interim definition of old growth for the white/grand fir vegetation series.

PONDEROSA PINE (PP) (17% of Total Acres)

The PP LPAG includes the High, Moderate, and Lower Productivity Sites in the CP Series. Generally, in all of these associations, ponderosa pine is the main early seral and climax species. Lodgepole pine can be a major or minor early seral and western juniper is also an early seral species in some associations. Lodgepole pine as an early seral species generally occurs after disturbance or on colder sites. Minor amounts white fir and Douglas-fir may be present particularly in the ecotones with the mixed conifer plant associations.

This LPAG associations are generally found on the low elevation flats in the eastern portion of the watershed, but can also be found on the lower elevation slopes of the Cascades. Annual precipitation ranges from 25 to 35 inches per year.

Veg. Table 11 shows the distribution of size and structure for the PP LPAG.

Veg. Table 11 was developed the same way and describes the same information for the ponderosa pine (PP) PAG as Veg. Table 9 does for MCD LPAG and Veg. Table 10 does for MCW LPAG.

Trends Since 1995:

- There has been a fairly significant shift in overall size/structure due to recent wildfires, however, this shift is the least significant of all the LPAG's.
- The acres dominated (canopy cover) by the grass/forb/shrub class has increased by 16% of the total acres.
- The medium/large size class remained approximately the same at 13%.
- The small class has decreased by 13%.
- The pole class has decreased by 5%.
- The seedling/sapling/pole class has decreased by 2%.
- The acres estimated to be potential old growth has decreased by 1%.
- There has been a significant shift in overall species composition due to recent wildfires. The number of acres dominated by climax (i.e., late-seral species) and mixed species decrease 29% and 13% respectively and the acres dominated by early seral species (pioneer) increased by 44%.

Veg. Table 11. Ponderosa Pine -- Overall Comparison of Size/Structure, Species Composition and Potential Old Growth.

PONDEROSA PINE LPAG (Total Acres = 26,044)		
Vegetation Type	**1995**	**Present**
Not Classified Non-Forest	1%	<1%
Forested	99%	100%

Percent of Classified Forested Acres

Size / Structure	Year or Time-frame*	Species Composition: Not Separated by Pioneer or Climax	Potential Old Growth**
Grass / Forb / Shrub	HRV	5-30	
	1953/Historic	10	n/a
	1995	0	0
	2004	16	0
	Change	+16	0
Seedling / Sapling (0-4.9")	HRV	3-21	
	1953/Historic	0	n/a
	1995	7	0
	2004	5	0
	Change	-2	0
Pole (5-8.9")	HRV	3-21	
	1953/Historic	2	n/a
	1995	36	4
	2004	31	4
	Change	-5	0
Small (9-20.9")	HRV	20-50	
	1953/Historic	0	n/a
	1995	43	8
	2004	36	8
	Change	-13	0
Medium / Large (21"+)	HRV	30-70	
	1953/Historic	88	98
	1995	13	12
	2004	13	11
	Change	0	-1
TOTALS	HRV		
	1953/Historic	100	98
	1995	99	24
	2004	101	23
	Change		-1

Note:
* HRV equals estimated Historic Range of Variability. Percentages for the present are calculated on the entire LPAG acres. Change equals the change from 1995 to 2004.
** Acres were classified as ***potential*** old growth if it was estimated that they had at least 10% canopy cover (i.e., approximately 10 TPA) in trees 21"+ dbh. Acres were classified as only ***potential*** because TPA was the only variable considered out of the 6 variables identified in Region 6 interim definition of old growth for the ponderosa pine vegetation series.

LODGEPOLE PINE (LP) LPAG (5% of Total Acres)

This vegetation type is found mostly at higher elevations where the majority of the acres are within wilderness or roadless areas. The areas where lodgepole pine is climax tend to have poor cold air drainage, or soil or moisture conditions that other species can't tolerate.

Veg. Table 12 shows the distribution of size and structure for the LPP LPAG. Veg. Table 12 was developed the same way and describes the same information for the lodgepole pine (LP) PAG as Veg. Tables 9 and 10 do for the MCD and MCW LPAGs.

Trends Since 1995:

- There has been a very significant shift in overall size/structure due to recent wildfires and is the most significant of all the LPAG's. This has resulted in a significant increase in the grass/forb/shrub size class and a decrease in all other size classes.
- The acres dominated (canopy cover) by the grass/forb/shrub class has increased by 47% of the total acres.
- The small class has decreased by 30%.
- The pole class has decreased by 12%.
- The seedling/sapling/pole class has decreased by 5%.
- The acres estimated to be potential old growth has decreased by 37% to 42%.

Veg. Table 12. Lodgepole Pine -- Overall Comparison of Size/Structure, Species Composition and Potential Old Growth.

LODGEPOLE PINE LPAG (Total Acres = 7,750)		
Vegetation Type	**1995**	**Present**
Not Classified Non-Forest	<1%	<1%
Forested	100%	100%

Percent of Classified Forested Acres

Size / Structure	Year or Time-frame*	Species Composition: Not Separated by Pioneer, Mixed or Climax	Potential Old Growth**
Grass / Forb / Shrub	HRV	0-60	n/a
	1953/Historic	8	0
	1995	0	0
	2004	47	0
	Change	+47	
Seedling / Sapling (0-4.9")	HRV	0-60	n/a
	1953/Historic	0	2
	1995	8	1 to 2
	2004	3	0 to -1
	Change	-5	
Pole (5-8.9")	HRV	10-80	n/a
	1953/Historic	11	9
	1995	38	1 to 2
	2004	26	-7 to -8
	Change	-12	
Small (9-20.9")	HRV	0-80	88
	1953/Historic	72	52
	1995	53	19 to 22
	2004	23	-30 to -33
	Change	-30	
Medium / Large (21"+)	HRV	0-2	5
	1953/Historic	6	0
	1995	0	0
	2004	0	0
	Change	0	
TOTALS	HRV		
	1953/Historic	97	93
	1995	99	63
	2004	99	21 to 26
	Change		-37 to -42

Note:
* HRV equals estimated Historic Range of Variability. Change equals the change from 1995 to 2004.
** Acres were classified as ***potential*** old growth if it was estimated that they had at least 15% canopy cover (i.e., approximately 60 TPA) in trees 9"+ dbh. Acres were classified as only ***potential*** because TPA was the only variable considered out of the 6 variables identified in Region 6 interim definition of old growth for the lodgepole pine vegetation series.

HIGH ELEVATION LPAG (15% of Total Acres)

Generally, these associations are of low to moderate productivity. This plant association is found at the higher elevations with most of the acres in wilderness and roadless areas. In these plant associations, lodgepole pine is the major early seral species and sub-alpine fir, whitebark pine and western white pine, are minor early seral species.

Veg. Table 13 shows the distribution of size and structure for the high elevation LPAG. Veg. Table 13 was developed the same way and describes the same information for the lodgepole pine (MH) PAG as Veg. Tables 9 and 10 do for the MCD and MCW LPAGs.

Trends Since 1995:

- There has been a fairly significant shift in overall size/structure due to recent wildfires. This has resulted in a fairly significant increase in the grass/forb/shrub size class and a decrease in all other size classes.
- The acres dominated (canopy cover) by the grass/forb/shrub class has increased by 19% of the total acres.
- The medium/large size class has decreased by 1%.
- The small class has decreased by 14%.
- The pole class has decreased by 2%.
- The seedling/sapling/pole class has decreased by 1%.
- The acres estimated to be potential old growth has decreased by 2% to 4%.

Veg.Table 13. High Elevation -- Overall Comparison of Size/Structure, Species Composition and Potential Old Growth.

HIGH ELEVATION/MT. HEMLOCK LPAG (Total Acres = 22,023)			
Vegetation Type	**1995**	**Present**	
Not Classified Non-Forest	1%	1%	
Forested	99%	99%	
Percent of Classified Forested Acres			
Size / Structure	**Year or Time-frame***	**Species Composition** — **Not Separated by Pioneer, Mixed or Climax**	**Potential Old Growth****
Grass / Forb / Shrub	HRV 1953/Historic 1995 2004 Change	0-5 4 0 19 +19	 n/a 0 0 0
Seedling / Sapling (0-4.9”)	HRV 1953/Historic 1995 2004 Change	0-8 0 13 12 -1	 n/a 0 0 0
Pole (5-8.9”)	HRV 1953/Historic 1995 2004 Change	0-35 2 11 9 -2	 n/a 0 0 0
Small (9-20.9”)	HRV 1953/Historic 1995 2004 Change	5-53 85 65 51 -14	 n/a 11 9 to 10 -1 to -2
Medium / Large (21”+)	HRV 1953/Historic 1995 2004 Change	5-20 5 10 9 -1	 3 10 8 to 9 -1 to -2
TOTALS	HRV 1953/Historic 1995 2004 Change	 96 99 99	 3 21 17 to 19 -2 to -4

Note:
* HRV equals estimated Historic Range of Variability. Percentages for the present are calculated on the entire LPAG acres. Change equals the change from 1995 to 2004.
** Acres were classified as ***potential*** old growth if it was estimated that they had at least 15% canopy cover (i.e., approximately 15 TPA) in trees 21”+ dbh. Acres were classified as only ***potential*** because TPA was the only variable considered out of the 6 variables identified in the Region 6 interim definition of old growth for the white/grand fir vegetation series.

RIPARIAN LPAG (2% of Total Acres)

This LPAG includes various plant associations identified by Kovalchiak (1987). Generally, these associations are of fairly high productivity. These plant associations are found at all elevations along a moisture gradient that ranges from less than 25”/year to over 100” of precipitation per year. These associations also span the range of potential natural vegetation of climax species from ponderosa pine to Mt. Hemlock.

Veg. Table 14 shows the distribution of size and structure for the PP LPAG. Veg. Table 14 was developed the same way and describes the same information for the lodgepole pine (LP) PAG as Veg. Tables 9 and 10 do for the MCD and MCW LPAGs.

Trends Since 1995:

- The amount of riparian habitat has probably not changed much from historic conditions. The quality of riparian habitats, however, has probably changed over the decades. In the early 1900’s, sheep grazing, and to a lesser degree, cattle grazing were common. More recently, timber harvest activities and recreational uses have impacted many of the riparian habitats in the watershed.
- There has been a significant shift in overall size/structure due to recent wildfires. This has resulted in a significant increase in the grass/forb/shrub size class and a decrease in all other size classes.
- The acres dominated (canopy cover) by the grass/forb/shrub class has increased by 27% of the total acres.
- The medium/large size class has decreased by 3%.
- The small class has decreased by 20%.
- The pole class has decreased by 1%.
- The seedling/sapling/pole class has remained approximately the same.
- The acres estimated to be potential old growth has decreased by 3% of the total acres.
- There has been a significant shift in overall species composition due to recent wildfires. The number of acres dominated by climax (i.e., late-seral species) and mixed species decrease 10% and 13% respectively and the acres dominated by early seral species (pioneer) increased by 26%.

Veg. Table 14. Riparian -- Overall Comparison of Size/Structure, Species Composition and Potential Old Growth.

RIPARIAN LPAG
(Total Acres = 3,291)

Vegetation Type	1995	Present
Not Classified or Non-Forest	25%	22%
Forested	75%	78%

Percent of Classified Forested Acres

Size / Structure	Year or Time-frame*	Species Composition				Potential Old Growth**
		Pioneer (P)	Mixed (M)	Climax (C)	Totals	
Grass / Forb / Shrub	HRV					
	1953/Historic	9	0	0	9	n/a
	1995	0	0	0	0	0
	2004	27	0	0	27	0
	Change	+27	0	0	+27	0
Seedling / Sapling (0-4.9”)	HRV					
	1953/Historic	0	0	0	0	n/a
	1995	0	1	0	1	0
	2004	1	0	0	1	0
	Change	1	-1	0	0	0
Pole (5-8.9”)	HRV					
	1953/Historic	0	1	0	1	n/a
	1995	3	2	5	10	0
	2004	4	1	4	9	0
	Change	+1	-1	-1	-1	0
Small (9-20.9”)	HRV					n/a
	1953/Historic	0	1	0	1	
	1995	14	17	23	54	3
	2004	11	9	14	34	1
	Change	-3	-8	-9	-20	-2
Medium / Large (21”+)	HRV					
	1953/Historic	48	37	1	86	80
	1995	2	7	1	11	8
	2004	2	4	0	7	7
	Change	0	0	-3	-3	-1
TOTALS	HRV					
	1953/Historic	57	39	1	97	80
	1995	19	27	29	76	11
	2004	45	14	19	78	8
	Change	+26	-13	-10		-3

Notes:
* HRV equals estimated Historic Range of Variability. Percentages for the present are calculated on the entire LPAG acres. Change equals the change from 1995 to 2004.
** Acres were classified as ***potential*** old growth if it was estimated that they had at least 15% canopy cover (i.e., approximately 15 TPA) in trees 21”+ dbh. Acres were classified as only ***potential*** because TPA was the only variable considered out of the 6 variables identified in the Region 6 interim definition of old growth for the white/grand fir vegetation series.

Landscape Patch Conditions

The original Metolius Watershed analysis noted that historically (i.e., prior to 1953) and in 1953, the watershed was dominated by basically two large unfragmented patches, the high elevation (Mt. Hemlock) habitats/patch and the medium/large (21”+DBH) ponderosa pine dominated habitats/patch that included both the mixed conifer plant associations (fire climax ponderosa pine maintained by fire) and the ponderosa pine plant associations.

By 1991 (the year of the aerial photos used in the original watershed analysis), the high elevation patch (i.e., the area that is now primarily designated wilderness) had not changed significantly except for a few moderate sized fires (Airstrip and Jefferson 1 and Jefferson2). However, the medium/large ponderosa pine dominated habitats patch had changed significantly as a result of fire exclusion and timber management practices. It was found that the large unfragmented medium/large dominated patch was now highly fragmented and dominated by a combination of seedling/sapling (<4.5’ tall/4.5’ tall to 4.9” dbh) and pole/small (5”-8.9/9”to20.9”dbh) sized patches. The seedling/sapling patches resulted from regeneration type (e.g., shelterwood, seed tree and clearcut) management and the pole/small patches resulted from the removal of the medium/large components by partial or near-complete overstory removal type management. Additionally, the species composition of the pole/small patches has changed from being dominated by ponderosa pine (and also a mix of medium/large ponderosa pine and medium/large Douglas-fir in some of the higher site mixed conifer plant associations) to being dominated by white/grand fir and Douglas-fir. In general, the seedling/sapling patches are composed of early seral species primarily ponderosa pine (Douglas-fir may be part of the reforestation mix and some patches are dominated by Douglas-fir, and other species may be in the mix due to natural regeneration), through reforestation by planting.

The primary events that have changed the patch characteristics in the watershed since 1991 are the recent large wildfires, especially the Cache Creek fire, Eyerly fire, Link fire and the B and B fire. Each of these fires resulted in a portion of the landscape being converted to early successional status by stand replacement wildfire. Within the watershed project boundary, these new early seral patches can be delineated into four new large early seral patches as follows: one centered around Cache Mt. and Round Lake, one centered around Abbot Butte from approximately 1 mile west of the Metolius River to the crest of the Cascades, one centered around Sugar Pine Ridge and one on the north end of Green Ridge and within the eastern portion of the Horn of the Metolius.

Recent Fire Activity Related to Fire Regimes and Historic Fires

Some questions have been raised regarding the size and intensity of the recent wildfires in relation to historic fire regimes. Specifically, was the size and intensity of the B and B fire within the historical range of variability for where it burned? The B and B burned primarily within 4 fire regimes: 1 (low severity), 3 (mixed severity), 4 (high severity/stand replacement) and 5 (high severity/stand replacement). The following comments regarding fire size and intensity were developed after reviewing “Forest Conditions in the Cascade Range Forest Reserve Oregon” by Langille and others (1903), “Fire History in the Jefferson Wilderness Area East of the Cascade Crest” by Simon (1991) and the results of the original Metolius Watershed Analysis regarding the historic distribution of forest size/structure, species composition and density.

Fire Regimes 4 and 5

Within fire regimes 4 and 5, which are primarily found within the wilderness areas, the intensity of the fire was well within the historic range and would be expected. The size of the stand replacement event may or may not be within the historic range of variability, especially if one considers the portion that burned west of the Cascade crest too. In Langille and others (1903) numerous large fires are apparent on their maps but none are larger than approximately 10,000 to 15,000 acres and most appear in the high elevation country that roughly corresponds to the current wilderness designations. Langille and others (1903) also attribute a portion, and perhaps a good portion, of these fires as being caused by humans. Consequently, it is difficult to say that the fires mapped in 1903 are a good representation of the "natural" historic range of variability.

Simon (1991) conducted an analysis of the fire history in the portion of the Jefferson wilderness that lies east of the crest of the Cascades. Regarding the extent of historic fires over the last 270 years, Simon identified 3 fires that exceeded 7,000 acres, with the largest at nearly 13,000 acres which he considered conservative because he also identified gaps in the data due to more recent fires that eliminated potential evidence of a possible larger fire. For the 13,000 acre fire, Simon identified 9,920 acres of stand replacement and 3,000 acres of low intensity underburning and that the fire burned most of the acreage below 5,500 feet elevation for the entire length of the wilderness from the north to the south. Simon did not comment on whether any of the wilderness fires left the wilderness and burned additional acres outside of wilderness. Simon also identified 13 other large (i.e., >50 acres) fires and of those, 4 were larger than 1,000 acres, and 9 were less than 1,000 acres.

In conclusion, regarding fire regimes 4 and 5, fire intensity was within the historic range of variability, however, the size of the stand replacement event is likely outside the historic range of variability especially if one includes the stand replacement portions that lie west of the Cascade crest.

Fire Regimes 1 (low severity) and 3 (mixed severity)

Historically, in the Metolius Watershed, the ponderosa pine and much, if not most of the mixed conifer plant associations outside of the higher elevations (i.e., wilderness), especially the mixed conifer dry plant associations, burned under fire characteristic of fire regime 1. A portion of the mixed conifer plant associations, especially the wetter/higher site mixed conifer associations, likely burned under fire regime 3.

Evidence for this lies in that there is no evidence that large stand replacement events occurred in these plant associations historically, except, perhaps, at the higher elevations adjacent to fire regimes 4/5. In the 1996 watershed analysis, most of the ponderosa pine and mixed conifer association were found to be dominated by medium/large sized early seral species (this includes large fire resistant Douglas-fir) and this condition is best achieved and maintained by low intensity fire regimes. Maps produced by Langille and others (1903) also do not show evidence of large stand replacement events in the ponderosa pine or mixed conifer plant associations outside of the higher elevations (i.e., <4,500 ft). Most fires mapped by Langille and others (1903) below about 4,500' elevation are in line with what might be expected in fire regime 3. Fire regime 3 likely occurred in specific locations within the mixed confer plant associations such as on higher sites (mixed conifer wet), on north slopes or at the higher elevations.

In conclusion, the stand replacement events from the recent wildfires, especially the B and B fire are outside the historic range of variability, in both size and intensity, for the ponderosa pine and mixed conifer plant associations.

Potential for Salvage Harvest

The recent fires of the last two years have presented large blocks of dead and dying trees that could be salvaged to reduce future fuel loads, provide funding for fire related restoration projects, provide economic value to local communities and provide timber resources to help meet the national demand for wood products and as suggested by Berlik and others (2002) lessen the national demand for wood products internationally (i.e., on a global scale). Using aerial photo interpretation data, it is estimated that approximately between 4,500 to 9,200 acres involved in stand replacement wildfire, and between 2,700 to 4,300 acres involved in mixed severity wildfire, may be economically viable for salvage harvest. These figures are tentative and are likely to change over time as more site-specific information becomes available. The actual acres available are also likely to decrease because riparian buffers and other sensitive resource area/issues have not been factored into these estimates.

Findings

- 54% (80,419 acres) of the watershed project area has been involved in wildfire since 1996.
- 26% (38,148 acres) or of the watershed experience stand replacement fire in which virtually all vegetation canopy was consumed/removed.
- 11% (16,628) acres or of the watershed experience mixed fire in which 25% to 75% of the vegetation canopy was consumed/removed.
- As a result of the recent wildfires, there has been a major shift in size structure across the landscape. The grass/forb/shrub class has increased from 6% to 31% with a concomitant decrease in all the other size classes.
- Continued mortality can be expected in areas that experience mixed mortality over the next 3-5 years as severely damaged trees succumb to secondary mortality agents.
- Potential Old Growth decreased by 23% to 30% as a result of the recent wildfires. This range is based on stand replacement to stand replacement plus mixed mortality.
- From continuous vegetation survey plots approximately 17% (113,000 trees) of the trees 21”+ DBH tree in the watershed outside of wilderness were killed in the stand replacement areas outside of wilderness and approximately 14% of the trees 21”+ DBH were within mixed severity stands.
- For vegetation management purposes, the District analyzed 69,848 acres, proposed 35,336 acres of treatment and to date has accomplished 7007 acres of treatment. The acres treated to date are approximately 20% of the acres proposed to be treated, 10% of the acres analyzed and 5% of the entire watershed.
- The potential for natural regeneration post-fire for the B&B fire is good due to the timing of the fire in relation to seed maturity and seed fall.
- Vegetation treatment that was accomplished in the basin since the last watershed analysis and since the western spruce budworm outbreak of the late 1980’s/early 1990’s was designed in part to reduce fire hazard to promote a more fire resilient landscape. From an anecdotal perspective it appears that a majority of the treatments met this objective. There are a few

areas such as unit 17 of the Santiam Corridor timber sale in which the treatment did not seem to meet this objective.

- Salvage after fire is controversial especially when it is considered only in context of its ecological effects. However, the question of salvage should probably be considered from a larger perspective and take into account the scale of any proposed salvage in relation to the entire area that burned and that could be salvaged.
- Potential salvage exists on 4,500 acres to 16,200 acres. Final acres being dependent on more site-specific information and potential acres removed because of resource concerns.
- The concept of fire regimes and conditions classes and how to use them on
- Both fire size and intensity of stand replacement events within the ponderosa pine and mixed conifer plant associations, fire regimes1 and 3, is outside the historic range of variability.
- Within the high elevation plant associations, fire regimes 4 and 5, fire intensity of the stand replacement events was within the historic range of variability, however the size of those stand replacement events was probably outside the historic range of variability.

Recommendations

1. **<u>General</u>:**
   a. The recommendations related to vegetation management from the original watershed analysis were reviewed and found to still be valid, especially in areas not involved in recent fires or, if involved, the areas that burned at low intensity or were unburned.
   b. In areas outside of the recent wildfires and in the low intensive wildfire areas, aggressively implement the recommendations from the original watershed analysis to:
      i. Reduce fire hazard in fire regimes 1 and 3
      ii. Maintain and enhance the early seral large tree (21”+ DBH) component.
      iii. In mixed conifer stands, shift species composition from primarily late seral to primarily early seral.
      iv. Reduce stand densities to more sustainable levels.
      v. Maintain, enhance and move toward desired wildlife habitat objectives
      vi. Minimize potential negative environmental effects of vegetation treatments
   c. Incorporate the research community into any restoration or salvage activities to:
      i. Integrate the latest scientific knowledge into project planning.
      ii. Assist in developing appropriate research/project monitoring protocols.

2. **<u>Salvage</u>:**
   a. Salvage to reduce hazards in areas where human safety may be threatened (e.g., along roads, within campgrounds, etc.).
   b. Outside of wilderness areas consider aggressive salvage in fire regimes 1 and 3 (i.e., ponderosa pine and mixed conifer plant association groups). This would have the following objectives:
      i. Reduce future fuel loads to those that are more in line with the historic range of variability.
      ii. Help protect developing stands from future near-term stand replacement events to meet long-term resource management objective.
      iii. Allow the reintroduction of low and mixed severity prescribed fire and wild fire.
   c. Salvage is very time sensitive related to value and should be accomplished within the first year to maximize value and within the first 2 to 3 years to have any value to offset the cost of the treatments and perhaps provide funding for other restoration objectives.

d. Salvage should be designed and conducted in such a manner to minimize any potential adverse environmental effects. Fitzgerald, (2002), describes approaches to ensuring salvage harvest success that help avoid or reduce negative environmental effects.

3. **Reforestation**
   a. Monitor natural regeneration and do not plant where adequate regeneration of desired species is occurring. The level of natural regeneration will not be completely evident for 2 to 5 years post fire.
   b. In the absence of natural regeneration, reforest areas in the following order of priority:
      i. Previous regeneration harvest units.
      ii. Areas with no salvage potential but with sensitive resource concerns
      iii. Areas with salvage potential and sensitive resource concerns that are not likely to be salvaged.
      iv. Areas with no salvage potential and no sensitive resource concerns.
      v. Areas with salvage potential that are ultimately salvaged.
      vi. Areas with salvage potential and no sensitive resource concerns that are not salvaged.
   c. Since funding is limited, consider not reforesting areas without sensitive resource concerns that are not salvaged.
   d. LSRs
      i. Since timber production is not an objective of LSRs plant at lower densities such as 100 to 200 trees per acre to reduce the number of future entries needed to meet long-term management objectives.
      ii. Design in variability in reforestation densities (e.g., limit animal damage control, incorporate natural regeneration, etc.) to mimic historic patterns of variability of reforestation that might have been found in post-wildfire stand replacement events.
   e. Matrix:
      i. Since timber production is one objective of matrix lands, plant at higher densities than LSRs such as (200 to 300 trees/acre) to ensure this management objective can be met over most acres.

Data Gaps

- Plant association mapping needs to be continuously refined and improved.
- Continue to refine estimates of site potential (e.g., management zones for maintaining healthy densities) for the various plant associations, especially the major ones, found in the watershed. This would allow managers and decision makers to more confidently determine current stand conditions/site potential and weigh the tradeoffs of different management scenarios.
- The numbers of acres of old growth in the watershed are only estimates. Old growth stands should be identified and mapped using all the variables in the Region 6 Interim Definitions of Old Growth.
- Sources of historic vegetation information are scarce. Additional sources, such as the maps from the Samuel Johnson Foundation and the “Forest Conditions in the Cascade Range Forest Reserve, Oregon 1903” should be preserved by inclusion into the Forest GIS/database system.
- Accurate estimates of current levels of snag and down wood material are not currently available. It will be necessary to develop a long-term plan for data accumulation and maintenance for future landscape analysis and vegetation management projects.
- Further analysis is needed to determine the extent of salvage harvesting opportunities.
- The use of fire regimes and fire hazard condition class is relatively new and at this point there is some controversy at the local level as to how fire regimes should be mapped. Fire regimes

is a broad concept used to describe broad landscapes and does not lend itself to site specific acre by acre type applications. Consequently, the development of fire regime concepts and maps needs to be done in a multidisciplinary way and at the local level.

Monitoring

- Monitoring of the post-wildfire landscape would be beneficial to learn how the landscape responds to both passive and active management.

SPECIAL FOREST PRODUCTS

Mushrooms

Comment:

"Mushrooms, especially spring morels are an important forage base for big game coming off winter range and many other wildlife species with important ecosystem functions such as rodents. Large numbers of mushroom pickers that grid the landscape could diminish this food source for many wildlife species. There is a concern that we manage this use so that both available food for wildlife and sustainability of fungi is not negatively affected." -ODFW

Response:

I have not been able to locate any research addressing big game species preferences for spring mushrooms. While managing the wild edible mushroom program on the district for the past ten years, my personal observations indicate that morels are used very little as forage by big game. Nearly all foraging of morels, other than by humans, seems to be by insects. I have observed some evidence of foraging by rodents, but very little.

Coral mushrooms, mainly yellow coral, are what I have seen deer and elk seeking out and foraging upon. I have also seen a lesser amount of what appears to be incidental foraging of boletus. I believe the boletus foraging I've seen has mostly been incidental to the foraging for yellow coral mushrooms, as the boletus and coral mushrooms are often found growing together. Where the corals and boletus are found together, and where deer and elk foraging is evident, it is apparent the animals are much more interested in the corals. I've seen some use of boletus by rodents, but it is usually limited to some nibbling on the caps, consuming small portions of individual mushrooms. The other main mushroom species that I have seen used by big game to a significant extent is a white species of Russula, which is not a mushroom sought after to any extent by wild edible mushroom hunters.

Much of the concern for sustainability of wild edible mushrooms in the face of long-term harvest seems to come from the declines in productivity of such mushrooms seen in Europe. There are many reasons that have been theorized as contributing to the decline, including loss of forest habitat, industrial pollution, climate changes, and long-term mushroom harvesting.

The effects of long-term harvesting of mushroom fruiting bodies on mushroom productivity and sustainability have not been scientifically proven. Harvesting techniques are significant in their effect to the overall health of the organism. Picking mushroom fruiting bodies without disturbance to the underlying mycelium is thought to have little effect to the overall organism, which many have compared to the picking of apples from an apple tree. Harvest techniques that create greater disturbance, such as raking surface litter away to reveal mushrooms, is thought to be more harmful.

In an attempt to discern changes in mushroom productivity over time on the Sisters Ranger District, data for the quantities of mushrooms purchased by mushroom buyers sited on the district has been collected for several years. Due to wide natural variations in annual mushroom productivity, such information is only useful if collected over decades-long time periods. Additional variables that have occurred on the district during the data collection period include wildfires that have significantly altered large amounts of prime forest habitat, and mushroom harvesters bringing mushrooms to sell to Sisters buyers that have been harvested off-district. Because of those variables, I would consider the mushroom quantity data largely corrupt.

Alan Heath,
Sisters Ranger District
February 18, 2004

INSECTS AND DISEASE

Introduction

The original Metolius Watershed analysis was completed in January 1996. This report updates the original analysis by reviewing the insect activity from January 1996 through 2003 utilizing aerial survey maps and analyzing the potential impacts of insects relative to the large fires that have occurred in the watershed over the last 2 years.

History Relative to Insect Activity Since 1996

Aerial surveys indicate that several species of bark beetles have been active in the Metolius Watershed since 1996. The level of tree mortality has been quite variable from one year to the next, with some areas being affected every year and others with less activity.

The highlights for the period of time since 1996 are described below:

1996

Extensive fir engraver *(Scolytus ventralis)* was noted throughout the northern portion of the Watershed including Green Ridge from Castle Rocks to Whiskey Springs and on the west side from Sheep Springs Horse Camp to Suttle Lake.

The high-elevation lodgepole forests experienced significant mortality to mountain pine beetle *(Dendroctonus ponderosae)* in several large patches, including areas west of Abbott Butte and south all along the crest of the Cascades from the Jefferson Wilderness to the south end of the watershed.

Small patches of western pine beetle *(Dendroctonus brevicomis)* were noted, primarily on the east side of Black Butte.

1997

The mountain pine beetle was still active in the lodgepole pine host around Abbott Butte, but at substantially lower levels than in the previous year. Mountain pine beetle was also noted in small pockets between Abbott Butte and Canyon Creek in the ponderosa pine host.

The fir engraver occurred in just a few small pockets around Suttle Lake.

1998

The mountain pine beetle persisted in the same area west of Abbott Butte that was affected in the previous year, affecting the lodgepole pine host

A sizeable patch of western pine beetle was detected north of Sugar Pine Ridge

1999

No maps available

2000

There was a decline in the level of mountain pine beetle activity in lodgepole pine around Abbott Butte.

Several small pockets Douglas-fir beetle *(Dendroctonus pseudotsugae)* were detected near Abbott Butte Spring and Cabot Creek.

2001

There was a slight increase in mountain pine beetle in the lodgepole host once again in the Abbott Butte area, along with a number of pockets of mountain pine beetle in ponderosa pine in the Horn of the Metolius, Bear Butte and south of Bear Valley Creek.

2002

Mountain pine beetle activity increased again in lodgepole pine around Abbott Butte and further north toward the Warm Springs Reservation.

Several small pockets of mountain pine beetle were also noted in ponderosa pine, particularly in the Horn of the Metolius and the southern portion of Green Ridge.

Western pine beetle activity was evident along the Metolius River and on Green Ridge.

There was also a slight increase in fir engraver activity in several spots in the watershed.

2003

A substantial increase in fir engraver activity was noted on Little Squaw Back and Fly Creek near Whiskey Spring, with scattered pockets also present on Green Ridge.

Wildfire and Insects

After a wildfire, there is typically a large increase in the populations of certain forest insects. Recently dead wood is colonized by a wide variety of wood boring insects and bark beetles that sometimes come from great distances to take advantage of a new and abundant food source. These insects introduce various fungi into the wood that they infest and the fungi begin the decay process that eventually leads to the recycling of the dead material and the release of nutrients back into the system. Many of the same insects, particularly the bark beetles, will also infest trees that are not yet dead but that have been sufficiently wounded by the fire to have their defense systems impaired. In subsequent years, typically two to four years after the fire, the populations of bark beetles may become quite large and may move beyond the perimeter of the fire and infest trees that did not sustain any damage in the original fire event.

Description of significant insects related to wildfires in the Metolius Watershed Project Area

Western pine beetle, Dendroctonus brevicomis

The western pine beetle is most commonly associated with large-diameter ponderosa pine and is a primary mortality agent under the right conditions. Wildfires provide those conditions that lead to rapid population increase of these beetles. The ability to complete two generations in one year enables these beetles to take advantage quickly when a food source becomes available to them. In the first and second year after the fire, the western pine beetle will colonize trees that were killed in the fire, but that still have their cambium intact to support the developing beetle broods. In past monitoring of tree survival, large pines that lose over half of their crown in a wildfire have been found to be very likely to die from attacks by western pine beetle (Miller and Patterson 1927). In years three and four after the fire, the beetles may infest pines that were weakened but still retain some live crown, or trees that are fairly healthy outside the fire perimeter. Fire-damaged trees that are being left as part of the green-tree replacement component for wildlife purposes are very likely to be killed by the western pine beetle within three to four years after the fire. Western pine beetle populations will then decline unless other enabling factors such as drought prevail at the time.

Mountain pine beetle, Dendroctonus ponderosae

The mountain pine beetle is most commonly associated with second-growth ponderosa pine and is commonly found on fire-damaged trees. Unlike the western pine beetle that infests trees well after a fire is over, the mountain pine beetle often responds shortly after a fire and may actually be attracted by odors emanating from burned trees (Miller and Keen 1960). The flight period of these insects (July-September) is nicely synchronized to coincide with freshly available host material provided by wildfires that tend to occur in the latter part of summer. In order to be suitable for colonization by mountain pine beetle, these damaged trees must have their cambial tissue intact. (The thickness of ponderosa pine bark usually insures that such is the case, even for trees with severe bole scorch).

Infested trees are easily recognized by the thumbnail-sized globs of pitch on the bole where each point of attack has occurred.

Pine engraver, Ips pini

Pine engravers are also associated with ponderosa pines, but typically prefer trees of small diameter. On occasion they will infest and kill the tops of larger trees, producing a spike top. Fire damaged trees are attractive to *I. pini* as long as there is cambial tissue present to support the developing larvae. Within the perimeter of the fire, trees having sustained a significant level of fire damage are vulnerable to infestation by pine engravers. Outbreaks have been known to occur in green stands shortly after the fire, but are usually confined to dense stands of pole-sized trees.

Red turpentine beetle, Dendroctonus valens

Turpentine beetles usually confine their attacks to the basal portion of the boles of host trees (pines exclusively). The presence of pitch tubes resulting from turpentine beetle attack is an indicator that the host tree has been sufficiently wounded to produce pitch flow which serves as an attractant to these bark beetles. Although not a mortality agent *per se*, the turpentine beetle is a good indicator that the host may be vulnerable for colonization by other more aggressive bark beetles.

Douglas-fir beetle, Dendroctonus pseudotsugae

The Douglas-fir beetle is associated with Douglas-firs of large diameter and is known for infesting trees that have sustained light levels of fire damage (Furniss 1965). Outbreak populations typically arise a few years after the fire and, in a manner similar to the western pine beetle, can spread well beyond the perimeter of the fire.

Wood borers, Coleoptera: Cerambycidae and Buprestidae; Hymenoptera: Siricidae

There are three important families of wood boring insects that use recently dead wood as their food source. These include the two beetle families *Buprestidae* (flat-headed or metallic wood borers) and *Cerambycidae* (round-headed or longhorned wood borers), and the wasp family *Siricidae* (woodwasps or horntails). Most of these wood-boring insects are fairly large, measuring about one inch in length in their adult stage (beetle or wasp), with larval stages that can be considerably larger. Most of them have a one-year life cycle that begins with the adult stage in the spring or summer. Eggs are laid within the bark (beetles) or within the sapwood (woodwasps) and larvae feed for nearly a year as they grow from a small egg to a fairly large-sized grub at maturity. Both of the beetle families feed on the cambial tissue between the bark and the wood before they enter the sapwood (the woodwasps do not). The majority of wood borers infest trees that are recently dead, usually within the first year after death. Any dead tree is likely to be infested by wood borers, but as a general rule, trees killed by fires will have a higher proportion of attacks than trees dying of other causes.

Given their roles as primary decomposers, the wood boring insects are the primary reason for the sense of urgency that accompanies the salvage of fire-killed wood. All wood borers appear to have a strong association with fungi. Some of these associations may be passive (insects creating holes for fungi to enter the wood) while others are active (vectoring of a symbiotic fungus into the wood). These associated fungi are ones that produce stains and decays. It has been recognized that wood infested by woodborers decays considerably faster than uninfested wood.

The wood-boring insects are also the main reason that woodpecker populations increase dramatically in a forest after a wildfire occurs. The larvae of all wood borers are a highly prized food source for woodpeckers; their feeding can be a diagnostic tool for recognizing infested wood.

Desired Condition for insect populations

Many of the forest insects such as wood borers and bark beetles are important agents in nutrient cycling, in producing the disturbances that are critical to the diversity of the forest, and in providing a food source for other organisms. As such, it is important to achieve a balance that allows for these ecological processes to continue, but that still limits insect populations to endemic levels. The populations of all of these insects are ultimately regulated by the amount of habitat (food source) that is available to them.

Opportunities and objectives regarding insect populations

A large-scale disturbance such as the recent wildfires temporarily disrupts the balance of insect populations in the forest and can lead to even greater imbalance without some directed effort at reducing current and potential insect habitat. Salvage harvest of recently dead and dying trees can reduce insect habitat, and to some extent the insect populations themselves, by targeting those trees that are infested at the time of the harvest, and those that would likely be the next to be infested. However, it is important to note that we do not have the ability to entirely eliminate the possibility of insect outbreaks through salvage activity because timing is critical and large areas of potential bark beetle habitat remain untreated in any project.

Alternatives to Address Potential Insect Activity in the Post-fire Landscape

Even though the manager has limited ability to avoid outbreak populations of bark beetles (the greatest forest insect-related concern that arises after a wildfire), there are some opportunities. The removal of infested trees and soon-to-be-infested host material helps to limit bark beetles populations to a certain degree. The greatest gains are with the largest infested trees; removal of small infested trees, or trees colonized two years previously have no relevance to reducing bark beetle populations from within the fire area.

The more aggressive the salvage alternative is, regarding the removal of currently infested or soon-to-be-infested trees, the greater will be the potential benefit to live surrounding stands.

Formal monitoring should be done to determine tree survival with various levels of fire damage.

The Relationship of Forest Insects in the Post-Fire Environment Relative to Important Resource Issues Identified in the Eyerly Timber Salvage Project

The relationships between forest insects and the five issues are described as follows:

- The effects of forest insects on Soils and Water are indirect. Trees that are killed by bark beetles will eventually fall over and, on steep slopes, may lead to increased soil movement and sedimentation into water sources.
- Within riparian areas, insects may be important contributors to in-stream wood by killing trees that grow under dense conditions in these corridors. In this way, the relationship between forest insects and Fish Habitat is indirect as well.
- The relationships between forest insects and Wildlife Habitat and Ecosystem Diversity are much more direct. As key disturbance agents, the bark beetles create gaps in the forest by infesting and killing certain species, ages and sizes of trees that represent the most appropriate host for each beetle species. As such, insects are directly responsible for snag levels within the forest and for their temporal and spatial arrangement.
- Wildlife habitat can be affected by insects in either positive or negative ways, depending on the species under consideration. The conversion of live trees to dead trees may be positive for some species (e.g., woodpeckers), but extensive mortality can lead to loss of cover and/or a reduction in the large-tree stand component that might be critical for other species such as the northern spotted owl.
- Bark beetles and wood borers introduce fungi into the wood they colonize and thus influence the rate at which dead wood decays and becomes usable by other organisms, either as food or as habitat.

Post-Fire Effects

In the short term, wood-boring insects will colonize most of the trees killed in the fire. In the larval form, the wood borers will provide a nutritious food source for woodpeckers that congregate in the burned area. The colonized wood will begin to decompose quickly through the action of decay fungi brought in by the woodborers. In the medium to long term, these insects will be replaced by others such as carpenter ants that utilize wood in a more advanced state of decay. In general, the significance of these wood-boring insects will be confined to recently dead wood and will decrease as time goes on.

The bark beetles in ponderosa pine and Douglas-fir will be important as tree mortality agents in the short to mid term, causing the death at first of trees severely damaged by the fire and then subsequently infesting trees less severely damaged. Within three to four years small infestations may develop in stands outside the perimeter of the wildfire areas if weather conditions favor the buildup of these insect populations within the fire-damaged trees. Larger trees in surrounding stands may be infested and killed if bark beetle populations reach epidemic (outbreak) levels. In the long term, populations will revert to endemic levels until the next disturbance event generates more habitat for them.

Guidelines for the assessment of tree survival

One of the many challenges that arise after a wildfire is making an assessment of the level of fire damage sustained by trees and judging how that damage relates to subsequent tree survival. Many variables are involved in the survival of fire-damaged trees, including the following:

- Tree species
- Season of fire
- Fire intensity
- Pre-fire tree vigor and growth rate
- Site quality
- Arrangement and distribution of down woody material
- Post-fire moisture conditions
- Disease occurrence
- Bark beetle pressure

Similar levels of fire damage will produce different results in terms of tree survival from one wildfire event to another, depending on the factors named above. In many cases, the damage is unseen, occurring in the root zone or beneath the bark, making an accurate assessment very difficult.

Numerous case studies and publications are available to assist in the evaluation of fire damage and the likelihood of tree survival. Some very thoroughly developed guidelines relevant for the Pacific Northwest include two reports from the Blue Mountains (Scott and others 1996; Scott and others 2002). These guidelines were developed after an extensive literature review and field observations taken from numerous wildfires.

In the first report (Scott and others 1996), the following standards of damage are used for judging survival of ponderosa pine and Douglas-fir:

> Where burn severity has been **moderate**, ponderosa pine is highly likely to die if 30-40% of the crown volume has been scorched and if the tree has sustained bole scorch exceeding 40% of the total tree height. For **high** severity burns, ponderosa pine is highly likely to die if more than 70% of the crown volume has been scorched and bole scorch exceeds 40% of the total tree height. For Douglas-fir under the **moderate** burn severity, trees are highly likely to die if 20-30% of the crown volume has been scorched and if 30-50% of the bole circumference has been charred to a height of 5-8 feet. Under the **high fire severity** scenario, Douglas-firs are highly likely to die if more than 40% of the crown volume has been scorched and >50% of the bole circumference has been charred for a height of 8 feet or more.

The second report (Scott and others 2002) also rates fire damage to individual trees, but first assigns a rating value to the parameters of the fire event itself (i.e., season of fire, growth rates and site quality for affected trees, arrangement of down wood material, etc.). Individual trees are then rated, evaluating factors such as crown volume scorch, bole char, total scorch height and duff consumption, assigning points according to the degree of damage. A composite rating score is derived from totaling each of the “event” variables and adding them to the points accumulated for the individual trees based on the damages they have sustained. The composite rating score then predicts the probability of the tree surviving.

The points associated with the “event” factors for the Metolius Watershed fires are as follows:

- Season of Fire: early-season fire, **2** points
- Pre-fire growth rates: **1** point where poor sites were involved
- Distribution of down woody material: **1** point where large material was within the dripline of trees
- Dwarf mistletoe occurrence: **1** point for those Douglas-firs that were infected
- Root disease presence: **1** point for most of the area with white fir and Douglas-fir
- Bark beetle pressure: **2** points for most of the area, since bark beetle evidence was apparent within 2 miles of the fire perimeter, but not less than one-quarter mile

The points accumulated for the event would be added to the individual tree rating to determine the likelihood of tree survival. For ponderosa pine, 6 points from the event would apply, and for Douglas-fir, 8 event points would apply, if infected with dwarf mistletoe. Large-diameter ponderosa pines would need to accumulate 15 additional points in order to be rated as “low probability of tree surviving”. If the crown volume scorch is 50-80% of pre-fire live crown (**4** points) and bole is scorched more than 50% of the bole to 8 feet or more (**3** points) and total scorch height is 100 feet (**2** points) and litter and duff consumption is complete with mineral soil reddish (**6** points), then the 15 points have been reached and the tree is unlikely to survive. For mature Douglas-fir, an additional 11 points would need to be accumulated for the individual tree damage in order to rate the tree as “low probability of surviving”. If crown volume scorched is 30-50% (**4** points) and bole char is greater than 50% of the circumference up to 5-8 feet (**3** points) and litter and duff is completely consumed (**4** points), then the 11 points are reached and the tree is rated as having a “low probability of survival”.

These standards give the decision-maker a baseline from which to judge the number of currently live trees that may soon die and to incorporate that information into long-term planning. Some of these damaged trees may be left on site to serve as “green tree replacements” for existing snags once those snags fall over.

FIRE AND FUELS

Overview

During the summer of 2002, the Eyerly and Cache Mountain Fires burned 26,958 acres in and adjacent to the Metolius watershed.

This was significant because in the previous 100 years, only 29,449 acres of the watershed had burned.

The following summer in 2003, the Link and B&B fires burned another 95,492 acres.

Therefore, in 2 years time, four times as many acres burned, than had burned in the previous 100 years. The terms "natural disaster" and "catastrophic" have frequently been used to describe these events.

Were these fires uncharacteristic?

Fire as an Ecological Process

Fire is an important ecological process in eastside forests. Records of fire occurrence on the Sisters Ranger District support that fire has played a major role in shaping the forests and landscape of Central Oregon. Fire frequency intervals ranged from 8 years in the Ponderosa Pine to over 50 years in Mixed Conifer. Historically these natural disturbances ranged from benign to severe depending on the Fire Regimes in which the fire occurred and the environmental factors at the time.

Predictions from 1996

In the 1996 Metolius Watershed Analysis, Fire Planners identified 14 trends related to fire and fuels and predicted there would be larger, higher intensity fires that would put firefighters and the public at greater risk and cost more to suppress (Metolius Watershed Analysis, pg. 47). As a result of past management practices (logging and fire exclusion), pine forests were continuing to evolve from open stands with frequent, low intensity fires to denser stands where moderate and high intensity fires were possible. The high elevation forests were nearing the natural end of their fire cycles and the conditions were favorable for a stand replacement fire. Other trends noted were an increase in wildland/urban interface, where fire suppression would be hazardous, and the need for evacuation plans for Camp Sherman, residential housing and recreational developments.

Management Follow-up

Several projects to reduce fuels, thin forests, create fuel breaks in high mortality areas, and reintroduce the natural process of fire were completed. Jack Canyon, Santiam Corridor, Highway 20, and portions of Santiam Restoration were all projects based on recommendations of the 1996 analysis. Many of these project areas were tested for efficacy during the fires of 2002 and 2003. No formal study has been completed but District specialists observed a modification of fire behavior in many treated areas and estimate that about 75% of the fuels breaks had a beneficial effect during the Cache, Link, and B&B Fires.

Other forest management projects to reduce fuels, regenerate high mortality areas, and reintroduce fire, such as McCache and Metolius Basin were planned but held up by appeals and litigation. Both the McCache and Metolius Basin Project area were partially burned during the 2002/2003 fires.

Evolving Fire Science:
Fire Regime and Condition Class (FRCC) and other terminology

As the National Fire Plan was developed, Hann (2001) and others introduced Fire Regime and Condition Class mapping to National Forest managers as an additional tool to assess the risk to ecosystem sustainability and risk of uncharacteristic wildfire behavior and effects. The following concepts are now widely used and will be used in this report:

Fire Regime - A general classification of the role fire would play across a natural landscape in the absence of modern human mechanical intervention, but including the influence of aboriginal burning (Agee 1993, Brown 1995).

Condition Class - The departure from the central tendency of the natural (historic) range of variability within the fire regime.

Uncharacteristic Wildfire - Fire that occurs outside the range of its typical ecosystem, geography, and presettlement fire regime.

Fire Hazard - Composed of fire risk, fuel condition, weather (hot, dry, and windy) and topography.

Fire Risk - The probability that fire will start.

Fire Intensity - A general term relating to the heat energy released by a fire.

Fire Severity - The magnitude of the fire on specific resources.

Fire History Analysis

To understand whether a fire is characteristic or uncharacteristic it is important to examine fire of the past. Fire history studies provide strong evidence that fires of the past occurred quite frequently, many times within the life span of the dominant tree species (Skinner, and Chang 1996). Unlike today, fires of the past did not occur as isolated events. Instead, they occurred regularly and greatly influenced the development of forest habitats (Agee 1993, Chang 1996, Skinner & Chang 1996, Mohr and others 2000). It is appropriate that fire be viewed as a persistent ecological process rather than an event.

This is evident in the Metolius watershed analysis area where 32 large fires have burned 106,566 acres, 72 % of the watershed during the last century. The "Fires By Decade" document has a complete series of maps depicting the location of each fire by decade within the watershed over the past century. See Key Findings.

F. Table 1- Historic Large Fires in the Metolius Basin

Decade	Number of Fires	Acres Burned Total fire/In watershed	% of Watershed Burned
1900- 1910	3	306/306	0.2%
1911-1919	3	5523/5521	3.7%
1920- 1929	3	5556/5556	3.7%
1930-1939	1	636/601	0.4%
1940-1949	3	5616/5616	3.8%
1950-1959	0	0	0
1960-1969	2	3495/2002	1.3%
1970-1979	1	74/74	0.05%
1980-1989	4	3819/3700	3.5%
1990-1999	6	4424/2721	2.6%
2000-2003	**5**	**122,617 (total) 80,469 (in the watershed)**	**54%**

The fires of the past 3 years are unprecedented in size, compared to the fires in the past century.

Recent Large Fires

Between 1995 and 2003 eight large fires burned in the Metolius Watershed (WS) consuming 82,944 acres. Large fires are defined as over 100 acres.

1996- On a hot afternoon of July 8th 1996 careless hikers started the **Jefferson** fire near Cougar Springs in the Mt Jefferson Wilderness. The fire was initially contained at about 1,100 acres south of the lava flow adjacent to Jefferson Creek but became active again on July 26 when it burned additional acres in the wilderness before spreading onto the Confederated Tribes of Warm Springs Reservation, where it burned approximately 1,703 acres.

F. Table 2. Recent Large Fires in the Metolius Basin.

Year	Fire	Cause	Total Size	Acres in WS
2003	Bear and Booth	Lightning	91,902	67,251
2003	Link	Person Caused	3,590	3,590
2002	RNA	Management	167	167
2002	Cache Mountain	Lightning	3,859	3,809
2002	Eyerly	Lightning	23,099	5,652
1999	Cache Creek	Lightning	382	382
1998	Square	Lightning	113	113
1996	Jefferson	Person caused	3,689	1,989
		Total	126,801	82,953

1998- Lightning sparked the 113 acre **Square Lake** fire north of Highway 20.

1999- Another lightning event started the **Cache Creek** fire that burned 382 acres in a long narrow pattern through Mountain Hemlock and Lodgepole pine.

2002- On July 9, 2002 the **Eyerly** fire started on the Confederated Tribes of Warm Springs Reservation just north of the Metolius River. It burned on a steep south facing slope for several days before it spotted across the Metolius and made a wind driven run toward Three Rivers Subdivision to the east. On July 13th the fire grew 4000 acres in 1 day and 18 houses and 19 buildings burned at Three Rivers Subdivision. Houses along Lake Billy Chinook were threatened but saved; Perry South Campground was extensively damaged. On July 23rd the fire crossed Green Ridge into the Metolius valley in a 50 acre spot. A rainstorm that night helped stop the fire but started the Cache Mountain Fire. The fire size grew from 212 acres on July 11 to 23,573 acres on July 26th. The fire was contained on July 26th after 17 days. About 80 miles of fireline were constructed. Suppression cost was over 10 million dollars.

2002 - On July 23, 2002 the **Cache Mountain** fire started by lightning on the north side of Cache Mountain. Camp Tamarack on Dark Lake was evacuated on July 25th. After days of waiting and preparation, Black Butte Ranch was evacuated on July 28th and Highway 20 was closed. Two houses burned at Black Butte Ranch as the fire made a run to the east. After 3 days residents were allowed to return. About 26 miles of fire line were constructed. A total of 3,858 acres burned, including 1,618 acres of private land.

2002- Later that fall a prescribed burn to research the effects associated with the re-introduction of fire into fire adapted ecosystems escaped and burned 167 acres in the **Metolius Research Natural Area** near Green Ridge.

2003 - On July 5th, the human caused **Link Fire**, started near Cache Lake and burned through dead fir, lodgepole pine and mountain hemlock with uncharacteristic severity across the north side on Cache Mountain consuming 3,594 acres before it was contained. The Cache Mountain Research Natural Area was partially burned and damaged by fire suppression roads and bulldozed safety zones. About 11 miles of fire line were constructed.

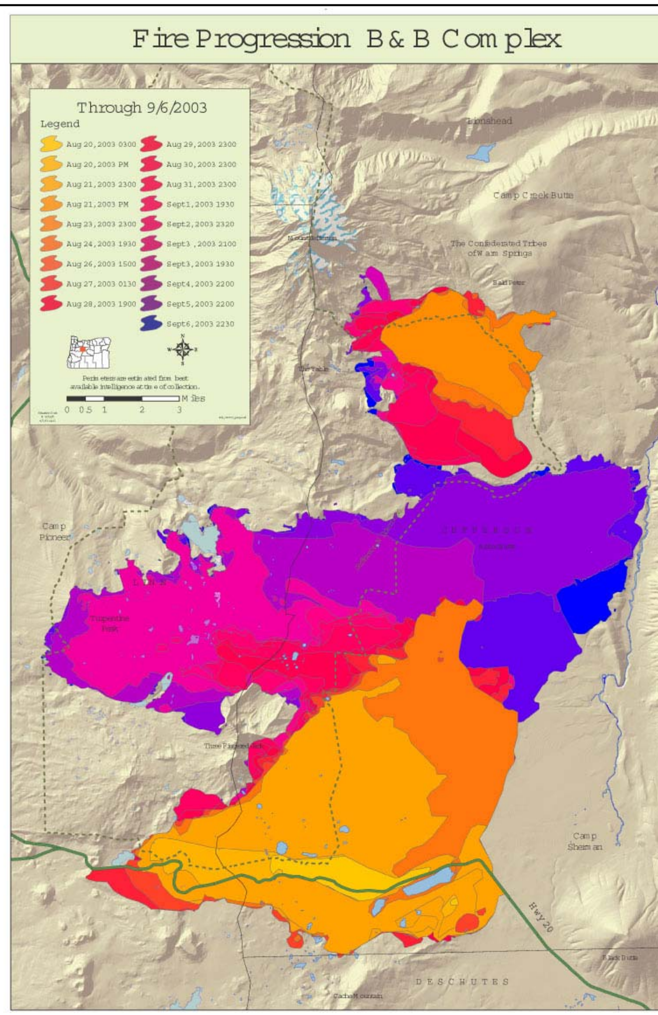
2003 – On August 19th, as crews were still working to mop-up the remains of the Link Fire two fires were discovered in the Mt Jefferson Wilderness to the north. During the first burning period of the **Bear** and **Booth** fires, both grew rapidly creating towering black columns which resulted in long range spotting. Over the next three weeks both fire burned with uncharacteristic intensity until they eventually burned together consuming 91,902 acres.

The Bear & Booth Fires (B&B Fire): On the afternoon of August 19, 2003 two fires were reported in and adjacent to the Metolius Watershed. The fire weather forecast predicted extreme conditions with Minimum RH of 5% and Temperatures in the mid 80's at the weather station near Tollgate Subdivision.

The first of the two fires, the **Bear Butte Fire** was discovered by a helicopter on the Warm Springs Reservation near Hole in the Wall, in the Mt Jefferson Wilderness area at 13:09 on August 19, 2003. When discovered the fire was ¼ acre in heavy fuels located 5 miles from the nearest road. Air attack and smoke jumpers were ordered and were above the 3 acre fire around 14:20. After dropping streamers to evaluate the wind Smoke Jumpers determined it was unsafe to deploy because of 20-30 mile winds. By 14:45 the fire was reported at 5 acres, within the next 30 minutes the fire grew to 20 acres and began spotting. Air tankers were requested but diverted to another fire found that afternoon, the Booth Fire, where it was believed they could be more effective. At 18:00 hours the fire had generated a sizable column and was estimated to be 700 acres. The fire had spotted over a mile onto the west side of Bald Peter on the Warm Springs Reservation. By nightfall Air attack estimated the fire at over 1000 acres.

At 15:23, little more then two hours after the Bear Butte fire was detected, Hinkle Butte Lookout observed the beginnings of the **Booth Fire**, a smoke west of Square Lake.. Within minutes it had grown to 20 plus acres and was torching out individual trees and spotting. By 14:42 the fire was estimated at 100 acres with numerous spot fires ¼ to ½ mile in front of the main fire. At 15:30 hours the fire was estimated at 200 acres and growing. The fire moved rapidly across the dry south facing slope through heavy dead and down fuels as the wind pushed it to the east paralleling Highway 20 and north west past Long Lake toward Round Lake Christian

F. Figure 1. Final B&B Complex Fire Map



Camp. By 15:50 a significant column had developed with long range spotting occurring. Jefferson County and USFS personnel with the help of air attack and helicopters moved rapidly to locate and evacuate individuals in the immediate proximity of the fire. In spite of efforts of three dozers with support personnel the fire continued to advance and by 18:00 hours was 700 acres. The fire was estimated at 1500 acres by 20:00 hours and around 21:30 the column rolled over Highway 20 and started several spot fires south of Suttle Lake ¾ of a mile ahead of the main fire. *(Personal observation by Kirk Metzger & Initial Attack Narrative by Lorri Heath (Appendix F1).*

The B&B Fires started along the crest of the Cascades in areas dominated by long interval Fire Regimes subject to stand replacement fires. A significant portion of the fire area had a canopy with a late-closed vegetation structure. Aerial fuels consisted of moss draped hemlock, and fir. An additional factor that contributed to the intensity in the early stages of the B&B Complex was fuel loading that occurred as a result of the spruce budworm infestation and tree mortality across the area between 1995 and 2003. Estimated fuel loading in some areas was in excess of 50 tons/per acre.

