Lower Sycan Watershed Analysis

Fremont-Winema National Forest

2005

Lower Sycan River T33S,R12E,S23

Lower Sycan Watershed Analysis
Table of Contents

INTRODUCTION *1*

General Watershed Area **2**

Geology and Soils **5**

Climate **6**

STEP 1. CHARACTERIZATION OF THE WATERSHED *7*

I. Watershed and Aquatics **7**
Soils And Geomorphology 10
Aquatic Habitat 10

II. Vegetation **12**
Forested Uplands 13
Non-Forested Uplands 14
Riparian Vegetation 17
Invasive Plant Species 18
Threatened, Endangered, and Sensitive Plant Species 18

III. Terrestrial Species and Habitats **18**

IV. Human Uses **19**

STEP 2. IDENTIFICATION OF ISSUES AND KEY QUESTIONS *21*

I. Watershed and Aquatics **21**

II. Vegetation **21**

III. Terrestrial Species and Habitats **22**

IV. Human Uses **22**

Step 3. DESCRIPTION OF CURRENT CONDITIONS *24*

I. Watershed and Aquatics **24**
Uplands 24
Summery of Current Conditions 27
Road Density, Location, and Drainage Network 31
Stream Flow 36
Drainage Characteristic 37
Riparian Vegetation and Associated Bank Stability 39
Rosgen Stream Types 40
Habitat for Aquatic Species 43
Water Quality 44
Fish Populations and Distribution 45
Fish Passage – Culverts 46
Fine Sediment 46

II. Vegetation **46**
Forested Uplands 47
Invasive Species 55
Threatened, Endangered, and Sensitive Plants 56
Terrestrial Species and Habitat 57
Human Uses 59

STEP 4. REFERENCE CONDITIONS *62*

I. Watershed and Aquatics **62**

Uplands **63**

Roads and there Effect on Amount of Sediment and Water Reaching Riparian Areas **65**

Riparian Vegetation and Stream Channels **66**
1. Riparian Vegetation and Associated Bank Stability 66
2. Rosgen Stream Types 66

Habitat for Aquatic Species **68**
1. Large Woody Debris (LWD) and its Contribution to Fish Habitat 68
2. Desired Pool Numbers 69
3. Spawning Gravel Fines and their Influence on Fish Habitat and Reproductive Success 70
4. Stream Temperature and its Influence on Fish Habitat 70
5. Desired Fish Passage: 71

Soils **73**

II. Vegetation **74**
Forested Uplands 75
Non-Forested Uplands 78

Invasive Species **80**

Threatened, Endangered, and Sensitive Plants **81**

III. Terrestrial Species and Habitat **82**
1. Northern Goshawks 82
2. Primary Excavators 82
3. Mule Deer 82

IV. Human Uses **82**
Prehistory 83
History 83

STEP 5. SYNTHESIS AND INTERPRETATION *85*

I. Watershed and Aquatics **85**
Road Density, Location, and Drainage Network 86
Riparian Vegetation and Stream Channels 87
Rosgen Stream Type(s) 88
Watershed Summary 90

II. Vegetation **92**
Forested Uplands 92
Invasive Species 95
Threatened, Endangered, and Sensitive Plants 96

III. Terrestrial Species and Habitats **96**
1. Northern Goshawks 96
2. Primary Excavators 98
3. Mule Deer 98

IV. Human Uses **100**
Timber 100
Grazing 100
Recreation 101
Subsistence Hunting 101

STEP 6. RECOMMENDATIONS *102*

I. Watershed and Aquatics **102**

Uplands 102

2. Road Density, Location, and Drainage Network 103

3. Riparian Vegetation and Stream Channels 104

DATA GAPS AND MONITORING ACTIVITIES: 105

II. Vegetation **105**

Forested Uplands **105**

GENERAL 105

PRESCRIPTIVE 106

Early Seral Stage Stands 110

Mid Seral Stage Stands 110

Late or Old Seral Structure (LOS) Stands 111

Western Juniper and Hardwoods 113

Non-Forested Uplands 114

Fire 114

Invasive Species **115**

Threatened, Endangered, and Sensitive Plants **115**

III. Terrestrial Species and Habitats **115**

1. Northern Goshawk 115
2. Primary Excavators 116
3. Mule Deer 116

IV. Human Uses **117**

REFERENCES *118*

List of Tables	Page
Table 0-1. Fifth and 6th fields HUC's for Sycan River, Oregon	4
Table 1.1 Miles of stream by type in Lower Sycan Watershed, Oregon.	11
Table 1.2. Important Insects and Disease	14
Table 1-3. Plant Associations in the Lower Sycan Watershed, Oregon.	15
Table 3-1: Lower Sycan's dominant upland soil map units, crown and ground cover types by allotments	23
Table 3-2: Lower Sycan dominant meadow soil map units, setting and ground cover.	24
Table 3-3: Lower Sycan rangeland cover and trends: Trends are based on relative cover values over the time period, for trends: up, down (d), or static (s).	25
Table 3-4 Percent land cover from National Land Cover Dataset for Lower Sycan Watershed, Oregon by 6th Field HUC.	26
Table 3-5 Percent of topography by degree slope by 6th HUC in the Lower Sycan Watershed, Oregon	27
Table 3-6 Aspect for the Lower Sycan Watershed, Oregon.	28
Table 3-7 Miles of road and trails, road density by road class and sub watershed Lower Sycan, Oregon	31
Table 3-8 Miles and density of roads by sub watershed Lower Sycan Watershed, Oregon.	31
Table 3-9 Miles of road within 300 ft. of streams by road class, slope and sub watershed in the Lower Sycan Watershed, Oregon.	32
Table 3-10 Miles of road within 300 ft of stream by degree slope, stream type, and subwatershed. Lower Sycan Watershed, Oregon.	33
Table 3-11 Sum of road miles 300 ft. of stream by stream type and slope range. Lower Sycan Watershed. Oregon.	33
Table 3-12 Characteristics of the entire Sycan River Basin Attributes of the Entire Sycan Basin.	36
Table 3-13 Riparian Vegetation and associated bank stability. Lower Sycan Watershed, Oregon.	38
Table 3-14 Rosgen channel types by reach and other physical channel characteristic. Lower Sycan Watershed, Oregon.	41
Table 3-15 Habitat features in June 2001 Lower Sycan River, Oregon.	42
Table 3-16 Annual maximum 7-day average of maximum daily water temperature.	43
Table 3-18. Invasive Species in the Lower Sycan Watershed.	53
Table 3-19 Current Open Road Density in the Lower Sycan Watershed.	56
Table 4-1 - Conifer Species and Associated Water Yield.	60
Table 4-2 - Natural or Near Natural Frequency of LWD in Northern Great Basin Streams (ICBEMP 1997).	65

List of Tables continued	Page
Table 4-3 - Natural or Near Natural Frequency of Pools in Northern Great Basin Streams (ICBEMP 1997).	66
Table 4-4: Historic range of seral reference conditions are shown for Ponderosa pine (PIPO) and Sierra lodgepole pine (PICO) in the Pacific Northwest and Great Basin.	69
Table 4-5: Historical range of seral conditions for Ponderosa pine and Sierra lodgepole pine in the Williamson River/Upper Klamath Basin.	70
Table. 4-6 1946-47 Vegetation Condition.	71
Table 4-7. Reference Seral Stage Distribution in the Ponderosa Pine Type.	73
Table 4-8. Reference Seral Stage Distribution in the Mixed Conifer Type.	73
Table 4-9. Reference Seral Stage Distribution in the Lodgepole Pine Type.	74
Table 5-1 Road density per square mile and the function rating. Lower Sycan Watershed, Oregon.	83
Table 5-2 Road miles within 300 foot of stream channels by degree slope and subwatershed. Lower Sycan Watershed, Oregon.	83
Table 5 - 3 Riparian Vegetation and associated bank stability. Lower Sycan Watershed, Oregon.	84
Table 5-4 Habitat ratings Lower Sycan June 2001 Sycan Rivar Oregon.	85
Table 5-5 Existing and potential channel dimensions . Sycan River Upper Browns Spring Reach, Oregon.	87
Table 6-1. Management Zones by Forested Plant Associations Within the Lower Sycan Watershed Expressed as Stand Density Index (SDI)	102
Table 6-2. Comparison of three stocking regimes	103

List of Figures

Figure 0-1 Location of Sycan Watershed in Klamath River Basin, Oregon.	3
Figure 0-2 Sycan Watershed 5th and 6th field HUC's.	4
Figure 1-1 Lower Sycan Wild and Scenic Area Sycan River, OR	8
Figure 1-2 Elevation range and mountain peaks in the Lower Sycan Watershed Sycan River, OR	9
Figure 1-3. Spring locations in the Lower Sycan Watershed. Sycan River, Oregon.	12
Figure 3-1 Land cover types for Lower Sycan Watershed, Oregon	27
Figure 3-2 Map of Lower Sycan Watershed displaying degree of slope. Lower Sycan, Oregon.	28
Figure 3-3 Aspect of topography for Lower Sycan Watershed, Oregon	29
Figure 3-4 Stream flow values from Sycan below Snake Creek. Upper chart displays average monthly flow values 1974-2003 and the lower chart displays the peak flow for the month. Sycan River, Oregon.	35
Figure 3-5 Longitudinal profile of the Lower Sycan River (Sycan Marsh to Sprague) , Oregon.	36
Figure 3-6 Drainage pattern for the Lower Sycan River Watershed, Oregon	37
Figure 3-7 Reach locations for June 2001 stream survey Lower Sycan River, Oregon.	40

List of Preparers

Richard Ford - Fisheries Biologist

John Kaiser – Archaeologist

Sarah Malaby – Botanist

Norm Michaels – Silviculturist

Mike Ramey - Wildlife Biologist

Desi Zamudio - Soil Scientist

INTRODUCTION

Watershed analysis is a process used to characterize the human, biological and physical conditions, processes, and interactions within a watershed. By looking at the ecosystem as a whole, the analysis provides a systematic way to understand and organize ecosystem information. Watershed analysis is an intermediate analysis between land management planning and project planning. It helps us understand how past land use activities interacted with the physical and biological environments in the landscape. The analysis focuses on specific issues, values and uses identified within the landscape that are essential for making sound management decisions. This document presents a current understanding of the processes and interactions of concern occurring within the Lower Sycan Watershed.

The Lower Sycan Watershed includes portions of the Paisley, Bly, and Chiloquin Ranger Districts of the Fremont-Winema National Forests.

The team followed the six-step process as outlined in the Ecosystem Analysis at the Watershed Scale, Federal Guide for Watershed Analysis. This process includes six steps:

Step 1 - **Characterization** of the watershed – a summary of the dominant conditions and interactions within the watershed.

Step 2 - Identification of **issues** and key questions.

Step 3 - Description of **current conditions**.

Step 4 - Description of **reference conditions** - in general this is the historical condition prior to the influence of European settlement. Since historical conditions for hydrologic parameters are generally not available, the "Watershed and Aquatics" sections of this document will focus on "desired condition" (see Step 4, page 1).

Step 5 - **Synthesis and interpretation** of information – a comparison of current and reference conditions including discussion of similarities, differences, causes and trends.

Step 6 - Management **recommendations**.

In watershed analysis, each step focuses on core topics. Readers of this document accustomed to the topic organization of recent Watershed Analyses will note some differences in the organization of this document. In order to present hydrologic and aquatic analysis in a more integrated fashion, core topics relating to watershed and aquatics are presented under just three headings: (a) uplands; (b) riparian vegetation and stream channels; and (c) aquatic habitat. In previous documents produced on the Fremont-Winema National Forests, information on these topic areas was divided among six or seven headings.

This document is organized by "**Steps**". Since the document is structured in relation to the six steps, rather than in relation to the core topics, it is often necessary for the reader to move from one step to the next in order to gain the complete "story" in relation to a given core topic. In order to assist such a search, a unique two-part number which reports step and page number within that step can be used to identify each page. For example, (3–7) would be the 7th page in Step 3, Current Conditions. References are included throughout the document, using this "Step-Page Number" format, in order to assist the reader in locating closely related material.

This document presents the information gathered by the ten-member core team. It is not a decision document under the National Environmental Policy Act (NEPA), nor does it initiate or result in land management allocations. It does not select specific projects for implementation. The Fremont-Winema National Forests will use this analysis to identify potential projects which would move the watershed toward the desired condition described in the current Land and Resource Management Plans, as amended. Such projects will be analyzed separately by District interdisciplinary teams. Project

analysis will include involvement by the public and result in a site-specific decision as required by the National Environmental Policy Act.

General Watershed Area

Located in the Klamath River Basin, the Sycan Watershed covers 357,751 acres (559 mi^2) and contains three 5th field watersheds (Figure 0-1 and 0-2). Sycan Marsh HUC 1801020202 covers 143,689 acres (225 mi^2), Upper Sycan HUC 1801020201 covers 65,752 acres (103 mi^2) and the Lower Sycan, HUC 1801020203, the subject of this report, covers 148,310 acres (233 mi^2). The Sycan River flows into the Sprague River approximately 2 miles NW of Beatty, Oregon. The Sycan Watershed is bounded by Yamsay Mountain at 8,196 ft. on the NW corner the headwaters for Long Creek. The area known as Winter Ridge is along the eastern boundary at an elevation of 7,565 ft. The Upper Sycan Watershed flows onto the Sycan Marsh Watershed. The Sycan Marsh itself is in the middle of the Sycan Watershed and it flows into the Lower Sycan Watershed. It is important to note that there are two Long Creeks, one in Upper Sycan Watershed and the other in Sycan Marsh Watershed, both of the creeks flow into the Sycan Marsh which in turns flows into down the Sycan River. The Lower Sycan Watershed is comprised of five 5th field watersheds, Snake Creek, Sycan above Sprague, Merritt Creek, Silver Dollar Flat, and Marsh Reservoir (Table 0-1).

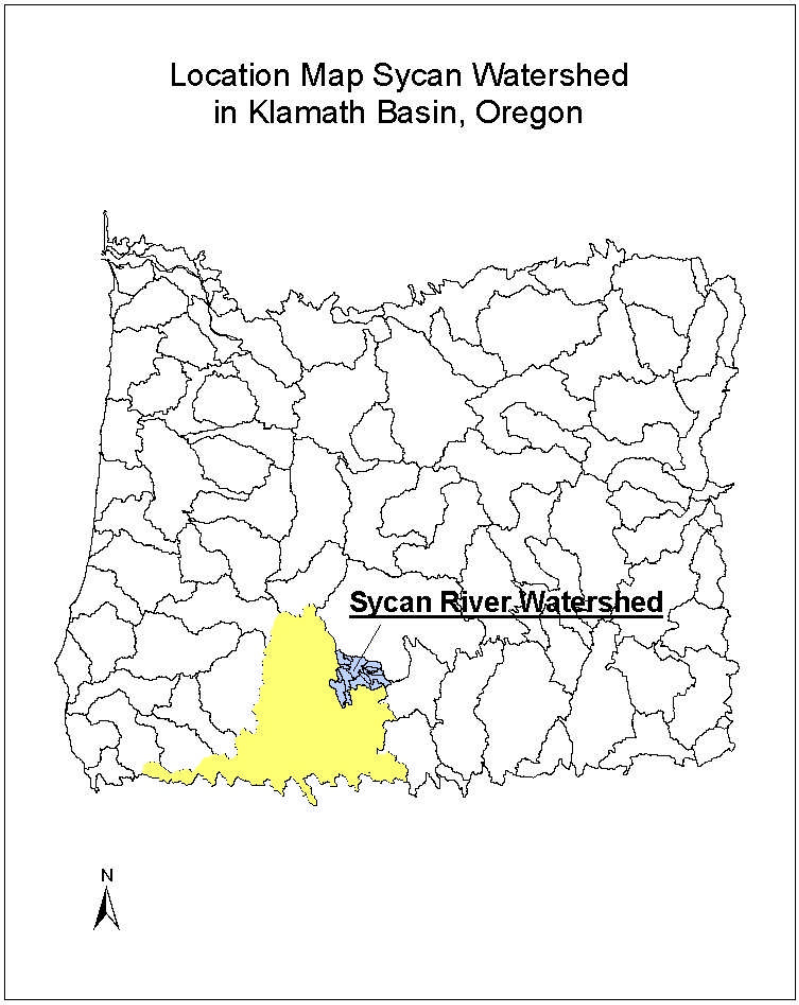

Figure 0-1 Location of Sycan Watershed in Klamath River Basin, Oregon.

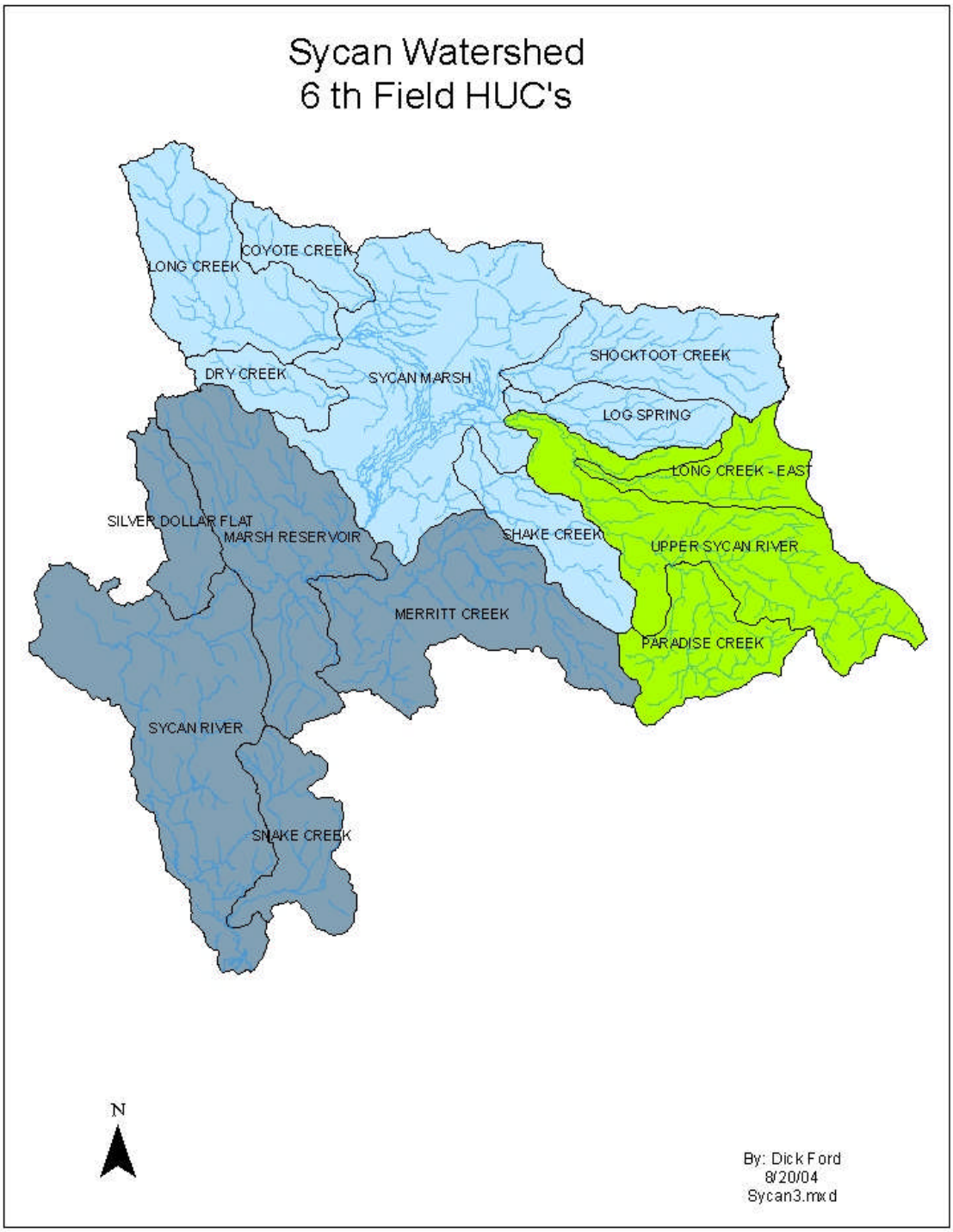

Figure 0-2 Sycan Watershed 5th and 6th field HUC's.

Table 0-1. Fifth and 6th fields HUC's for Sycan River, Oregon.

HUC5 Name	HUC6 Name	Area Acres
Upper Sycan	LONG CREEK	11,308.0
	PARADISE CREEK	16,017.0
	UPPER SYCAN RIVER	38,430.4
Upper Sycan Total		65,755.4
Sycan Marsh	COYOTE CREEK	7,623.2
	DRY CREEK	7,267.5
	LOG SPRING	10,636.7
	LONG CREEK	26,358.1
	SHAKE CREEK	13,625.3
	SHOCKTOOT CREEK	21,536.9
	SYCAN MARSH	56,636.2
Sycan Marsh Total		143,683.8
Lower Sycan	MARSH RESERVOIR	36,575.0
	MERRITT CREEK	35,219.2
	SILVER DOLLAR FLAT	9,995.1
	SNAKE RIVER	15,191.3
	SYCAN RIVER	51,330.4
Lower Sycan Total		148,310.9
Grand Total		357,750.1

The vegetation types consist of meadow, grassland/shrub non-forested uplands, ponderosa pine, lodgepole pine, mixed conifer, juniper woodlands, and stream edges vegetated with willows, alder, and other deciduous shrubs.

The Lower Sycan Watershed totals approximately 148,310 acres. About 89,325 acres (60.2%) are managed by the USDA Forest Service, with the remaining 58,984 acres (39.8%) being privately owned. All statements which report area (typically in acres) refer to both public and private land, unless otherwise stated. Frequently information was only available or gathered on National Forest lands. In the desire to display as much information as possible, information about private lands is included where available.

Geology and Soils

Sycan River Watershed is one of extrusive basaltic and andesitic volcanic origin with volcanic eruptions resulting in topographic high points, and flatter lava flows resulting in high plateau land. Only in the lower portions of the watershed does the geology change; in the Black Hills in the Lower Sycan Watershed, the geologic material is a rhyolitic and

rhyodacitic domal formation. Soils within the watershed have varying thicknesses of ash, which are generally less than 1 foot and may be absent within the profile.

The Sycan Marsh is one of the two largest marshes in the Klamath Basin. It covers a large portion of the Sycan Watershed and is composed of fine to coarse-grained sedimentary deposits. Below the Forest boundary, alluvial material overlies fluvial lacustrine deposits, which include minor interfingerings of lava flows and tuff. These alluvial surficial deposits and some other minor deposits are located in the topographically low portions of the watershed.

Climate

The watershed stands in the shadow of the Cascade Mountains to the west. The Lower Sycan Watershed receives rain and snow, totaling between 15-20 inches of precipitation each year, depending on elevation. Winter temperatures drop below 0°F. Even during the summer, frost and snow may occur at higher elevations. Convective thunderstorms provide rain in spring and summer.

STEP 1. CHARACTERIZATION OF THE WATERSHED

The characterization identifies the dominant physical, biological, and human processes and features of the watershed that affect ecosystem functions and conditions. This section identifies the primary ecosystem elements needing more detailed analysis in subsequent sections. Additional detail on the current condition of these elements is included in Step 3.

I. Watershed and Aquatics

The lower Sycan Watershed is located in the north of Beaty Oregon administrated by the Bly Ranger District on the east side and the Chemult Ranger District in the northwest. The Lower Sycan includes five sixth field watersheds: Merritt Creek (HUC 180102020301), Silver Dollar (HUC 180102020302), Snake Creek (HUC 180102020303, Marsh Reservoir (HUC 180102020304) and Sycan above Sprague (HUC 180102020205). The Lower Sycan watershed is located below the Sycan Marsh a 30,537 acre wetland in which all waters of the upper portion of the Sycan Watershed flow into and exit via the Sycan River (Fig 0-2).

The Sycan River running through the middle of the watershed is designated Wild and Scenic for the 24-mile segment within the National Forest below the Sycan Marsh to Coyote Bucket at the Fremont-Winema National Forest boundary. Outstandingly Remarkable River Values (ORVs) are those values that cause a river to be designated by Congress under the Wild and Scenic Rivers Act. ORVs for the Sycan River are: geology, scenery, fisheries, and wildlife. When the river was designated as Wild and Scenic, an area ¼ mile from each side of the river (measured from the ordinary high water mark) was established as an interim corridor covering 14,500 acres. The Sycan Wild and Scenic River Management Plan will:

- Protect and enhance the value for which the river was designated
- Insure water quality meets federal non-degradation standards
- Maintain a visual quality
- Provide opportunities for livestock grazing when it is consistent with other resource values
- Preserve and protect archaeological values
- Provide appropriate fire protection
- Protect and/or improve riparian habitat
- Prohibit timber harvesting and firewood gathering except for recreational use

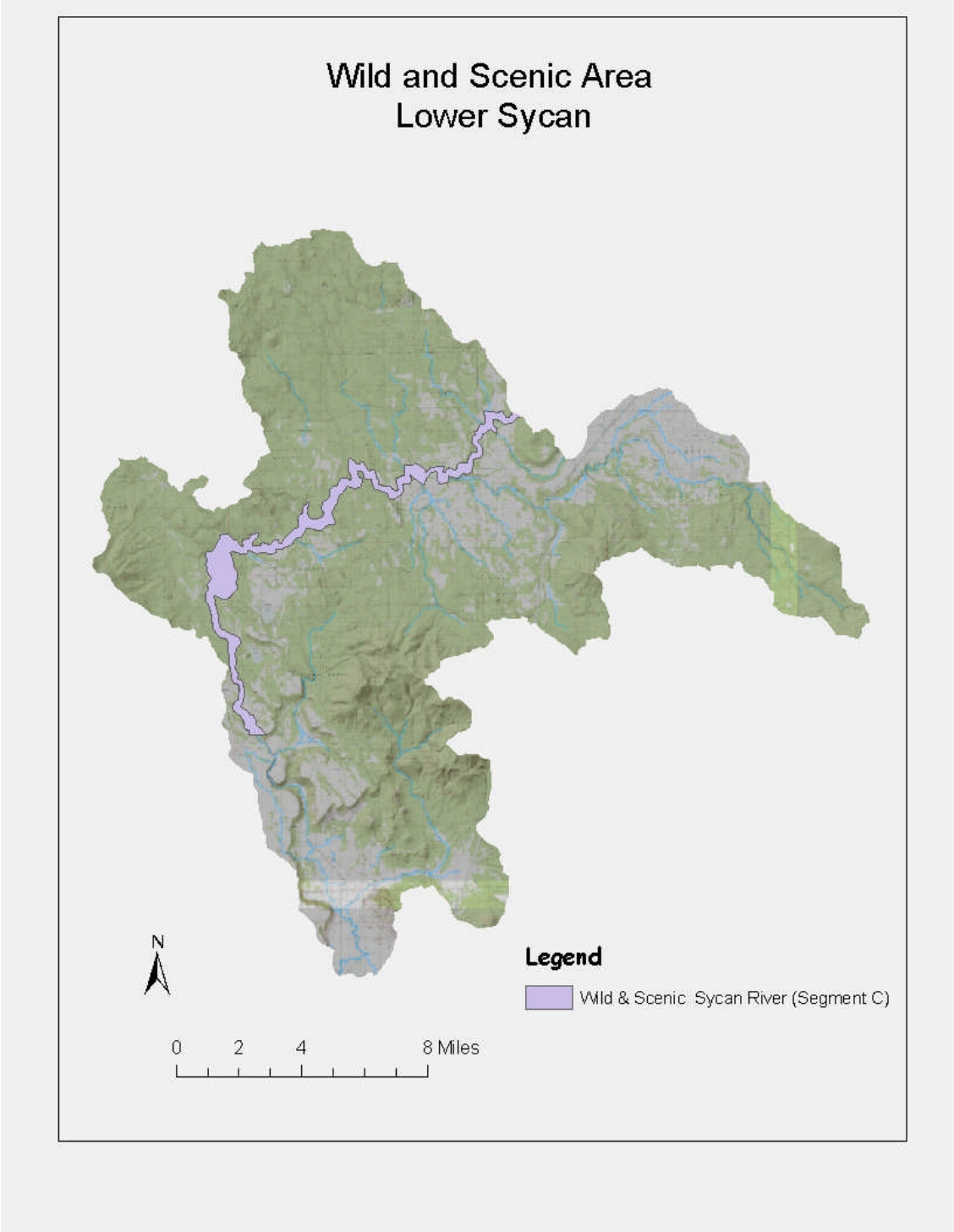

Figure 1-1 Lower Sycan Wild and Scenic Area Sycan River, OR

The Lower Sycan highest point is Shake Butte at 7,138 ft located on the east side. Figure 1-2. Four other high elevation points are located around the basin all above 6,000 ft. Average basin elevation is approximately 5,500 ft. The lower Sycan exits the Sycan Marsh at 5,000 ft and flowing for 36 miles and enters the Sprague River at 4,300 ft. for a slope of 0.4%.