Over the next two and a half weeks the fire continued to burn through, then out of the Mt Jefferson wilderness areas where fuel loads contributed to multiple days of extreme fire behavior with large acreage gains. The fire burned into and across lands owned or managed by the Deschutes National Forest, Confederated Tribes of Warm Springs, Willamette National Forest, Oregon State Parks, Weyerhaeuser Timber Company and other private holdings.

The Suttle Lake Recreation complex, resident camps and businesses were evacuated south of the highway. The community of Camp Sherman in the Metolius Basin was evacuated twice. Oregon State Highway 20 was closed from August 19 through August 31st and the economy of Sisters was disrupted during the time when many businesses make a significant portion of their annual income.

On September 7 a deep trough developed over the Pacific that brought several cold storms to the area and moderated the fire behavior. It was during this time that fire crews were able to hold the advancing fronts of the fire. The fire was contained on September 26, 2003.

The B&B Fire Complex burned approximately 91,902 acres, 13 structures, resulted in approximately 90 miles of dozer line, 75 miles of hand lines, and numerous safety zones being constructed. It cost approximately 38.7 million dollars to suppress.

Investigation by the Central Oregon Arson Team, an interdisciplinary group comprised of 18 local, state, and Federal fire and law enforcement agencies found lightning started both fires.

For complete listing of fires that have burned in the area see: ***Appendix F2: Fire Narratives 1996 to 2003.***

Small Fires

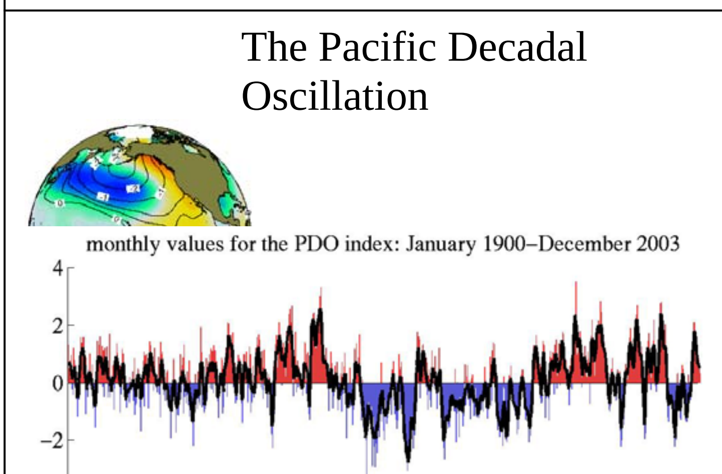
Review of the records of small fires within the Metolius Basin indicates that there has been a slight reduction in the total number of fires in the area. This reduction can be attributed to public awareness, increases in Fire Prevention patrols and the presence of Field Rangers contacting campers and recreationists.

F.Table 3. Small Fires between 1987 and 2001

Year	Total	Lightning	Equipment	Smoking	Campfires	Debris Burn	Railroad	Arson	Children	Other
1987	19	13		1	2					3
1988	10	1	1	1	2					5
1989	16	8		1	5					2
1990	30	27		1		1				1
1991	28	20	1	1	2			1		3
1992	30	20		1	4	1			1	3
1993	10	0		4	1				1	2
1994	7	3		1					1	2
1995	17	7		3	4	1				2
1996	7	1		4	1				1	2
1997	11	4		1	3	1				2
1998	22	13			7					2
1999	23	19		2	2					
2000	13	3	1	3	6					
2001	6	3			3					

Influence of Weather Patterns on Fire Occurrence

F. Figure 2. Pacific Decadal Oscillation: Climate Variation



The Pacific Decadal Oscillation (PDO) is the predominant reason for climate variation through time in the Pacific Northwest. Similar to better known phenomena like El Nino, it was identified by researchers in 1996. It is characterized by changes in sea surface temperature, sea level pressure, and wind patterns. The PDO has two phases: a warm phase and a cool phase. (Center for Science in the Earth System).

The PDO may also influence fluctuations in forest structure, composition, and function through drought-related forest fire activity, which is generally higher during warm phases of the PDO (Mote et al. 1999).

Across the Pacific Northwest, forest fires were more extensive during the 1925-45 PDO warm phases than during the cool phases before and after. The increase in fire activity in the late 1980s was consistent with the warm-dry phase of the PDO. Fire Suppression programs may have had some effect on the decline of fires during the cool phase after 1945 and some of the increase in the most recent warm phase.

The Pacific Decadal Oscillation weather patterns likely played a role in the intensity of fires within the Metolius Watershed. The area experienced a warmer then normal weather cycle that started in the early 1900’s and lasted about four decades. During this period the watershed experienced an average of 2.6 fires per decade and burned an average of 4650 acres per decade. In the mid 1940 a cooling trend became established and the number and size of fires declined. There were no large fires in the 1950’s and the size of the fires in the 1960’s and 1970’s were below the average of the first half of the century. During this cooler wetter period, true firs were able to encroach into dry sites, ponderosa pine seedlings took advantage of optimum growing conditions, and many stands became overstocked.

The drier warmer conditions of the 1980’s and 1990’s began to stress the stands and trees became susceptible to insect and disease. By 2000 many trees in mixed conifer areas had died and were creating concentrations of snags and patches where heavy fuel loads had developed. During the winter of 1999 a winter storm resulted in thousands of acres of small diameter trees within the Metolius Basin becoming snow bent and damage. This event contributed to an increase in both the coarse down wood fuel loadings and the creation of additional ladder fuels within an already overstocked forest.

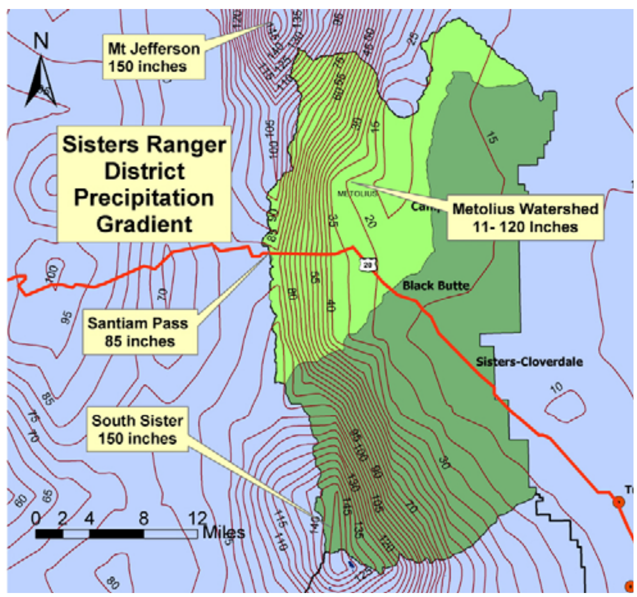
Classification of Metolius Basin Watershed Fire Regimes

Influence of Precipitation Gradient

The Metolius Basin is located on a steep rain gradient in the shadow of the Cascade Mountains that creates a complex mix of forest types. The ability for fires to burn is also attributed to the rainfall gradient which creates a complex of different fire regimes.

The reason fire is a fundamental ecological process east of the Cascades, is the climate guarantees that, even in years that are wetter then average the conditions for fire to spread easily are achieved annually in the dry season.

F. Figure 3. Rainfall Gradient from Cascades to Metolius River



(http://www.gis.state.or.us/data/)

The rainfall gradient across the Metolius watershed analysis area ranges from a 150 inches near the crest of the Cascades to 11 inches near the eastern portions of the watershed on the horn of the Metolius. The elevations across the watershed are equally dynamic Mount Jefferson dominates the skyline to the west at 10,497 ft., Three Fingered Jack is 7841 ft. and Santiam Pass is 4,700 ft. . Further to the south the Cascades rise again and to over 10,000 ft. in the Three Sisters Wilderness area. The elevation in the central part of the Metolius Basin near the Metolius River is 2,700 ft. the elevation and the eastern part watershed near Lake Billy Chinook is below 2,000 ft.

At Three Fingered Jack along the Cascade Crest north of Santiam Pass the average precipitation is 90 inches (228cm). Higher elevations around Mt Jefferson and The North Sister average between 145 and 165 inches of precipitation a year (368cm & 419cm). Most of this precipitation occurs as snow. This rainfall gradient results in blending of Fire Regimes and plant associations depending on slope, aspect, and proximity to riparian corridors and the abundant springs in the area.

Fire Regime and Condition Class

The 1996 Metolius Watershed Analysis discussed historic fire return intervals, fire frequencies, and patch sizes, however the classification of forest areas by Fire Regimes and Condition Class is relatively recent analysis tool that is now widely applied to fire and fuels management as interpreted by Hann and Bunnell (2001). This analysis updates the use of this new concept in relation to the Metolius Watershed.

Each plant community has a unique fire regime based on our understanding of historic conditions and description of the role that fire played in an ecosystem (Agee, 1993). The fire regime identifies potential fire effects, historic size, frequency and intensity of fire within vegetation types. A fire regime is a general classification of the role fire would play across a natural landscape in the absence of modern human mechanical intervention, but including the influence of aboriginal burning (Agee 1993, Brown 1995).

Natural or historic fire regimes for the the Metolius Watershed, were mapped based on the definitions in the **Pacific Northwest Fire Regime Variant developed by Evers**. The Pacific Northwest Fire Regime Variant is based on the five natural (historical) fire regime classes from Hardy et al. (2001) as interpreted by Hann and Bunnell (2001).

Fire Regimes of Oregon and Washington (PNW Variant)

From: Louisa Evers' White Paper
<http://fsweb.r1.fs.fed.us/jm/Louisa_Evers.doc>

Fire Regime 1: 0-35 years, Low severity.

Typical climax plant communities include ponderosa pine, eastside/dry Douglas-fir, pine-oak woodlands, Jeffery pine on serpentine soils, oak woodlands, and very dry white fir. Large stand-replacing fire can occur under certain weather conditions, but are rare events (i.e. every 200+ years).

Fire Regime 2: 0-35 years, Mixed and High severity

Includes true grasslands (Columbia basin, Palouse, etc.) and savannahs with typical return intervals of less than 10 years; mesic sagebrush communities with typical return intervals of 25-35 years and occasionally up to 50 years, and mountain shrub communities (bitterbrush, snowberry, ninebark, ceanothus, Oregon chaparral, etc.) with typical return intervals of 10-25 years. Certain specific communities include mountain big sagebrush and low sagebrush-fescue communities. Grasslands and mountain shrub communities are not completely killed, but usually only top-killed and resprout.

Fire Regime 3: 35-100+ years, Mixed severity

This regime usually results in heterogeneous landscapes. Large, high severity fires may occur but are usually rare events. Such high severity fires may "reset" large areas (10,000-100,000 acres) but subsequent mixed severity fires are important for creating the landscape heterogeneity. Within these landscapes a mix of stand ages and size classes are important characteristics; generally the landscape is not dominated by one or two age classes. In southeastern Oregon this regime also includes aspen, riparian communities, most meadows, and wetlands.

Fire Regime 3a: <50 years, Mixed severity

Typical potential plant communities include mixed conifer, very dry westside Douglas-fir, and dry grand fir. Lower severity fire tends to predominate in many events.

Fire Regime 3b: 50-100 years, Mixed severity

Typical climax plant communities include well drained western hemlock; warm, mesic grand fir, particularly east of the Cascade crest; and eastside western red cedar. The relative amounts of lower and higher severity patches within a given event is intermediate between IIIa and IIIc.

Fire Regime 3c: 100-200 years, Mixed severity

Typical potential plant communities include western hemlock, Pacific silver fir, and whitebark pine at or below 45 degrees latitude and cool, mesic grand fir and Douglas-fir. Higher severity fire tends to dominate in many events.

Fire Regime 4: 35-100+ years, High severity

Seral forest communities that arise from or are maintained by high severity fires, such as lodgepole pine, aspen, western larch, and western white pine, often are important components in this fire regime. Dry sagebrush and mountain-mahogany communities also fall within this fire regime. Natural ignitions within this regime that result in large fires may be relatively rare, particularly in the Cascades north of 45 degrees latitude.

Fire Regime 4a: 35-100+ years, High severity, Juxtaposed

Typified by what would normally be considered long interval regime that lies immediately above a shorter interval or lower severity fire regime. Most often the fire originates lower on the slope and burns uphill into regime IVa. In southeastern Oregon, this subregime includes Wyoming big sagebrush communities on deeper soils below 5000 feet elevation. Forest examples include lodgepole pine immediately above ponderosa pine in the eastside Washington Cascades and aspen imbedded within dry grand fir in the Blue Mountains. This regime is often found in lower elevations or drier sites than is considered typical for regime IV.

Fire Regime 4b: 100+ years, High severity, Patchy arrangement

Typical potential forest communities include subalpine fir and mountain hemlock parkland and whitebark pine north of 45 degrees latitude.

Other community types include mixed Wyoming big sagebrush and low sagebrush on low productivity sites such as scablands, stiff sagebrush, and true old growth juniper savannah (<10% canopy closure). Some forbs are present, such as Sandberg's bluegrass and the availability of many of these areas for burning depends on wet years that result in much greater grass production than is typical. Typical fire return intervals in these communities is 100-150 years.

Fire Regime 4c: 100-200 years, High severity

Typical forest plant communities include subalpine mixed conifer (spruce-fir), western larch, and western white pine. Important potential forest plant communities include mountain hemlock in the Cascades and Pacific silver fir north of 45 degrees latitude.

Other plant communities include the intergrade between Wyoming big sagebrush and greasewood, shadscale on non-alkali soils, spiny hopsage, and alpine grasslands and heath in southeastern Oregon.

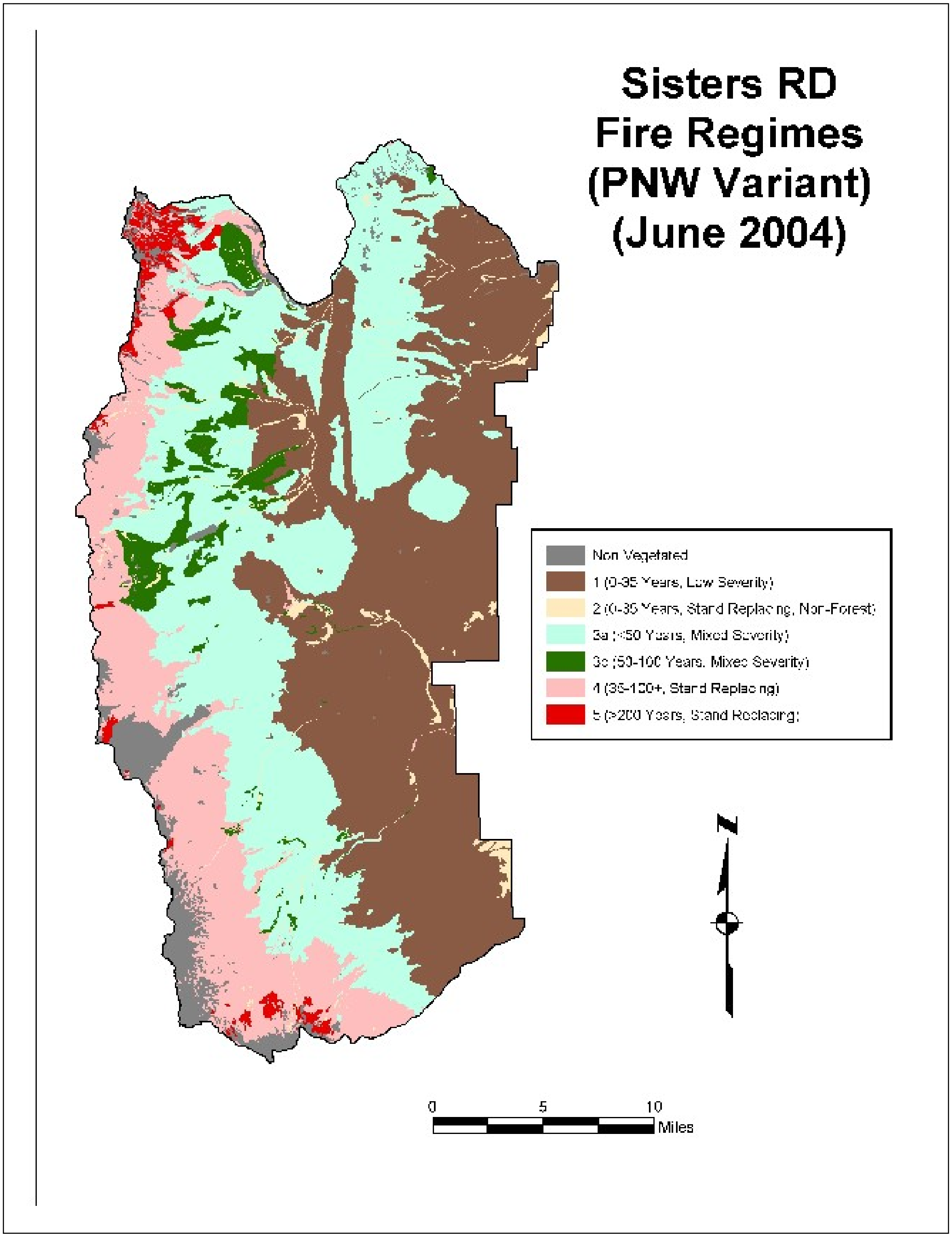
Fire Regime 5: >200 years, High severity

This fire regime occurs at the environmental extremes where natural ignitions are very rare or virtually non-existent or environmental conditions rarely result in large fires. Sites tend to be very cold, very hot, very wet, very dry or some combination of these conditions.

Typical plant communities include black sagebrush, salt desert scrub, greasewood on dunes, true old-growth juniper with at least 10% canopy closure and mountain-mahogany in rocky areas, and alpine communities and subalpine heath in the Blue Mountains and Cascades. Most species tend to be small and low growing. Bare ground is common.

Using these definitions along with local experience and knowledge, fire regimes were developed by assigning local plant associations (Plant Associations of the Central Oregon Pumice Zone, Volland, 1985) to the most appropriate fire regime and then mapping the reclassified plant associations as fire regimes. See Appendix 3 for crosswalk of plant associations and fire regimes.

Metolius Watershed Fire Regimes



Fire Regime I:

Fire frequency: 5-20 years
Fire Severity: Low
Patch Size:<1 acre
Fire Size: Large
Overstory Mortality: Rare

This fire regime is composed of all the ponderosa pine plant associations, except one that since the original Plant Association Guide for the Central Oregon Pumice Zone was published, has been determined to be a mixed conifer plant association.

Fire Regime II:

Fire frequency: 0-35 years
Fire Severity: Mixed and High
Patch Size:?
Fire Size: ?
Overstory Mortality: Mixed and Stand Replacement

This fire regime is composed of all the juniper, shrub and meadow plant associations.

Fire Regime IIIa:

Fire frequency: 20-40 years
Fire Severity: Low w/ Mixed
Patch Size: <1 -50 acres
Fire Size: Medium- Large
Overstory Mortality: Rare to Low

This fire regime is composed primarily of the mixed conifer dry plant associations and the drier mixed conifer wet plant associations and one ponderosa pine plant association.

Fire Regime IIIb:

Fire frequency: 40-60 years
Fire Severity: Mixed
Patch Size: 10-75 acres
Fire Size: Large to Small
Overstory Mortality: Moderate

This fire regime is composed of the wetter mixed conifer wet plant associations as well as the hardwood (cottonwood and aspen) plant associations.

Fire Regimes IV

Fire frequency: 35-100+ years
Fire Severity: High
Patch Size: 50-8000+ acre
Fire Size: Small to Large?
Overstory Mortality: Stand Replacement

Fire Regimes V

Fire frequency: 200+ years
Fire Severity: High
Patch Size: 50-8000+ acre
Fire Size: Small to Large?
Overstory Mortality: Stand Replacement

These two fire regime are composed of most of the high elevation plant associations, primarily the lodgepole pine and mountain hemlock plant associations, but also include other plant associations found mixed in with these primary plant associations.

Most of the high elevation area is mapped as fire regime IV because much of the limited information available related to the high elevation area indicates that most of the fire return intervals are less than 200 years. For example, Simon (1991) found that the average fire return intervals during the previous 470 years, for plant associations in the Jefferson Wilderness, ranged from 53 years for the grand fir zone to 168 years for the mountain hemlock zone with the parkland zone and the silver fir zone in the middle with 113 year and 138 year return intervals, respectively. Additionally, maps for the Central portion of the Cascade Range Forest Reserve, Oregon, dated 1901 and found in “Forest Conditions in the Cascade Range Forest Reserve, Oregon” Langille et al. (1903), show numerous fires scattered across the high elevation zone that range from several hundred acres to the largest ranging from 10,000 to 15,000 acres. A number of these fires are likely human caused but the limitation on size would suggest that forest conditions were not conducive to extremely large stand replacement events such as the B&B Fire.

This effort is a best first attempt at defining and mapping broad natural/historical fire regimes for the Sisters Ranger District. Additional refinement of these regimes should be considered as more time allows and new information is attained.

Recommendations Regarding Fire Regime Refinement

Some suggestions on how these fire regimes may be improved include the following:

- Many of the improvements to this effort would likely result from consideration of topographic position/features such as aspect, elevation, slope position and landform rather than exclusively plant association. For example, the boundary between fire regimes 1 and IIIa may be further to the west than currently mapped using plant associations and there may be more fire regime IIIb within the larger/broader fire regime IIIa based on aspect and slope position and at the higher elevations adjacent to fire regime IV.
- Fire regime V that as mapped under this effort was limited to plant associations and is the result of trying to identify plant associations found associated with topographic positions/features that may have been likely to experience fire with an average fire return interval of greater than 200 years. The high elevation zone likely contains more fire regime V than is mapped under this effort and is likely related more to topographic position on the landscape rather than plant association.
- Fire regime II, as mapped, contains the juniper, meadow (except alpine meadow), and the xeric and mesic shrub plant associations. All of these plant associations are inclusions within much larger/broader fire regimes and should probably be considered within those larger/broader fire regimes. They should still be considered as stand replacing-non-forest types, but within the time-frames of the larger/broader fire regimes they are found within and not necessarily the 0-35 years as specified by fire regime II.
- Further refinements of these broad natural/historic fire regimes may not result in new fire regimes being identified so much as an identification of the variation within or “inclusions” within, and that define, the broader/larger fire regimes. For example, fire regime IIIb within the broader fire regime IIIa, or fire regime V within the broader fire regime IV or fire regime II in all other fire regimes.

Condition Class:

The Condition Class of Fire Regimes is a classification of the amount of departure from the natural regime (Hann and Bunnell 2001). Three condition classes are identified for each fire regime.

The classification is based on a relative measure describing the degree of departure from the historical natural fire regime. This departure results in changes to one or more of the following ecological components:

- Vegetation characteristics (species composition, structural stages, stand age, canopy closure, and mosaic pattern);
- Fuel composition;
- Fire frequency, severity, and pattern;
- and other associated disturbances (e.g. insect and diseased mortality, grazing, and drought).

There are no wildland vegetation and fuel conditions or wildland fire situations that do not fit within one of the three classes.

The three classes are based on low (FRCC 1), moderate (FRCC 2), and high (FRCC 3) departure from the central tendency of the natural (historical) regime (Hann and Bunnell 2001, Hardy et al. 2001, Schmidt et al. 2002). Low departure is considered to be within the natural (historical) range of variability, while moderate and high departures are outside.

- **Condition Class 1 -** For the most part, fire regimes in this Fire Condition Class are within historical ranges. Vegetation composition and structure are intact. Thus, the risk of losing key ecosystem components from the occurrence of fire remains relatively low.

- **Condition Class 2 -** Fire regimes on these lands have been moderately altered from their historical range by either increased or decreased fire frequency. A moderate risk of losing key ecosystem components has been identified on these lands.

- **Condition Class 3 -** Fire regimes on these lands have been significantly altered from their historical return interval. The risk of losing key ecosystem components from fire is high. Fire frequencies have departed from historical ranges by multiple return intervals. Vegetation composition, structure and diversity have been significantly altered. Consequently, these lands verge on the greatest risk of ecological collapse.

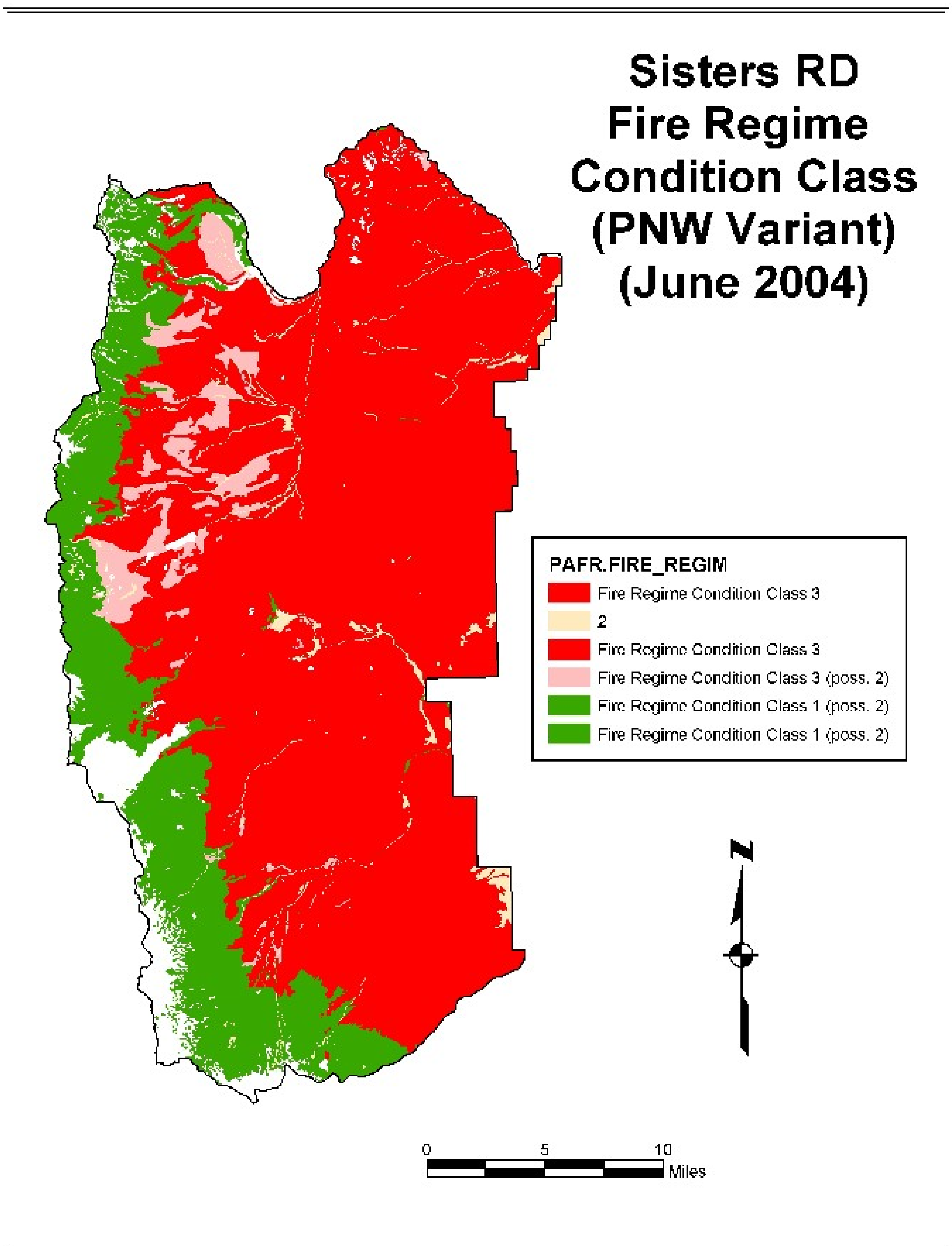
Condition class for the fire regimes in the Metolius Watershed Analysis Project Area were subjectively determined considering information found on the Fire Regime Condition Class website (www.frcc.gov). Information considered, included the following:

- Vegetation structure, density and species composition departure from the natural (historic) range of variability.
- Fuel amount and arrangement departure from the natural (historic) range of variability.
- Fire frequency departure from the natural (historic) range of variability.
- Fire severity departure from the natural (historic) range of variability.

The following table displays the conditions classes that were determined for the major fire regimes found within the Metolius Watershed Analysis Project Area.

F.Table 4. Metolius WA Project Fire Regimes by Condition Class

Fire Regime	Condition Class
I	3
IIIa	3
IIIb	3 (possibly high 2)
IV/V	1 (possibly low 2)


Sisters RD
Fire Regime
Condition Class
(PNW Variant)
(June 2004)
PAFR.FIRE_REGIM
Fire Regime Condition Class 3
2
Fire Regime Condition Class 3
Fire Regime Condition Class 3 (poss. 2)
Fire Regime Condition Class 1 (poss. 2)
Fire Regime Condition Class 1 (poss. 2)
N
0
5
10
Miles

Condition class was not determined using the quantitative methods described in the "Interagency Fire Regime Condition Class Guide book", version 1.0.5 – March 2004. This method was not used because it was felt that the District was not yet prepared to conduct this level of analysis due to lack of compatible data and lack of understanding of how to use the methods.

As with fire regimes above, this effort is a best first attempt at determining condition class for the major natural/historical fire regimes for the Sisters Ranger District. Additional refinement of these condition classes should be considered as more time allows, compatible information is attained and as understanding of the methods for determining condition classes is gained.

Some suggestions on how condition class determination may be improved include the following:

- Reference conditions and data sets specific to the Sisters Ranger District need to be developed in a manner in which they are compatible with the methods described in the "Interagency Fire Regime Condition Class Guide book", version 1.0.5 – March 2004.
- Refinement of the fire regimes may influence condition class determination.

Was the B&B Fire Uncharacteristic?

Was the size and intensity of the B & B fire within the historical range of variability for where it burned?

The B & B burned primarily within 4 fire regimes: 1 (low severity), 3 (mixed severity), 4 (high severity/stand replacement) and 5 (high severity/stand replacement). The following comments regarding fire size and intensity were developed after reviewing "Forest Conditions in the Cascade Range Forest Reserve Oregon" by Langille and others (1903), "Fire History in the Jefferson Wilderness Area East of the Cascade Crest" by Simon (1991) and the results of the original Metolius Watershed Analysis regarding the historic distribution of forest size/structure, species composition and density.

The B&B Fire in Fire Regimes 4 and 5

Within fire regimes 4 and 5, which are primarily found within the wilderness areas, the intensity of the fire was well within the historic range and would be expected.

The size of the stand replacement event may or may not be within the historic range of variability, especially if one considers the portion that burned west of the Cascade crest.

In Langille and others (1903) numerous large fires are apparent on their maps but none are larger than approximately 10,000 to 15,000 acres. Most appear in the high elevation country that roughly corresponds to the current wilderness designations. Langille and others (1903) also attribute a portion, and perhaps a good portion, of these fires as being caused by humans. Consequently, it is difficult to say that the fires mapped in 1903 are a good representation of the "natural" historic range of variability.

Simon (1991) conducted an analysis of the fire history in the portion of the Jefferson wilderness that lies east of the crest of the Cascades. Regarding the extent of historic fires over the last 270 years, Simon identified 3 fires that exceeded 7,000 acres, with the largest at nearly 13,000 acres which he considered conservative because he also identified gaps in the data due to more recent fires that eliminated potential evidence of a possible larger fire. For the 13,000 acre fire, Simon identified 9,920 acres of stand replacement and 3,000 acres of low intensity underburning and that the fire burned most of the acreage below 5,500 feet elevation for the entire length of the wilderness from the north to the south. Simon did not comment on whether any of the wilderness fires left the wilderness and burned additional acres outside of wilderness. Simon also identified 13 other large (i.e., >50 acres) fires and of those, 4 were larger than 1,000 acres, and 9 were less than 1,000 acres.

In conclusion, regarding fire regimes 4 and 5, fire intensity was within the historic range of variability, however, the size of the stand replacement event is likely outside the historic range of variability especially if one includes the stand replacement portions that lie west of the Cascade crest.

The B&B Fire in Fire Regimes 1 (low severity) and 3 (mixed severity)

Historically, in the Metolius Watershed, the ponderosa pine and much, if not most of the mixed conifer plant associations outside of the higher elevations (i.e., wilderness), especially the mixed conifer dry plant associations, burned under consistant with fire regime 1. A portion of the mixed conifer plant associations, especially the wetter/higher site mixed conifer associations, likely burned under fire regime 3.

There is no evidence that large stand replacement events occurred in these plant associations historically, except, perhaps, at the higher elevations adjacent to fire regimes 4/5. In the 1996 watershed analysis, most of the ponderosa pine and mixed conifer association were found to be dominated by medium/large sized early seral species (this includes large fire resistant Douglas-fir) and this condition is best achieved and maintained by low intensity fire regimes. Maps produced by Langille and others (1903) also do not show evidence of large stand replacement events in the ponderosa pine or mixed conifer plant associations outside of the higher elevations (i.e., <4,500 ft). Most fires mapped by Langille and others (1903) below about 4,500’ elevation are in line with what might be expected in fire regime 3. Fire regime 3 likely occurred in specific locations within the mixed confer plant associations such as on higher sites (mixed conifer wet), on north slopes or at the higher elevations.

In conclusion, the stand replacement events from the recent wildfires, especially the B and B fire, are outside the historic range of variability, in both size and intensity, for the ponderosa pine and mixed conifer plant associations.

F. Table 5. Fire Hazard Summaries

Fire Hazard summary by acres Acres

Hazard	Inside Fire Area	Outside Fire Area	Total Acres
High	27,133	18,920	46,053
Moderate	42,017	41,387	83,404
Low	11,690	7,557	19,247
Total Acres	80,840	67,864	148,704

Table 1

Fire Hazard summary by percent

Hazard	Inside Fire Area	Outside Fire Area	Total Acres
High	18.2%	12.7%	31.0%
Moderate	28.3%	27.8%	56.1%
Low	7.9%	5.1%	12.9%
Total Acres	54.4%	45.6%	

Table 2

Relationship of Fire Hazard to Actual Severity

Hazard	Stand Replacement	Mixed Severity	Underburn
High	18.5%	6.3%	9.5%
Moderate	24.1%	9.9%	17.4%
Low	7.3%	3.4%	3.6%
Total Acres	49.9%	19.6%	30.5%

Fire Risk and Hazard after the Fires

As a result of the fires, portions of the watershed are at lower risk.

There is still potential fire hazard and a significant risk to the remaining portions of the watershed that did not burn during the fires in the summers of 2002 and 2003. Green Ridge, the Horn of the Metolius, the Metolius Basin and the Wildland Urban Interface still have sufficient crown cover to sustain a crown fire during 90th percentile weather conditions.

Fire Risk is the chance of a fire starting based on the presence of causative agents such as humans, their equipment, their facilities; or lightning. Past fires in a given area are the most commonly used measure of risk. The influx of humans and equipment into the forest increases risk. Fire hazard is composed of fire risk, fuel condition, weather (hot, dry, and windy) and topography.

The hazardous fuels in the watershed fall into two primary categories: existing and future hazards. The existing hazards are associated with the continued buildup of hazardous fuels in the form of brush, small diameter trees and canopy closure.

The future risk is the continued growth of biomass of all type and the increase of coarse woody material as a result of dead trees falling and contributing to the fuel loading. As dead trees begin to fall and create a heavier then normal, fuel loading could peak in 10 to 30 years and remain at hazardous levels another 40 years until the decay rate exceeds the fall rate of the snags.

A fire hazard assessment was applied to each vegetation type based on the seral structure stage of each plant association group. The plant association groups utilized to develop the fire risk layer included; mountain hemlock, moist mixed conifer, dry mixed conifer, mesic lodgepole pine, dry lodgepole pine, mesic ponderosa pine, dry ponderosa pine, and western juniper with specific calls on hazard based on the seral stage

This evaluation of fire hazard on a landscape scale within the Metolius Watershed Analysis area is based on the des_fh_pisat.shp file generated in February 2004 by Mike Simpson, Deschutes National Forest.

Communities at Risk, Wildland Urban Interface in the Metolius Watershed

The term ‘‘at-risk community’’ is a community within the vicinity of Federal Lands that are at high risk from wildfire.

The Healthy Forest Restoration Act (HFRA) identifies these communities as:

> (a) A group of homes and other structures with basic infrastructure and services within or adjacent to Federal land;
>
> (b) in which conditions are conducive to a large-scale wildland fire disturbance event; and
>
> (c) for which a significant threat to human life or property exists as a result of a wildland fire disturbance.

In the central Oregon area each community was buffered by 1-1/2 miles to establish a Wildland Urban Interface (WUI). Camp Sherman, Round Lake and the Suttle Lake Recreation complex are all communities at risk within the watershed.

All of these communities were evacuated during the B&B fire in 2003. All currently have a short term reduced risk. The community of Camp Sherman luckily escaped the fire, however a dominant portion of the area proposed for treatment in the Metolius Basin Forest Management Project is still at risk. Butte Ranch, directly south of the watershed is in the path where fires typically spread from west to the east.

Status of Proposed Recommendations in the Metolius Watershed Analysis of 1995

Landscape Area 1 - Wilderness (pg 151)

Wilderness Fire Plan: The recommendation to develop a Wilderness Fire Plan was explored but not implemented. After further review fire managers concluded that the risk associated with managing potential high intensity stand replacement fire was not feasible adjacent to WUI. After the B&B Fire, this may be ripe to be reconsidered.

Landscape Area 2 - Central Basin: (pg 152-153)

Integrated Vegetation Management: The reintroduction of fire and reduction of fire hazard was identified in this LA. Public education was emphasized as a need to gain support in using fire as a tool to these goals.

- **Reintroduce Fire and Introduce Mechanical Treatments:** A significant amount of planning to accomplish forest restoration, hazardous fuels reduction, sustainable habitat and increased public safety has been addressed in the Metolius Forest Vegetation Management Plan. This process is on hold pending appeal and changed condition assessment.

- **Reduce Fire Risk and Develop Fuelbreaks:** Urban interface boundaries have been developed and utilized in the planning process to identify Wildland Urban Interface areas and prioritize treatments within the watershed area.

- **Public Education:** The Heritage Demonstration Project in the heart of the Metolius Basin along the 1419 road applied a variety of vegetative treatments and burning on 63 acres to demonstrate what different treatments would look like. The Friends of the Metolius worked in conjunction with the USFS to provide public meetings and tours of the project to open dialogue with the public about potential impacts, consequences and benefits of applying sound silvilculture management and the reintroduction of fire to the landscape.

Landscape Area 3 - Highway 20 Corridor: (Pg 157)

Integrated Vegetation Management: The reintroduction of fire -and fire hazard reduction - to protect scenic byways, highway safety, commodity extraction, while protecting the recreational experience, riparian and soil.

- **Fuelbreak:** The Santiam Corridor, Corridor Follow-Up timber sales have been completed adjacent to Hwy 20 and around the Suttle Lake recreation complex. Both these harvest activities were instrumental in reducing the intensity of the Bear and Booth fires and minimized the loss of structures as recreational facilities in the area. Coil Fiber timber sale was in process and areas that had been thinned along the 12 road were effective fuel breaks. Additional pre commercials thinning for scenic enhancement and fuelbreaks have been completed along Highway 20 between Black Butte Ranch and Suttle Lake.

Landscape Area 4 - Meadow Lake: (Pg 159)

Integrated Vegetation Management: Features fire risk reduction and protection of habitat

- **Thinning:** The Santiam Corridor timber sale involved a combination of conventional and helicopter logging to remove dead, dying and diseased trees on the eastern portion of this landscape. Under Burning, thinning, piling and burning had been completed on all the units within the sale area.

- **Fuelbreak:** A fuel break strategy along south of Corbett Sno-park along Forest Road 2076 then east paralleling the 2076-600 road had been completed. Portions of these fuelbreaks were very successful and reduced the intensity of the Booth fire as it swept east. Some fuel breaks less successful, especially in draws where heat was concentrated as the fire advanced.

Landscape Area 5 – Black Butte: (Pg 159)

Integrated Vegetation Management: Mechanical treatments on steep slopes of Black Butte were not proposed because of concerns with erosive soil. The effects of prescribed fire use or wildfire will be very visible through much of Central Oregon. The area has not been identified as a high priority for treatment based on the difficulty of accomplishing the treatments, high visibility and need for maintaining scenic.

Note: Portions of the Butte have missed multiple fire cycles. What this means is when a fire starts during a period of high fire danger (90% percentile weather) there is a very high probability it will result in a stand replacement fire.

Landscape Area 6 – Cache: (pg 162)

Integrated Vegetation Management: Goals included determining if mechanical treatment or prescribed burning should be used to accomplish thinning and brush reduction. Treatment options should consider prescribed fire and/or mechanical treatments.

The McCache planning area has undergone analysis and has a NEPA document prepared that proposes treat as much as 2392 acres within the watershed.

Landscape Area 8 – Upper Tributaries: (pg 165)

Integrated Vegetation Management: Goals include Restoration of fire and opportunities for fire risk reduction.

- **Reintroduction of fire, including mechanical treatment:** A significant portion of this landscape area was affected by the fire. Some of the area benefited from a low intensity burn however other areas burned very intensely and resulted in larger stand replacement patches on the landscape. Prior to the B&B complex a limited amount of underburning had been undertaken and no fuels only mechanical treatment had been completed. Some underburning for site preparation and fuels cleanup had been accomplished on the Jack Canyon and Happy Jack Sales.

- 4350 acres in the eastern portion of Upper Tributaries Landscape Area are within the Metolius Basin Vegetation Management Project Area where extensive thinning, mowing and prescribed burning has been proposed.

- **Public Support:** Public and Political support is strong in this post B&B Fire environment. Locally, the Friends of the Metolius worked in conjunction with the USFS to provide public meetings and tours of the Heritage Demonstration Project to discuss potential impacts, consequences and benefits of applying sound silvilculture management and the reintroduction of fire to the landscape

- **Fuelbreak:** A continuing Fuel Break strategy associated with the upper tributaries includes harvesting of timber and fuels cleanup on of Corridor Follow-Up, Happy Jack, Jack Canyon and Coil Fiber timber sales.

Landscape Area 9 – Green Ridge: (pg 168)

Integrated Vegetation Management Features: Goals include fire risk reduction, soil restoration the development of a Lower Metolius Fire Plan

- The Eyerly fire burned 5652 acres of Landscape unit 9. The Eyerly Salvage EA provided specific guidelines for harvesting timber on a portion of the area. The level of treatment on activity was optimized to reduce fire risk while meeting snag and down log retention for wildlife habitat. There has been no discussion on the development of a Fire Management Plan for the natural use of fire. There were allowances to use fire to treat post fire fuels on portions of the area.

Landscape Area 10 – Scarp: (pg. 169)

Integrated Vegetation Management: Goals include allowing natural disturbances to influence the character of the landscape and develop a Fire Management Plan.

- No Fire Management Plan or other activities have been undertaken in this Management unit

Special Features: Maintained Green Ridge Lookout to serve as a backup for Black Butte and provide additional detection coverage for the Metolius Basin.

- An active volunteer program at GREEN RIDGE Lookout provides additional detection during the summer.
- Green Ridge Lookout is managed as a rental pre and post fire season.

Landscape Area 11 – Lower River: (Pg 170)

Integrated Vegetation Management: Goals include allowing natural disturbances to influence the character of the landscape and develop a Fire Management Plan that provides guidelines for the use of natural fire. The reintroduction of fire will benefit many species which have evolved with low intensity recurring fire.

- No Fire Management Plan or other activities have been undertaken in this Management unit.
- The 754 acres along the lower portion of the Metolius River above Monty campground was affected by the Eyerly fire in the summer of 2002.

Fuels treatment activities have been accomplished on many areas within the watershed. These projects include fuel reduction through mowing, thinning and burning on the portions of the Black Butte Ranch Natural Fuels Reduction, Heritage Demonstration Project, Highway 20 Natural Fuels Project, and

Santiam Restoration PCT. Additional acres were burned after harvest activities on several timber sales within the watershed.

F. Table 6. Fuels Treatment by Landscape Area

UNIT	DESCRIPTION	PROJECTS
1A	WILDERNESS, JEFFERSON	
1B	WILDERNESS, WASHINGTON	
2	CENTRAL BASIN	Jack Canyon, Heritage Demo, RNA, Metolius Basin Project (Not implemented yet)
3	HIGHWAY 20 CORRIDOR	Santiam Corridor, Corridor Follow-Up, Coil Fiber
4	MEADOW LAKE BASIN	Santiam Corridor
5	BLACK BUTTE	
6	CACHE	McCache (Not implemented yet) ,
7	SUTTLE LAKE	Santiam Restoration
8	UPPER TRIBUTARIES	Santiam Rest, Jack Canyon, Happy Jack, Heritage
9	GREEN RIDGE	
10	SCARP	
11	LOWER RIVER	

TRENDS 2004

Trends common to all fire regimes:

Weather: Weather patterns attributed to the Pacific Decadal Oscillation (PDO) resulted in warmer drier weather between the early 1900's and mid 1940's. After 1945 the weather became cooler once again and continued moist until the early 1970's. By the mid 1970’s the cool trends reversed and turned. Some research indicates this warmer dryer trend could last 70 years.

Condition class: The condition class within each fire regime will continue to evolve and deviate from the historic range of variability (HRV) with suppression of fire. This will expose each plant association to more intense fire behavior, greater resistance to control and potential loss of habitat (or creation of different habitat).

Fire suppression: Aggressive fire suppression will continue across the watershed to protect life, property and habitat. No Fire Management Plan to allow for Fire Use (old term Prescribed Natural Fire) is currently being considered because of risk.

Fuels Management: There is recognition that the conditions of the vegetation in the watershed represent a hazard that puts the habitat and public at risk. The Healthy Forest Initiative (HFI) and the Healthy Forest Restoration Act (HFRA) reflect the public and political awareness of the need to treat these public lands. Funding should be stable for the next several years.

Trends specific to Fire Regime IV and V (28%)

Unburned & Underburned (low intensity)
The high elevation forests, (Fire Regimes IV and V) are recognized as being near the “natural” end of their fire cycles and stand replacement events is probable. The natural disturbances caused by insects, disease and fire are typical mechanisms that resulted in landscape changes within these fire regimes. During 1990's large portions of the landscape within and adjacent to the Mt. Jefferson wilderness area were affected by the spruce budworm infestation. By the late 1990's many of these patches of timber had died and snags had begun to fall resulting in elevated fuel loading across much of the area. **All unburned portions of fir regime IV and V are still at risk of stand replacement fire events.**

Burned areas
Areas that burned at high intensities resulted in stand replacement or mixed mortality conditions. FVS-FFE modeling of stands predicted dead trees will fall faster then logs will decay and result in a buildup of ground fuels that will exceed 50 tons per acre. Fire hazard associated to fuel loading is predicted to peak in as soon as 5 years and last up to 60 years. Fire Risk is minimized because of the high annual precipitation and snow pack.

Recommendations specific to Fire Regime IV and V

Promote research opportunities
A majority of the watershed classified as fire regime IV and V is in the Mount Jefferson wilderness area. Wilderness areas provide a unique opportunity to study the effects of fire across the landscape and serve as a biological benchmark for natural processes. Identify opportunities to work with universities to study the effects of fire and recovery in the plant association groups represented by fire regime IV and V.

In non-wilderness areas develop opportunities to create landscape level fuels treatment zones along roads ridged and other natural features that could assist in managing future fires to protect life, ecosystems and habitat.

Trends specific to Fire Regime III (31%)

The various combinations of the slope, aspects, and elevation within this fire regime create a landscape that could burn with a mixture of high, mixed, and low severity effects to vegetation.

Areas Affected by the recent fires
The existing and potential fuel loading within Fire Regime III will range from light to heavy based on the severity of the burned within this area. Portions of the fire that burned at high and moderate severity can be expected to have fuel loading in excess of 50 tons per acre within the next five to ten years. The areas on the eastern portion of Fire Regime III can be expected to have lighter fuel loading representative of fire regime I.

Recommendations specific to Fire Regime III

Reduce fuel loading and canopy structure where appropriate so that fire can be re-introduced into the area to help restore and maintain habitat within the historic range of variability in fire regime III at condition class I.

Non Wilderness: Manage adjacent stands so fires originating in these fire regimes will be controllable before they can spread into stands being managed of long term habitat conservation strategies.

Trends/ Recommendations specific to Fire Regime II:
Not a significant portion of the watershed.

Trends specific to Fire Regime I

A significant portion of this Fire Regime area has been logged over last 50 years. This has resulted an under story that is missed several fire cycles and has moderate fuel loading. The canopy is typically void of the large open ponderous pine and the under story is dominated by smaller diameter pines mixed with Douglas fir. White-fir trees have encroached in wetter sites. There is sufficient crown bulk density through much of the area to carry wildfire.

The combination of ground vegetation dominated by bitterbrush and ladder fuels associated with the conifer contribute to increased resistance to control.

Areas Affected by the recent fires

Most of the area burned at low intensity with occasional opening created by concentrations of fuel and thick understory vegetation. Only portion of "Fire Regime I" burned leaving a significant portion of Metolius basin adjacent to wildland urban interface at risk.

Recommendations specific to Fire Regime I

Reintroduce fire in the Metolius Basin at intervals that represent the historic range of variability. Proceed with the implementation of Metolius Basin Vegetation Management project.

Aggressively pursue options to implement fuels reduction treatments around the Wildland Urban Interface and other areas where stand densities are high within the Metolius Forest Management Project Area.

Reduce the canopy structure (Crown Bulk Density) and surface fuel configurations in Fire Regimes 1 & 3, to reduce fuels towards the historic range and improve ability to re-introduce fire.

APPENDIX F1

Initial Attack Narrative

B&B Complex

Lorri Heath, October, 2003

Bear Butte Fire

The Bear Butte Fire was reported on August 19, 2003 at 1309 by the Warm Springs (WSA) helicopter. The fire was ¼ acre in heavy fuels. WSA Dispatch notified COIDC. COIDC contacted FDO Daryl Davis. Daryl said “yes” when asked if he wanted Warm Springs to take action. Daryl obtained approval from the line officer to use retardant, helicopter and chainsaws in the Wilderness. Daryl ordered Smokejumpers and Air Attack. Jumpers arrived at approx. 1420 but were not able to jump because it was too windy. The fire was approx. 3 acres with winds out of the east at 20-25 mph with gusts to 30 mph. Daryl ordered Airtankers (AT) at approx. 1420. At 1445, the fire was estimated at 5 acres. By 1515, it was 20 acres with spotting up to 200 feet in front of the fire. It had reached 200 acres by 1530 and had spot fires in front of it that were ¼ mile in front of the fire. The fire was spreading to the west. By 1800 that night, the fire was estimated to be approx. 700 acres and there was a spot fire on Bald Peter. Davis requested retardant at that time, but Air Attack told him that is was too smoky and the AT would not be able to get under the column. The fire moved on to the Confederated Tribes of Warm Springs lands at 1900. At 1930, Air Attack estimated the fire size at 1,000 acres.

On August 20, Tim Bisby assumed command of the incident. At 0930 he recon’d the fire but was not able to see the fire due to the smoke. There were no resources committed to the incident (the FS lands) at that time. WSA had 4 engines and 1 crew on the fire on the Reservation (Warm Springs) lands. At 1410, Bisby reported that the fire had a large, active front on the West and South sides of Balk Peter. The fire was burning very actively at that time. At 1428, COIDC was notified that Glen Smith had been assigned as the IC on the Warm Springs lands. Tim Bisby was notified of this at approx. 1434. Bisby then notified COIDC that he was going to “tie in” with the WSA IC. The fire was spreading West/Southwest at the time. Bisby worked with Smith in a unified command until Anderson’s IMT took command of the fire.

Booth Fire

Hinkle Lookout reported the Booth fire at 1523 on August 19, 2003. At first report the fire was spot sized. Before Hinkle completed the initial report, the fire had grown to approx. 20 acres. It was only a short time later that the fire was estimated to be 100 acres in size. By 1530, the fire was torching and spotting to the east (downhill), parallel to Highway 20, while being pushed by strong west winds of 30+ miles per hour. Travis Moyer, who was working with the DOC crews on Highway 20 was dispatched to the fire. Daryl

Davis, FDO, requested evacuation of Round Lake Church Camp. The fire was 100 yards from Highway 20 with 2 spots in front of the main fire. By 1550, spotting was reported to be ½ mile in front of the fire (to the east) and Davis sent Kirk Metzger to Square Lake to assist with public evacuations. Metzger went to Square Lake, Long Lake and Round Lake to evacuate public. Dave Robertson proceeded to Round Lake to assist with evacuations along with Dave Blann (David 7, Jefferson County Sheriff) and Paul Engstrom. Kevin Stock arrived at the incident and began to recon the heel of the fire. The heel of this fire was located on the east edge of the Square Fire. There were no anchor points that could be used to begin suppression actions.

At 1540, COIDC was notified that 911 had received a broken cell phone call from people who were on the NE corner of Square Lake. They stated "we need help" and "the fire is ½ mile from us". 911 also contacted David 7. David 7 contacted Dave Robertson. Robertson then hiked toward Square Lake (which was at the front of the fire). Metzger requested a helicopter to check on the people at Square Lake. Robertson found the 7 people and their dogs on the NE side of Square Lake. Robertson carried packs for some people to hurry their departure from the area. The fire was spotting toward the lake and moving quickly in that direction. The fire was less than ¼ mile to the west of the lake when Robertson arrived and escorted the people to the Round Lake trailhead. There were no injuries.

Travis Moyer assumed command of the Booth fire, delegated the IC responsibility, at 1619. Kevin Stock was assigned as Operations. Davis requested an ICT3 for the Bear Butte fire.

At 1442, the fire was reported at 200 acres with numerous spot fires located ¼ to ½ mile in front of the fire. The Pacific Crest Trail was closed at 1448 hrs. Highway 20 was closed at 1449 hrs. One of the two AT's that had been ordered was on scene. Their drops were not effective, due to too much wind. The AT returned to Redmond. All evacuations were conducted from the ground due to the strong winds. All known citizens were cleared from the fire area at approx. 1722.

By 1739, the fire was estimated at 200 acres with lots of spots and a 5-acre spot east of Long Lake. Bill Anthony was contacted at 1748 to notify him of the need to evacuate Suttle Lake area by Jefferson County. By 1800, the fire was 700 acres and moving. It was estimated at 1,200 to 1,500 acres at 2000 hrs. It was contained within Highway 20 and the 1210 Road. Spots were up to 1 mile in front of the fire. Under the supervision of Stock, the IA resources moved to the 1210 Road to look for an anchor point. 3 dozers were working to put fireline in. Each time they constructed line, it would shortly get spots across it and they would need to go back and try again. Spots were scattered everywhere so there was no opportunity to burn out. Embers were raining across 1210 Road as resources scouted for anchor points. Resources then staged at the 12/1210 jct.

About 2130, the column rolled over Highway 20 and there were spot fires across (south) of the highway. Once the column rolled over the highway, there were multiple spots across (south) of Suttle Lake. The main fire front then crossed Highway 20 and was burning toward Suttle and Blue Lakes. Long range spotting up to ¾ mile ahead of the fire. Structure protection was ordered for the structures and infrastructure around Suttle Lake and the private property around Blue Lake. By 2300, the fire was approx. 2,000 acres in size,

On August 20 at 0600, Kirk Metzger briefed the incoming IC, Mike Benefield. The weather forecast showed a predicted wind change that would bring winds out of the Northeast/East. East winds were unusual for this time of year and weather conditions. Mike Benefield assumed command of the Booth Fire on August 20 at 0745.

Daryl Davis briefed Tim Bisby who was the incoming IC for the Bear Butte Fire. Bisby requested a flight of the fire but was informed that it was too smoky to fly. The Bear Butte resources were then sent to the Booth Fire. Bisby was unaware of the Warm Springs resources and their actions until the afternoon of August 20.

By 0830, the Booth Fire had backed over the Crest of the Cascade Mountains and the Pacific Crest Trail onto the Willamette National Forest. The fire was also east of Corbett Snow Park and a 40-acre spot fire was located in Section 25. Black Butte lookout reported that the plume was 12,000 feet in the air and was picking up intensity. At 1010 hrs., the fire took a run to the west and structure protection at the Pacific Crest Trail was requested. Evacuation of Big Lake Resort and other recreation facilities in the area, including Hoodoo ski area, began at 1050 hrs. Lost Lake was also evacuated. A 2-3 mile fire front was reported on the west side of the fire, near Hogg Rock. The fire crossed Highway 20 to the south about 1330 to 1430 hrs. Spots landed and took off quickly. Many resources in staging as there was no overhead to manage them.

Briefing for Anderson's Type 1 Team occurred at 1300 or so.

At 1350, the fire was 2 miles south of Highway 20 on the 2067 Road. No action could be taken on it at that time as there was no Dozer Boss to put with the dozer that was waiting is staging. The IC discussed AT use with Air Attack. Air Attack felt they would not do any good, at that time, as they would not be able to see through the smoke. The fire continued to spot and move west. At 1430 hrs., Ryan Cardula (9502) reported that there was a 4 mile flame front moving to the west and the there was fire west of Hogg Rock. A spot fire near the 2067 road was approx. 200 acres in size and burning toward the east side of Suttle Lake.

COIDC informed IC-Benefield at approx. 1620 hrs that the IMT had decided not to take the fire today. Travis Moyer was identified as the night IC and was expected at 1800 on the fire.

When Davis found out that the IMT would not take responsibility for the incident that evening, her began ordering a night IC and replacement resources. Doug Johnson went to the fire to gather information about needs of assigned resources from IC Benefield.

At approx. 1710, IC informed COIDC that the spots across Highway 20 were getting more active and moving southwest. The fire was within 4 miles of staging at 1724 hrs. Winds picked up and the IC ordered evacuation of the staging area. The fire was expected to bump the 2067 Road in a couple hours and burn into the 2002 Cache Mountain Fire, which is south of 2067. Staging was moved to the junction of Highway 20 and Road 2066. The Highway closure was moved to the entrance of Black Butte Ranch.

Travis Moyer assumed command of the Booth Fire on August 20 at 2000 hrs. The Task Force was dispatched to Santiam Lodge to help with structure protection. Approx. 2030, the fire crossed the Big Lake road and began threatening Hoodoo Ski Area.

At 0451 hrs, IC Moyer informed COIDC that the 300 acre spot south of Suttle Lake was 100% lined, which reduces the threat to Black Butte Ranch.

At approx. 0910 hrs., on August 21, Anderson's Type 1 IMT completed transition with ICT3 Travis Moyer.

APPENDIX F2

Fire Narratives 1996 to 2003

Between 1995 and 2003 eight large fires burned in the Metolius watershed consuming 80, 469 acres. Large fires are defined as over 100 acres.

1996 Jefferson Fire

Started: July 8, 1996 **Origin**: T11S, 9E, Sec. 20 **Size**: 3689

1996- On a hot afternoon of July 8th 1996 careless hikers started the **Jefferson** fire near Cougar Springs in the Mt Jefferson Wilderness. The fire was initially contained at about 1,100 acres south of the lava flow adjacent to Jefferson creek but became active again on July 26 when it burned additional acres in the wilderness before spreading onto the Confederated Tribes of Warm Springs where it burned approximately 1,703 acres.

1998 Square Fire

Started: August 19, 1998 **Origin**: T13S, 8E, Sec. 19 **Size**: 113

Narrative: Lightning sparked a fire 1/4 mile north of Highway 20 west of Square Lake on the edge of the Mt Jefferson Wilderness. The fire made significant up hill runs to the north then spotted into a basin on the north side of the ridge. The fire shifted directions several times and highway 20 was closed for a short period of time. Numerous dead snags and down trees from the spruce budworm attack in the early 1990 contributed to the intensity and resistance of control of the fire. Air Tankers played important in containing the fire on the north and west flanks.

1999 Cache Creek Fire

Started: August 2, 1999 **Origin**: T14S. 8E, Sec. 8 **Size**: 382

Narrative: A late afternoon thunder storm started the Cache Creek Fire in the Mt Washington Wilderness. The trees in the area were a mixture of moss draped lodgepole pine, mountain hemlock and true fir. Initial attack personnel from the Sisters Ranger District with the help from 23 smoke jumpers attacked the fire. Numerous dead and down logs hampered line construction and approval to use chainsaws in the wilderness was approved. Five bulldozers were requested and utilized outside the wilderness. At least 5 additional hand crews were called in to aid in the suppression of the fire. Camp Tamarack evacuated the staff and kids to Sisters while the threat of the fire was evaluated. The wind driven fire was less then a half mile wide and over three miles long. Most of the fire in the wilderness burned with high intensity and resulted in a stand replacement fire. The managed stands to the east outside the wilderness burned with stand replacement and mixed severity in this portion to the fire.

2002 Eyerly Fire

Started: July 9, 2002 **Origin**: T11S, 11E, Sec. 18 **Size:** 23,099 acres

F. Figure 2-1. Eyerly Fire on Green Ridge

Fire backing into Metolius River Basin

Narrative: On the afternoon of July 9, 2002 a bolt of lightning ignited a fire on the north side of the Metolius arm of Lake Billy Chinook. Despite the effort of fire crews with the aid of a helicopter dropping water, the fire grew rapidly in steep rugged terrain burning in cheatgrass, juniper, bitterbrush, ponderosa pine and Douglas fir. The maximum temperature recorded at the Colgate RAWS station on July 9th was 84°F, the following day the temperature rose to 94°F, followed by increase over the next three days with temperatures at 105°F, 106°F, and 108°F. During the same 5-day period the relative humidity fell from 17% to 15%, 12%, 11%, and 9%. On July 11th the fire spotted to the south across the Metolius River. Where it continued to evade control and on the afternoon of July 12th 2002, with temperatures at 106 and relative humidity at 11% the fire made a significant run to the east which resulted in 18 residences, 19 outbuildings and 2 campgrounds being destroyed.

Most of the explosive fire behavior and rapid rates of spread occurred at the lower elevations near Lake Billy Chinook the day after the fire spotted across the Metolius River near the Eyerly Property. Early in the day firefighters were observing long range spotting from passive crown fire events as the fire spread up slope from the lake. By mid afternoon the wind shifted out of the west and turned the eastern flank into a half mile wide active crown fire that rolled unchecked across roads streams and natural barriers. During this burning period a dry front pushed the fire from Perry South campground 6 miles east toward Three Rivers subdivision. The fire spread through a young forest was predominately occupied by smaller diameter Ponderosa pine and Douglas fir that had colonized during fire-free periods. There were occasional large Ponderosa pines; Western juniper (Juniperus occidentalis), Cyprus, Bitterbrush (Purshia tridentata), grasses and various shrubs were intermixed in the understory of most stands. Dead down woody fuel loading was typically less then 10 tons per acre except in areas where snags had fallen.

Over the next several days additional dozers and support from structural fire departments from across the state firefighters were able to contain the eastern flanks. However, the rest of the fire continued burning west toward areas with higher fuel loadings, thicker canopy cover and steeper terrain. Dozers, supported by fire engines and hand crews started flanking the southern portion of the fire. Hotshot crews and heavy lift helicopters lost then regained several handlines while struggling to hold hand line and burn out as they flanked the north side of the fire from the river. Simultaneously a taskforce of dozers started to construct a contingency fire line across the top of Green Ridge. Despite success on the flanks the head of the Eyerly fire continued to burn intensely each afternoon on its westerly march.

During the Eyerly fire all the down dead woody fuel size classes were at critically low moisture levels. The 1hr fuels dropped as low as 2%, the 10 hr. fuels reached 4%, the 100 hr fuels hung between 6%-7% and the 1000 hr fuels were steady at 8% to 9%. This resulted in a fire that burned very fast in light fuels (grass and brush) into young stands of ponderosa pine timber that had sufficient crown mass density to support an active crown fire. Post burn analysis revealed that 32% (over 7300 acres) of the area burned at high intensity killing every living tree. An additional 34% (7700 acres) burned at a moderate intensity range killing most of the true firs and stressing or killing the Ponderosa pine.

Once the westerly winds subsided the fire began to spread up slope into the drainages of Spring Creek, Street Creek, and Bean Creek. Dozers were recruited to construct line up rocky ridges but were unsuccessful in containing the fires spread mid slope. When the fire reached elevations of 2500 on the south side it found an almost continuous Ponderosa pine forest with abundant ground fuels to sustain a steady spread across the xeric landscape. Once established the fire burned impressively with the most intense burning occurring being between 4:00 pm and 10:00 pm daily. The fire was advanced by both active and passive crown fires. Attempts to burn out from the 1170 road were partially successful on the flats but were unsuccessful mudslide and at the head of small draws. Dozers were used to engage the fire, reinforce existing roads and build additional line as needed. Over the course of the operation 48 miles of dozer line was constructed on Federal land not counting an estimated 8 to 10 miles of line that was built on BIA and Private lands around Three Rivers Subdivision.

On July 22 the head of the fire breached the dozer line across the top of Green Ridge and proceeded to back into the steep canyon formed by the Metolius River. The following day the forward spread was contained at 23,573 acres with the help of heavy rains rain and hail from the same thunder storm that started the Cache Mountain Fire six miles to the southwest.

2002 Cache Mountain Fire

Started: July 23, 2002 **Origin**: T14S, 8E, Sec. 3 **Size**: 3859

Narrative: In the late afternoon of July 23, 2002 a bolt of lightning ignited a fire on the northwest side of Cache Mountain. The little rain that had accompanied the thunderstorm had quickly evaporated and the fire began to grow in the heavy accumulation of dry fuels on the north slope of Cache Mt. Initial attack crews were not able to contain the numerous spot fires caused by the torching of trees. The following day fire crews were able to make good success containing the heel and southern flanks of the fire but continued to have difficulty containing the north flank and head of the fire. By July 28th the fire had grown to 2100 acres and had over 200 firefighters assigned to work with the Type II team. Burn outs had been successful the previous night and fire fighters were hopeful. The outlook was predicted to be extreme and public meetings had been called at Black Butte Ranch to discuss evacuation plans. Then on the afternoon of July 29 dry winds pushed the fire into the crowns of the trees where it rapidly advanced toward Black Butte Ranch where it destroyed two houses. The following day additional air support was move to the Redmond air Center and Air tankers made 50 drops on the fire.

2002 Metolius RNA Fire

Started: October 9, 2002 **Origin**: T12S, 9E, Sec. 26 **Size**: 167

Narrative: Crews successfully completed the ignition of Unit 12 in the morning and Unit 62 in the afternoon in the Metolius Research Natural Area to study the affects of reintroducing fire in ponderosa pine fire dependent ecosystems. On the following day a dry cold front moved through the area which caused a snag to loft sparks across the control line on the east side of Unit 62. The sparks ignited in a small draw with thick vegetation that resulted in the fire running to the top on Green Ridge in less than an. A small Type III team was assembled to manage the fire. Additional Control lines were built on the north flank and the slope was underburned from the top down.

2002 Link Lake Fire
Started: July 5, 2002 **Origin**: T13S, 8E, Sec. 33 **Size**: 3590

Narrative: The Link Fire started during the late afternoon on July 5, 2003 near Cache Lake. The weather was warm and dry with maximum temperatures in the lower to mid 80's and minimum humidity in the upper teens and low 20's. The dry fuels, steep topography and winds pushed the Link fire easterly up the northwest slopes of Cache Mountain where its southeasterly spread was initially checked when it burned into an area where the fuels were reduced by the 2002 Cache Mountain Fire. The fire continued to spread to the east as a passive crown fire, torching groups of trees that resulted in spotting down wind into receptive fuel beads. Fire personnel initially attempted a direct attack with a dozer supported by hand crews but were forced to abandon this strategy and backed down to forest road 2068 and start burnout operations. By the morning of July 6th the fire had grown to 607acres. A Type III team managed the fire until a Type II took over the management on July 7th. The additional personnel, good access and managed stands on the west of Cache Mountain afforded crews the opportunity to contain this portion of the fire. However the west and south sides of Cache Mountain had marginal access, unmanaged stands of dead and dying hemlock, and the Cache Mountain Research Natural Area. This proved much more difficult to control and after several failed attempts firefighters eventually retreated to existing roads and flat ground to construct dozer lines. By July 15th the forward spread of the fire had been contained at 3589 acres and mop-up was progressing.
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2002 Bear Fire
Started: August 19, 2002, 13:09 **Origin**: T11S, 8E, Sec. 10 **Size**: 1000+ 1st burning Period

2002 Booth Fire
Started: August 19, 2002, 15:23 **Origin**: T13S, 8E, Sec. 19 **Size**: 2500+ 1st burning Period

B&B Complex (Bear & Booth Fires): On the afternoon of August 19, 2003 two fires were reported in and adjacent to the Metolius Watershed. The fire weather forecast predicted extreme conditions with Minimum RH of 5% and Temperatures in the mid 80's at the weather station near Tollgate Subdivision. The first of the two fires, The Bear Butte fire was discovered by a helicopter on the Warm Springs Reservation near Hole in the Wall, in the Mt Jefferson Wilderness area at 13:09 on August 19, 2003. When discovered the fire was ¼ acre in heavy fuels located 5 miles from the nearest road. Air attack and smoke jumpers were ordered and were above the 3 acre fire around 14:20. After dropping streamers to evaluate the wind Smoke Jumpers determined it was unsafe to deploy because of 20-30 mile winds. By 14:45 the fire was reported at 5 acres. Within the next 30 minutes the fire grew to 20 acres and began spotting. Air tankers were requested but diverted to the Booth fire where they could be more effective. At 18:00 hours the fire had generated a sizable column and was estimated to be 700 acres. The fire had spotted over a mile onto the west side of Bald Peter on the Warm Springs Reservation. By nightfall Air attack estimated the fire at over 1000 acres.

Little more then two hours after the Bear Butte fire was detected, Hinkle Butte Lookout observed a smoke west of Square Lake at 15:23. Within minutes it had grown to 20 plus acres and was torching out individual trees and spotting. By 14:42 the fire was estimated at 100 acres with numerous spot fires ¼ to ½ mile in front of the main fire. By 15:30 the fire was estimated at 200 acres and growing. The fire moved rapidly across the dry south facing slope through heavy dead and down fuels as the wind pushed it to the east paralleling Highway 20 and north west past Long Lake toward Round Lake Christian Camp. By 15:50 a significant column had developed with long range spotting occurring. Jefferson County and USFS personnel with the help of air attack and helicopters moved rapidly to locate and evacuate individuals in the immediate proximity of the fire. In spite of efforts of three dozers with support personnel the fire continued to advance and by 18:00 hours was 700 acres, it was estimated at 1500 acres by 20:00 hours and around 21:30 the column rolled over Highway 20 and started several spot fires south of Suttle Lake ¾ of a mile ahead of the main fire. *(Personal observation by Kirk Metzger & Initial Attack Narrative by Lorri Heath)*

Over the next two and a half weeks the fire continues to burn through then out of the Mt Jefferson wilderness areas where decades of dead and dying fuels (Fire Regime IV and V) contributed to multiple days of extreme fire behavior with large acreage gains. The fire burned into and across lands owned or managed by the Deschutes National Forest, Warm Springs Confederated Tribes, Willamette National Forest, Oregon State Parks, and other private holdings. The Suttle Lake Recreation complex, resident camps and businesses were evacuated south of the highway. The community of Camp Sherman in the Metolius Basin was evacuated twice. Oregon State Highway 20 was closed from August 19 through August 31st and the economy of Sisters was disrupted during the time when many businesses make a significant portion of their income. The Bear and Booth fire complex burned approximately 91,902 acres, 13 structures, resulted in 33 miles of dozer line being constructed and cost 38.7 million dollars to suppress. On September 7 a deep trough developed over the pacific that allowed several cold storms to move over the area and moderate the fire behavior. It was during this time that fire crews were able to hold the advancing fronts of the fire. The fire was called contained on September 26, 2003.

Investigation by the Central Oregon Arson Team, an interdisciplinary group comprised of 18 local, state, and Federal fire and law enforcement agencies found lightning started both fires.

APPENDIX F3

Sisters Ranger District Natural/Historical Fire Regimes

Based on Plant Associations (June 2004)

Fi. Table 3-1. Sisters RD Natural/Historical Fire Regime by PAG

Plant Association Group	Plant Association Group Code	Plant Association Code	Riparian	Sisters Ranger District Acres	Fire Regime
Alpine Meadow	AMDW	CAG1		38	5
		CAG3		27	5
		MS31-11	RIP	17	4
Cinder	CINDER	CINDER		4,340	n/a
Glacier	GLACIER	GLACIER		736	n/a
Hardwood	HWD	HCC1-11	RIP	183	3b
		HQM1-21	RIP	23	3b
		HQM4-11	RIP	123	3b
		HQS2-21	RIP	74	3b
Juniper	JUN	CJS3-11		1,736	2
Lava	LAVA	LAVA		6,204	n/a
Lodgepole Pine Dry	LPD	CLG3-11		779	4
		CLG3-14		132	4
		CLG4-13		29	4
		CLS2-14		83	4
		CLS3-11		136	4
		CLS4-12		176	4
		CLXX-XX		2,109	4
LPW	LPW	CLG4-11		12,054	4
		CLG4-12		5,785	4
		CLM1-11		21	4
		CLM3-12	RIP	8	4
		CLM3-13	RIP	11	4
		CLM4-11		3,359	4
Mixed Conifer Dry	MCD	CEXX-XX		123	3a
		CRS1-11		304	3a
		CWC2-11		29,667	3a
		CWC2-13		30,733	3a
		CWH1-11		3,001	3a
		CW-RCK		1,290	4
		CWS1-12		14,704	3a
		CWS1-14		948	3a
		CWS1-15		12,027	3a
		CWSX-XX		26	4
		CWXX-XX		4,827	4

Mixed Conifer Wet	MCW	CDS6-12		3,805	3b
		CDS6-13		11,678	3b
		CDS6-14		11,132	3a
		CEM1-11	RIP	212	3b
		CEM2-22	RIP	152	3b
		CWC2-12		8,861	3a
		CWCX-XX		164	3b
		CWF4-31	RIP	11	3b
		CWS1-13		13,432	3a
		CWS9-11	RIP	698	3b
		CWXX-XX		1,073	3a
Meadow	MDW	FW42-11	RIP	224	2
		MD19-11	RIP	500	2
		MD31-11	RIP	103	2
		MM19-12	RIP	34	2
		MM29-12	RIP	51	2
		MM29-13	RIP	6	2
		MM29-15	RIP	11	2
		MM-90	RIP	20	2
		MW	RIP	578	2
		MW19-23	RIP	3	2
		MW49-11	RIP	28	2
Mountain Hemlock Dry	MHD	CAGO		328	5
		CAXX		2,500	4
		CMF1		115	5
		CMG2		4,084	4
		CMG2-11		1,594	5
		CMG3		12,777	4
		CMGX-XX		25	4
		CM-RCK		345	4
		CMS1-11		6,928	4
		CMS2-10		4,050	5
		CMS2-13		16	5
		CMS2-16		5,004	4
		CMSX-XX		59	4
		CMXX-XX		242	5
Mesic Shrub	MSHB	SM39-11	RIP	587	2
		SW11-11	RIP	27	2
		SW11-13	RIP	196	2
		SW11-15	RIP	93	2
		SW11-16	RIP	391	2
		SW11-21	RIP	24	2
		SW22-11	RIP	357	2
		SW22-12	RIP	1,105	2
		SW22-13	RIP	86	2
		SW22-14	RIP	614	2
		SW29-11	RIP	390	2
		SW31-11	RIP	2	2
		SW41-12	RIP	21	2

		SW41-13	RIP	36	2
Ponderosa Pine Dry	PPD	CPS1-11		8,304	1
		CPS2-11		49,165	1
		CPS2-12		1,823	1
		CPS2-13		13,818	1
		CPS2-14		343	1
		CPS2-15		72	1
		CPS2-16		5,506	1
		CPS2-17		49,891	1
		CPS2-18		12	1
		CPS3-12		2,063	1
Ponderosa Pine Wet	PPW	CPG2-12		5,068	3a
		CPS3-11		11,231	1
		CPS3-14		8,844	1
		CPS5-11	RIP	170	1
Riparian	RIP	XXXX-XX		1,941	4
Rock	ROCK	ROCK		6,851	n/a
Water	WATER	WATER		1,310	n/a
Whitebark Pine Dry	WBPD	CA		131	4
Xeric Shrub	XSHB	GB-9		92	2
		SD33-11		221	2

BOTANY AND NOXIOUS WEEDS

The following Botany report is an addendum to the 1996 Metolius Watershed Analysis. In this addendum, the following questions will be addressed:

Since the 1996 analysis…

- *What Botanical Species of Concern have been downlisted or uplisted?*
- *What are new findings for rare plants?*
- *What are new findings for noxious weeds?*
- *How have fires impacted rare plants and weeds?*
- *What are revised and new recommendations?*

Species of Concern listed in the 1996 Metolius Watershed Analysis that have since been de-listed

Vascular Plants:
Allotropa virgata
Campanula scabrella
Cymopteris nivalis
Draba aureola
Hieracium bolanderi

Fungi:
Gomphus floccosus
Nivatogastrium nubigenum (removed from OR Eastern Cascades)

Lichens:
Listed as "*Calicium sp.*" Specifically removed species are: *C.albietum, C. adspersum, C. glaucellum, C. viride*
Cladonia norvegica
Hydrotheria venosa
Lobaria hallii
Lobaria pulmonaria
Nephroma helveticum
Nephroma resupinatum
Pseudocuphellaria anthrapsis

NOTE: *Survey and Manage requirements were redefined during the writing of this report. The information is included as a record of our best information on these species.*

These species are still unusual components of eastside forests in the Metolius Basin and should be protected when possible. Reasons for de-listing Species of Concern based on current knowledge include:

- Moderate-to-high number of sites
- High proportion of sites and habitat in reserve land allocations such as late successional reserves (LSR)
- Sites are well distributed within the species range
- Standards and Guidelines of the NWFP provide a reasonable assurance of species persistence

Bot. Table 1. Currently Listed Species of Concern found within the watershed

Species	Type	Status	Occurrence	Plant Association	Location(s)
Vascular Plants					
Agoseris elata	Vascular Plant	TES	PNW endemic	PP	11 populations within the Metolius Basin
Collomia debilis larsenii	Vascular Plant	Watch List (OR Natural Heritage Database)	WA to CA Cascades	MCD, Lava	Stable population on Cache Mountain
Cypripedium montanum	Vascular Plant	S&M C	Within range of NWFP	MCD	1 population near Bridge 99, eight sites in area north of FR 1170 and east of FR 1150. Middle elevations with ponderosa pine.
Lobelia dortmanna	Vascular Plant	TES	Only known site in Oregon	Riparian	Dark Lake and Hortense Lake
Penstemon peckii	Vascular Plant	TES	Sisters endemic	PP, MCW, MCD	Over 80 populations centered around Black Butte
Fungi					
Alpova alexsmithii	Rare Sequestrate Fungus	S&M B	Cascade endemic	High Elevation Forest	With mountain hemlock, true firs, huckleberry, mid to upper mid elevations. One site near Carl Lake.
Arcangeliella lactarioides	Rare Sequestrate Fungus	S&M B	California and Oregon endemic	High Elevation Forest.	Found with ponderosa pine, silver fir and other conifers. One site near head of Jack Creek
Choiromyces alveolatus	Rare Sequestrate Fungus	S&M B	Principally the Cascades of Oregon, California, and Washington	High Elevation Forest	Often with true firs, lodgepole, ponderosa pine, Douglas-fir, and hemlock. One site north of Meadow Lakes Basin
Elaphomyces anthracinus	Rare Sequestrate Fungus	S&M B	Only know site within the NWFP	PPW	Associated with mature ponderosa pine forests. Site near Riverside Campground.
Gastroboletus ruber	Rare Sequestrate Fungus	S&M B	Cascade endemic	High Elevation Forest	Closely associated with old-growth mountain hemlock above 4000 feet. Also with silver fir, noble fir, lodgepole pine and whitebark pine. Three sites near Cabot and Shirley Lakes
Gymnomyces abietis	Rare Sequestrate Fungus	S&M B	Endemic to Pacific Northwest	High Elevation Forest	Found with true firs and pine forests above 3000 feet. One site near Shirley Lake

Species	Type	Status	Occurrence	Plant Association	Location(s)
Gyromitra melaleucoides	Rare Polypore Fungus	Off S&M but continue to protect known sites	Endemic to western North America	MCW	Seven sites from Brush Creek south to Scout Lake
Hygrophorus caeruleus	Rare Mushroom	S&M B	Cascade endemic	MCW	Late-succession, montane, low elevation habitats. One site near Jack Creek.
Martellia sp. Trappe #5903	Rare False Truffle	S&M B	Cascade endemic	High Elevation Forest	Found with old-growth silver fir/mountain hemlock. One site near Shirley Lake.
Ramaria coulterae	Rare Coral Fungus	S&M B	Endemic to Idaho, NE California and Eastern Oregon	MCW	Two possible sites east of Green Ridge, One near Head of Jack Creek
Bryophytes					
Tritomaria exsectiformis	Bryophyte (Liverwort)	S&M B	Most sites in area of NWFP are on Deschutes and Umpqua NFs	Riparian zones in Mixed Conifer Forests	Three sites on Jack Creek and Roaring Creek

January 2001 ROD S&M Category definitions, summarized:

<u>Category A:</u> (Rare, Pre-disturbance surveys practical)

1) Pre-disturbance surveys are practical
2) There is a high concern for species persistence
3) The species occurs rarely or is sparsely distributed within the range of the Northwest Forest Plan (NWFP)
4) All known sites or populations must be managed to provide reasonable assurance of persistence

<u>Category B:</u> (Rare, Pre-disturbance surveys not practical)

Same as Category A, however pre-disturbance surveys are not practical.

<u>Category C:</u> (Uncommon, Pre-disturbance surveys practical)

1) Pre-disturbance surveys are practical
2) There is not a high concern for species persistence
3) The species is uncommon, as opposed to rare
4) Only high priority sites must be managed to provide assurance of persistence.
5) Until high priority sites are determined, must manage all known sites.

Bot. Table 2. Currently Listed Species of Concern that have the potential to occur within the watershed.

Species	Type	Status	Occurrence	Plant Association	Habitat
Vascular Plants					
Arnica viscosa	Vascular Plant	TES	Regional endemic	High elevation forest	Rocky places, lava, near or above timberline.
Artemisia ludoviciana ssp. estesii	Vascular Plant	TES	Central Oregon endemic	Riparian	Gravelly areas in riparian zones
Aster gormanii	Vascular Plant	TES	Oregon endemic	Alpine, subalpine MCD and MCW	Cliffs and ridges in high Cascades
Astragalus peckii	Vascular Plant	TES	Oregon endemic	Juniper	Sandy soil. Deep pumice.
Botrychium minganese	Vascular Plant	S&M A	North American endemic	Riparian, MC	Associated with old growth *Thuja plicata,* near swamps and streams.
Botrychium montanum	Vascular Plant	S&M A	North American endemic	Riparian, MC	Associated with old growth *Thuja plicata* near swamps and streams.
Botrychium pumicola	Vascular Plant	TES	Central Oregon endemic	LP, Alpine	Pumice on high, exposed ridges
Calamagrostris breweri	Vascular Plant	TES	Regional endemic	Alpine to subalpine	Streambanks, lake margins, meadows
Calochortus longebarbatus var. longebarbatus	Vascular Plant	TES	Regional endemic	LP, PP	Vernally moist meadow interfaces with pine forests
Carex hystricina	Vascular Plant	TES		Riparian	Wet ground near streams
Carex livida	Vascular Plant	TES	Circumboreal	Riparian	Low elevation bogs and swamps
Castilleja chlorotica	Vascular Plant	TES	Central Oregon endemic	PP, LP	Flat to gently sloping grounds, with sagebrush.
Gentiana newberryi	Vascular Plant	TES	Regional endemic	Alpine-Subalpine MC	Alpine to sub-alpine meadows
Lycopodiella inundata	Vascular Plant	TES	Interrupted Circumboreal		Lakes, fens, sphagnum bogs
Lycopodium complanatum	Vascular Plant	TES	Circumboreal.	MC forests	Moist or dry thickets

Species	Type	Status	Occurrence	Plant Association	Habitat
Ophioglossum pussilum (syn. *O. vulgatum)*	Vascular Plant	TES	Circumboreal		With *Spiraea, Carex, Fraxinus* Moist meadows, pastures and thickets
Pilularia americana	Vascular Plant	TES	Suspected on DES	PP	Aquatic, often submerged. Shallow vernal pools..
Rorippa columbiae	Vascular Plant	TES	Regional endemic	Riparian	Moist sites, gravelly soil along rivers
Scheuchzeria palustris var. americana	Vascular Plant	TES	Documented on DES	MCD, MCW	Open canopy bogs, fens and wetlands
Scirpus subterminalis	Vascular Plant	TES	Documented on DES	PICO/PIEN MC	Partially submerged, aquatic.
Thelypodium howellii	Vascular Plant	TES	Suspected on DES	PP	Ponderosa pine forests and marshes
Fungi					
Albatrellus caeruleoporus	Rare Ecto-Polypore Fungi	S&M B	Regional endemic	MCW, MCD	Old growth forests. Roots of *Tsuga*
Arcangeliella lactariodes	Rare False Truffle	S&M B	Pacific NW endemic	High elevation forest	Mycorrhizal associations with *Pinus spp.* and *Abies spp.*
Bridgeoporus nobilissimus	Rare Polypore Fungi	S&M A	Cascade endemic	High elevation forest, ABAM	Mesic to wet Pacific Silver Fir and Noble Fir forests
Choiromyces alveolatus	Rare Truffle	S&M B	Pacific NW endemic	High elevation forest	Roots of *Tsuga spp.,Pinus spp., Abies spp.*
Clavariadelphus truncatus	Club Fungi	S&M D	Global, but uncommon	MCW, MCD	Soil or duff under mixed conifer
Cortinarius wiebeae	Rare Gilled Mushroom	S&M B	Cascade endemic	MCW, MCD, PP	With PSME and PIPO, above 3500 ft
Elaphomyces subviscidus	Rare Truffle	S&M B	Documented on SIS RD at Three Creeks.	LP, High elevation forest	Mycorrhizal association with lodgepole, mountain hemlock. Site near Three Creeks Lake.
Fevansia aurantiaca (syn. Alpova aurantiacus)	Rare False Truffle	S&M B	Two sites in the Central Cascades	High elevation forest	Roots of ABLA and PSME
Gastroboletus subalpinus	Bolete Fungi	S&M B	Found on Mt. Hood	High elevation forest	Roots of *Pinus* spp, TSME, ABMA

Species	Type	Status	Occurrence	Plant Association	Habitat
Gautieria magnicellaris	Rare False Truffle	S&M B	Two sites in Western Cascades	High elevation forest	Mycorrhizal association with old growth ABCO
Gymnomyces abietis	Rare False Truffle	S&M B	Rare local endemic	High elevation forest	Within roots of *Abies*, above 3000 ft
Helvella crassitunicata	Rare Cup Fungus	S&M B	North American endemic	Riparian, MCW	*Abies* forests. Site near Three Creek Lake.
Hydnotrya inordinata (Trappe #787, #792)	Rare False Truffle	S&M B	Rare local endemic	High Elevation Forest	Found with old-growth silver fir/mountain hemlock around 6000 feet.
Polyozellus multiplex	Rare Chanterelle	S&M B	Regional endemic	MCW, MCD	Roots of *Abies* species.
Ramaria amyloidea	Rare Coral Fungi	S&M B	Pacific NW endemic	MCW, MCD	Associated with PSME and TSHE
Ramaria rubrievanescens	Rare Coral Fungi	S&M B	Known from east Cascades	MCW, MCD	Associated with PSME and TSHE
Rhizopogon evadens var. subalpinus	Rare False Truffle	S&M B	Regional endemic	High elevation forest	Roots of mountain hemlock and *Abies.* One site on east foot of South Sister.
Rhizopogon flavofibrillosus	Rare False Truffle	S&M B	Regional endemic	MCW, MCD	Mycorrhizal association with *Pinus spp,* ABCO.
Bryophytes					
Rhizomnium nudum	Bryophyte	S&M B	North Pacific distribution		
Schistostega pennata	Bryophyte	S&M A	Documented site at Odell Lake, Deschutes N.F.	MCW, MCD	High humidity, densely shaded microsites (tree roots, crevices)
Tetraphis geniculata	Bryophyte	S&M A	Circumboreal	Riparian, MCW	Humid locations, rotten conifer stumps and logs

Species of Concern within Major Habitat Types of the Metolius Watershed

I. Low Elevation, Old Growth Ponderosa Pine Species:

Many plant and fungi species found within this habitat type are believed to be fire adapted species. Historically, frequent cycles of low intensity fires played a large role in maintaining plant habitat by opening forests, exposing bare mineral soil for germination and reducing understory vegetation.

<u>Focal Species:</u> Peck's penstemon (*Penstemon peckii*). R6 Sensitive

Characterization

Peck's penstemon is endemic to an area of about 325 miles centered around Black Butte on the Sisters Ranger District.

Current Condition (Also see Appendix Bot2)

Out of 83 total known sites, 40 occur within the Metolius watershed on National Forest Lands. Three populations totaling over 1000 plants occur outside of this area and possibly on the edge of its range, on the Crooked River National Grasslands.

Fifty-five percent of the global population of Peck's penstemon occurs within the Metolius watershed, with an estimated 133,433 plants out of 241,525.

There are also records of 9 populations on private lands, with an estimated total of 4268 plants. More information is needed to accurately describe their current condition since some of these populations are anecdotal and have not been visited for more than 10 years.

The Species Conservation Strategy for PEPE has identified 25 populations that should be managed for the benefit of PEPE to ensure long term viability of the species. Twelve of these are in the Metolius watershed. The Species Conservation Strategy recommends that no permanent habitat loss is allowed in these sites and that loss of individual plants due to active resource management not exceed 0.2 % in populations greater than 2000 individuals and 0 in populations less than 2000 individuals.

The remaining 28 populations within the watershed are considered "managed" populations. These are to be managed for the enhancement of PEPE habitat with existing or experimental forest management tools suspected to be of benefit to the species. Loss of more than 20% of a population that exceeds 500 individuals is not recommended. Losses of individuals less than 500 plants should not exceed 10%. Permanent loss of habitat is not recommended.

Status Update:

Since the 1996 Metolius Watershed Analysis, several significant Peck's penstemon populations have been found:

- Two large populations with over 8000 plants found along roadsides and in swales in the vicinity of Davis Creek

- One population with over 2000 plants upland from Jack Creek, northwest of the House on the Metolius

Effects of Cache/Link/Eyerly/B and B Complex Fires:

Within the past two years, four wildfires have burned within the Metolius watershed. The effect of these fires on Peck's penstemon has not been formally studied, however, field observations in the Cache and B&B Fire in known populations found rapid resprouting of burned plants and a strong fire stimulated flowering response.

Summary of PEPE habitat in acres in the Metolius Watershed

	Acres
Total acres of PEPE habitat on Sisters	**3428**
Total acres of PEPE habitat within Metolius Watershed project area	**2566**
% of PEPE habitat acres in project area	**75 %**
Acres of PEPE burned within the Metolius Watershed Project area	**555**
% acres of PEPE habitat affected by fire	**16%**

A large percentage of PEPE populations were in underburned areas, or areas where the burn severity affected less than 25% of the canopy in the area. This type of burn is typical of historical fire regimes that occur within ponderosa pine forests and is beneficial to the plant. Observations of populations in fire areas have not identified direct detrimental fire effects. Indirect detrimental effects include: damage to plants by bulldozing them in fireline construction and the spread of noxious weeds into burned Peck's penstemon population areas.

Burn Severity within PEPE populations

Burn Severity	**% of acres burned**
Stand Replacement (>75% of canopy consumed)	**36**
Mixed Severity (25-75% canopy consumed)	**24**
Underburned (<25% canopy consumed, understory burned)	**41**
Source: Schantz, 2003	

The fire is expected to have a beneficial effect on the Peck's penstemon populations. Historically, Peck's penstemon has responded positively after fire. In cases where the stems of the plant have been burned, the plants will branch and spread vegetatively (Field 1988). Light burning encourages the plant to reproduce clonally. The fire enhances Peck's penstemon habitat by:

- Reducing canopy and increasing available sunlight
- Reducing understory vegetation and exposing bare soil for germination and establishment
- Increasing runoff and bringing available moisture in habitat areas

In September 2002, several of the PEPE populations were revisited within the Cache Fire area. It was observed that in mixed severity and stand replacement areas of the fire, there were still islands of unburned vegetation. Within these, as well as in areas where the duff layer was well burned, PEPE was resprouting vigorously. Surveys in the B&B are finding a similar fire stimulated sprouting response.

Focal Species: Tall agoseris (*Agoseris elata*). R6 Sensitive

Characterization

The range of *Agoseris elata* is thought to extend from the southern Washington Cascades into the Sierra Nevada Range (Gamon and Rush, 2000). On the Sisters Ranger District, the historical distribution and abundance of tall agoseris is unknown.

The earliest collection of tall agoseris on Sisters was made by Peck in 1925 at a location described as "three miles southwest of Blue Lake", possibly in the vicinity of Meadow or Link Lake. Other historically known locations are the meadow at Prairie Farm, Green Ridge and along the Metolius River near the Camp Sherman Bridge. (Personal communications Dr. Kenton Chambers, November 2000.)

Current Condition (Also see Appendix Bot1)

Status update:

Positive identification of this composite has been difficult since the size of the achenes and beaks of mature fruits of similar species are more variable and overlapping than available descriptions and technical keys indicate. Contrary to what many botanical keys state, tall agoseris has orange flowers in Oregon, with a few yellow specimens occurring in the Mt. Hood area (Chambers, 2000). Because this is recent information, the potential for overlooking tall agoseris during past surveys is likely.

In 2001, suspect tall agoseris plants were collected on Sisters Ranger District and sent to Dr. Kenton Chambers at Oregon State University where they were confirmed to be *Agoseris elata.*
In Sisters Ranger District, there are now 18 known populations of tall agoseris and two sites on Green Ridge with less than 50 plants that have not been documented. There is also one anecdotal site near Meadow Lake that has not been verified or revisited. All of the 18 known sites occur within the Metolius watershed, and there is an estimated 1546 plants within these sites.

- Largest group is around Jack Creek area, 315 plants
- Populations found in moist ecotones, edges of clearcuts, roadsides, trails, upland areas near creeks.
- Habitat similar to Peck's penstemon, often occur near each other.

Summary of AGEL habitat in acres in the Metolius Watershed

	Acres
Total acres of AGEL habitat on Sisters	**490**
Total acres of AGEL habitat within Metolius Watershed project area	**490**
% of AGEL habitat acres in project area	**100 %**
Acres of AGEL burned within the Metolius Watershed Project area	**5**
% acres of AGEL habitat affected by fire	**<1%**

Fire Effects:

Tall agoseris tends to prefer open areas with little to no canopy cover, possibly because it is a shade-intolerant species (Gamon and Rush, 2000) It is very successful at setting seed and surviving in disturbed areas, which may imply that it is an early seral species (Chambers, 2000) Fire is expected to have a beneficial effect on tall agoseris and its habitat by:

- exposing bare mineral soil for seed germination
- maintaining the open, meadow habitats in which it occurs
- opening up areas where populations can expand

Focal Species: Mountain Lady Slipper *(Cypripedium montanum)* S&M Category B: Manage all known sites and reduce the inadvertent loss of undiscovered sites.

Characterization

Cypripedium montanum is a long-lived rhizomatous orchid that may depend on a symbiotic relationship with a soil fungus for survival. *C. montanum* grows in a variety of habitats, including moist areas, dry slopes, open to shrub or forest covered valleys or mountainsides, and deciduous, broadleaf evergreen forests or thickets. Typical habitat in drier climates would be a hillside in a coniferous forest with few to no associated understory species (Seevers and Lang, 1998).

The range of mountain lady slipper is from southern Alaska, British Columbia, and western Alberta south to Montana, Idaho, Wyoming and northern California. The historical distribution and abundance of this orchid is unknown within the Metolius watershed.

Current Condition

Status Update:

There are 9 documented *Cypripedium montanum* sites on the Sisters Ranger District. Within the Metolius Watershed there are three documented sites and two anecdotal sites along the Metolius River.

- Within old thinning unit Wizard 11, in the vicinity of FS Rd 1270-990, 20 plants revisited in 2001
- Two sites along cut banks in the vicinity of FR 1190, totaling 19 plants
- Along 1499 road, botanist from another district relocated historic population in 2000, 15 plants
- Reported sightings along lower Metolius River Trail, unverified, amount unknown
- Within the 9 documented sites there are approximately 240 plants

Fire effects:

Two of the *C. montanum* sites occur within the Eyerly Fire perimeter. These populations are in locally unburned areas and were found during surveys one year after the fire.

The effects of fire related disturbance on mountain lady slipper are not well studied. In areas east of the Cascades, mountain lady slipper seems to persist in areas that have been burned. It is thought that fire may have been a part of historical ecosystem processes that provided habitat for the mountain lady slipper. (Seevers and Lang, 1998)

Focal Species: Rare Sequestrate Fungus *(Elaphomyces anthracinus)* S&M Category B: Manage all known sites and reduce the inadvertent loss of undiscovered sites.

Characterization

Little is known about the ecology of this truffle. It is believed to have a dependent mycorrhizal association with old growth ponderosa pine.

Current Condition

There are only two known sites within the Northwest Forest Plan, near Riverside Campground.

<u>Fire effects:</u>

The *E. anthracinus* sites are not located within the fire perimeter and are assumed to be unaffected by the fires.

The viability of this mycorrhizal species is threatened by any actions that disrupt stand conditions, such as damage to host trees and roots and/or disturbance of the surrounding soil. Fire is therefore viewed as a potential threat to this taxon.

II. Dry and Wet Mixed Conifer Forests

<u>Focal Species</u>: Rare Polypore Fungus (*Gyromitra melaleucoides)* S&M Category B: Manage all known sites and reduce the inadvertent loss of undiscovered sites. (De-listed, but still manage known sites).

Characterization

Gyromitra melaleucoides is a non-gilled mushroom that grows on or adjacent to well decayed wood in moist coniferous forests. There is a lack of information on this species.

Current Condition

There are seven known sites within the Metolius Watershed project area, from Brush Creek south to Scout Lake. See Map "XXX" for specific locations.

<u>Fire effects:</u>

All seven of the known sites were within the B&B and Cache/Link Fire boundaries in underburned severity areas. The effects of the fire are not known and it is recommended that these sites be revisited for "ground-truthing".

It is expected that fire and the associated actions related to fire suppression could potentially have a negative impact on fungi species and their habitats. All actions that disrupt stand conditions, host species, associated litter, humus and soil, or any modifications of the microclimate surrounding these known sites could be harmful to the viability of these species.

<u>Focal Species</u>: Uncommon Gilled Fungus *(Hygrophorus caeruleus)* S&M Category B: Manage all known sites and reduce the inadvertent loss of undiscovered sites.

Characterization

Hygrophorus caeruleus is endemic to the Cascade Range in Oregon and Washington and is believed to have a mycorrhizal relationship with true firs in montane, coniferous forests.

Current Condition

There are two known sites of *H. caeruleus* within the Metolius Watershed Analysis project area and one known site adjacent to the project area, east of Green Ridge.

- North of Jack Creek, in the triangle between FS Rd 1230-338 and FS Rd 1230-300. Near Lower Jack Unit 85.
- Vicinity of Brush Creek, FS Rd 12-828 (now washed out and a stream channel)
- East of Green Ridge, in the vicinity of FS Rd.1140 and 1140-990 intersection.

<u>Fire effects:</u>
The site north of Jack Creek was in a mixed severity burn area and the site near Brush Creek was in a stand replacement fire area. The site east of Green Ridge does not appear to be affected by the fires.

The effects of fire are likely to have a negative impact on the habitat of this fungus. Threats to *H. caeruleus* include all actions that disrupt stand conditions, associated litter, humus and soil, or any modifications of the microclimate surrounding the site.

<u>Focal Species</u>: Rare Coral Fungus *(Ramaria coulterae)* S&M Category B: Manage all known sites and reduce the inadvertent loss of undiscovered sites.

Characterization

Ramaria coulterae is a coral fungus that is endemic to Idaho, northeast California and eastern Oregon. It is found on duff and litter in coniferous forests.

Current Condition

There is one known site within the Metolius Watershed project area, near the Head of Jack Creek. There is also a recorded site east of the Metolius Research Natural Area (this is potentially misplotted-communication with Assistant Forest Botanist RickDewey)

Fire effects:
The *R. coulterae* site near the Head of Jack Creek was in a mixed severity burn area. There is not much information on this species, but other rare *Ramaria* are known to be ectomycorrhizal with coniferous species, and are negatively impacted by fire due to the disturbance of the surrounding soil and host species (Castellano and O'Dell 1997).

III. High Elevation Forest

Focal Species: Rare Sequestrate Fungi (*Alpolva alexsmithii, Arcangeliella lactarioides, Choiromyces alveolatus, Gastroboletus ruber, Gymnomyces abietis, Martellia sp.* Trappe #5903). S&M Category B: Manage all known sites and reduce the inadvertent loss of undiscovered sites.

Characterization

Sequestrate fungi are truffle or truffle-like fungi that have an enclosed, below ground fruiting habit and a reduced stalk (Castellano 1999). They are important ectomycorrhizal fungi that aid in forest ecosystem functioning by facilitating nutrient and water uptake, protecting roots from disease, and maintaining soil structure (Amaranthus, n.d.). They are major components of food webs and depend on animal consumption for spore dispersal.

Current Condition

There are several known sites within the project area.-

Fire effects:

See fire effects narrative for *G. melaleucoides.*

IV. Riparian

Focal Species: Rare Liverwort *(Tritomaria exsectiformis)* S&M Category B: Manage all known sites and reduce the inadvertent loss of undiscovered sites.

Characterization

T. exsectiformis is a rare leafy liverwort that occurs in mid-elevational (3200-5200 feet) riparian zones in open to shaded coniferous forest. It is associated with low volume, perennial water flow along very gentle topographic gradients and can occur on rotten wood, peaty soil and with other liverwort species.

Current Condition

There are 17 documented *T. exsectiformis* sites on U.S. Forest Service lands within the Northwest Forest Plan. Of these sites, 10 of them occur on the Deschutes National Forest.

Within the Metolius Watershed, there are sites along Jefferson Creek, the Head of Jack Creek, and the confluence of Jefferson and Roaring Creek.

<u>Fire effects:</u>

On a local scale, fire has a tendency to limit the persistence of *T. exsectiformis* (Rick Dewey, personal communication December 4, 2003). Fire can destroy its primary substrate, rotten logs and wood. Fire may also alter essential moisture availability by reducing canopy cover and shade within its habitat. It is possible that the riparian zones in which it exists may buffer the damaging effects of fire; however there is not enough information on this subject to make this assumption. Fire damage to the primary site at the Head of Jack Creek was minimal.

Terrestrial Non-native Plants and Noxious Weeds

Noxious Weeds and Fire

The B&B Complex, Link, and Cache Mountain Fires have changed environmental conditions within the watershed, making them more favorable to the spread and increase of noxious weed populations. Fire creates suitable habitat for weeds by exposing ground surfaces, reducing shade and increasing available sunlight, and creating a flush of nutrients.

Many noxious weed species are able to survive even high severity fires if they have extensive and/or deep root systems, such as spotted knapweed, toadflax and Canada thistle (Zouhar, 2001). There may be a short term decline in populations of bull thistle immediately after a fire; however, there is usually an increase in plants 3 years after the burn. Fire does not appear to have any impact on St. Johnswort species (Bushey, 1995).

With all weeds, if weed seed is present in the soil, fire may actually favor weeds by improving environmental conditions for seed germination and plant establishment (Goodwin, Sheley and Clark, 2002). Low severity fires may not be hot enough to kill weeds or their seeds in the soil. Since the majority of the burn in the Metolius watershed is of low and mixed severity, it is expected that the known weed sites in these areas were not negatively impacted. There is a high probability that these populations will persist and increase.

The suppression efforts related to wildfires can disturb and expose weed seed banked in the soil. They can also introduce vectors that can transport weed seed into previously unoccupied areas. There are miles of dozer line and acres of safety zones within the Metolius watershed. These disturbed areas are prime habitat for weed introduction and establishment. Surveys of dozer lines in the past have shown that 70% of these suppression related structures had some type of weed or invasive species present.

Current Condition

Fifty-eight percent (70 out of 121) of the weed sites on the Sisters Ranger District are known to occur in this watershed, occupying a gross area of roughly 197 acres. Sixteen of these sites were new sites found during BAER Weed Monitoring surveys in 2003.

The following noxious weed species are known to occur in the Metolius watershed. Some weed sites have crossovers of more than one type of weed present:

- *Centaurea diffusa:* Diffuse Knapweed (Found in 20 sites)
- *Centaurea maculosa:* Spotted Knapweed (Found in 27 sites)
- *Cirsium arvense:* Canada Thistle (Found in 1 site)
- *Cirsium vulgare:* Bull Thistle (Found in 3 sites)
- *Cytisus scoparius:* Scotch Broom (Found in 8 sites)
- *Hypericum perforatum:* St Johnswort (Found in 31 sites)
- *Linaria dalmatica:*Dalmatian Toadflax (Found in 2 sites)
- *Senecio jacobea:* Tansy Ragwort (9 historic sites, only one with found plants)
- *Brachypodium sylvaticum:* False brome (first site found east of the Cascades)

The knapweeds and St. Johnswort are the most prevalent weeds in the Metolius watershed. Out of the sixteen new sites found in 2003 field season, there was only one site that was not St Johnswort or a type of knapweed.

<u>Knapweed</u>
The knapweeds are the most invasive species on the District. It is common to see both species of knapweed within one weed site. The worst infestations occur along well traveled roads and parking areas. Almost half of the knapweed sites also have St. Johnswort present (12 sites).

<u>St. Johnswort</u>
The emerging weed threat in the Metolius basin is St. Johnswort, (accounting for) forty-four percent of the weed sites in this area. Ten out of the sixteen new weed sites found in 2003 were St. Johnswort sites, and three new populations were found in already existing weed sites. Populations are almost always associated with roadsides and disturbed sites such as dispersed camping areas.

<u>False Brome</u>
The first sighting of false brome on the east side of the Cascade Range was found at the Head of the Metolius. False brome is a category “B” noxious weed on the Oregon Department of Agriculture Noxious Weed List. It has become a nuisance in western Oregon, particularly the Corvallis-Albany area (Kaye, 2003). It is capable of invading a

broad range of habitats where it quickly dominates and out competes native vegetation. People are thought to be the main agent of spread.

Nonnative Invasive plants

In addition to weed species classified as "noxious", there are other nonnative plant species that are considered invasive and are increasing in the watershed. Like noxious weeds, these plants are a concern because they displace native plants, degrade habitat for wildlife, promote soil erosion, alter fire regimes, and lessen the value of recreational experiences. Nonnative/introduced invasive species found within the Metolius watershed include:

- *Bromus tectorum*: Cheatgrass
- *Poa bulbosa:* Bulbous wheatgrass
- *Agropyron cristatum:* Crested wheatgrass
- *Agropyron intermedium:* Western wheatgrass

Cultural Plants

The Metolius Watershed contains sites of culturally important plants such as big huckleberry (*Vaccinium membranaceum).* Big huckleberry is a historically important food item for Pacific Northwest Native Americans. The berries are an important food source for black bears, elk and deer. Big huckleberry plants provide resting or hiding cover for small birds and mammals.

Big Huckleberry and Fire:
The effect of fire on the ecology and habitat of big huckleberry depends on the level and type of associated disturbance. In moderately disturbed sites, berry production can be delayed for up to five years (Simonin, 2000). After a wildfire, there can be an increase in berry production after fifteen to twenty years.
Berry production decreases with increased canopy cover. Native Americans used to burn regularly in the fall after harvest to reduce shrub and tree invasion and maintain optimal habitat for huckleberry.

With low to moderate severity fire disturbance, huckleberry coverage will increase. The stem number of the plants will increase, and heavy resprouting is stimulated from deep underground rhizomes. After a wildfire, a huckleberry population can recover to its preburn occupation within three to seven years.

In moderate to high severity fire disturbance, there is a slow recovery of huckleberry populations due to reduced sprouting and the mortality of underground rhizomes.

Recommendations

Mushroom harvest

- Prepare for large influx of mushroom pickers in wildfire areas.
- Consider additional enforcement and limits on mushroom harvest in LSR.
- Implement consistent mushroom policies regarding LSR mushroom harvesting.
- Evaluate whether extensive fire related mushroom harvest may have adverse effects on LSR objectives: Restrictions should apply if: (1) unacceptable resource damage from gathering activities or (2)perceived decline in fruiting body abundance over a specified period of time

Rare Plants

- Follow Conservation Guide Recommendations for designation of additional protected populations of Peck's penstemon in underrepresented subwatersheds.
- Follow Conservation Guide Recommendations and set up management monitoring treatment studies if extensive salvage is planned in Peck's penstemon population areas.
- Monitor response of Water Lobelia to fire and recreation impacts.

Special Habitats

- Promote and protect hardwoods, including:
    - Aspen, cottonwood and other distinctive species such as pacific yew, Douglas maple, dogwood, willow for their value as habitat and contribution to biological diversity.

- Avoid siltation in lakes and streams-Habitats for water lobelia and other rare species.
- Protect meadows from mechanical disturbance and noxious weed invasion.

New Common to All: Integrated Weed Management Plan

- Continue aggressive weed surveys and manual control in the wildfire areas as a high priority to avoid detrimental effects of weed spread into native plant habitats. Approval for more effective weed control in some large populations is needed. i.e. herbicides

- All projects should incorporate guidelines from the USDA Forest Service 2001 Guide to Noxious Weed Prevention Practices. All practical and feasible precautions to prevent noxious weed introduction and spread should be undertaken.

- Recommend weed-free order for the Metolius Basin Project Area in concert with the Willamette National Forest.

- **Utilize Required Practices by Forest Service Policy for weed prevention:**
  (1) For forested vegetation management operations, use equipment cleaning contract provisions, USDA Forest Service 2001 Guide to Noxious Weed Prevention Practices. WO-CT 6.36 p.21
    (a) Highlights:
      (i) Prior to operations, all off road equipment free of soil, seeds, debris that could contain or hold seeds. Certified in writing prior to each start up or move.
      (ii) New infestations of weeds should be reported promptly and treated.