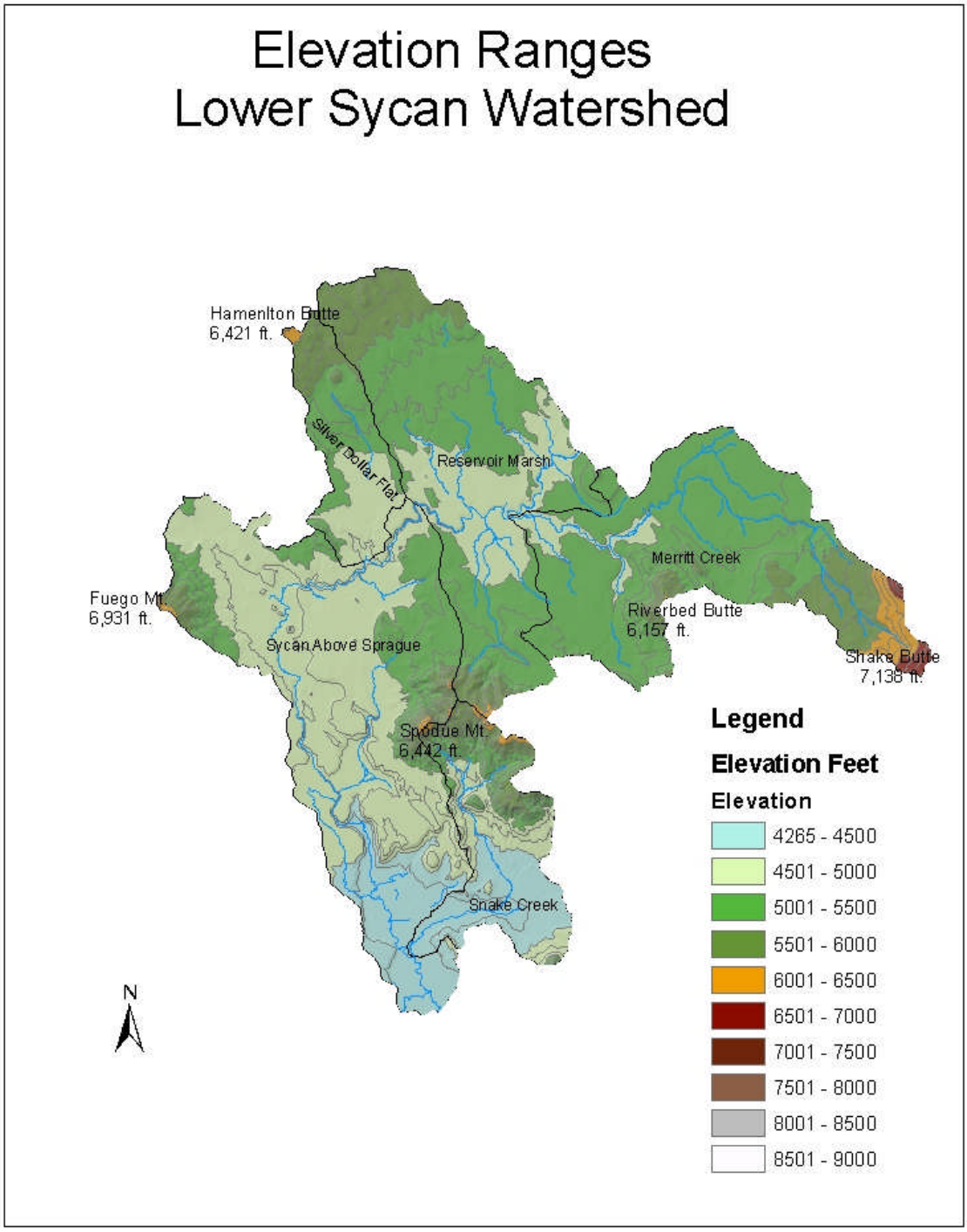

Figure 1-2 Elevation range and mountain peaks in the Lower Sycan Watershed Sycan River, OR

Soils And Geomorphology

Lower Sycan watershed characterization of Soil and Geomorphology focuses on ground cover and erosion conditions. In "Dust Bowl" recovery, we learned soil erosion is moderated by well-rooted ground cover in farms, rangelands and forests. With effective ground cover, soils catch, store, and release water for plant growth and stream flow over the dry season.

In eastern Oregon, the most common soils are in the Mollisol order (Loy et al 2000). Mollisol soils have dark surface features record the history of organic carbon accumulation with grass-steppe ground vegetation. Locally grass root decay accumulated in semiarid environs with recurring ground fire in open grown ponderosa pine forest and sagebrush steppe. Now, the Atlas of Oregon notes the shift away from this historic open park land to dense stands with fire suppression (Loy et al. 2000).

Soils in the Lower Sycan watershed occur on lava tablelands in the Basin and Range terrain and are weathered from ash, rhyolite, and basalt materials (Carlson, 1979, Wenzel, 1979, Orr and Orr, 1999). The tablelands have linear catchments, rim rock stream reaches, and low drainage densities. Detail soil map unit descriptions of the local semiarid forests and rangelands are identified in the Winema and Fremont Soil Resource Inventories (Carlson, 1979, Wenzel, 1979). The basement lava rocks also have sandy ash loess deposit from the adjacent Western Cascade terrain for a mix of dark Andisol and Mollisol soils.

Local ground cover and crown cover information are found in Plant Association guides (Hopkins, 1979a, 1979b) as well as range conservation trend studies. The references show, local ponderosa pine forest ground cover should have ample grass and grass-like plants such as Idaho fescue, Wheeler's bluegrass, and long-stolon sedge (Hopkins, 1979a).

Erosion rates in the Lower Sycan are moderated by very low drainage density, relatively level landscapes, sandy ash, and grassy ground cover. For Basin and Range terrain the slope are gentle (Orr and Orr, 1999, Carlson, 1979, Wenzel, 1979). Rocky lava rims form soil map unit boundaries along many streams and riparian corridors. For this watershed analysis, sediment and soil erosion rates are estimates with the Water Erosion Prediction Project (WEPP, 2001) technology that varies with vegetation cover, soil, topography, and climate Lower Sycan watershed characterization of Soil and Geomorphology focuses on ground cover and erosion conditions.

Aquatic Habitat

The aquatic habitat within the analysis area presents an interesting scenario of a river mostly confined within a narrow canyon and a very consistent gradient of 0.2% except for reach two. Reach two, consisting of Coyote Bucket and the lower gorge section (T35S, R12E, S8), has an average gradient of 1.5% with much steeper areas within these two gorges. Such a low gradient stream usually exists in broad valleys that allow the stream to meander which creates ample aquatic habitat in the form of undercut banks and lateral scour pools. Within the confines of the canyon, the Sycan has very limited opportunity to develop sufficient sinuosity to develop meander bends large enough to provide high quantities of fish cover habitat.

The channel and aquatic habitat in this river are influenced by the high peak and low baseflow of the hydrograph, the narrow canyon and floodplain, the bedrock control, and riparian vegetation. Large woody debris plays a very minor role in this system. The high peakflows and low gradient combine to float large woody debris out of the channel and on to the floodplain. Trees that fall partially into the channel, and are well anchored above the floodplain, can scour a lateral pool or build a bank at that point. Healthy riparian vegetation holds and organizes stream sediments in channels like the Sycan to form aquatic cover and habitat complexity that is missing today.

Climate and geology of the watershed provide for a baseflow on the order of ten cubic feet per second (cfs). High peak flows, recently over 3000 cfs, are not conducive to development of stable habitat. Ten cfs spread over a channel scoured by 3000 cfs does not provide significant habitat.

Where sufficient cover and water quantity do exist, healthy redband trout are present. The water chemistry is rich enough to support a productive aquatic system. Redband trout collected in 2001 ranged to 18 inches and approximately two pounds. These fish had very good condition factors and overall appearance. Water from Torrent Springs has a similar chemical profile to the Head of the River Spring on the Upper Williamson. If the Sycan had a more stable hydrograph similar to the Williamson, it might be expected to be on a par with the Williamson's biological productivity. However, basic differences in geology naturally prevent this.

The large size, good condition factor and small population of mature redband trout in the lower Sycan implicate hiding cover as the limiting factor of the redband population.

Information from the Winema and Fremont National Forests indicate the presence of the following fish species: redband trout, brown trout, marbled sculpin, pacific lamprey, Pit-Klamath brook lamprey, tui chub, speckled dace and Klamath largescale sucker.

The drainage network in the watershed consists of approximately 306 miles of perennial and intermittent streams. Approximately 53 miles of these streams are perennial, thus flowing continuously throughout the year. Intermittent stream channels, ones that flow only at certain times of the year i.e. in the spring during snow melt, account for 254 miles Table 1.1 Stream channel density for perennial streams is 0.17 miles/mi^{-2}, compared to the Upper Sycan with a density of 0.7 miles/mi$^{2.}$
Much of the precipitation does not run off as surface flow, but goes into the ground water reappears in the numerous springs found in the lower of the watershed. Figure 1-3.

Table 1.1 Miles of stream by type in Lower Sycan Watershed, Oregon.

Sum of MILES	NAME									
TYPE	Blue Creek	Bob's Creek	Merritt Creek	Mill Creek	Ponina Creek	Shake Creek	Snake Creek	Sycan River	Unnamed	Grand Total
INTERMITTENT	1.1	2.4	16.9	3.4	6.6	3.6	1.3		218.6	253.8
PERENNIAL	3.6			1.8		0.1	2.9	38.0	6.3	52.8
Grand Total	4.8	2.4	16.9	5.2	6.6	3.7	4.2	38.0	225.0	306.7

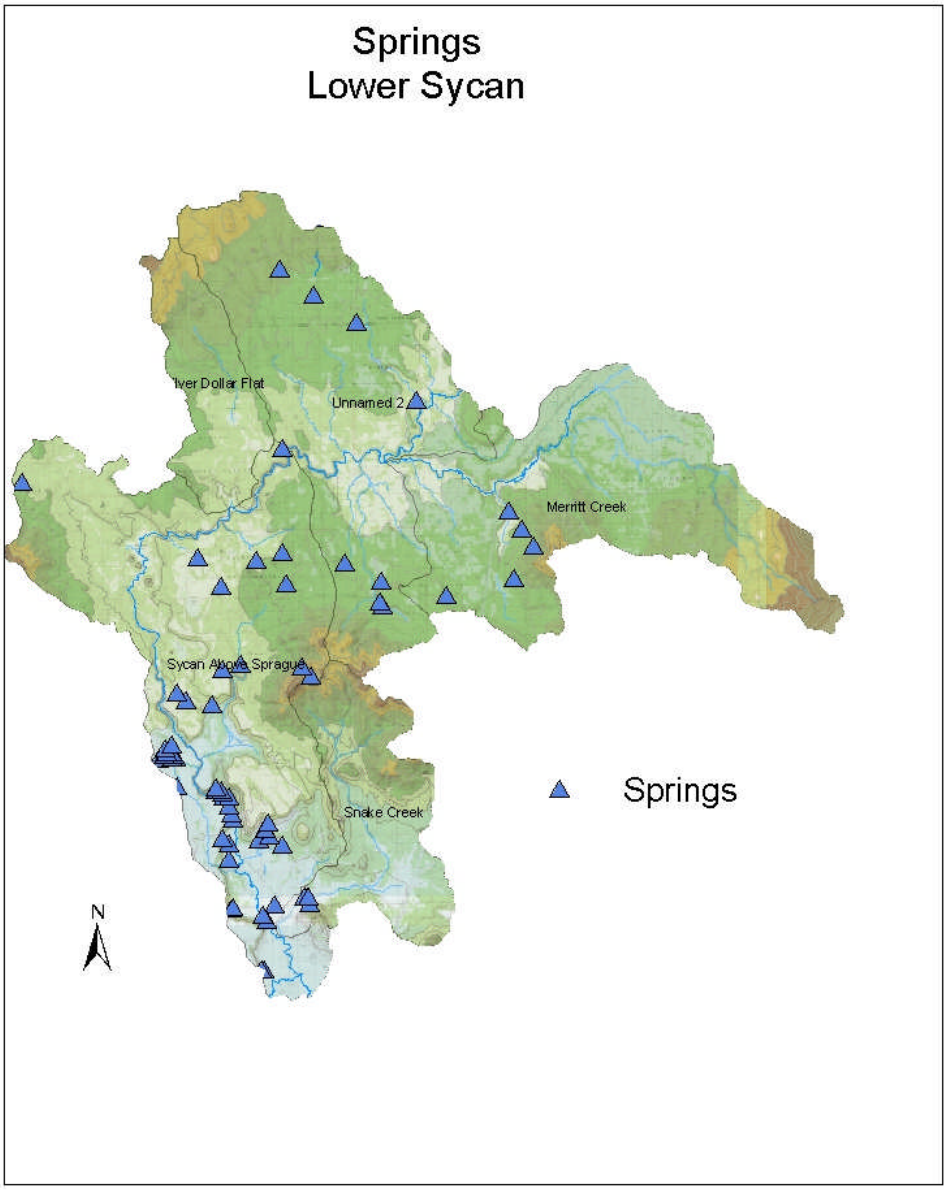

Figure 1-3. Spring locations in the Lower Sycan Watershed. Sycan River, Oregon.

II. Vegetation

The vegetation of the watershed can be classified into three broad groupings: forested uplands, non-forested uplands and riparian. Riparian vegetation was discussed beginning on page xx

Forested Uplands

National Forests lands comprise approximately 89,377 acres of the 148,310 acres in the Lower Sycan Watershed. About 77% of National Forest lands within the watershed, or 69,042 acres, are forested. Three community types are represented: ponderosa pine, mixed conifer, and lodgepole pine. Table 1-2.

Ponderosa pine stands occur across approximately 33,000acres of National Forest within the watershed. Ponderosa pine plant communities exist and thrive at the drier, warmer end of the climatic spectrum of forest types. These conditions exist at lower elevations as well as southern and western exposures (high-energy sites). Ponderosa pine stands will grade into mixed conifer and then lodgepole pine with increased elevation.

Mixed conifer stands occur across approximately 17,500 acres of National Forest lands within the watershed. Relative to the ponderosa pine types, these stand types exist at higher elevations and northern exposures (low energy sites). Always, ponderosa pine plays the seral role while white fir is the climax species. Within these plant communities, ponderosa pine and white fir will dominate with highly variable cover percentages that range from 5 to 75%. Lodgepole pine can also become a component in the stand but is not usually in a dominant or codominant position, though it will be an early pioneer following disturbance.

Lodgepole pine stands occur across approximately 33,00 acres of National Forest within the watershed. As a species, Lodgepole pine is the most adaptive coniferous species on the Fremont. The lodgepole pine on the Fremont NF is of the subspecies *murrayana* (Sierran lodgepole). This subspecies does not have serotinous cones but is a prolific seed producer. This species is the most cold hardy of all the conifers on the Fremont. These stand types occur at the highest elevations within the watershed. Lodgepole pine is also found along edges of ponderosa pine and mixed conifer stands where the stands reach down into low laying areas where cold air becomes restricted (frost pockets) or in any concave topographic feature where cold air may become trapped. Between disturbances, lodgepole pine will frequently encroach into areas such as aspen and grass meadows. These areas tend to be too cold or wet for other conifers to grow well.

Lodgepole pine type is the dominant forest plant community in the Sycan Watershed. This pine type is found associated with understory shrub and bunchgrass communities that make up an important portion of the land suitable for grazing in this watershed. These open timberlands were historically maintained by fires, which reduced seedling density and favored an open, herbaceous understory.

The inclusive **Ponderosa pine-juniper/mountain mahogany-bitterbrush-big sagebrush/fescue (CP-C2-11)** and the **Ponderosa pine/bitterbrush/fescue (CP-S2-11)** plant associations occupy high productivity sites in the Sycan watershed. Ponderosa pine, mountain mahogany and western juniper make up the overstory vegetation type. The shrub-layer consists of basin big sagebrush and bitterbrush with some gray rabbitbrush. Herbaceous cover is Idaho fescue and squirreltail.

The **Ponderosa pine-Quaking aspen/bluegrass (CP-H3-11)** community type consists of a dominant overstory of Ponderosa pine with quaking aspen as intermediate. Juniper, lodgepole pine and white fir can also be found in the understory. A dominant shrub layer is lacking, although mountain big sagebrush, serviceberry, creeping snowberry Oregon grape and wax currant are sometimes present. Wheeler's bluegrass, long stolon sedge, squirreltail, Idaho fescue, yarrow and strawberry are common in the herbaceous layer. This plant association is found adjacent to streambanks where the soil surface is wet in spring and early summer and the water table is at or near the surface year round which makes the soil subject to compaction in this type (Hopkins 1979).

Ponderosa pine/mountain big sagebrush/bluegrass (CP-S1-21) association has a Ponderosa pine overstory with an understory dominated by mountain big sagebrush. Understory herbaceous species are

long-stolon sedge, Idaho fescue, strawberry and white hawkweed. Western juniper can also be an understory component, but was probably only a minor component. Rabbitbrush, long-stolon sedge and squirreltail increase with site disturbance. This association is typically found in the eastern portion of the watershed adjacent to Winter Rim.

Insects and disease are one of the major disturbance factors, which are important in the development of upland forests. The following table displays the most important insects and diseases that affect the three primary forest types found in the Lower Sycan Watershed. More detailed information on insects and disease, including current distribution and/or risk, is presented in Step 3 – Current Condition; pages (3-16) through (3-21).

Table 1.2. Important Insects and Disease

Forest Type	Insects	Disease
Ponderosa Pine	Western pine beetle, mountain pine beetle, turpentine beetle, pine engraver	*Annosus* and *armillaria* root disease, dwarf mistletoe
Mixed Conifer	Those listed above for ponderosa pine, plus fir engraver beetle, Modoc budworm, Douglas-fir tussock moth	Those listed above for ponderosa pine, plus Indian paint fungus
Lodgepole Pine	Mountain pine beetle	Dwarf mistletoe, pine needle cast, western gall rust

Non-Forested Uplands

Non-forested uplands within the watershed are characterized by meadow, shrub/bunchgrass communities and scattered juniper/low sage "scab-rock flats". Approximately 23% of the National Forest land within the watershed is non-forested. In addition, several open forested associations, with a ponderosa pine overstory and characteristic shrub/grass understory, contribute to the forage base. Table1-3.

Meadow Communities

Three distinct plant associations represent the meadow communities in the Lower Sycan watershed. These communities represent the most productive forage producing lands within the watershed. Fire suppression has allowed conifers to encroach on meadows, resulting in decreased productivity and inhibited nutrient cycling. Historic improper livestock grazing practices has lead to downcut stream channels and lowered water tables at some sites.

The riparian “stringers” or greenline generally found in conjunction with these meadows are not defined separately from the meadow ecoclass associations in this analysis. Riparian vegetation is associated with streams that may or may not intersect these meadows and isolated riparian sites associated with springs and seeps are found within both forested and non-forested plant associations. A detailed description of characteristic riparian plant associations found on the Fremont National Forest is a work in progress under the USFS Area 4 Ecology Program and as a result, a summary of this classification was not available at the time of this analysis.

Dry meadow sites are represented by the **Bluegrass-Dry Meadow (MD-31-11)** association. The dominant species in this association are Kentucky bluegrass, Baltic rush and smallwing sedge, western yarrow and longstem clover. Sites with lowered water tables due to streambed downcutting may be dominated by silver sagebrush. Dry meadow sites have a water table at or near the surface in early summer and the entire soil profile is dry by early fall. These meadows can be sensitive to impacts with early season grazing due to saturated soils (Hopkins 1979).

The **Hairgrass-Sedge-Moist Meadow (MM-19-11)** association is comprised of tufted hairgrass and various combinations of sedges such as Nebraska sedge and smallwing sedge. Baltic rush and pullup muhly are subordinate species found in this association. Small percentages (1% or less) of silver sage may inhabit these sites and are prevalent on sites that have unnaturally lowered water tables. Moist meadow sites typically have a water table within 20-30 inches throughout most of the growing season and the rooting zone is almost always saturated. A wet site is indicated by trace amounts of forbs such as American bisort and monkeyflower. Trace amounts of Kentucky bluegrass, meadow barley and cinquefoils represent a

Table 1-3. Plant Associations in the Lower Sycan Watershed, Oregon.

Plant Associations			
Forested	**Code**	**Percent**	**Acres**
Lodgepole/bearberry	CL-M2-11	3.77%	3,365
Lodgepole/bitterbrush/fescue	CL-S2-14	0.07%	66
Lodgepole/shrub	CL-S2-15	0.30%	269
Lodgepole/bitterbrush/forb	CL-S2-13	0.56%	501
Lodgepole/bitterbrush/needlegrass	CL-S2-11	8.35%	7,466
Lodgepole/bitterbrush/sedge	CL-S2-12	0.07%	59
Lodgepole/blueberry/forb wetland	CL-M3-11	2.30%	2,054
Lodgepole/needlegrass basins	CL-G3-11	0.11%	99
Lodgepole/shrub	CL-G3-15	4.94%	4,414
Lodgepole/sedge-lupine	CL-H1-11	0.16%	143
Lodgepole/whitebark	CL-C1-12	0.00%	1
Mixed conifer/snowbrush-bearberry	CW-C3-11	2.49%	2,227
Mixed conifer/snowbrush-chinkapin	CW-H1-11	0.03%	26
Mixed conifer/snowbrush-manzanita	CW-S1-12	17.02%	15,214
Ponderosa/bitterbrush/fescue	CP-S2-11	3.75%	3,348
Ponderosa/bitterbrush/needlegrass	CP-S2-12	21.92%	19,593
Ponderosa/bitterbrush/sedge	CP-S2-17	2.24%	2,003
Ponderosa/bitterbrush-manzanita/needlegrass	CP-S2-13	6.07%	5,428
Ponderosa/bitterbrush-sagebrush/fescue	CP-S1-11	1.38%	1,233
Ponderosa/bitterbrush-snowbrush/needlegrass	CP-S3-11	1.65%	1,472
Pondrerosa/sagebrush	CP-C2-11	0.06%	51
White fir/chinquapin-boxwood-prince's pine	CW-H2-11	0.01%	10
Sub Total		77.25%	69,042
Non-forested			
Cold Desert, (freezing winters)	DC	0.02%	15
Dry Meadows (water table available part year)	MD	1.65%	1,479
Dry shrubland, sagebrush, nonforest zone shrubland not desert	SD	0.30%	272
Juniper/low sagebrush/fescue	CJ-S1-12	0.04%	35
Low sage/Idaho fescue-squirrel tail	SD-19-13	10.00%	8,941
Low sage/bunchgrass	SD-19-11	0.09%	77
Low sagebrush/Idaho fescue	SD-19-12	4.61%	4,117

Moist Meadow (water table available all growing season)	MM	0.01%	5
Mountain hemlock/grouse huckleberry	CM-S1-11	0.02%	20
Non-vegetated (cinders, lava flow, mud flow, glacial wash)	NC	0.00%	2
Non-vegetated landform failure (natural slumps, avalanches)	NO DATA	0.15%	134
Non-vegetated rocky land with minimal vegetation potential	NR	5.70%	5,093
Quarry, rock pit	NR-Q9	0.00%	0
Wet Meadow (surface moist or wet all growing season)	MW	0.04%	35
#N/A	105-???	0.12%	109
Sub Total		22.75%	20,335
Grand Total		100.00%	89,377

fluctuation to a drier site. Kentucky bluegrass can become a weak dominant to tufted hairgrass due to overgrazing, but will not completely outcompete tufted hairgrass.

The **Sedge-Wet Meadow (MW-19-11)** association is comprised of wetland sedges such as Nebraska sedge, smallwing sedge, water sedge, bigleaf sedge and beaked sedge. Also present is Baltic rush and pullup muhly in small amounts. Tufted hairgrass will be present in trace amounts only. These sites are characterized by coarse sedge "mats" and have water at or near the surface year round.

Shrub/bunchgrass Communities

Several plant associations in the watershed are represented by sagebrush as the major shrub species. A majority of the sagebrush-dominated communities are in mid to late seral ecological status, primarily due to the suppression of fire on these rangelands.

Big sagebrush/bunchgrass (SD-29-12) sites are dominated by a big sagebrush shrub cover and bunchgrass herbaceous understory. Representative bunchgrasses include Idaho fescue, bluebunch wheatgrass, Sandberg bluegrass, and bottlebrush squirreltail. Although only lightly browsed by cattle, big sagebrush is represented as a climax shrub with significance for wildlife browse and cover. Big sagebrush communities are supported by a variety of soils, but are typically found on deep, well-drained, alluvial clay loams. Mesic north aspect sites tend to support more Idaho fescue with bluebunch wheatgrass found on southerly exposures associated with well-drained soils. Big sagebrush associations are particularly susceptible to juniper invasion with continued fire suppression or overuse by livestock (Hopkins 1979).

The **Low sagebrush/fescue-squirreltail (SD-19-13)** association supports low sagebrush, Idaho fescue, bluebunch wheatgrass, western needlegrass, Sandberg bluegrass, and bottlebrush squirreltail. Mesic sites will support one-spike oatgrass and prairie junegrass. Low sagebrush plant associations are supported by shallow, heavy clay soils that may be saturated in parts of winter and early spring (Hopkins 1979). Soils associated with this community are shallow, rocky and underlain by fractured bedrock at depths of 6-20 inches. Typically found in the northeastern portion of the watershed, this association has a high amount of surface rock or exposed fractured bedrock, hence the name "scab-rock flats". Low sagebrush-goldenweed-bluegrass (SD-92-11) is barely represented in the watershed.

The **Low sagebrush/bluegrass-onespike oatgrass (SD-92-12)** association is found scattered in more mesic pockets within the low sagebrush/fescue-squirreltail type. The soils are saturated in the spring, however, a shallow restrictive layer causes the soil profile to dry to an extreme in the summer and fall. Surface rock is prevalent.

Juniper Communities

Western juniper can be found in scattered pockets of the Sycan watershed. Low sagebrush, curl-leaf mountain, and Idaho fescue make up the greatest composition on these **Juniper/low sagebrush/fescue (CJ-S1-12)** sites. Additional bunchgrasses such as bluebunch wheatgrass, western needlegrass, Sandberg bluegrass and squirreltail make up the additional herbaceous cover.

Riparian Vegetation

Water which escapes interception and use from trees, shrubs, and grasses becomes subsurface flow, eventually making its way through the soil to the narrow strips of land, called riparian areas, along creeks and rivers or other bodies of water. Riparian areas occupy a small percentage (about 5%) of the watershed, but they are an extremely important component of the landscape, especially in arid eastern Oregon (Elmore and Beschta 1987). Riparian vegetation buffers the fluvial system from potential impacts and disturbances caused by land management activities and natural events. Because of their close proximity to water, plant species within riparian zones differ significantly from those of adjacent uplands. Included within the analysis area are a variety of sedges, shrubs such as thinleaf alder and willow and deciduous trees such as and black cottonwood (note: see Appendix B for a complete list of scientific names for the species referred to in this document, cross-referenced and arranged first alphabetically by common name, then alphabetically by scientific name). These riparian plants play a significant role in retaining water received from the uplands. The stems of these plants provide roughness and resistance to dissipate floodwater energy and act as a filter to trap sediment transported by the stream (the sediment that is captured provides microsites for the germination and establishment of new plants within riparian areas). The strong root systems of these plants also provide resistance to a stream's erosive power, holding the soil mantle together, which minimizes stream bank erosion into the channel. By stabilizing stream banks and collecting sediment, riparian plant species act to maintain the integrity of riparian areas and elevate or maintain water tables. The increased subsurface flow, resulting from water storage in the riparian area, may be greater than the amount of water used by willow, cottonwood, alder, sedge, and rush (Elmore and Beschta 1987). In addition, low-gradient areas with willow attract beaver, resulting in ponds that expand riparian zones, further ensuring stream flow during summer months (Olson and Hubert 1994). Conifer species such as ponderosa pine, white fir, and lodgepole pine also occur along the edges of the riparian areas and within active floodplains.

The major influencing factors affecting riparian conditions within the analysis area are associated with grazing, fire suppression, and timber harvesting activities. Historical improper livestock grazing and beaver trapping has resulted in changes in the hydrologic functioning of streams and riparian areas. Beaver dams, which maintain floodplains, dissipate stream energy, and deposit sediment, were not maintained and eventually failed. This caused stream energy to be confined to discrete channels, leading to channel erosion and downcutting. In addition, livestock were allowed to graze season long and with concentrated use in riparian areas. Improper livestock grazing, in itself, can change species composition and reduce or eliminate riparian vegetation and can degrade riparian areas through channel widening, channel aggrading, or lowering of the water table (Platts 1991). In 1915, Reginald Bradley, the Fremont National Forest Deputy Supervisor, described intense grazing which had downcut a once productive meadow in Lake County, Oregon:

> "Before this area was grazed, the whole of the flat, approximately 200 acres, was a fine meadow with a small stream running on to it and spreading out, naturally irrigating the grass, no pronounced channel being anywhere in evidence. Then came grazing by cattle and horses--principally cattle. Soon it was heavily overstocked and erosion commenced." (Bradley, 1915).

Although historical livestock grazing has resulted in riparian and stream channel degradation, current livestock numbers are considerably lower and most stream channels are steadily improving under present management.

In addition, fire suppression has affected the vegetative component of riparian areas by allowing encroachment of shade tolerant conifers into meadow, aspen, and willow communities. This, combined with livestock use, has reduced the ability of these deciduous communities to compete for site resources and to regenerate in the low light conditions caused by conifer encroachment. There has also been extensive timber harvesting and associated activities within the assessment area, although harvesting along riparian areas has had limited effect on the amount of shading and the number and type of large woody material in streams. All of these activities together have cumulatively influenced riparian areas within the watershed.

Invasive Plant Species

Musk thistle, Canada thistle, spotted knapweed, diffuse knapweed, St Johnswort, and dalmation toadflax have been located in the Lower Sycan Watershed. The negative effects that invasive species can have on croplands, forage for domestic livestock and wildlife, native biological diversity, and overall ecosystem health is well documented. The rising economic and environmental expense attributed to invasive species management has increased public awareness and concern.

Threatened, Endangered, and Sensitive Plant Species

There is no habitat for federally listed plant species in the Lower Sycan Watershed. Two species on the Region 6 Sensitive species list are known to occur. Long-bearded mariposa lily (*Calochortus longebarbatus var. longebarbatus)* grows in moist to dry meadows scattered throughout the watershed. Tricolor monkey flower (*Mimulus tricolor*) grows in vernal pools and swales along the Sycan River.

III. Terrestrial Species and Habitats

There are many wildlife species that receive consideration during project planning on the Forest. These include Federally threatened and endangered, Forest Service sensitive, Management Indicator Species, Tribal Species of Concern, if within former Reservation Lands, and other wildlife species that have specific management direction. This watershed analysis will focus on three areas of specific interest, which includes northern goshawks, primary excavators, and mule deer. These areas were chosen because they have the greatest management implications in this area at this time. There are no known Bald eagle nests within the watershed, or they would have also been discussed.

Northern goshawks prefer dense patches of late and old seral tree vegetation, and across the Forest this has included stands of mixed conifer, white fir with an understory of lodgepole pine, and ponderosa pine, while in other areas it includes aspen and cottonwoods in riparian areas. The specific direction in the Eastside Screens that modified the Forest Plan has the potential to make goshawks and their habitat a concern during project planning and implementation.

Primary excavators are dependant on dead and dying trees to provide habitat across the Forest. This group of species is a management indicator species (group) in the Forest Plan. There has been a lot of interest in

these species mainly from the habitat perspective, and how many should be retained and managed for in project areas. As additional information is gained, and processes get worked out, there will be additional guidance and rationale available.

Mule deer are management indicator species, a species of concern for the tribe, and a species of public interest. There have been many factors that have affected deer populations since European occupation of North America both positively and negatively. Currently, the area is below management objectives set by the Oregon Department of Fish and Wildlife. One of the current limiting factors appears to be lower quality forage due to older, less palatable and nutritious shrubs. Future projects in the watershed may be able to change this limiting factor.

IV. Human Uses

The lower sycan watershed is a varied natural environment that has provided natural resources to both historic and aboriginal human beings. Both groups to sustain them in their daily sustenance needs used the majority of these natural resources. However, this area of a flowing river surrounded by pristine forests also provided an area for human spiritual renew and mental stimulation and satisfaction. The area has most probably been seasonally lived in and had resources extracted from it for approximately the last 10,000 years. Everything prehistoric aboriginal peoples needed could be found in the watershed area. Euro-Americans that moved into the area at the end of the 19th century found the lumber they needed and forage for grazing their livestock.

At the time of contact with western settlers, the lower sycan river area was utilized and occupied by the Klamath tribe as well as the Modoc people. Because of the elevation of the area and isolation from major village sites, the area was used during a very short season when access and resources were available.

Euro-American resource extraction and settlement activities focused around the sycan marsh area and where the river enters into the Sprague river valley.

Historically, the area was used for livestock grazing and as an area for extracting saw logs. Most of the road construction was begun after World War II (1945) when timber harvesting accelerated.

Recreational use activities within this watershed include fishing, swimming, camping, picnicking, sightseeing, hunting, wildlife observation and winter activities such as snowmobiling and cross-country skiing. The sycan river and its tributaries provide opportunities for recreation in river-type environment in this otherwise drier ecosystem.

STEP 2. IDENTIFICATION OF ISSUES AND KEY QUESTIONS

Step 2 identifies the issues and corresponding key questions developed by the analysis team. This identification of key questions helps focus the analysis on the elements of the ecosystem that are most relevant to the management objectives, human values, or resource conditions within the watershed.

I. Watershed and Aquatics

A variety of issues related to watershed processes arose during the analysis. These include issues and concerns relating to:

- The quantity of water used by increasing numbers of juniper and other overstocked conifer stands crowding the landscape. This water could be available for forage production and maintenance of stream flow.
- Conifer encroachment into meadows and aspen stands
- Roads and culverts and their effects on sediment delivery to streams and fish passage, respectively.
- Riparian and stream channel conditions and whether these conditions provide suitable habitat for aquatic species.
- The ability to manage for viable populations of native trout, which can be used to indicate whether or not land management activities are ecologically sound.

The broad question dealing with the discussion of these processes and issues is: how *can the watershed be managed to improve the capture, storage, and slow release of water, and improve fish habitat*? To answer this, four key questions were formulated which reflect the connection between uplands, riparian areas, stream channels, and native trout. These four questions will provide the basis of discussion and analysis of watershed and aquatic resources for the remainder of this document.

Key Questions:

1. Is the upland portion of the watershed producing hydrological conditions (water and sediment outputs) which contribute to properly functioning riparian areas?

2. Is vegetation in riparian areas contributing to the appropriate channel types and hydrologic regime?

3. Are the channels providing adequate fish habitat?

4. How are the above watershed conditions influencing native trout viability?

II. Vegetation

Past management activities and alteration of natural disturbance processes, including fire exclusion, have changed the function, pattern, composition, structure, and density of vegetation within the watershed. Noxious weed infestations have the potential to negatively impact natural biological diversity, ecosystem health with resultant degradation of forage for wildlife and domestic livestock, recreational values, croplands and soil productivity. The level of threat posed by various species of

noxious weeds depends on factors such as the degree of detrimental effects they can produce, their reproductive and dispersal capabilities, difficulty of control, and overall distribution.

Key Questions:

1. How have landscape patterns of plant communities and seral stages changed over time?
Parameters: Past and present landscape matrix (pattern analysis) of plant species composition (TES species), size, age structure, and density.

2. What caused the changes in the landscape patterns of plant communities and seral stages? What effect have the changes had on the watershed's ability to withstand catastrophic events?
Parameters: Past and present distribution of condition class and seral stages, magnitude, intensity, and location of fires, in the past century, management actions in terms of logging, grazing, road construction, and fire suppression, incidence of insect and disease activity.

3. What rare or designated sensitive plants occur in the watershed?
Parameters: Habitat of protected or managed sensitive species.

4. Why and to what extent are noxious weeds invading sites within the watershed, and what strategies can be used to slow or prevent the spread of noxious weeds?
Parameters: Extent and location of noxious weeds. Agents of spread or transport of noxious weeds including, general public use, logging, grazing and road construction and maintenance.

III. Terrestrial Species and Habitats

Management practices such as logging, grazing, and road building have been shown to potentially alter wildlife habitat conditions.

Key Questions:

1. How have wildlife abundance, distribution, diversity and habitat conditions been altered?
Parameters: Past and present habitat potential, suitability, security, and conditions. Wildlife species composition, distribution and populations.

2. What key terrestrial habitat components are scarcest or most at risk? What threatens species viability?
Parameters: Core late/old seral forest habitat, cover/forage habitat, nesting/fawning/rearing habitat, security habitat, dead wood habitat, and wildlife species distribution and population. Also, location of habitat for threatened, endangered, and sensitive (TES), keystone, and management indicator species and habitat connectivity.

3. Where are the known problem areas that are contributing to reduced wildlife habitat capability?
Parameters: Location and timing of management activities and natural disturbance events affecting wildlife habitat abundance, condition, distribution, and diversity.

IV. Human Uses

Appropriate uses of resources can benefit watershed health while contributing to the viability of local communities. On the other hand, people's needs for uses, values, products, and services have the potential to exceed the limitations of maintaining ecosystem health, diversity, and productivity.

The Upper Sycan Watershed is within the "Area of Cultural Influence" of The Klamath Tribes (also referred to as "Area Impacting the Tribes' Treaty Rights") as defined by the February 15, 1999 Memorandum of Agreement between the Klamath Tribes and the U.S. Forest Service. The United States has a trust responsibility to protect the Klamath Tribes' Treaty Rights. The initiation, development and implementation of management activities in the watershed have the potential to affect Treaty Right resources either positively or negatively.

Key Questions:

1. How should the watershed provide for future human uses and needs?
Parameters: Timber harvest opportunities and trends, livestock grazing, road access, recreation facilities and opportunities, and cultural plant and animal abundance and distribution.

2. How will roads be managed to meet present and future uses and protect all resource values?
Parameters: Public access, fire control, livestock grazing and logging systems needs, road closures and obliterations, accelerated erosion and stream sediment, fish and wildlife habitat suitability, and species productivity.

3. What logging and grazing methods may be necessary to meet resource and vegetation goals and objectives, and provide commercial products?
Parameters: Logging and road systems, soil compaction and erosion, water quality, fish and wildlife habitat suitability and species productivity, and wood products availability.

4. How should the watershed be managed to ensure that Treaty Rights and Trust Resources are protected?
Parameters: Mule deer and other game traditionally hunted or trapped by Tribal members, downstream effects on fish and other aquatic species, cultural plants, cultural sites.

Step 3. DESCRIPTION OF CURRENT CONDITIONS

The purpose of this step is to present detailed information that deals with the current range, distribution and condition of the relevant ecosystem elements within the watershed. These elements were initially discussed in a less detailed manner in Step 1 "Characterization". Current condition generally reflects information that has been gathered within the past 3 or 4 years.

I. Watershed and Aquatics

Uplands

Soils

Lower Sycan watershed is composed of lava tablelands catchments with a mosaic of pine forest, sagebrush steppe and meadow lands (Carlson, 1979, Wenzel, 1979, Orr and Orr, 1999). Soil map units are formed from ash, rhyolite, and basalt. Common soil map are listed in Table 3-1 and 3-2 from the Winema and Fremont Soil Resource Inventories (Carlson, 1979, Wenzel, 1979). Sandy texture soils are common in map units such as: B2 and 56A in ash; 78 in ash over rhyolite; 88A in ash over basalt and andesite; and similar soils. Draws and streams often occur along fault lines for linear catchments and rim rock stream reaches with soil map unit 2. Fault blocks also form large meadows with map units G3 and 13 in Table 2 associated with low geologic erosion rates.

Table 3-1: Lower Sycan's dominant upland soil map units, crown and ground cover types by allotments.

Allotment Name	Soil Map Unit	Crown cover	Ground cover	Soil Texture	Slope
Yamsey	B2	ponderosa pine, bitterbrush	needlegrass	Sandy	0 to 15
Silver Dollar	B4	ponderosa pine, bitterbrush, manzanita	needlegrass	Sandy	0 to 35
Five Mile	77A, 77B, 84, 85, 88A 13, 16, 28	ponderosa pine, white fir, lodgepole sagebrush	fescue, bluegrass, sedge, needlegrass bunchgrass	Sandy loam Loam	0 to 40 0 to 5
Horseglades	77B, 84, 88B 13, 28	lodgepole pine sagebrush	fescue, sedge fescue, squirrel tail	Sandy loam	0 to 40 0 to 5
Black Hills	77A, 77B, 84, 87 28	ponderosa pine sagebrush & juniper	fescue, bitterbrush bunchgrass	Sandy Clay loam	0 to 40 0 to 5

Two ground cover condition themes emerge in the Lower Sycan, in forest there is a decline and in rangelands there is a general rise shown in Table 2. Common upland and meadow plants are listed in Table 1 and 2. Meadows often range in size from 100 to 600 acres.

Forest Ground Cover

Forest plant communities have canopy closures above historic values. In Landsat Imagery crown closure in the Black Hills ranges from 50 to 70 percent which are well above the 15 to 20 percent in reference conditions. The elevated crown cover is a local expression of a wide spread shift away from historic open park land to dense stands with fire suppression (Loy et al. 2000). Friedrichsen (2003) begins to highlight the watershed dysfunction associated with the shift to dense stands in the Silver Lake Watershed Assessment. With a rise in forest crown cover there is a decline in ground cover for dysfunctions in soil water and nitrogen cycles.

Along road ways, sediment slowing grasses are being replaces by less effective pines for notable soil conservation or water quality problem. Weak-rooted pines are also replacing sod-binding sedge or willow root systems (Riegel's (2002) for enhance steam bank erosion risk.

Rangeland Ground Cover

Common meadows, where grazing occurs, are listed in Table3-2 from the Winema and Fremont Soil Resource Inventories (Carlson, 1979, Wenzel, 1979). Dry to moist meadows in map unit 13 and G3 are the most common. There are dryer areas (inclusions) in the meadows that support silver and big sagebrush communities.

Meadows are mostly in fair condition. The fair rating is based on species composition associated with desirable soil plant functions. Fair is mid ecological condition where there is ample well rooted ground cover. However, historic ditches and past grazing practices previously caused streams channels to incise. Generally, the meadows like the upland rangelands in Table 3-3 show positive ground cover trends.

Table 3-2: Lower Sycan dominant meadow soil map units, setting and ground cover.

Allotment Name	Soil Map Unit	Setting	Ground cover	Soil Texture	Slope
Silver dollar Yamsay	G3	Pumice ash on valley bottoms	Sedges, grasses, and bearberry	Sandy	0 to 5
Black Hills Horseglades	13	Fine lake deposits over coarse pumice	Fescue, bluegrass, and sedge	Clay loam Sandy loam	0 to 5
Five Mile	16	Moderately to some what poorly drained broad basins	Sedges, meadow foxtail, rushes, and hairgrass	Silt loam	0 to 5
Black Hills Horseglades	18	Some what to poorly drained alluvial valleys adjacent to streams	Sedges, meadow foxtail, rushes, and bluegrass	Silt loam Clay loam	0 to 5

At key areas positive soil and range conservation trends have occurred in the decades since the 1950's. Table 3 shows bare soil exposure has diminished and grass as well as general plant cover has increased overall. In all cases grasses that hold and catch soil show positive trends.

Grasses tend to build soil because their cellulose polymers are relatively digestible and form organic partials than bind soil minerals. Well rooted ground cover also provides food and habitats for grubs, earthworm, and voles. Table 3 show existing conditions and tend yield sustain the soils life.

Table 3-3: Lower Sycan rangeland cover and trends: Trends are based on relative cover values over the time period, for trends: up, down (d), or static (s).

ALLOTMENT NAME	Bare soil	Grass cover	Ground plant cover
Five Mile C3/C4 C5	From 1964 to 2000 Soil 25 to 14%, up Soil 39 to 2%, up	From 1964 to 2000 Grass 12 to 41%, up Grass 5 to 58%, up	From 1962 to 2000 Plants 13 to 49%, up Plants 5 to 63%, up
Horseglades C1 C4	From 1958 to 2000 Soil 28 to 33%, d From 1955 to 2000 Soil 18 to 1%, up	From 1958 to 2000 Grass 13 to 23%, up From 1955 to 2000 Grass 33 to 63%, up	From 1958 to 2000 Plants 47 to 39%, d From 1955 to 2000 Plants 53 to 71%, up
Black Hills C2 C1	From 1962 to 2000 Soil 46 to 15%, up From 1962 to 1989 Soil 39 to 34%, up	From 1962 to 2000 Grass 8 to 32%, up From 1962 to 1989 Grass 11 to 21%, up	From 1962 to 2000 Plants 38 to 61%, up From 1962 to 1989 Plants 18 to 36%, up

<u>Sediment Risk</u>

Drainage density in miles of stream per square miles of area is a very low 0.17, so geologic erosion rates are apt to be low. For comparison the fractured and dry summer conditions along the California coast range yield low to moderate drainage density values of 20 to 30 miles per miles^2 (Strahler 1964). With perennial and intermittent streams combined the drainage density is 1.08 miles/miles^2 associated with low erosion geologic setting and climate.

Local geologic and climate data in erosion estimates has become practical,with computer modeling. This analysis uses Water Erosion Prediction Project technology, based on the Green-Amp infiltration equation that uses local climate data sets, soil texture, vegetation type, ground cover, and topography (WEPP, 2001). Prior to the WEPP technology, erosion estimates were statistical extrapolations of crop studies with limited forest and rangeland studies. Extensive forest and rangeland studies have and are being funded to field test the WEPP model.

Soil map units in the Soil Resource Inventories are used as inputs to the WEPP technology. WEPP erosion and sediment estimates are 0.00 ton per acre using the Sprague River climate data and soil vegetation data in Table 1 and 2. The value 0.00 is below the measurable value of 0.01. Using the wetter Mount Shasta climate data, estimated erosion was also 0.00 ton per acre, but the runoff probability increased a few percent. Wildfire scenarios yielded soils erosion of 0.06 to 0.08 tons per acre. In all cases erosion is well below 1.0 ton per acre of accelerated erosion.

A low erosion rate is sensible considering the semiarid climate with low slope angles, and sandy forest soils and ample rangeland ground cover. Meadow erosion rate are below measurable values with slope from 0 to 5 percent. After wildfires erosion is apt to be moderated by grassy ground cover as in the adjacent 1992 Lone Pine (Malaby, 2002). Ten years after the Lone Pine burn, the area has extensive needle grass and shrub succession that moderates erosion.

Summery of Current Conditions

In summary rangeland ground cover has a positive long term trend in Table 3. Similarly the meadow soils show positive ground cover trend. With few perennial streams, sediment transport is also low. Yet scattered channel incisions do occur but they are historic and are recovering with regulated grazing. Yet vegetation rather than check dams should be used to enhance soil conservation.

However forests do not have positive ground cover trends, which effects water and nutrient supplies. Fortunately sediment risks are low at less than 0.01 tons per acre that are below accelerated rates of 1.0 tons per acre or greater. And current regulated grazing system and timber harvest practices have controls in place for soil and water conservation. Wildfire or prescribed fire in the forest may over time improve ground cover.

Data available from the National Land Cover Dataset (NLCD) complied from Landsat TM imagery (circa 1992) is used to show the current land cover types. Slope and aspect were calculated using Arc Hydro extension for ArcGIS on a 30 meter digital elevation data set.

The Lower Sycan Watershed is composed of two predominate land cover types evergreen forest makes up 71 % and shrubland 17% or 88% of the 149,000 acres. Silver Dallor Flat has the highest percent of evergreen forest (90%) while Merritt Creek contains the highest percent of shrubland at 26%. Table 3-4 and Figure 3-1.

Table 3-4 Percent land cover from National Land Cover Dataset for Lower Sycan Watershed, Oregon by 6th Field HUC.

	HUC_6_NAME					
NLCD	Merritt Creek	Silver Dollar Flat	Snake Creek	Sycan Above Sprague	Unnamed 2	Grand Total
Barren	0.00%	0.15%	0.20%	0.12%	0.00%	0.07%
Deciduous Forest	0.01%	0.00%	0.02%	0.04%	0.01%	0.02%
Evergreen Forest	61.33%	89.90%	75.15%	63.43%	82.31%	70.57%
Grasslands	6.25%	3.73%	4.10%	6.71%	3.33%	5.30%
Low Density Residential	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Pasture/Hay	0.00%	0.00%	3.12%	5.63%	0.00%	2.27%
Row Crops	0.00%	0.00%	0.18%	0.10%	0.00%	0.05%
Small Grains	0.00%	0.00%	0.26%	0.27%	0.00%	0.12%
Shrubland	25.67%	2.82%	11.33%	18.58%	12.40%	16.93%
Transitional	0.71%	1.26%	0.17%	0.42%	0.32%	0.50%
Transportation	0.01%	0.09%	0.01%	0.05%	0.01%	0.03%
Water	0.00%	0.00%	0.00%	0.10%	0.00%	0.03%
Wetlands Woody	0.03%	0.00%	0.03%	0.03%	0.04%	0.03%
Wetlands Emergent	6.00%	2.04%	5.42%	4.52%	1.58%	4.07%
Grand Total	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%

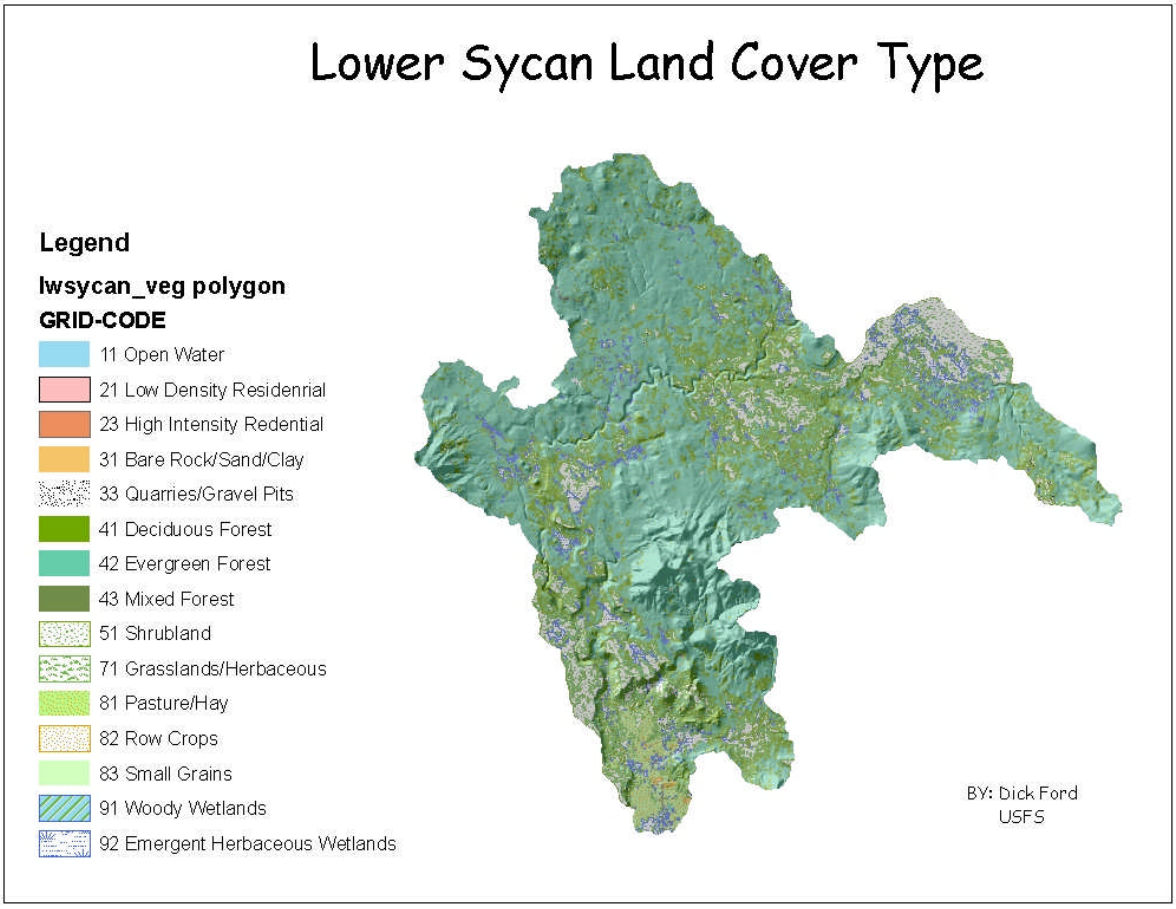

Figure 3-1 Land cover types for Lower Sycan Watershed, Oregon

Slopes are gentle for most of the watershed with 78% of the land having slopes less than 10 degrees. The Snake Creek sub watershed has the steepest slopes with 20% greater than 30 degrees.(Table 3-5) Merritt and Unnamed 2 have the gentlest topography with 57% of the land sloping less the 5 degrees. (Figure 3-2)

Table 3-5 Percent of topography by degree slope by 6th HUC in the Lower Sycan Watershed, Oregon

Sum of acres2	SLOPE_CODE							
HUC_6_NAME	5	10	15	20	25	30	100	Grand Total
Merritt Creek	57.44%	23.30%	10.43%	5.24%	2.16%	0.56%	0.87%	100.00%
Silver Dollar Flat	44.17%	38.89%	12.87%	2.62%	0.72%	0.00%	0.74%	100.00%
Snake Creek	29.44%	20.49%	10.88%	6.59%	6.54%	5.89%	20.16%	100.00%
Sycan Above Sprague	54.79%	20.30%	8.15%	5.90%	2.73%	0.69%	7.44%	100.00%
Unnamed 2	57.37%	32.89%	4.93%	1.87%	1.05%	0.36%	1.54%	100.00%
Grand Total	52.72%	25.44%	8.50%	4.59%	2.43%	1.07%	5.25%	100.00%

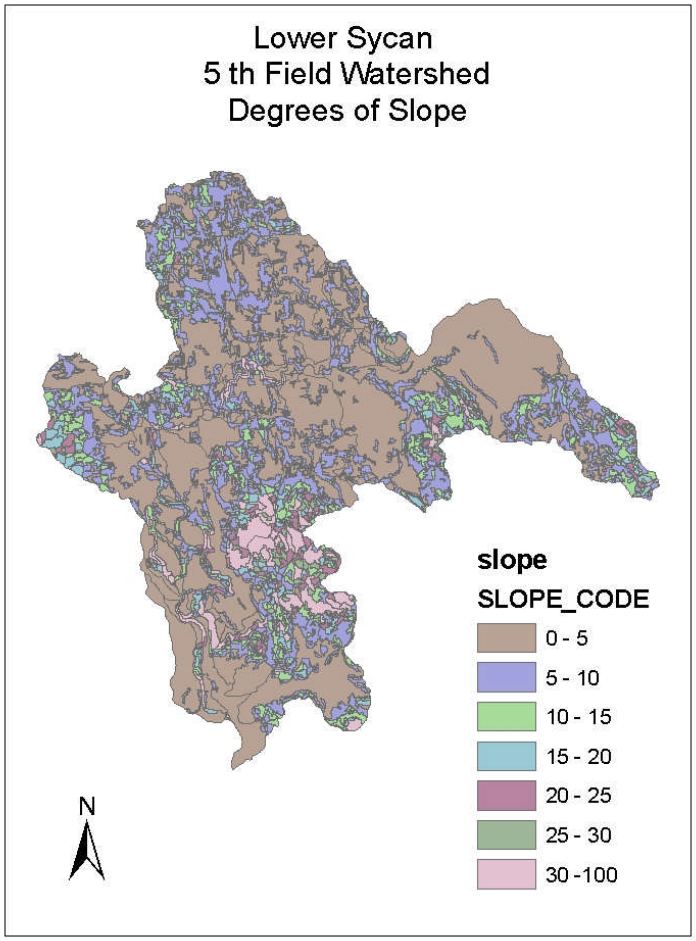

Figure 3-2 Map of Lower Sycan Watershed displaying degree of slope. Lower Sycan, Oregon.

Looking at aspect we see that 18% of the landscape has north facing slope with the other directions being relative equal and 7% is flat. Table 3-6. Figure 3-3 is a graphic representation of the aspect and you can see that there is no large area laying in a particular direction.

Table 3-6 Aspect for the Lower Sycan Watershed, Oregon.