APPENDIX BOT1 – AGEL POPULATIONS

POLY_NO	DISTRICT	PLANT_CODE	PROJECT_NA	SURVEYOR	TOT_SIZE
0500001	SISTERS	AGEL	WEST SIDE METOLIUS RIVER		5
0500102	SISTERS	AGEL	JACK CREEK	J. Dollhausen	315
0500103	SISTERS	AGEL	JACK CREEK SUBPOP A	J. Dollhausen	120
0500105	SISTERS	AGEL	JACK CREEK WEST	R. Schuller	100
0500106	SISTERS	AGEL	HOUSE ON THE METOLIUS	J. Dollhausen	200
0500107	SISTERS	AGEL	FIRST CREEK BRIDGE	J. Dollhausen	65
0500108	SISTERS	AGEL	FIRST CREEK SUBPOP 1	J. Dollhausen	75
0500109	SISTERS	AGEL	FIRST CREEK SUBPOP 2	J. Dollhausen	62
0500110	SISTERS	AGEL	FIRST CREEK NORTH	R. Schuller	84
0500111	SISTERS	AGEL	METOLIUS BEND	J. Dollhausen	87
0500112	SISTERS	AGEL	DAVIS CREEK	J. Dollhausen	65
0500113	SISTERS	AGEL	DAVIS CREEK SUBPOP 1	J. Dollhausen	42
0500114	SISTERS	AGEL	DAVIS CREEK SUBPOP 2	J. Dollhausen	20
0500115	SISTERS	AGEL	ALLINGHAM MEADOWS	J. Dollhausen	50
0500116	SISTERS	AGEL	N LAKE CREEK CAMPSITE	J. Dollhausen	40
0500117	SISTERS	AGEL	E LAKE CREEK	J. Dollhausen	60
0500118	SISTERS	AGEL	LAKE CREEK RESORT	J. Dollhausen	6
0500119	SISTERS	AGEL	SOUTH FK LAKE CREEK	J. Dollhausen	150
0500129	SISTERS	AGEL	N of SMILING RIVER CG	J. Dollhausen	20
Total					**1566**

Appendix BOT2 – PEPE Populations

POLY_NO	PROJECT_NA	DISTRICT	TOT_SIZE	PLANT_CODE
0500007	ALLINGHAM	SISTERS	300	PEPE2
0500018	BLACK BUTTESW	SISTERS	12000	PEPE2
0500020	SE OF COW CAMP	SISTERS	1600	PEPE2
0500021	INDIAN FORD CK.	SISTERS	105	PEPE2
0500022	CACHE CREEK LOWER	SISTERS	2000	PEPE2
0500023	ROAD 1012 TOLLGATE	SISTERS	1700	PEPE2
0500024	INDIAN FORD ROAD	SISTERS	400	PEPE2
0500025	GLAZE MEADOW	SISTERS	25000	PEPE2
0500029	ABBOT CREEK	SISTERS	1200	PEPE2
0500030	GRAHAM CORRAL	SISTERS	150	PEPE2
0500031	SUTTLE TROA	SISTERS	650	PEPE2
0500033	VERNAL POOL	SISTERS	5000	PEPE2
0500034	DRY CREEK BED	SISTERS	10000	PEPE2
0500035	COLD SPRINGS CAMPGROUND	SISTERS	2600	PEPE2
0500036	CANYON CREEK FISH	SISTERS	250	PEPE2
0500037	CANAL 16 #1	SISTERS	359	PEPE2
0500038	CANAL 16 #7	SISTERS	800	PEPE2
0500039	TROUT CK LOWER	SISTERS	22000	PEPE2
0500040	CACHE CK	SISTERS	10000	PEPE2
0500041	UPPER SQUAW CK	SISTERS	85	PEPE2
0500042	TROUT CK UPPER	SISTERS	6000	PEPE2
0500043	JACK CK	SISTERS	2200	PEPE2
0500044	JACK CK TS	SISTERS	8100	PEPE2
0500045	RD 800	SISTERS	250	PEPE2
0500046	RD 520 BB RANCH	SISTERS	1000	PEPE2
0500047	WINDY POINT	SISTERS	2	PEPE2
0500048	FLY CREEK	SISTERS	3000	PEPE2
0500049	FIRST CK	SISTERS	300	PEPE2
0500050	SOUTH OF LAKE CK	SISTERS	10000	PEPE2
0500051	LAKE CK ROADSIDE	SISTERS	2	PEPE2
0500052	METOLIUS EAST	SISTERS	3000	PEPE2
0500053	SMILING RIVER	SISTERS	4000	PEPE2
0500054	RIVERSIDE	SISTERS	1000	PEPE2
0500055	NORTH SHACKLE	SISTERS	40000	PEPE2
0500056	CACHE GRAVEL PIT	SISTERS	250	PEPE2
0500057	ADJ TO RIVERSIDE	SISTERS	5620	PEPE2
0500058	LOWER SQUAW 1	SISTERS	21	PEPE2
0500059	LOWER SQUAW 2	SISTERS	203	PEPE2
0500060	LOWER SQUAW 3	SISTERS	2000	PEPE2
0500061	COLD BEAR 1	SISTERS	500	PEPE2
0500062	COLD BEAR 2	SISTERS	100	PEPE2

POLY_NO	PROJECT_NA	DISTRICT	TOT_SIZE	PLANT_CODE
0500063	COLD BEAR 3	SISTERS	2000	PEPE2
0500064	COLD BEAR 4	SISTERS	100	PEPE2
0500065	BRUSH CREEK	SISTERS	1000	PEPE2
0500066	COLD BEAR 6	SISTERS	500	PEPE2
0500067	COLD BEAR 7	SISTERS	50	PEPE2
0500068	COLD BEAR 8	SISTERS	100	PEPE2
0500069	STEVENS CANYON	SISTERS	3100	PEPE2
0500070	STEVENS CANYON BURN	SISTERS	500	PEPE2
0500071	STEVENS CANYON BURN 2	SISTERS	1700	PEPE2
0500072	STEVENS CANYON SCAB	SISTERS	2030	PEPE2
0500073	BBR ENTRANCE	SISTERS	100	PEPE2
0500074	UNDERLINE/COLD SP	SISTERS	200	PEPE2
0500075	DAVIS CREEK HTH	SISTERS	3420	PEPE2
0500076	METOLIUS RNA	SISTERS	2000	PEPE2
0500077	HWY 20 S10-11	SISTERS	220	PEPE2
0500078	HEAD OF THE METOLIUS	SISTERS	25	PEPE2
0500079	MTN BIKE TRAIL	SISTERS	15	PEPE2
0500080	N GREEN RIDGE	SISTERS	500	PEPE2
0500081	INDIAN FORD FOOT BRIDGE	SISTERS	650	PEPE2
0500082	METOLIUS REHAB	SISTERS	12	PEPE2
0500083	ROAD 1120/GREEN RIDGE	SISTERS	3000	PEPE2
0500084	ALLEN SPRING CG	SISTERS	150	PEPE2
0500085	LOWER FLY CREEK	SISTERS	1000	PEPE2
0500086	INDIAN FORD NORTH	SISTERS	40	PEPE2
0500093	UPPER FLY CREEK	SISTERS	1000	PEPE2
0500094	INDIAN FORD EXTENSION	SISTERS	12000	PEPE2
0500095	ZIMMERMAN PIT	SISTERS	2000	PEPE2
0500096	COLD SPRINGS EXTENSION	SISTERS	5000	PEPE2
0500097	TROUT CREEK OVERFLOW	SISTERS	205	PEPE2
0500098	INDIAN FORD ALLOTMENT	SISTERS	3000	PEPE2
0500099	DAVIS CREEK WEST	SISTERS	6000	PEPE2
0500121	CAMP SHERMAN	SISTERS	31	PEPE2
0500122	LAKE CREEK	SISTERS	2	PEPE2
0500123	N of NORTH SHACKLE	SISTERS	50	PEPE2
0500124	E of NORTH SHACKLE	SISTERS	60	PEPE2
0500125	JACK CREEK DRAINAGE	SISTERS	2340	PEPE2
0500126	DAVIS CREEK EAST	SISTERS	750	PEPE2
0500127	MARIEL CREEK	SISTERS	1000	PEPE2
0500128		SISTERS	500	PEPE2
0500132	Eyerly BAER monitoring	SISTERS	568	PEPE2
Total			**240665**	

TES Plant populations and fire severity

TES_NO	PLANT_CODE	Mixed_sev	Stand_repl	Underburned	Total acres
0500102	AGEL	0.58		1.82	2.40
0500105	AGEL	0.2		2.31	2.51
		0.78	0.00	4.13	4.91
0500016	CODEL	0.93	9.19	0.12	10.24
0500004	LODO3	0.21	0.49	1.4	2.10
0500018	PEPE2	13.39	26.1		39.49
0500029	PEPE2	17.58	17.95	8.76	44.29
0500031	PEPE2	0.74	8.94		9.68
0500034	PEPE2	19.44	62.48	8.91	90.83
0500040	PEPE2	6.88	53.31		60.19
0500043	PEPE2	1.52	3.13	34.36	39.01
0500044	PEPE2	3.09		18.52	21.61
0500055	PEPE2			0.43	0.43
0500061	PEPE2	36.27	1.89	44.4	82.56
0500062	PEPE2	2.39	0.22	6.66	9.27
0500063	PEPE2	1.04		50.84	51.88
0500064	PEPE2	2.44	4.22	1.96	8.62
0500065	PEPE2	6.45	14.53	1.52	22.50
0500066	PEPE2	5.89	0.22	5.49	11.60
0500067	PEPE2	0.3		0.62	0.92
0500068	PEPE2	1.78	1.28	2.75	5.81
0500075	PEPE2	11.65	5.15	35	51.80
0500125	PEPE2	0.34		4.55	4.89

Total acres		131.19	199.42	224.77	555.38
% of burn		23.62	35.91	40.47	

Total acres of TES plants within the Metolius Watershed

TES_NO	PLANT_CODE	GIS_AC
500102	AGEL	108.05
500103	AGEL	11.09
500105	AGEL	2.95
500106	AGEL	133.31
500107	AGEL	6.3
500108	AGEL	65.84
500109	AGEL	11.88
500110	AGEL	2.74
500111	AGEL	4.03
500112	AGEL	12.61
500113	AGEL	4.82
500114	AGEL	4.47
500115	AGEL	8.73
500116	AGEL	13.42
500117	AGEL	21.9
500118	AGEL	2.64
500119	AGEL	74.85
Total		**489.63**
500016	CODEL	**10.24**
500004	LODO3	**2.09**

TES_NO	PLANT_CODE	GIS_AC
500007	PEPE2	4.58
500018	PEPE2	320.67
500022	PEPE2	112.48
500029	PEPE2	44.28
500031	PEPE2	9.69
500034	PEPE2	100.89
500036	PEPE2	0.76
500040	PEPE2	60.19
500043	PEPE2	39.01
500044	PEPE2	21.6
500045	PEPE2	4.63
500049	PEPE2	56.06
500050	PEPE2	186.89
500051	PEPE2	0.42
500052	PEPE2	7.55
500053	PEPE2	14.39
500055	PEPE2	308.88
500056	PEPE2	4.26
500057	PEPE2	73.17
500061	PEPE2	82.56
500062	PEPE2	9.27
500063	PEPE2	51.88
500064	PEPE2	8.62
500065	PEPE2	22.5
500066	PEPE2	11.6
500067	PEPE2	0.92
500068	PEPE2	5.81
500075	PEPE2	60.25
500076	PEPE2	24.24
500078	PEPE2	0.3
500079	PEPE2	0.16
500082	PEPE2	0.1
500083	PEPE2	269.61
500084	PEPE2	0.59
500093	PEPE2	8.98
500099	PEPE2	283.53
500121	PEPE2	23.2
500122	PEPE2	6.79
500123	PEPE2	60.6
500124	PEPE2	21.78
500125	PEPE2	29.97
500126	PEPE2	212.26
	Total	**2565.92**

WILDLIFE

Introduction

This report will update the wildlife information found in the Metolius Watershed Analysis (1996) in light of the recent events occurring within the watershed, primarily the B&B, Link, Cache Mountain, and Eyerly wildfires. Updated information will also include recent vegetation management projects, as well as, other projects completed since 1996 to best of our knowledge.

The following will show where there have been changes or updates by section.

Biological Domain – Aquatic/Riparian Summary (pp. 33-34)

The species listed in the Wildlife Appendix may be changing slightly. A new wildlife habitat relationship model is being developed and will be based on plant association groups found in the new updated Pumice Guide of Central Oregon (under construction). Changes will also occur where information on wildlife species and use of habitats has been updated with new research findings.

Change sentence: Species like the American marten and Pacific fisher are known to use riparian corridors for foraging and as movement pathways.

Biological Domain – Terrestrial Summary (p. 35)

The species listed in the Wildlife Appendix may be changing slightly. A new wildlife habitat relationship model is being developed and will be based on plant association groups found in the new updated Pumice Guide of Central Oregon (under construction). Changes will also occur where information on wildlife species and use of habitats has been updated with new research findings.

Focal species represent a variety of other species found in similar habitats within the watershed. Focal wildlife species include: PETS species identified as Federally threatened, endangered, or Candidate; and selected species. The selected species are those identified as management indicator species (MIS). Examples of focal species include the spotted owl for climatic climax mixed conifer wet habitats and the white-headed woodpecker for fire climax ponderosa pine habitats.

The Metolius watershed (148,926 acres) has experienced many changes since 1996. It has changed from a pre-dominantly interior forest landscape to one dominated by large complex patches. Insects and disease outbreaks began changing the landscape by impacting overstocked stands and then wildfires further opened up the landscape. Approximately 86,727 acres (58%) have burned since 1996, of which 38,570 acres (26%) have resulted in stand replacement. Due to these significant changes on the landscape, a shift in wildlife species composition is likely to occur from a landscape inhabited by interior late-successional species to one that is dominated by open, early seral species.

Terrestrial Threatened and Endangered Species

This section will show changes that have occurred since 1996 and will update any known information regarding survey results, etc. and expected trends. The following two tables represent the updated R-6 Sensitive Species list and those species identified in the Deschutes National Forest Land and Resource Management Plan (LRMP) as well as other important species requiring specific management considerations.

The following threatened, endangered or sensitive animal species are either known to occur or may potentially occur on the Sisters Ranger District:

WL Table 1. Threatened, Endangered, and Sensitive Species

SPECIES	COMMON NAME	FEDERAL CLASSIFICATION
Falco peregrinus anatum	American Peregrine Falcon	S
Haliaeetus leucocephalus	Northern Bald Eagle	T
Strix occidentalis caurina	Northern Spotted Owl	T
Podiceps auritus	Horned Grebe	S
Podiceps grisegena	Red-necked Grebe	S
Bucephala albeola	Bufflehead	S
Histrionicus histrionicus	Harlequin Duck	S
Coturnicops noveboracensis	Yellow Rail	S
Agelaius tricolor	Tricolored Blackbird	S
Centrocersus urophasianus	Western Sage Grouse	S, SOC
Lynx canadensis	Canada Lynx	T
Gulo gulo luteus	California Wolverine	S, SOC
Martes pennanti	Pacific Fisher	S
Brachyiaqus idahoensis	Pygmy Rabbit	SOC
Rana pretiosa	Oregon Spotted Frog	PT
Notes: E= Endangered, T= Threatened, S= USFS Region 6 Sensitive, C= USFWS Candidate Species, SOC=USFWS Species of Concern, PT= Proposed Threatened.		

WL Table 2. Management Indicator Species and Species of Concern

BIRDS		MAMMALS	
Species	**Status**	**Species**	**Status**
Northern Goshawk*	MIS, SOC	Bats*	MIS, SOC
Coopers Hawk*	MIS	Elk*	MIS
Sharp-shinned Hawk*	MIS	Marten*	MIS
Great Gray Owl*	MIS	Mule Deer*	MIS
Great Blue Heron*	MIS		
Cavity Nesters*	MIS		
Waterfowl*	MIS		
Red-tailed Hawk*	MIS	**MOLLUSKS**	
Osprey*	MIS	Crater Lake Tightcoil*	Survey and Manage
White-headed Woodpecker*	MIS		
Flammulated Owl*	MIS	**HABITAT**	
Neotropical Migrants*	MIS	Snags and Down Wood Habitat*	
		Connectivity	
Notes: MIS = Management Indicator Species, Deschutes National Forest LRMP SOC = USFWS Species of Concern Scientific Names provided in Appendix 1. * = Occurs or potentially occurs in project area.			

Peregrine Falcon

The peregrine falcon is no longer listed as a threatened species. It was delisted August, 1999. This species remains on the R-6 Sensitive Species list. No known nest sites have been found within the watershed to date.

In the Pacific states, preferred peregrine falcon nesting sites are sheer cliffs 150 feet or more in height, located near water with an abundant prey source (Willamette National Forest FEIS 1990). Suitable nest sites for peregrine falcons are found in substantial rock outcroppings, usually southern exposure, and with a small cave or overhang ledge large enough to contain 3-4 full grown nestlings (Wilderness Research Institute 1979). Peregrine falcons feed almost exclusively on birds, many of which are associated with riparian zones and large bodies of water.

There are no known nest sites within the watershed and no current surveys have been conducted. There is limited habitat within the watershed (Castle Rocks, Cathedral Rocks, Hole-in-the-Wall area, Rockpile Lake area, and Three-fingered Jack area) most of which are located within wilderness.

The fires resulted in approximately half of the riparian reserves being burned to some degree with about 40% of those receiving stand replacement or mixed severity burn intensity. This altered habitat for many prey species especially those areas associated with high wilderness lakes and Suttle Lake. However, the Metolius River still provides diverse habitat which could support healthy prey populations.

TREND: Neutral. If a site does become occupied, it will be protected and contribute to the overall species viability.

Bald Eagle

Three nest sites were still present within the watershed prior to the fires of 2002 and 2003: Wizard Falls, Suttle Lake, and Eyerly sites. The Eyerly nest site and nest grove were impacted during the Eyerly fire of 2002. This is a newer nest site than the one previously used in 1995. A portion of the new nest grove experienced mixed to stand replacement fire, however the nest was not burned. An eagle pair still occupies this nest site. The Suttle Lake side was impacted by the B&B fire while the Wizard Falls site is still intact.

Suttle Lake

The Suttle Lake nest grove was heavily impacted during the B&B fire of 2003 however the nest is still intact. The nest grove experienced stand replacement fire and was the most impacted area within both the BEMA and BECA (WL Table 3). Other areas within the BEMA/BECA were impacted heavily including the north and southwest sides of Suttle Lake and the isolated piece on the northwest side of Blue Lake. There is still potential habitat remaining within the vicinity of Suttle Lake, primarily the road corridors along the 2070 and 2066 roads where recent treatment had occurred and near Dark and Scout Lakes. It may be unlikely that the birds will use these areas due to the high recreation use and it is unknown if the pair will re-use the historic nest.

WL Table 3. Fire Intensity for the areas influencing the Suttle Lake bald eagle pair.

Fire Intensity	Suttle Lake Bald Eagle Areas (ac)		
	BECA	BEMA	Nest Grove
Stand Replacement	525	217	16
Mixed Severity	1,064	728	3.5
Underburned/Unburned	994	503	.5
Total	**2,599**	**1,458**	**20**

Eyerly

The Eyerly nest grove suffered mixed to stand replacement fire as a result of the Eyerly fire of 2002. Information regarding how the Eyerly fire specifically impacted the nest grove is unknown at this time. However, the pair re-nested in the same nest in 2003 as in 2002. Therefore, it is assumed that the grove and nest tree are still functional at this time.

Wizard Falls

The Wizard Falls nest grove is still intact. The B&B fire perimeter is approximately 0.25 miles from the nest site. It is assumed that this pair will continue to be successful as they tend to focus more on the Metolius River area. The fire impacted the uplands primarily on the opposite side of the ridge in areas dominated by ponderosa pine not used heavily by this pair.

Fall/Winter Roosts

In 1996 a bald eagle communal winter roost study, funded by PGE (Portland General Electric) revealed two communal roosts along Spring Creek (Tressler et al. 1999). In 1997 a fall communal roost study funded by PGE revealed one communal roost site near Lake Billy Chinook (Clowers 1997). All three communal roost sites were within the Eyerly fire area and stand replacement occurred within all three sites.

Along the Metolius River and around the larger lakes, several factors influence eagle habitat including campgrounds, summer home tracts, private lands, major roads, and past harvest activities. Hazard trees are routinely removed from recreation facilities and along major travel routes. Continued loss of large snag habitat in and adjacent to campgrounds and summer home tracts and major travel routes due to safety reasons limits the available nesting and perching sites along the river. Therefore, large snag habitat outside designated recreation areas is very important to retain since most, if not all, large snag habitat will eventually be lost in the recreation sites. Private lands occur near potential habitat. These sections are not managed for eagle habitat. Therefore, it is assumed that any habitat provided by these parcels is incidental and may not be long term. Past harvest activities resulted in the removal of large trees and snags. This coupled with the loss of large snag habitat has reduced the available nesting, roosting and perching habitat for eagles.

Recommendations

1. Survey annually.
2. Manage the area around Suttle Lake to develop bald eagle habitat. This will include the restoration of large tree habitat with large limb structure to support nesting structures. Ponderosa pine and Douglas fir are preferred tree species.
3. Assess the Meadow Lakes area as an additional area in which to manage for bald eagle habitat. Promotion of large tree habitat, large snags, and long-lived species are desired.
4. Assess the Wizard Falls bald eagle area for potential treatment to lessen the risk of loss and for the perpetuation of large tree habitat.
5. Protect large snags outside campgrounds and recreation sites along the Metolius River.

TREND: Stable. However, there is a loss of large trees within vicinity of large water bodies that will prolong the establishment of habitat and may result in a reduction or no net gain in eagle pairs for several decades.

Northern Spotted Owl

The northern spotted owl is still a federally threatened species. The majority of the Metolius watershed lies within the range of the spotted owl and also encompasses two Critical Habitat Units (CHU) (OR-3 and OR-4). All of OR-4 lies within the watershed while 93% of OR-3 falls within the boundary as well as most of the Metolius Late-Successional Reserve (RO245). The spotted owl is a species used to represent many late-successional associated species and will be a focal species for the mixed conifer wet plant association group.

NRF History

There have been many changes regarding suitable nesting, roosting, and foraging (NRF) habitat for the spotted owl across the district and primarily within the Metolius watershed. As stated in the 1996 Watershed Analysis, spotted owl habitat was defined as mixed conifer, multi-storied stands between 3,000 and 6,000 feet in elevation, with at least 40 contiguous acres and at least 60% canopy cover. Where ground verification was conducted, more specific attributes were considered including tree density, size, and age as well as snag size and density and down woody material levels.

This effort was limited in the ability to predict habitat abundance and distribution across the Deschutes NF. However, it still represents the best characterization of habitat at the stand level until the nest stand study initiated in 2000 is completed.

The process for identifying suitable habitat was refined using improved coverages in 1998. The suitable NRF map was generated from various GIS coverages along with an additional dataset based on 1991 photo interpretation and field verification. Datasets varied in scale and accuracy.

A forest-wide photo interpretation (PI) layer was completed in 2000. The new PI layer showed the impact of the budworm epidemic, which caused high mortality on an estimated 50,000 to 60,000 acres of forested habitat on the Deschutes NF (Eglitis 2001, pers. comm.). The PI layer also gave us a more accurate depiction of tree size class and canopy cover than had ever been previously available.

In 2001, another mapping effort utilizing the 1995 PI layer along with an updated activities layer and DEM layer (elevation) was completed. The objective was to identify stands which had the necessary canopy cover and tree size classes to provide NRF habitat. It was assumed that an overestimation of habitat may occur due to the assumptions used. Forest stands (regardless of plant association) having a total canopy cover greater than or equal to 40% AND a canopy cover of at least 5% among trees >21" dbh were labeled as NRF. This definition assumed that stands were multi-storied and contained some large trees. Modifications could be made at the project level to further refine habitat if needed.

During the update to the 2003 Programmatic Biological Assessment, two errors were discovered in the way habitat was mapped in 2001. First, there were occasional errors made in estimating acres of habitat when converting from square meters to acres. Secondly, "donuts" of non-habitat surrounded by NRF had been incorrectly included in the NRF layer and in the total acreages. In addition, NRF lost to fires and vegetation management actions as well as field verification also led to updating the current NRF layer.

An additional mapping effort occurred in January 2004 to reflect changes in NRF habitat due to the large fires of 2003. In mapping NRF habitat for this iteration, two refinements were incorporated. First, all "slivers" less than 2 acres in size were eliminated (~84 acres). Second, a mapping error for the Sisters RD was corrected. Some polygons were not "closed" where FS boundaries touched other ownership boundaries causing those polygons to be coded incorrectly. This error resulted in approximately 2,500 acres of NRF being added back into the totals.

A more detailed summary of the mapping efforts can be found in the 2003-2006 Programmatic Biological Assessment, Appendix WL1. The following table shows the forest totals of NRF habitat through all of the mapping efforts.

WL Table 4. Total Forest NRF acres by mapping efforts.

Year	Acres of Suitable NRF Habitat on Deschutes NF	Acres of Suitable NRF Habitat on Sisters RD
1992	152,024	Unk.
1998	166,157	55,952
2001	123,135	59,793
2003	116,632	49,601
2004	93,931	34,891

As indicated in WL Table 4, acres of suitable NRF habitat have declined within the Metolius watershed, primarily due to the fires of 2002 and 2003. See Table 5 for pre and post fire NRF acres. **NOTE:** Since most of the fires occurred near each other or overlapped, it will not be broken down by fire but shown as a total watershed figure.

Table 5. Pre- and post-fire NRF acres within the Metolius watershed.

Habitat	Pre-fire NRF Acres	Post-fire NRF Acres	NRF Acres Lost
NRF	26,901	16,610	11,562*
% of watershed	18%	11%	7%
Note: *Acres do not directly correspond due to mapping errors. Total watershed acres = 148,926 acres			

Suitable NRF habitat was declining throughout the watershed even prior to the fires due to increased mortality from insects and disease. However, the fires accelerated the rate of loss. Stands were "falling apart" in areas but still contained some live canopy, large snags, and down woody material. This may have allowed spotted owls to occupy marginal habitat.

The fires resulted in a mosaic burn pattern across the watershed. There were areas where high to moderate burn intensity resulted in stand replacement, leaving only scorched tree boles to burned trees with dead needles and limbs still attached. These areas will likely receive minimal to no use by spotted owls due to the lack of canopy cover needed to protect against predators. Low burn intensity resulted in a mixed burn within stands. Stands may exhibit gaps where a tree or clump of trees resulted in stand replacement to a severely underburned stand with little understory remaining. These stands will likely be used by spotted owls for foraging and dispersal. In addition, there are stands which received a light underburn with most stand elements still intact.

Remaining suitable habitat within the watershed primarily exists in small isolated patches, especially within the fire areas. However, large patches of habitat still remain within the Mt. Washington wilderness, around Black Butte, and along Green Ridge. These areas, however, have not been field verified and reductions in habitat totals are likely. It is still unknown what specific habitat conditions are needed for east-side owl pairs. There is a need to refine habitat definitions to allow for the persistence of this species in a disturbance dominated system.

Most existing NRF prior to the fires was defined as non-sustainable due to overstocked stand conditions and the likelihood of loss either from insects and disease or fire. Much of this habitat was located within MCD PAGs. Approximately 5,222 acres (51%) of suitable MCD stands were lost as a result of the 2002 and 2003 fires. Similar results occurred within the MCW stands with approximately 3,750 acres (56%) of suitable habitat were lost. However, it is assumed that due to stand composition that MCW stands would result in stand replacement.

Critical Habitat Units

Critical Habitat Units (CHU) were established by the U. S. Fish and Wildlife Service because 1) spotted owl habitat is continually decreasing and becoming more fragmented, 2) the resultant increased threat of isolation of spotted owl populations, and 3) the exacerbation of poor habitat conditions for dispersing spotted owls.

The objectives for CHUs, developed by USFWS (1992), are as follows:

1. Increase the amount of suitable habitat within home ranges of known spotted owls in the Southern Deschutes Area of Concern.
2. Maintain and improve dispersal habitat throughout the province, particularly across lower elevation passes along the crest of the Cascades.
3. Maintain all existing and future resident spotted owls within the southern Deschutes area until populations recover sufficiently to provide stable breeding units.

CHU OR-3 was designated to develop and maintain essential nesting, roosting, and foraging habitat and help support the dispersal of owls along the eastern slope of the Cascades. This CHU is important for maintaining the eastern extent of the range within the Eastern Cascade province and for providing the north-south continuum of critical habitat along the East Slope of the Cascades.

CHU OR-4 was designated to provide essential breeding, roosting, and foraging habitat and to assist the dispersal of spotted owls along the eastern extent of the Cascades. This CHU provides an inter-provincial link with the Western Cascades and also helps maintain the north-south continuum of habitat along the eastern slope of the Cascades.

The majority of these two CHUs occupy the Metolius Watershed. Reductions in suitable NRF habitat have occurred since 1996. See WL Table 6 for more information.

WL Table 6. Metolius watershed Critical Habitat Units and amount of NRF.

CHU #	Total Federal Acres	Amount within Metolius WA	Total Pre-fire NRF Acres	Total Post-fire NRF Acres
OR-3	21,560	19,973	5,018	3,106
OR-4	17,287	17,287	2,272	429

Suitable habitat was reduced by 14% overall in CHU OR-3. This CHU had little suitable habitat to begin with. Both the B&B and Eyerly fires impacted this CHU. Basically, dispersal habitat is limited to a linear strip along Green Ridge. CHU OR-4 only has approximately 2% suitable habitat remaining, severely limiting its ability to provide essential breeding, roosting, and foraging habitat. Dispersal habitat is also very limited. The B&B, Link, Cache Mountain, and Cache Creek fires have all occurred in this CHU since 1996. It is assumed that these CHUs will not function as intended due to the extent of habitat loss. Coordination with USFWS is needed to determine how to address these areas in light of recent events.

Connectivity

Prior to the fires of 2002 and 2003 adequate north/south connectivity existed along the east slope of the Cascades even with the increased mortality levels. It was marginal in some areas like the Santiam Corridor project area around Suttle Lake but the wilderness provided an additional avenue for movement north and south. Green Ridge also provided a north/south route although this area was more open than other areas.

Since the fires of 2002 and 2003, north/south connectivity has been compromised due to the high burn intensity. Large areas of the watershed experienced stand replacement. Much of the wilderness was also included within the fire perimeter reducing the potential for movement in this area as well. Green Ridge is still intact and may provide the only north/south corridor available at this time.

Remaining areas are primarily comprised of MCD and PP PAGs and are recognized as not being sustainable. These areas do not provide the best quality dispersal habitat due to the more open nature of these stands. However, these are the only avenues left. Therefore, protection of this corridor is essential until stands begin to recover.

Updated Owl Sites

There was an increase in the number of known owl sites from the 1996 Watershed Analysis from 17 known sites to 21. However, due to the recent wildfires, that number has been reduced to 7 known sites that may still be viable (Suttle South, Obsidian, Davis, Canyon Creek, Jefferson Creek, Candle Creek, and Castle Rocks). See WL Table 7 for an updated list of known sites and acres of suitable habitat remaining within 0.7 and 1.2 miles for the Metolius watershed. The minimum amount of habitat considered necessary to ensure viability of a pair is 40% (1182 acres) of that home range in suitable NRF habitat. Less habitat reduces the ability of the owls to survive and successfully reproduce.

WL Table 7. Known spotted owl sites and acres of suitable habitat within each home range pre and post fire, which fire it was affected by, and the plant association group it's located in.

Owl Site	Acres of Suitable Habitat within 0.7 miles		Acres of Suitable Habitat within 1.2 miles@		Fire	PAG
	Pre-fire	Post-fire	Pre-fire	Post-fire		
Abbot/Cabot	195	0	577	4	B&B	MCD
Bear Valley	175	9	404	19	B&B	MCD
Brush Creek	275	0	362	0	B&B	MCW
Cabot*					B&B	MCD
Cache East	47	0	115	19	Cache Mtn., Link, B&B	MCD
Cache West	372	4	684	146	Cache Mtn., Link, B&B	MCW
Candle Creek	602	37	1326	182	B&B	MCW
Canyon Creek	340	146	698	336	B&B	MCW
Castle Rocks	280	280	582	582	Eyerly	MCD
Davis Creek	295	256	834	672		MCW
Dry Creek	18	17	228	332	None	MCW
First Creek	297	2	569	13	B&B	MCD
Jefferson Creek	484	57	855	158	B&B	RIP
Key West	180	3	538	48	B&B	MCD
Obsidian	488	488	1045	1045	None	MCD
Santiam Pass	296	0	584	0	B&B	MCD
Spring Creek	73	12	378	102	B&B	MCD
Suttle	155	6	744	21	B&B	MCD
Suttle 96	329	26	855	187	B&B	MCD
Suttle South	160	50	345	102	Cache Mtn, Link, B&B	MCD
Upper Canyon Creek	100	36	346	88	B&B	MCD

Notes:
*Cabot pair found to be Abbot/Cabot pair.
@ - Acre figures gathered from update to the 2003-2006 Programmatic Biological Assessment due to the fires.

Results of the 2002 and 2003 wildfires reduced suitable habitat across the watershed. An update to the Forest NRF layer was completed. The following table shows how NRF was analyzed for this mapping exercise.

WL Table 8. Suitable habitat analysis as related to fire intensity and re-mapping of habitat.

Fire Intensity	Habitat
High	Non-habitat
Moderate	Non-habitat
Low	NRF degraded to Dispersal Habitat
Underburned	Remains NRF
Unburned	Remains NRF

Remaining habitat was analyzed as it related to each known home range and a determination made on whether each site could have the potential to still be viable. Patch size and fragmentation of habitat were used to help make each determination. WL Table 9 provides a summary of the analysis for each home range.

WL Table 9. Known pair viability analysis for the Metolius watershed.

Pair	NRF Analysis	Determination of Viability
Abbot/Cabot	No habitat left	Non-viable
Bear Valley	No habitat left	Non-viable
Brush Creek	No habitat left	Non-viable
Cabot*	No habitat left	Non-viable
Cache East	No habitat left	Non-viable
Cache West	Remaining NRF on edge of home range in small patches (25-35 ac)	Non-viable
Candle Creek	No habitat near nest site. Approximately .5 miles to nearest patch but this is a large patch (170 ac). However that's the only habitat left.	Potentially Viable
Canyon Creek	Nest stand somewhat intact but fragmented by fire. Potential for occupation.	Potentially Viable
Castle Rocks	Fragmented patches of habitat remaining. MCD and not sustainable.	Potentially Viable
Davis Creek	Nest stand has high mortality from I&D but fragmented larger patches remaining throughout rest of home range.	Potentially Viable
Dry Creek	Even though not impacted by the fires, suffered high mortality from I&D. Remaining NRF on edges of home range and no NRF in nest stand or adjacent to it.	Non-viable
First Creek	No habitat left	Non-viable
Jefferson Creek	Nest near a 20 acre patch and area near trailhead still intact.	Potentially Viable
Key West	No habitat left	Non-viable
Obsidian	Not affected by fires. Large patch of habitat (>1000 ac) surrounding core area.	Potentially Viable
Santiam Pass	No habitat left	Non-viable
Spring Creek	Remaining NRF in small isolated patches near edge of home range and no habitat near nest site.	Non-viable
Suttle	No habitat left	Non-viable
Suttle 96	Most of remaining habitat lies on ease side of home range across 12 Rd and along Hwy. No habitat around nest core.	Non-viable
Suttle South	Nest site is in a 30 acre stand still typed as NRF. Remaining NRF is scattered in isolated small patches.	Potentially Viable
Upper Canyon Creek	Remaining NRF found in small isolated patches (<30 ac)	Non-viable

Survey History Update

Surveys conducted according to the R-6 protocol have occurred within the watershed every year since 1995. However, the watershed was not surveyed in its entirety but rather focused on specific planning areas, therefore productivity for each pair cannot be readily established. See Tables 10 and 11 for more information on survey areas and years surveyed and the reproductive history for each pair since 1995. The Obsidian and Suttle 96 pairs are the only pairs known to be found since 1996.

WL Table 10. Spotted owl survey areas and years surveyed within the Metolius Watershed.

Planning Areas	Years Surveyed
Jack Canyon	1996, 1997
Santiam Restoration	1996, 2001, 2002
McCache	1998, 1999, 2000
Non-Erfo Sites	1999
Lower Jack (part of Jack Canyon)	2000
Metolius Basin	2001, 2002
Eyerly	2003

WL Table 11. Reproductive history of known spotted owl sites within the Metolius Watershed.

Owl Site	Status 96	Status 97	Status 98	Status 99	Status 00	Status 01	Status 02
Abbot/Cabot	P-1	NA	NA	NA	Unk	Unk	NA
Bear Valley	P	P-1	P-1	Unk	S	Unk	S
Brush Creek	NA	NA	Unk	NA	Unk	Unk	Unk
Cabot**							
Cache East	NA	Unk	Unk	NA	Unk	Unk	Unk
Cache West	R/2	P	R/2	Unk	Unk	S	NA
Candle Creek	Unk	Unk	Unk	Unk	Unk	Unk	Unk
Canyon Creek	R/0	P	NA	NA	NA	S	NA
Castle Rocks	Unk	Unk	Unk	Unk	Unk	Unk	Unk
Davis Creek	Unk	NA	Unk	NA	Unk	NA	NA
Dry Creek	P-1	NA	NA	NA	Unk	Unk	NA
First Creek	P-1	NA	Unk	NA	Unk	S	NA
Jefferson Creek	Unk	P-1	Unk	Unk	Unk	Unk	Unk
Key West	NA	Unk	Unk	Unk	Unk	NA	Unk
Obsidian	Unk	Unk	Unk	Unk	Unk	P	P
Santiam Pass	R/1	NA	NA	NA	Unk	Unk	Unk
Spring Creek	P	P-1	P-1	NA	Unk	Unk	NA
Suttle	NA	P-1	P-1	NA	Unk	NA	NA
Suttle 96	R/2	NA	Unk	NA	Unk	NA	NA
Suttle South	P+1	P	R-0	NA	R/2	S	NA
Upper Canyon Creek	R/1	NA	Unk	Unk	Unk	Unk	NA

Notes:
** Cabot site was found to be the Abbot/Cabot pair site.
S = Single bird R/# = pair, nesting attempt/# of young P = pair site, occupied
NA = surveyed, not active P-1 = pair site occupied, 1 bird located Unk = unknown site status

There is a need to survey the watershed as a whole to gain more information on site fidelity, habitat needs, productivity of known sites and whether these sites are still viable.

Management Strategy

NRF:

A refinement is needed on where to manage for suitable spotted owl habitat. It would include the mixed conifer wet plant association group but would limit management to the CD plant series. This specific plant series is more likely to be sustainable and support higher stand densities needed by spotted owls. Prior to this proposal, management for suitable habitat included the entire MCW PAG and north slopes >20% in the MCD PAG. It is unlikely that these areas can provide high density, multi-layered stands that are sustainable.

- Manage existing NRF except those patches <2 acres.
- Identify the MCW CD series locations and promote the development of NRF in these areas except for Green Ridge (large tree habitat, multi-story stands, more canopy closure, etc.).
- Supplement the CD patches with other MCW plant series where needed to make a larger patch or where adjacent to a CD patch. These areas could provide foraging habitat with stands exhibiting slightly higher stand densities, 1-2 layers, etc.
- In MCD areas, promote the development of fire climax habitat focusing on large tree development (potential foraging and dispersal habitat).

WL Table 12. Suitable spotted owl habitat analysis within the Metolius watershed.

Habitat	Acres
Existing NRF in watershed	16,316 acres
Potential NRF in watershed (CD series)	17,822 acres
Existing NRF within potential NRF areas	4,068 acres

Due to the alignment of potential NRF and patch size, this would equate to managing for 8 pairs of spotted owls, which includes the wilderness. Much of the area has experienced stand replacement or mixed severity burn intensity. Therefore, stand development is beginning at the grass/forb/shrub stage and it may be 150-300 years before NRF is established and functional.

Connectivity:

Due to the loss of connectivity and looking at the alignment of potential NRF, a north/south corridor is proposed to facilitate movement across the landscape. The entire corridor extends slightly outside the watershed boundary (includes the Metolius LSR) but the majority lies within. It also includes the established corridor for the McCache project which is not totally functional. This corridor did not look out long-term and may need to be refined. Due to the extensive mortality within the McCache planning area, the corridor was placed in areas that were predominantly still green and did not consider the sustainability of these areas to persist long term. Most of the corridor occurs within mixed conifer dry and ponderosa pine PAGs.

- Two branches proposed – one along the east slope of the Cascades and another along Green Ridge (functional now).

- Move toward connecting patches of potential NRF by providing slightly higher stand densities in PAGs capable of sustaining this.

Table 13. Proposed corridor strategy as it relates to suitable NRF habitat within the Metolius watershed.

Area	Acres
Total Corridor Acres	41,179 acres
Total Acres within Watershed	32,247 acres
Potential NRF within Corridor	10,584 acres
Stand Replacement within Corridor	12,282 acres (30%)
Mixed Severity within Corridor	4,642 acres (11%)
Low Severity within Corridor	7,028 acres (17%)

As the table shows, the majority of the corridor is not functional at this time and treatments would need to be designed to promote the development of habitat. This may take at least 100 years before it becomes functional.

Recommendations

1. Survey the watershed in its entirety to determine if sites are still viable, if site locations have changed, and to gain more knowledge on habitat needs, responses to large scale events, etc.
2. Coordinate with the Forest to develop a study to refine habitat definitions which more likely depict east-side spotted owl habitat.
3. Coordinate with USFWS to determine how to address the loss of habitat and functionality of CHUs OR-3 and OR-4.
4. Coordinate with the Forest and USFWS to determine where and how to manage for future NRF looking at what burned.
   a. Adopt NRF strategy across the watershed. Coordinate with the Forest and USFWS to come to consensus on strategy.
   b. Adopt the connectivity strategy to provide dispersal in and out of the watershed. Coordinate with the Forest and USFWS to reach consensus on strategy.

TREND: Reduced population levels are expected within the watershed due to the loss of suitable habitat, the limited area in which to produce sustainable long-term habitat, the potential isolation of remaining pairs, and the loss of connectivity and dispersal habitat.

Bufflehead

The bufflehead is listed as a R6 Sensitive Species and has an undetermined status for breeding populations for the State of Oregon.

Buffleheads nest near mountain lakes surrounded by open woodlands containing snags. In many areas, the preferred nest trees are aspen but they will use ponderosa pine and Douglas-fir snags. In Oregon, most nest in artificial nest boxes. This duck eats both animal and plant material. However, during the breeding season, aquatic insects and larvae are the most important item in their diet. They also eat seeds of pondweeds and bulrushes. Bufflehead population numbers are generally low in Oregon and a shortage of natural cavities has brought attention to the breeding segment of the population. (Csuti et al. 1997)

No surveys have been conducted for this species. Buffleheads have been documented at Wizard Falls fish hatchery, Suttle Lake, Scout Lake, and the Meadow Lakes area (district files). Potential habitat exists around wilderness lakes, small water bodies in the Meadow Lakes area, Suttle Lake, Round Lake, and streams with open slack water.

Prior to the fires of 2002 and 2003, a trend toward decreased snag levels was occurring leading to a reduction of potentially suitable habitat. This was due in part to increased recreation use resulting in hazard tree removal around popular recreation destinations and firewood gathering. An increase in recreation use may have also led to increased disturbance potential especially around popular lakes and ponds both inside and out of the wilderness. The Meadow Lakes area was one such place experiencing these trends.

The fires have led to an influx of snag habitat. However, many of these snags are fire-hardened and may not be usable for some time by secondary cavity users. This may lead to more competition for remaining suitable snag habitat by a variety of species. After 15-30 years, much of the existing snag habitat will begin to fall and there will be a long lag time before suitable habitat is established. It is also unknown how the fires impacted small water bodies. The composition of plant and animal matter may have changed due to an increase in temperatures, sediment delivery, etc. This is yet to be determined.

Recommendations

1. Provide nest boxes around potential habitat to account for snag/cavity loss due to hazard trees, fire, etc.
2. Survey to determine if and where nesting is occurring.
3. Limit the use of some lakes in Meadow Lakes area to provide an undisturbed setting or limit vehicle use there. Designated campsites may also be an option to reduce disturbance in important areas.

TREND: Unknown. Due to the limited information on habitat needs and use of the watershed, effects of the resulting changes on this species are unknown. Continued snag loss and increased human use could limit use of the watershed.

Harlequin Duck

The harlequin duck is listed as a R6 Sensitive Species and has an undetermined status for breeding populations for the State of Oregon.

Harlequins breed along relatively low-gradient, slower-flowing reaches of mountain streams in forested areas. It is easily disturbed and seeks out the most remote streams for breeding. It uses swift waters and rapids during other seasons. They feed primarily on aquatic insects and their larvae, which are found on stream bottoms. (Cassirer and Groves 1989).

Potentially suitable habitat within the watershed includes Jefferson and Candle Creeks and the Metolius River. However, the Metolius River receives high recreation use. Caddisfly levels are good all along the river (Riehle, pers. comm. 11-28-01). However, the upper river is dominated by gravel and sand while the lower reaches are more dominated by cobble. The substrate found in the upper reaches along with high recreation use, may have some bearing on foraging success.

PGE and district employees conducted surveys for harlequin ducks along the Metolius in 1998. These surveys began at Jack Creek and proceeded to Lake Billy Chinook. No ducks were detected during these surveys (Concannon 1998). Two harlequins were sighted near the Wizard Falls fish hatchery bridge during the fall of 2001 (district files). It appears that the Metolius River may be an important stopover during migration.

Several fisheries enhancement projects have been implemented along the Metolius River by adding wood to the river. This has increased the quality of harlequin habitat as well by providing loafing sites and pool habitat. However, increased recreation use along this area may off-set the potential use of the river due to disturbance and degradation of some riparian habitat. The fires also reduced riparian vegetation along potential habitat, primarily Jefferson and Candle Creeks resulting in a short term loss of cover which may be important for nesting and foraging.

TREND: Unknown.

Canada Lynx

The Canada lynx was identified as a protection buffer species in the 1994 Record of Decision for the Northwest Forest Plan requiring additional protection measures. In 1998, the lynx was proposed for listing and an interagency team was formed to deal with emerging issues. Three products were produced: The Scientific Basis for Lynx Conservation (Ruggerio et al. 2000), the Lynx Conservation Assessment and Strategy (LCAS), and the Lynx Conservation Agreement.

Surveys were initiated in 1998 following a protocol developed by Dr. Weaver. The protocol was refined in 1999 by McKelvey et al. and surveys continued through 2001. No lynx were detected in Oregon from these surveys.

In 2000, the Canada lynx was listed as a threatened species. However, due to specific habitat requirements outlined by the Lynx Biology Team, it was determined that the Deschutes National Forest did not possess any suitable lynx habitat. Therefore, proposed and ongoing land management activities would have no effect on lynx or its habitat. This determination was based on the following information.

Verified Canada Lynx Records in Oregon and Their Correlation with Population Cycles in Canada and Alaska

There have been twelve verified[1] Canada lynx records in Oregon from 1897 (1), 1916 (3), 1920 (2), 1927 (3), 1964 (1), 1974 (1), and 1993 (1) (McKelvey et al. 2000). One specimen was collected in the Willamette Valley, two were collected from the Oregon Cascades (including one from the DNF near Lava Lake about 35 miles west/southwest of Bend, Oregon), one from the Steens Mountains (about 75 miles southeast of the ONF), one from the Stinkingwater Mountains (about 60 miles east of the ONF), six from the Blue Mountains, and one from the Wallowa Mountains (Verts and Carraway 1998). The specimen collected from Lava Lake on October 7, 1916, remains the only verifiable record of lynx having occurred on the DNF, ONF or the CRNG.

Verts and Carraway (1998), suggest that the occurrence of lynx in Oregon is directly related to cycles in snowshoe hare (*Lepus americanus*) populations in Alaska and Canada. A decline in snowshoe hare numbers following a peak in lynx populations in Alaska and Canada likely contributes to lynx dispersal south. Peak lynx populations in Canada occurred in 1896 (MacLulich 1937) and in Alaska in 1914-1916, 1916-1918, 1926-1928, 1963-1966, and 1974-1975 (Quinn and Parker 1987). McKelvey et al. (2000) reported that the three most recent specimens in Oregon were collected from anomalous habitats and were within several years of population peaks in western Canada. Thus, most of the verified lynx records in Oregon were collected during peaks in lynx populations in Alaska and Canada. Self-maintaining lynx populations in Oregon have not existed historically, and their occurrence here is likely the result of dispersal from occupied areas with declining prey populations (Verts and Carraway 1998, McKelvey and Aubry 2001). Like Oregon, verified records of lynx in North Dakota (16), South Dakota (10), and Nebraska (13) appear to be correlated with lynx population cycles in Canada (McKelvey et al. 2000).

Resident, Reproducing Lynx in Oregon

Extensive, standardized surveys have been conducted throughout the Pacific Northwest using remote cameras and hair-snag pads. No detections of lynx have resulted from these efforts outside of northeastern Washington. In 1999, 2000, and 2001 the DNF and ONF conducted lynx surveys designed to attract lynx to a to "cheek rub" on a carpet pad, leaving hair which was later collected for DNA testing (McKelvey et al. 1999). In 1999, three additional sites were surveyed by the US Fish and Wildlife service on the ONF using the "Weaver" survey design. None of these surveys resulted in lynx detections. Likewise, the USDA Animal and Plant Health Inspection Service (APHIS) has no record of a lynx ever being taken by wildlife services during predator control activities in the State of Oregon (Wagner 2003). The Lynx Biology Team reported that the Oregon Department of Fish and Wildlife (ODFW) had conducted aerial detection and snow tracking surveys on over 800 miles in the Cascade Region between the early 1970s and the middle 1990s to detect carnivores. In addition, ODFW was reported to have monitored 160 baited camera sites on National Forest System lands in the middle

[1] "Verified" records are described by McKelvey et al. (2000) as "…a museum specimen or written account in which a lynx was either in someone's possession or observed closely, i.e., where a lynx was killed, photographed, trapped and released, or treed by dogs."

1990s. No lynx were reported as a result of these surveys.

The Final Rule published in the Federal Register on March 24, 2000 (50 CFR Part 17) states: "…we cannot substantiate the historic or current presence of a resident lynx population in Oregon." In their response to a paper prepared by the US Fish and Wildlife Service, McKelvey and Aubry (2001) state that "…as our assessment of available lynx data…indicate, there is no compelling body of verifiable evidence to suggest that resident populations of lynx have ever occurred in Oregon or Western Washington." Furthermore, they describe the conclusion reached by Verts and Carraway (1998) that in Oregon, "…no evidence of self-maintaining populations of lynxes in the state exists."

Habitat Mapping

The Lynx Biology Team describes the history and rationale for modifications in lynx habitat mapping advice and guidance since 1999 (Claar et al. 2001). In 1999, mapping was designed "…in order to: 1) include all potential areas within which to direct lynx survey efforts, and 2) provide an inclusive outer lynx habitat map boundary within which to begin further refinements." By 2000, guidance for mapping lynx habitat incorporated historical and current distribution information contained in Ruggerio et al. (2000). Guidance was "…based on literature related to lynx habitat and home ranges, discussions with the Lynx Science Team, Biology Team, and biologists from the Boise, Portland, and Lacey U.S. Fish and Wildlife Service offices." Lynx habitat mapping on the DNF, ONF and the CRNG in 2000 and 2001 reflect the advice and guidance provided by the Lynx Biology Team in 1999 and 2000, respectively.

The Lynx Biology Team concluded in October of 2001 that "The best scientific information available suggests that the conditions that provide some minimum density of snowshoe hares combined with adequate distribution of those hares across the landscape create conditions that support lynx." They stated that those conditions were "…best expressed in the Subalpine Fir Series…" which is "…a reasonable surrogate for describing lynx habitat conditions…" and that "Early seral vegetation in the subalpine fir series is an important component of lynx habitat because of its relationship to snowshoe hare density" (Claar et al. 2001). The team also reported that all investigations into habitat used by lynx in the southern portion of its range showed an association between lynx and lodgepole pine cover types within the subalpine fir series. Therefore, the most recent advice and guidance and the best scientific information available suggest that subalpine fir plant associations capable of supporting some "minimum density" of snowshoe hare are a reasonable surrogate for describing lynx habitat conditions primary vegetation to support survival and reproduction and constitute a Lynx Analysis Unit [LAU]).

On the DNF, one plant association (subalpine fir-englemann spruce) is considered primary vegetation that could contribute to lynx habitat. If enough primary vegetation is present (about 6,400 acres) then other cool moist habitat types may contribute to lynx habitat if they are intermixed with primary vegetation. Only 3,650 acres of subalpine fir plant associations occur across the entire Deschutes National Forest. Three other alpine parkland plant associations (alpine parkland sedge, alpine parkland woodrush, and alpine parkland sagebrush) are capable of producing some clumps of subalpine fir forest but, based on observations of local biologists, they are not capable of supporting adequate snowshoe hare populations to support resident lynx. Likewise, Naney (pers. comm. 2003) reported that Franklin and Dryness (1973) classify the subalpine parkland as a transitional area where "tree dominance is gradually giving way under the increasingly harsh alpine environment" and suspect that deep late snow packs are the reason for the forest/meadow ecotone. Naney (pers. comm. 2003) agreed that subalpine parklands do not appear to provide the necessary conditions to support snowshoe hare that prefer denser more closed canopy forests. About 3,500 acres of alpine parklands occur on the DNF. Two other plant associations (mountain hemlock subalpine parks and lodgepole-whitebark pine-alpine) included in earlier, more inclusive mapping efforts, are not considered primary vegetation that could contribute to lynx habitat.

The Lynx Conservation Assessment and Strategy (LCAS) (Ruediger et al. 2000) identified the need for at least 10 square miles (6400 acres) of primary vegetation to support survival and reproduction and constitute a LAU. The basis for recommending 10 square miles of primary vegetation was derived from Koelher (1990). Based on our analysis the ONF, DNF, nor the CRNG, have adequate primary vegetation to develop an LAU or support lynx survival and reproduction; therefore we have no mapped lynx habitat on the Forests or any LAUs within which to apply the LCAS habitat objectives.

TREND: No lynx habitat is currently mapped in the Cascade Mountains of Oregon. The nearest mapped lynx habitat in the Cascade Mountains lies several hundred miles north of the DNF on the Mt. Baker-Snoqualmie National Forest in Washington. No habitat has been identified south of the DNF in the Cascade Mountains. It is, therefore, unlikely that the ONF, DNF, nor the CRNG are important for maintaining connectivity between lynx populations and/or habitat.

California Wolverine

The classification for the wolverine has changed from a Candidate species to a federal species of concern. It is also included on the R-6 Sensitive Species list and is listed as threatened for the State of Oregon.

Wilderness or remote country where human activity is limited appears essential to the maintenance of viable wolverine populations. Habitat use is probably dictated largely by food availability; wolverines are primarily scavengers, but also depend on a variety of prey items. High elevation alpine wilderness areas appear to be preferred in summer, which tends to effectively separate wolverines and humans. In winter, they tend to den in the ground under snow or in rocky ledges or talus slopes (Ingram 1973; Banci 1994). However, Copeland (1996) found they tended to prefer montane coniferous forest habitats during the winter. Wolverines make little use of young, thick timber and clear-cuts (Hornocker and Hash 1981). Wolverines were documented using burn areas in Idaho (Copeland 1996) from immediately after the fire to up to several years after the event. These seemed to be associated with following ungulate herds.

Wolverines appear to be extremely wide-ranging and unaffected by geographic barriers such as mountain ranges, rivers, reservoirs, highways, or valleys. For these reasons, Hornocker and Hash (1981) concluded that wolverine populations should be treated as regional rather than local. However, Edelman and Copeland (1999) suggest that wolverine populations move along corridors of mountainous habitats and that features such as the Columbia River Gorge and shrub-steppe habitats serve as barriers to dispersal. They also conclude that sightings occurring across the arid mountains of Central Oregon may suggest a movement corridor from the Cascade Mountains to the Wallowa Mountains.

Several historic sitings have been documented in and around the watershed. One siting occurred near Suttle Lake, while the remainder of sitings occurred within the Mt. Jefferson and Mt. Washington wilderness areas. The watershed is fragmented with open road densities averaging 2.02 miles/sq. mile. However, this density also includes the wilderness area and includes a large portion of roadless area therefore, shows overall lower densities. Areas within the watershed comprised of low elevation ponderosa pine forests and areas that receive heavy recreation use may not be suitable for wolverine use.

Two aerial flights were conducted of the Three Sisters, Mt. Washington, and Mt. Jefferson wilderness areas and adjacent roadless areas during the winter/spring of 1998 and 1999 by an interagency group consisting of several National Forests, ODFW, and PNW. A potential den site was located south of the project area during the 1998 flight, but nothing was detected during the 1999 flight. The den site also corresponds to an earlier visual sighting in the same vicinity in 1992. Infrared camera systems were placed near the wilderness boundary to try and detect wolverine presence. Wolverine were not detected using this method. No other surveys have been conducted for this species.

The B&B fire burned a large majority of the Mt. Jefferson wilderness resulting in stand replacement in most of the area. It is unknown how this will affect wolverine use of the area. However, an increase in big game populations is predicted over the next few years and this is likely to be beneficial for local wolverine. Due to the openness of the area, an increase in use may also occur due to mushroom picking, firewood removal, hunting, and winter recreation. This may lead to an increased disturbance potential, especially if encroachment into the wilderness continues.

Recommendations

1. Continue to close roads to reduce road densities, primarily in stand replacement areas where little cover is remaining.
2. Consider seasonal road closures to reduce disturbance to big game populations and to enhance wolverine foraging success.
3. Enforce wilderness policies and guidelines to reduce the potential for wilderness encroachment by motorized equipment.
4. Coordinate with State and Federal agencies to continue to survey remote areas to determine areas of wolverine use for protection.

TREND: Unknown. Increasing recreation trends and human use patterns within the watershed may lead to a decline. However, the potential for an increase in big game populations may lead to an increase in use. More information is needed on wolverine use of the watershed and how fire effects this species.

Pacific Fisher

The fisher has changed to a Federal species of concern and is included on the R-6 Sensitive Species list.

Fisher populations are considered to be extremely low in Oregon, Washington, and parts of the Rocky Mountains. They occur in landscapes dominated by late-successional and mature forests. Fishers have been found to use riparian areas disproportionately to what exists. On the Westside of the Cascades, fishers tend to be associated with low to mid-elevational forests dominated by late-successional and old growth Douglas-fir and western hemlock. However, on the eastside of the Cascades, they occur at higher elevations in association with true firs and mixed conifer forests. They tend to prefer areas with high canopy closure and late-successional forests with relatively low snow accumulations. Critical features of fisher habitat include physical structure of the forest and prey associated with forest structure. Structure includes vertical and horizontal complexity created by a diversity of tree sizes and shapes, light gaps, down woody material, and layers of overhead cover. Major prey species include small to medium sized mammals, birds, and carrion. Porcupine are the best known prey species but fisher will also prey on snowshoe hare, squirrels, mice and shrews. (Powell and Zielinski 1994)

Large forest openings, open hardwood forests, and recent clearcuts were found to be infrequently used by fishers in the West (Ruggerio et. al 1994). Fishers have shown an aversion to open areas and this has affected local distributions and can limit population expansion and colonization of unoccupied areas (Coulter 1966, Earle 1978). However, Kelly (1977) found that fishers tended to use recently harvested areas when brush and saplings provided some low overhead cover but these areas were avoided during the winter.

Much of the watershed has now experienced stand replacement wildfire and large tracts of late-successional forests have been impacted by recent insect and disease events reducing habitat quality due to more open stand conditions. More open stand conditions also result in greater snow accumulations, which may result in lowered habitat quality over large areas. Snow accumulations tend to be fairly deep in this area (4-5' deep on average in areas). Therefore, increases in fragmentation may delay expansion of fisher occupation in the watershed until such time as higher density stands become frequent on the landscape. The loss of large structure across the landscape from disturbance events (wildfire, insects, and disease) may also lead to reduced survivorship of fishers until conditions are restored.

TREND: Downward trend from historic levels due to the increase in open stand conditions, lack of suitable habitat, and loss of connectivity.

Townsend's Big-eared Bat

This species was removed from the R-6 Sensitive Species list for this forest. Discussion pertaining to this species will be included under the BATS subheading.

Oregon Spotted Frog

The Oregon spotted frog is a federally proposed threatened species.

Spotted frogs generally inhabit warm (>20C) perennial marshes, lakes, ponds, or slow moving waters with abundant aquatic vegetation (Corkran and Thoms 1996). This species is most often associated with non-woody wetland plant communities with species such as sedges, rushes, and grasses (Leonard et al. 1993). They require very shallow water for breeding, and often use flooded meadows or water trapped in flattened vegetation at the edges of ponds. Populations have been reduced throughout much of their range due to wetland reclamation and introduction of non-native amphibian and fish species (Leonard et al. 1993; Corkran and Thoms 1996).

The watershed contains streamside riparian habitat along many streams and the Metolius River along with other riparian habitats like springs found in Allingham meadow. However, suitable habitat for spotted frogs is very minimal in the watershed. Water temperatures are generally too cold and emergent wetland vegetation is absent except in isolated areas. There are no known occurrences of spotted frogs on the Sisters Ranger District.

Very few surveys for amphibians have been conducted within the watershed. A survey in 1995 of Jack Creek yielded Cascades frogs. First Creek was surveyed, however, no spotted frogs were found (district files).

Approximately half the riparian areas burned to some degree many of which experienced stand replacement. Fire may have resulted in the consumption of non-woody vegetation. However, this will be a short term impact. Water bodies may see an increase in water levels due to the loss of other vegetation. This may be both beneficial and negative as more wet areas may be present and some existing sites may be to deep for this species. It is unknown how the fires changed small water bodies or how it may have impacted existing populations and dispersal.

Recommendations

1. Collaborate with research to determine fire effects on montane amphibian species.

TREND: Unknown. No spotted frogs have been located on the Sisters Ranger District.

Management Indicator Species (formerly Species of Concern)

Northern Goshawk

The goshawk is no longer a Candidate species but has been changed to a species of concern. It is also referred to as a management indicator species (MIS) in the Deschutes Land and Resource Management Plan (1990).

This species is associated with mature and old growth forests, and is a fire and climatic climax focal species for the watershed. All mature and late-successional habitats are considered potential nesting habitat and all other forested seral stages are considered potential foraging habitat. Moist mixed conifer and moist ponderosa pine late-successional areas are preferred habitats. Preferred nest stands have a minimum of 40% canopy cover. Nest sites within these stands have >60% canopy closures. (Reynolds et. al 1991).

Seven known goshawk sites were present within the Metolius WA boundary. See WL Table 14 for more information. Jack Canyon, Roaring Creek, Link Creek, and First Creek nest sites were all impacted by the B&B fire while the remaining three sites have not been impacted.

WL Table 14. Known northern goshawk nest sites within the Metolius Watershed.

Site Name	Legal Location	Date Nest Last Active
Jack Canyon	T.12S., R9E., Sec 30/31	1997
Roaring Creek	T.12S., R9E., Sec 19	1994
Link Creek	T.13S., R8E., Sec 29	1995
First Creek	T.13S., R9E., Sec 7	1993
Lower Bridge	T.12S., R9E., Sec 2	1994
Davis Creek	T.13S., R9E., Sec 9	1995
Wizard Falls	T.12S., R9E., Sec 23/14	1987

Surveys completed since 1995 within the watershed boundary include the following project areas (WL Table 15).

WL Table 15. Northern goshawk survey areas and years surveyed.