	ASPECT					
	East	Flat	North	South	West	Grand Total
Total	24.37%	6.70%	18.73%	22.35%	27.85%	100.00%

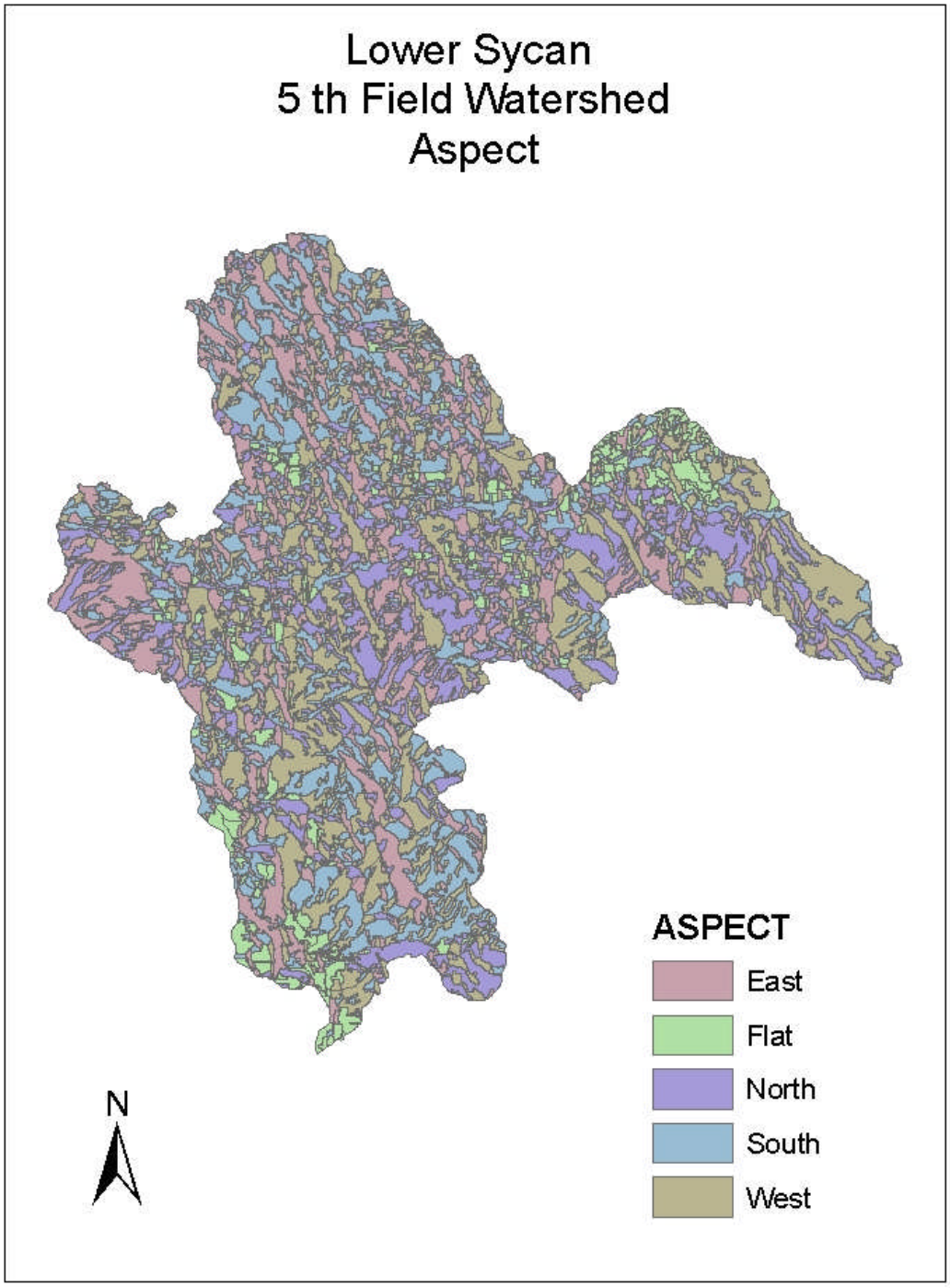

Figure 3-3 Aspect of topography for Lower Sycan Watershed, Oregon

Road Density, Location, and Drainage Network

Methodology: Current road locations, densities, and crossings were acquired from the Fremont/Winema National Forest GIS 1998 road layer. Road crossings were identified from GIS and checked for accuracy. Those crossings determined to be inaccurate were deleted. Roads account for most of the sediment problems in a watershed because they are a link between sediment source areas (skid trails, landings, and cutslopes, etc.) and stream channels. They directly affect the channel morphology of streams by accelerating erosion and sediment delivery and by increasing the magnitude of peak flows (Furniss et al. 1991). The following are general descriptions of the methods used to evaluate the effects of roads within the analysis area.

Wemple (1994) focused on the interaction of forested roads with stream networks and found that nearly 60% of the road network drained into streams and gullies, and are therefore, hydrologically integrated with the stream network. The 60% figure, from Wemple's study, will be used in this analysis to estimate the percent increase in drainage network efficiency for each subwatershed. Closed roads are considered to contribute to the overall drainage efficiency and are therefore included.

Rosgen (1991) has developed a Road Impact Index, which is a qualitative indicator of sediment delivery risk associated with road density and the number of stream crossings. This index will be used for this assessment (only on a subwatershed basis) and relies on the following formula: Road Impact Index = (acres of road within the subwatershed) / (acres within the subwatershed) x (the number of stream crossings). This method is based on the following assumptions: 1) the higher the road density the higher the potential for sediment yield increases due to the larger acreage of exposed surfaces, 2) the more drainage ways that are crossed the higher probability that direct sediment introduction will occur, and 3) the higher on the slope that the road is from the drainage network, the less probability for delivered sediment to occur (erosion may occur but is less likely to be routed to the stream). Road Impact Index is used as a comparison tool to determine relative impact by roads between one subshed and another. Almost all roads present benefits, problems, and risks, though these effects differ greatly in degree. Roads provide motorized access, which creates a broad spectrum of options for management but forecloses other options, such as nonmotorized recreation or wildlife refugia. Even a well-designed road system inevitably creates a set of changes to the local landscape, and some values are lost as others are gained; for example, road density and fish populations correlate negatively over a large area in the interior Columbia basin. The basin's environmental assessment shows that subbasins with the highest forest-integrity index were largely unroaded, and subbasins with the lowest integrity had relatively high proportions of moderate or greater road density. In general, greater short- and long-term watershed and ecological risks are associated with building roads into unroaded areas than with upgrading, maintaining, closing, or obliterating existing roads. Gucinski et.al. (2001)

There are 1,034 miles of roads and trails in the GIS database in the Lower Sycan Watershed. Class 4 (natural surface) roads and trails total 784 miles. Road and trail density in the Lower Sycan Watershed is 4.5 mi/mi^2. The Snake Creek sub watershed has the lowest road densities at 2.2 mi/mi^2 the other sub watersheds are roughly the same in density. If we just look at maintained roads or class 3 roads the density is much lower at around 1 mi/mi2. (Tables 3-7 and 3-8)

Table 3-7 Miles of road and trails, road density by road class and sub watershed Lower Sycan, Oregon

Sum of L_Miles	ROAD_CLASS					Road Density
HUC_6_NAME	3A	3B	3C	4*	Grand Total	mi/mi^2
Merritt Creek	13.10	26.95	9.98	207.39	257.42	4.7
Silver Dollar Flat		7.63	7.07	64.84	79.54	5.1
Snake Creek	1.92	14.37	4.94	30.96	52.18	2.2
Sycan Above Sprague	6.92	69.14	39.66	272.62	388.35	4.8
Unnamed 2	0.64	34.38	14.37	207.91	257.30	4.5
Grand Total	22.58	152.48	76.01	783.72	1034.79	4.5

Sum of L_Miles	ROAD_CLASS				Road Density
HUC_6_NAME	3A	3B	3C	Grand Total	mi/mi^2
Merritt Creek	13.10	26.95	9.98	50.03	0.9
Silver Dollar Flat		7.63	7.07	14.70	0.9
Snake Creek	1.92	14.37	4.94	21.22	0.9
Sycan Above Sprague	6.92	69.14	39.66	115.73	1.4
Unnamed 2	0.64	34.38	14.37	49.39	0.9
Grand Total	22.58	152.48	76.01	251.07	1.1

* Class 4 is all natural and unknown surface roads or trails from the USFS Fremont /Winema roads data.

Table 3-8 Miles and density of roads by sub watershed Lower Sycan Watershed, Oregon.

There are 176 miles of roads and trails are within 300 ft of all stream channels. (Table 3-9) Silver Dollar Flat and Snake Creek subwatershed has the least amount while the highest number is found in Unnamed 2 (48.6) followed by the Sycan above the Sprague at 52 miles. Thirty two miles (18%) are located on slopes greater than 10 degrees with 6.7 miles located on a greater than 30 degree slope.

Table 3-9 Miles of road within 300 ft. of streams by road class, slope and sub watershed in the Lower Sycan Watershed, Oregon.

Sum of miles		Slope_Range							
HUC_6_NAME	ROAD_CLASS	5	10	15	20	25	30	100	Grand Total
Merritt Creek	3A	0.4	0.8	0.2					1.4
	3B	1.9	0.6	0.6	0.1	0.1			3.4
	3C	0.5	0.8	0.8	0.0		0.1		2.2
	4	18.1	13.4	4.3	1.5	0.4			37.7
Merritt Creek Total		20.9	15.6	5.9	1.6	0.5	0.1		44.8
Silver Dollar Flat	3B	0.1	0.2	0.4					0.8
	3C	0.4	0.1	0.2	0.1				0.8
	4	1.8	5.5	1.6	0.2				8.9
Silver Dollar Flat Total		2.3	5.8	2.2	0.2				10.5
Snake Creek	3A	0.2							0.2
	3B	0.3	0.8	0.5	0.4	0.2	0.6	1.3	4.1
	3C	0.1	0.2	0.1	0.2			0.3	0.9
	4	0.5	1.9	0.6	0.4	1.0	0.9	1.9	7.1
Snake Creek Total		1.1	2.9	1.2	1.0	1.2	1.5	3.5	12.4
Sycan Above Sprague	3A	0.8							0.8
	3B	5.9	1.8	0.9	0.6	0.3		0.9	10.5
	3C	2.0	1.8	0.6	0.4				4.8
	4	20.4	9.6	3.1	0.9	0.1	0.2	1.6	35.9
Sycan Above Sprague Total		29.2	13.1	4.6	1.9	0.4	0.2	2.5	52.0
Unnamed 2	3A	0.3							0.3
	3B	5.5	2.7	0.5	0.3	0.4	0.0	0.3	9.7
	3C	1.1	0.6	0.1	0.1	0.1			2.0
	4	17.1	21.9	3.9	0.4	1.1	0.1	0.5	44.9
Unnamed 2 Total		24.0	25.2	4.5	0.8	1.5	0.1	0.7	56.8
Grand Total		77.4	62.7	18.3	5.6	3.7	1.9	6.7	176.4

There are 10.3 miles of road within 300 ft 0f perennial streams with 8.6 miles in the Sycan above the Sprague subwatershed being the greatest and Silver Dollar Flat the least. Snake Creek Sycan above the Sprague and Unnamed 2 each have roads on steep slopes (greater than 30 degrees) close to the streams totaling 6.7 miles 3.9 miles on intermittent streams and 1.2 miles along perennial . Tables 3-10 and 3-11.

Table 3-10 Miles of road within 300 ft of stream by degree slope, stream type, and subwatershed. Lower Sycan Watershed, Oregon

Sum of miles		Slope_Range							
HUC_6_NAME	Stream Type	5	10	15	20	25	30	100	Grand Total
Merritt Creek	E	4.6	3.9	2.2	0.4	0.1			11.2
	I	15.7	11.7	3.7	1.2	0.4	0.1		32.9
	P	0.2	0.0						0.2
Merritt Creek Total		20.4	15.6	5.9	1.6	0.5	0.1		44.3
Silver Dollar Flat	E	0.2	0.7						0.9
	I	1.8	5.1	2.2	0.2				9.3
	P	0.1	0.0						0.1
Silver Dollar Flat Total		2.1	5.8	2.2	0.2				10.3
Snake Creek	E	0.0	1.2	0.6	0.7	0.4	0.4	1.3	4.6
	I	0.4	1.2	0.6	0.3	0.9	1.1	2.2	6.7
	P	0.6	0.5						1.1
Snake Creek Total		1.1	2.9	1.2	1.0	1.2	1.5	3.5	12.4
Sycan Above Sprague	E	6.2	4.2	0.8	0.5			0.2	11.9
	I	17.7	7.6	3.2	1.4	0.3		1.2	31.4
	P	5.2	1.4	0.6	0.0	0.1	0.2	1.2	8.6
Sycan Above Sprague Total		29.1	13.1	4.6	1.9	0.4	0.2	2.5	51.8
Unnamed 2	E	4.1	2.3	0.5	0.7	0.6		0.2	8.2
	I	19.8	22.9	3.9	0.1	0.9	0.1	0.6	48.3
	P	0.2	0.1						0.3
Unnamed 2 Total		24.0	25.2	4.5	0.8	1.5	0.1	0.7	56.8
Grand Total		76.7	62.7	18.3	5.6	3.7	1.9	6.7	175.6

Table 3-11 Sum of road miles 300 ft. of stream by stream type and slope range. Lower Sycan Watershed. Oregon.

Sum of miles	SLOPE_CODE							
FLOWR	5	10	15	20	25	30	100	Grand Total
E	15.0	12.2	4.1	2.3	1.1	0.4	1.6	36.8
I	55.5	48.7	13.6	3.3	2.5	1.3	3.9	128.8
P	6.2	2.0	0.6	0.0	0.1	0.2	1.2	10.3
Grand Total	76.7	62.9	18.3	5.6	3.7	1.9	6.7	175.9

Stream Flow

The annual hydrograph of the Sycan River averaging data for 1974 - 2003 April is the month of greatest average discharge and these spring flows usually generated for snow melt in the headwaters. The average hydrograph shows a low flow period August through October. Flows begin increasing in November peak in April and drop rapidly in June and July. See upper chart Figure 3-4.

Peak flows (lower chart Figure 3-4) accrue in January and February. These flows and usually the result rain on snow events with frozen ground conditions. The USFS maintained a stream flow gage (1993-2003) at the upper end of the lower Sycan River at the 27 road bridge. Flows coming out of the marsh showed the much the same pattern, however the peak flow was in January and the Spring high average flow occurs in May.

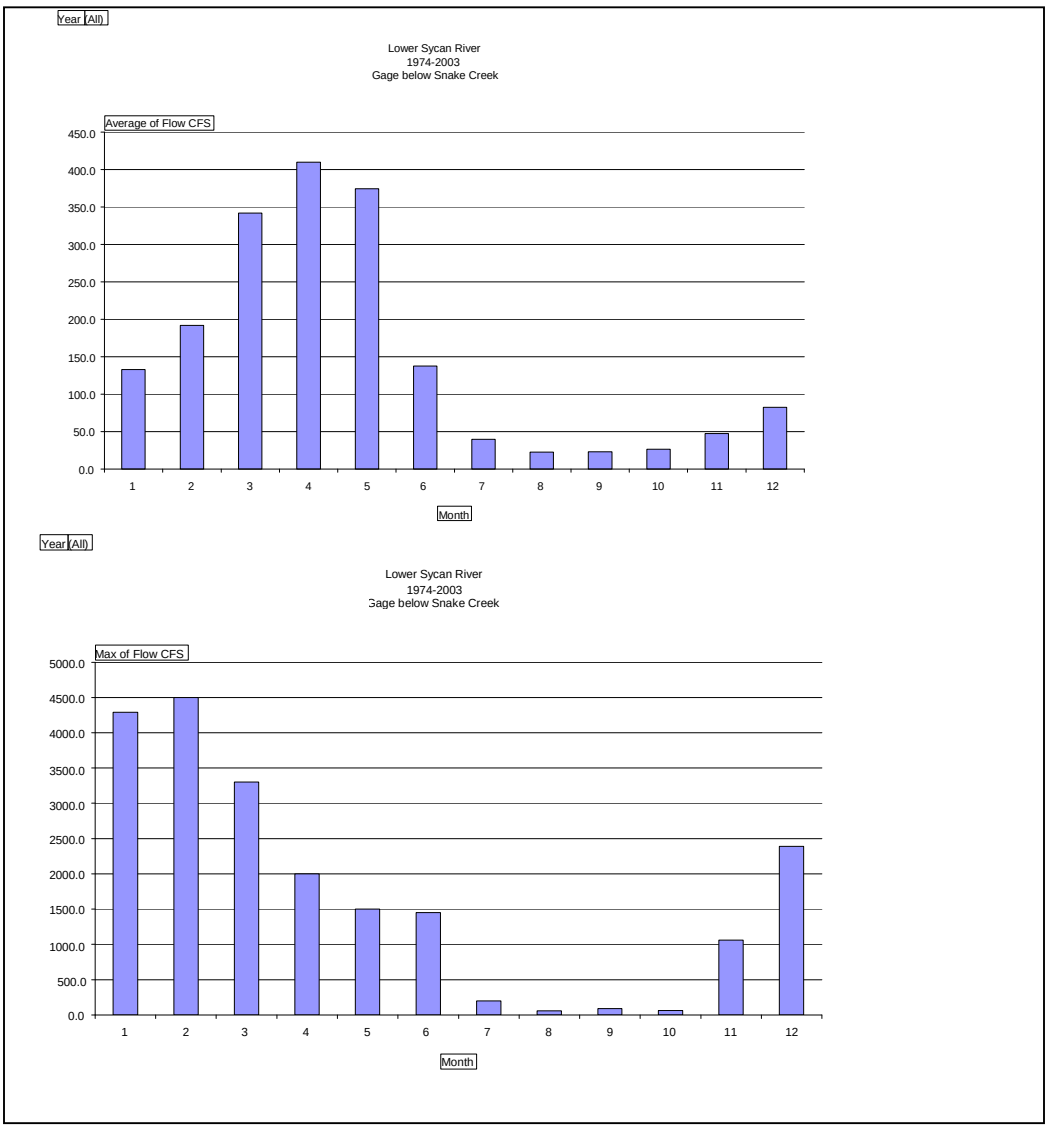

Figure 3-4 Stream flow values from Sycan below Snake Creek. Upper chart displays average monthly flow values 1974-2003 and the lower chart displays the peak flow for the month. Sycan River, Oregon

Drainage Characteristic

The entire Sycan River basin covers 559 mi^2 and has a drainage density of 48.5 mi/mi^2 (Table 3- 12) The Lower Sycan begins at 4973 feet of elevation and flows down to 4,307 feet for a drop of 666 ft over a distance of 34.5 miles for an average slope of 3.6 %. (Figure 3-6) The steepest slope is from the area known as Coyote Bucket down past the USFS boundary for a distance of approximately 6.2 miles about 6 miles from the Sprague river.

Table 3-12 Characteristics of the entire Sycan River Basin
Attributes of the Entire Sycan Basin

Outlet x-coordinate: -121.28602
Outlet y-coordinate: 42.467870
Outlet elevation: 4,307 (ft)
Basin relief: 3976 (ft)
Pruning method: Order
Pruning threshold: 3.00000
Strahler order: 10
Basin Area: 375,751 (acres), 559 (mi^2)
Longest channel length: 81 (mi.)
Total channel length: 27,095 (mi)
Drainage density: 48.5 (miles/mi^2)

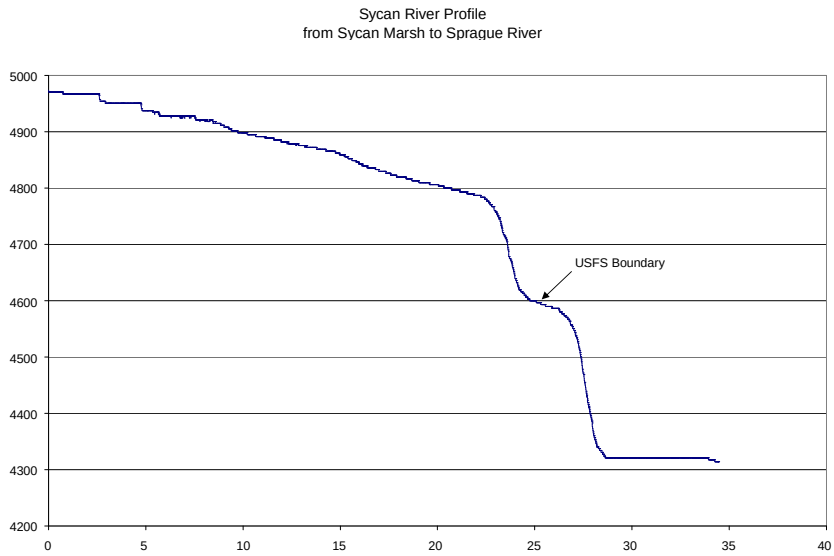

Figure 3-5 Longitudinal profile of the Lower Sycan River (Sycan Marsh to Sprague) , Oregon.

The drainage pattern a see in Figure 3-6 dendritic pattern which is found in areas of relatively uniform geological structure. It is interesting to note that Merritt Creek located to the south of Sycan Marsh has a parallel pattern, the tributaries are located south of the main channel and flow north. And the lower portion of the Sycan shows the same pattern with the tributaries to the east.

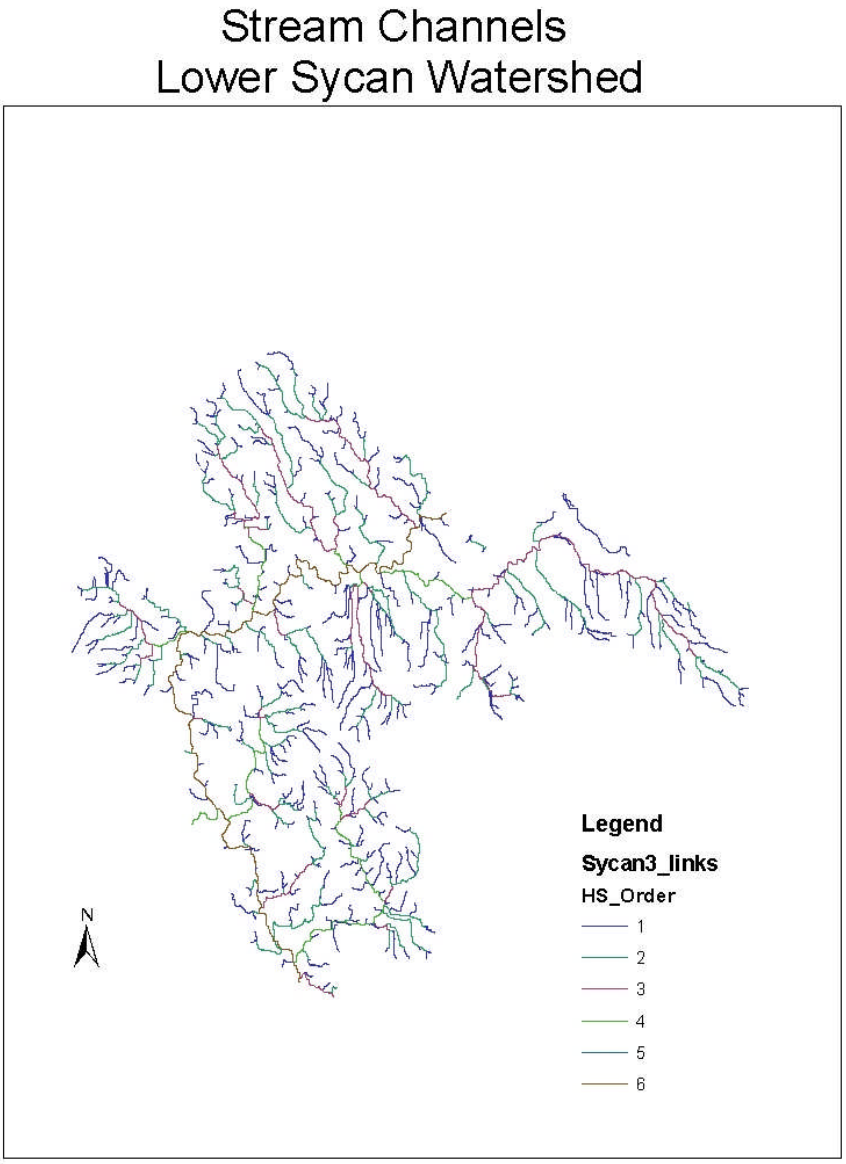

Figure 3-6 Drainage pattern for the Lower Sycan River Watershed, Oregon

Riparian Vegetation and Associated Bank Stability

Methodology: During stream surveys conducted in 1998 and 1999, the dominant vegetation types within the riparian area were documented. In addition, the associated bank stability (100-(feet unstable/reach length X 100)) was described. Actively eroding banks, above the bankfull height, were counted as unstable.

Grassland/Forbs is the dominant vegetation in the Sycan River riparian zone. Bank stability was over 90% except in reaches 3 and 4 where bank stability is low. (Table 3-13)

Table 3-13 Riparian Vegetation and associated bank stability. Lower Sycan Watershed, Oregon
.

	Dominant Vegetation Class	Over Story	Under Story	Bank Stability
Reach 1	Grassland/Forbs	Grassland/Forbs	Shrub Seedling	94%
Reach 2	Grassland/Forbs	Grassland/Forbs	Shrub Seedling	99%
Reach 3	Grassland/Forbs	Grassland/Forbs	Grassland/Forbs	82%
Reach 4	Grassland/Forbs	Grassland/Forbs	Grassland/Forbs	55%
Reach 5	Grassland/Forbs	Ponderosa pine	Grassland/Forbs	98%
Reach 6	Grassland/Forbs	Ponderosa pine	Grassland/Forbs	90%
Reach 7	Grassland/Forbs	Ponderosa pine	Grassland/Forbs	99.6%
Reach 8	Lodgepole pine	Lodgepole pine	Grassland/Forbs	98.4%

Rosgen Stream Types

Methodology: As part of the stream surveys that occurred within the watershed, field measurements outlined in Rosgen (1996) were conducted to determine stream type. These measurements included entrenchment, bankfull width-to-depth ratio, sinuosity, gradient, and dominant channel substrate. *Entrenchment* is the vertical containment of the stream channel and refers to the ability of a stream to access its floodplain. The stream is entrenched when floodwaters are confined to the channel and is not entrenched when floodwaters are able to access the floodplain. *Bankfull width-to-depth ratio* indicates the shape of the channel, and is the ratio of bankfull width to mean bankfull depth. Bankfull stage is the point at which the stream accesses its floodplain and is a required measurement in order to determine width-to-depth ratios. It is synonymous to the flood stage, has an average return interval of 1.5 years (Leopold, 1964), and is considered the channel forming flow. Width-to-depth ratios indicate whether the stream is wide and shallow or narrow and deep. *Sinuosity* refers to the extent with which a stream meanders across the landscape. Highly sinuous streams have many meanders and curves, while streams with low sinuosity are straighter with few meanders and curves. Gradient is the slope or steepness of the stream while the *dominant channel substrate* refers to the size of particle or rock that covers the stream channel. The following discussion provides a general description of each of the Rosgen Stream Types found within the surveyed reaches of the watershed (see Step 4 for desired conditions and further stream type descriptions, including illustrations).

Rosgen A stream types are associated with landforms of high relief, are deeply incised and characterized by steep gradients. They typically have cascading, step/pool morphology with high energy, sediment supply and transport potential. Rosgen B stream types typically occur on narrow, gently sloping valleys and terrain and are characterized by moderate gradients and colluvial deposition. They are riffle-dominated channels with infrequently spaced scour pools. These stream types are typically very stable and usually found in forested systems where large woody debris plays an important role in pool formation.

Rosgen C streams types are associated with broad alluvial valleys with well-defined floodplains. They are low gradient, meandering streams characterized by riffle/pool sequences and point bars.

Rosgen E stream types are also found in broad alluvial valleys and meadows with well-developed floodplains. They are low-gradient, highly sinuous streams that are stable due to well-vegetated banks.

When vegetation is lacking these channel types are highly sensitive to disturbance, which may result in increased levels of streambank erosion and downcutting. The E stream type provides excellent fish habitat through undercut banks, clean spawning gravels, and numerous deep pools

The Sycan is the only perennial stream in the study area inwitch a level II stream survey has been conducted . There are numerous intermittent and ephemeral tributaries which contribute to runoff discharge, but summer baseflow depends primarily on springs within the Sycan canyon such *as* Torrent springs and Blue Creek. It is possible that Sycan Marsh contributed to baseflow before the marsh was dredged, but not likely during drought. Lower Merritt Creek contains disconnected fish bearing pools. It is not known if these pools persist during drought. The channel is down cut and can not access it flood plain. We could find on information on Snake Creek or Mill Creek the other two perennial streams.

A level II stream survey was conducted June 2001 on the Sycan River below the marsh on USFS lands beginning at river mile 12.5 in the Coyote Bucket area approximately one mile above the confluence with Blue Creek to the Sycan March river mile 38.5 for a length of 26 miles. Figure 3-7 Survey reach descriptions are:

Reach 1. From River mile 12.5 in Coyote Bucket upstream for 3 miles to river mile 15.5. This is a moderate V shaped canyon, valley with approximately 150 ft width and 150 ft canyon walls, with a 1 percent gradient. Beginning UTM 637246, 4714057.

Reach 2. From river mile 15.5 upstream through a more open flat floor valley 300 ft wide with moderate sloping sides upstream for 2.4 miles to river mile 18.2. Beginning UTM 635499, 4718372.

Reach 3. From river mile 18.2 upstream for 0.8 miles to river mile 19.2. the valley floor opens wider to over 300 feet. Beginning UTM 634224, 4721441.

Reach 4. From river mile 19.2 to river mile 20.5 a distance of 1.1 miles. This is much like reach 4 and is separated because the stream channel type changes from a type E to an F. Beginning UTM 635026, 4722502.

Reach 5. From river mile 20.5 upstream for 2.9 miles to river mile 23.6 the valley floor narrows to 200 feet and the side slope increases. Beginning UTM 635197, 4724028

Reach 6. Runs from river mile 23.6 to river mile 2.54 for 2.52 miles Valley floor is 200 ft amd side slopes are steep. Beginning UTM 638696, 4724730

Reach 7. From mile 25.4 to 30.8 for 3.78 miles valley floor widens and stream channel gradient increases and sinuosity increases. Beginning UTM 640614, 4726510

Reach 8. From river mile 30.8 upstream to the Klamath Marsh 5.30 miles valley floor widens a side slope decreases while gradient and sinuosity are similar to reach 7. Beginning UTM 643942, 4727505

Table 3-14 contains a summary of the stream characteristics for the Lower Sycan Watershed. Of the 26 miles surveyed 91% of the river is classified as a Rosgen C. the remaining 9 % is approximately equal length of Rosgen E and F channel types. Entrench ratios range from 1.96 to 4.2. and residual pool depths from 1.88 to 2.64 ft.

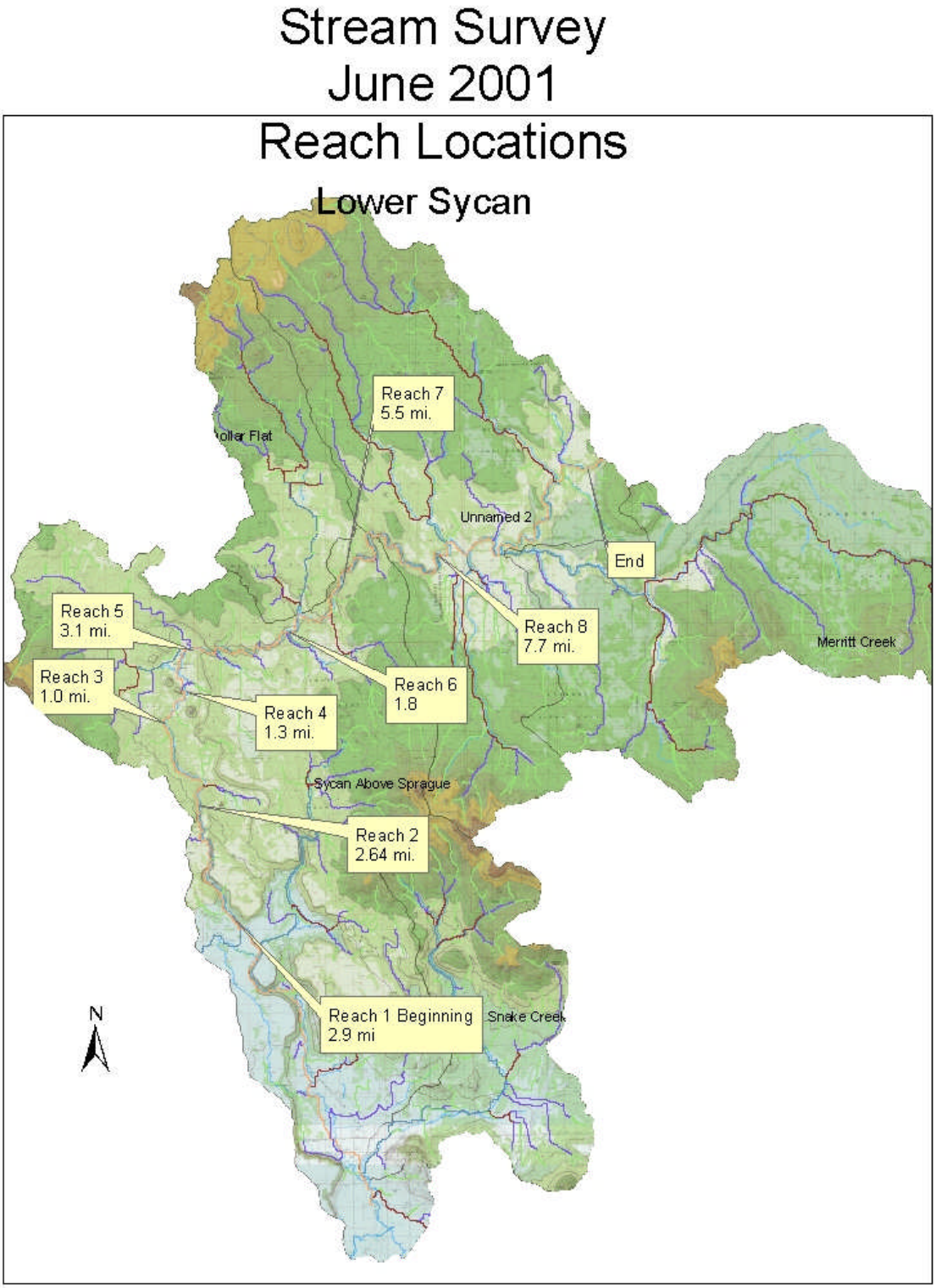

Figure 3-7 Reach locations for June 2001 stream survey Lower Sycan River, Oregon.

Table 3-14 Rosgen channel types by reach and other physical channel characteristic. Lower Sycan Watershed, Oregon

Stream Name SYCAN RIVER L

Survey Start Date 6/20/2001

Reach	Rosgen Channel Type	Entrenchment Ratio	Flow	Miles	Bankfull Depth	Average Riffle Width	Bankfull W:D Ratio	Residual Pool Depth	Water Temperature
1	B	2	6.11	3.03	2.26	29.96	22.99	2.07	58
2	C	3.2		2.69	1.75	31.52	30.76	1.32	71
3	C	4.2		1.01	1.71	24.85	23.86	2.64	75
4	C	4.2		1.32	1.83	23.67	28.37	1.98	75
5	C	2.2		3.09	1.64	31.18	37.43	1.54	75
6	C	3.3		1.84	1.8	24.15	28.62	1.86	73
7	C	3.1		5.46	1.99	18.88	20.99	1.72	71
8	C	1.96		7.71	2.1	25.98	25.50	1.93	70
Totals		2.98		26.15	1.85	26.27	27.26	1.88	

Habitat for Aquatic Species

Methodology:

1) Woody Debris (LWD) - Large wood was counted and classified into three categories. Small is 6 inches in diameter and 20 feet in length. Medium is 12 inches in diameter and 35 feet in length. Large is 20 inches in diameter and 35 feet in length

2) Pools - To be classified as pool, two conditions were required. First, a pool needed to span the entire stream channel. Second, pool length needed to be longer than its width. Using these criteria, pocket pools that occur in the middle of channels were not counted.

Table 3-15 describe current fish habitat conditions in all stream reaches surveyed within the watershed. Using methods described in the beginning of this chapter, habitat conditions are summarized based on the following parameters: large woody debris, pools, spawning gravel fines, stream temperature, and fish passage

Table 3-15 Habitat features in June 2001 Lower Sycan River, Oregon.

Reach	Stream Type	Pools/mi	Pool Depth (ft.)	Wood Small	Wood Medium	Wood Large	Wolman D84 mm	Wolman Class
1	C	43	2.02	6	3	1	436/216	Boulder/Cobble
2	C	24	1.32	9	10	2	223/153	Cobble
3	E	64	2.64	6	1	0	38/109	Gravel/Cobble
4	F	18	1.98	3	1	1	46/59	Gravel
5	C	21	1.54	20	5	1	266/105	Boulder/Cobble
6	C	62	1.86	5	1	1	62/42	Gravel
7	C	20	1.72	4	2	2	120/83	Cobble
8	C	20	1.88	4	2	1	43/37	Gravel

Water Quality

The Oregon Department of Environmental Quality has listed two streams within the Upper Sycan Watershed on their ``303d' list (a list of streams that do not meet the requirements of the Clean Water Act). The two stream segments are listed due to high summertime stream temperatures. These streams were removed from the 2002
303(d) list because Oregon DEQ completed a TMDL for the Upper Klamath Lake Drainage, which the EPA approved on August 7, 2002. In February 2003, a Water Quality Restoration Plan (WQRP) to address load allocations identified in the TMDL was submitted by the Fremont-Winema National Forests and approved by Oregon DEQ. These documents can found at
http://www.fs.fed.us/r6/winema/management/tmdl/.

State water quality parameters of dissolved oxygen, bacteria, total dissolved solids and toxic pollutants are not addressed as separate subjects because long-term monitoring data for these parameters are not available. Field samples were taken at the mouth of the watershed during August 1999, with pH recorded at 8.15 (within ODEQ standards of 6.5-9.0) and dissolved oxygen recorded at 7.52 mg/l (below ODEQ standard of >8.0 mg/l).

Stream Temperatures

Stream temperatures are mainly influenced by the amount of stream flows, the amount of topographic and vegetative shading from direct solar radiation, channel morphology, and distance from the watershed divide or groundwater inflow. Reductions in stream shading as a result of land management activities or natural disturbance can increase incoming solar radiation during the summer months and decrease longwave re-radiation during the winter months. This can lead to increasing summertime maximum stream temperatures and diurnal fluctuations, and decreased winter temperatures, which may lead to icing. Small, shallow streams that do not have significant groundwater inflow or vegetative cover will show the largest changes in stream temperatures. Stream temperature increases are additive. Stream temperatures will not decrease merely from passing thorough a shaded reach, unless there is an inflow of cooler groundwater.
Tab

Important stream temperatures associated with Table 3.16

- • INFISH Riparian Management Objective and current US Fish and Wildlife standard for bull trout - rearing: 7-day maximum of 15.0°C (59°F)
- • Current state water quality standard for stream temperature: 7-day maximum of 17.8°C (64°F)
- • Stream temperature unfavorable to salmonids: 21°C (70°F)
- • Stream temperature for optimum growth of salmonids: 15°C (59°F)

Table 3-16 Annual maximum 7-day average of maximum daily water temperature.

Loaction and elevation	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
Torrent Springs 4,888			8.9								
Teddy Powers 4,840							22.7	25.6	24.8	24.3	27.2
Teddy Powers 4,820							25.0	27.4	27.2	25.8	28.2
Coyote Bucket 4,590	25.5						23.8	27.9	27.9	27.8	30.2

Fish Populations and Distribution

The Lower Sycan River contains redband trout, Pacific lamprey, Pit- Klamath Lampray speckled dace, tui chubs marbled sculpin and Klamath largescale sucker. No fish were found in Blue Creek the spring of 2004. Clubs and dace were reported in Merritt in 2000. No other reports of fish presents could be found in the Lower Sycan Watershed

Redband trout spawn in the lower Sycan from Torrent Spring down to the confluence of the Sprague (ODFW personnel communication ODFW) Spawning substrate is good, redds and spawning fish observed. The redband population in the lower Sycan is both resident and migratory. It is theorized that fish migrate from upper Klamath Lake in the winter and spring to spawn in the lower Sycan River. R Smith and W Tinniswood ODFW Klamath District Office personal communication). Most of these fish migrate back

downstream. Two redband trout tagged in 2001 in Long Creek above the Sycan Marsh was located in Agency Lake and Klamath Lake. These fish were two to three years and had a strong desire to migrate 100 plus miles. (C. Beinz The Nature Conservency personal Communication)

Fish Passage – Culverts

There are no known fish passage issues on USFS property in the Lower Sycan Watershed. There may be culverts on the tributaries to the Sycan on private property however this was not assessed. Road crossing over the Sycan River is by bridge except for the Sycan Ford FS road 30 in Reach 6.

Fine Sediment

Fine sediments in spawning substrates were sampled at nine locations within the watershed. Sediment samples were taken from potential spawning habitat areas or potential redd areas in gravel/cobble portions of pool tail outs. (Table 3-17)

Table 3-17 Percent fines Lower Sycan stream survey data June 2001.

Reach	1	2	3	4	5	6	7	8	Average
Fines %	13/23	10/19	13/16	24/20	23/30	25/23	32/19	66/83	27

II. Vegetation

Fire was historically the major disturbance in the Lower Sycan watershed. All major vegetation types in the watershed have evolved to their current condition through a historical sequence that included fire of varying return interval (depending on vegetative type). There has been a general exclusion of fire beginning in about 1910. Seventy five percent of the fires are lightning caused. Based on the typical fire size in the watershed, the fire behavior has not posed serious control problems. However, due to changes in forest stand structure and increases in fuel loading, any wildfire which would now occur within the Lower Sycan watershed has a high potential for severe fire behavior coupled with large-scale and undesirable effects.

Fire ecology, as it pertains to specific vegetative communities, is included in the discussions below.

Forested Uplands

Forest vegetation occupies approximately 125,500 acres of National Forest lands, or 70% of the National Forest lands within the Lower Sycan Watershed. Three forest plant community types occur within the watershed. They are ponderosa pine, mixed conifer (a.k.a., ponderosa pine associated), and lodgepole pine.

Ponderosa pine forests

Ponderosa pine forests cover approximately 46,500 acres of the National Forest lands in the Lower Sycan watershed; this represents 37 percent of the National Forest lands in the watershed. Ponderosa pine plant communities exist and thrive at the drier, warmer end of the climatic spectrum of forest types. These conditions exist at lower elevations as well as southern and western exposures (high-energy sites). Ponderosa pine stands will grade into mixed conifer then lodgepole pine with increased elevation. Within most of the Lower Sycan, ponderosa pine stands are densely stocked with small diameter pines and are also experiencing abundant establishment of white fir in the higher elevations and young juniper in the lower elevations

This forest type is dominated by ponderosa pine in both the overstory and the understory with the exception of extreme mesic and xeric conditions. On the very dry end, at lowest elevations or on excessively drained soils, western juniper makes up a portion of the tree layer. At the moister end, at higher elevations, and northern exposures, white fir will appear in stands that are beginning to grade into true mixed conifer types. Quaking aspen may be found within and adjacent to ponderosa pine stands. Aspen stands are small and very scattered across the landscape. These stands are usually associated with a micro site affording plenty of available moisture such as a spring or a perched water table. Most of these aspen stands show evidence of decline from grazing and forest encroachment.

The ponderosa pine community types can support a significant shrub component. Big sagebrush, antelope bitterbrush, and mountain-mahogany are common on lower to moderate sites. Greenleaf manzanita and squawcarpet can be found on the higher sites. This shrub layer can cover up to 60 to 70% of the area. Heights can range from two to seven feet but generally are about two to four feet.

The herb/grass layer is highly variable with a diverse number of species occurring throughout the range (Hopkins 1979). Species such as bottlebrush squirreltail are common.

The mean stand productivity in terms of both wood and forage is highly variable depending upon the density of the stand. In relative terms ponderosa pine forests are considered to demonstrate low to moderate productivity. Mean wood productivity ranges from 42 to 54 cubic feet per acre per year.

Fire Ecology

Broad changes in stand structure and large-scale species conversions can be attributed to fire exclusion, historical grazing practices and timber harvest. Fire has played a profound role upon the development and structure of ponderosa pine stands within the Lower Sycan watershed as it has across the whole western United States. Fire's historical role in stand development is also discussed in Steps 4 and 5. Fire history studies in Oregon's ponderosa pine forests indicate a fire return interval of 3 to 50 years, depending on the site conditions and weather patterns (Agee 1993). In general, higher-elevation sites, or sites on the fringe of mixed-conifer forests, usually had longer fire-free intervals compared to lower-elevation sites.

The process of stand development in ponderosa pine forests is a result of the shade intolerance of ponderosa pine, periodic good years of seedling establishment associated with years of above normal precipitation, and frequent fire (Agee 1993). Gaps in the forest created by insects, wind, or disease and cleaned by a fire, allow the shade intolerant pine to become established. In this opening, the stand of young trees will be protected from fire because of lack of fuels on the forest floor, while the fire will burn under mature stands and remove any reproduction there. As the trees in the opening continue to grow, they provide enough fuel to carry the fire and thin the stand. These groups escape relatively quickly to the canopy and maintain codominance for very long periods of time. So, what appears to be an open "parklike" even-aged and single-storied structure, is actually characterized by groups of trees of varying ages. The age of codominants within a stand can typically range from 150 to 500+ years old

A fire management strategy of prevention, detection, and suppression has resulted in virtually all of the LOS ponderosa pine stands developing multistory structures. A limited number of mid seral stands do exhibit single storied structure. Current conditions (densely stocked stands with variable age class) increase the likelihood of large scale, stand-replacing wildfires. Fire in the Fremont's ponderosa pine forests in the past five years (Thomas Creek, Robinson Springs, Alder Ridge etc.) is much more intense than the fire behavior that was typical 100 years ago. Recent management activities have included the use of fuels reducing prescribed fire**.**

2. Insects

Western pine beetle, mountain pine beetle, turpentine beetle, and pine engraver are the four most important insects affecting ponderosa pine forests in the Lower Sycan watershed.

Western pine beetle (WPB) kills large ponderosa and sugar pine, singly, or in small groups, especially if these trees are stressed by competition for moisture. Survey estimates of mortality from western pine beetle are not accurate or available. The risk of attack is loosely tied to stand density but less so than with other bark beetles. Stands with white fir understories are particularly at risk. Very little recent mortality can be observed within the Lower Sycan Watershed.

Mountain pine beetle will typically infest and kill pole and sapling sized ponderosa in groups of less than one acre. This beetle also attacks mature or stressed sugar pine. Stand risk to attack is directly linked to density thresholds. Currently, most unmanaged post and pole stands in the Lower Sycan Watershed are at high risk of mountain pine beetle infestation. Stands, which have been tended by thinning or prescribed underburning, appear to be resistant.

Typically **turpentine beetle** is a secondary invader, present in trees that have succumbed to bark beetles or injured by fire scorch. Information on current distribution within the Lower Sycan Watershed is not available.

The **pine engraver** is a pest of sapling to small saw timber sized ponderosa pine. The beetles infest logging slash, fire-killed trees, or windthrows. In addition to killing small trees, the beetle will kill the tops of larger ponderosa. Pine engraver mortality is much less severe on the Fremont than it is in the Sierra Nevada region (Eglitis, et al.1993).

3. Disease

Annosus and Armillaria root disease, and dwarf mistletoe are the three most important diseases within ponderosa pine communities in the Lower Sycan watershed. Of lesser importance is comandra blister rust.

Annosus root disease is one of the most important forest diseases on the Fremont N.F. The P-strain (*H. annosum*) produces the disease that affects ponderosa pine. Surveys on the Fremont (Hopkins et al, 1988) indicate the P-strain is a management concern on marginally productive ponderosa pine sites. Infection has been most notable in southern portions of the Fremont NF and District with no P-strain having been documented within the Lower Sycan watershed (Hopkins et. al. 1988). There also appears to be a strong association between P-strain annosus and soil compaction. Multiple timber entries have exacerbated the problem on portions of the Forest. Although no P-strain has been reported within the Lower Sycan Watershed, there are many areas at risk of infection and prevention strategies should be prescribed.

The fungus *Armillaria ostoyae* causes **Armillaria root disease**. Throughout its distribution, this fungus is extremely variable in terms of its virulence (Eglitis 1998). Ponderosa pine does not have as high of infection risk as the true firs, but it can become infected when stressed by such factors as competition or drought. Armillaria has never been documented within the Lower Sycan watershed. Stands at risk of infection are similar to those of Annosus root disease.

Dwarf mistletoe is a species-specific parasitic plant. There is a species of dwarf mistletoe specific to ponderosa pine, which is common within the Lower Sycan watershed. Spread and damage is greatest in pure ponderosa stands with a multi-layered canopy. Heavily infected trees will grow at less than half the expected growth rate and have a much higher mortality rate. Though not mapped, it is suspected that this disease occurs within approximately 1/4 of its host stands. Some of the heaviest mistletoe in ponderosa pine on the district occurs in the northwestern corner (stringer country) of the watershed and is most damaging on drier sites.

Comandra blister rust is the pathogen responsible for creating the "spire tops" on old growth ponderosa pine. Very little documentation exists concerning this disease. Ecologists suspect that up to 10 percent of trees in the historic "parklike" stands exhibited spire tops caused by this disease (Hopkins 1993). This process helped maintain snag habitat in an environment where true snags burned up quickly.

4. Management

Disturbances due to management practices, this century, have shaped the structural stage distribution of ponderosa pine within the watershed. Large ponderosa pine has always been the premium timber product produced on the Fremont N.F. Timber extraction within the ponderosa pine types has been extensive across the watershed. Early activities were designed to conserve and protect the resource while capturing mortality through **single tree selection**. Later activities in the 1970's and 80's removed the majority of mature ponderosa overstory to release the younger faster growing understory. Though up to 40% of today's late and old ponderosa stands remain, they do not retain the single mature canopy structure that was expressed historically. In fact, very little of the historic single story LOS remains. Areas where overstories have been almost completely removed and the advanced regeneration managed have yielded most of today's mid seral component. Many of these **overstory removal** prescriptions have had a pre-commercial thinning treatment performed. **Clear-cutting** within ponderosa pine began to occur in the 1980's but was not a dominant practice. This silvicultural system was used to clean dwarf mistletoe from the stands and was used most notably within fringe stands along the Sycan River and above the Sycan Marsh. The last timber entry, in ponderosa pine type, was a clear-cut/overstory removal sale in the late 1980's. Currently, these early seral areas exhibit densities that predispose the stands to attack by bark beetles, particularly mountain pine beetle.

Wherever openings were created and especially when cleaning out mistletoe, pine plantations were established (approximately 2,000 acres). These areas were planted at densities of 300 to 500 trees per acre. Due to the risks of animal damage from gophers, porcupines and big game browse, a considerable

investment was spent protecting seedlings. Being relatively successful, most plantations have been scheduled for a thinning before they reach a mid-seral size/structure.

MIXED CONIFER (Pine Associated)

Mixed conifer forests cover approximately 24,500 acres of the National Forest lands in the Lower Sycan watershed; this represents 19 percent of National Forest in the watershed. Relative to the ponderosa pine types, these stand types exist at higher elevations and northern exposures (low energy sites). Always, ponderosa pine plays the seral role while white fir is the climax species. Within these plant communities, ponderosa pine and white fir will dominate with highly variable cover percentages that range from 5 to 75%. Lodgepole pine can also become a component in the stand but is not usually in a dominant or codominant position, though it will be an early pioneer following disturbance

Species composition depends upon the position of the stand within the landscape, past disturbance regimes, and moisture/site relations. In most cases within the Lower Sycan watershed, ponderosa pine will be the dominant species in the overstory. Species composition in the understory depends upon disturbance regimes, topography, overall stand density, and moisture/nutrient relations. Ponderosa pine is out-competed when shade tolerant white fir or fast growing lodgepole are present. Most mixed conifer stands today exhibit abundant white fir in the understory that relates to the area's fire ecology. Some forest stands that are classified as mixed-conifer today may historically have been ponderosa pine forests. Absence of large-diameter white fir may indicate that the stand is not a true mixed conifer.

Relative productivity of mixed conifer sites is rated moderate to high. Mean wood productivity ranges from 45 to 69 cubic feet per acre per year.

1. Fire Ecology

The fire regimes affecting mixed conifer forests across the west are highly variable. Historical fire return intervals within true mixed-conifer forests are probably between 25 and 75 years. Where white fir occurs with ponderosa pine, fire-return intervals are probably at short end of the range. In the lodgepole pine/white fir associations, the fire-return interval is probably on the longer end of the range. As fire return intervals lengthen, likely due to cooler, wetter climate, there is a tendency to have higher proportions of white fir in the overstory (Agee 1993).

Ponderosa pine has a competitive advantage in the presence of fire that it loses in a fire free environment. Today most mixed conifer stands in the Lower Sycan watershed exhibit abundant white fir in their understory. The fire free period experienced this century has caused mixed conifer stands, which evolved similar to open ponderosa stands, to become dense stands of true fir with unprecedented stocking levels. As a result, fires that were historically a maintenance event would today likely be a high intensity stand replacement event.

2. Insects

In addition to the insects that affect ponderosa pine, fir engraver beetle, Modoc budworm and the Douglas-fir tussock moth are important insects with respects to white fir. Although threats by insects and diseases seem numerous, they tend to be species specific. Mixed conifer stands typically provide a greater resiliency to insect attack than stands that are composed of a single species.

The **fir engraver beetle** is an opportunist that will attack and kill white fir under stress (Eglitis, et al. 1993). Periods of drought generally correlate to beetle attacks within the Lower Sycan watershed. The stands at highest risk are those occupying sites at the drier fringe of their range.

The **Modoc budworm** has a small natural range between NE California and SE Oregon. The insect is considered to be less aggressive than the western spruce budworm with sporadic outbreaks that haven't caused severe damage to host stands. The Modoc budworm is not a primary mortality agent. In extreme cases, trees can be totally defoliated. The weakened tree then succumbs to more aggressive agents such as fir engraver (Eglitis, et al. 1993)

Information on current distribution in the Lower Sycan Watershed is not available, though it is not uncommon to find the larvae feeding on white fir foliage. There has never been a reported outbreak to the extent that trees had been severely defoliated. Due to fire exclusion, host stands have been increasing across the landscape. The stands at highest risk are those multistory stands, heavy to white fir, under stress from density or drought.

The **Douglas-fir tussock moth** has potential to be an important insect within white fir stands. Annual "early detection" monitoring has yet to detect harmful population levels on the Fremont NF, nor has there ever been a documented outbreak on this forest.

3. Disease

Because ponderosa pine in an integral species in mixed conifer stands in the Lower Sycan watershed, Annosus and Armillaria root disease, and dwarf mistletoe are important diseases to these stands. In addition, Indian paint fungus among others are important stem decay pathogens in white fir.

S-strain Annosus, which infects only white fir, has been documented throughout the Fremont NF including the Lower Sycan watershed, within examples of every mixed conifer plant association. Multiple entries within stands of high white fir composition tend to aggravate the occurrence of this root disease.

Armillaria root disease prefers white fir to pine. Though probably present within the Lower Sycan watershed there are no documented infection centers.

There is a species of **dwarf mistletoe** that infects only white fir. Due to the fact that white fir has expanded its presence so quickly across the landscape, this mistletoe is not distributed as widely as the ponderosa species. Information on current distribution in the Lower Sycan watershed is not available.

Indian paint fungus affects only white fir within the Lower Sycan watershed. It becomes established by infecting shade-killed twiglets on suppressed trees. Once the infection point heals, the fungus remains dormant for up to 50 years or longer. Death of large branches, mechanical wounds, insect patch kills, and fire scars appear to activate dormant fungus infections (Aho 1981). The percentage of trees which are of less commercial value as a result of these pathogens varies widely from drainage to drainage but can run as high as 30 to 50 percent. Fir damaged during management activities runs the risk of accelerating development of these decays and will likely lead to substantial decay losses by Indian paint fungus and others. It is thought that mechanical wounds today play the same role as fire scars had played historically in initiating stem decays in white fir (Aho 1981). Information on current distribution in the Lower Sycan Watershed is not available.

4. Management

Management within the mixed conifer stands began much as it had with the ponderosa pine type. Protecting and capturing mortality of the valuable mature pine was paramount. By far, most of the intensive forest management practices occurring on the Fremont NF were implemented in these relatively productive mixed conifer types. Due to the management imposed fire free period partial **overstory removals** became practical and common. Valuable ponderosa was harvested and the fast growing white fir understory was treated as advanced regeneration thus avoiding the cost of artificial regeneration. Many of these areas have had a pre-commercial thinning treatment done to them. **Clear-cutting** became common practice in the 1970's and 80's. The last timber entry into mixed conifer stands was under the Elementary

and Taylor Timber Sales (completed in 1990), which featured clear-cut and overstory removal style silvicultural systems. Clear-cutting was implemented when the fir understory was deemed too suppressed to be released.

To date on the Fremont NF, very little prescribed underburns have occurred in mixed conifer types. The natural fuels underburn project plan addressed only treating ponderosa pine types.

LODGEPOLE PINE

As a species, lodgepole pine has the widest adaptive amplitude of any conifer on the Fremont National Forest. Lodgepole pine forests cover approximately 25,900 acres of the National Forest lands in the Lower Sycan watershed; this represents 21 percent of the N.F lands in the watershed. The lodgepole pine on the Fremont NF is of the subspecies *murrayana* (Sierran lodgepole). This subspecies does not have serotinous cones but is a prolific seed producer. This species is the most cold hardy of all the conifers on the Fremont. These stand types occur at the highest elevations within the watershed. Lodgepole pine is also found along edges of ponderosa pine and mixed conifer stands where the stands reach down into low laying areas where cold air becomes restricted (frost pockets) or in any concave topographic feature where cold air may become trapped. Between disturbances, lodgepole pine will frequently encroach into areas such as aspen and grass meadows. These areas tend to be too cold or wet for other conifers to grow well. Lodgepole pine is a seral species where it interfaces with most other conifers and will establish itself quickly following a disturbance. Being relatively short-lived it cannot compete successfully with ponderosa or white fir on such sites.