Project Area	Year Surveyed
Jack Canyon	1995
McCache	1999
Metolius Basin	2001
Metolius Demo	2002

The fires of 2002 and 2003 resulted in a decrease in both mature and late-successional stands and canopy cover over a large proportion of the watershed. This has led to a decrease in potentially available habitat for this species. However, where underburning occurred, habitat may have been enhanced by opening up the understory and allowing for greater use of these stands.

Much of the existing habitat has a significant white fir component, is overstocked, and in some areas, has a high occurrence of disease problems. Mixed conifer stands would continue to lose large ponderosa pine and Douglas-fir components being replaced by white fir. Canopy closure may be sufficient for goshawks, however large structure would be sparse over the landscape and may reduce potential nesting habitat.

Recommendations

1. Consider the following strategy for managing for goshawks primarily in mixed conifer and ponderosa pine PAGs within the Metolius watershed.

Goshawk habitat can be determined by looking primarily at three factors – total canopy closure, size class of existing trees, and the number of canopy layers. This information can be gathered from stand exam data where available. If this information is not available from stand exams, photo interpretation data can be used. Goshawk habitat is considered to exist in all PAGs with no requirements on species composition. The following stand parameters are used to delineate goshawk habitat.

% Canopy Closure	Size Class	# Canopy Layers
Nesting:		
>60%	>9" dbh	>1
Foraging:		
>40%	>9" dbh	1 or 2

Moore and Henney (1983) found that accipiters in general use macrohabitats (i.e. patches) across the landscape. Therefore, managing small (30-50 acres) patches in appropriate PAGs may allow goshawks to reoccupy the watershed over time.

2. Consider following the draft Regional guidance for goshawk management.
   a. Protect at least 30 acres of the most suitable nesting habitat around active sites.
   b. Consider establishing a 400 acre Post-Fledgling Area (PFA) around each active site.
3. Survey potential habitat to determine the approximate population size within the watershed and to gather more information on habitat requirements.
4. Treatment of remaining areas may be appropriate to reduce risk of loss.

TREND: A downward trend is expected due to the loss of mature and late-successional habitats and canopy cover over a large portion of the watershed.

White-headed Woodpecker

The white-headed woodpecker has been identified in the Northwest Forest Plan as a species needing additional mitigation measures to ensure viability. It is also listed as a focal species in the *Conservation Strategy for Landbirds of the East-Slope of the Cascade Mountains in Oregon and Washington* for ponderosa pine – large patches of old forest with large snags. The Birds of Conservation Concern (2002) list the white-headed woodpecker as a species in need of conservation action for BCR (Bird Conservation Region) 9 (Great Basin). Thus, this species has received a lot of attention in the past few years due to the loss of habitat from fire suppression primarily. It is also a focal species for ponderosa pine plant associations for the Metolius watershed.

The white-headed woodpecker is the focal species for fire climax ponderosa pine. The preferred habitat is typically a mosaic of open forests containing mature and old growth ponderosa pine trees, interspersed with patches of second growth. All stands with a significant component of mature and old growth trees are considered potential habitat The white-headed woodpecker nests in large diameter snags (>1/ac 25" dbh or greater) with moderate to extensive decayed wood. It relies heavily on seeds of conifers (primarily ponderosa pine) to supplement their diet of insects from tree bark and lichens (Dixon 1995, Frenzel 1999).

Wisdom et al. (2000) has found that white-headed woodpecker habitat has declined by more than 60% from historical to current times and has been eliminated in >40% of the watersheds within the Inter-Columbia Basin area. Fire suppression is the primary factor for this decline. It has led to increased shrub cover and understory layers which has led to an increase in small mammal and avian predation on white-headed woodpeckers. The loss of old growth ponderosa pine and large snags has led to an increase in competition for nest sites. It has also decreased the seed source, a primary food source.

As noted in Wisdom et al., there is limited suitable habitat on the district for white-headed woodpeckers. The 1996 Metolius watershed analysis also shows this with the loss of large open ponderosa pine stands. This has led to a decline in white-headed woodpecker populations and these populations may be acting as sink populations (Frenzel 2002). Factors contributing to this include a low density of existing snags and the diminished availability of cavities for other cavity excavators, increased shrub densities and understory layers, and the selection of nesting sites near edges which may mimic more open pine habitat. However, woodpeckers using these sites may be more visually apparent to predators and other cavity excavators and have lower success rates than those found in differing stand types.

A white-headed woodpecker study was initiated in 1991 through 1993 by Rita Dixon to determine important habitat characteristics for this species. The Metolius area was one of her study sites. It was later followed up (1998-2003) by the Nature Conservancy and Richard Frenzel as part of a Challenge Cost Share project with the Forest in hopes of furthering our knowledge on white-headed woodpecker habitat. Multiple nests were located in the study areas from these efforts, primarily between the 1419/1420 Road and just east of the Metolius River to the base of Black Butte.

In addition, a monitoring strategy was established in 2003 to test the effectiveness of different treatments designed to enhance white-headed woodpecker habitat for the Metolius Basin Forest Management project. This will be an ongoing strategy as funding allows.

The fires of 2002 and 2003 had varying results on white-headed woodpecker habitat. Areas experiencing stand replacement burn intensities are virtually unsuitable for white-headed woodpeckers. This is due primarily to a lack of a seed source and the insects to glean from the bark which are primary food sources. Mixed severity areas resulted in some patches of killed trees. However, stand densities were reduced, and shrub and brush layers were reduced as well as down woody material. Snags in later decay stages more typically used by this species were potentially consumed which may further limit nesting structure. However, due to the mosaic nature of this type of burn intensity, unburned patches still remain. Underburned areas saw fewer trees killed and potentially fewer snags consumed but also resulted in beneficial treatments to the area. Reduced down woody material, shrub and brush layers may also result in decreased small mammal populations resulting in less potential for predation. Potential habitat within the Eyerly fire experienced stand replacement burn intensity over most the area which will equate to long-term recovery. The B&B fire area experienced more of a mix of burn intensities in the ponderosa pine PAGs allowing for both long and short term recovery.

Continued fire suppression has led to unsuitable conditions for this species. Due to this, an increase in shrub layers is likely to persist. Increased shrub layers may lead to an increase in small mammal densities which could lead to increased predation pressures on white-headed woodpeckers (Frenzel 1999).

Increased stand densities perpetuates the problem of losing large structure over time, which is required for suitable nesting and foraging habitat. It also allows for less available nest sites, which could result in more competition for existing sites between species and may lead to greater predation risks. Increased stand densities may increase the risk of loss from fire. This species requires snags for nesting and it utilizes softer snags (moderate decay). These structures would be consumed more rapidly with increased fire intensities and may lead to large areas of the landscape being unsuitable if such an event were to occur.

Management Strategy

A long term strategy for the management of potential white-headed woodpecker habitat was initiated for this analysis to help determine where development of habitat is most warranted and how it relates to other issues and concerns. First, all large blocks of ponderosa pine wet and dry PAGs were identified as potential habitat. This occurs primarily within the Metolius Basin, the Horn of the Metolius, and some smaller blocks south of Highway 20. A large block of mixed conifer dry was also included as potential habitat adjacent to the Dahl Ranch. This area was surrounded by ponderosa pine and is dominated by ponderosa pine. Therefore, to simplify management, it was included. Small isolated patches were not included along with a linear strip occurring on Green Ridge. The area along Green Ridge was identified as a potential connectivity corridor for species like the spotted owl. Identification of this potential habitat is being conducted at a gross scale and should be refined during site-specific project analyses. The overall goal is to produce stands with large ponderosa pine, open understories, decreased shrub layers, and minimum down woody material levels.

White-headed woodpecker habitat is determined by looking primarily at four factors – percent canopy closure, size class of existing trees, number of canopy layers, and the number of large trees over both 21" and 32" dbh. This information can be gathered from stand exam data where available. If it is not available from stand exams, photo interpretation data can be used. White-headed woodpecker habitat is considered to exist in the PPD, PPW, MCD, and MCW PAGs where species composition must be early or mid seral for the MCD and MCW PAGs. The following stand parameters are used to delineate white-headed woodpecker habitat.

% Canopy Cover	Size Class	# Canopy Layers	Med/Lg Trees
20-40%	>8"	1 or 2	Min 10 >21" or 2 tpa >32"

Part of the Metolius watershed is located within the ponderosa pine PAG where the white-headed woodpecker has been identified as a focal species. A recently released draft of the Decayed Wood Advisor (DecAID) by Marcot et al. (2000) is an advisory tool to help land managers evaluate effects of forest conditions and existing or proposed management activities on organisms that use snags, down wood, and other wood decay elements. DecAID shows levels of "assurance" or confidence of providing for a particular species (tolerance levels). Following is data from the ponderosa pine/Douglas fir habitats. The potential white-headed woodpecker habitat is listed in Table 16.

A **tolerance interval** is similar to a confidence interval but with a key difference: tolerance intervals are estimates of the percent of all *individuals* in the population that are within some specified range of values. In the DecAID Advisor tolerance *levels* are used. Levels are one-sided intervals with the lower limit of the interval being zero. Thus, an 80% tolerance level indicates 80% of the individuals in the population have a value for the parameter of interest between 0 and the value for the 80% tolerance level. Or conversely, 20% of the individuals in the population have a value for the parameter of interest greater than the 80% level. An alpha level of 0.10 was used when calculating the tolerance levels. For example, an 80% tolerance level of wildlife use of snag diameter (dbh) means that 80% of all individuals observed of some species (combined across one or more wildlife studies) uses snags less than or equal to some specifiec dbh, and 20% use snags greater than that dbh.

WL Table 16. Potential snag levels prescribed by the DecAID advisory tool for white-headed woodpeckers for the ponderosa pine/Douglas-fir habitat type.

Snag Size	30% Tolerance Level	50% Tolerance Level	80% Tolerance Level
≥ 15 cm (5.9" dbh)	1.1 snags/ac	4.0 snags/ac	8.2 snags/ac
≥ 25 cm (9.9" dbh)	0.3 snags/ac	1.7 snags/ac	3.7 snags/ac
≥ 50 cm (19.7" dbh)	0.5 snags/ac	1.8 snags/ac	3.8 snags/ac
Total snags/ac	**1.1 snags/ac**	**4.0 snags/ac**	**8.2 snags/ac**

As you can see from WL Table 16, the 25 and 50 cm size classes are subsets of the 15 cm size class. For example, for the 50% tolerance level a total of 4.0 snags per acre are needed. This equates to 0.5 snags/acre needed in the 15 cm size class, 1.7 snags/acre in the 25 cm size class, and 1.8 snags/acre needed in the 50 cm size class.

Recommendations

1. Manage for late-successional fire climax ponderosa pine stands with open understories by adopting the white-headed woodpecker habitat strategy for the watershed.
2. Limit large snag removal in green stands.
3. In stands impacted by fire, keep shrub densities low to accelerate growth of the new stand.
4. Consider continuing the ongoing research project. This project has established important baseline data and can be used as a long term study to gain additional knowledge of the white-headed woodpecker.
5. Continue effectiveness monitoring and incorporate findings into future projects.

TREND: Decreasing in the short term due to increased stand densities, lack of suitable nesting structures (snags), and loss of large ponderosa pine. Potential for an increased trend with proposed vegetation treatments and results from the fires.

Cooper's and Sharp-shinned Hawk

The Cooper's and sharp-shinned hawks are new additions to the watershed analysis. They are considered Management Indicator Species in the Deschutes National Forest Land and Resource Management Plan.

Cooper's hawks often pursue and capture their prey in the air. They routinely use dense cover to hunt. Frequently taken prey includes robin-sized birds, however small mammals will be taken occasionally. They are generally found in densely wooded coniferous forests and to a lesser degree, in deciduous woods. They select nest sites in dense second growth of mixed conifer and ponderosa pine stands usually near water. (Jackman and Scott 1975). Moore and Henney (1983) noted that Cooper's hawks routinely utilize mistletoe brooms as nesting sites as well.

The sharp-shinned hawk is an aerial predator pursuing and capturing most of its food in the air. It feeds primarily on sparrow and warbler sized birds. Suitable habitat usually includes thickets in mixed conifer and deciduous woods. It routinely uses dense cover to escape detection by predators or from being harassed. (Jackman and Scott 1975).

Nesting habitat has been grouped into 3 types by Reynolds (1976):

1. Young, even-aged conifer stands with single-layered canopies
2. Mature, old-growth stands of mixed conifer with multi-layered canopies
3. Dense stands of aspen

Nests are usually located in cool, moist, well-shaded stands with little (<10%) ground cover. Sharp-shinneds usually place their nests in the densest portion of the canopy.

No formalized surveys have occurred for these two species however, both have been documented within the watershed. Documentations were gathered from sitings from other species surveys occurring or from casual observations.

The fires of 2002 and 2003 have resulted in a decrease in potential habitat especially in the stand replacement and mixed severity burned areas. However, as stands begin to reestablish, habitat may be provided in approximately 60-80 years but resulting monotypic stands may be more widespread with fewer "patches" on the landscape. Moore and Henney (1983) found the best potential for nesting habitat are younger successional stands with a high density of foliage in layers from 3 to 15 meters.

In areas not impacted by fire, stand densities would continue to increase due to white fir encroachment. This would increase the potential habitat over time. However, with increased stand densities comes increased risk of loss from disturbance events. These events would likely impact the densest stands the greatest due to the stand conditions which would result in reduced availability of suitable habitat in the project area.

TREND: Decreasing for the short-term until stands begin to reestablish.

Great Gray Owl

The great gray owl is a new addition to the watershed analysis. This species was identified in the NWFP (1994) as a protection buffer species requiring surveys due to an apparent range expansion resulting from opening up dense-canopied stands with shelterwood type harvest activities. A Regional protocol was developed in 1995 and surveys have been implemented. An amendment to the NWFP occurred in 2001 which moved the great gray owl from a protection buffer species to a Category C species. This category contains uncommon species for which pre-disturbance surveys are practical. Therefore, surveys are conducted at the project level prior to habitat disturbing activities. All known nest sites will be managed according to Management Recommendations. These have not been established to date.

This species represents the focal species for mature stands associated with meadows or like openings. Mixed conifer/lodgepole pine/mountain hemlock communities associated with meadows are considered the preferred habitat for this species. Recent studies in the Blue Mountains (Bull and Henjum 1990, Bull et al. 1988) have shown that owls will inhabit openings created by timber harvest activities, especially those that mimic natural gaps. Some mature and late-successional ponderosa pine stands may provide habitat as well especially if they possess dense inclusions with open understories.

Surveys have been conducted within the watershed since 1996 with varied results. See WL Table 17 for more information on survey area and year.

WL Table 17. Great gray owl survey areas, year surveys were conducted, and results.

Survey Area	Years Surveyed	Results
Suttle	1996	None located
McCache	1998, 1999	None located
Metolius Basin	2001, 2002	One nest located
Black Butte (part of Metolius Basin)	2002, 2003	None located
Eyerly	2003	One auditory response

An additional activity center was located during spotted owl monitoring of historic sites in 2002. A pair and two young were observed however, no nest was located. The following table displays where additional responses have been heard or observed. Most were detected during spotted owl surveys.

WL Table 18. Additional great gray owl responses or observations.

Survey Area	Year	Legal Location	Response or Observation
Jack Canyon	1996	12S, 8E, 34 NW NE	Response
Santiam	2002	13S, 8E, 02 SE SE	Response
Historic Spotted Owl Monitoring	2002	12S, 8E, 35 SW SE	Observation – Pair + 2 juveniles
Local College Professor	2003	12S, R9E, 31 NE	Observation

Two nest areas were known within the watershed, Cracker Jack and Canyon Draw. Both sites had similar characteristics as both were located in mature mixed conifer wet stands with adjacent openings created by past timber harvest. These stands both exhibited a shelterwood appearance and were open for foraging. Both nest stands contained adequate structure for young to utilize after leaving the nest. It is unknown how these two great gray owl sites will respond to the recent events. It is also unknown if additional sites were present within the watershed and if the surrounding landscape will provide suitable conditions for continued or further occupation by great gray owls.

The results of the insect infestation of the early 1990's along with timber harvest resulted in an increase in potential great gray owl habitat due to more open understories and openings for foraging. The fires of 2002 and 2003 have also created a large increase in foraging habitat especially in stand replacement and mixed severity stands. However, nesting habitat may have been decreased. Since this species relies on existing nests from other raptor species or broken top snags for nesting, it is assumed many of these structures were potentially consumed in the fires in stands heavily impacted. Therefore, nesting structure may be the limiting factor for occupation in the watershed. However, Bull and Henjum (1990) found that great gray owls readily accept artificial nest structures and that this structure may be relatively unimportant compared to the nest site habitat and the availability of foraging habitat. There is also the potential that nesting structure will be created by other disturbance factors such as wind. High wind events could result in snapped off trees and snags which could equate to potential nest structures.

Recommendations

1. Conduct landscape level surveys to determine great gray owl presence and habitat preferences as related to large scale disturbances.
2. Consider the installation of platforms if nesting structure is found deficient and management of this species is warranted.
3. Continue to enhance existing habitat, especially around natural meadows, by thinning or other appropriate vegetation treatments.

TREND: Potential increase based on the increase in foraging habitat and assuming adequate nesting structure is available. However, loss of large trees and snags may limit use.

Great Blue Heron

The great blue heron is listed as a MIS in the Deschutes LRMP. This species was not included in the previous watershed analysis.

Great blue herons are colonial nesters and nest in large deciduous and conifer trees adjacent to water. They forage in shallow water or open fields for fish, crustaceans, insects, rodents, amphibians, and reptiles. They are very sensitive to disturbance, especially during the nesting season. (Jackman and Scott 1975).

A historic rookery was located in 1981 in T.13S., R.9E., Section 10. It was active until 1994. Records indicate that it hasn't been surveyed since that time (district files). It was surveyed in the summer of 2002 but was not located. Riparian reserves along the Metolius River, larger streams, and lakes provide marginally suitable habitat as well as meadows in the watershed and on private lands within the watershed boundary. However, abundance of prey may limit use in some areas.

In the absence of disturbance events, habitat trends would continue with increased stand densities, canopy cover, down woody debris and snags. Meadow habitat may also exhibit conifer encroachment, which would limit available foraging habitat. Over time, large diameter trees would be replaced by white fir and other less tolerant or short-lived species. This would limit future nesting structure due to the loss of large structure. Increased stand densities may also lead to smaller limb structure, which would limit nesting habitat.

Continued hazard tree removal in recreation sites has led to a decrease in large live trees adjacent to potentially suitable habitat. In addition, throughout the watershed, recreation use is increasing. This has led to increased disturbance potential. It is hypothesized that recreation use may be displaced into areas not affected by the fires. This may increase impacts to great blue herons since it is likely they would also seek out these areas. The fires have also led to a decrease in large live trees adjacent to potential habitat. However, great blue herons may nest in snags but this would only provide short term habitat.

TREND: Decreasing in watershed due to increased disturbance potential and until large trees become established throughout.

Waterfowl

This is a new group of species added to this update. Waterfowl are listed in the Deschutes LRMP as MIS species.

Open lakes, ponds, streams, rivers, and wet/dry meadows provide foraging habitat for most waterfowl species. Some species utilize large snags for nesting, while others utilize open grassy areas near the water's edge. Most waterfowl diets consist primarily of vegetation although some animal matter (caddisflies, crustaceans, and mollusks) may be consumed. (Csuti et. al 1997).

Ten waterfowl species, excluding the species mentioned earlier in the report, have been documented in the watershed (mallard, canvasback, common merganser, hooded merganser, wood duck, green-winged teal, blue-winged teal, ring-necked duck, Barrow's goldeneye, and Canada goose). Most sitings have occurred along Lake Creek, the Metolius River, the meadows associated with Lake Creek and the Head of the Metolius, Suttle Lake, and the Meadow Lakes area (district files). Potential habitat exists along the Metolius River, major streams, lakes and some meadow areas (i.e. Allingham meadow). However, much of the suitable meadow habitat occurs on private land. No formal surveys have occurred for most waterfowl species to date.

Continued hazard tree removal in recreation sites has led to a decrease in potential nesting habitat for cavity dwelling waterfowl. In addition, throughout the watershed, recreation use is increasing. This has led to increased disturbance issues and degradation of habitat, especially within the Meadow Lakes area. However, it is hypothesized that recreation use may be displaced into areas not affected by the fires. This may reduce some impacts to nesting and migrating waterfowl. The fires may also lead to an increase in grassy vegetation along some streams and lakes which would increase forage potential. However, for species who also consume animal matter, forage may be decreased by the fire as crustaceans and mollusks were likely consumed by the fire.

Recommendations

1. Conduct surveys to determine areas of importance for waterfowl.
2. Place boxes around areas heavily impacted by both hazard tree removal and fire to provide nesting sites.
3. Limit the use of some lakes in the Meadow Lakes area to provide an undisturbed setting or limit vehicle use there. Designated campsites may also be an option to reduce disturbances in important areas.

TREND: Potential decrease in cavity dwelling species due to loss of large snags from the fires and continued hazard tree removal. Potential increase in species associated with grassy vegetation.

Red-tailed Hawk

The red-tailed hawk is a new addition to the watershed analysis. It is identified in the Deschutes LRMP as a Management Indicator Species.

The red-tailed hawk inhabits mixed country of open areas interspersed with woods (agricultural areas, grasslands, woodlands, meadows). They roost in thick conifers and nest in large conifer snags often in the tallest tree on the edge of the timber. They feed mainly on small rodents (mice, squirrels) but eat larger mammals (skunks, rabbits), birds, reptiles, and insects. (Jackman and Scott 1975).

Past harvest activities had produced habitat conditions favorable for red-tailed hawks by clear-cutting stands adjacent to mature and late successional stands. This provided open areas for foraging adjacent to potential roosting and nesting habitat. Numerous sitings have occurred throughout the watershed however, no known nests have been documented.

Outside the fire areas, suitable habitat would be maintained for the short-term until past harvest units begin to grow, which will reduce foraging opportunities. Large snags and trees will remain on the landscape. However, stand densities will continue to increase with white fir out-competing ponderosa pine and Douglas fir. Over time, large trees may become limited due to white fir encroachment. Increased stand densities also increases the risk of a large scale fire event occurring, which may result in a loss of large snags and structure. This would reduce both existing and future nesting habitat.

The fires have created a landscape with more edge habitat and an influx of snags. However, the open landscape may only be available short term until new stands begin to grow. In addition, snags created by the fire may only last 15-30 years as well.

TREND: Increasing in the short term (15-30 years) due to a more open landscape. Decreasing long term due to the growth of new stands and the lack of large tree habitat.

Osprey

The osprey is identified in the Deshutes LRMP as a Management Indicator Species.

Osprey are specialized for catching fish. They nest near lakes and rivers in the tops of large snags or they may use artificial platforms if available. Their main prey is fish – slow-moving species that swim near the surface. However, they may also take other vertebrate species (birds, reptiles, and small mammals). (Csuti et. al 1997).

Fifteen historic nests were present along the Metolius River and an additional nest documented near Scout Lake (district files). It is unknown how many nests are actually present or active each year as annual surveys are not conducted. Cursory surveys have been conducted for this species and the potential for additional nests to be located in the watershed is high.

The Metolius River, larger lakes with fish, and larger streams provide suitable habitat for ospreys for both nesting and foraging. Loss of large snag habitat within campgrounds and summer home tracts is a concern due to the limited amount of snags available especially along the Metolius River. Increased recreation use along the river is also a concern. Disturbance to nesting osprey may negatively affect successful reproduction.

The B&B fire did not impact habitat along Metolius River. However the Eyerly fire resulted in several nests being lost along the lower stretches of the Metolius River and Lake Billy Chinook. The B&B fire impacted areas around larger lakes (i.e. Suttle, Round, Scout, Meadow Lakes). It is unknown how many nest sites were lost around these features. Since osprey need broken top trees or trees with large limb structure, snags created by the fires will only be short term and most will be unsuitable. There will also be a long lag time before large structure is present in some areas. Competition for nesting structure between osprey and other raptor species may increase so retention of snag habitat is important.

Recommendations

1. Survey along highly potential habitat to determine population levels in the watershed.
2. Retain large snags along major water bodies to provide for potential nest structures.

TREND: Stable especially along the Metolius River. Continued loss of large snags may limit use over time.

Flammulated Owl

The flammulated owl is a MIS species in the Deschutes National Forest Land and Resource Management Plan and is a new addition to the watershed analysis.

The flammulated owl is a focal species for fire climax ponderosa pine and mixed conifer dry habitats. The preferred habitat is typically a mosaic of open forests containing mature and old growth ponderosa pine and Douglas-fir trees, interspersed with dense patches of second growth providing roosting areas. All stands with a significant component of mature and old growth trees are considered potential habitats. This owl nests in medium to large snags (12" to 25 dbh") in cavities created by flickers or pileated woodpeckers. It forages primarily on arthropods and other insects (USDA 1994a). Open pine forests are becoming limited within the watershed due to fire suppression.

This species has been documented within the watershed in various locations. Most detections were gathered during surveys for other owls, primarily spotted and great grays. No nest locations have been found to date and no formalized surveys have been conducted for this species.

Continued fire suppression has led to unsuitable conditions for this species. An increase in shrub layers has resulted from fire suppression and is likely to persist. This limits the available forage base for the owl by decreasing the diversity of forest floor plants, which may discourage some arthropods and other insects from occupying these sites. It also hinders foraging attempts due to the somewhat limited maneuverability of flammulateds with increased shrub structure (USDA 1994a).

Increased stand densities perpetuates the problem of losing large structure over time, which this species requires for suitable nesting and foraging habitat. It also allows for less available nest sites, which could result in more competition for existing sites between species and may lead to greater predation risks. Increased stand densities may increase the risk of loss from fire. This species requires snags for nesting and it utilizes softer snags (moderate decay). These structures would be consumed more rapidly with increased fire intensities and may lead to large areas of the landscape being unsuitable if such an event were to occur.

The fires of 2002 and 2003 had various impacts to flammulated owl habitat. Areas experiencing stand replacement fire lost large snag and green tree habitat. This habitat component will not be present in these areas for some time (150-200 years) and will not be able to provide potential nesting and foraging habitat until large green trees and snags are again available. Roosting habitat will be available prior to this but doghair thick stands will not provide adequate foraging habitat. Mixed severity and underburn areas resulted in a mosaic of conditions. Some large tree and snag habitat was lost however due to the patchy way the fire burned, there are still areas remaining that have not been impacted. Snags consumed were probably those in more decayed classes which are used by this owl and may result in greater competition of nesting structure. The flammulated owl relies on woodpecker cavities and prefers larger cavities for nesting (usually flicker or pileated sized cavities). Therefore remaining habitat would need to allow for continued use by woodpeckers in order to provide nesting structure for this species. Understories were opened up as a result of these fires and more forb and grass species may be available. However, the loss of some brush species (bitterbrush, rose, etc.) may result in the decreased abundance of insect populations which may decrease foraging opportunities in the short term.

Recommendations

1. Manage for late-successional fire climax ponderosa pine stands with open understories and occasional dense thicket habitat.
2. Limit large snag removal in green stands.

TREND: Decreasing due to the loss of large ponderosa pine and Douglas fir and large snag habitat.

Neotropical Migrant Birds

In the past few years, attention has increasingly focused on the downward population trends of many bird species. Neotropical migratory birds are of particular concern. While reasons for the declines are complex, factors believed to be responsible include habitat loss and fragmentation on both wintering and breeding grounds, predation, cowbird parasitism, and pesticide use. The Deschutes National Forest is following guidelines from the "Conservation Strategy for Landbirds of the East-Slope of the Cascade Mountains in Oregon and Washington" (Altman 2000) document which outlines conservation measures, goals and objectives for specific habitat types found on the east-slope of the Cascades and the focal species associated with each habitat type. See Table 19 for specific habitat types highlighted in that document, the habitat features needing a conservation focus and the focal bird species for each.

WL Table 19. Priority habitat features and associated focal species for Central Oregon.

Habitat	Habitat Feature	Focal Species for Central Oregon
Ponderosa Pine	Large patches of old forest with large snags	White-headed woodpecker
	Large trees	Pygmy nuthatch
	Open understory with regenerating pines	Chipping sparrow
	Patches of burned old forest	Lewis' woodpecker
Mixed Conifer (Late-Successional)	Large trees	Brown creeper
	Large snags	Williamson's sapsucker
	Interspersion grassy openings and dense thickets	Flammulated owl
	Multi-layered/dense canopy	Hermit thrush
	Edges and openings created by wildfire	Olive-sided flycatcher
Lodgepole Pine	Old growth	Black-backed woodpecker
Meadows	Wet/dry	Sandhill Crane
Aspen	Large trees with regeneration	Red-naped sapsucker
Subalpine fir	Patchy presence	Blue grouse

Another publication became available in 2002 from the U.S. Fish and Wildlife Service entitled "Birds of Conservation Concern 2002" (BCC) which identifies species, subspecies, and populations of all migratory non-game birds that, without additional conservation actions, are likely to become candidates for listing under the Endangered Species Act (ESA) of 1973. Bird species considered for inclusion on lists in this report include non-game birds, gamebirds without hunting seasons, subsistence-hunted non-game species in Alaska, and Endangered Species Act candidate, proposed endangered or threatened, and recently delisted species. While all of the bird species included in BCC 2002 are priorities for conservation action, the list makes no finding with regard to whether they warrant consideration for ESA listing. The goal is to prevent or remove the need for additional ESA bird listings by implementing proactive management and conservations actions (USFWS 2002).

Bird Conservation Regions (BCRs) were developed based on similar geographic parameters. Two BCRs encompass the Sisters Ranger District – BCR 5, Northern Pacific Rainforest and BCR 9, Great Basin. See WL Tables 20 and 21 for a list of the bird species of concern for each area, the preferred habitat for each species, and whether there is potential habitat for each species within the Metolius watershed.

WL Table 20. BCR 5 (Northern Pacific Rainforest) BCC 2002 list.

Bird Species	Preferred Habitat	Habitat within the Metolius Watershed (Y or N)
Yellow-billed Loon	Tundra Lakes	No
Black-footed Albatross	Off-shore Islands	No
Northern Goshawk	Mature Coniferous Forests	Yes
Peregrine Falcon	Cliffs	Yes
Black Oystercatcher	Coastal Mudflats	No
Whimbrel	Marsh/Mudflats	No
Long-billed Curlew	Meadows	No
Marbled Godwit	Marsh/Wet Meadow	No
Black Turnstone	Coastal Salt-grass Tundra	No
Surfbird	Open Rocky Habitat	No
Red Knot	Wet Low Tundra	No
Rock Sandpiper	Tundra	No
Short-billed Dowitcher	Wet Meadows in Boreal Forests	No
Caspian Tern	Sand or Gravel Beaches	No
Arctic Tern	Inland Lakes and Rivers	No
Aleutian Tern	Grassy Coastal Flats	No
Marbled Murrelet	Conifer Forests near Coast	No
Kittlitz's Murrelet	Coastal Mountains near Glaciers	No
Yellow-billed Cuckoo	Dense riparian/cottonwoods	No
Flammulated Owl	Ponderosa pine forests	Yes
Black Swift	Cliffs associated with waterfalls	No
Rufous Hummingbird	Forest edges near meadows/rip	Yes
Lewis's Woodpecker	Ponderosa pine forests	Yes
White-headed Woodpecker	Ponderosa pine forests	Yes
Olive-sided Flycatcher	Open coniferous forests	Yes
Horned Lark	Open Habitat	No
Vesper Sparrow	Open habitats/meadow	Yes

WL Table 21. BCR 9 (Great Basin) BCC 2002 list.

Bird Species	Preferred Habitat	Habitat within the Metolius Watershed (Y or N)
Swainson's Hawk	Open lands with scattered trees	No
Ferruginous Hawk	Elevated Nest Sites in Open Country	No
Golden Eagle	Elevated Nest Sites in Open Country	No
Peregrine Falcon	Cliffs	Yes
Prairie Falcon	Cliffs in open country	No
Greater Sage Grouse	Sagebrush dominated Rangelands	No
Yellow Rail	Dense Marsh Habitat	No
American Golden-Plover	Burned Meadows/Mudflats	No
Snowy Plover	Dry Sandy Beaches	No
American Avocet	Wet Meadows	No
Solitary Sandpiper	Meadow/Marsh	Yes
Whimbrel	Marsh/Mudflats	No
Long-billed Curlew	Meadow/Marsh	No
Marbled Godwit	Marsh/Wet Meadows	No
Sanderling	Sandbars and beaches	No
Wilson's Phalarope	Meadow/Marsh	No
Yellow-billed Cuckoo	Dense riparian/cottonwoods	No
Flammulated Owl	Ponderosa pine forests	Yes
Burrowing Owl	Non-forested Grasslands	No
Black Swift	Cliffs associated with waterfalls	No
Lewis's Woodpecker	Ponderosa pine forests	Yes
Williamson's Sapsucker	Ponderosa pine forests	Yes
White-headed Woodpecker	Ponderosa pine forests	Yes
Loggerhead Shrike	Open country with scattered trees or shrubs	No
Gray Vireo	Arid scrub habitat	No
Virginia's Warbler	Scrubby vegetation within arid montane woodlands	No
Brewer's Sparrow	Sagebrush clearings in coniferous forests/bitterbrush	Yes
Sage Sparrow	Sagebrush	No
Tricolored Blackbird	Cattails or Tules	No

Nineteen species are identified from these lists with the potential to be found within the Metolius watershed. Some of these species are covered in other sections of this document either as an individual species or as a group of species. The following species can be found elsewhere in the document: white-headed woodpecker, pygmy nuthatch, Lewis' woodpecker, Williamson's sapsucker, flammulated owl, olive-sided flycatcher, black-backed woodpecker, northern goshawk, and peregrine falcon. The remaining species will be addressed as they relate to specific habitat associations.

Open Habitats/Open Understories with Regenerating Pines – Chipping Sparrow, Brewer's Sparrow, and Vesper Sparrow

All three species are summer residents preferring open habitats with a shrub or grass component. Chipping sparrows prefer open coniferous forests or stands of trees interspersed with grassy openings or low foliage (Marshall et al. 2003). All three species seem to be associated with higher elevations with the Brewer's sparrow occupying the widest elevational band (up to 6000' in the Cascades). The Brewer's sparrow is more reliant on shrub-steppe communities while the chipping and vesper sparrows can be found in a wider variety of habitat types. Declines in populations have been noted from Breeding Bird Survey (BBS) results for all three species ranging from 2.6% per year for the Brewer's sparrow to 3.9% per year for the chipping sparrow. Some reasons for these declines include habitat changes due to fire suppression, grazing, invasion of exotic species and fragmentation.

The fires had varying impacts on these species. The Brewer's and vesper sparrows most likely inhabited areas on the fringe of the forest or may have been associated with high elevation montane meadows while the chipping sparrow is more likely to be found in ponderosa pine or juniper habitats. Most shrubs (bitterbrush and sagebrush) were consumed in the Eyerly fire while the B&B fire burned through many montane meadows, thus reducing potential habitat. However, with increased precipitation levels, grasses and shrubs are likely to become re-established quickly in those areas. Therefore, populations may decline for the short-term but may begin to recover as shrubs become established.

Mixed Conifer, Large Trees – Brown Creeper

The brown creeper is the only North American bird that relies on both the trunk and bark of trees for nesting and foraging. It is found predominantly in coniferous forests but can be located in hardwood stands as well. It nests under loose sloughing bark of large diameter snags with little to moderate decay. The mean diameter of nest trees range from 16" dbh to 42" dbh. In northeastern Oregon, creeper abundance was positively associated with the height of the canopy and density of trees. (Marshall et al. 2003). Adams and Morrison (1993) found similar results with creepers being highly correlated with mature-aged stands with moderate overall stand density. Threats to this species include the loss of large diameter snags and live trees.

The fires significantly reduced potential habitat for this species. Most stand replacement fire occurred within mixed conifer plant associations. Approximately 16% of MCD and 42% of MCW stands identified as potential old growth experienced stand replacement fire. Marshall et al. (2003) reported that brown creeper populations were substantially reduced for at least 3 years following stand replacement fires in northeastern Oregon. Adams and Morrison (1993) reported similar findings in that brown creepers seldom used areas with low overall tree densities and little understory. Therefore, brown creeper populations may be reduced within the watershed until stands begin to recover. Creepers have been documented using several stand structural stages including stem exclusion, closed canopy, understory reinitiation, and old forest structure in the Blue Mountains (Marshall et al. 2003).

Mixed Conifer, Multi-layered/Dense Canopy – Hermit Thrush

The hermit thrush is a summer resident preferring mid to high elevation mature and old growth forests. It breeds in mature forests of all types especially those with a shaded understory of brush and small trees ranging from aspen groves to juniper woodlands to moderately open coniferous forests. It nests on the ground or uses small trees in the understory. Populations seem to be stable at this time. However, threats to this species include the loss of mature forests and controlled burning of forest understories. (Marshall et al. 2003).

The fires significantly reduced habitat for the hermit thrush. Approximately 38,570 acres (26%) of the watershed have experienced stand replacement fire in the last several years. In addition, 17,000 acres (11%) experienced mixed severity fire. Understory vegetation was lost as well as the overstory rendering much of the landscape unsuitable for several decades. Increased focus on further reducing fire risk across the landscape by treating the understory and ground fuels will further reduce habitat. It is likely that hermit thrush populations will decline in the watershed.

Meadows – Sandhill Crane and Solitary Sandpiper

Both species are rare residents associated with freshwater, high elevation meadow/marsh habitats. However, the sandhill crane utilizes floating nests while the solitary sandpiper is the only arboreal nesting sandpiper using other bird species nests. Both feed on aquatic and terrestrial invertebrates as well as small vertebrates. Little is known about the solitary sandpiper due to its solitary nature and limited occurrence on the landscape. Sandhill crane populations seem to be fairly stable in Deschutes County. However, conversion of wetlands and predation continue to be major threats to this species. (Marshall et al. 2003).

It is unknown how the fires have impacted these species. Neither species has been documented in the watershed however limited habitat did exist. Meadow habitats are likely to re-establish quickly due to high precipitation levels. However, impacts may be more pronounced for the solitary sandpiper where surrounding forests were heavily impacted.

Aspen – Red-naped Sapsucker

The red-naped sapsucker is a summer resident typically found in riparian habitats, especially in aspen and cottonwood stands. It can be found in ponderosa pine stands as well and occur less frequently in mixed conifer forests. Most nests are found in large diameter aspen trees with a mean diameter of 10.8". It also breeds in cottonwood trees and prefers more moderately decayed trees for nesting. It drills holes resulting in sap wells, which provides food for other birds, insects, and mammals. Threats known to this species include long-term degradation of aspen and other riparian forest habitats from fire suppression and the lack of hardwood regeneration. (Marshall et al. 2003).

The fires probably had fewer impacts to this species as impacts were more concentrated in the high elevation and mixed conifer plant associations. However, many cottonwood stands were lost or heavily impacted. There are few known locations of aspen in the watershed with stands in the Dry and Cache Creek areas being the largest. There are a couple of stands known within the Metolius Basin project area as well. In the past 100 to 150 years, there has been a dramatic decline in aspen forests due to a change in fire intervals (Bartos and Shepperd 1999). The lack of fire has allowed late successional species to move into aspen stands and out compete the aspen. Bartos and Shepperd (1999) stated that most aspen will eventually be replaced by other communities like conifers, sagebrush, and other tall shrubs without some type of disturbance. All known stands have experienced conifer encroachment and are in need of treatment. Therefore, treatments to enhance existing aspen and cottonwood stands would benefit this species and help in maintaining diversity across the landscape.

Subalpine Fir – Blue Grouse

The blue grouse is the largest grouse in Oregon and a short distant migrant throughout coniferous forests. It uses a wide variety of habitats in the spring and summer including forests, forest edges, shrublands, openings, and riparian habitats with dense cover. However, it is more associated with subalpine and true firs in the winter months using dwarf mistletoe brooms for thermal protection. Population trends are unknown at this time.

The fires resulted in a 20% reduction of wintering habitat due to stand replacement fire. This occurs in large patches throughout the high elevation plant associations, potentially resulting in the concentration of birds into remaining habitat. An additional 10% of high elevation forest experienced mixed severity burns. This probably reduced potential habitat and enhanced summering habitat. Those areas which were underburned were also enhanced. Marshall et al. (2003) notes that methods that maintain mature, park-like stands may benefit this species.

Edges near Riparian or Meadows – Rufous Hummingbird

The rufous hummingbird is a summer resident that uses a wide variety of habitats. It prefers wooded areas with a fairly high canopy and well developed understory for breeding. Arrival from wintering grounds may be tied to the availability of nectar producing plants (i.e. tubular flowers like paintbrushes, columbine, penstemons, and scarlet gilia). A downward trend has been documented for this species in Oregon; however reasons are still unclear as to why.

It is unknown to what extent the fires have impacted this species. However, it can be assumed that areas resulting in stand replacement may be unsuitable for nesting for some time. However, fire may stimulate the growth of herbaceous plants including many species used for foraging.

Other Bird Species

Although not discussed, many other bird species are important. Some species have showed declines in the last 30 years (WL Table 22) but these species are not specific to the East-Slope Cascades area but to the whole Cascades physiographic region which also includes the west slope of the Cascades as well.

WL Table 22. Native Birds with Significantly Declining Trends in the Cascades BBS Physiographic Region (Altman 2000).

Significantly Declining Bird Species	
Blue Grouse	Varied Thrush
Vaux's Swift	Cedar Waxwing
Rufous Hummingbird	Chipping Sparrow
Olive-sided Flycatcher	Fox Sparrow
Western Wood Pewee	Dark-eyed Junco
Barn Swallow	Brown-headed Cowbird
Brown Creeper	Pine Siskin
Golden-crowned Kinglet	Evening Grosbeak

Birding has become an important industry, past time and means for conservation. Because of this, Important Bird Areas have been established globally. Some of those occur on the Sisters Ranger District and many are part of the new Cascades Birding Trail. The Cascades Birding Trail is a self-guided auto tour that promotes selected sites for viewing birds. It links a network of observation sites and birding experiences by using existing infrastructure and promotes the development or maintenance of identified sites.

Important bird sites within the Metolius watershed include the following. Those highlighted with an asterisk are sites identified as stops along the Cascades Birding Trail.

WL Table 23. Important bird sites within the Metolius watershed.

Important Bird Site	Impacted by Fire
Jack Lake/Canyon Creek Meadow*	B&B
Jefferson Lake Trailhead*	B&B
Wizard Falls Fish Hatchery*	None
Moyer Spring	Cache Mountain
Suttle Lake*	B&B
Meadow Lakes*	Link, B&B
Vernal Pool	None
Cache Creek Aspen	Cache Creek
Metolius River*	None
Head of Metolius	None
Allingham Meadow	None
Cache Mountain*	Cache Mountain, Link
Eyerly Burn*	Eyerly

Fires have impacted habitat and/or infrastructure at eight of the thirteen sites identified. Due to declining population trends in many species and the loss of important habitat features, important focus should be given to these sites to re-establish or further enhance or develop habitat and/or infrastructure.

Recommendations

1. Re-establish, promote, and/or enhance important habitats for identified declining bird species.
2. Map hardwood stands and develop a strategy for treatment to determine priorities for restoration.
3. Work with local groups, state and federal agencies to develop a strategy for the development and promotion of local birding locations along the Cascades Birding Trail.

4. Enhance birding locations not identified on the Cascades Birding Trail (i.e. Moyer Springs).
5. Work with local schools and groups to establish educational programs and projects.

TREND: Declining for species dependent on multi-layered, dense stands, large trees, and high elevation habitats. Likely stable for species associated with special features like meadows or grassy openings. Trends are unknown for other species due to the lack of information on species needs.

Bats

Bats have been identified in the Deschutes National Forest LRMP as Management Indicator Species.

Most bat species are associated with foraging within forested areas with a few other species closely associated with foraging in and adjacent to riparian areas. See WL Table 24 for a breakdown of the potential bat species that could be found in the Metolius watershed and their habitat characteristics. (Csuti et. al 1997).

WL Table 24. Potential bat species and habitat requirements for the Metolius watershed.

Species	Forage Substrate	Roost Site	Main Prey Species	Comments
California Myotis	Forest edges and over water	Cliff faces, tree crevices, caves and structures	Butterflies and small flies	
Western Small-footed bat	Ponderosa pine and mixed conifer forests	Rock crevices, under boulders, and beneath bark	Small insects	Will also forage over rocks
Yuma Myotis	Riparian, moist woodlands, and open forests	Buildings, caves, and bridges	Moths, midges, flies, and termites	Closely associated with water and very sensitive to disturbance
Little Brown Myotis	Moist forests and riparian areas		Flying insects	Closely associated with water
Long-legged Myotis	Coniferous forests and riparian areas	Crevices, buildings, and caves	Moths	Closely associated with forests
Long-eared Myotis	Forested habitats and forested edges		Moths	
Silver-haired bat	Forested areas and over ponds and streams	Under bark	Soft-bodied prey	Deforestation and loss of snags is a threat
Big Brown Bat	More common in deciduous versus coniferous forests	Structures	Beetles	Forages over open areas and uses hollow trees
Hoary Bat	Riparian and brushy areas	Trees	Moths	Solitary forest dwelling
Pallid Bat	Arid regions and open forest types	Cliff faces, caves, and buildings	Flightless arthropods	Forages on ground and very intolerant to disturbance
Western big-eared Bat (Townsend's)		Buildings, caves, and bridges	Moths	Presence of roost sites more important than veg type; very sensitive to disturbance

Three known surveys have occurred on the Sisters Ranger District for bat species. Two surveys were conducted in consecutive years in 1996 and 1997 by Stuart Perlmeter as part of a Forest-wide Challenge Cost Share project. First Creek and Canyon Creek were surveyed to determine species presence near the 1420 road. Another survey was conducted on district but outside the project area in the Metolius winter range area near Fly Creek by Mark Perkins in 1998 for PGE. The following species were located: western pipistrelle, Yuma myotis, western big-eared bat, pallid bat, big brown bat, silver-haired bat, California myotis, western small-footed bat, long-eared bat, long-legged bat, and hoary bat. Only the silver-haired bat, big brown bat, hoary bat, little brown bat, long-legged bat, and western small-footed bat have been documented in the watershed.

It was noted in the 1997 study by Perlmeter that the high number of species found at First Creek indicated that the forest stands around this area offered a variety of day roost options that fulfilled the needs of a broad spectrum of bat species. Also noted in this study is that even though there was a high number of different species found, the number of individual bats captured was low compared to other places on the forest. Potential habitat exists across the watershed in varying degrees of quality.

Primary risks to habitat include fire suppression, which can result in increased stand densities and loss of large tree structure. Increased stand densities may intensify a wildfire event resulting in the loss of large trees, large snags, and important special habitat components like hollow trees. Continued hazard tree removal also limits the availability of snag habitat, especially near the Metolius River and other riparian areas. Increased human use of the project area can also lead to increased disturbance of day and night roosts, maternity sites, and winter hibernaculum.

The fires of 2002 and 2003 impacted potential bat habitat in various ways. The fires created a complex edge pattern which occurs primarily in the middle of the watershed. Species associated with this habitat element may remain stable. However, species associated with mixed conifer forests, large snags with sloughing bark, riparian areas, and unique habitat features like hollow trees were heavily impacted. It is unknown how the fire impacted insect populations. In a study completed for the spraying of BT for the spruce budworm outbreak on the Sisters Ranger District, it was found that the largest concentrations of insects were associated with shrub species, primarily bitterbrush, ceanothus, rose, and manzanita. Therefore, it is assumed that there may be a slight decrease in insect populations for the short term until adjacent populations can repopulate impacted areas. This may also have a negative effect on bat species. Shifts in recreation use or general forest use to remaining green areas may result in an increase in disturbance levels.

Recommendations

1. Protect large snags near riparian areas.
2. Protect unique habitat features (i.e. caves, hollow trees, etc.).
3. Retain large snags across the landscape to provide roost and hibernacula sites.
4. Reduce the risk to remaining habitat by reducing stand densities.
5. Place boxes around areas heavily impacted by both hazard tree removal and fire to provide roosting and hibernaculum sites.
6. Survey Meadow Lakes area and compare with findings along First Creek to further define habitat in the watershed.
7. Collaborate with research to determine how fire affects bat species.

TREND: Downward trend due to the loss of suitable habitat and habitat features.

Big Game

Deer

Most of the watershed consists of deer summer range (77%). This delineates the biological potential of the area developed during the Integrated Fuels Strategy process (1998). It is not considered an official allocation in the Deschutes LRMP; however, it was recognized by ODFW as an important area for mule deer. There is no allocated Management Area 7 – Deer Habitat found in the Deschutes LRMP within the Metolius watershed.

The Metolius Mule Deer Winter Range Plan was initiated in 1986 as a cooperative venture between the USFS, Portland General Electric, BLM, and ODFW. It outlined issues, goals, objectives and action items for this land area. Some of the major issues identified include declining forage quality, the need for road closures, and the loss of mule deer habitat primarily related to private lands. The Metolius watershed has little private land within the boundary and the majority of these lands lie outside winter range. However, actions have been planned or implemented regarding forage and roads. Thinning, mowing and burning have been prescribed in the Metolius Basin Forest Management project as well as road closures. Much of the Plan revolves around the use of the Mule Deer Habitat Model. This model is now outdated and information of vegetation changes, habitat enhancements, road closures, etc. need to be incorporated to update it so it could be more useful in future project planning.

Elk

There is also a portion of a Key Elk Habitat Area (KEHA) located in the watershed. Specific management guidelines can be found in the Deschutes LRMP regarding this area. See Table 25 for a breakdown of big game habitat.

WL Table 25. Big game habitat acres in the Metolius watershed.

Deer Habitat Type	**Acres of Habitat**	**Percent of Watershed**
Winter Range	22,875 acres	15%
Summer Range	114,240 acres	77%
Transition Range	11,581 acres	8%
Management Area 7	0 acres	0%
Elk Habitat Type	**Acres of Habitat**	
Key Elk Habitat Area	6,093 acres	4%

Target road densities for the watershed are 2.5 miles/sq. mile. However, target road densities for the KEHA are much lower ranging from 0.5 to 1.5 miles/sq. mile. Road densities are above target densities for deer winter and transition range and for the Key Elk Habitat Area as shown in Table 26. Some road closures have been proposed through project specific analyses however, few have been implemented to date.

WL Table 26. Open road densities by big game habitat type for the Metolius watershed.

Road Information	Deer Habitat			Elk Habitat
	Winter	Summer	Transition	KEHA
Miles of Road	148.1	392.3	113.5	22.7
Project Area (mi^2)	35.74	178.5	18.1	9.5
Open Road Density	4.14	2.20	6.27	2.38

There are several existing water sources within the watershed. However, many have been impacted by the fires. Water is not limiting in most of the watershed however, as you move eastward, it becomes more scarce. The area south of Cache Mountain is also dry. See WL Table 27 for a listing of existing water sources, their location, what fire they were impacted by, and recommendations for each site.

WL Table 27. Water sources found within the Metolius watershed.

Water Source	Location	Fire Impacts	Recommendations
SPRINGS			
Can Spring	T13S, R8E, 25	Link	Non-functioning, Repair
Moonshine Spring	T12S, R9E, 22	B&B (near)	Move from road edge
Rock Spring	T14S, R8E, 9	Link	Unable to locate
Yew Spring	T14S, R8E, 2	Cache Mtn.	Needs assessment
IMPOUNDMENTS			
Allingham Cutoff	T13S, R9E, 24	N/A	Recommendations under Metolius Basin Project
Bean Creek	T11S, R10E, 16	Eyerly	Leave as is
Castle Rocks	T11S, R10E, 5	N/A	Leave as is
GUZZLERS			
3	T13S, R9E, 28	N/A	Needs replaced, not urgent
12	T11S, R10E, 23	Eyerly	Covered under separate CE

Several large vegetation management projects have occurred in the past several years. These include Big Bear, Broken Rim, Highway 20, Jack Canyon, McCache, Santiam Corridor, and Santiam Restoration. With the exception of Highway 20, all occurred within summer range and were developed to address the mass mortality caused by insects in the early 1990's. Within these project areas, there has been an overall decrease in cover. However, stands were declining or dead. A decrease in cover was going to occur whether the area was treated or left alone. Down woody material levels also increased across the landscape. This provides added benefits in the form of hiding cover, especially in fawning and calving areas; but abundant down woody material levels also impede movement and increase the risk of loss of existing cover to a large fire event. An increase in forage also resulted in these project areas. This may have helped to increase the health and vigor of resident herds using the area leading to increased survival rates.

A total of 69,322 acres of biological winter range occurs on the Sisters Ranger District. None of the above-mentioned projects has impacted winter range. The Highway 20 project area was located within transition range. However, the Metolius Basin project area is the first vegetation management project planned to occur within biological winter range. Overall, an estimated 12% of the winter range on the

Sisters Ranger District is proposed to be treated with the Metolius Basin project. This area is not as important as other portions of the winter range in that snow conditions may preclude use for much of the winter. It was noted in the Metolius Mule Deer Winter Range Plan that approximately 90% of the deer occupying the Metolius Basin area during the summer move toward the east to the high plains area for the winter months.

During the summer of 2002, two large wildfires occurred on the district. The largest fire, Eyerly, occurred within biological winter range and resulted in a decrease in cover and winter forage opportunities. An estimated 7,069 acres resulted in stand replacement which eliminated cover and most of the bitterbrush in the area. However, summer forage values were expected to increase dramatically within the fire area with the resprouting of forbs and shrubs. This prediction held true with an explosion of grasses, forbs, and shrubs occurring throughout the fire area. It was also noted through casual observation, increases in the amount of big game use, primarily elk, within the fire area.

During the summer of 2003, additional large wildfires occurred within the watershed, the largest being the B&B fire. This impacted a large portion of the watershed and occurred primarily within deer summer and winter range and impacted the KEHA somewhat. Two areas used heavily by big game were located in the highest fire intensity areas, the First Creek and Abbot Butte areas. However, forage species are expected to increase dramatically, as like Eyerly, and improve big game populations within the watershed.

The following table displays the amount of big game habitat impacted in the past two years by fire. Percent of watershed refers to the amount of habitat impacted relative to the total amount of big game habitat.

WL Table 28. Big game habitat impacted by fires within the Metolius watershed.

Deer Habitat	Mixed Severity	Percent of Big Game Habitat in Watershed	Stand Replace.	Percent of Big Game Habitat in Watershed	Underburn	Percent of Big Game Habitat in Watershed	Total Acres	Total Percent
Summer	14,961	13%	34,159	30%	25,204	22%	74,324	65%
Transition	1,056	9%	1,840	16%	2,604	22%	5,500	47%
Winter	1,002	4%	2,572	11%	3,331	15%	6,905	30%
Elk Habitat								
KEHA	428	7%	546	9%	883	14%	1,858	30%

Additional impacts from the fires include impacts related to the loss of cover. There is an increased chance of mortality due to hunting, predation, etc. due to the increased visibility. This will become greater as snags begin to fall across the landscape. Big game will also need to expend more energy during extreme weather conditions trying to stay warm or cool. And snow levels will increase resulting in additional energy needs to move. Winter forage is also lost as a result of the fires. Lichens and shrubs utilized during the winter months were consumed during the fires. However, much of the area that experienced stand replacement fire is not typically occupied during the winter months so this impact may be minor across the watershed except for the Eyerly area. Another potential impact may result in the lowered quantity and quality of forage species if shrubs like ceanothus and manzanita become established over large tracts of the fire. These species do not equate to valuable forage and replace other potential species like bitterbrush which is more heavily utilized.

Recommendations

1. Update the Metolius Mule Deer Winter Range Plan with more site-specific information.
2. Coordinate with ODFW to refine the Mule Deer Habitat Model if applicable and possibly refine winter range boundaries using information collected over the last decade.
3. Strive to meet proposed road density levels outlined in the Deschutes LRMP and associated plans.
4. Coordinate with ODFW on a forage strategy for the fire areas.
5. Look for options to partner with local organizations and agencies on the repair and reconstruction of existing water sources. Also look for opportunities to develop new sites (i.e. Moyer spring).

TREND: Stable. Winter range is still largely intact and summer range is expected to have a dramatic increase in forage, although cover has decreased.

American Marten

The marten is listed as a MIS species in the Deschutes National Forest Land and Resource Management Plan.

The American marten is associated with mixed conifer and high elevation hemlock/lodgepole pine late-successional habitats, and is a focal species for climatic climax habitats. Marten habitat is generally dense-canopied (greater than 40% canopy cover) and supports significant amounts of large down logs (≥20" at rest sites and > 30" at den sites, 8-20/acre) and snags (2-3/acre) ≥20" dbh. Moist forests where marten are usually found have down woody material densities as high as 39 pieces per acre with 40% of the pieces >20" dbh. Especially significant are riparian areas, ridgetops, and areas where high concentrations of down logs and snags occur. (Ruggerio et al. 1994).

Ruggerio et al. (1994) found that martens tend to avoid openings and stands that lack horizontal structure. Changes due to the fires of 2002 and 2003 have resulted in loss of canopy cover, horizontal structure, and connectivity which have resulted in a loss of suitable marten habitat or habitat of degraded quality. Habitat development will occur over several decades and suitable habitat conditions are not expected in areas that experienced stand replacement or mixed severity for at least 150 years.

Recommendations

1. Implement the spotted owl habitat enhancement strategy to accelerate the development of suitable habitat which would equate to similar habitat needs for marten.
2. Re-establish camera set surveys to determine level of use by marten.

TREND: Downward trend due to the loss of suitable habitat and the prolonged establishment of long-term sustainable habitat.

Survey and Manage

Crater Lake Tightcoil

One terrestrial mollusk, the Crater Lake Tightcoil (*Pristiloma arcticum crateris*), has been identified as needing surveys under the ROD and S&G's for Amendments to the Survey and Manage, Protection Buffer, and other Mitigation Measures Standards and Guidelines (USDA 2001). This species falls into Category B (Rare, Pre-disturbance Surveys not Practical). Within this category, strategic surveys are to be conducted and all known sites are to be managed until further notice. This species is considered to be rare and identification of specimens is difficult because of its small size and cryptic habits. In March 2004, a Record of Decision to Remove or Modify the Survey and Manage Mitigation Measure Standards and Guidelines in Forest Service and Bureau of Land Management Planning Documents within the Range of the Northern Spotted Owl was signed and amends existing LRMPs to include eligible species from the Survey and Manage lists for inclusion under Sensitive Species policies.