1. Fire Ecology and the Mountain Pine Beetle

Most of the lodgepole pine stands that occur on the pumice derived soils and in the "coldest" cold air pockets are considered climax lodgepole forest and no other species will succeed them. The fire regime connected with these type stands is considered to have a moderate severity. Combinations of low, moderate and high severity fires occur in space and time (Agee 1993). Fire studies completed on the Fremont show a fire return interval of 60 to 350 years (Stuart 1984). The average is probably found between 60 and 100 years, and areas of higher productivity (or adjacent to those areas) probably experienced fire return intervals on the more frequent end of the spectrum. Agee (1993) reports evidence of natural fires in Oregon's lodgepole pine that range from slow burning logs on the forest floor to stand-replacement crown fire driven by strong winds. Under some weather conditions, lodgepole pine acts as a barrier to fire spread because of the lack of understory vegetation. During some fire events in adjacent stands, even during summer, fire will not spread into climax lodgepole pine stands (Agee 1993), suggesting that these stands may be a natural fire barrier except under unusual fire behavior. However, large-scale fire driven by strong winds is also within the observed range of fire behavior in these forests. Several examples of past fires in lodgepole on the Paisley Ranger District were purely wind driven events (Watson and Timber Falls Butte fires).

The relationship between fire and insect is a cycle based upon the beetles' food base (lodgepole phloem). When a high proportion of the stand reaches approximately nine inches DBH, a beetle epidemic will begin. Natural regeneration quickly establishes and any advanced regeneration that gets released will respond and grow into the gaps created. Killed timber will fall to the ground within a 5-10 year period. Unless pushed by exceptional wind, subsequent fires vector along these decaying logs, many of which have decayed heartwood due to the partial insect kill. These fires of low to moderate intensity encourage secondary mortality by insects. Decay agents infect standing trees whose roots were damaged by the fire, another way of creating a decay column. The trees killed by either fire or insects form the next generation of logs, which will become ideal fire vectors in another 50-75 years. The next disturbance could be another insect attack, another fire of low to moderate severity, or perhaps a crown fire if conditions are right. A combination of these events can be combined across a landscape making for a diversity of age groups and structure within a large homogeneous stand.

There are apparently at least two time periods after a mountain pine beetle outbreak when fire could easily spread in this system: the first few years following tree fall and approximately 50 years later (Gara et al. 1985). The spatial scale and proximity of beetle outbreak areas determine the magnitude of a fire disturbance. The size of recent disturbances from insects, disease, fire and timber harvest is much smaller than what was observed historically in similar forest types. Although 100 years of fire exclusion may not have significantly interrupted natural fire processes in a particular stand where the typical fire return interval is between 60 and 100 years, the geographic scale of disturbances has been significantly altered and has affected plant associations with shorter fire return intervals. For example, the lower elevation forests, now densely stocked with flammable material, have had the natural role of fire disrupted and are now susceptible to high-intensity fire that can easily spread to adjacent forest types and alter the fire regime in the mature lodgepole pine forests.

2. Insects

Within the Lower Sycan watershed, **mountain pine beetle** is the only primary insect disturbance agent related to lodgepole pine. The effects of this insect currently dominate portions of the Lower Sycan. During the summer of 1998, a dramatic increase in MPB mortality was observed which has involved approximately 5,000 acres of National Forest Lands west of Winter Ridge, in the northeast portion of the watershed. Most of the killed timber is mature lodgepole pine occupying dominant and codominant positions within late seral lodgepole pine stands. Many stands have lost the majority of their high crown cover. Mortality ranges between 10% and 80% of the overstory. This equates to 15 to 100 trees per acre. These lodgepole stands are behaving normally with respect to their age and susceptibility to beetle attack. Historically, fires tended to be small, infrequent and not much of an ecological factor in these plant communities. At these higher elevations with relatively high precipitation, the mountain pine beetle is the primary disturbance factor that recycles lodgepole pine at the landscape scale. These stands are abruptly dropping back to an earlier seral stage with a combination of natural and advanced regeneration quickly establishing the next generation of trees.

3. Disease

Dwarf mistletoe, pine needle cast, and western gall rust are the three most important diseases relating to lodgepole pine within the Lower Sycan watershed. Two other rusts are present in the watershed but very little documentation exists. They are stalactiform blister rust and comandra blister rust.

The heaviest infections of **dwarf mistletoe** occur in the higher elevations within the Hanan Roadless Area and the uplands above the South Fork of the Sycan River. The large area of lodgepole pine, west of Winter Ridge, is largely uninfected. The biology of this parasite is similar to that of the ponderosa pine variety, except that it will only infect lodgepole pine. An exception is that birds can be a more important vector of mistletoe in lodgepole pine than in ponderosa, particularly in stands along streams and meadows.

Pine needle cast affects lodgepole pine across the entire Lower Sycan Watershed. Needle casts are favored in situations where moist conditions prevail in early summer. Microsites, such as borders of wet meadows and riparian areas are high-risk areas. Needle casts have their greatest impacts in young even-aged stands or plantations, especially those established with offsite stock. Needle casts seldom kill trees directly but when severe, may predispose them to other agents. (Scharpf 1993)

Western gall rust is a common occurrence within lodgepole stands that developed in the cool moist draws across the Lower Sycan watershed. It is within these more moist areas that the disease seems to stay confined. Unlike most other rusts, western gall rust requires no secondary host.

4. Management

Unlike ponderosa pine, lodgepole products have been at the bottom rung of the economic ladder. Within the Lower Sycan, lodgepole stands tend to be large and old.

Two schools of thought prevail as to why thinning increases a stand's resistance to mountain pine beetle attack. Thinning will increase the general vigor of individual trees, better enabling them to expel (blow out) the insect as they attempt to enter the tree (Mitchell, et. al. 1983). Bark beetles evolved to fly though a dense canopy in search of its host tree, and use pheromones to aggregate in order to over whelm the target. Thinning changes the microclimate within the canopy layer and can disrupt beetle behavior during dispersion (Schmitz, et. al. 1989

No prescribed burning has occurred within any pure lodgepole pine types within the Lower Sycan watershed.

Other Species

Juniper Communities

There are 18,900 acres of Juniper and low sagebrush/fescue lands in the Lower Sycan Watershed. Exclusion of periodic fire invites juniper expansion out of this community. Presettlement juniper woodlands were once restricted to rocky bluffs, ridges and dry shrub communities with low fire frequencies, however, expansion since the late 1800s has been into the more mesic environments where this invasive species has dramatically increased from its historic range. Encroachment has been slow into areas with prevalent low sagebrush, primarily due to soil depth limitations. Western juniper is commonly found outside of its range of natural conditions, encroaching primarily on big sagebrush/bunchgrass range and the low/drier end of ponderosa pine and aspen communities. The true Juniper/low sagebrush/fescue association is typically found in mid to late seral condition, but has expanded out of its historic range and created early-mid successional juniper stands within low and big sagebrush communities. Range condition on these sites is fair with a downward trend.

On poor condition sites, bunchgrasses are predominantly found under the protection of shrub and juniper canopies.

Good condition sites are dominated by low sage and scattered western juniper (2-4 trees/acre). Mountain mahogany is present on less rocky areas.

With burning, the forb cover increases and rabbitbrush and cheatgrass easily invade these sites. Herbage production ranges from 200-700 lbs/acre. Scattered juniper woodland is evident in the northwest portion of the watershed in scabrock flat areas and adjacent to the Sycan River corridor in the eastern portion of the watershed. Low sagebrush flats dominate this plant association. Idaho fescue is the dominant herbaceous species.

A 1997 study conducted in the eastern portion of the Chewaucan watershed of the Paisley Ranger District, shows that juniper expansion and establishment on deep soils has peaked in many areas and created closed juniper woodlands. Although the extent of juniper encroachment in the Sycan River is less extreme, it is a concern. Fire exclusion has allowed juniper establishment and/or expansion in many scab-rock flats. Studies indicate historic fire return intervals in juniper to be between 10 and 25 years, but may be considerably longer on isolated patches of juniper. Fire histories are extremely difficult to determine in sagebrush, but historical fire return intervals were probably between 10

and 50 years, depending on the site productivity. Past grazing practices may have also significantly affected the ecology of these scab-rock flats.

Lower densities of post settlement juniper are found in low sagebrush sites compared to mountain big sagebrush primarily due to soil depth parameters, as establishment and growth of juniper are somewhat restricted on the shallow rocky clay soils associated with low sage sites (Miller 1997).

Open Forest Communities

Aspen stands are found within all the forest types in the watershed and their fire return interval is probably related to the surrounding stands fire return intervals. Periodic disturbance stimulates sprouting and encourages mixed age and size structure. There are areas of decadent aspen found within the watershed that are not experiencing regeneration. Disturbance, either by cutting or fire, is necessary to stimulate new growth in these dying stands. Aspen may often act as a barrier to fire spread since it typically grows in more moist conditions.

Suppressed aspen stands are commonly encountered in the watershed due to the absence of fire in the ecosystem. Natural regeneration of these aspen stands has been thwarted due to fire suppression efforts. In the absence of fire, conifers have encroached into a majority of aspen stands in the watershed. Encroachment by lodgepole pine, white fir and in some cases juniper is contributing to the degradation of these groves. Past heavy livestock grazing has had a negative impact on aspen regeneration, particularly at the time when sheep were the prominent class of livestock on the range. Relatively short-lived aspens are in danger of being replaced by longer-lived conifers. Aspen provides a high protein palatable food source for wildlife such as mule deer and elk, during times of the year when other plants are unavailable for browse. The extent of current utilization of aspen by either native herbivores or cattle is unknown. Use by cattle is expected to be more intense in pastures grazed later in the season.

Invasive Species

Twelve sites of invasive species have been mapped in the Lower Sycan Watershed along roadsides and in gravel pits (Table 3-18).

***Musk Thistle*:** Musk thistle (*Carduus nutans*) is a taprooted biennial that germinates and grows into a rosette the first season. The second season, the plant bolts, produces seeds, and then dies. Musk thistle reproduces solely by seeds, which are dispersed by wind, water, wildlife, livestock, and human activities. Seed may remain viable up to 10 years. Population size can fluctuate from year to year with climatic conditions. Rapid increases may occur following disturbances which create bare soil. Musk thistle has been established in southeastern Klamath County for decades. On the Forests it is found most often in plantations, in burns, along roadsides, and on landings within mixed conifer or upper elevation ponderosa pine forest types. It also can occur in riparian areas. The largest infestations on the Forests occur south of Highway 140 on Bly District, where plants are generally scattered throughout old burns and clearcuts.

***Canada Thistle*:** Canada thistle (*Cirsium arvense*) is a perennial species with an extensive creeping root system. Canada thistle primarily reproduces vegetatively from horizontal creeping roots, but can also reproduce from seed. Buried seed can be viable up to 26 years. Seed is dispersed primarily via wind, water, and human activity. On the Forests, Canada thistle is most often found in disturbed sites such as

roadsides, landings, and plantations. However, the species also has the ability to invade meadows and riparian areas.

***Spotted Knapweed*:** Spotted knapweed (*Centaurea biebersteinii*) is a deep taprooted biennial or short-lived perennial. This species reproduces by seeds, which are dispersed by wind, animals, and human activity. Seeds may remain viable up to 8 years. Spotted knapweed most often occurs in disturbed areas, but can also invade rangelands. Spotted knapweed is a new invader to the Forests.

***Diffuse Knapweed*:** Diffuse knapweed (*Centaurea diffusa*) is a highly competitive taprooted annual, biennial, or short lived perennial. Diffuse knapweed produces large numbers of seeds, which are dispersed primarily by wind in a tumbling manner, or by animals and humans. Diffuse knapweed spreads quickly along roadsides and in overgrazed rangelands, but can also invade undisturbed grasslands, shrublands, and riparian communities. Diffuse knapweed is a new invader to the Forests.

***St. Johnswort*:** St. Johnswort (*Hypericum perforatum*) is a perennial species with a deep penetrating taproot that reproduces by seed and lateral runners. Seed is dispersed by wind, animals, water, and human activity. Seed viability in the soil is 6-10 years. This species can become established in degraded or pristine range and forestlands. On the Forests, it is most abundant on Klamath District, where there is close proximity to a large seed source on the west side of the Cascades.

***Medusahead rye*:** Medusahead rye (*Taeniatherum caput-medusae* subsp. *asperum*) is an annual grass that reproduces by seed. The seeds have small barbs, which enable them to cling to animals, human clothing, and machinery. Seeds are also transported by wind and water. Seeds can germinate in fall, winter or spring. Fall germination allows primary roots to develop during the winter, which is followed by lateral root growth in the spring. This gives medusahead a competitive advantage over native plant species. Medusahead tends to invade areas where vegetation has been weakened by overgrazing, burning, or other disturbance, such as roads or utilities. It appears to favor heavier soils. Once established, medusahead forms thick mats of dead stems which decompose slowly and exclude growth of competing species. On the Forests, the species is established in localized areas. The largest infestations occur on scabrock flats east and southeast of the town of Bly and in juniper shrublands on Silver Lake District.

***Dalmatian Toadflax*:** Dalmatian toadflax (*Linaria dalmatica*) is a deep-rooted perennial species that reproduces by seed and vegetative buds on lateral roots. Reproduction by seed is important for initiating new toadflax infestations, while vegetative reproduction is important for increasing the plant density at a site. A mature plant can produce up to 500,000 seeds annually. Seeds are dispersed by wind and human activity and retain high viability for 2-3 years. Dalmatian toadflax invasion is favored by disturbance, which can be found along roads, near dwellings, and gravel pits. Once established, the species can spread onto adjacent rangelands and open slopes. Dalmation toadflax is a new invader to the Forests.

Table 3-18. Invasive Species in the Lower Sycan Watershed.

Invasive Species	Number of Sites	Infested Acres	Site Type
Musk thistle	7	2.7	Roadside, gravel pit
Canada thistle	1	0.1	Roadside
Spotted knapweed	1	0.1	Roadside
Diffuse knapweed	1	0.1	Roadside
St Johnswort	1	0.1	Gravel pit
Dalmation toadflax	1	0.1	Roadside

Threatened, Endangered, and Sensitive Plants

Two species of Region 6 sensitive plants have been located in the Lower Sycan Watershed. Potential habitat is present for other species on the R6 Sensitive list, however they have not been located in the watershed during past surveys.

Calochortus longebarbatus* var. *longebarbatus S. Watts long-bearded mariposa lily
Status: Natural Heritage: G4T3/S3
Region 6: Sensitive Species List

Calochortus longebarbatus var. *longebarbatus* (long-bearded mariposa lily) is widespread but infrequent over eastern Oregon, Washington, and California. Locally, this species occurs on the Fremont-Winema National Forests (Chiloquin, Bly, Lakeview, and Paisley Ranger Districts) and on the adjacent Modoc National Forest in northern California. *Calochortus longebarbatus* var. *longebarbatus* occupies 3,263 acres on the Fremont-Winema National Forests. Approximately 315 of these acres exist within the Lower Sycan Watershed. Of these acres, 16 acres have been designated as Protected (17 percent of Protected habitat on the Forests) and 299 acres as Managed (9 percent of Managed habitat on the Forests) under the Conservation Strategy for *Calochortus longebarbatus* var. *longebarbatus* on the Fremont National Forest (Kaye and Rittenhouse, 1990 as revised by Wooley, 1994) and the Interim Conservation Strategy for Calochortus longebarbatus var. longebarbatus on the Winema National Forest (Goldenberg, 1995). Population sizes are difficult to determine for this species, existing site reports estimate over 200,000 plants are present in the watershed.

Calochortus longebarbatus var. *longebarbatus* inhabits grassy openings and meadows surrounded by ponderosa or lodgepole pine at elevations between 4,500 to 6,000 feet. These sites are seasonally wet and dry out by mid-summer. These sites may be along the edges of large meadows, in small, forested openings, or along streams. Soil moisture appears to determine the distribution of this plant. In meadows that are fairly dry, typically dominated by Sandburg bluegrass or Idaho fescue and low sage, this plant will only occur in the wetter areas. In moist meadows dominated by hairgrass, this plant grows in the drier, higher ground, often in a band along the forest margin.

Mimulus tricolor Hartw.ex Lindl. tricolored monkeyflower
Status: Natural Heritage: G4/S2
Region 6: Sensitive Species List

Mimulus tricolor is found in the Central Valley of California and occurs north sporadically to Marion County, Oregon. Disjunct populations occur in Klamath and Lake Counties, Oregon on the Fremont-Winema National Forests. Only two population centers occur on the Fremont-Winema National Forest. One population center is located at Antelope Flat/Bear Creek on Silver Lake District, the second is located in the Lower Sycan Watershed along the Sycan River. No conservation strategies have been completed for *Mimulus tricolor.* Because of its rarity on the Forests, maintenance of both populations is critical to the conservation of the species.

On the Forests, *Mimulus tricolor* occupies bare, seasonally flooded depressions, oxbow channels, and streambanks located in openings in pine and sagebrush habitats at elevations of 4,500-5,000 feet. Soils are typically clayey, not sandy. Because this species in an annual, population sizes can vary dramatically from year to year. Existing site forms report 16,000 plants on Silver Lake District and over 100,000 plants along the Sycan River. Known sites of *Mimulus tricolor* in the Lower Sycan Watershed begin at approximately the Sycan Guard Station and extend 13 miles downstream. The whole population lies within the Sycan National Wild and Scenic River.

Terrestrial Species and Habitat

1. Northern Goshawks

Suitable nesting habitat for goshawks does exist with the watershed. In 2005, the Snake Creek and the Sycan above Sprague subsheds were surveyed to protocol. There were several goshawk sightings, one territory located, goshawk feathers found, and 3 fledglings found (in separate areas, after surveys were completed). However, no active nests were located. The two subsheds surveyed in 2005 are planned to be surveyed again in 2006. There is one known goshawk in the Silver Dollar Flat subshed. In 2004, it produced one young, but was not active in 2005.

2. Primary Excavators

Cavity dependent species that may be present in the Lower Sycan Watershed include Lewis' woodpecker, northern flicker, black-backed woodpecker, hairy woodpecker, downy woodpecker, white-headed woodpecker, Williamson's sapsucker, red-breasted sapsucker, mountain chickadee and the red-breasted, white-breasted and pygmy nuthatches.

Snag and large down wood (also referred to as large woody debris (LWD)) densities for the forested portion of the analysis area are variable with higher numbers in areas of light or little management activities and relatively low numbers in areas of intensive management. Insect and disease activity, drought, and overstory mortality due to high stand densities have resulted in new snags and down wood that may exceed those required by LRMP Standards and Guides. However, large diameter snags and down logs are generally absent.

No snag and down wood surveys have been conducted within the Lower Sycan Watershed. Snag and down wood surveys based on proposed regional protocols were conducted in the Upper Sycan Watershed during the 1998 and 1999 field seasons within stands and previously harvested units of all species. The mean number of snags and LWD for the watershed in all stands was 4.9 snags and 12.8 logs per acre. In harvested units, the mean numbers were 0.3 snags and 5.1 logs per acre. It is expected that similar snag density levels would be found within this watershed. Snag and down log densities are variable across the watershed.

3. Mule Deer

The Lower Sycan Watershed includes portions of the Oregon Department of Fish and Wildlife (ODF&W) Sprague, Interstate, and Silver Lake Management Units for deer. Data are not available for deer numbers in the Sprague unit because inventories were discontinued in the 1980's. Portions of the range of the Interstate and Silver Lake deer herds occur within the watershed.

The watershed consists of mostly summer range with a small amount of winter range in the lower elevations, which are mostly private lands. The management objective for the Silver Lake Management Area is 10,300 deer, and the 2005 estimated population was 7,850, or 76% of that management objective. The management objective for the Interstate Management Area is 14,800 deer, and the 2005 estimated population was 6,000, or 41% of that management objective. Deer in the Sprague management unit migrate to the Silver Lake or Fort Rock management areas, and population information is not currently available (Tom Collom, ODFW, pers. com.).

The Lower Sycan Watershed provides fair habitat for mule deer. Cover, both hiding and thermal, though plentiful is generally poorly distributed throughout the watershed.

All seasonal habitats are in a state of advanced plant succession and thus have a reduced capacity to support big game. Forage availability in LOS stands has declined as density and structure within these stands has increased. An increase in the density and distribution of juniper at lower elevations has reduced the productivity of herbaceous and woody forage, but has increased cover.

The current Forest Plan Standards and Guides for open road density is not more than 2.5 miles per square mile within summer range. Road densities on National Forest lands exceed this standard. Road densities by subshed are listed below in Table 3-19. It is believed that the "trails" included in the far right column are actually roads. There are a couple of problems with the available road data. The actual open road densities are unknown because 1) less traveled roads tend to close themselves over time, and 2) there are roads on the ground that do not show up on existing maps. However, this is the best available information,

and while it does have limitations it can be used for comparison purposes in the future as road densities are decreased.

Table 3-19 Current Open Road Density in the Lower Sycan Watershed

Subshed	Road Density Paved, Aggregate, and Improved (Mi/Sq. Mi.)	Road Density including "Trails" (Mi/Sq. Mi)
Merritt Creek	0.9	4.7
Silver Dollar Flat	0.9	5.1
Snake Creek	0.9	2.2
Sycan above Sprague	1.4	4.8
Unnamed 2	0.9	4.5
Entire Watershed	1.1	4.5

Human Uses

Key Questions:

1. How should the watershed provide for future human uses and needs?

2. How will roads be managed to meet present and future uses and protect all resource values?

3. What logging and grazing methods may be necessary to meet resource and vegetation goals and objectives, and provide commercial products?

4. How should the watershed be managed to ensure that Treaty Rights and Trust Resources are protected?

Timber

Up until World War II, the harvesting of timber and the building of roads to access the saw logs was limited to a small scale and was most dependent on local markets and somewhat dependent on the regional economics and building material needs.

The Sycan Watershed is probably one of the most distant and isolated areas from sawmill, roads and markets and it is because of this that logging and road building didn't occur until much later in the current period as compared to other locations on the Forest. As the large mature trees were harvested, the Forest timber management program gradually extended roads and harvest activities in the Upper Sycan Watershed area. Timber harvesting and road building accelerated after the end of World War II with the sole purpose of removing the large ponderosa pine trees.

During this period there was an active mill in Paisley, Oregon, and several large limber mills in and around the Lakeview area.

Boards milled from ponderosa pine were a coveted material for non-structural construction. Their fine white to blonde color was attractive in window frames, doors and furniture. Most of the large pine logs that went to mills in Lakeview and Klamath Falls ended up as boxes for carrying and storing fruit and vegetables in the California markets.

Beginning in the early part of the 1990's, changing management direction within the Forest Service, both regional and nationwide, significantly reduced the amount of timber harvested within the watershed.

Grazing

There are two grazing allotments in the Lower Sycan Watershed the Silver Dollar in the Silver Dollar subwatershed and the Black Hills Allotment in the Black Hills subwatershed.

Livestock grazing on the public lands contributes to the economic viability and stability of local communities in the Summer Lake basin. It supports a lifestyle that many people feel is important to maintain and support.

Recreation

Today the majority of recreational use centers on the traditional themes of fishing, hunting, and camping, but improved access, facilities, and technologies have brought more picnicking, hiking, kayaking, and float-tubing into the mix. Changing tastes in hobbies have also brought steadily increasing numbers of birders, rock hounds, wild flower viewers, and photographers into the area. Some recreational users find the Upper Sycan area appealing due to it's isolated nature and the solitude it offers.

Camping occurs within rustic forest camps. Dispersed camping is done in the general forest areas. Hiking, horseback riding, mountain bike riding takes place along the OC&E Woods Line State Trail.

The lower Sycan River is designated as Wild and Scenic. The stream is free flowing and has high recreational fisheries values.

Cultural Plants and Subsistence Hunting and Fishing

Plants in the watershed have been used and continue to be used by the Klamath Tribes. References are made by Isabel Kelley (1932) concerning plants associated with the ecosystems found in the Sycan Watershed area. Verification of this information by a Lakeview Bureau of Land Management botanist has been completed. Plants of note that were used for food, medicine, ceremonies and craft materials were ipos or epos, mountain mahogany, juniper, currant, choke-cherry, service berry, elder berry, wild plum and rose hips.

Resources of native food plants appear to be in good condition within the watershed boundaries.

Subsistence hunting and fishing within the watershed are important activities for the members of the Klamath Tribes. Tribal members have traditionally used the area for subsistence hunting of mule deer. Providing habitat to maintain current mule deer populations is important in preserving this integral part of their culture.

Archaeology

The area contains a number of archaeology sites. These include lithic scatters, occupation sites, stone tool material quarries, vision quest sites and other American Indian religious sites. Historical sites include debris from logging activity, road building, sheep camps and recreational hunting camps. Historical livestock grazing near springs has impacted some pre-historic lithic scatters in the area, though no impact on more significant sites is known. Some sites are being impacted by the activities of artifact collectors

STEP 4. REFERENCE CONDITIONS

The purpose of Step 4 is to describe ecological conditions prior to change over time as a result of human influence and natural disturbance. Such conditions are termed "reference" conditions. Establishing reference conditions allows the comparison between reference and current conditions to be presented in Step 5 "Synthesis and Interpretation". The Reference Conditions step is presented with the premise that ecosystems adapted over extended time periods and that the greatest probability for maintaining future sustainability will require management practices which mimic or borrow from natural components, processes and structures.

I. Watershed and Aquatics

Historical conditions for hydrologic parameters are generally not available. Instead, the Watershed and Aquatics section of this document focuses on "desired condition".

Desired conditions provide a target for private and public land managers to aim for as they conduct resource management activities across the landscape. In addressing the four key questions pertaining to watershed and aquatics, numerous individuals and representatives from natural resource agencies and institutions were contacted for advice and technical expertise about desired watershed conditions. These include: Oregon State University, Oregon Department of Fish and Wildlife, Oregon Department of Forestry, Oregon Department of Agriculture, Oregon Department of Environmental Quality, Izaak Walton League, USDA Natural Resources Conservation Service, USDA Forest Service, USDI Fish and Wildlife Service, USDI Bureau of Land Management, the National Riparian Team (NRT) and others.

Most of the discussion was focused on the terminology used to describe the ecological status of riparian areas, such as PFC (Proper Functioning Condition) and PNC (Potential Natural Community). Proper Functioning Condition, as described by the NRT and defined in "Riparian Area Management: Process for Assessing Proper Functioning Condition" (USDI 1995, PFC manual), is described as *meeting the minimum conditions for a riparian area to function properly.* "Riparian areas are functioning properly when adequate vegetation, landform, or large woody debris is present to dissipate stream energy associated with high water flows, thereby reducing erosion and improving water quality; filter sediment, capture bedload, and aid floodplain development; improve flood-water retention and groundwater recharge; develop diverse ponding and channel characteristics to provide the habitat and the water depth, duration, and temperature necessary for fish production, waterfowl breeding, and other uses; and support greater biodiversity." The NRT and PFC manual also discussed Potential Natural Community (PNC) --"the highest ecological status an area can attain given no political, social, or economical constraints" (USDI 1995). Realizing that PFC is not the end point in stream evolution, but near the mid-point along the continuum towards PNC, the desire is to have all streams and riparian areas first meet minimum conditions, then strive to get as close to PNC as is attainable under multiple-use management. This concept would involve managing the watershed in a manner which is in harmony with the ecological processes of the area, thus resulting in enhanced water quality, fish habitat, and forage for livestock and wildlife.

In order to prevent confusion and provide consistency when describing other elements within the watershed, terminology was chosen that was cooperatively designed by the US Forest Service and the US Fish and Wildlife Service. This terminology relates to PFC and PNC in the following ways. When a

parameter is in its desired condition, it is considered to be Functioning Appropriately, highly similar to PNC. When a parameter is in a functional condition, but has an existing attribute that makes it susceptible to degradation, it is determined to be Functioning Appropriately but-at-Risk. A Functioning Inappropriately rating is given when a parameter is considerably less than its desired state or does not exhibit conditions of sustainability. The overall goal is to manage for conditions that are Functioning Appropriately.

Based on the numerous discussions, desired conditions were developed for (A.) Uplands, (B.) Riparian Vegetation and Stream Channel and (C.) Habitat for Aquatic species in relation to the key questions first presented in Step 2.

-

Uplands

Key Question 1: Is the upland portion of the subwatershed/watershed producing hydrological conditions (water and sediment outputs) that contribute to properly functioning riparian areas?

Parameters: 1. Desired upland plant communities
2. Desired road density, location, and drainage network

1. Upland Plant Communities and their Effect on the Amount of Water and Sediment Reaching Riparian Areas

Of the upland plant communities, the primary focus is conifers as they influence the amount of precipitation available for subsurface flow into riparian areas particularly during the summer months--the period of low flows. In such an arid environment, water becomes scarce during this time so low flows become important for maintaining riparian and aquatic habitat, water for irrigation, wildlife, and livestock. Low precipitation, reduced drainage from soil and bedrock, and sustained high evapotranspiration are factors affecting the amount of available water.

Upland conifers evapotranspirate incoming rain and snowfall--that is, they evaporate the precipitation that is intercepted on stems and leaves and transpire water that is absorbed through the roots. The precipitation, which is not evapotranspirated, becomes water yield available to ground water reserves, streams, and lakes. Bassman (1985 and 1988) provided information on the water use of ponderosa pine, mixed conifer, and lodgepole pine, which are the major forest types in the Lower Sycan River Watershed. Data referring to juniper was acquired from Bedell et al. (1993). These are listed below along with water yields--the water left over which is absorbed into the soil and available for grasses, shrubs, and subsurface flow. Refer to Table 4-1.

Table 4-1 - Conifer Species and Associated Water Yield.

Conifer Species	Annual Precipitation	Evapotranspiration Rate	Estimated Water Yield	% of Annual Precip. Resulting in Water Yield
Juniper	11-18” (14.5” ave.)	12”	2.5”	17%
Ponderosa Pine	18-30” (24” ave.)	16”	8”	33%
Mixed Conifer	20-35” (27.5” ave.)	17”	10.5”	38%
Lodgepole Pine	25-35” (30” ave.)	17”	13”	43%

Although juniper plant communities occupy only a small percentage of the watershed, juniper trees are slowly encroaching into the drier pine sites. This is a concern, since juniper trees are able to use water in

the early spring before other plants begin to grow. Throughout the summer, it will continue to draw water when ponderosa pine shut their stomata and discontinue water use. A tree 18 inches in diameter at its base can transpire 30 to 40 gallons per day if adequate soil moisture is available during the summer. Because juniper has the ability to use such a large amount of water, it reduces available of water for nearby plants. This lowers shrub and grass density, soil cover, and infiltration rates. It also increases nutrient loss, overland flow, and soil erosion, often resulting in a reduction of site productivity (Bedell et al. 1993).

For all of the above reasons, an increase in conifer densities results in a loss of water available for stream flow during the dry summer months. To determine the conifer densities under which the Lower Sycan River Watershed streams evolved, Fremont National Forest silviculturists described a range of presettlement canopy closures--or the Historic Range of Variability (HRV) for various forest types. These include the following: ponderosa pine, 11-40%; mixed conifer (ponderosa pine and white fir), 26-55%; lodgepole pine and white fir, 41-70%.

In addition, the non-forest plant communities described in the uplands include the following:

- • Bluegrass-Dry Meadow
- • Hairgrass-Sedge-Moist Meadow
- • Sedge-Wet Meadow
- • Big Sagebrush/Bunchgrass
- • Juniper/Low Sagebrush/Fescue
- • Low Sagebrush/Fescue-Squirreltail
- • Low Sagebrush/Bluegrass-Onespike Oatgrass
- • Ponderosa Pine/Bitterbrush/Fescue
- • Ponderosa Pine-Juniper/Mountain Mahogany-Bitterbrush-Big Sagebrush/Fescue
- • Ponderosa Pine-Quaking Aspen/Bluegrass
- • Ponderosa Pine/Mountain Big Sagebrush/Bluegrass (Hopkins 1979).

Of particular interest are the three meadow types because they are water storage sites, tucked away in the bottom of almost every small basin throughout the watershed and are the sources of many headwater streams. Tree densities in the surrounding catchment area influence the amount of water collected and stored in these meadows.

Fire in the uplands is essential in maintaining desired upland vegetation. The integrity of the above vegetation types (HRV forest types) and associated flow regimes are dependent on historic low intensity fires. These low intensity fires promote ecosystem stability because fuel levels are kept at a minimum, reducing the possibility of a catastrophic fire (Agee 1990). For pure ponderosa pine sites in a nearby watershed, the Upper Chewaucan Watershed, a fire return interval of 11 years was documented (Miller 1997). Mixed conifer sites, characterized by ponderosa pine and white fir, had fire intervals up to 30 years (Agee 1990). These frequent and low intensity ground fires maintained vast stands of open ponderosa pine forests, leaving a fuel gap between the overstory and ground. In the Upper Sycan River Watershed, it is estimated that these historical fire intervals maintained about 70-95% of the forested stands in a late-seral condition (mature and old), with roughly 5-15% being in a mid-seral condition (young and mid-aged), and the remaining 5-15% in openings and early seral condition.

When natural fire regimes are excluded and canopy cover increases, forested communities become susceptible to catastrophic fire. The removal of large areas of conifer by wildfire or timber harvesting has the potential to increase the amount of runoff and change the stream flow regime. Research has shown detectable changes in stream flow when 20 to 30% of a watershed is in a cutover (early-seral) condition (Troendle and Leaf 1982). For this analysis, forested lands in a cutover condition are those areas in openings--mainly as seedling/sapling stands. Further, when high intensity fires consume vegetation and forest ground cover, erosion increases (McNabb and Swanson 1990). Mass erosion into streams after a wildfire can overwhelm the channel with more sediment than local stream flows are able to transport and deposit onto floodplains, resulting in high levels of sediment in spawning gravels (Swanston 1991).

Desired Upland Vegetation:

Functioning Appropriately - Forested communities are within recommended canopy closures and/or openings (early seral condition) account for approximately 5-20% of the subwatershed; meadow and other upland communities have little or no conifer encroachment. This is the desired condition.

Functioning Appropriately but-at-Risk - Less than 50% of forest communities are outside recommended canopy closure ranges and/or openings (early seral condition) account for approximately 20-30% of the subwatershed; meadows and other upland communities have experienced conifer encroachment.

Functioning Inappropriately - Over 50% of forested communities are outside recommended canopy ranges and/or openings (early seral condition) account for more than 30% of the subwatershed; the majority of meadow and other upland communities have a high level of conifer encroachment.

Roads and there Effect on Amount of Sediment and Water Reaching Riparian Areas

Roads account for most of the sediment problems in a watershed because they are a link between sediment source areas (skid trails, landings, and cutslopes, etc.) and stream channels. They directly affect the channel morphology of streams by accelerating erosion and sediment delivery and by increasing the magnitude of peak flows (Furniss et al. 1991). Wemple (1994) focused on the interaction of forested roads with stream networks and found that nearly 60% of the road network drained into streams and gullies, and are therefore, hydrologically integrated with the stream network. Sediment entering streams from roads is delivered by mass soil movements, surface erosion, failure of stream crossings, and accelerated scour at culvert outlets (Furniss et al. 1991). Further, a study on the Medicine Bow National Forest showed that fine sediment increased as culvert density increased (Faglin 1991).

To reduce the adverse effects of roads on aquatic resources, road miles should be progressively decreased through permanent closure or obliteration in subwatersheds with high (1.7 - 4.7 road mi/mi^2) and extreme (>4.7 road mi/mi^2) road densities (Interior Columbia Basin Ecosystem Management Project (ICBEMP) 1997). A study of eroded material travel distances below fill slopes shows that more than 95% of relief culverts can be prevented from contributing sediment to streams if the travel distance from the culvert outlet to the stream is at least 300 feet. When broad-based dips are used for drainage, instead of culverts, nearly 100% of the contributing eroded material stopped within 100 feet of the road prism (Burroughs and King 1989). As a result, INFISH (1995) recommends buffer strips of 300 feet between riparian areas and roads. Also, maintaining a buffer between the road and stream channel provides a filter that minimizes the introduction of fine sediment into the stream channel.

Desired Road Densities:

Functioning Appropriately - Road density less than 1.7 mi/mi^2. This is the desired condition.

Functioning Appropriately but-at-Risk - Road density of 1.7 - 4.7 mi/mi^2

Functioning Inappropriately - Road density greater than 4.7 mi/mi^2.

It is assumed that the number of stream crossings and roads that are within 300 feet of streams are in relative proportion to the above road densities.

Riparian Vegetation and Stream Channels

Key Question 2: Is vegetation in riparian areas contributing to appropriate channel types and hydrologic regime?

Parameters: 1. Desired riparian vegetation and bank stability
2. Desired Rosgen stream types

1. Riparian Vegetation and Associated Bank Stability

One of the many functions of riparian plants is to stabilize banks through root mass. Manning et al. (1989) documented that sedge and rush species produced significantly more root mass than dry-land grasses, making these plants conducive to high bank stability. Other vegetation types such as willows, cottonwoods, and conifers provide additional bank stability. The stems of these herbaceous and shrub species provide roughness and resistance to high flows, which allows for sediment trapping and bank building (Elmore and Beschta 1987). Under these conditions, water is stored during the wet season and slowly released to the stream during the summer months. In an area where sheets of ice form on the stream surface during the winter--such as the Lower Sycan River Watershed--ice break-up during spring thaw accelerates bank erosion when riparian vegetation is absent (Platts 1991).

The vegetation types that contribute to the above conditions have been described. Willow, sedge, and rush associations characterize late-seral communities in low gradient meadow stream systems, where approximately 95% of the riparian area provides conditions for late-seral species (Burton et al. 1992). Along steeper-gradient mountain streams, where at least 75% of the bank substrate supports late-seral species, mountain alder will dominate the site while black cottonwood, willows, sedges, grasses, are subdominant (Burton et al. 1992, Kovalchik 1987). Early seral species, such as grasses, occupy riparian areas, but under reference conditions these species are subdominant (Kovalchik 1987). The relationship between these plant types and bank stability is reflected in the Native Inland Fish Strategy (USDA 1995) which details standards and guidelines that suggest bank stability should be greater than 80%. The Interior Columbia Basin Ecosystem Management Project recommends 90% for areas where this is attainable (ICBEMP 1997).

Desired Riparian Vegetation and Bank Stability:

Functioning Appropriately - Riparian communities are highly similar to the late-seral species composition and structure described by Burton et al. (1992), Kovalchik (1987), and bank stability >90%. This is the desired condition.

Functioning Appropriately but-at-Risk - Riparian communities are moderately similar to the late-seral species composition and structure described by Burton et al. (1992), Kovalchik (1987), and bank stability is 80-90%.

Functioning Inappropriately - Riparian communities have low similarity to the late-seral species composition and structure described by Burton et al. (1992), Kovalchik (1987), and bank stability is <80%.

2. Rosgen Stream Types

Stream classification systems are an attempt to simplify complex relationships between streams and associated watersheds. Anderson et al. (1998) suggests that a purpose of classification systems is to describe a stream's position in the landscape and the range of variability for parameters related to channel size, shape, and pattern. Channel morphology measurements associated with a particular classification system provide a great deal of information in determining whether or not the width-to-depth ratio, sinuosity, and gradient of a stream are in balance with the landscape setting. A stream's ability to dissipate energy is closely tied to its sinuosity, width-to-depth ratio, and gradient. When one of these parameters is altered, the stream becomes out of balance in terms of the shape and size expected for its setting. For example, a decrease in sinuosity (stream length relative to valley length) results in a higher stream gradient, which in-turn increases velocities. Increased velocities lead to accelerated erosion, which may further alter channel shape and gradient.

For this assessment, the Rosgen Classification system was selected because it aids in describing the natural potential of each stream, based on numerous measurements, such as entrenchment, bankfull width-to-depth ratio, sinuosity, gradient, and dominant channel substrate (Rosgen 1996). *Entrenchment* is the vertical containment of the stream channel and refers to the ability of a stream to access its floodplain. The stream is entrenched when floodwaters are confined to the channel and is not entrenched when floodwaters are able to access the floodplain. *Bankfull width-to-depth ratio* indicates the shape of the channel, and is the ratio of bankfull width to mean bankfull depth. Bankfull stage is the point at which the stream accesses its floodplain and is a required measurement in order to determine width-to-depth ratios. It is synonymous to the flood stage, has an average return interval of 1.5 years (Leopold 1964), and is considered the channel forming flow. Width-to-depth ratios indicate whether the stream is wide and shallow or narrow and deep. *Sinuosity* refers to the extent with which a stream meanders across the landscape. Highly sinuous streams have many meanders and curves, while streams with low sinuosity are straighter with few meanders and curves. Gradient is the slope or steepness of the stream while the *dominant channel substrate* refers to the size of particle or rock that covers the stream channel. Rosgen (1996) describes enhancement methods that work with natural processes of the stream, for each channel type.

Desired Rosgen Stream Types:

Surveys conducted in the Upper Sycan River Watershed reveal stream types A, B, C, and E. The stream type descriptions illustrated on the following 4 pages are based on Rosgen (1996). Numbers, which follow the letter designation, refer to substrate size – for example "E4" would be a Rosgen Type E stream dominated by a gravel substrate. In this summary, the number "4" refers to gravel sized substrate, while "3" refers to substrate ranging from baseball to basketball size.

Desired Channel Evolution for a Degraded Low-Gradient System: When vegetation is lacking along an E stream type, lateral (bank) and vertical (downcutting) erosion may lead to progressive stages of channel adjustment, resulting in altered channel dimension, pattern, and profile. As a result of the bank erosion and downcutting, the channel becomes wider and shallower, resulting in a higher width/depth ratio (a conversion from an E to C stream type). During downcutting events, the channel becomes an incised gully, straighter and steeper than the original channel—a G stream type. In doing so, the channel abandons its original floodplain, resulting in a lowered water table. Although downcutting subsides, lateral erosion continues because flood energies are confined within the incised channel. As the banks erode, the width-to-depth ratio continues to increase, creating a wide, shallow, and entrenched stream with no floodplain--an F stream type. The lateral erosion will continue until a floodplain is developed that is wide enough to dissipate flood energies. The development of a floodplain will only occur with good riparian vegetation that is resistant to flows and able to trap sediments and build banks. This will continue until the stream reaches a condition where it is naturally stable and in balance with the landscape setting. Once at this desired state (an E stream type), the stream is able to accommodate the flow and sediment produced by its watershed while maintaining its dimension, pattern and profile.

Functioning Appropriately - stream channel is highly similar to the Rosgen stream type expected for its setting.

Functioning Appropriately but-at-Risk - stream channel is highly similar to the Rosgen stream type expected for it's setting, but its bankfull width-to-depth ratio is larger than expected.

Functioning Inappropriately - stream channel is different from the Rosgen stream type expected for its setting (i.e. we expect an E stream type and it is an F stream type).

Data collected from stream surveys in both the Upper Sycan River and Chewaucan River watersheds indicate that E stream types are expected in low gradient meadow reaches with a drainage area of less than 18 square miles, while C Stream Types are expected where drainage areas exceed approximately 18 square miles.

Habitat for Aquatic Species

Key Question 3: Are the stream channels providing adequate fish habitat?

Parameters:
1. Desired amount of large woody debris
2. Desired pool numbers
3. Desired percentage of fines in spawning gravel
4. Desired stream temperature
5. Desired fish passage - culverts

1. Large Woody Debris (LWD) and its Contribution to Fish Habitat

Large woody debris in streams is an important roughness element influencing channel morphology, sediment distribution, and water routing (Swanson and Lienkaemper 1978, Bisson et al. 1987). Large wood forms a step gradient, a stair-step effect along the channel. As a result, stream velocity is reduced in the relatively long stretches between debris steps and increases where water falls over the logs. A straight stream will be converted into a more sinuous or meandering stream with the LWD (Swanson 1991). These alterations in flow patterns may either protect or erode banks, but in general, this energy distribution reduces the streams ability to erode banks and enhances sediment storage (Zimmerman et al. 1967). Wood also serves as an important agent in pool formation. For instance, in southeast Alaska streams, LWD accounted for up to 75% of all pools (Robison and Beschta 1990). The resulting effect on fish habitat is significant. Large wood in the low energy segments traps organic matter such as leaves, which remains in the stream longer, providing food for aquatic organisms (Speaker et al. 1984). Reeves et al. (1991) notes that low velocity areas required by fish--during floods--increase with additional LWD. Bjornn and Reiser (1991) cited several studies that documented an increase in fish densities with higher levels of LWD. It should be noted that the role of LWD decreases as streams become larger, because greater currents will carry the wood out of the active channel and onto the banks (Murphy and Meehan 1991).

Desired amount of LWD:

Large woody debris is evaluated against the 50th and 75th percentile for natural and near natural streams in the northern Great Basin (ICBEMP 1997).

Functioning Appropriately - Large woody debris numbers are >75th percentile. This is the desired condition.

Functioning Appropriately but-at-Risk - Large woody debris numbers are ≥ 50th and ≤ 75th percentile.

Functioning Inappropriately - Large woody debris numbers are <50th percentile.

For this assessment, LWD is defined as being 20 inches in diameter on the small end and greater than 35 feet long in ponderosa pine and mixed conifer sites. In lodgepole pine sites, LWD is defined as 12" in diameter and greater than 35 feet long. The natural or near natural frequency is determined using the table below, and the formula for desired numbers per mile = table value x 5280/average riffle width in feet. For example, a stream with a 10-foot average riffle width and a slope of 2-4% would be expected to have 11 pieces of LWD/mile at the 50th percentile and 45 pieces at the 75th.

Table 4-2 - Natural or Near Natural Frequency of LWD in Northern Great Basin Streams (ICBEMP 1997).

Slope Class	Large Woody Debris/Mile	
	50th Percentile	75th Percentile
All	0.019	0.062
<2%	0.006	0.025
2-4%	0.02	0.085
>4%	0.02	0.067

2. Pools and their Contribution to Fish Habitat

Pools are considered to be one of the most important fish habitat features, and for most fish, pools are the preferred habitat type (Bestcha and Platts 1986). Reeves et al. (1991) describes some of the reasons why trout use this habitat type: pools offer low velocity refuges, cooler stream temperatures during the summer months and over-wintering habitat. Furthermore, the majority of trout spawning occurs at pool tailouts, where spawning gravel is deposited (Bjornn and Reiser 1991, Reeves et al. 1991). In addition, pools provide rearing habitat for juvenile fish and resting habitat for adult fish (Bjornn and Reiser 1991), and refugia from drought, fire, winter icing and other disturbances (Sedell et. al. 1990). When pool numbers, volume, and complexity increases, the stream's capacity to support a diversity of species and life stages/history types increases (Bisson et. al. 1992; Bjornn and Reiser 1991). Further, Decker and Erman (1992) found that rainbow trout numbers were more abundant with an increase in pool habitat. Finally, an increase in pool numbers and complexity produces conditions for increased fish numbers and biomass (Fausch and Northcote 1992).

2. Desired Pool Numbers

The number of pools, and large pools, is evaluated against the 50th and 75th percentile for natural and near natural streams in the northern Great Basin (ICBEMP 1997). Large pools are those that have a depth of greater than 2.6 feet during low flow.

Functioning Appropriately - Pool numbers are >75th percentile. This is the desired condition.

Functioning Appropriately but-at-Risk - Pool numbers are ≥50th and ≤75th percentile.

Functioning Inappropriately - Pool numbers are <50th percentile.

The natural or near natural frequency is determined using the table below, and the formula for desired numbers per mile = table value x 5280/average riffle width in feet. For example, a stream 10 feet wide with a slope of <2% would be expected to have 14 pools/mile at the 50th percentile and 28 pools/mile of at the 75th percentile.

Table 4-3 - Natural or Near Natural Frequency of Pools in Northern Great Basin Streams (ICBEMP 1997).

	Pools/Mile (all pools)	Large Pools/Mile

Slope Class	50th Percentile	75th Percentile	50th Percentile	75th Percentile
All	0.027	0.049	0.000	0.003
<2%	0.027	0.053	0.000	0.005
2-4%	0.029	0.044	0.001	0.004
>4%	0.030	0.051	0.000	0.000

3. Spawning Gravel Fines and their Influence on Fish Habitat and Reproductive Success

Willers (1991), describes the effects of spawning gravel size on egg and alevin survival (hatched fish that have not emerged from spawning gravels). In general, he states mortality increases as spawning gravel size decreases because fine sediment impedes the flow of oxygenated water over the eggs or can trap the alevins in the gravel. Likewise, other studies show an inverse relationship between fine sediment and reproductive success (Everest et al. 1987). Bjornn and Reiser (1991) documented rainbow trout embryo survival as it related to substrate fines <6.4 mm: 90% embryo survival with fines at 10%, 75% embryo survival with fines at 20%, and 50% embryo survival with fines at 30%. In general, habitat guidelines for incubation of salmonid embryos require less than 25% volume of fines. Sieve analysis of potential spawning substrate has been conducted forest-wide in a broad range of geologic types. The reference level of fines for a particular geologic type has not been identified; however, analysis shows that a level of less than 30% fines is generally attainable in the top four inches of spawning substrate throughout the Fremont National Forest. Based on this information and ICBEMP (1997) recommendations, desired conditions for spawning substrates were determined.

Desired Percentage of fines in Spawning Gravels:

Functioning Appropriately - <20% fines for C and E stream types, and <25% fines for A and B stream types. This is the desired condition.

Functioning Appropriately but-at-Risk - 20-30% fines for C and E stream types, and 25-30% fines for A and B stream types.

Functioning Inappropriately - >30% fines for all stream types.

4. Stream Temperature and its Influence on Fish Habitat

Stream temperature is an important factor regulating aquatic life. Fish are cold blooded, and thus, assume the temperature of the water in which they live. For this reason, a fish's metabolism, and consequently their growth and development, are directly controlled by their thermal environment (Brown 1983). Therefore, the growth and survival of fish can be greatly affected by temperature extremes (Beschta et al. 1987). Because stream temperature affects fish habitat, the Oregon Department of Environmental Quality (DEQ) has established a state water quality temperature criteria: 7 consecutive average daily maximum temperatures are to be at or below 17.8°C (64°F) with fish being the primary benefiting resource. Generally, water temperatures in excess of 21°C (70°F) are unfavorable and may cause stress to all age classes (Sigler and Sigler 1991). However, Behnke (1992) states that redband trout possess a hereditary basis to persist at higher water temperatures than other species of trout. Further, Sonski (1985) noted that redband trout raised in a hatchery increased growth until 24°C (75°F) and recommended temperatures ranging from 18.3 to 23.8°C (65 to 75°F) to keep broodstock in good condition. Behnke (1992) has captured (fly-fishing) live redband in streams with temperatures of 28.3°C (82.9°F). Finally, temperatures

exceeding 29.4°C (84.9°F) can be fatal to rainbow trout (Bjornn and Reiser 1991). It should be noted that desired stream temperatures are discussed in relation to redband trout, since these fish are the only native trout known to exist within the Upper Sycan Watershed. Bull trout were not found in recent ODF&W surveys, nor were they noted during USFS Level II stream surveys.

Desired Stream Temperatures:

Functioning Appropriately - Seven-day maximum stream temperatures are < 17.8°C. This is the desired condition.

Functioning Appropriately but-at-Risk - Seven-day maximum stream temperatures are between 17.8°C and 24.0°C.

Functioning Inappropriately - Seven-day maximum stream temperatures are >24.0°C.

5) Fish Passage--Culverts

Fish need to move up and down streams for a variety of reasons, including spawning migration and to seek more suitable habitat as a result of competition or unfavorable stream temperature. However, redband may move great distances to seek more suitable water temperatures (Bjornn and Reiser 1991), particularly during the summer months and when seeking spawning habitat during April and May (Kunkel 1976).

Road culverts can block the movement of fish; the most common access inhibitors being excessive water velocities and associated vertical drops (Baker and Votapka 1990). When assessing culverts for trout passage, the following parameters should be evaluated: (1) jumping pools, (2) vertical jumps of <1 foot, (3) velocities that do not exceed maximum sustained swimming speed, and (4) culvert length (Furniss et al. 1991). Baker and Votapka (1990) document sustained speeds of rainbow trout being 2.0 - 6.6 feet per second. Further, as the water velocity increases, the length of a culvert that a trout can swim through decreases. For example, a trout can maneuver through a 50-foot culvert with water velocities up to 3 feet per second; however, at water velocities of 4 feet per second, a trout can only swim through a 30-foot culvert.

5. Desired Fish Passage:

Functioning Appropriately - All culverts are passable. This is the desired condition.

Functioning Appropriately but-at-Risk - When a culvert is a barrier in the middle to upper reaches of a subwatershed.

Functioning Inappropriately - When a culvert is a barrier in the lower reaches of a subwatershed.

Key Question 4: How are the above subwatershed conditions influencing native trout viability?

Parameters: 1. Desired native trout viability

Population viability addresses the continued existence of well-distributed populations or subpopulations over specific time periods (Marcot and Murphy 1996). High genetic variability will help ensure the viability of populations. Meffe (1996) states that genetic variability of a population determines its fitness

or ability to respond and adapt to environmental changes, and low genetic variability may result in decreased adaptability. This variability, Meffe continues, can be maintained by managing for a hierarchy of habitat types across a geographical area and uses stream order as an example for stratification. Salmonids within first order streams may contain subtle genetic differences from fish in the second and third order streams of the watershed; however, the genetic constitution of these fish can diverge genetically from fish in other first order streams in different watersheds.
Lpper Sycan River Watershed, native redband trout may possess subtle genetic differences from redband in the upper reaches of the Sycan River. It is important to manage for a diversity of high-quality habitat types to maintain genetic diversity (Meffe 1996).

The Upper Klamath Lake basin contains the remnants of Pleistocene Lake Modoc, which redband trout may have entered from interior connections. Currently, the Upper Klamath Lake Basin supports the largest and most functional adfluvial redband trout populations of Oregon interior basins, however, some populations are severely limited in distribution and abundance by habitat quality. The Klamath Basin species management unit is comprised of 10 populations that vary in life history, genetics, disease resistance, and status. Eighty percent of the populations meet three of the six interimcriteria, thereby classifying this SMU as 'at risk. The Lower Sycan is in the Lower Sprague population separate from the Upper Sycan and Upper Sprague populations. (ODFW 2005)

A reserve is an area of high-quality habitat that can sustain a viable subpopulation. In this document, reserves in the context of a subwatershed will be assessed. Several principles should be considered when evaluating an individual reserve or network of reserves. Reserves should be well distributed across the landscape, the idea being that widely distributed subpopulations will not experience a catastrophe or adverse impact across its entire range. Some subpopulations will escape the impact, eventually re-colonize the affected area, and sustain the population as a whole. Secondly, large reserves are better than small ones, because there is a greater opportunity for habitat diversity and larger population size. As a result, genetic variability within the subpopulation will be optimized, promoting increased adaptability to environmental change. Thirdly, reserves that are close together are better than those far apart. A short travel distance between reserves promotes dispersion and genetic interchange. If enough interchange occurs between reserves, fish are functionally united into a larger population that can better avoid extinction. In other words, connectivity between reserves is required. Finally, the above three principles can be achieved by managing at the landscape level, managing for watershed conditions that are within the natural range of variability (Noss et al. 1997).

Desired native trout viability:

Functioning Appropriately - The uplands are producing hydrological conditions (water and sediment outputs) that contribute to properly functioning riparian areas and stream channels, resulting in high-quality habitat and connectivity. Under current management, habitat conditions are able to recover from one short-term disturbance (i.e. flood or small-scale wildfire) within one or two generations (3-5 years).

Functioning Appropriately but-at-Risk - The uplands are producing hydrological conditions (water and sediment outputs) that are adversely affecting--or have the potential for adversely affecting--the functioning of riparian areas and stream channels, contributing to reduced habitat quality and connectivity over a portion of the subwatershed. Under current management, altered habitat conditions will not recover to pre-disturbance conditions within one or two generations (3-5 years).

Functioning Inappropriately - The uplands are producing hydrological conditions (water and sediment outputs) that are adversely affecting the functioning of riparian areas and stream channels, resulting in low quality habitat and connectivity over much of the subwatershed. Under current management, habitat conditions are not expected to improve within one to two generations (5-10 years).

Soils

Reference conditions for Ponderosa pine (PIPO) and Sierra lodgepole pine (PICO) in the Pacific Northwest and Great Basin fire regimens are shown in Table 4-4 (www.frcc.gov; Hann, et al. 2003). With iterative ground fire cycles they were 85 percent open Ponderosa pine forest. The ground vegetation was a mixture of grasses, forbs, and shrubs, which were rejuvenated by recurring ground fires. This open forest structure is often described as park-like, yet grassy-park-like better describes the soil and vegetation formation conditions. Initial snow survey reports also identify the open "honeycomb like" forests where snow packs well in the openings (Church 1912).

Table 4-4: Historic range of seral reference conditions are shown for Ponderosa pine (PIPO) and Sierra lodgepole pine (PICO) in the Pacific Northwest and Great Basin.

	FRCC Seral Stages					
Veg Type	Early seral %	Mid seral closed %	Mid seral open %	Late seral closed %	Late seral open %	Overall Open %
PIPO	10	5	20	10	55	85
PICO	20	10	30	10	30	80

Relative to the reference conditions in Table 4, ground cover condition in the Lower Sycan watershed have canopy closures well above historic values. Landsat Imagery from the Black Hills ranges to the Fuego Mountains shows crown closure of 60 percent canopy on average. The shift from "honeycomb like" forests is part of the wide spread shift due to fire suppression (Loy et al. 2000). Forest seed in over time, and without iterative ground fire cycles they loose their balance of ground and crown cover.
Native people in the past nurtured the balance to sustain hunting and gathering.