Habitat: "The Crater Lake Tightcoil may be found in perennially wet situations in mature conifer forests, among rushes, mosses and other surface vegetation or under rocks and woody debris within 10 m. of open water in wetlands, springs, seeps and riparian areas, generally in areas which remain under snow for long periods during the winter. Riparian habitats in the Eastern Oregon Cascades may be limited to the extent of permanent surface moisture, which is often less than 10 m. from open water" (Duncan et al. 2003).

Threats to the species include activities that compact soils, reduce litter and/or vegetative cover, or impact potential food sources (i.e. livestock grazing, heavy equipment use, ORV's, and camping on occupied habitats). Fluctuations from removal of ground vegetation on ground temperature and humidity may be less extreme at higher elevations and on wetter sites, but no studies have been conducted to evaluate such a theory. These snails appear to occur on wetter sites than general forest conditions, so activities that would lower the water table or reduce soil moisture would degrade habitat (Burke et al. 1999).

Intense fire that burns through the litter and duff layers is devastating to most gastropods, and even light burns during seasons when these animals are active can be expected to have more serious impacts than burns during their dormant periods. Snowmobiling or skiing would impact these snails if snow, over their occupied habitats, is compacted losing its insulative properties and allowing the litter or ground to freeze (Burke et al. 1999).

Surveys were conducted to protocol using Version 2.0 from the fall of 1998 through the fall of 2002 (Furnish et al. 1997). These surveys occurred both in and outside of riparian areas since little was known about the species. The new survey protocol (Version 3.0) was introduced in February of 2003, and subsequent survey efforts were modified to meet requirements of the new protocol. Version 3.0 states that surveys are required only in perennial wet areas (Duncan et al. 2003). See Table 29 for more information regarding surveys within the Metolius watershed.

Most *Pristiloma* have been located along perennial streams within 15 feet of the water's edge. Several streams within the Metolius watershed do not contain suitable habitat for mollusk species due to the intermittent nature of the streams, lack of riparian vegetation, and low moisture content (Cache Creek, Davis Creek, portions of First Creek, stretches along the Metolius River for example). Remaining riparian areas vary but most have a narrow band of riparian vegetation, averaging 10-30' wide.

WL Table 29. Mollusk survey results for the Metolius watershed.

Project	Year	Fall/Spring	Acres Surveyed	Known Sites
Bugs	1998	Fall	550 acres	No
Bugs	1999	Spring	550 acres	No
Beetle	1999	Both	35 ac – 70 ac total	No
Suttle Lake	1999	Both	20 ac – 40 ac total	No
Heritage Demo	1999	Both	30 ac – 60 ac total	No
Springtail	1999	Fall (2 surveys)	179 ac – 358 total	No
Lower Jack	1999	Fall	117 acres	No
Lundgren LEX	2000	Spring	12 acres	No
Camp Sherman Store RV area	2000	Spring	3 acres	No
McCache	2000	Spring	1066 acres	No
CEC Powerline	2001	Fall	Combined with Metolius	Yes
Metolius	2001	Both	1126 acres	Yes
Metolius	2002	Spring	739 acres	Yes
First Creek Cottonwood	2002	Both	43 ac – 86 ac total	Yes
Eyerly	2002	Fall	120 acres	No
Eyerly	2003	Spring	42 acres	Yes
Bull Trout Rest. (Phase 1)	2003	Spring	41 acres	Yes
Bull Trout Rest. (Phase 2)	2003	Fall	37 acres	Yes
Total Acres			**5017 acres**	

There are approximately 15,000 acres of riparian habitat within the Metolius watershed which includes the full riparian buffer of 150-300' area on either side of the stream. There are 4800 acres of perennial streams within the watershed which would equate to an approximation of potential habitat for the Crater Lake tightcoil. Approximately 1375 acres received some type of burn through them. That equates to approximately 29% of the potential habitat being impacted. Therefore, it is important to protect the remaining sites and riparian areas not impacted by fire to allow for further occupation of the watershed. These sites may aid in re-populating the watershed over time. However, this will be a very slow process due to the species involved.

The following table outlines the number of known sites by project area and the number of those that were impacted by fire. It is assumed that if fire went through an area, that site was lost.

WL Table 30. Known mollusk sites by project area and number impacted by fires for the Metolius watershed.

Project Area	Number of Known Sites	Known Sites Impacted	Fire
Metolius Basin	39	0	B&B
First Creek Cottonwood	2	2	B&B
Eyerly	1	1	Eyerly
Bull Trout (Phase 1)	11	5	B&B
Bull Trout (Phase 2)	2	1	B&B
Total	**55**	**9**	

Recommendations

Management recommendations were developed for several mollusk species including *Pristiloma arcticum crateris*. The following objectives were designed to assist in maintaining the viability of the species:

At known sites:

1. Minimize disturbance of the forest floor litter, duff, and woody debris within the extent of the riparian vegetative habitat.
2. Maintain a component of riparian vegetation, including hardwood trees and shrubs where they exist, to provide a constant supply of logs, leaves, and leaf mold.
3. Maintain or enhance naturally occurring diversity of plant species in Habitat Areas. Maintain natural understory vegetation and a layer of uncompacted organic litter and debris on the ground within the riparian vegetation zone.
4. Avoid activities that would cause soil compaction within 33' of the stream edge.
5. Maintain existing logs and other woody debris within the extent of riparian vegetation.
6. Avoid prescribed burning in Habitat Areas and protect them from wildfire by fuels management in adjacent areas.
7. Avoid activities that would lower the water table.

TREND: Decreasing due to the magnitude of fire throughout the watershed and the fragile nature of this species.

Snags, Down Woody Material, and Cavity Nesters

Dead wood, standing or down, plays an important role in overall ecosystem health, soil productivity and numerous species habitat. It is crucial in the continuation of species that depend on snags for all or parts of their life cycle. (Laudenslayer 2002) Bird and mammal species rely on the structure for dens, nests, resting, roosting, and/or feeding on the animals and organisms that use dead wood for all or parts of their life cycle. Snags come in all sizes and go through breakdown and decay processes that change them from standing hard to soft, then on the ground to continue decaying into soil nutrients.

Not every stage of the snag's demise is utilized by the same species, but a whole array of species at various stages or conditions. "Of the 93 wildlife species associated with snags in forest environments, 21 are associated with hard snags, 20 with moderately decayed snags and 6 with soft snags." (Rose et al.

2001) There were 86 vertebrate wildlife species associated with down wood, of which 58 were exclusively associated with down wood.

O'Neil with others (2001) developed a matrix of habitat elements for wildlife species in Washington and Oregon. In Washington and Oregon there are 55 bird species, 28 mammal, 1 amphibian and 12 reptiles listed in the matrix that have fire as a habitat component. Most of those species rely on fire for opening up the under-story, maintaining open stands or in the case of the spotted owl, find it beneficial for developing trees with large branches. For the east slope of the Cascades the black-backed woodpecker, chipping sparrow, Lewis' woodpecker, brown creeper, Williamson's sapsucker, hermit thrush, and olive-sided flycatcher are bird species that rely on habitats with old burn patches, open patches from wildfires or snag/insect densities resulting from wildfire (Altman 2000). Those species whose populations actually increase with fire include three-toed and black-backed woodpeckers (populations peak 3-5 years post-fire), mountain bluebird (1-15 years post-fire) and olive-sided flycatcher (1-3 years post fire) (O'Neil 2001).

Stand structure often influences species that utilize snags. Frenzel (2002) noted snag density may be less important for white-headed woodpeckers than other woodpeckers since they forage mostly in live trees. He found the mean snag densities at nest sites to be 1.5 trees per acre. Nesting success was greatly influenced by the number of large green trees available at the nest site; specifically there was greatest success in stands where there were 12 ponderosa pine per acre greater than 21 inches. Development of dense understories due to fire suppression is one cause of reduced white-headed woodpecker habitat. Goggans and others (1989) found nests excavated by three-toed and black-backed woodpeckers were in portions of lodgepole pine trees with heartrot. Three-toed habitat was predominately mixed conifer forest stands above 4500 ft elevation and black-backs were predominately lodgepole pine forest stands below 4500ft elevation. Both associated with stands that are susceptible to attacks by bark beetles, generally mature and over-mature with high tree densities.

Both Saab and Dudley (1998) and Haggard and Gaines (2001) looked at the effects of stand-replacement fire and salvage logging on cavity nesting birds. Both studies found black-backed woodpeckers utilized the highest density of snags, and Lewis's woodpecker avoided high snag density areas. The numbers of snags retained varied by study. Neither study recommended leaving snags at specific densities but recommended snags be left in varying densities to provide for a greater number and diversity of cavity dependent birds.

Looking larger than the stand level and managing for varying densities of dead wood in green stands and post fire situations was recommended in much of the literature (Rose et al. 2001, Mellon et al. 2003, Laudenslayer 2002, Saab and Dudley 1998, Haggard and Gaines 2001). Management guidelines for snags and down wood on the Sisters Ranger District are wide ranging. Direction includes:

- retaining snags that are likely to persist until late-successional condition (greater than 80 years old) have developed and large snags are being produced (NWFP S&G C-14)

- retain coarse woody debris in quantities so that in the future it will still contain amounts similar to naturally regenerating stands (NWFP S&G C-14)

- in matrix… a minimum of 120 linear feet of logs per acre greater than or equal to 16 inches in diameter and 16 feet long should be retained (NWFP S&G C-40)

- in matrix… as a minimum retain snags within the harvest unit at levels sufficient to support species of cavity-nesting birds at 40 percent of potential population levels based on published guidelines and models (NWFP S&G C-42)

- in matrix …for white-headed woodpecker, black-backed woodpecker, pygmy nuthatch and flammulated owl snags over 20 inches dbh may be marked for cutting only after retaining the best available snags (considering size, longevity, etc.) in sufficient numbers to meet 100 percent of the potential population levels of these four species (2001 NWFP amendment S&G pages 34 & 35)

- east of the range of the spotted owl… maintain snags of ≥ 21 inches dbh at 100% potential population levels of primary cavity excavators (1995 Regional Forester's Amendment No. 2, Appendix B p11)

- use the best available science on species requirements (2001 NWFP amendment S&G pages 34 & 35 and 1995 Regional Forester's Amendment No. 2, Appendix B p11)

A recently released draft of the Decayed Wood Advisor (DecAID) by Marcot et al. (2000) is an advisory tool to help land managers evaluate effects of forest conditions and existing or proposed management activities on organisms that use snags, down wood, and other wood decay elements. In this publication, it is possible to relate the abundance of dead wood habitat, both snags and logs, to the frequency of occurrence of various wildlife species that require dead wood habitat for some part of their life cycle. This publication includes information on primary cavity excavators as well as a host of other organisms that use dead wood habitat. DecAID shows levels of "assurance" or confidence of providing for a particular species. Information is given at the 30, 50, and 80 percent tolerance levels.

Habitat is defined within DecAID by habitat types. Four habitat types correspond to conditions found in the Metolius watershed: Eastside Mixed Conifer, Lodgepole, Ponderosa Pine/Douglas-fir, and Montane Mixed Conifer. However, the primary habitat types found are Eastside Mixed Conifer and Ponderosa Pine/Douglas-fir. Within each habitat type, specific species are known to be associated. See Table 31 for more information. Species were chosen from the NWFP survey and manage species, USFWS Birds of Conservation Concern, and "A Conservation Strategy for Landbirds of the East-Slope of the Cascade Mountains in Oregon".

Post-Fire Habitats

WL Table 31. Species with dead wood or fire created habitat as a primary habitat feature.

Species	Status*	Behavior	Habitat Feature/Conservation Focus	Habitat	Presence in Watershed
Lewis' Woodpecker	ESC BCC	Primary Cavity Excavator	Patches of burned old forest	Old Growth Ponderosa Pine	Documented
Flammulated Owl	ESC BCC SM	Secondary Cavity Nester	Large snags	Old Growth Ponderosa Pine	Documented
White-headed Woodpecker	ESC BCC SM	Primary Cavity Excavator	Large patches of old forest with large snags	Old Growth Ponderosa Pine	Documented
Pygmy Nuthatch	SM	Primary Cavity Excavator	Large trees	Pine Forest	Documented
Williamson's Sapsucker	ESC BCC	Primary Cavity Excavator	Large snags	Mixed Conifer	Documented
Pileated Woodpecker	MIS	Primary Cavity Excavator	Large snags/down wood	Mixed Conifer	Documented
Black-backed Woodpecker	SM MIS ESC	Primary Cavity Excavator	Old Growth	Lodgepole Pine	Documented
American Marten	MIS	Secondary Cavity User, Preys on rodents found in abundant down wood	Snags and down wood	Mixed, Complex	Documented
Northern Flicker	MIS	Primary Cavity Excavator	Snags and down wood	Mixed, Complex	Documented
Olive-sided Flycatcher	BCC	Aerial Insectivore	Fire created openings in old forest	Mixed, Complex	Documented
Mountain Bluebird	None- population increase after fire	Secondary Cavity Nester	Burned areas	Mixed, Complex	Documented

Notes:
*ESC – East-Slope Cascades bird species BCC – Bird of Conservation Concern
MIS – Management Indicator Species SM - Survey and Manage Species

Differing snag and down wood levels are documented for each species. These levels change as the habitat type and structural stage changes. An analysis was completed using the guidelines discussed in DecAID to stratify the watershed based on habitat type, fire regime, and topography in order to determine what levels of dead wood are attainable based on these features. A detailed description of the process used can be found in Appendix WL2. This will help determine the objectives for the landscape and then specific species requirements can be applied on a more site-specific basis. Focal species for each habitat type are discussed below.

Ponderosa Pine/Douglas-fire Habitats – Lewis' Woodpecker, White-headed Woodpecker, Pygmy Nuthatch

Habitat for the Lewis' woodpecker, a migrant in this part of its range, includes old-forest, single-storied ponderosa pine. Burned ponderosa pine forests created by stand-replacing fires provide highly productive habitats as compared to unburned pine (Wisdom et al. 2000). Lewis' woodpeckers feed on flying insects and are not strong cavity excavators. They require large snags in an advanced state of decay that are easy to excavate, or they use old cavities created by other woodpeckers. Nest trees generally average 17 inches to 44 inches (Saab and Dudley 1998, Wisdom et al. 2000). White-headed woodpeckers and pygmy nuthatches share similar habitat of large open ponderosa pine, low shrub levels and large snags. The white-headed woodpecker is a primary cavity excavator of soft snags, while the pygmy nuthatch is a secondary cavity nester and can take advantage of natural cavities as well as woodpecker created cavities. Both species prefer larger diameter trees than the Lewis' woodpecker, averaging 23 inches for the pygmy nuthatch and 31 inches for the white-headed woodpecker (Wisdom 2000). On the Winema National Forest, white-headed woodpeckers were found to be using small-diameter trees, log in a slash pile and upturned roots (6-13" dbh) where large snags were uncommon (Frenzel 2002). There are numerous sightings of white-headed woodpeckers and pygmy nuthatches in the watershed. Lewis's woodpeckers have been sighted particularly in the Eyerly and Cache Mountain fire areas. In evaluating landscape predictor variables for Lewis's woodpecker, Saab (2002) found a negative relation to burned ponderosa pine/Douglas-fir with high crown closure. It is possible that crown closures are too high for Lewis's in much of the fire areas.

The fires created habitat for the these species where stands were underburned or experienced mixed burn intensities in ponderosa pine or mixed conifer habitats where the resulting structure was single story or open canopy. Moderate and high intensity burn areas could provide habitat for the Lewis's woodpecker as snag densities become favorable. It is questionable how suitable these acres would be for white-headed woodpeckers or pygmy nuthatches. White-headed woodpeckers were found in both study areas of ponderosa pine/Douglas-fir in Washington and Idaho, but densities were to low for statistical analyses. Pygmy nuthatches were not found in either study area. This may be in part on the reliance of pine seed sources for the white-headed, or leaf insects for the nuthatch as a seasonal part of their diet (Marshall et al. 2003).

Mixed Conifer Habitats – Williamson's Sapsucker, Pileated Woodpecker

Williamson's sapsuckers, a summer resident, prefer large decadent snags in mixed conifer or ponderosa pine forests. They feed mostly on sap from "wells" they drill in ponderosa pine or Douglas-fir trees, phloem fibers, cambium, and insects. They are not strong cavity excavators and select soft decayed wood in about any tree species for nesting (Marshall et al. 2003). They favor larger trees, generally averaging 27"dbh. Pileated woodpeckers share similar habitats in denser mixed conifer forests. They are rarely found in pure ponderosa pine forests. The largest woodpecker in the U.S., it needs large snags for nesting, generally averaging 27-33 inches in diameter. Both woodpeckers have been found in the watershed.

The fires reduced habitat for these species especially where stands experienced stand replacement or mixed burn intensities. Softer snags, likely existing from the insect and disease outbreaks of the early 1990's, were probably consumed. Marshall et al. (2003) also noted that pileated woodpeckers need large logs for foraging and dense canopy to protect against predators. These habitat features were also reduced or affects of the fire have left them unsuitable (i.e. fire-hardened logs).

Lodgepole Pine Habitats – Black-backed Woodpeckers

Wisdom (2000) describes source habitats for black-backed woodpeckers as a year round resident that occurs in various forest types. Within its range it is most abundant in recently burned forests, but in Oregon, bark-beetle killed forests are frequently occupied. Marshall et al. (2003) reports for this species the "center of abundance" in Oregon is the "lodgepole pine forest east of the Cascade crest between Bend and Klamath Falls". Endemic levels of mountain pine beetles, common in lodgepole pine (10"+ dbh and 170 tpa), provide a constant food source. In a study conducted on the Deschutes National Forest, Goggans et al. (1989) found black-backed woodpeckers used stands with a mean diameter of 8 inches for nesting. Mean nest tree diameter was 11 inches. All nests in the study were in lodgepole pine stands and 93% of foraging took place in lodgepole pine forests. Goggans found mountain pine beetles had infested 81% of the trees used for foraging. Recent dead trees were used most often (68%) for foraging.

The fires reduced the green base lodgepole habitat but created acres of burned habitat for the black-backed woodpecker, with an abundance of insects. Wood boring insects that come in with fire differ from mountain bark-beetle. Marshall et al. (2003) warns that burned forests and bark-beetle outbreaks should not be considered equivalent habitats. Wisdom contrasted nesting success of 68.5 percent in bark beetle infested forests in Oregon with 100 percent success in burned forests of western Idaho and northwestern Wyoming. Squirrel predation accounted for nest losses in Oregon. In the Idaho fire recolonization of large burn areas by squirrels did not take place during the first 3 years after the fire. It should be noted however that black-backed population increases in fire areas lasts for 5 years (Saab and Dudley 1998), whereas large infestations of mountain bark-beetle in the lodgepole pine forests on the Deschutes National Forest last 10 years. In small-scale infestations of mountain bark-beetles in lodgepole pine or mixed conifer forests occur on a never ending cycle. Snag densities in this habitat type vary widely.

Complex Habitats – Flammulated Owl, American Marten, Mountain Bluebird, Northern Flicker, Olive-sided Flycatcher

Wisdom (2000) combined the flammulated owl and American marten with the northern goshawk and fisher because they share source habitats. He describes the source habitat as late seral stages of the montane community group and young forests with sufficient large-diameter snags and logs. Flammulated owls are found in a mosaic of open forests containing mature and old growth ponderosa pine or mixed conifer plant associations. More specifically ponderosa pine dominated stands with dispersed dense thickets and grassy openings. They utilize cavities in live or dead trees created by pileated woodpeckers or northern flickers. Average diameter of snags and trees used for nesting were 12 and 25 inches (USDA 1994a).

American marten are found in a variety of habitats with large (20 inches dbh or larger) diameter trees, snags and logs. They use snags and logs with intermediate levels of decay with greatest use in the larger (30 inches in diameter or larger) size classes when available (Raphael and Jones 1997). Canopy cover plays a greater role in winter where marten select for higher canopy cover during snow periods than snow-free periods. A study conducted in lodgepole pine forests of the Winema National Forest, estimated 0.2 live trees, 0.3 snags, 0.6 logs and 1.3 slash piles/ha (0.08 live, 0.12 snags, 0.24 logs, and 0.52 slash piles per acre) of appropriate size would meet denning and resting needs (Raphael and Jones 1997).

Blue-birds are the most diverse species in this group utilizing all forest types for nesting and openings for foraging. It is associated with burned areas that have openings and fairly high densities of snags. A secondary cavity nester, it prefers cavities created by the northern flicker. The northern flicker is a most unconventional woodpecker. It feeds on ants, beetles and other insects on the ground and nests in open stands of older trees where there are larger snags, 13-22 inches dbh, with some decay. The key habitat features for all these species are down logs and snags. The olive-sided flycatcher, an aerial insectivore, prefers forest openings or edge habitats where forest meets meadows, harvest units, rivers, bogs, marshes etc. (Marshall et al. 2003). Nesting success was highest within forest burns where snags and scattered tall, live trees remain (Marshall et al. 2003, Sallabanks et al. 2001).

Prior to the fires, habitat for most of these species occurred scattered across the watershed in stands of multi-story mid, late and old forest. The olive-sided flycatcher probably utilized poor quality edge habitats along old harvest units. Existing snag levels varied across the landscape. Fire reduced the habitat for the flammulated owl and American marten. The fire increased habitat for the northern flicker, mountain blue-bird and olive-sided flycatcher. These species are less dependent on a green component or canopy cover. Marshall et al. (2003) noted that mountain bluebird and olive-sided flycatcher populations increased after a fire. This was based on a mosaic of green trees scattered through-out the fires, so habitat could be over-estimated and limited to edges with green trees or mixed intensity areas.

The Metolius watershed had been experiencing increasing levels of snags and down woody material since the early 1990's primarily from insect and disease outbreaks due to fire suppression. This was occurring in the mixed conifer habitats prior to the fires. Vegetation treatments were designed to reduce fuel loadings and fire risk so within units, lower dead wood levels were present than found in the surrounding landscapes. However, retention levels were based on the most current information at the time and snags were being retained at higher than historic management levels throughout the watershed.

The fires of 2002 and 2003 created a large influx of dead material over the landscape. This material will be existing on the landscape for some time. However, due to the relatively short standing time of snags, which equates to about 75% of the snags falling within 20 years (Parks et al. 1999, Dahms 1949, Keen 1950, Haggard and Gaines 2001), much of the material will be present as down wood. There will be a very long lag time before snag recruitment will be at natural levels.

Other factors should be considered if treatment of burned areas is proposed. One is the arrangement of snags on the landscape. Saab and Dudley (1998) found that all species of cavity excavators selected for clumps of snags rather snags with a more uniform distribution. Also, cavity nesters selected for larger snags in general and many selected for more heavily decayed snags, meaning that most were snags prior to the fire (Saab and Dudley 1998, Haggard and Gaines 2001, Laudenslayer 2002). Therefore, the retention of snags in green forests, including broken top trees, may be critical for providing nest trees for the first few years after the fires until snags become softer and are more easily excavated.

Recommendations

1. Use the DecAID stratification as a basis for dead wood retention and refine retention levels based on specific species requirements.
2. Maintain large structure (both live and dead) on the landscape.

TREND: Increased levels of dead wood currently. Standing snags will dramatically decrease after 15-30 years and there will be a long lag time before large snags occupy the watershed.

TERRESTRIAL WILDLIFE NON-NATIVE SPECIES

Turkeys

Since 1996, one additional turkey release has been implemented. Approximately 52 Rio Grande turkeys were released outside the watershed near Fly Creek. Turkey populations within the Metolius watershed have not changed greatly due to increased stand densities primarily from fire suppression. However, with the implementation of thinning, mowing and burning prescriptions, habitat has been increasing and use by resident turkeys has been documented.

Use in the Eyerly fire by turkeys has increased greatly due to the emergence of several forb, grass, and shrub species. The B&B, Link, and Cache Mountain fires as well as the Eyerly fire, have resulted in an increase in potential habitat. This is primarily due to reduced stand densities and heavy shrub layers and the increase in more desirable forage species. It is assumed that use will increase in these areas, especially during the summer and fall. However, snow levels may preclude yearlong use in some portions of the watershed.

There may be some competition with other gallinaceous bird species, however it is unknown how this affects these populations.

Recommendations

1. Coordinate with Oregon Department of Fish and Wildlife and local organizations (i.e. National Wild Turkey Federation, Oregon Hunters Association, Quail Unlimited, etc.) to develop a study related to turkey occupation and competition between native gallinaceous birds and possibly landbirds as well.

TREND: Increasing due to increase in potential habitat.

Barred Owl

Since 1996, there have been a few sitings of barred owls in the watershed. However, no nest locations have been found.

It is unknown what affects of the fires will have on the potential for barred owls to occupy the watershed. There are known sitings on adjacent lands on the Willamette National Forest, the Warm Springs Reservation and on the Bend district. Therefore, there is potential for this species to move into the watershed now due to the fire effects. More edge has been created and this species may be more adaptable that other interior species.

Recommendations

1. Coordinate with research or USFWS to develop a strategy for documenting occupation of the watershed and steps on how to address management of this species related to other TES species in the watershed.

TREND: Unknown.

Goats and Sheep

In 2003, Oregon Department of Fish and Wildlife prepared the "Oregon's Bighorn Sheep and Rocky Mountain Goat Management Plan" to address management of three big game species. Both the California bighorn sheep and Rocky Mountain goat are proposed for re-introduction into the Metolius watershed or areas directly adjacent which may have future management implications.

California Bighorn Sheep

Historically, California bighorn sheep were the most abundant wild sheep in Oregon (Toweill and Geist 1999). They were found throughout the non-timbered portions of the Deschutes and John Day River drainages. Declines related to hunting pressure for food and trophies, and disease mortality from interactions with domestic sheep led to this species being extirpated in Oregon by 1915.

California bighorn herds are non-migratory in Oregon. They prefer rugged, open habitats with high visibility of their surroundings. Survival is positively correlated with amounts of cliffrock, rimrock, and rocky outcroppings. Rocky outcroppings are particularly important for lambing and escape from predators. Grasses make up the bulk of their diet along with seasonal use of forbs and shrubs. Water is also an essential requirement of suitable habitat and may limit distribution.

Much of the historic habitat is no longer suitable for occupation due to civilization, fire suppression, and lack of forage due to juniper encroachment. The fires of 2002 and 2003 may have enhanced bighorn habitat primarily along Lake Billy Chinook with the reduction of brush and shrub species. However, the spread of noxious weeds may reduce forage quality.

The Upper Deschutes has been identified as a future release location for bighorns. However, limitations exist with the presence of domestic sheep and other exotic species in the area. Therefore, it is unknown when this release will occur.

TREND: Increasing due to the future release.

Rocky Mountain Goats

It is unclear as to what extent Rocky Mountain goats occupied the area, but the management plan developed by ODFW (2003) documents occurrences in the Oregon Cascades and in particular, the Mt. Jefferson and Three Sisters wildernesses (Richardson et al. 1829, Rideout and Hoffman 1975, Ord 1815, Suckley and Gibbs 1860, Coues 1897, and Grant 1905). It is surmised that goats disappeared from the Oregon Cascades during the 19th century as a result of climatic fluctuation, impacts of severe weather on isolated populations, impacts of Native American hunters, and impacts from European fur traders.

Habitat varies but is dominated by cliffs or extremely steep slopes (Kerr 1965, Holroyd 1967, Johnson 1983, and Chadwick 1983). Cliffs and rock outcrops provide security cover but these are often broken by narrow talus chutes, lush avalanche slopes, or are adjacent to less steep areas that provide forage. South and west facing wind swept slopes provide the greatest food availability during the winter.

Mountain goats have broad food tolerances but grasses are preferred and used more year round if available (Saunders 1955, Chadwick 1973, Smith 1976, Johnson 1983). Where goats inhabit forests to escape deep snow or excessive heat, arboreal lichen are preferred forage (Richardson 1971, Chadwick 1973, Smith 1976). Frequent conifer consumption, particularly firs (Saunders 1955, Geist 1971, Smith 1976) seems to be associated with severe winter conditions (Geist 1962, Kerr 1965, Johnson 1983). This species also frequents natural mineral licks which may result in some degradation of the area.

The Mt. Jefferson and Three Sisters wilderness areas are number one priority areas for release sites. The main limiting factor identified is winter range. It is unknown what impacts this species would have on alpine areas, especially in the fire area.

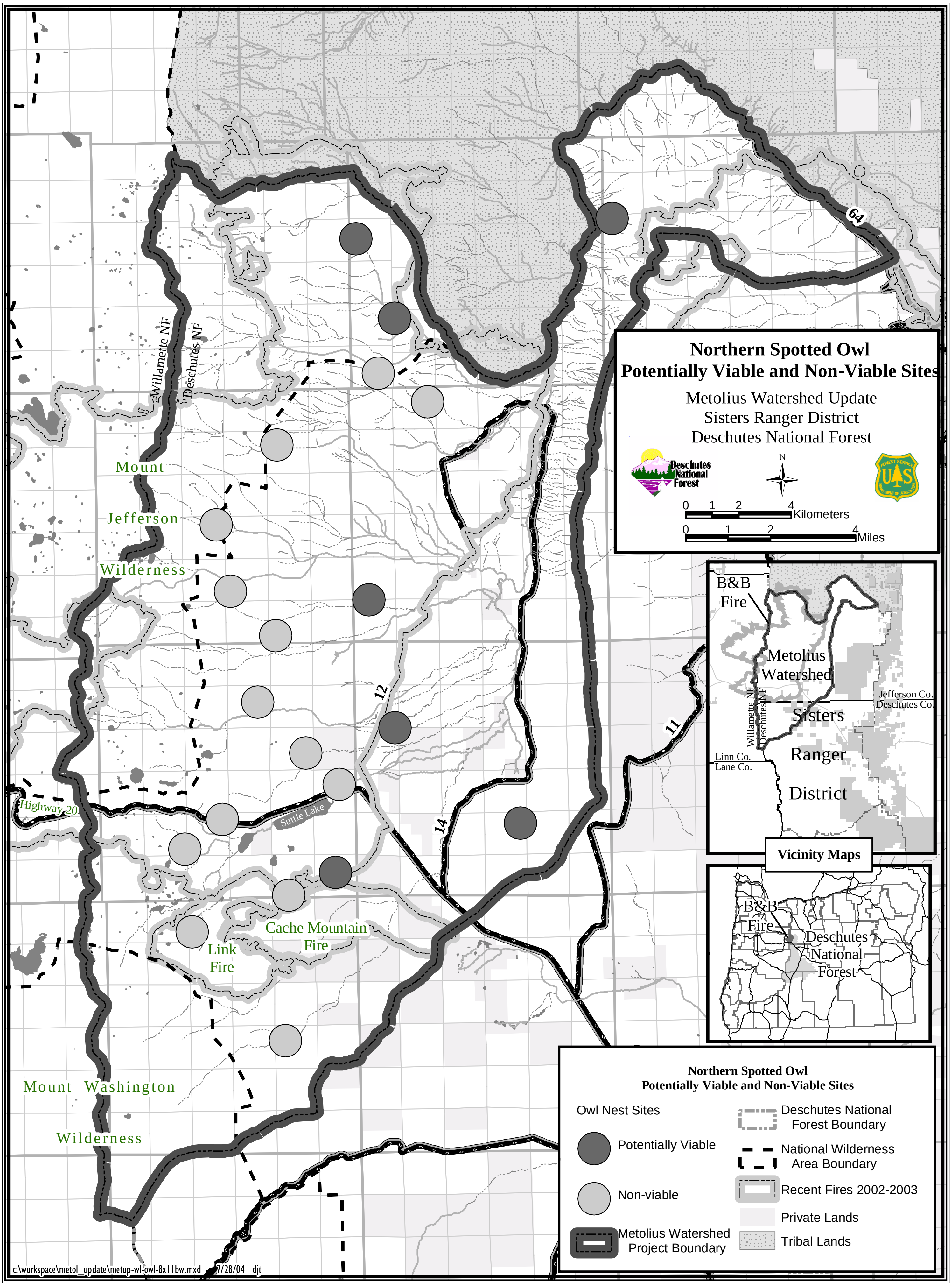
TREND: Increasing due to potential release.

MONITORING

1. Surveys should occur for focal wildlife species to determine population trends, essential habitat, and impacts of recent events.
2. Snag densities are needed to validate the DecAID analysis.
3. Monitor open road densities to ensure meeting forest plan standards.
4. Map and develop a strategy for treatment of hardwood stands (i.e. aspen).

RESEARCH QUESTIONS/DATA GAPS

1. How do large scale habitat changes affect interior and late-successional species (spotted owl, bats, great gray owl, flammulated owl, etc.)? The flammulated owl is also migratory so how do large scale changes affect movement?
2. Will barred owls occupy the watershed?
3. What affects does the loss of forested habitats, especially within wilderness areas, have on connectivity related to large ranging carnivores (i.e. wolverine)?
4. Determine historic/recent presence of spotted frogs within the Mt. Jefferson and Mt. Washington wilderness areas and how does the change in habitat affect connectivity?
5. Fire effects are largely unknown to many wildlife species. How does the occurrence of fire affect species shifts on the landscape and the use of remaining habitats?
6. Spotted owl habitat preferences in eastside ecosystems are still not widely understood.



Northern Spotted Owl
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B&B Fire
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Deschutes Co.
Sisters Ranger District
Linn Co.
Lane Co.
Vicinity Maps
B&B Fire
Deschutes National Forest
Northern Spotted Owl
Potentially Viable and Non-Viable Sites
Owl Nest Sites
Potentially Viable
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Deschutes National Forest Boundary
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Tribal Lands
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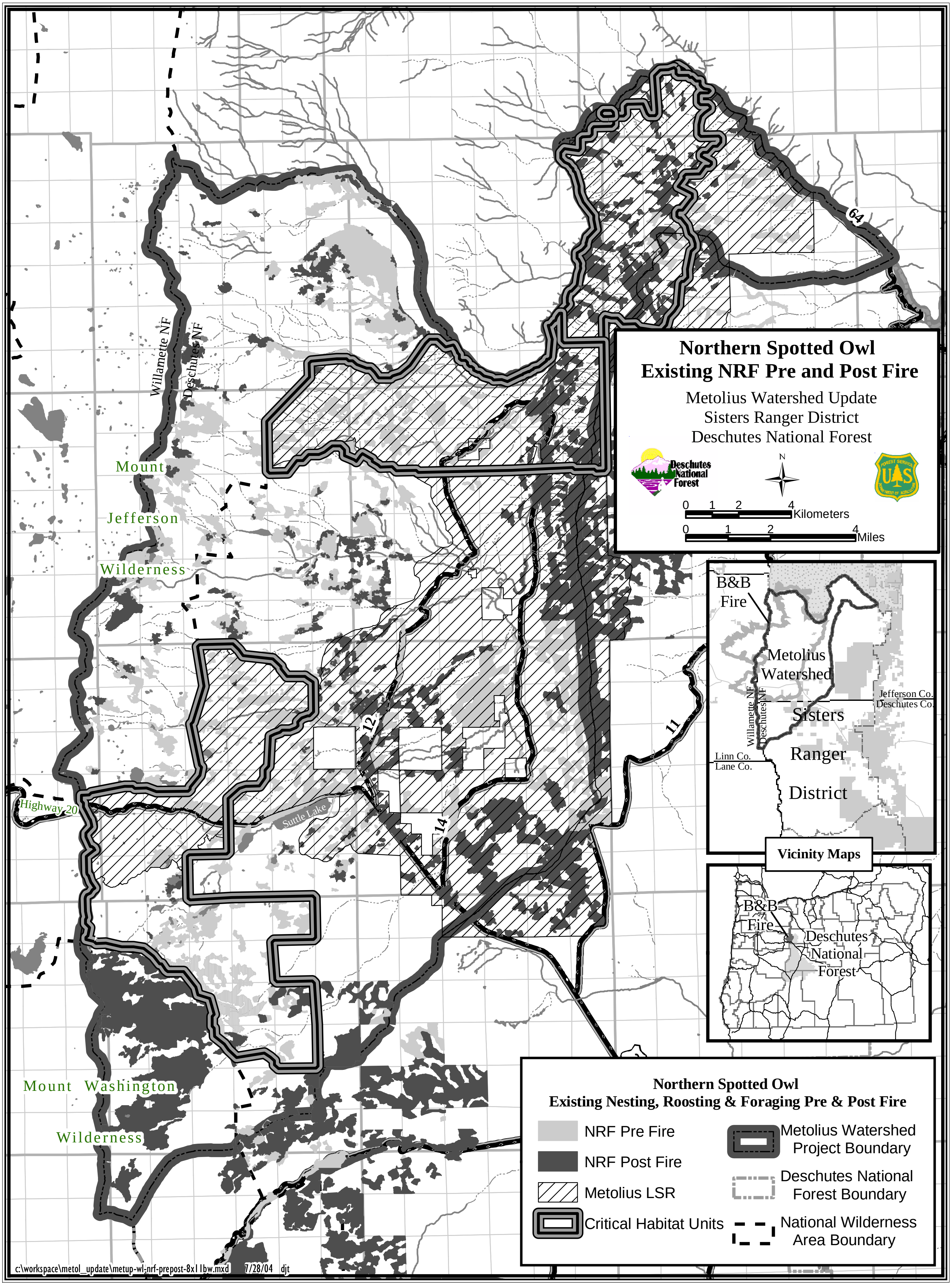
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Linn Co.
Lane Co.
Vicinity Maps
B&B Fire
Deschutes National Forest
Northern Spotted Owl
Existing Nesting, Roosting & Foraging Pre & Post Fire
NRF Pre Fire
NRF Post Fire
Metolius LSR
Critical Habitat Units
Metolius Watershed Project Boundary
Deschutes National Forest Boundary
National Wilderness Area Boundary
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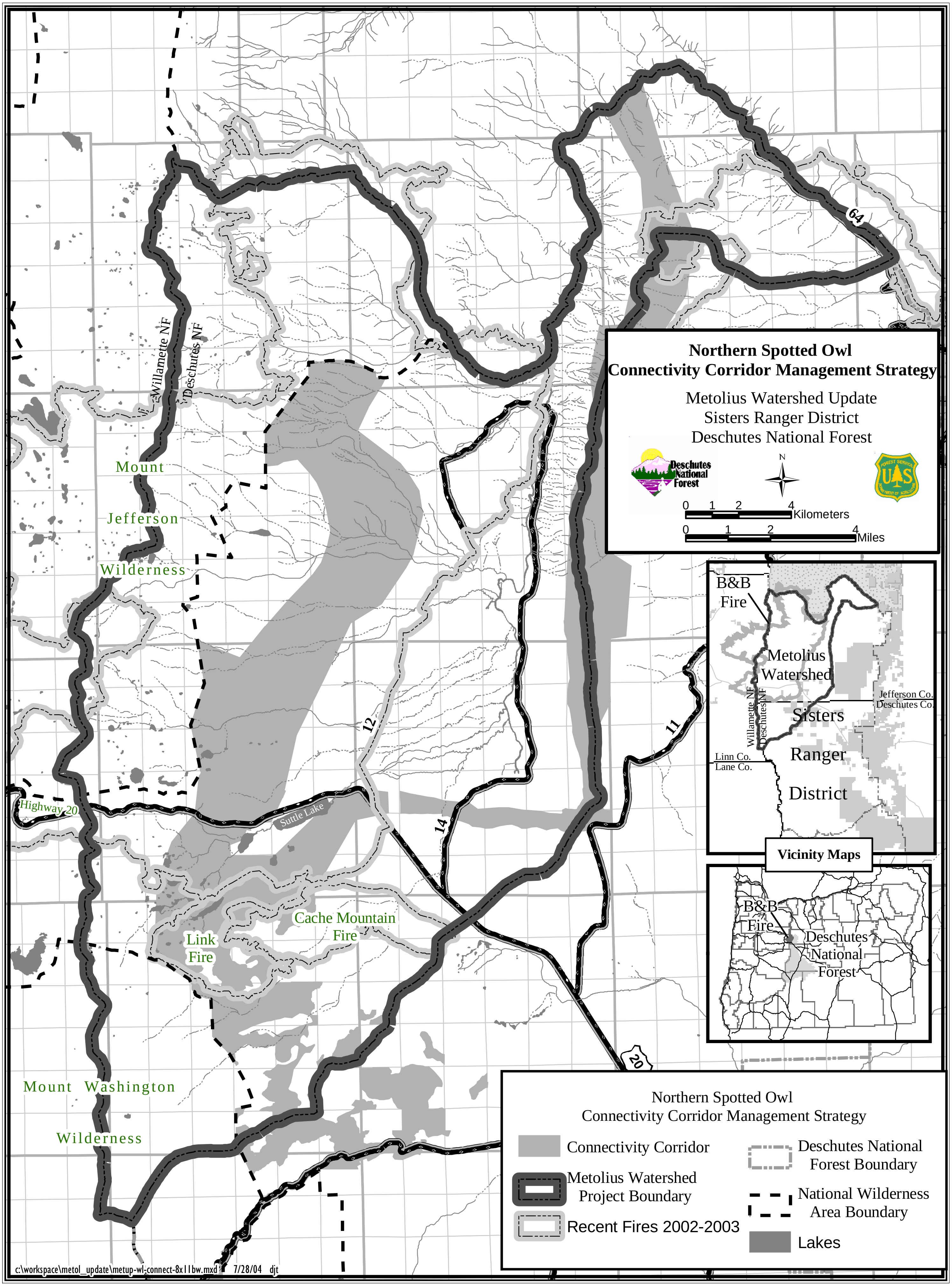
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Mount Jefferson Wilderness
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Deschutes NF
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Link Fire
Cache Mountain Fire
Mount Washington Wilderness
Northern Spotted Owl
Connectivity Corridor Management Strategy
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Metolius Watershed Project Boundary
Recent Fires 2002-2003
Deschutes National Forest Boundary
National Wilderness Area Boundary
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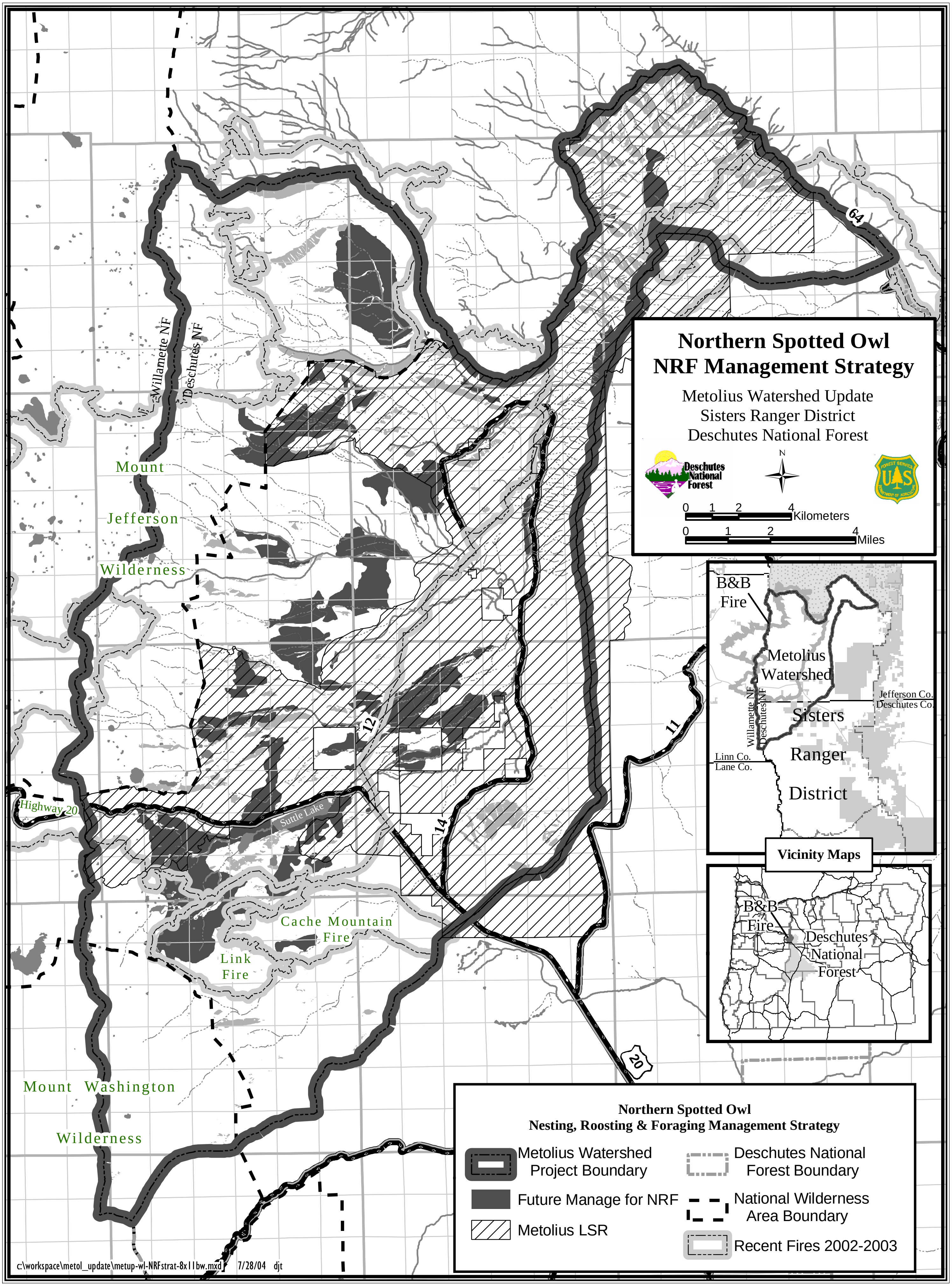
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Northern Spotted Owl
Nesting, Roosting & Foraging Management Strategy
Metolius Watershed
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Deschutes National
Forest Boundary
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Metolius LSR
Recent Fires 2002-2003
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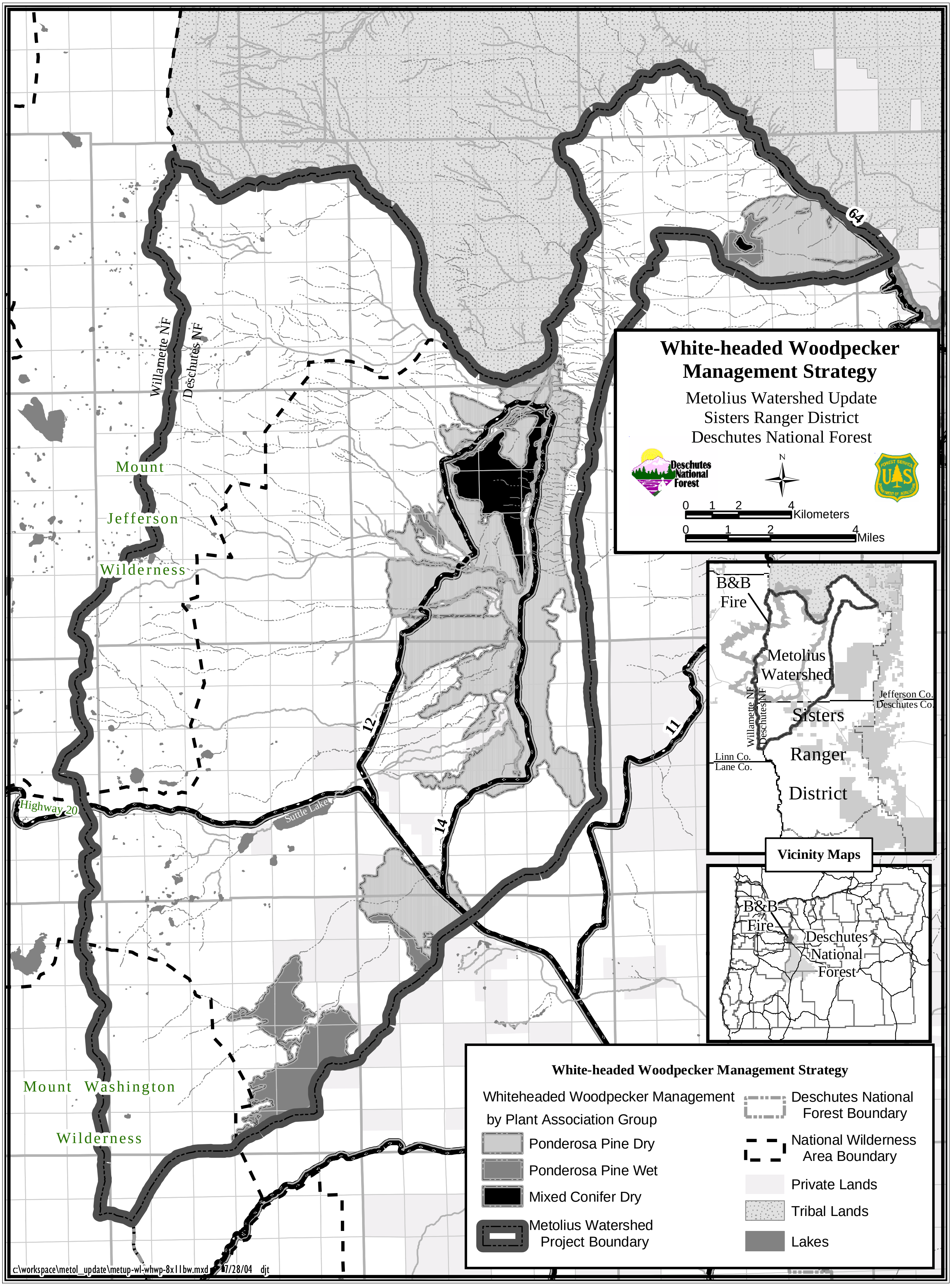

White-headed Woodpecker Management Strategy
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Metolius Watershed
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Sisters Ranger District
Linn Co.
Lane Co.
B&B Fire
Deschutes National Forest
White-headed Woodpecker Management Strategy
Whiteheaded Woodpecker Management by Plant Association Group
Ponderosa Pine Dry
Ponderosa Pine Wet
Mixed Conifer Dry
Metolius Watershed Project Boundary
Deschutes National Forest Boundary
National Wilderness Area Boundary
Private Lands
Tribal Lands
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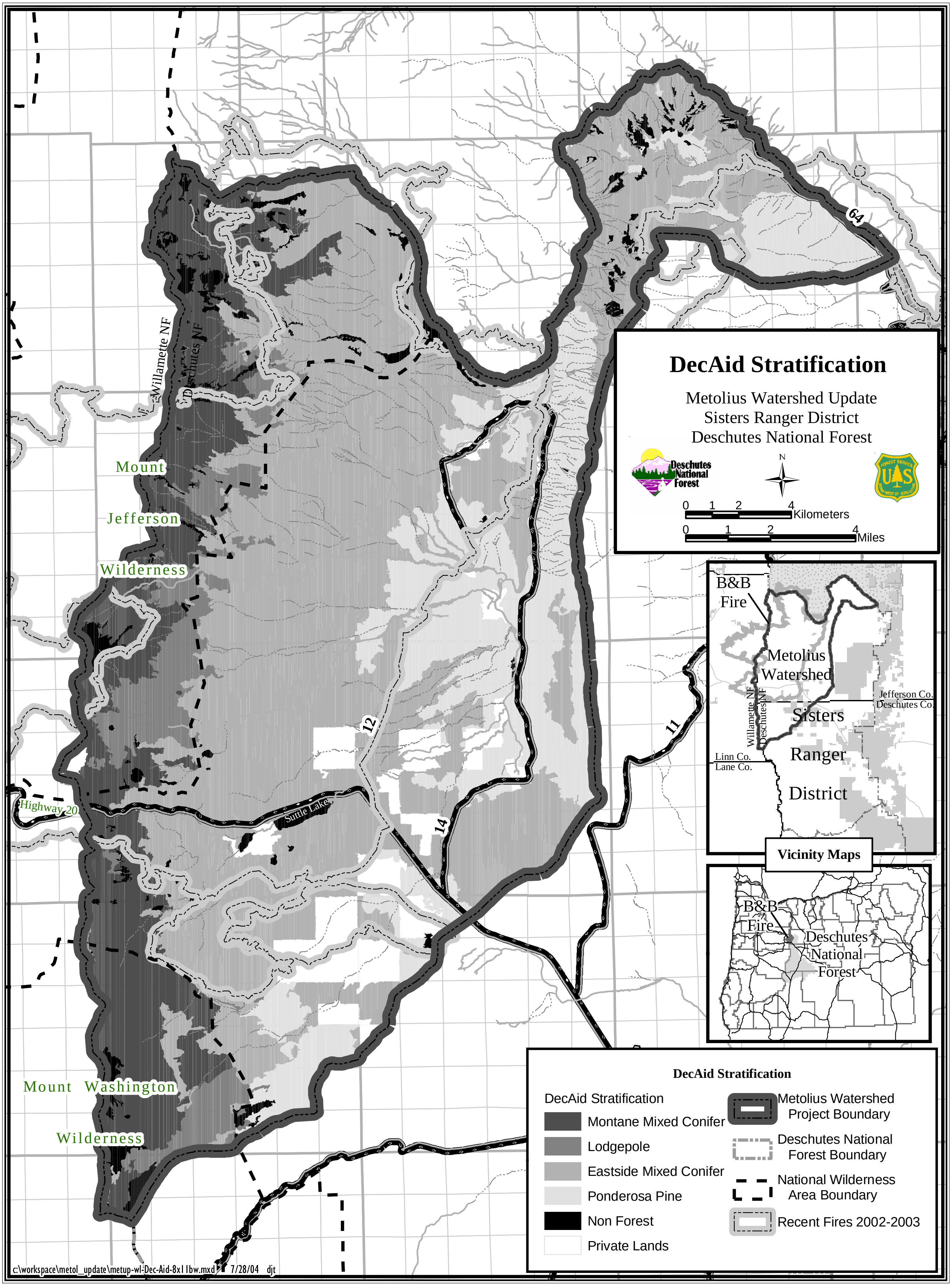
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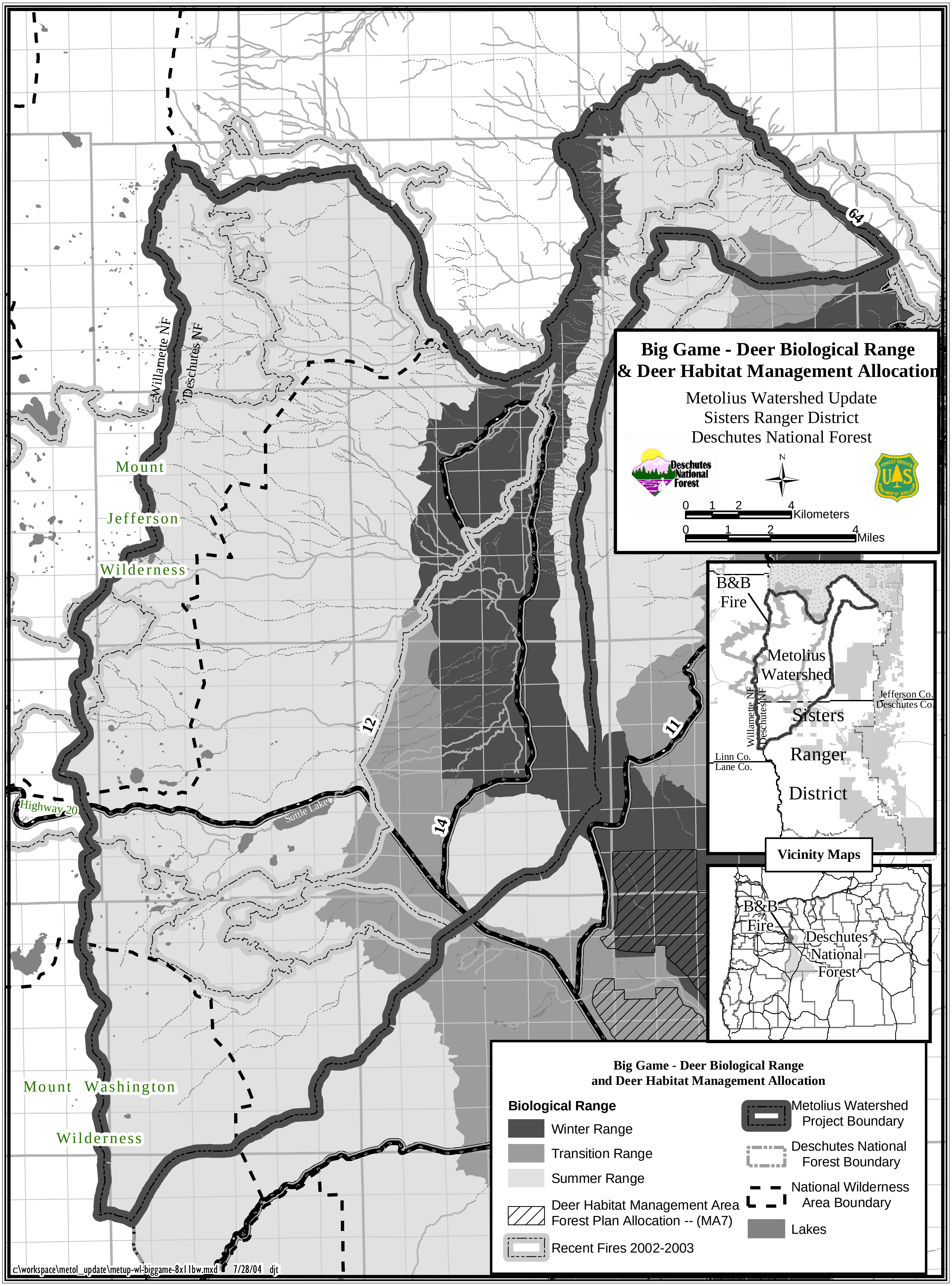

Big Game - Deer Biological Range
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Big Game - Deer Biological Range
and Deer Habitat Management Allocation
Biological Range
Winter Range
Transition Range
Summer Range
Deer Habitat Management Area Forest Plan Allocation -- (MA7)
Recent Fires 2002-2003
Metolius Watershed Project Boundary
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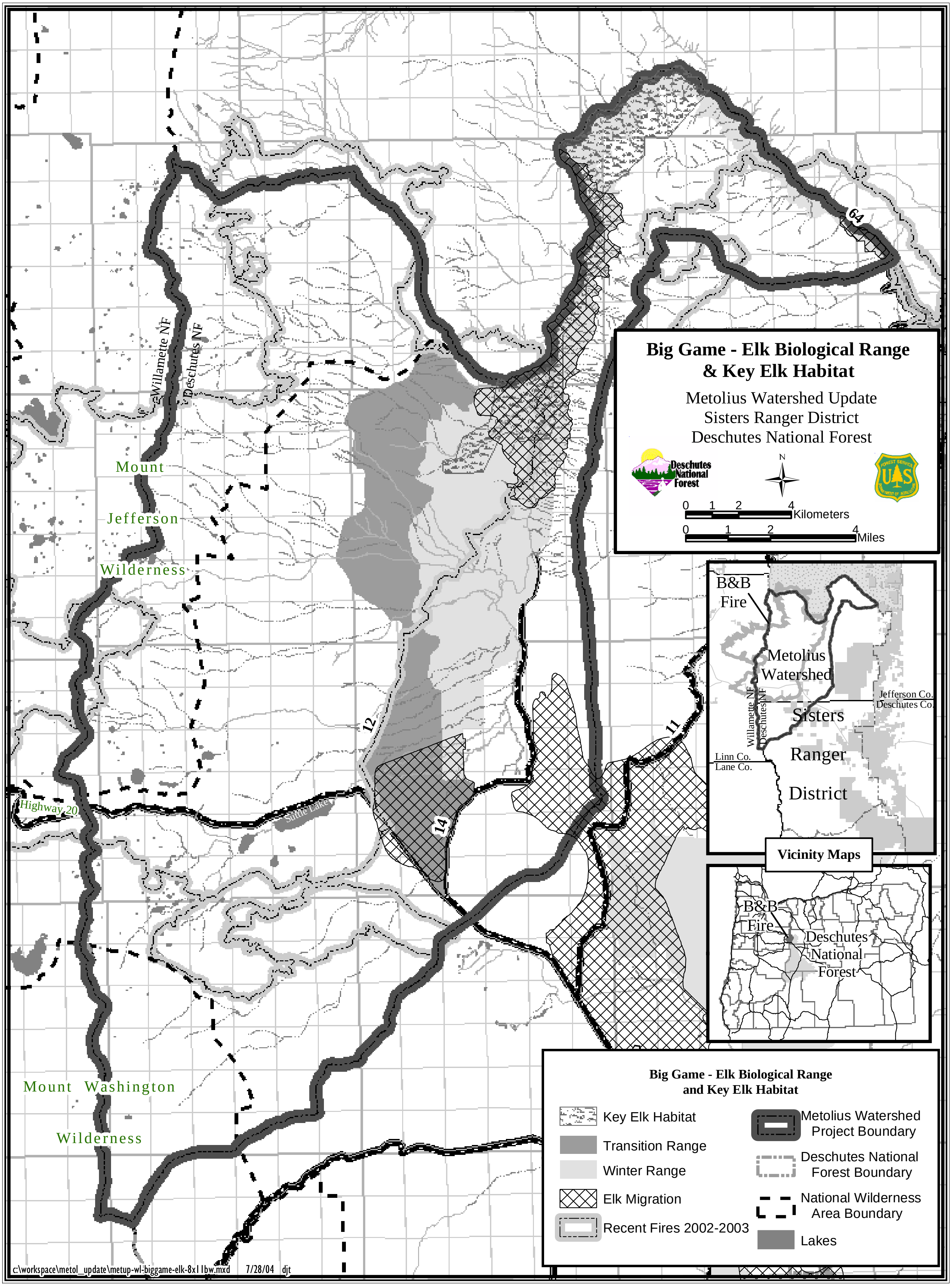

Big Game - Elk Biological Range
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Vicinity Maps
B&B Fire
Deschutes National Forest
Big Game - Elk Biological Range
and Key Elk Habitat
Key Elk Habitat
Transition Range
Winter Range
Elk Migration
Recent Fires 2002-2003
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Deschutes National Forest Boundary
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Appendix WL1 – Scientific Names of Species Included in the Document

Common Name	Scientific Name
Deschutes LRMP Species	
Northern Goshawk	*Accipiter gentiles*
Coopers Hawk	*Accipiter cooperii*
Sharp-shinned Hawk	*Accipiter striatus*
Great Gray Owl	*Strix nebulosa*
Great Blue Heron	*Ardea herodias*
Red-tail Hawk	*Buteo jamaicensis*
Osprey	*Pandion haliaetus*
White-headed Woodpecker	*Picoides albolarvatus*
Flammulated Owl	*Otus flammeolus*
Elk	*Cervus elephas*
Mule Deer	*Odocoileus hemionus*
American Marten	*Martes Americana*
Crater Lake Tightcoil	*Pristiloma arcticum crateris*
Cavity Excavators	
Pileated Woodpecker	*Dryocopus pileatus*
Black-backed Woodpecker	*Picoides arcticus*
Northern Flicker	*Colaptes auratus*
Hairy Woodpecker	*Picoides villosus*
Williamson’s sapsucker	*Sphyrapicus thryroideus*
Three-toed Woodpecker	*Picoides tridactylus*
Lewis’ Woodpecker	*Melanerpes lewis*
Red-naped Sapsucker	*Sphyrapicus nuchalis*
Birds of Concern	
Pygmy Nuthatch	*Sitta pygmaea*
Chipping Sparrow	*Spizella passerine*
Brown Creeper	*Certhia Americana*
Hermit Thrush	*Catharus guttatus*
Olive-sided Flycatcher	*Contopus borealis*
Sandhill Crane	*Grus Canadensis*
Blue Grouse	*Dendragapus obscurus*
Rufous Hummingbird	*Selasphorus rufus*
Solitary Sandpiper	*Tringa solitaria*
Mountain Bluebird	*Sialia currucoides*
Brewer’s Sparrow	*Spizella breweri*
Vesper Sparrow	*Pooecetes gramineus*
Waterfowl	
Canada Goose	*Branta Canadensis*
Wood Duck	*Aix sponsa*
Mallard	*Anas platyrhynchos*
Northern Pintail	*Anas acuta*

Common Name	Scientific Name
Blue-winged Teal	*Anas discors*
Cinnamon Teal	*Anas cyanoptera*
Northern Shoveler	*Anas clypeata*
American Wigeon	*Anas Americana*
Canvasback	*Aythya valisineria*
Redhead	*Aythya Americana*
Hooded Merganser	*Lophodytes cucullatus*
Common Merganser	*Mergus merganser*
Green-winged Teal	*Anas carolinensis*
Ring-necked Duck	*Aythya collaris*
Barrow's Goldeneye	*Bucephala islandica*
Bats	
California Myotis	*Myotis californicus*
Western Small-footed Bat	*Myotis cilioabrum*
Yuma Myotis	*Myotis yumanensis*
Little Brown Bat	*Myotis lucifugus*
Long-legged Bat	*Myotis volans*
Long-eared Bat	*Myotis evotis*
Silver-haired Bat	*Lasionycteris noctivagans*
Big Brown Bat	*Eptesicus fuscus*
Hoary Bat	*Lasiurus cinereus*
Pallid Bat	*Antrozous pallidus*
Western Big-eared Bat	*Plecotus townsendii*
Western Pipistrelle	*Pipistrellus Hesperus*
Threatened, Endangered, and Sensitive Species	
American Peregrine Falcon	*Falco peregrinus anatum*
Northern Bald Eagle	*Haliaeetus leucocephalus*
Northern Spotted Owl	*Strix occidentalis caurina*
Bufflehead	*Bucephala albeola*
Harlequin Duck	*Histrionicus histrionicus*
Canada Lynx	*Lynx canadensis*
California Wolverine	*Gulo gulo luteus*
Pacific Fisher	*Martes pennanti*
Oregon Spotted Frog	*Rana pretiosa*
Other Species of Interest	
Rio Grande Turkey	*Meleagris gallopavo intermedia*
Merriam's Turkey	*Meleagris gallopavo merriami*
Barred Owl	*Strix varia*
California Bighorn Sheep	*Ovis canadensis*
Rocky Mountain Goat	*Oreamnos americanus*

APPENDIX WL2 – DECAID HABITAT ANALYSIS FOR THE METOLIUS WATERSHED

An analysis based on the draft version of "A Guide to the Interpretation and Use of DecAID" (Gunderson 2003) was used to determine what level and where to manage for snags and down woody material. DedAID uses a multi-tier approach for the management of snags across the landscape. Much of the analysis is based on information relating to habitat types or species needs. For this watershed analysis, snag levels were proposed based on the larger landscape context. The following outlines the steps taken to come up with these determinations.

The use of DecAID is best when applied to the larger landscape scale. Therefore, the Metolius Watershed and the Metolius Late-Successional Reserve will be used as the analysis area.

Several habitat types are defined in DecAID. Four of these correspond to conditions found in the watershed: Eastside Mixed Conifer, Lodgepole, Ponderosa Pine/Douglas-fir, and Montane Mixed Conifer. The primary habitat types present are the Eastside Mixed Conifer and Ponderosa Pine/Douglas-fir. Using the corporate Plant Association Group layer, the following PAGS were grouped to correspond to the following DecAID wildlife habitat types (WL Table 2-1).

WL Table 2-1. PAGs converted to DecAID Wildlife Habitat Types.

<table>
<tr><th>DecAID Wildlife Habitat Type</th><th>PAG</th></tr>
<tr><td rowspan="4">Non-forest</td><td>Alpine Meadow</td></tr>
<tr><td>Non-forest</td></tr>
<tr><td>Meadow</td></tr>
<tr><td>Xeric Shrublands</td></tr>
<tr><td>Private</td><td>All Private Lands were put in this category</td></tr>
<tr><td rowspan="3">Eastside Mixed Conifer
(Blue Mtns)</td><td>Mixed Conifer Wet</td></tr>
<tr><td>Mixed Conifer Dry</td></tr>
<tr><td>Riparian that occurs within MCW and MCD</td></tr>
<tr><td rowspan="3">Lodgepole</td><td>Lodgepole Pine Wet</td></tr>
<tr><td>Lodgepole Pine Dry</td></tr>
<tr><td>Riparian that occurs within LPW and LPD</td></tr>
<tr><td rowspan="3">Montane Mixed Conifer Forest</td><td>Mountain Hemlock Dry</td></tr>
<tr><td>White Bark Pine Dry</td></tr>
<tr><td>Riparian occurring within MHD and WBPD</td></tr>
<tr><td rowspan="3">Ponderosa Pine/Douglas-fir</td><td>Ponderosa Pine Wet</td></tr>
<tr><td>Ponderosa Pine Dry</td></tr>
<tr><td>Riparian occurring within PPW and PPD</td></tr>
</table>

Plant series, fire regimes, and topographic position within each habitat type were analyzed to arrive at a desired level in which to manage snags and down woody material. The DecAID guide recommends using slope and aspect as criteria to delineate different management strategies. North and east slope aspects as well as flat to moderate slopes were criteria used to help separate differences in topographic positioning. Flat to moderate were defined as slopes less than 30%.

Fire regime was then overlaid with topographic position and habitat type. It was determined that all areas within the analysis area have either moderate or high fire frequencies. Moderate fire frequency was defined as predominately Eastside Mixed Conifer or Montane Mixed conifer which represents most of the western portion of the Watershed. High fire frequency was defined as predominately Ponderosa Pine and Eastside Mixed Conifer on Green Ridge. These areas represent most of the eastern portion of the Watershed. Using the Guide, a management level was then assigned to each area (WL Table 2-2).

WL Table 2-2. Management Level Selected for DecAID Wildlife Habitat Types.

DecAID Wildlife Habitat Type	Fire Regime	Series/Sub-series	Topographic Position	Management Level
Montane Mixed Conifer	All	MHD, WBPD, RIP	All	80%
Eastside Mixed Conifer	Moderate	Mesic	Greater than 30% slope and north aspects	80%
Eastside Mixed Conifer	Moderate	Mesic	Not as above	50%
Eastside Mixed Conifer	High	Dry	Greater than 30% slope and north aspects	50%
Eastside Mixed Conifer	High	Dry	Not as above	30%
Ponderosa Pine/ Douglas-fir	High	Wet	Greater than 30% slope and north aspects	80% **
Ponderosa Pine/ Douglas-fir	High	Dry	Greater than 30% slope and north aspects	50%
Ponderosa Pine/ Douglas-fir	High	Dry	Not as above	30%
Lodgepole	Moderate	Wet and Dry	Greater than 30% slope and north aspects	80%
Lodgepole	Moderate	Wet and Dry	Not as above	50%

Note:
** For Ponderosa Pine, if high densities of snags are located on north aspects the management level should be change to the 80% Tolerance Level.

All lands within designated wilderness were given an 80% tolerance level, since we will not be managing these lands.

The Lodgepole Pine DecAID wildlife habitat type is still under construction. The rationale for assigning the above lodgepole pine management levels are as follows: Lodgepole pine stands are usually associated with stand replacement events whether it is fire or insects and most lodgepole stands occur within a moderate fire regime. Fire cycles are longer in this habitat type which calculates into higher snags densities. Slopes greater than 30% with north aspects were assigned the highest snag numbers (80% tolerance level). It is assumed that north facing aspects with slope over 30% have higher stocking rates, therefore they can support higher snag levels. The remainder of the area was assigned moderate snag numbers (50% tolerance level).

Finally the structural condition of stands was calculated. The small and medium size structural condition was chosen for this analysis. The quadratic diameter for small and medium size structure class is 10 to 20 inches. It was felt that this best represented what occurs over the landscape within the Metolius Watershed and the Metolius LSR.

WL Table 2-3. DecAID Habitat Types by Tolerance Level.

Tolerance Level	Eastside_MC	Lpole	Montane_MC	Non_Forest	Ppine	Private
30	41395.49	0	0	0	20016.61	0
50	21803.89	746.07	0	0	10492.78	0
80	20746.36	7206.87	22798.69	0	46.67	0
NA	0	0	0	6077.62	0	7907.39
Totals	83945.74	7952.94	22798.69	6077.62	30556.06	7907.39

WL Table 2-4. Small and Medium Trees Associated with Tolerance Levels based on CVS Plots.

Tolerance Level	30%		50%		80%	
DBH	≥ 10	≥ 20	≥ 10	≥ 20	≥ 10	≥ 20
Eastside MC	6.7	2.7	12.6	4.3	25.3	8.6
Lpole **	NA	NA	NA	NA	NA	NA
Montane MC	25.2	6.6	40.7	10.5	79.9	23.6
Ppine	1.3	1.1	2.7	1.1	7.2	2.5

Note:
** The lodgepole habitat type portion of DecAid is currently under construction.

The CVS numbers defined in WL Table 2-4 are what should be managed for across the landscape. This does not suggest that every acre should have this amount of snags.

HERITAGE

TRIBAL RESOURCES

Treaty Rights and Ceded Lands

On June 25, 1855, the Tribes of Middle Oregon signed a Treaty with the United States that established the Warm Springs Reservation and reserved rights for fishing, hunting, gathering, and grazing on lands ceded by the Tribes to the United States. These ceded lands cover 1/6th of the State of Oregon with boundaries at the middle of the Columbia River, the summit of the Cascade Mountains, the 44th parallel, the summit of the Blue Mountains, and the headwaters of Willow Creek. The entire Sisters Ranger District and the watershed analysis area are ceded lands with protected treaty rights, managed in trust for the Tribes.

Current Tribal Uses and Cultural Resources

Trust responsibilities for tribal interests on ceded lands include protection of archeological materials and sites and the protection of cultural materials and sites for present and future generations. The Tribes have provided us the following definitions regarding cultural resources:

- *"Cultural Materials" means materials or objects designated by the Tribal Council as having cultural significance that are obtained from (a) protected lands or (b) outside the Reservation if associated with treaty rights or other tribal rights. Cultural materials may included such things as eagle feathers, fish, game, roots, berries, cedar bark, Indian medicines, and water having special significance." (Tribal Ordinance 490.010- 1)*

A partial list of tribal cultural materials is included in the Tribal Ordinance 490.510. The Tribes may expand this list by amendment. They have also provided us with confidential lists of cultural plant materials to be used in project planning and analysis.

- *"Cultural site" means an area designated as such by the Tribal Council which has particular cultural, religious, or traditional value to the Confederated Tribes and which requires the protection of this chapter to prevent damage, abuse, or deterioration." (Tribal Ordinance 490.010-5)*

Information regarding cultural sites is sensitive and is shared with the Forest Service and others as needed.

Tribal Resource Issues

The following issues have emerged from Tribal input to project level analysis, cooperative planning efforts between the Forest Service and the Tribes, and discussions with the Culture and Heritage Committee and other tribal members during this analysis.

Restoration of Anadromous Fish to the Deschutes River Basin

The Tribes are interested in restoring steelhead and salmon runs and recognize the Metolius Basin as critical to that objective because it historically provided significant spawning habitat in the middle Deschutes system.

Forest Service Management of Ceded Lands

The Forest Service has a trust responsibility in managing ceded lands. This means that resources valued by the tribes need to be protected and enhanced, especially during management activities. The Tribes closely monitor and comment on Forest Service management.

Sharing information about Cultural Plants

The Tribes rely on the Forest Service to survey, inventory and protect desirable cultural plants. They have asked to be notified when we find potential gathering areas for certain plants. The Forest Service provides courtesy permits to Tribal Members to help us monitor use and protect the gathering rights of enrolled Tribal members.

Project-level plant surveys have identified many species of plants that have cultural significance. Most of these are common species of shrubs, trees, lichens, and forbs that can be found in many places on the Sisters Ranger District. Good stewardship of the forest will enhance these plants. One of the most important cultural food plants found within the watershed is huckleberries. The exclusion of fire and closing of forest canopies has reduced huckleberry habitat. Potential habitat for another important plant, Blue Camas, may have existed in seasonally wet meadows in the Metolius Basin. Camas may have been extirpated through long and intensive grazing. If oral histories reveal it was once present there may be an opportunity to work with the Tribes to reintroduce this important cultural plant.

Protection of Known and Undiscovered Archeological and Cultural Sites

The Tribes rely on the Forest Service to survey, inventory and protect prehistoric and cultural materials and sites. This is further discussed under Heritage Resources.

TRENDS: relevant to Tribal Issues

- **Communication and information sharing between the Forest Service and the Tribes has improved in the last decade. Continuing efforts to understand and address Tribal concerns is needed**. Several projects have brought Tribal elders and resource specialists together with Forest Service specialists. Information sharing and cooperation is at unprecedented levels, but still needs improvement. Confidential lists of important cultural plants are helping us understand which plants are most important to protect and enhance. The Culture and Heritage Committee has toured the District twice this year to discuss cultural plants and assess opportunities for gathering. The common goal of restoration of anadromous fish is bringing agencies and the Tribes together. Much more needs to be done to address the issues discussed above.

Increased human use and disturbance have increased the probability that undiscovered and known sites of cultural importance are being impacted. Inventory and protection of culturally significant sites needs to continue at a more rapid pace to match growth pressures.

ACCOMPLISHMENTS: relevant to tribal issues

Communications and coordination with the Confederated Tribes of Warm Springs of Oregon has improved. We are notifying them of any and all upcoming projects and informing them as we locate any unusual cultural use plants, archaeological resources, or other cultural use locations
.

ARCHAEOLOGY

At this point, approximately 1/3 of the Metolius watershed has been inventoried for the location of heritage resources. These inventories have been conducted over a period of about 20 years by various people; both in the FS and contracted archaeologists. Over time standards of survey have changed as has the standards of recording sites. As a result, some of these inventories are no longer considered adequate for completeness of methods or of recording.

As a result of these past inventories; approximately 200 heritage “sites” have been recorded within the Metolius watershed. These sites are mostly associated with the time period prior to written records of events in this area. These are mostly lithic scatter sites and consist of about 2/3 of all the sites located. Another five percent contain both a prehistoric and historic components. About ¼ of the sites are considered historic. These consist of travel routes, structures or structure remains, and historic debris.

With the amount of survey completed and the number of sites located; it is estimated that between 400 and 500 sites probably exist within the watershed.

Of the sites known, about 1/3 have been evaluated for significance and 2/3 have not. Of the sites evaluated, approximately two have been determined eligible for every site determined not eligible. If this ratio is carried out to the unevaluated sites; we are probably “protecting” 40 to 50 sites that we don’t need to just because we haven’t evaluated their significance yet.

ARCHAEOLOGY ISSUES

Recent fires have removed surface vegetation and duff from large areas of the basin. This results in exposure of archaeological sites to discovery by visitors and potential surface collection and unauthorized excavation. Much of this exposure is in areas that have not been inventoried. Some of these locations will be inventoried this coming summer.

Fire suppression efforts have impacted up to 15 recorded sites that are either significant or unevaluated. Several of these impacts have been mitigated as possible but more work will be completed this summer.

A prioritized list of archaeological resources has not been developed. Protection and research continue on an as needed or as opportunities occur basis.

The picnic shelters in Metolius campgrounds continue unevaluated and in a deteriorated condition.

Ideas for management of the Santiam Wagon Road and providing better information to the public are being considered but are not being implemented. Recent fires along the Santiam Wagon Road have impacted the road in several locations.

The old tower on Black Butte has collapsed and part of the history of fire detection on the butte is now degraded. The area continues to be managed as a fire detection facility and a trail location with bare tolerance for the historic values present that continue to degrade.

Some of the historic structures at Suttle Lake Resort and Cinder Beach Day Use Area are being managed and maintained. Others are still being neglected with no planned use or management.

ARCHAEOLOGY TRENDS

Damage to prehistoric sites is resulting in slow loss of data, especially in developed locations.

Quickly losing historic structures and features due to neglect, deterioration and development. Overall, historic structures are viewed as a problem and an obstacle rather than as a significant resource to be managed.

Continued lack of sufficient information to develop overall view of prehistoric use and some gaps in understanding of specific historic events.

Information about resources of Tribal interest remains fragmentary and incidental. No systematic methods in place to locate, identify, and communicate to Warm Springs about such resources.

ARCHAEOLOGY ACCOMPLISHMENTS

Most of the prehistoric sites in develop locations in the watershed have been evaluated. Only a couple are left to be done.

Rehabilitation work has been accomplished on the cupola building on Black Butte

Management of the Santiam Wagon Road is being considered in current planning efforts ongoing with the Willamette NF.

Suttle Lake Resort development is considering the historic element there and incorporating it into their plans to rebuild a lodge and cabins.

RECOMMENDATIONS COMMON TO ALL LANDSCAPE AREAS

HERITAGE RESOURCES – TRIBAL AND ARCHAEOLOGY

- Most developed recreation sites have heritage resources evaluated, several to finish up. Highest needs are the historic resources in Camp Sherman including the summer homes, the CCC structures, and one prehistoric site not yet evaluated
- Need to develop better guidelines on how to manage these heritage resources where recreation use and management is ongoing and occasional needs for utility development or improvement are needed in campgrounds, summer homes, resorts, and group camps. This is of highest concern with historic structures in developed locations.
- Continue integrating heritage resources in dispersed recreation management and trails in the watershed.
- Inventory huckleberry patches and manage for continued vigor. Share information with the Confederated Tribes of the Warm Springs Reservation of Oregon

- Maintain and improve water quality throughout the Metolius Basin.
- Continue to recruit and encourage archaeology research with university professors and graduate students in the Metolius Basin.
- Specifically look for opportunities to research the prehistoric use of aquatic resources such as anadromous fish on the Metolius River, Lake Creek, and Suttle Lake.
- Continue to collect more in depth information about sites in the watershed utilizing PIT projects and local volunteers.
- Develop interpretive opportunities to tell the history and prehistory of the basin at such places as Black Butte, Suttle Lake, and the Santiam Wagon Road.

RECOMMENDATIONS FOR SPECIFIC LANDSCAPE AREAS

LANDSCAPE AREA 1

Identify Huckleberry patches and maintain vigor. Share information and discuss management with Warm Springs Culture and Heritage Committee.

LANDSCAPE AREA 2

Maintain the character of the Head of Jack Creek and maintain access for traditional uses.

LANDSCAPE AREAS 4 AND 6

Implement an interpretive plan for the Santiam Wagon Road and Cache Creek Toll Station through these areas for the recreating public.

LANDSCAPE AREA 5

Continue rehabilitation of historic structures and resources present and develop a plan for continued maintenance of these resources. Develop a plan to incorporate historic interpretation into the recreation experience on the butte top.

LANDSCAPE AREA 8

Maintain health and vigor of the western red cedar stand in this LA.

LANDSCAPE AREA 10

Maintain access for traditional uses.

MONITORING

Archaeology

Monitor at least 50% of unevaluated and significant heritage resources annually that are located where ongoing management occurs such as in campgrounds, on roads with management of 2 or above, in summer home tracts, and at resorts or group camps.

Monitor 20% of other significant and unevaluated sites in the watershed annually on a rotational basis so that each site is visited at least every five years.

Tribal Resources

Monitor health of huckleberry patches, western red cedars, and water quality. Share monitoring information with appropriate tribal officials.

DATA GAPS/LIMITATIONS OF ANALYSIS

Archaeology

Approximately 2/3 of the watershed has never been inventoried for heritage resources. As a result, there is a high probability of significant sites being present that are unknown.

Of the sites recorded and known in the watershed, only 1/3 have been evaluated for significance. The remainder may or may not contain important information about our knowledge of the historic and prehistoric past of the watershed.

Only a few of the approximately 200 sites recorded have any in depth analysis that can allow us to determine prehistoric time periods of occupation, specific associations with activities conducted at the site or other locations. As a result, very little is known about the overall patterns of prehistoric land use in the Metolius or how that use may have changed over time.

SCENERY MANAGEMENT SYSTEM

A Sustainable Aesthetic Approach

INTRODUCTION

This purpose of this document is to update changes to the landscape and scenic views to the Metolius Watershed Analysis area, brought on by the B & B Complex fires, which burned over 90,000 acres during the summer of 2003. Additionally, the Eyerly Fire, which burned an estimated 23,500 acres in 2002, has altered the landscape within the Metolius Watershed Analysis area. The 1996 Metolius Watershed Analysis document forms the basis and the foundation of this update.

Existing Scenic Conditions

The Metolius Watershed Analysis area encompasses a very dynamic landscape on the foothills of Oregon's Cascade Mountain range. The analysis area has been divided into 11 Landscape Areas including: 1. Wilderness, 2. Central Basin, 3. Highway 20 Corridor, 4. Meadow Lake Basin, 5. Black Butte, 6. Cache, 7. Shuttle Lake, 8. Upper Tributaries, 9. Green Ridge, 10. Scarp, and 11. Lower River. Please refer to the 1996 Metolious WSA, Social Domain section, for more detail.

During the early 1980's, the Metolius Watershed Analysis area had healthy forest with numerous trees of various age and size classes. At about the same time, one of Oregon worst drought season was looming, which was to last for several years. Serious insect and disease infestations followed, wrecking havoc on the forest structure in the late 1980 and 90's. Much of the area's forest was affected by a spruce bud worm infestation, which killed many trees—as much as 60 percents mortality rate in some pockets.

Much of the affected areas have subsequently been thinned (salvaged), such as areas along the Hwy 20 scenic corridor, during the 1990's. This decade saw more drought, which led to numerous high intensity wildfires in the area.

The 2000 decade saw forest structure within vicinity of the Metolius WSA area burned extensively by high intensity wildfires, such as the Eyerly and B & B Complex Fire. The B & B Complex fire of 2003, at 90,000+ acres, represents one of the largest wildfires to have burned within the Metolius Watershed Analysis area. This wildfire alone has directly affected and altered five (5) of eleven (11) landscape areas (refer to the 1996 Metolius Landscape Areas) within the watershed. As a result, it has highly altered the existing landscape character, scenic quality, and scenic integrity level within the Metolius Watershed Analysis area.

Cultural Values

Scenic Resources

The USDA Forest Service has a Handbook for a Scenery Management System (SMS--USDA FS 1995) used to protect and enhance scenic resources, which may be diminished by human activities, such as vegetation management, recreation, and/or administrative facility development.

The Scenery Management System is used in conjunction with the Deschutes National Forest Land and Resource Management Plan (LRMP 1990). The analysis will take into consideration the balance between Social and Ecological needs within the study area.

The Forest Service also implements regulations, which establish a variety of **Scenic Quality Standards** (SQO's for MA-9). These standards include:

1. Natural Appearing Landscape with High Level Scenic Integrity (formerly Retention, SV-1 allocation),
2. Slightly Altered Landscape with Medium Level Scenic Integrity (formerly Partial Retention, SV-2 allocation),
3. Altered Landscape with Low Scenic Integrity (formerly Modification or General Forest, GFO allocation).

Scenic View Allocations

The Deschutes National Forest Land and Resource Management Plan established Management Areas (MA) use to manage National Forest lands. Within the Metolius WSA project area they include: Scenic Views (MA 9, SV-1, SV-2, and SV-4) and General Forest (MA 8, GFO).

Highway 20, Forest Road 14, 12, 2070, and Forest Road 2076 scenic corridors are the primary access routes into and out of the Metolius Basin and the Metolius Watershed Analysis area. Secondary access route include Forest Road 1210, 1220, 1230, 1232, and 1234. Highway 20 and Forest Road 14, 2070, 2076 are allocated as Natural Appearing Landscape with High Level Scenic Integrity (formerly Retention, SV-1 allocation) within the Foreground landscape area. Forest Road 12, 1210, 1220, 1230, 1232, 1234 are allocated as Slightly Altered Landscape with Medium Level Scenic Integrity (formerly Partial Retention, SV-2 allocation) within the Foreground landscape area. Black Butte are allocated as Natural Appearing Landscape with High Level Scenic Integrity (formerly Retention, SV-4 allocation) within the Middleground landscape area. Please refer to the Deschutes NF LRMP MA-9 map for more detail scenic allocation areas and classification.

Distance Zone

There two primary distance zones that falls within the study area as view from a viewer location or a travel corridor, such as access and travel routes. The area is primarily viewed as **Foreground** (0-1/2 mile) and **Middleground** (1/2-5 miles) landscape areas. Please refer to Deschutes NF LRMP **Management Area 9** map for more detail.

Landscape Character and Scenic Quality Trends

Trends affecting landscape character, scenic quality, and scenic integrity within the Metolius Watershed Analysis area include: past and present cultural/human disturbance processes within the landscape, continuing and increasing recreation use with greater pressure on existing recreation sites and facilities, natural disturbance processes, such as insects, diseases, and wildfires. These trends are expected to directly affect all 11 landscape areas as specified and described within Social Domain section of the 1996 Metolius WSA document (PP 132-134).

- The 2000 decade of severe stand replacement wildfires is expected to lead to the collapse of existing burned forest structure, rehabilitation, and regeneration of new forest structure.

- Fire salvage, of burned, dead and downed trees, is an important part of landscape restoration process, along with rehabilitation and regeneration of a new forest to replace what has been lost due to wildfires within the Metolius Watershed Analysis area.

- The short-term (0-5 years) effects on scenic resources, brought on by wildfires, the subsequence collapse of forest structure, and any proposed management activities (salvage and/or thinning), is expected to lead to an altered landscape with low scenic integrity level.

- The long-term (5 years and beyond) effects are expected to be more beneficial to scenic resources as rehabilitation and regeneration of new forest take effect.

- Recreational and commercial mushroom (morel species) collection is expected to increase drastically during the first and second spring growing season.

- Wild flowers and shrubs will naturally populate the fire area. This will draw people and wildlife alike to the area.

- Increase traffic and recreation uses are also expected, including driving for pleasure, dispersed uses, OHV, and snowmobile uses. These may occur all season long, due to open vistas and open access within the analysis area.

- Heavy snow packs could lead to rapid melting during spring rains and could lead to soil displacement from erosion, debris flows, and land slides. These could have a direct effect on scenic quality along access and travel corridors.

Recommendations

These recommendations are designed to protect short-term scenic quality and promote long-term scenic viability within the Metolius Watershed Analysis area, particularly along the primary and secondary travel corridors, within the Foreground and Middleground landscape.

- Rehabilitate impacted areas, such as soil displacement or disturbance.

- Actively manage and monitor travel corridors, especially within the areas impacted by wildfires to meet Highway Safety Act standards.

- Actively manage and monitor dispersed recreation and special uses, such as mushroom harvesting, within the Metolius Watershed Analysis area.

- Salvage dead and down trees within the high severity areas and plant in stand replacement burn areas to help facilitate and perpetuate landscape components (line, form, color, and texture) to meet the desired future scenic conditions.

- Salvage dead and down trees within the mixed severity areas and allow natural regeneration to take hold to help facilitate and perpetuate landscape components (line, form, color, and texture) to meet the desired future scenic conditions.

- Thin from below (0-12” dbh) along primary and secondary travel corridors, including within areas that have been lightly impacted by wildfires to help facilitate and perpetuate landscape components (line, form, color, and texture) to meet the desired future scenic conditions.

- Design treatment activities to minimize additional impacts to the existing forest and landscape character by keeping tree stumps low to the ground, disposing of associated slash in a timely manner, and protecting healthy trees with live crown.

RECREATION

Summary

Since 1996, over 50% of the Metolius Key Watershed has been burned by wildfires of varying size and intensity. The Eyerly Fire of 2002 and the B& B and Cache Fires of 2003 had significant impacts on natural resources. Changes are most noticeable to vegetation and soils, and vary depending on the plant associations and local fire severity. Recreation experiences that are dependent on vegetation, such as scenery, have been greatly altered, but not necessarily adversely. Some recreation facilities such as trails and dispersed campsites have been damaged or lost. Some experiences that are more dependent on disturbance processes, such as collecting wild mushrooms, or viewing and hunting big game, may be improved. As a result of the fires, some areas, such as wet meadows and riparian areas, have become more sensitive to human impact and will need extra protection at least in the short term.

The following assessment uses the same outline and Landscape Management Areas as the original 1996 Watershed Analysis. Organized by Landscape Areas that were affected by the fires, it notes what has changed since 1996, especially as a result of the fires. Where trends were identified in the original analysis, the status of those trends is noted, as well as any new trends. Finally, the analysis records any accomplishments of the 1996 recommendations, and new recommendations as a result of changes in the watershed.

Trends Common to All Landscape Areas

- Recreational use is increasing overall, and types of recreational activities continue to diversify.
- The level of awareness in the general public of urban/wildland fire risks will be acute for the next several years. There is a higher level of acceptance among residents and visitors for some types forest management such as thinning, prescribed fire, and brush removal.
- There will be a short-term (about 5 years) loss of scenic quality in high intensity burned areas.
- There will be a long-term (more than 10 years) improvement in scenic quality as forests recover and approach their historic appearances.
- There will be a increase in falling tree hazards to visitors until most trees fall or are removed in recreation areas and travel corridors.
- Road use will continue to shift from timber to recreational.
- Off-road use will continue to increase, with increasing complexity of management as new OHV direction is implemented.
- Opportunities for some forest products harvest will increase (berries, mushrooms), while others will decrease (firewood).

Recommendations Common to All Landscape Areas

- Take advantage of the short window of opportunity to increase knowledge and understanding of the urban/wildland interface fire risks.
- Continue to reduce road densities and manage travel patterns, especially in and across riparian areas.
- Continue and increase noxious weed management efforts.
- Encourage fire recovery and effects research and monitoring.

Landscape Area 1 - Wilderness

Changed Conditions and Trends

Approximately one third of the Mt Jefferson Wilderness Area in both the Willamette and Deschutes National Forests was burned in the B & B Fire. Much of this was stand replacement fire. Fire intensities were generally consistent with what would be expected in high elevation lodgepole and hemlock forests, although the size of the burned area greatly exceeded any historical fire in the area. Especially hard hit were high recreational use areas around Square and Long Lakes, and the upper portions of Cabot, Abbot, Brush, Canyon, and Jack Creeks. Visitors to these areas will definitely notice the change. Trees and shrubs are gone in many areas. In some cases, expectations for privacy and solitude may be compromised by the loss of cover. In other locations, the views and vistas are expanded and perhaps enhanced. Where trees still exist, boles are charred and blackened, so that the expectations for a green lush forest may not be met. Some traditional campsites are no longer very desirable because of the loss of cover and the conversion of soft duff and humus to ash and bare soil. Some trails, or trail improvements such as bridges, water bars, check dams, and drain dips, were damaged or destroyed by the fire. Trails that pass through high mortality stands of medium to large trees or dense thickets of small trees will be difficult to maintain and keep open as dead trees begin to fall. Trail users may notice more evidence of trail clearing and maintenance as blow down is cut out year after year. After the 1910 fires in the Bitterroot Mountains of Montana, traveling rangers noted that trails cut through blowdown left berms of slash higher than a man on a horse could see over (Pyne, 2001*)*. But forests were denser there with larger trees than in the Jefferson Wilderness.

Many of these changes are relatively short term. Except for the loss of large living trees and the change in views, the site-specific impacts to recreational experience will be unnoticeable in 2 to 5 years.

Visitor numbers may drop slightly and slowly increase back to pre-fire levels because of the perception that the wilderness may no longer be an attractive place to visit.

Competition may increase for the remaining undamaged campsites around high use areas such as Square Lake. Dispersed sites may shift around to take advantage of unburned areas or areas that are perceived as safer from blowdown.

Forest products that are stimulated by disturbance processes, such as mushrooms and huckleberries, will likely increase as a result of fire-related nutrient pulses and changes in forest cover. Recreational visits to the more accessible portions of the Wilderness will likely increase.

Open forests as a result of stand replacement fire may increase the likelihood of wilderness trespass by snowmobiles and OHVs.

Accomplishments

The 1996 WA recommended a number of measures to protect and restore sensitive riparian habitat associated with high use alpine lakes. In some areas camping was limited to designated sites. Much of that work was completed, including moving campsites back from shorelines and rerouting eroding trails. However, fire impacts may have negated much of that work, because designated sites are no longer safe to use, and most sites will need additional restoration.

Wilderness rangers and trail crews have used the fire damaged trails as an opportunity to assess and relocate trails rather than reconstruct trails segments with erosion or grade problems.

A one-way loop trail was constructed into Canyon Creek meadows to increase the sense of solitude for visitors.

Wilderness rangers and Field Rangers have received noxious weed awareness training, and educational messages about weeds and using clean hay have been posted at some trailheads.

Recommendations

- Consider re-designating campsites around high-use lakes such as Square and Wasco. This would require extensive snag falling to ensure safety.

- Develop partnerships with trail user groups to increase the amount of trail clearing and maintenance that can be done.
- Encourage or require weed-free hay to be used by horse packers.
- Increase monitoring and enforcement of wilderness trespass.

Landscape Area 2 - Central Basin

Changed Conditions and Trends

The Central Basin LA includes the upper and middle Metolius River and the lower portions of Jack, Canyon, Brush, Abbot, Cabot, and Jefferson Creeks. Most of this area west of Road 12 burned lightly, with mixed or no mortality. Lower Brush, Abbot, and Cabot Creeks had higher mortality with a great deal of stand replacement fire in dense stands of pine and mixed conifer. The Metolius River itself had only a few acres of adjacent riparian area burned. Aside from changes to scenery similar to those described above, the largest impacts to recreation use are the loss of some traditional dispersed camping sites to fire impacts or fire-related road closures. Abbot Creek campground was destroyed by the fire and will likely be permanently closed, as will the access road. Closing the road into the campground may allow for the removal of a fish barrier culvert.

Accomplishments

The Friends of the Metolius completed a survey and inventory of all dispersed camping sites and related roads on the lower portions of tributaries to the Metolius River. This information will used as baseline data for an ongoing Limits of Acceptable Change analysis of recreation use along the tributaries.

As an initial result of the LAC survey, many dispersed sites along Candle Creek have been closed or relocated to protect water quality and bull trout spawning habitat.

Portions of the Metolius River Trail have been rerouted or hardened to reduce riparian impacts. Some fishing access points have been hardened.

The Field Ranger program has been initiated and expanded with the help of local partners. The Forest Service has greatly increased its uniformed presence in the major recreational portion of the basin. Visitors are generally pleased with the availability of help and information provided by the program.

The old interpretive trail at the Head of Jack Creek was relocated and reconstructed to reduce impacts to unique sensitive riparian habitats. A new parking lot has been constructed.

Recommendations

- Interpretive and educational signs should be completed at the Head of Jack Creek Trailhead as decided in the EA and decision for that project.

- Fire related hazard trees need to be assessed and removed where necessary to protect visitors.
- Continue monitoring use along Canyon Creek. Determine where displaced campers have moved to as a result of closed dispersed sites.

Landscape Area 3 – Highway 20 Corridor

Changed Conditions and Trends

The entire Highway Corridor LA burned in the B&B Fire except for a small portion between Road 12 and Road 14. The west end of the highway from the Forest boundary to Suttle Lake was mostly stand replacement fire. Most of the area southeast of Suttle Lake burned with low intensity, but areas of dense mixed conifer stands had moderate to heavy mortality. Visitors will notice the greatest change along the highway between Santiam Pass and Corbett Sno-Park, where most of the forest is dead except for some areas of fuelbreak and units from the Santiam Corridor Timber Sale where fire intensities were lower and large trees survived. Some of the highway corridor has been noticeably altered by heavy snow damage to smaller trees over the last several winters. Prior to the fires, visitors noticed that the forest on either side of the highway was more open and dominated by large pine. Extensive thinning had been done prior to the fires, which greatly reduced fire intensity and damage.

Over time, visitors will notice a more open landscape with new views of the Cascades, particularly towards Mt Washington. Large live trees will be scarce for many generations. Large dead trees will persist for several decades, but falling trees will cause safety problems for the next several seasons. Blowdown and landslides will increase, likely increasing highway corridor maintenance and related traffic tie-ups. As shrubs return to the burned area, particularly berries and vine maple, fall leaf colors will become a new attraction to the highway corridor.

Accomplishments

The Santiam Corridor and Restoration Projects resulted in open stands and fuelbreaks that largely reduced fire behavior and resulted in low mortality in the few remaining large trees.

The ongoing Highway 20 Integrated Vegetation Management Project also altered stands by removing small trees and brush, resulting in the open park like stands of large pine that visitors traditionally associate with the Metolius country.

Noxious weed work along the highway has been challenged by the spread of knapweed and St John's wort, and the fires have increased the risk by exposing new areas of bare soil, creating optimal seedbeds.

Recommendations

- Increase efforts to control highway weeds
- Add fire and recovery interpretation to the information panels at the Mt Washington overlook.

- Develop a highway traffic safety plan to manage hazard trees and land slides.

Landscape Area 4 – Meadow Lake Basin

Changed Conditions and Trends

Virtually all of this LA burned in either the Cache Mtn Fire or the Link Fire, sometimes in both. Most of the basin, particularly areas that burned twice, suffered high intensity stand replacement fire. Some riparian areas burned with low severity or moderate mixed mortality. Because of the extent of suppression efforts from serving as the flank of two overlapping fires, this area received a great deal of suppression damage from heavy equipment. While an extensive investment in fire line rehabilitation was made, some areas will take a long time to recover from soil displacement and compaction, and loss of large wood and cover vegetation.

Since this area was just beginning to resemble the forest that existed prior to the 1964 Airstrip Fire, visitors may not notice much change beyond the temporary evidence of charring and loss of small trees and shrubs. The largest trees in this area were primarily white pine or Douglas fir. Many had already died before the fires from insects or disease.

Many traditional dispersed campsites were damaged or access to them has been blocked. The Meadow Lakes Basin continues to be a popular area for those that prefer a less formal and regulated experience. Visitors will likely find new campsites and/or pioneer new access routes to old sites.

Until the early 1990's, historical recreational use in the basin was largely camping, fishing, berry picking, and hunting. Since then, Off Highway Vehicle (OHV) use in the basin continues to increase, becoming the dominant form of recreation here in the last few years, in many areas to the exclusion of other types of recreation. Most OHV users behave responsibly, and ride safely on existing roads. However, there has been an increase in pioneered trails and loops through streams and riparian areas, as well damage to the roads. Several groups have been cited for illegally constructing elaborate and damaging trail systems. With the prevalence of fire lines that cannot be effectively closed to motorized travel, inappropriate use by OHVs is likely to increase.

Accomplishments

None

Recommendations

- A dispersed recreation management planning process was initiated in 2003 in conjunction with the Willamette NF, but not completed due to other priorities. This plan should be completed as soon as possible. OHV use in the area should be managed consistent with the new USFS policy, taking into account traditional use patterns and the LSR and Cache RNA management objectives.

- Prior to the fires, this area was a popular and productive huckleberry area. An opportunity exists to restore enhance huckleberry habitat which is an important subsistence and spiritual food to the Confederated Tribes of Warm Springs, as well as a popular recreational activity.
- Monitor and follow up on BAER and fireline rehabilitation.

Landscape Area 5 – Black Butte

Changed Conditions and Trends

The most dramatic change in this area was the collapse and fall of the historic Black Butte Lookout Tower on December 7, 2001. The ruin was salvaged for historic lookout parts such as metal fittings, but much of the structure is piled near its original location.
Use continues to increase on the Black Butte trail and sanitation is a growing issue since the public outhouse was closed due to sanitation issues and a new more remote facility was built for the lookouts use.

Accomplishments

Some rehabilitation of the top of Black Butte was undertaken in the late 90's while a new lookout tower was constructed. Signs were lowered to be less visually obtrusive and several benches were installed to concentrate use in less sensitive areas.

Recommendations

- Complete a site management plan for the top of Black Butte and associated trails.
- Address sanitation issues.

Landscape Area 6 – Cache

Changed Conditions and Trends

As in the Meadow LA, virtually all of this LA also burned in either the Cache Mtn Fire or the Link Fire, sometimes in both. Most of the basin, particularly areas that burned twice, suffered high intensity stand replacement fire. Some riparian areas burned with low severity or moderate mixed mortality. Areas that had been recently logged had more mixed mortality because lower fuel loads resulted in lower fire intensity. Because of the extent of suppression efforts from two overlapping fires, this area received a great deal of suppression damage from heavy equipment. While an extensive investment in fire line rehabilitation was made, some areas will take a long time to recover from soil displacement and compaction, and loss of large wood and cover vegetation.

Visitor use in this area is relatively low, and primarily road and trail related. OHV use will likely increase because of the more open forest and availability of firelines. The open forests and slopes of Cache Mountain may attract increased use by snow mobiles.

Accomplishments

The Santiam Restoration and Corridor Projects reduced fuel loads, created fuelbreaks, and closed roads. Stand modifications were largely successful in reducing fire intensities, but many young plantations were entirely lost.

Recommendations

- This area should be a priority for implementing the new OHV rules.
- Protect the Cache RNA from OHV impacts and trespass.
- Cache Mountain provides a huckleberry management opportunity.
- Monitor and follow up on BAER and fireline rehabilitation.

Landscape Area 7 – Suttle Lake

Changed Conditions and Trends

All of the Suttle LA burned in the B&B Fire, generally with mixed mortality and small pockets of stand replacement. The area around Blue Lake burned much hotter with more mortality. Much of this area is private land that has already been extensively salvage logged. Visitors will especially notice high mortality areas on the north side of the lake, and around Scout and Dark Lake. No recreation facilities were lost in the fire, so use remains much the same as always. Suttle Lake continues to be one of the most popular recreation areas in Central Oregon.

A noticeable change since 1996 is the conversion of Blue Lake Resort to a private Arts facility – Camp Caldera. The only public access remaining to Blue Lake is a difficult trail from Corbett State Park on the northwest corner of the lake. Public recreational use of Blue Lake and the surrounding winter trail system (private) has dropped to almost nothing.

Accomplishments

Suttle Lake Lodge is in the process of implementing a new Master Development Plan. A new lodge is under construction, and several new cabins have been completed to replace the old campground and temporary cabins. The old entrance from Highway 20 has been replaced by a new road and bridge across Lake Creek, greatly increasing visitor safety. The recreational experience has shifted, from being primarily tent camping and fishing, to a more developed cabin/lodge experience. Long term plans are for a full service resort. Cinder Beach remains a day use area open to the public.

Trail improvements around lake reduced erosion and made the trail easier to use.

The condemned Link Creek bridge is scheduled for replacement in fall, 2004.

Recommendations

- Assist Suttle Lake Resort in aggressive re-vegetation of the resort area as specified in their Master Plan.
- Follow up and continue riparian restoration around the lake and in the campgrounds.
- Work with Camp Tamarack to develop a vegetation restoration and management Plan around Dark Lake.

Landscape Area 8 – Upper Tributaries

Changed Conditions and Trends

This LA received the greatest amount of change from the B&B Fire. Most of the upper tributaries, but especially Cabot, Brush, Abbot, and First Creeks, had almost stand replacement burns. Jack Creek and Canyon Creek experienced more moderate mixed mortality with portions of their upper reaches mostly stand replacement.

Round Lake Campground and Christian Camp are the center of a large area of stand replacement. Some structures were lost at the Christian Camp, and the future operations are uncertain at this time. Both outhouses burned at Round Lake. The campground may be closed temporarily until hazard trees can be removed, and the toilets replaced.

Both the fire and management efforts to reduce riparian impacts have resulted in closed or moved dispersed camping sites and lost or changed access to due to road closures.

Accomplishments

Hazard trees around Round Lake and Road 1210 will be removed this fall.

Recommendations

- Monitor dispersed camping for increases as a result of changes in use around the Metolius tributaries.
- Implement the new OHV management direction.

Landscape Area 11 – Lower River

Changed Conditions and Trends

Only a very small portion of this LA was affected by the western edge of the Eyerly Fire where it burned upstream past Monty campground from the river's outlet into Lake Billy Chinook. While a significant portion of the Eyerly Fire was within the Metolius watershed proper, most was east of the boundary of the NWFP, and thus not within the Key Watershed that was analyzed in the 1996

Metolius Watershed Analysis. Most of the burned area within the Key Watershed burned lightly, and little change will be noticed by visitors floating the river or visiting Monty campground. However, visitors coming from Perry South and points east will have traveled through areas of the Eyerly Fire that suffered considerably more fire related change.

Accomplishments

Road 1499 was closed at both ends to meet objectives for the Metolius WSR River primitive area management.

Recommendations

- Continue to implement Metolius WSR recommendations for managing the primitive area, especially dispersed camping monitoring below Bridge 99.

Improve Monty campground via the Pelton hydro relicensing agreement. Continue early season closure as a way to manage the traditional party use and

TRANSPORTATION, ACCESS, AND ROADS DATA

Introduction and Objective

The objective of this report is to describe the existing transportation system (roads) within the Metolius Watershed and more specifically to discuss any changes/updates to the system that have occurred since the writing of the *Metolius Watershed Analysis* of 1996.

Data

Data for this analysis update utilized existing records from the Travel Routes database (INFRA), Geographic Information System (GIS), and manual calculations. Traffic data was taken from the Oregon Department of Transportation's Transportation Volume Tables, and the Deschutes National Forest's Traffic Volume Reports and traffic database. INFRA and traffic databases are constantly being updated to reflect conditions as they are found. *In 1995 when the original report was written the roads data base was the Transportation Management System (TMS). Some differences in mileages and other road figures exist that are related to the differences in those databases as well as changes in required record keeping since that time.*

ROADS

Historic Use

The first road was built into the watershed in 1865, the Santiam Wagon Road or Willamette Valley Cascade Mountain Military Wagon Road. In 1938, Highway 20 through the Santiam Pass was completed allowing relatively easy movement of people to and from the more populated Willamette Valley.

Much of the current forest road system was put into place to facilitate hauling logs from private and National Forest lands. This process started late in the 19th century and was well in place by the 1940's. From 1945 until the 1990's, roads were being developed into most timbered areas except designated wildernesses. These logging roads have since become the road system you see today and are most often used for recreational purposes.

Road Management

Maintenance Levels

Forest roads are managed by assigning maintenance levels to each road. Those in maintenance level 1 (inactivated or closed). Maintenance level 2 roads are kept open for use but only for high clearance vehicles (pickups, utility vehicles, etc.). Levels 3 through 5 are maintained for use by low clearance vehicles (passenger cars). Levels 4 and 5 also consider user comfort and provide a smoother surface.

Closed vs. Decommissioned

The difference between "closed" (inactivated) roads and "decommissioned" roads has been confusing as definitions have evolved in recent years. For example at the time the 1996 report was done the word "obliteration" was used to describe the elimination of a road from the system. That term is no longer used and has been replaced in use by the term "decommission". Therefore, for the purpose of discussions in this document, road closures and road decommissioning will be defined as follows:

- A *closed (inactivated) road* remains part of the transportation system, but motorized use has been eliminated for one or more years. These roads are stabilized and placed in an inactive status such that their influence on hill slope hydrology, water quality, and wildlife disturbance is minimized, but they remain on the Forest Transportation Inventory and are available for future project use.

They are in a maintenance level 1 classification, and are kept in "storage" until access for the next project is needed.

Stabilization treatments for closing roads may consist of light scarification, seeding, or installing water bars. If a field risk assessment determines that existing drainage structures, (e.g., culverts) pose a high risk of plugging if left unattended for a long period of time, these roads could have additional water bars installed to reduce the impacts of failure and they may be placed on the District's Annual Road Maintenance Plan to be monitored for drainage maintenance needs.

- A *decommissioned road* is a road that has been determined to not be needed for current or future access and would be removed from the permanent transportation system inventory. The ground occupied by the decommissioned road would return to management according to the original land allocation description for the area, or it may be converted to another suitable use such as a hiking trail or OHV trail.

  Stabilization treatments for decommissioned roads may consist of some or all of the following: removal of stream crossing culverts, constructing cross ditches or water bars at all but low risk hill slope depressions, removal of high-risk side cast fills, out-sloping of the road prism, deep ripping of compacted roadbeds, backup ditches or water bars at stream crossings, recontouring the roadway to produce a cross section that blends in with surrounding slopes, and seeding and mulching of exposed soils around stream crossings and other culvert removal sites.

Road closures and decommissioning continue to be very controversial. They prohibit motorized access to roads and areas people have traditionally been able to access by driving. This watershed is a very popular area for hunting and dispersed camping. These activities traditionally utilize the low use local roads that we tend to consider as prime candidates for closure or decommissioning.

Road Mileages

The 1996 Metolius Watershed Analysis included a Road Density table (Table 6, page 25). A direct comparison of subwatershed miles or densities then until now cannot be made. Since 1996 watershed/subwatershed boundaries of been remapped, renamed, and new ones created. The 1996 report had 8 subwatersheds. Currently within the original boundary there are now 18 subwatersheds. Other user built or otherwise previously unclassified roads have been added, as have some other entities (pvt) roads during that period. Routine database corrections such as those created by Deferred Maintenance or any survey to the length of a road can account for differences in overall mileage. For the purposes of this report the original boundary has been overlaid onto the new subwatersheds. This report will display miles and densities for the current subwatersheds within the original boundary.

This table shows a total for all types of roads of 861.8 miles. The 1996 report indicated a total of 895.3 miles of road. That is 33.5 or 3.9% fewer miles than in 1996. Project records show a total of 30.7 miles of road (3.6%) decommissioned and 9.5 miles of road closed since 1996. Other miles have been added or edited since that time as well as the numbers being from two different databases can account for differences in total miles.

The attached table reflects current mileages by maintenance level and watershed/subwatershed within the original study boundaries.

Road Table 1. Metolius Exisiting Road Miles

Metolius Bdy Subwatershed	Closed Level 1	Open Lev 2	Open Lev 3	Open Lev 4	Open Lev 5	Other Roads	Total Miles
ABBOT CREEK	12.50	37.81	1.13		3.70	1.41	56.56
CACHE CREEK	11.72	70.80	1.59	2.33	1.10	24.74	112.29
CANDLE CREEK	1.73	8.10	0.79			0.11	10.73
CANYON CREEK	37.39	55.34	1.16	0.88	2.76	3.77	101.30
DRY CREEK	10.84	40.02				8.21	59.08
FIRST CREEK	27.27	28.34	8.71	1.45	3.69	9.69	79.16
FOURMILE BUTTE		0.81					0.81
HEADWATERS METOLIUS RIVER	34.39	53.95	7.63	13.92	1.41	10.50	121.80
JACK CREEK	16.23	34.82	6.62	0.98	1.24	5.69	65.58
JEFFERSON CR		0.56				0.00	0.56
LOWER FLY CR		0.05					0.05
LOW. INDIAN FRD	0.35	0.07	0.02			0.02	0.46
LOWER LAKE CR	23.61	50.84	12.42		10.22	24.81	121.90
MID METOL. RIV.	12.65	20.99	0.24	6.30		0.47	40.64
UPPER FLY CR		0.52				0.01	0.54
UP. INDIAN FORD	3.25	10.91	0.21		0.75	4.48	19.60
UPPER LAKE CR	7.36	37.45	0.45		4.79	2.70	52.75
UP. METOL.RIVER	8.03	9.51				0.45	17.98
Total Miles	**207.33**	**460.90**	**40.98**	**25.85**	**29.65**	**97.08**	**861.79**

Road Densities

The following table shows a watershed wide **all roads** density of **3.7 miles per square mile**. The **1996** report indicated a watershed wide road density of **3.9 miles per square mile,** a 5% reduction. (The 1996 study did not portray an Open Road only density). The current overall **Open Road Density** for this watershed is **2.8 miles per square mile**. This includes all areas including wilderness. If wilderness and other unroaded areas are excluded the density is increased considerably. See Table "Road Density Excluding Wilderness Road Density". Individual sections of this report such as the Biological Domain and others discuss specific density calculations, which are more relevant to wildlife and other specific issues and typically exclude wilderness and unroaded areas.

The following table depicts current Road Densities by watershed/subwatershed.

Road Table 2. Metolius Exisiting Road Density

Metolius Bdy Existing Watershed / Subwater-Shed Density	Metolius Bdy Exisiting Road Density Subwatershed	All Road Miles	All Roads Density Mi/Sq. Mi.	Open Road Miles	Open Road Miles Density Sq.Mi.	Sq. Miles
UPPER METOL. RIVER	ABBOT CREEK	56.56	5.66	44.06	4.41	9.99
	CACHE CREEK	112.29	6.06	100.57	5.42	18.54
	CANDLE CREEK	10.73	0.63	9.00	0.53	17.11
	CANYON CREEK	101.30	3.08	63.91	1.94	32.87
	DRY CREEK	59.08	3.16	48.24	2.58	18.70
	FIRST CREEK	79.16	3.85	51.89	2.52	20.56
	HDWTRS METOL.	121.80	5.05	87.41	3.62	24.13
	JACK CREEK	65.58	4.56	49.35	3.43	14.39
	JEFFERSON CR	0.56	0.04	0.56	0.04	12.73
	LOWER LAKE CR	121.90	7.12	98.30	5.74	17.13
	UPPER LAKE CR	52.75	3.06	45.39	2.63	17.24
UPPER METOLIUS RIVER Total		**781.71**	**3.84**	**598.66**	**2.94**	**203.39**
LOWER METOLIUS RIVER	LOWER FLY CREEK	0.05	1.35	0.05	1.35	0.04
	MID. METOL. RIV.	40.64	2.84	27.99	1.96	14.29
	UPPER FLY CR.	0.54	13.40	0.54	13.40	0.04
	UPPER MET. RIV.	17.98	1.59	9.95	0.88	11.29
LOWER METOLIUS RIVER Total		**59.21**	**2.31**	**38.53**	**1.50**	**25.66**
SQUAW CREEK	FOURMILE BUTTE	0.81	7.38	0.81	7.38	0.11
	LOW. INDIAN FRD	0.46	5.09	0.11	1.18	0.09
	UP. INDIAN FORD	19.60	7.37	16.35	6.15	2.66
SQUAW CREEK Total		**20.87**	**7.32**	**17.26**	**6.06**	**2.85**
Grand Total		**861.79**	**3.70**	**654.46**	**2.81**	**232.69**

Road Table 3. Existing Road Density Excluding Wilderness

Sub-Watershed	Road Density Including Wilderness	Road Density Excluding Wilderness
ABBOT CREEK	5.66	5.71
CACHE CREEK	6.06	7.32
DRY CREEK	3.05	6.33
CANDLE CREEK	0.63	5.45
JEFFERSON CREEK	0.59	1.06
CANYON CREEK	3.08	4.87
FIRST CREEK	3.84	6.17
JACK CREEK	4.56	5.56
HWTRS METOL. RIVER	5.05	5.05
UPPER LAKE CREEK	3.04	3.04
LOWER LAKE CREEK	7.12	7.12
UPPER FLY CREEK	6.27	6.27
LOWER FLY CREEK	4.43	4.43
UPPER METOL. RIVER	2.96	2.96
MIDDLE METOL. RIVER	3.14	3.14
UPPER INDIAN FORD	6.51	6.51
LOWER INDIAN FORD	5.78	5.78
FOURMILE BUTTE	3.59	6.58

Road densities exceed 2.5 mi. per square mi. in all but one subwatershed.

Road Maintenance

Typically about 12% of the miles of road in this watershed receive routine maintenance each year. These are primarily the maintenance level 3-5 roads. These roads are maintained to Highway Safety Act standards, are the higher level, higher use roads and typically are paved, rocked, or have an otherwise improved surface. Maintenance deficiencies have been identified in annual Deferred Maintenance surveys and in recent BAER and other post fire road condition surveys. See Recommendations. BAER recommendations are also discussed and listed in the Hydrology section.

The remaining road miles receive little or no routine maintenance. They receive only what is necessary to correct safety problems, when environmental damage is detected or when they are being used for commercial activity. Traditionally, maintenance associated with commercial use (log haul) has been the primary means of maintaining these otherwise low use roads. These roads typically are single lane, unsurfaced roadways.

In many areas of this watershed these low use roads are closing themselves over time due to a lack of use, blow down, manzanita, greasewood and other vegetation encroaching into the roadway. These are objective maintenance level 2 roads (open for use) but have become undriveable. In the recent burn areas falling snags will create a similar situation. This will be especially true after 5 to 10 years as roots rot and giveway. These dead trees will fall into the roadway effectively in sufficient numbers to prevent the use of the road. At the time these roads become undriveable they are functioning as operational maintenance level 1 roads (closed). If a Roads Analysis determines that these roads are unneeded this is an opportunity to declare these roads decommissioned. However, prior to this occurring, assurance is needed that these roads are hydrologically stable, have drainage features assessed, culverts removed if appropriate.

Although much has been done in the post fire arena in regards to surveying and analyzing the drainage features (culverts, dips, ditches, etc…..) of high risk roads we must also remember that it was done under emergency conditions (very quickly) and many other roads have not yet received a comprehensive survey. It is recommended that continued monitoring is done to insure that future unknown needs to remove, replace, or improve those features are discovered, documented, and planned for implementation.

Road Reconstruction/Restoration

The ability to finance road construction and reconstruction through timber sales has changed since 1996. Today's timber sales tend to be small in scale and seldom produce enough funding for road reconstruction. Some funds are produced by other miscellaneous forest products such as firewood sales that contribute to upkeep of popular woodcutting roads. Some new road construction may be needed in the future to replace poorly located existing roads or to access isolated areas. In key watersheds, it is a requirement that there be no net increase in road miles.

While commercial timber sale traffic has decreased, overall traffic counts have remained similar. This is possibly due to increased recreation traffic.

Vegetation management projects, mineral extraction, and the removal of other forest products will continue to require an adequate transportation system.

TRAFFIC

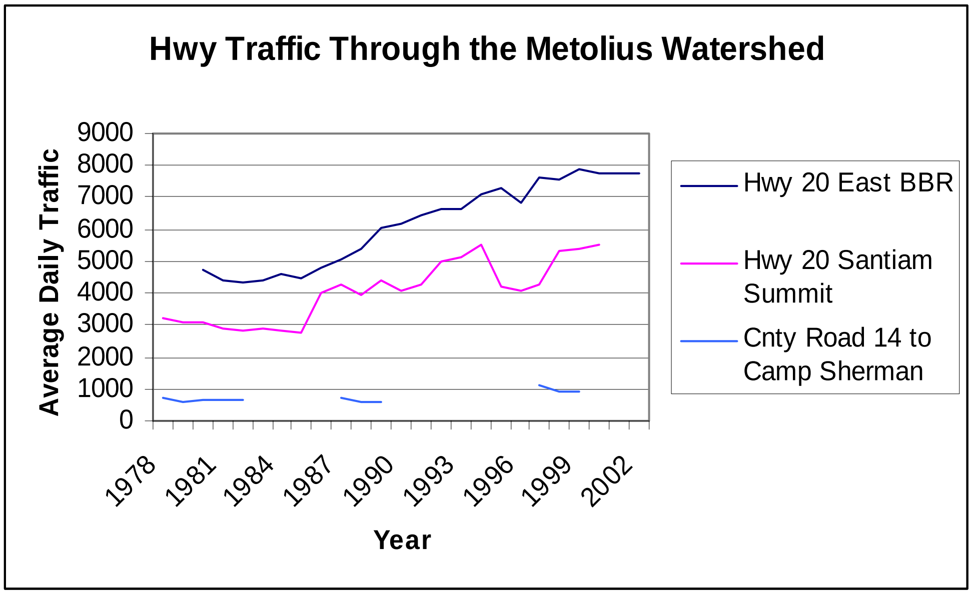
Traffic Volumes and Trends

Locally forest roads are a popular driving experience for many people. Typically an estimated 95% or more of forest road traffic is now recreation traffic. Nationally, driving for pleasure is the number one recreation activity of forest visitors. Some areas of the watershed are experiencing new roads and trails being created by off road vehicles and high clearance vehicles for off-road recreation. Driving off-road is not by itself illegal, unless specifically prohibited (e.g., area closure) or if is it causing resource damage.

State Highway 20, The Santiam Highway

Oregon Department of Transportation Volume tables show an 80% increase in 20 years (1982 to 2002), from 4300 to 7800 vehicles per day east of the Black Butte Ranch entrance. Over the summit traffic has increased 96% for the same period (2850 to 5600). These are year round daily averages, ADT (Average Daily Traffic).

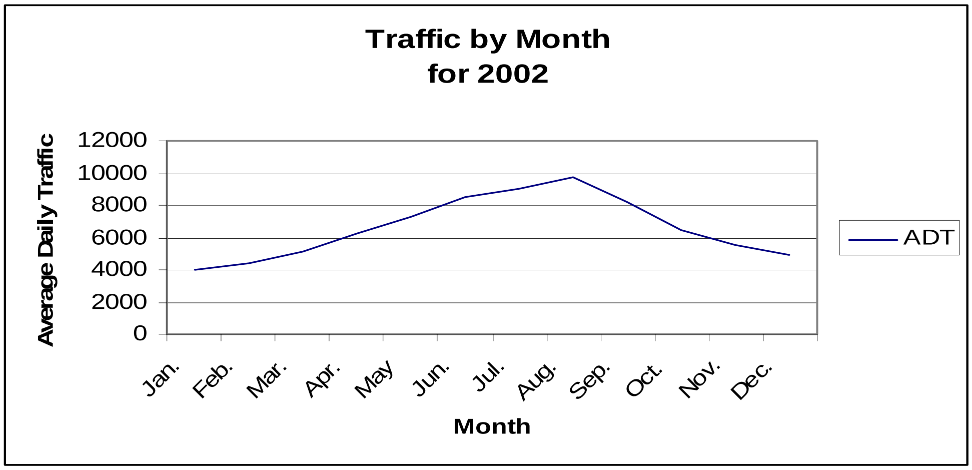
Road Figure 1. Historical Daily Traffic on Hwy 20



The area between the line representing "Hwy20 East of BBR" and the line for "Hwy 20 Santiam Summit" represents the traffic that comes and goes from Black Butte Ranch, the Camp Sherman and Metolius River area traffic, and the rest can be assumed to be forest traffic that leaves the highway and enters the forest at Rd 12, Rd 2070, and other road intersections along the highway.

There is a significant traffic volume change seasonally on the highway, from a January low of about 4000 vehicles per day to a high of over 9,000 per day in July and August. This is a typical yearly cycle.

Road Figure 2. Seasonal Traffic



Of the 7763 vehicles per day on the highway in 2002, 90% were classified as passenger or light vehicles.

Road 11, Green Ridge Road

Although this road only influences the eastern and northeastern edges of this watershed area a discussion of it's traffic is included here because it has been more consistently studied on this road historically and more recently because of the FERC relicensing effort for Round Butte Dam. It is felt that this road represents some typical forest traffic that can be projected to traffic use within the watershed.

From 1977 through 2000, the yearlong Average Daily Traffic (ADT) on this road near it's beginning at Hwy 20, Indian Ford has varied from a high of 159 (1986) to a low of 72 (2000). Fluctuations have historically been due to changes in logging related traffic. Overall, even with a seemingly significant fluctuation from year to year, the overall ADT has remained fairly constant, 100-150. (See attached Traffic Count Tables). Although there hasn't been a traffic classification done recently, it can be assumed that the commercial traffic has dropped significantly and the recreation traffic has increased. Recreation traffic is estimated to comprise about 90% of the use. During the spring and summer months, an estimated 30% to 40% of this traffic is traveling through to the Lake Billy Chinook area. The classification work done in the past showed typically 8-10% of the traffic to occur at night and during the hunting season. This has been as high as 23%. Shorter days at that time of year and travel to and from favorite hunting areas in the pre-dawn and post-sunset hours could account for that increase. Counts on this road and many others on the forest used to show the hunting season as the single largest traffic event of the year. This road typically shows a 300% increase for the first two weeks of October, historically the general rifle deer season.

Road 12, Jack Lake Road

Some traffic counts were conducted on this road in 1997, 1998, and 1999 showing ADTs of 165 to 190. The average has probably not changed greatly through 2002. Of course during the B&B Fire, 2003 traffic was and still is very restricted.

Road 14, Metolius River Road

The traffic on the main road into the Camp Sherman area was also counted in 1997, 1998, and 1999. ADTs ranged from 937 to 950. This is up from twenty years earlier when counts were 600 to 700. An approximate 54% increase in twenty years.

Road 2070, Suttle Lake Road

The traffic on the main road into and around Suttle Lake was last counted in 1997 and shows a 57% increase between 1982 and 1997. This road continues to serve resorts, campgrounds, organizational camps, and day use areas which are only increasing in use. This road and a number of the campground roads have been recently resurfaced.

No other significant traffic counts are available for roads in this area.

TRANSPORTATION TRENDS:

- Current road densities still exceed recommended densities.
- Erosion problems are not widespread, but some localized problems exist that need repair or restoration.
- Road use has shifted from logging use to recreational use.
- Most roads were built to facilitate logging. Logging use and associated funding for maintenance and reconstruction has declined dramatically.
- Traffic counts are not current for many forest roads and need updating.
- Unmaintained roads that are closing themselves are a priority to inventory to detect drainage problems and pull culverts.
- Driving forest roads is a popular activity, 95+% are for recreation purposes.
- Road closures and decommissionings are very controversial.
- New roads and trails are being created by off road vehicles.
- Traffic volume on Hwy 20 has increased by 80 to 90+% in 20 years (1982 - 2000).
- Traffic volume on Rd 14 has increased by 54% in20 years (1979 – 1999).

Current Recommendations

Rd 1490 has been identified in the Deschutes NF Road Rules as "unsuitable for haul". This road needs additional drainage work including additional structures. This road has no remaining surfacing on it and is left with an extremely rough, unmaintainable, subgrade only. It is not an immediate threat to the environment for its current use but if used for commercial haul would need to be reconstructed.

Rd 1216185 in Sec. 16 (may be identified as 1216179). Log stringer bridge across the N. Fork of Lake Creek has been closed to vehicle traffic and is probably at the end of its usefulness as a foot bridge. Originally (2001) it was recommended by the district ATM committee that this bridge be removed at such time or replaced with a trail bridge to maintain foot traffic. However since that time an adjacent parcel of property has been acquired by the Deschutes Basin Land Trust. No rights to access the southwest corner of section 16 were retained and the DBLT are most likely going to remove the roads across their lands leaving that piece inaccessible by vehicle. This needs to be addressed whenever the next management activity on this piece occurs. Perhaps either acquire R/W across DBLT lands or construct a bridge across one of two branches of Lake Creek either the North Fork from the north side or the South Fork from the south.

Recommendations from the 1995 Study:

(Original Recommendations Italicized)

Landscape Area 1: Wilderness

(No Motorized Travel Access)

Landscape Area 2: Central Basin

4) Access

C) Road Closures and Obliteration
Road Closures and obliteration would reduce sediment input and improve stream conditions. These include:

Metolius Road 700 (Road 1419700). MP 0.83 to MP 1.53 of this road has been inactivated (closed). MP 0.00 to MP 0.83 remains open as a Jefferson County road.

Canyon Rd 400 (Road 1200400). Dispersed camping areas along this road have been redefined including the closing of several user created roads to protect streams. The 1200400 road remains open. Work accomplished under the Bull Trout Streamside Protection Project 2003.

Canyon Rd 1420200 (Presume this to actually be Road 1230200). This road remains open.

Roaring Creek north of Road 200 This may refer to a former bridge site north of 1230200. Road berms and boulders have been removed and area rehabilitated. Work accomplished under the Bull Trout Streamside Protection Project 2003.

Lower Abbot roads A number of roads were closed and obliterated in this area under the ERFO 96 project.

Landscape Area 3: - Highway 20 Corridor

No change

Landscape Area 4: - Meadow Lake Basin

4) Access Strategy

Road Closures

5.2 miles of road obliteration was accomplished under the Corbett Road Obliteration contract in 1995.

Note: OHV use has increased dramatically. The Santiam Pass Dispersed Recreation Planning ID Team has been formed to address this and other issues for this area.

Landscape Area 5: - Black Butte

Move TH down to 1110 road.

No change

Landscape Area 6: - Cache

3) Access Strategy

Reduce open road densities
2.91 miles of inactivation and 1.7 decommissioning have been proposed under the McCache Project ?

Landscape Area 7: - Suttle Lake

Access to the Suttle Lake Resort has been relocated including a new road and bridge to access the resort from Forest Road 2070. This was done to alleviate a long standing hazardous intersection situation with Hwy 20. Road 2070 has also been repaved.

Landscape Area 8: - Upper Tributaries

4) Access Strategy and road restoration

Culvert Removal in Jack Watershed

Culvert inadequate for peak flows are between Road 1220 and 1232.

All work identified under the Jack Canyon Planning Area for this area has been accomplished as well as the restoration work in the area of the 1232 road that was done under the ERFO 96 and ERFO 98 projects. These projects included road inactivation, obliteration, and restoration of drainage including culvert removal.

Road Closures and Obliteration - Reduce open road densities

Roads west of Road 1230 under the "Non ERFO – 98" project. ERFO 96 ERFO 97 and Jack Canyon TS, Jack Canyon Road Closure project closed several roads in this area.

East Abbott Butte 5.24 miles of roads have been Decommissioned in the Abbot Butte area (1280 system) as well as 3.68 miles have been restored to correct or improve drainage from these roads. This work was accomplished under the "Non ERFO – 98" project.

Upper Canyon Road 090 (Rd 1235090) which has been inactivated.

Jack Creek south of Road 1220 All roads identified under the Jack Canyon Planning Area for inactivation or decommissioning in this area has been accomplished.

Landscape Area 9: - Green Ridge

2) Access Strategy

Reduce open road densities

North part of 1190900 road has been decommissioned approximately 0.5 miles.
Decision Notice has been signed to close Road 1190 at 1190900 jct…Remains to be implemented.

Landscape Area 10: Scarp

(No access recommendations)

Landscape Area 11: - Lower River

3) Access Strategy

Reduce motorized access and road below Bridge 99.
Rd 1499 has been gated. Provides access to private land by permit only.

REFERENCES CITED

Adams, E.M. and M.L. Morrison. 1993. Effects of forest stand structure and composition on red-breasted nuthatches and brown creepers. Journal of Wildlife Manage. 57(3):616-629.

Agee, J.K. 1993. Fire ecology of Pacific Northwest Forests. Island Press, Wash. DC. (Agee 1993, Brown 1995)

Agee, J.K. 2002. Fire as a Coarse Filter for Snags and Logs. Gen Tech. Report PSW-GTR-181 Albany, CA: U.S. Department of Agriculture, Forest Service, Pacific Southwest Research Station.

Altman, B. 2000. Conservation Strategy for Landbirds of the East-Slope of the Cascade Mountains in Oregon and Washington. Version 1.0. Oregon-Washington Partners in Flight. 81 pp.

Amaranthus, M., H. Jubas, and D. Arthur. 1989. Stream shading, summer streamflow, and maximum water temperature following intence wildfire in headwater streams. US. Forest Service General Technical Report PSW-109:75-78.

Amaranthus, M.P. and Luoma, D.L. 1997. The Importance and Conservation of Diversity of Ectomycorrhizal Fungi in Forest Ecosystems. Pacific Northwest Research Station Document. USDA Forest Service.

Aquatic Analyst. 1990. Suttle Lake water quality report. Department of Environmental Quality. Portland, Oregon.

Banci, V. 1994. Wolverine. IN: Ruggerio, L.F., K.B. Aubry, S.W. Buskirk, L.J. Lyon, and W.J. Zielinski, tech eds. 1994. The Scientific Basis for Conserving Carnivores: American Marten, Fisher, Lynx and Wolverine in the Western United States. Gen. Tech. Rep. RM-254. Ft. Collins, CO: U.S. Dept. of Ag, Forest Service, Rocky Mountain Forest and Range Experiment Station. 184 pp.

Bartos, D. and W. Shepperd. 1999. Aspen restoration in the western United States. [Available online] http://www.fe.fed.us/rm/aspen/ [14 April 2000].

Beaty, K.G. 1994. Sediment transport in a small stream following two successive forest fires. Canadian Jornal of Fisheries and Aquatic Sciences. 51:2723-2733.

Bennett, Karen, 1994. Metolius Watershed Analysis Soil Specialist Report.

Berlik, Mary M., David B. Kittredge and David R. Foster. 2002. A Global Environmental Argument for the Local Production of Natural Resources. Harvard Forest Paper No. 26. Harvard Forest, Harvard University, Petersham, Massachusetts. 23 pp.

Bozek, M.A. and M.K. Young. 1994. Fish mortality resulting from delayed effects of fire in the Greater Yellowstone Ecosystem. Great Basin Naturalist. 54:91-95.

Brown, J.K. 1995. Fire regimes and their relevance to ecosystem management. Pages 171-178. *In* Proceedings of Society of American Foresters National Convention, Sept. 18-22, 1994, Anchorage, AK. Society of American Foresters, Wash. DC. (Agee 1993, Brown 1995).

Bull et al. 1988. Nesting and foraging habitat of Great Gray Owls in northeastern Oregon IN USDA Forest Service. Flammulated, Boreal, and Great Gray Owls in the United States: A Technical Conservation Assessment. General Technical Report RM-253. Rocky Mountain Forest and Range Experiment Station.

Bull, E.L. and M.G. Henjum. 1990. Ecology of the Great Gray Owl IN USDA Forest Service. Flammulated, Boreal, and Great Gray Owls in the United States: A Technical Conservation Assessment. General Technical Report RM-253. Rocky Mountain Forest and Range Experiment Station.

Burke, T.A., Applegarth, J.S. and T.R. Weasma, N. Duncan ed. 1999. Management Recommendations for Survey and Manage Terrestrial Mollusks. Version 2.0.

Burned Area Emergency Response website, 2003. USDA Forest Service.

Bushey, C. 1995. Fire Effects on Noxious Weeds within the Columbia River Basin. Interior Columbia Basin Management Project. [Available Online] http://www.icbemp.gov/science/bushey.pdf [November 23, 2003]

Cassirer, E.F. and C.R. Groves. 1989. Breeding ecology of harlequin ducks (*Histrionicus histrionicus*). Idaho Department of Fish and Game.

Castellano, M.A., and O'Dell, T. 1997. Management Recommendations for Survey and Manage Fungi. v.2.0. USDA Forest Service.

Castellano, M.A., Cazares, E., Fondrick, B., and Dreisbach, T. 2003. Handbook to Additional Fungal Species of Special Concern in the Northwest Forest Plan. USDA Forest Service, General Technical Report PNW-GTR-572.

Chitwood, L. and B. Jensen. 1996. Debris flows induced by the storm of 1996, Deschutes National Forest. Unpublished white paper. USDA Forest Service, Deschutes National Forest, Supervisor's Office, Bend, Oregon.

Chitwood, L., Riehle, M. Craigg, T., and B. Jensen. Flood of February 1996, Preliminary assessment of consequences of the Sisters District, Deschutes National Forest. Unpublished white paper. USDA Forest Service, Deschutes National Forest, Supervisor's Office, Bend, Oregon.

Chitwood, Larry, and Bob Jensen 1996. Debris Flows Induced by the Storm of 1996 – Deschutes National Forest. White Paper.

Clowers, G. 1997. PGE 1997 Bald eagle fall communal roost study. Portland General Electric.

Concannon, G. 1998. Study Plan: 1998 Harlequin duck surveys, Pelton Round Butte Hydroelectric Project, FERC No. 2030. Portland General Electric.

Copeland, J.P. 1996. Biology of the wolverine in Central Idaho. Masters Thesis. University of Idaho. 137 pp.

Corkran, C.C. and C. Thoms. 1996. Amphibians of Oregon, Washington, and British Columbia: a field identification guide. Lone Pine Publishing, Edmonton, Alberta, Canada. 175 pp.

Coulter, M.W. 1966. Ecology and management of fishers in Maine. Syracuse, NY: Syracuse University, University College of Forestry. Ph.D. thesis. IN: Ruggerio, L.F., K.B. Aubry, S.W. Buskirk, L.J. Lyon, and W.J. Zielinski, tech eds. 1994. The Scientific Basis for Conserving Carnivores: American Marten, Fisher, Lynx and Wolverine in the Western United States. Gen. Tech. Rep. RM-254. Ft. Collins, CO: U.S. Dept. of Ag, Forest Service, Rocky Mountain Forest and Range Experiment Station. 184 pp.

Csuti, B.A., A.J. Kimerling, T.A. O'Neil, M.M. Shaughnessy, E.P. Gaines, and M.M. Huso. 1997. Atlas of Oregon Wildlife: Distribution, Habitat, and Natural History. Oregon State University Press, Corvallis, OR. 492 pp.

CTWSR and PGE (Confederate Tribes of the Warm Springs Reservation and Portland General Electric). 2002. Pelton Round Butte Project Water Quality Management and Monitoring Plan. 4th DRAFT proposal. www.deq.state.or.us/wq/401Cert/Hydropower/PRButte/PRButteWQMMP.pdf

Dachtler, N. 2003. Street Creek post Eyerly Fire channel condition survey. Unpublished USFS Report. Deschutes National Forest, Supervisors Office, Bend, OR.

Dachtler, N. 2003. Street Creek 2003 post Eyerly Fire pebble count monitoring update. Deschutes National Forest. Sisters Ranger District. Sisters, OR.

Dachtler, N. 2003. Post Eyerly Fire 2003 fish survey results for Street Creek, Oregon. Deschutes National Forest. Sisters Ranger District. Sisters, OR.

Dahms, W.G. 1949. How long to ponderosa pine snags stand? USDA Forest Service, Pacific Northwest Forest and Range Experiment Station, Deschutes Branch, Portland, Oregon. Research Note No. 57.

DeBano, Leonard F., Daniel G. Neary, Peter F. Folliot. 1998. Fire's effects on Ecosystems. John Wiley andSons, Inc. New York, NY. pp.55-62, 108-114, 148-158.

Deschutes Soil Monitoring Reports, 1996-2001.

Dewey, R. 2003. Eyerly Fire Salvage Project: Biological Evaluation for Survey and Manage and Sensitive Plant Species, and Noxious Weeds. USDA Forest Service internal report. Sisters Ranger District. Sisters, Oregon.

Dixon, R.D. 1995. Density, nest-site and roost-site characteristics, home range, habitat use, and behavior of white-headed woodpeckers: Deschutes and Winema National Forests, Oregon. Non-game Project #93-3-01, Oregon Department of Fish and Wildlife.

DNF LRMP. 1990. Deschutes National Forest Land and Resource Management Plan.

Duncan, N., T. Burke, S. Dowlan, and P. Hohenlohe. 2003. Survey Protocol for Survey and Manage Terrestrial Mollusk Species from the Northwest Forest Plan V3.0. U.S.Department of Agriculture, Region 6, Portland, OR. 70pp.

Earle, R.D. 1978. The fisher-porcupine relationship in Upper Michigan. Houghton, MI: Michigan Technical University. M.S. Thesis. IN: Ruggerio, L.F., K.B. Aubry, S.W. Buskirk, L.J. Lyon, and W.J. Zielinski, tech eds. 1994. The Scientific Basis for Conserving Carnivores: American Marten, Fisher, Lynx and Wolverine in the Western United States. Gen. Tech. Rep. RM-254. Ft. Collins, CO: U.S. Dept. of Ag, Forest Service, Rocky Mountain Forest and Range Experiment Station. 184 pp.

Edelman, F. and J. Copeland. 1999. Wolverine distribution in the northwestern United States and a survey in the Seven Devils mountains of Idaho. Northwest Science, Vol. 73, No. 4.

Eglitis, A. 2001. Personal Communication. Entomologist, Deschutes National Forest, Bend, Oregon.

Fitzgerald, Stephen A. 2002. Post-Fire Salvage Cutting and Rehabilitation Treatments. In: Fire in Oregon's Forests: Risks, Effects, and Treatment Options – A synthesis of current issues and scientific literature. Oregon Forest Resources Institute. Pages 108-115.

Fies, T, M. Manion, B. Lewis, and S. Marx. 1996. Metolius River subbasin fish management plan. Upper Deschutes District. December 1996. Oregon Department of Fish and Wildlife. Bend, Oregon.

Frenzel, R.W. 1999. Nest-sites, nesting success, and turnover rates of white-headed woodpeckers on the Dechutes and Winema National Forests, Oregon in 1999. 50 pp.

Frenzel, R.W. 2000. Nest-sites, nesting success, and turnover rates of white-headed woodpeckers on the Dechutes and Winema National Forests, Oregon in 2000. 64 pp.

Frenzel, R.W. 2002. Nest-sites, nesting success, and turnover rates of white-headed woodpeckers on the Dechutes and Winema National Forests, Oregon in 2002. 56 pp.

Furnish, J., T. Burke, T. Weasma, J. Applegarth, N. Duncan, R. Monthe, and D. Gowan. 1997. Survey Protocol for Survey and Manage Terrestrial Mollusk Species from the Northwest Forest Plan V2.0. U.S. Department of Agriculture, Region 6, Portland, OR. 59pp.

Furniss, M. M. 1965. Susceptibility of fire-injured Douglas-firs to bark beetle attack in southern Idaho. Journal of Forestry 63:8-11.
Gamon, J., and Rush, T. 2000. Field Guide to Selected Rare Vascular Plants of Washington. USDI Bureau of Land Management and Washington Natural Heritage Program. [Available Online]: http://www.dnr.wa.gov/nhp/refdesk/fguide/htm/4ageltxt.htm [December 3, 2003]

Goggans, R., R.D. Dixon, and L.C. Seminara. 1989. Habitat use by three-toed and black-backed woodpeckers Deschutes National Forest, Oregon. Technical Report #87-3-02. Oregon Department of Fish and Wildlife, Nongame Wildlife Program.

Gresswell, R.E. 1999. Fire and aquatic ecosystems in forested biomes of North America. Transactions of the American Fisheries Society. 128:193-221.

Goetz F. 1994. Distribution and juvenile ecology of bull trout (*Salvelinus confluentus*) in the Cascade Mountains. MS. Thesis, Oregon State University, Corvallis.

Goodwin, K., Sheley R., and Clark, J. 2002. Integrated Noxious Weed Management AfterWildfires. Montana State University Extension Service. USDA Forest Service.

Haggard, M. and W.L. Gaines. 2001. Effects of stand-replacement fire and salvage logging on a cavity-nesting bird community in eastern Cascades, Washington. Northwest Science 57(4):387-396.

Hann, Wendel J.; Bunnell, David L. 2001. Multi-scale land and fire planning. International Journal of Wildland Fire. 10: 389-403.

Hardy CC, Schmidt KM, Menakis JP, Sampson RN. 2001. Spatial data for national fire planning and fuel management. International Journal of Wildland Fire, Vol. 10. 353-372 pp.

Hornocker, M.G. and H.S. Hash. 1981. Ecology of the wolverine in northwestern Montana. Can. J. Zool. 59:1286-1301.

Hillman, T.W., J.S. Griffith, and W.S. Platts. 1987. Summer and winter habitat selection by juvenile chinook salmon in a highly sedimented Idaho stream. Transactions of the American Fisheries Society. 116:185-195.

Hillman, T.W.,JW. Mullan and J.S. Griffith. 1992. Accuracy of underwater accounts of juvenile chinook salmon, coho salmon and steelhead. North American Journal of Fisheries Management. 1`2:598-603.

Houslet, B.S. 2004. Recruitment of large wood to the Metolius River, Oregon. Deschutes National Forest. Bend, Oregon.

Houslet, B.S. 2004. Use of woody material by junevile salmonids in the Metolius River, Oregon. Deschutes National Forest. Bend, Oregon.

Houslet B.S.and M.D.Riehle. 1998. Trends in fine sediment in bull trout spawning and rearing streams of the Metolius River Basin, Oregon, from 1988-1997. Deschutes National Forest. Sisters Ranger District. Sisters, Oregon.

Houslet B.S., M.D. Riehle and J. Harvey. 1999. Jefferson Fire monitoring final report- 1999. Deschutes National Forest, Sisters Ranger Distirct.

Hauer R. and C. Spenser. 1998. Phosphorous and nitrogen dynamics in streams associated with wildfire: a study of immediate and longterm effects. International Journal of Wildland Fire. 8(4): 183-198.

Hosman, K.J., L.L. Ely, and J.E. O'Connor. 2003. Haolocene paleoflood hydrology of the Lower Deschutes River, Oregon. *In* A Peculiar River: Geology, Geomorphology, and Hydrology of the Deschutes River, Oregon. 2003. *Eds*. O'Connor, J.E. and G.E. Grant. American Geophysical Union, Washington, DC.

Ingram, R. 1973. Wolverine, fisher, and marten in central Oregon. Oregon State Game Commission Report No. 73-2.

Jackman, S.M. and J.M. Scott. 1975. Literature Review of Twenty-three Selected Forest Birds of the Pacific Northwest. USDA Forest Service, Region 6. 382 pp.

Johnson, D.M., R.R. Peterson, D.R. Lycan, J.W. Sweet, M.E. Neuhaus, A.L. Schaedel. 1985. Atlas of Oregon Lakes. Oregon State University Press. Corvallis, Oregon.

Kaye, T. 2003. Invasive Plant Alert: False-brome (*Brachypodium sylvaticum)*. False Brome Working Group Publication. [Available Online] http://www.appliedeco.org/Reports/BRSYbrochureSmall.PDF [January 30, 2004]

Kemp, L. n.d. Mt Hood National Forest Sensitive Plants and Noxious weeds Field Guide. Oregon Department of Agriculture.

Keen, F.P. 1950. The rate of natural falling of beetle-killed ponderosa pine snags. Journal of Forestry 53:720-723.

Kelly, G.M. 1977. Fisher (Martes pennanti) biology in the White Mountain National Forest and adjacent areas. Amherst, MA: University of Massachusetts. Ph.D. thesis. 178 p. IN: Ruggerio, L.F., K.B. Aubry, S.W. Buskirk, L.J. Lyon, and W.J. Zielinski, tech eds. 1994. The Scientific Basis for Conserving Carnivores: American Marten, Fisher, Lynx and Wolverine in the Western United States. Gen. Tech. Rep. RM-254. Ft. Collins, CO: U.S. Dept. of Ag, Forest Service, Rocky Mountain Forest and Range Experiment Station. 184 pp.

Langille, H. D., Fred G. Plummer, Arthur Dodwell, Theodore F. Rixon and John B. Leiberg. 1903. Forest Conditions in the Cascade Range Forest Reserve Oregon. USDI United States Geological Survey. Professional Paper No. 9, Series H, Forestry. 298 pp.

Larsen, Dan, 1976. Soil Resource Inventory, Deschute National Forest. Bend, OR.

Laudenslayer, W.F. 2002. Cavity-nesting bird use of snags in eastside pine forests of northeastern California. Pacific Southwest Research Station, Fresno, California. USDA Forest Service Gen. Tech. Rep. PSW-GTR-181.

Leonard, W.P., H.A. Brown, L.C. Jones, K.R. McAllister, and R.M. Storm. 1993. Amphibians of Washington and Oregon. Seattle Audubon Society, Seattle, WA. 168 pp.

Lotspeich, F.B, E.W. Mueller, and P.J. Frey. 1970. Effects of large scale forest fires on water quality in interior Alaska. Federal Water Pollution Control Administration, Alaska Water laboratory, College, Alaska.

Marcot, B. G. 2002. An ecological functional basis for managing decaying wood for wildlife. Pp. 895-910 In: Laudenslayer, William F., Jr.; Valentine, Brad; Weatherspoon, C. Philip; Lisle, Thomas E., technical coordinators. Proceedings of the symposium on the ecology and management of dead wood in western forests. 1999 November 2-4; Reno, NV. Gen. Tech. Rep. PSW-GTR-181. Albany, CA: Pacific Southwest Research Station, Forest Service, U.S. Department of Agriculture. http://www.psw.fs.fed.us/Tech_Pub/Documents/gtr-181/068_Marcot.pdf

Marshall, D.B., M.G. Hunter, and A.L. Contreras, Eds. 2003. Birds of Oregon: A General Reference. Oregon State University Press, Corvallis, OR. 768 pp.

McDonald, L.H., A.W. Smart and R.C. Wissmar. 1991. Monitoring guidelines to evaluate effects of forestry activities on streams in the Pacific Northwest and Alaska, University of Washington, Seattle, Washington.

McKelvey, K.S., J.J. Claar, G.W. McDaniel, and G. Hanvey. 1999. National Lynx Detection Protocol. Missoula, MT.

Mellen, Kim, Bruce G. Marcot, Janet L. Ohmann, Karen Waddell, Susan A. Livingston, Elizabeth A. Willhite, Bruce B. Hostetler, Catherine Ogden, and Tina Dreisbach. 2003. DecAID, the decayed wood advisor for managing snags, partially dead trees, and down wood for biodiversity in forests of Washington and Oregon. Version 1.10. USDA Forest Service, Pacific Northwest Region and Pacific Northwest Research Station; USDI Fish and Wildlife Service, Oregon State Office; Portland, Oregon. http://wwwnotes.fs.fed.us:81/pnw/DecAID/DecAID.nsf

Miller, J. M. and Patterson, J. E. 1927. Preliminary studies on the relation of fire injury to bark beetle attack in western yellow pine. Journal of Agricultural Research 34:598-613, illus.

Miller, J. M. and Keen, F. P. 1960. Biology and control of the western pine beetle. USDA Forest Service, Pacific Southwest Forest and Range Experiment Station, Miscellaneous Publication 800. 381 p.

Minshall, G. W., C.T. Robinson, and D.E. Lawrence. 1997. Postfire responses of lotic ecosystems in Yellowstone National Park, U.S.A. Canadian Jornal of Fisheries and Aquatic Sciences. 54: 2509-2525.

Minshall, G.W., D.A. Andrews, J.T. Brock, C.T. Robinson and D.E. Lawrence. 1990. Changes in wild trout habitat following forest fire. Pages 174-177 in F. Richardson and R.H. Hamre, editors. Wild Trout IV, proceedings of the symposium. Trout Unlimited, Arlington, Virginia.

Moore, K.R. and C.J. Henny. 1983. Nest site characteristics of three coexisting accipiter hawks in northeastern Oregon. Raptor Research 17(3):65-76.

Newcomb, H.R. 1941. A biological investigation of forty lakes of the upper Deschutes River watershed in Oregon. Oregon State Game Commission, Portland.

Noss, R.F. and Cooperrider, A.Y. 1994. Saving Nature's Legacy: Protecting and Restoring Biodiversity. Island Press. Washington D.C. 416 pp.

O'Connor, J.E., G.E. Grant, T. L. Haluska. 2003. Overview of geology, hydrology, geomorphology, and sediment budget of the Deschutes River Basin, Oregon. In A Peculiar River: Geology, Geomorphology, and Hydrology of the Deschutes River, Oregon. 2003. *Eds*. O'Connor, J.E. and G.E. Grant. American Geophysical Union, Washington, DC.

ODEQ (Oregon Department of Environmental Quality). 2002. Final 2002 303(d) database. www.deq.state.or.us/wq/303dlist/303dpage/htm.

O'Loughlin, Colin and Robert Zeimer, 1982. The Importance of Root Strength and Deterioration Rates Upon Edaphic Stability in Steepland Forests. In: proceedings of an IUFRO workshop P.I.07-00, Ecology of Subalpine Zones/ R.H. Waring, editor. Corvallis : Oregon State University, Forest Research Laboratory.
Pacific Decadal Oscillation, The. http://jisao.washington.edu/pdo/, http://www.cses.washington.edu/cig/pnwc/aboutpdo.shtml

O'Neil, T.A., D.H. Johnson, C. Barret, M. Trevithick, K.A. Bettinger, C. Kiilsgaard, M. Vander Heyden, E.L. Greda, D. Stinson, B.G. Marcot, P.J. Doran, S. Tank, and L. Wunder. 2001. CD-ROM: Matrixes for wildlife-habitat relationships in Oregon and Washington. IN: D.H. Johnson and T.A. O'Neil (managing directors). 2001. Wildlife-Habitat relationships in Oregon and Washington. Oregon State University Press, Corvallis, OR. 768 pp.

Oregon Department of Fish and Wildlife. 2003. Oregon's bighorn sheep and Rocky Mountain goat management plan. Salem, Oregon. 80 pp.

Pajutee, M. 2003. Metolius Basin Forest Management Project Botany Report/Biological Evaluation. USDA Forest Service internal report. Sisters Ranger District. Sisters, Oregon.

Parks, C.G., D.A. Conklin, L. Bednar, and H. Maffei. 1999. Woodpecker use and fall rates of snags created by killing ponderosa pine infected with dwarf mistletoe. USDA Forest Service. Pacific Northwest Research Station. Portland, Oregon. Research Paper PNW-RP-515.

Perkins, M.J. 1998. 1998 Bat Surveys Final Report: Pelton Round Butte Hydroelectric Project FERC NO. 2030. 17pp.

Perlmeter, S. 1996. The 1996 Bat Project: Final Report. A Challenge Cost-Share Agreement between Stuart Perlmeter, Thurston High School, La Pine High School and the Deschutes National Forest. 30pp.

Perlmeter, S. 1997. The 1997 Bat Project: Final Report. A Challenge Cost-Share Agreement between Stuart Perlmeter, Thurston High School, La Pine High School and the Deschutes National Forest. 23pp.

Powell, R.A. and W.J. Zielinski. 1994. Chapter authors on Fishers. IN: Ruggerio, L.F., K.B. Aubry, S.W. Buskirk, L.J. Lyon, and W.J. Zielinski, tech eds. 1994. The Scientific Basis for Conserving Carnivores: American Marten, Fisher, Lynx and Wolverine in the Western United States. Gen. Tech. Rep. RM-254. Ft. Collins, CO: U.S. Dept. of Ag, Forest Service, Rocky Mountain Forest and Range Experiment Station. 184 pp.

Raphael M.G. and L.L.C. Jones. 1997. Characteristics of resting and denning sites of American martens in central Oregon and western Washington. Pp 146-165 In: *Martes*: taxonomy, ecology, techniques, and management. G.Proulx, H.N. Bryant, and P.M. Woodard, editors. 1997. Provincial Museum of Alberta, Edmonton, Alberta, Canada.

Reynolds, R.T., R.T. Graham, M. Hildegard Reiser, R.L. Bassett, P.L. Kennedy, D.A. Boyce Jr., G. Goodwin, R. Smith, and E.L. Fisher. 1991. Management Recommendations for the Northern Goshawk in the Southwestern United States. USDA Forest Service, Southwestern Region. 182 pp.

Riehle, M. 2001. Personal Communications. District Fisheries Biologist, Sisters Ranger District, Deschutes National Forest, Sisters, OR.

Rieman, B. E., D.Lee, G. Chandler, and D. Meyers. 1997. Does wildfire threaten extinction for salmonids: responses of redband trout and bull trout following recent large fires on the Boise National Forest. Pages 47-57 *in* J. Greenlee, editor, Proceedings of the symposium of fire effects on threatened and endangered species and habitats. International Association of Wildland Fire, Fairfield, Washington.

Robinson , C.T., and G.W. Minshall. 1996. Physical and chemical responses of streams in Yellowstone national Park following the 1988 wildfires. Pages 217-221 *in* J. Greenlee, editor, Proceedings of the symposium of fire effects on threatened and endangered species and habitats. International Association of Wildland Fire, Fairfield, Washington.

Roper, B.B, D. L. Scarnecchia, and T.J. LaMarr. 1994. Summer distribution and habitat use of chinook salmon and steelhead in a major basin of the south Umpqua River, Oregon. Transaction of the American Fisheries Society. 123:298-308.

Rose, C.L., B.G. Marcot, T.K. Mellen, J.L. Ohmann, K.L. Waddell, D.L. Lindley, and B. Schreiber. 2001. Chapter 24 authors: Decaying Wood in Pacific Northwest Forests: Concepts and Tools for Habitat Management. IN: D.H. Johnson and T.A. O'Neil (managing directors). 2001. Wildlife-Habitat relationships in Oregon and Washington. Oregon State University Press, Corvallis, OR. 768 pp.

Rosgen, D.L. 1994. A classification of Natural Rivers. Catena. 22: 169-199. Elsevier Science, B.V. Amsterdam.

Ruediger, B., J. Claar, S. Gniadek, B. Holt, L. Lewis, S. Mighton, B. Naney, G. Patton, T. Rinaldi, J. Trick, A. Vandehey, F. Wahl, N. Warren, D. Wenger, and A. Williamson. 2000. Canada Lynx Conservation Assessment and Strategy. USDA Forest Service, USDI Fish and Wildlife Service, USDI Bureau of Land Management, and USDI National Park Service. Forest Service Publication #R1-00-53, Missoula, MT. 142 pp.

Ruggerio, L.F., K.B. Aubry, S.W. Buskirk, L.J. Lyon, and W.J. Zielinski, tech eds. 1994. The Scientific Basis for Conserving Carnivores: American Marten, Fisher, Lynx and Wolverine in the Western United States. Gen. Tech. Rep. RM-254. Ft. Collins, CO: U.S. Dept. of Ag, Forest Service, Rocky Mountain Forest and Range Experiment Station. 184 pp.

Ruggerio, L.F. and K.S. McKelvey. 2000. The Scientific Basis for Lynx Conservation. Gen. Tech. Rep. RMRS-GTR-30. USDA Forest Service, Rocky Mountain Research Station.

Saab, V.A. and J.G. Dudley. 1998. Responses of cavity-nesting birds to stand-replacement fire and salvage logging in ponderosa pine/Douglas-fir forests of southwestern Idaho. Res. Pap. RMRS-RP-11. Ogden, UT: USDA Forest Service, Rocky Mountain Research Station. 17 p.

Saab, V.A., R. Brannon, J. Dudley, L. Donohoo, D. Vanderzanden, V. Johnson, and H. Lachowski. 2002. Selection of fire-created snags at two spatial scales by cavity-nesting birds. Gen. Tech. Rep. PSW-GTR-181. Pacific Southwest Research Station, USDA Forest Service. 14 pp.

Sallabanks, R., B.G. Marcot, R.A. Riggs, C.A. Mehl, and E.B. Arnett. 2001. Wildlife of eastside (interior) forests and woodlands. Pp. 213-238 in: D. H. Johnson and T. A. O'Neil, ed. Wildlife-habitat relationships in

Oregon and Washington. Oregon State University Press, Corvallis OR. http://www.nwhi.org/nhi/whrow/chapter8cwb.pdf

Scott, D. W.; Szymoniak J.and Rockwell, V. 1996. Entomological concerns regarding burn characteristics and fire effects on tree species during prescribed landscape burns: Burn severity guidelines and mitigation to minimize fire injuries. USDA Forest Service, Pacific Northwest Region. Blue Mountains Pest Management Zone. Report BMZ-97-1, 49 p.

Scott, D. W.; Schmitt, C. L. and Spiegel, L. H. 2002. Factors affecting survival of fire injured trees: A rating system for determining relative probability of survival of conifers in the Blue and Wallowa Mountains. USDA Forest Service, Pacific Northwest Region. Blue Mountains Pest Management Service Center. Report BMPMSC-03-1, 66 p.

Schantz, R. 2003. Eyerly Fire Salvage Existing Condition Report. USDA Forest Service unpublished report. Available for review at Sisters Ranger District, P.O. Box 249 (Pine St. @ Hwy 20), Sisters, Oregon 97759.

Seevers, J. and Lang, F. 1998. Management Recommendations for Mountain Lady's- slipper (Cypripedium montanum Douglas ex Lindley) v.2.0. USDA Forest Service.

Shank, Doug and Peter Sussmann, 2003. B&B Complex BAER field reconnaissance report.

Shepard, B.B, S.A. Leathe, T.M. Weaver, and M.D. Enk. 1984. Monitoring levels of fine sediment within tributaries to Flathead Lake, and Impacts of fine sediment on Bull Trout recruitment. Proceedings of Wild Trout III Symposium. Mammoth Hot Springs, Yellowstone National Park, Wyoming. Sept. 24-25, 1984.

Simon, Steven A. 1991. Fire History in the Jefferson Wilderness Area East of the Cascade Crest. USDA Forest Service. Deschutes National Forest Report. Unpublished Report. 122 pp.

Simonin, K. A. 2000. Vaccinium membranaceum. In: Fire Effects Information System. Rocky Mountain Research Station, Fire Sciences Laboratory. U.S.D.A Forest Service.[Available Online]: http://www.fs.fed.us/database/feis/ [January 22, 2004]

Sisters Ranger District Project Surveys and Wildlife Sightings Records.

Skinner, Carl N. 2002. Influence of Fore on the Dynamics of Dead Woody Material in Foreats of Cal;ifornia nad Southern Oregon.; Proceedings of the Symposium on the Ecology and Management of Dead Wood in Western Forests (November 2–4, 1999; Reno, NV.). General Technical Report PSW-GTR-181, USDA-FS Pacific Southwest Research Station, Albany, CA. 949 p.

Spenser, C. and R. Hauer. 1991. Phosphorus and nitrogen dynamics in streams during a wildfire. Journal of North American Benthological Society 10(1): 24-30.

Strohm, R. and P. Fisher. 2003. B & B Complex Deschutes National Forest Engineering Report (BAER). USDA Forest Service, Deschutes National Forest, Bend, Oregon.

Suna, H. 2003. Cache Mountain/Link Fire: Weed Monitoring Report. USDA Forest Service internal report. Sisters Ranger District, Sisters, Oregon.

Suna, H. 2003. B &B Complex Fire: Weed Monitoring Report. USDA Forest Service internal report. Sisters Ranger District, Sisters, Oregon.

Suna, H. and VanCampen, E. 2003. Eyerly Fire Weed BAER Monitoring Report**.** USDA Forest Service internal report. Sisters Ranger District, Sisters, Oregon.

Sussmann, P. 2003. B and B Complex Burned Area Emergency Response (BAER) soil specialist report. USDA Forest Service, Deschutes National Forest, Bend, Oregon.

Sweet, J. 2002. Suttle Lake phytoplankton data from 1995 and 2001. Report to Sisters Ranger District. January 26, 2002. Sisters Ranger District, Sisters, Oregon.

Tarapchak, S.J., and H.E. Wright, Jr. 1986. Effects of forest fire and other disturbances on wilderness lakes in northeastern Minnesota. I. Limnology. Archiv fur Hydrobiologie. 106:177-202.

Tressler, R., S. Bondi, and C. McShane. 1999. 1996-1997 Bald Eagle Communal Roost Study. Final report. EDAW, Inc. Prepared for Portland General Electric (FERC No. 2030), Portland, OR. 48pp.

USDA Forest Service.[Available Online]: http://www.fs.fed.us/database/feis/plants/forb/ [November26, 2003]

USDA Forest Service. [unknown date]. Character Table for Survey and Manage. PacificNorthwest Research Station. [Available Online]: http://mgd.nacse.org/fsl/survey/index2tabs.html[December 4, 2003]

USDA Forest Service. [unknown date].Toolbox Fire Recovery Project DEIS. [Available Online]: http://www.fs.fed.us/r6/winema/managment/analyses/ toolbox/deisspec/weeds.pdf
[December 2, 2003]

USDA Forest Service. 1986. Metolius mule deer winter range habitat management plan. Deschutes National Forest. Bend, OR. 38 pp.

USDA Forest Service. 1990. Final Environmental Impact Statement, Proposed Land and Resource Management Plan, Willamette National Forest.

USDA Forest Service. 1993a. Protocol for surveying for spotted owls in proposed management activity areas and habitat conservation areas.

USDA Forest Service, 1993b. Region 6 Interim Old Growth Definitions. Pacific Northwest Region. Portland, Oregon.

USDA Forest Service. 1994a. Flammulated, Boreal, and Great Gray Owls in the United States: A Technical Conservation Assessment. General Technical Report RM-253. Rocky Mountain Forest and Range Experiment Station.

USDA Forest Service. 1994b. Record of Decision for Amendments to Forest Service and Bureau of Land Management Planning Documents Within the Range of the Northern Spotted Owl: Standards and Guidelines for Management of Habitat for Late-Successional and Old-Growth Forest Related Species within the Range of the Northern Spotted Owl.

USDA Forest Service. 1995a. Inland Native Fish Strategy Environmental Assessment, Descision Notice and finding of no significant impact for the interim strategies for managing fish producing watersheds in eastern Oregon and Washington, Idaho and Western Montana and portions of Nevada.

USDA Forest Service. 1995b. Interim Management Direction Establishing Riparian, Ecosystems and Wildlife Standards for Timber Sales, Appendix B, Regional Forester's Plan Amendment #2. 14 pp.

USDA Forest Service. 1996. Metolius Watershed Analysis. Sisters Ranger District. Sisters, Oregon.

USDA Forest Service. 1997. Metolius Wild and Scenic River Management Plan. Sisters Ranger District, Sisters, Oregon.

USDA Forest Service. 1998. Integrated Natural Fuels Management Strategy. Deschutes National Forest. Bend, OR.

USDA Forest Service. 1999. Management Recommendations for Survey and Manage Terrestrial Mollusks. Version 2.0. Region 6, Portland, OR.

USDA Forest Service. 2000. Final Supplemental Environmental Impact Statement for Amendment to the Survey and Manage Protection Buffer, and other Mitigation Measures Standards and Guidelines. U.S. Dept. of Ag, Portland, OR.

USDA Forest Service. 2001a. Final Supplemental Environmental Impact Statement for Amendment to the Survey and Manage Protection Buffer, and other Mitigation Measures Standards and Guidelines. U.S. Dept. of Ag, Portland, OR.

USDA Forest Service. 2001b. Joint Aquatic and Terrestrial Programmatic Biological Assessment April 2001 – April 2003 for Federal Lands within the Deschutes Basin Administered by the Bureau of Land Management Prineville Office and for Federal Lands Administered by the Deschutes and Ochoco National Forests.

USDA Forest Service. 2001c. Record of Decision and Standards and Guidelines for Amendments to the Survey and Manage, Protection Buffer, and other Mitigation Measures Standards and Guidelines.

USDA Forest Service. . 2003. Joint Aquatic and Terrestrial Programmatic Biological Assessment April 2003 – April 2006 for Federal Lands within the Deschutes Basin Administered by the Bureau of Land Management Prineville Office and for Federal Lands Administered by the Deschutes and Ochoco National Forests.

USDA Forest Service. . 2003. White Paper by S. Jeffries and D. Zalunardo. Canada lynx (*Lynx canadensis*) habitat mapping. Deschutes National Forest, Bend, OR. 3 pp.

U.S. Fish and Wildlife Service List of Endangered and Threatened Wildlife and Plants (March 1, 1989).

U.S. Fish and Wildlife Service. 1992. Determination of critical habitat for the northern spotted owl; Final Rule. Federal Register. Vol. 57. No. 10:1796-1838. Jan. 15, 1992.

The following references are found in Oregon Department of Fish and Wildlife, 2003:

Chadwick, D.H. 1973. Mountain goat ecology-logging relationships in the Bunker Creek drainage of western Montana. Montana Job Final Rep. Proj. W-120-R-3, 4. 262 pp.

Chadwick, D.H. 1983. A beast the color of winter. Sierra Club Books, San Francisco. 208 pp.

Coues, E. 1897. 1965 Reprint. The manuscript journals of Alexander Henry and of David Thompson. Vol. II. The Saskatchewan and Columbia Rivers. Ross and Haines, Inc. Minneapolis, Minnesota.

Geist, V. 1962. Observations on the habitat-directed behavior of stone sheep (*Ovis dalli stonei*) and the mountain goat (*Oreamnos americanus*). Sci. in Alaska (Proc. Alaskan Sci. Conf.) 13:29-30.

Geist, V. 1971. Mountain sheep: a study in behavior and evolution. Univ. of Chicago Press. 383. pp.

Grant, M. 1905. The rocky mountain goat. Ann. Rep. of The Zool. Soc. 9:230-261.

Holroyd, J.C. 1967. Observations of Rocky Mountain goats on Mount Wardle, Kootenay National Park, British Columbia. Can. Field-Nat. 81-1-22.

Johnson, R.F. 1983. Mountain goats and mountain sheep of Washington. Wash. Dep. Of Game, Biol. Bull 18. 196 pp.

Kerr, G.R. 1965. The ecology of mountain goats in west central Alberta. M.S. Thesis. Univ. of Alta., Edmonton. 96 pp.

Ord, G. 1815. 1894 Reprint. A reprint of the North American Zoology. Originally published in 1815, second American Edition of Guthries Geography. Haddonfield, New Jersey.

Richardson, A.H. 1971. The Rocky Mountain goat in the Black Hills. South Dakota Dep. Game, Fish, and Parks. Bull. 2. 26pp.

Richardson, J., W. Swainson, and W. Kirby. 1829. Fauna Boreali-Americana; or the zoology of the northern parts of British America. Pt. 1. The Quadrupeds. London. 300 pp.

Rideout, C.B. and R.S. Hoffman. 1975. *Oreamnos americanus*. Mammalian Species 63:1-6.

Saunders, J.K., Jr. 1955. Food habits and range use of the Rocky Mountain goat in the Crazy Mountains, Montana. J. Wildl. Manage. 19:429-437.

Smith, B.L. 1976. Ecology of Rocky Mountain goats in the Bitterroot Mountains, Montana. M.S. Thesis, Univ. of Montana, Missoula. 203 pp.

Suckley, G., and G. Gibbs. 1860. Report upon the mammals collected on the survey. Pages 89-139 IN: Explorations and surveys for a railroad route from the Mississippi River to the Pacific Ocean, 1853-1855. Pacific R.R. Rept. 12.

U.S. Fish and Wildlife Service. 2002. Birds of conservation concern 2002. Division of Migratory Bird Management, Arlington, Virginia. 99 pp. [Online version available at http://migratorybirds.fws.gov/reports/bcc2002.pdf].

Volland, L.A.. 1985. Plant associations of the Central Oregon pumice zone. USDA Forest Service, Pacific Northwest Region. R6-ECOL-104-1985.

Volland, Leonard A. 1993. Plant Association of the Central Oregon Pumice Zone. USDA Forest Service. Pacific Northwest Region. Portland, Oregon. R6-ECOL-104-1985. 138 pp.

Wilcox, M., Wasniewski, L., Butler, D. and J. David. 2002. Eyerly Fire hydrology report. USDA Forest Service, Deschutes National Forest, Bend, Oregon.

Wilderness Research Institute. 1979. A peregrine falcon nesting habit study in the Shasta-Trinity National Forest. Arcata, California. 22pp.

Wisdom, M.J., R.S. Holthausen, B.C. Wales, C.D. Hargis, V.A. Saab, D.C. Lee, W.J. Hann, T.D. Rich, M.M. Rowland, W.J. Murphy, M.R. Eames. 2000. Source habitats for terrestrial vertebrates of focus in the interior Columbia basin: broad-scale trends and management implications. Gen. Tech. Rep. PNW-GTR-485. Portland, OR. USDA Forest Service, Pacific Northwest Research Station. 3 Vol.

Wright, H.E., Jr. 1976. The impact of forest fire on the nutrient influxes to small lakes in northeastern Minnesota. Ecology. 57: 649-663.

Zouhar, K. 2001. Centaurea maculosa.Centaurea diffusa. Linaria spp. Cirsium arvense. Cirsium vulgare. In: Fire Effects Information System. Rocky Mountain Research Station, Fire Sciences Laboratory.