Now, forest mangers are becoming more aware of fires roles in western forest. Some early Forest managers used fire in *native-like* under burns to manage forest ground cover, forest structure, and soil tilth for water percolation. Yet fire practices slowed in the 1920's with the debate about *good fire* and *bad fire.* The debate over fire in the west essentially ended in the 1920's with the adoption of fire suppression rather than fire use as policy on most federal lands (Steen, 1976). Considerable fire, soil, and nutrient research continued and began to change our understanding of fire's role in regulating forest stand composition, nutrients (Busse et al. 1996; Debano et al. 1998; Johnson et al 1998) and ground cover for forest health (Ziemer, 1998).

Mooney's (2005) local historic vegetation seral patterns for the Williamson River and Upper Klamath Basin are identified in Table 4- 5. This pattern is consistent with Andisol and Mollisol soil orders found in on the north and east portions of the Lower Sycan watershed.

Table 4-5: Historical range of seral conditions for Ponderosa pine and Sierra lodgepole pine in the Williamson River/Upper Klamath Basin

	Seral Stages					
Veg Type	Early seral %	Mid seral closed %	Mid seral open %	Late seral closed %	Late seral open %	Overall Open %
PIPO	8-18	0-14	0-14	4-6	70-90	88
PICO	33-56	0-37	0-37	2-5	5-16	78

Local and Longer Term Studies:

Ground cover estimates are available in Hopkins' (1979a. 1979b) Plant Associations and Riegal (2002) riparian guide with plant species, bare soil, litter, and ground cover values for select habitats. Soil Resource Inventories for the Winema and Fremont also provides map unit descriptions of local semiarid pine forest and rangeland habitat (Carlson, 1979, Wenzel, 1979).

The Soil Resource Inventories shows the soils are set in tablelands. Sandy ash deposit from the adjacent Western Cascade terrain occur over the Basin and Range basement lava rocks. For Basin and Range terrain the slope are gentle (Orr and Orr, 1999). Soil Resource Inventory data is used in erosion estimates with

Water Erosion Prediction Project (WEPP) technology. WEPP is a computer model bases on the Green-Amp infiltration equation that uses local climate data sets, soil texture, vegetation type, ground cover, and topography (WEPP, 2001).

From a soil microbial point of view, habitat quality varies with soil carbon nitrogen ratios. Busse's et al. (1996) study over 30 years in sandy eastside pine finds carbon nitrogen ratios improved with understory ground cover. Similarly, in wetland and riparian habitats Riegel (2002) shows correlations among carbon nitrogen and ecological gradient for meadows and cottonwood forest.

Wildfire and forest thinning in these plant associations are apt to recover the ground cover resources that moderate erosion and sustain forest habitat functions. Shrub and grass ground cover recovered quickly after wildfire in the adjacent 1992 Lone Pine burn, where ground cover recovery progressed through a flush of forbs such as lupine to relative abundance of western needlegrass (Malaby, 2002). Similarly the Alder Ridge wildfire of 1996 shows ample ground cover recovery.

II. Vegetation

The best information available on the historic vegetative types in the Upper Sycan Watershed comes from the 1946 and 1947 Timber Type Maps. While the terminology used in this historic mapping differs from designations currently in use, interpretation of the data indicates that it is reasonable to use the information to provide a comparison of historic and current forest vegetation conditions. The table below summarizes the information contained in the 1946 and 1947 Timber Type Maps. National Forest lands and private lands are included, together, in the data.

Table. 4-6 1946-47 Vegetation Condition.

Vegetation Type	Approximate Acres	% of Watershed
Ponderosa Pine - Large	29,600	46
Ponderosa Pine - Seedling, Saplings and Poles	130	-
Lodgepole Pine - Large	2	-
Lodgepole Pine - Small and Medium	24,400	37
Mixed Pine - Large	110	-
White Fir – Large	50	-
Hardwood	1,300	2
Ponderosa Pine Woodland	600	1
TOTAL FORESTED	56,200	86
Grass, Sagebrush, Brush	8,800	14
TOTAL FOREST and NON-FOREST	65,000	100

Key Questions:

1. How have landscape patterns of plant communities and seral stages changed over time?

2. What caused the changes in the landscape patterns of plant communities and seral stages? What effect have the changes had on the watershed's ability to withstand catastrophic events?

3. What rare or designated sensitive plants occur in the watershed?

4. Why and to what extent are noxious weeds invading sites within the watershed, and what strategies can be used to slow or prevent the spread of noxious weeds?

Forested Uplands

Historically, the size, structure, composition, and spatial arrangement of the three basic forest plant community types which exist within the Upper Sycan Watershed (ponderosa pine, mixed conifer, lodgepole pine) was mainly the product of natural fire frequency and intensity. Other disturbance factors did play a role. Insects, diseases, and abiotic events such as windstorms did affect the development of vegetation, but fires were the ever-constant pressure that shaped stand composition and drove plant succession. Aboriginal burning in this area was likely but was not significant on a landscape basis.

Ecologic disturbance is a complex study, but three important axioms are that:

1. There is an inverse relationship between fire frequency and intensity.
2. There exists a direct relationship between the degree of deviation from historic variability and the number of "fire cycles" skipped due to artificial pressures. Skipped fire cycles tend to accelerate "biologic" plant succession.
3. Not only is there variability of fire frequency and intensity between plant associations, but the frequency has also varied over time (Agee 1993).

This discussion will limit itself to fire histories evidenced over the past 1000 years. A discussion on fire ecology and ecologic mechanisms is supplemented in the Step 3 - Current Condition.

PONDEROSA PINE

Nature's ancient alliance with fire can be seen throughout the United States. The west's vast ponderosa pine forests are among the most fire dependent. Denied a fire every 5 to 25 years, they become primed for destruction (Stephen Pyne 1996). Frequent light surface fires with a low degree of variability characterized the natural fire regime for ponderosa pine. Historic fire return intervals of 1 to 25 years have been measured within similar watersheds. In other words, based on core sample research throughout the region, these stands burned on a regular basis with a high degree of predictability. Stand replacement fires were very rare. The average ponderosa stand today has skipped approximately 10 fire episodes and shows the greatest departure from reference conditions.

1. Spatial Arrangement

Naturally occurring fire maintained ponderosa pine type stands at different spatial arrangements on the landscape than we see them today. Stand structure analysis has revealed that historically, ponderosa pine forests grew in clumps of even-aged, uniformly spaced trees, a condition that was sustainable in a fire dependent ecosystem. Fires were described as creeping through the understory consuming branches, litterfall, grass and forbs on the forest floor. Ponderosa tended not to expand out through the sage and grass communities as we see them today. Looking at the edge of most grass/sage "meadows" there typically is a band of young ponderosa pine, 100 to 300 feet wide in front of the Late or Old Successional (LOS) ponderosa stand. That band of younger trees has encroached onto the meadow due to the elimination of fires this century.

Unlike the ponderosa invasion into the drier end of its range, ponderosa pine has been displaced by true fir at the wetter end. These stands are progressing in biological plant succession. In general, most of today's

mixed conifer plant communities, on all aspects below 6000 feet, and on south and west aspects above 6,000 feet functioned as ponderosa pine with a fire frequency pushing the higher 25-year interval.

Ponderosa pine stands tended to be large and extensive across the landscape. Gaps and patches occurred at irregular intervals across these stands. They probably ranged from 1/4 acre to as large as 40 acres (Hopkins 1993). Fragmentation across the landscape would have been considered low at the large scale yet some stands may have contained a higher degree of patchiness when looked at a finer scale. Other disturbance factors had little effect on the large-scale spatial arrangement of ponderosa pine types. Due to the uneven-aged/even-sized/low stocked nature of the canopy, these stands were highly resistant to large-scale mortality. Insect activity would have tended to be light. Predisposal of infestations at the stand level would have been rare due to the fact that the fire regime wouldn't allow stand densities to grow to a high risk condition. Trigger factors for bark beetle attacks would have been at the singular tree or small group level; i.e. lightning and fire scars or a patch of age related mortality.

2. Size/Structure

When John C. Fremont explored this region in 1843, he reported finding vast stands of timber typically described as "open" or "park-like." There were few, well-spaced trees of mammoth size (Hopkins 1993). In general, the ponderosa pine types tended to have LOS, single stratum characteristics, maintained for long periods of time with low intensity surface fires. Amounts of shrubs and large down wood was variable but tended to be sparse. The multi-stratum structures we see today couldn't exist long due to this historic fire regime. Though the stands where single stratum, there was a great variance in ages within the canopy. Pulses of regeneration would escape the understory in patches ranging from 1/4 acre to as much as 40 acres then maintain as codominants in the canopy.

The ponderosa pine forests tended to look "park like" and carry much less stocking than the stands of today. It is estimated that these forests produced as much as 30% less biomass then they do today (Hopkins 1993).

These even-sized/uneven-aged stands tended to be resistant to most other disturbance factors. Insect, wind, or disease mortality was largely restricted to singular or small groups of trees. The larger gaps allowed the shade intolerant ponderosa to regenerate. Due to the single-stratum structure, dwarf mistletoes tended to be confined. Frequent fires would have eradicated heavy infections and aided in creating gaps for regeneration. Root diseases would have been opportunists infecting the oldest and weakened trees. Though variable, their virulence may have been kept low due to the resistance of the pine species.

Comandra blister rust is a little known pathogen. Ecologists suspect that up to 10 percent of trees exhibited spire tops caused by the disease (Hopkins 1993). This process helped maintain snag habitat in an environment where true snags burned up quickly.

As the axioms predict, ponderosa pine plant communities today exhibit the greatest departure from reference conditions. (Table 4-7)

Table 4-7. Reference Seral Stage Distribution in the Ponderosa Pine Type

Early to Mid (unstocked to small sawtimber)	20% (95% single story, 5% multi story)
Late (medium sawtimber and greater)	80% (95% single story, 5% multi story)

Data interpreted from the 1994 REAP Report and the 1947 timber type map.

MIXED CONIFER

The natural fire regime for mixed conifer/pine associated types is characterized by a highly variable range of intensities from infrequent severe surface fire to long return crown fires. The associated fire return frequencies range from 25 to 300 years. Fires burned on an irregular basis with a low degree of

predictability. The average mixed conifer stand today may have skipped 1 to 2 fire cycles. Wildfires today probably cover more acreage and burn hotter than they did in the past but inherent variability has prevented generalizations about fire and its ecological effects. In general, the mixed conifer stands have not changed as radically as have the ponderosa pine type.

1. Spatial Arrangement

In general, mixed conifer stands have expanded aggressively into the drier ponderosa pine types and somewhat into colder lodgepole pine communities. A patchwork of even-aged and uneven-aged stands attest to the variability of past fire intensities.

True mixed conifer stands tended to be variable in size but remained somewhat fragmented. Many of the mixed conifer patches were actually stands that functioned as ponderosa pine types.

2. Size/Structure

In general, the mixed conifer stands tended to be small, and heterogeneous (variation within a stand), that exhibited a gradient of seral conditions across the stand as well as the landscape. The younger end of this gradient tended to be even-aged/even-sized "pioneer" species such as ponderosa and lodgepole pine. As the stands developed under a naturally long fire return interval, they became more uneven-aged and multi-storied as the shade tolerant "climax" species developed. Vertical diversity developed as gaps opened up and shade-tolerant fir advanced. Stands probably tended to look "jumbled up" with complex structure. Reference period density is generally less than what we see today, although not as drastic (on the average) as what has occurred in ponderosa pine types. (Table 4-8)

Table 4-8. Reference Seral Stage Distribution in the Mixed Conifer Type.

Early to Mid (unstocked to small saw timber)	40% (95% single story, 5% multi story)
Late (medium sawtimber and greater)	60% (5% single story, 95% multi story)

Data interpreted from the 1994 REAP Report and the 1947 timber type map.

Other disturbance factors were probably more significant in the mixed conifer than they were in ponderosa pine. With longer fire return intervals, stands tended to reach target densities desirable to fir engraver and bark beetles. Mistletoes had the time and stand structure to build to heavy levels. Root diseases would not have been present at current levels but would have persisted as opportunists. There would have been much more disease activity in the mixed conifer stands than would have been expected in the ponderosa pine type keeping in mind that much of what we recognize today as mixed conifer, functioned as ponderosa pine during the reference period. This mosaic of ponderosa pine/mixed conifer/fire frequency brought a certain level of resiliency on a landscape scale.

LODGEPOLE PINE

An extremely variable range of intensities, from minor fire influence to short return interval crown fires characterizes the natural fire regime for high elevation lodgepole pine. The associated fire return frequencies range from 25 to 300+ years. Fires burned on a highly irregular basis with an extremely low degree of predictability. Many lodgepole stands within the Chewaucan basin show no evidence of fire other than starts that went out after growing to less than an acre and in most cases involving only burning down a log.

1. Spatial Arrangement

Unmanaged lodgepole stands today somewhat resemble how they probably looked during the reference period. Lodgepole pine, being a persistent seral species on these sites, shifts to climax white fir very slowly over time. If any change can be described here it is an increase in the fir component within some stand's understory and the fact that the average stand age is older today than it would have been during the reference period.

Lodgepole stands tended to be large and homogenous (less variable within a stand), though at a finer scale exhibited variable degrees of patchiness. This is similar to what can be observed today in unmanaged lodgepole pine although the reference stand probably had the patchy structure more pronounced with more early seral components.

2. Size/Structure

In general, lodgepole pine stands tended to contain a gradient of seral stages mixed within a large homogenous stand. More early and mid seral strata probably existed than the abundant LOS conditions we see today. Bark beetles co-evolved with lodgepole pine and are the same threat today as they always have been, although there is a risk of an outbreak being larger today due to a general increase in the food base (LP > 9" DBH). In fact, evidence shows that mountain pine beetle (MPB) mortality is far more predictable than a fire event was in shaping the lodgepole stands (see "Fire Ecology and the MPB" section of Current Condition Report)(Agee 1993). Dwarf mistletoe is probably more abundant today than during the reference period. What few fires occurred would have put some pressure on serious infection centers. Root diseases may be more prevalent today given an increase in white fir. Reference period stand densities would have been lower due to more early seral components within the stands. (Table 4-9)

Table 4-9. Reference Seral Stage Distribution in the Lodgepole Pine Type.

Early to Mid (unstocked to small saw timber)	40% (one to ten acre patches)
Late (medium sawtimber and greater)	60% (all multi story)(see fire & MPB)

Data interpreted from the 1994 REAP Report and the 1947 timber type map.

Non-Forested Uplands

Past management activities such as grazing, road building and fire suppression have changed the range of natural conditions for non-forested vegetation in the watershed. Pioneer settlement in the west is synonymous with the introduction of domestic livestock, which were first introduced in the watershed in the late 1860's. Reference conditions are attributed to a time prior to this settlement. By the late 1800s, the range was overstocked and overgrazed as numerous bands of sheep, cattle, horses and swine grazed these lands relatively uncontrolled until the early part of this century. Extensive sheep operations, common in the early years, have since shifted over to cattle production. By the 1974, all of the sheep allotments within the Sycan watershed had been converted to cattle. Permitted numbers have dropped from nearly 400,000 sheep AUMs and 100,000 cattle AUMs in 1915 to about 70,000 AUMs (cattle) at present for all Forest issued permits. Actual use for the entire Fremont National Forest is somewhere around 50,000 AUMs when considering non-use (Fremont FEIS 1989).

Season long grazing had the most detrimental effects on riparian and meadow vegetation, especially at the lower elevations. The multitude of downcut stream systems and diminished populations of native

bluegrasses such as Cusick's bluegrass are evidence of this past abuse. Allotments in the watershed were historically grazed season long. Six allotments are located within the watershed boundary, if only partially: Currier Camp (all but one early season pasture), Bear-Lakes (small portion of West Bear pasture), Paradise Creek (northern portion of allotment), Sycan (southern half of the allotment), Riverbeds (eastern portion adjacent to Sycan River) and Withers Special Use. Currier Camp, and the Bear-Lakes allotments are grazed using a three pasture deferred rotation system. Paradise Creek Allotment has an early season pasture and two pastures that are used in a deferred rotation system. Withers Special Use is a two pasture allotment with deferred grazing. The Sycan River is fenced from grazing during the mid-summer season of use in this pasture. Use in the Sycan Allotment is deferred through herding/riding. Cattle are kept in the lower elevations in the spring and then driven towards Winter Rim to utilize the vegetation as it matures during the season. A portion of the Riverbeds Allotment occupies the western fringe of the Upper Sycan and is grazed season long.

1. Meadow Communities

Bluegrass-dry meadow communities were dominated by cool season native bluegrasses such as Cusick's bluegrass, Sandberg's bluegrass and Nevada bluegrass during reference times. Kentucky bluegrass, a highly competitive, introduced sod-forming grass, has become the dominant grass species in dry meadows once dominated by native bluegrasses. Conversion of the Kentucky bluegrass dry meadows back to historical conditions does not appear practical under any grazing management strategy, including complete rest. Kentucky bluegrass should be considered naturalized and is expected to remain a dominant species in dry meadow types, even on good condition range (Volland 1985). Dry meadows composed of native bluegrass species were evident in early, mid and late succession in reference times, depending on the degree of natural disturbance, as they were periodically altered by low intensity fires and herbivores. Fire frequency may have been higher for dry meadow systems than other meadow types due to dry surface conditions. Fire reduced litter accumulations, promoted nutrient cycling and limited conifer encroachment.

Hairgrass-sedge-moist meadows were dominated by all native species such as tufted hairgrass and sedges, similar to what is present today. However, a non-native species such as meadow foxtail and redtop, which are found in some moist meadows today, would not have been present. Fire influenced these higher elevation meadows on a low frequency scale. Moist meadows would have been in mid to late seral stages, similar to current conditions.

Sedge-wet meadows were dominated by wetland sedges and trace amounts of hairgrass. Fire had a restricted role in maintaining wet meadows due to their high water tables. Periodic late fall burns reduced litter or thatch. These “boggy” sites were late successional due to infrequent disturbance. Species composition was similar to current conditions.

The predicted fire frequency for all meadow systems in the watershed is directly tied to the type of forested vegetation surrounding the meadow where natural or lightening caused fire would ignite. Varying fire intervals in forested associations acted to limit forest succession on the edges of meadows to maintain distinct forest-meadow boundaries. Fire may not have occurred in years of normal to above normal precipitation; however, drought years, which cured the herbaceous vegetation, increased fire frequency considerably. Pine seedlings tended to establish on the meadow periphery in years of low snowpack and early melt-off, however, these conditions favored the likelihood of fire. Meadow encroachment by conifers was cyclical. Historic burning by herdsmen also influenced fire occurrence. Livestock grazing and suppression efforts beginning at the turn of the century reduced natural fire incidence. Fire incidence is expected to be higher for the surrounding watershed than for a particular meadow site due to factors such as fuel moisture. Forested vegetation is expected to burn more frequently due to drier fuel conditions where a direct burn in a meadow was less common. The effect of fire on meadow composition varies with the intensity and depth of burning. At the watershed scale, fire had the effect of increasing sediment and water flows and influencing meadow evolution and ecology (Ratliff 1985).

2. Shrub/Bunchgrass Communities

Sagebrush steppe communities of the Intermountain West were also maintained by periodic fire (Miller 1997). Sagebrush plant associations were found adjacent to the edges of meadows and buffered between timber types. Low sagebrush/fescue-squirreltail communities were found in scablands and areas with restrictive soil depths. A majority were found in mid-late succession in reference times, with few early seral stands represented due to the low fire frequency of these communities. Low sagebrush sites have shallow soils and low herbaceous plant productivity that limited fire to 100-200 year cycles. Dispersed old growth (>150 years old) juniper were present in this type.

Mature stands of big sagebrush/bunchgrass represented climax or near climax conditions. Big sagebrush sites were once dominated by bunchgrasses and forbs due to more frequent fire events (every 12-20 years) keeping a mosaic of these communities in early succession. Due to natural disturbance regimes, conifers did not generally grade into shrub communities. The big sagebrush/bitterbrush/fescue type has shifted to a more even-age shrub community that is a concern in regards to forage production and wildlife habitat needs. In reference times, differing age classes and plant community structure would have been present for all shrublands.

3. Juniper Communities

Periodic fires and drought kept western juniper restricted to rocky hillsides, ridges and outcrops, historically. Few juniper would have been found in either low sagebrush/fescue/squirreltail or big sagebrush/bunchgrass communities. The low sagebrush/fescue/squirreltail association would have had less than 2-4 trees per/acre and 0-4 trees/acre were found in big sagebrush/bunchgrass communities (Hopkins 1979). Juniper expansion out of juniper/ low sagebrush/fescue communities began in the mid 1880's (Miller 1997), however its expansion is limited to several communities such as the low/sagebrush/fescue-squirreltail and expansion within and outside of the ponderosa pine/juniper/mountain mahogany-bitterbrush-big sagebrush/fescue communities. Past overgrazing set the stage for initial juniper expansion by reducing herbaceous ground cover, competition and fuels necessary to carry fire.

4. Open Forest Communities

The forested plant communities in the watershed that provide a forage base for domestic livestock, such as Ponderosa pine-juniper/mountain mahogany-bitterbrush-big sagebrush/fescue, Ponderosa pine/bitterbrush/fescue, Ponderosa pine/bitterbrush-manzanita/fescue, Ponderosa pine-Quaking aspen/bluegrass and Ponderosa pine/mountain big sagebrush/bluegrass associations, were maintained by a natural fire regime during the reference period. Historic fire regimes maintained understory vegetation in early to mid seral condition, while maintaining old growth overstory characteristics. Ponderosa pine communities were more open and "park-like". Low intensity fire kept pine seedlings and sagebrush from reaching a mature stature and maintained a herbaceous understory.

Aspen communities were naturally maintained by fire, which limited conifer encroachment and promoted vegetative regeneration. In reference times, aspen communities were most likely found in various un-even aged patches with active regeneration stimulated by fire, beaver activity and other natural disturbance regimes. Conifer encroachment into aspen stands would have been a minor issue in reference times.

Invasive Species

By definition, invasive species are non-native species whose introduction does, or is likely to, cause economic or environmental harm, or harm to human health. It is unlikely that any invasive plant species occurred in the watershed prior to European settlement.

Threatened, Endangered, and Sensitive Plants

There is no historical data available to indicate the distribution and abundance of the sensitive plant species found in the watershed prior to European settlement. Information on trend is also not available. Most site forms were recorded in the 1990s, and little monitoring has been done since sites were recorded.

Historically, fire was likely important in maintaining open meadow habitat for *Calochortus longebarbatus* var. *longebarbatus.* Monitoring on the Winema National Forest found flowering and survival of plants in burned plots was not significantly different from control plots, indicating the species is probably adapted to fire.

Hydrologic conditions likely determined the abundance and distribution of *Mimulus tricolor* along the Sycan River. Periodic flooding of the Sycan River may have been important in creation of habitat and dispersal of *Mimulus tricolor* seeds.

III. Terrestrial Species and Habitat

-

1. Northern Goshawks

No historic information exists on goshawk abundance or distribution. Based on historical vegetation information and descriptions of park-like stands of ponderosa pine, it can be assumed that nesting habitat was more concentrated in riparian areas because they likely had a greater basal area and denser canopy, which is more typical of goshawk nesting habitat, than the surrounding stands. Also, lodgepole stands may have received greater use as nesting habitat due to their higher basal area and denser canopy.

2. Primary Excavators

No historic information exists on the abundance or distribution of primary excavators. Ponderosa pine stands grew in a dynamic patch configuration, which resulted in even age patches, dead tree patches, and single dead trees. Lodgepole pine stands typically experienced chronic mortality until there was a stand replacing event (such as fire) on about a 200-year return interval resulting in large patches of dead trees. The establishment and persistence of white fir as a component of these stands was largely dependant upon rainfall. During periods of above average rainfall, white fir would be established in these stands, and grow until periods of below average rainfall created drought stress and weakened the trees making them more susceptible to insect and diseases. The increase in dead and dying trees would also increase fire intensity in these areas thereby killing more trees, which along with the dying white fir would provide additional habitat for primary excavators.

3. Mule Deer

Historical accounts of the Interstate and Silver Lake mule deer herds describe herds as being small and scattered in the early 1900's. Seasonal distribution of deer was most likely similar to what occurs today as deer traditionally use the same seasonal ranges over time.

Prior to 1870, deer ranges in lower elevations were probably dominated by bunchgrasses with scattered or clumpy distribution of shrubs. Distribution and density of both curl leaf mountain mahogany and bitterbrush were less than what they are currently.

Hiding cover prior to 1870 was probably adequate in most areas above 5,500 feet elevation, and poor over much of the range below 5,500 feet where more open ponderosa pine stands dominated. Fire suppression during the twentieth century has resulted in dense stands of mixed conifer and regeneration thickets of ponderosa pine increasing available hiding and thermal cover.

IV. Human Uses

Key Questions:

1. How should the watershed provide for future human uses and needs?

2. How will roads be managed to meet present and future uses and protect all resource values?

3. What logging and grazing methods may be necessary to meet resource and vegetation goals and objectives, and provide commercial products?

4. How should the watershed be managed to ensure that Treaty Rights and Trust Resources are protected?

Prehistory

The known physical evidence of human occupation within the Upper Sycan Watershed basin boundaries indicates that humans began to move into the area about 10,000 years ago to extract and utilize the natural resources found there.

Downstream from the Upper Sycan basin is the vast, open Sycan Marsh. This area of abundant natural resources (plants and animals) was central and primary to the aboriginal people and the focus of their activities in the seasonal round of resource extraction. The Upper Sycan flows through National Forest system lands, enters the Sycan Marsh which is privately owned by the Nature Conservancy and presently leased by the ZX Ranch and then re-enters National Forest system lands to continue on its journey to the Sprague River system. Numerous archaeological sites are found in the Sycan Marsh.

Archaeological sites found at the higher elevations adjacent to the Upper Sycan drainage are usually small, seasonal, multi-purpose hunting and gathering sites to the early inhabitants. The area near the Marsh was probably a seasonal, semi-permanent village site.

From there, they would have moved into the forest and up-country to hunt and gather on a seasonal scheme. For thousands of years these people focused on the abundant resources of the Sycan Marsh. The same plants, to a lesser degree, matured much later in the season in the Upper Sycan basin as compared to the Sycan Marsh, which gave the local inhabitants a sustainable source of food with abundant periods of production.

The few small upland lithic scatter sites were probably related at times to the few much larger complex habitation sites located in the Sycan Marsh. This scheme of seasonal migration and resource extraction probably continued for 8,000 to 10,000 years or more until the Euro-American people started to move into the area about 150 years ago. This seasonal gathering, hunting and migration of the aboriginal peoples had little to no impact on the landscape.

Digging roots in the meadows only increased the meadow's productivity and any fires were allowed to burn to manipulate and revitalize the vegetation found across the forests and open lands. Adjacent to these mostly utilitarian sites, there were some sites of ceremonial and/or religious nature. These sites are very sensitive and their physical remains are more subtle than the many lithic scatters found in the area.

The archaeological sites known to exist in the sub-basin have been evaluated and continue to be included in ongoing archaeological research in the area.

History

The Upper Sycan Watershed was a seasonal hunting and gathering area to the native populations. To the

early white settlers it was an abundant natural resource area for exploitation. The first white people were probably trappers, traders and mountain men looking for gold and beaver. As homesteads began to be built at the lower elevations, the newly introduced cattle, horses, sheep, goats and swine from the central farm locations moved up into the mountains during the summer months following green-up of grasses and other vegetation. People would follow and spend time with their livestock and over time set up line shacks and homesteads in these higher elevation areas. By the turn of the century, there were a half dozen such locations in and around the watershed.

1. Timber

Prior to World War II the harvesting of timber was of a limited nature and on a small scale. However, one of the first visible impacts to the landscape occurred with the advent of logging. Lumber markets grew from local to regional at the end of the reference period.

2. Grazing

Prior to Euro-American settlement, there was no livestock grazing except for possible wild horse herds. During the time between the first homesteaders (1870s) and the 1940s, when many small homesteads were started within the watershed, there were still large areas of public land, which was used in common. Fifty years ago there were both active and abandoned homesteads scattered throughout the watershed. Following the Taylor Grazing Act in 1934, grazing districts were formed and allotments were established.

Even though livestock numbers peaked in the early decades of this century, not until the end of the reference period was considerable effort made to manage livestock grazing. Reduced stocking levels and the initiation of range improvements were major tasks of the Forest Service at this time. Beginning during the first decade of the century to about 1930, Forest-wide sheep numbers went from 120,000 to about 80,000. This effort to reduce sheep numbers Forest-wide was also seen in the watershed. Cattle and horse head numbers were reduced from 26,000 to about 10,000. Although these large numbers of animals had a definite impact on the condition of the forest's grasses and shrubs, it was the long grazing season that had the most detrimental effect. During low snow years, such as the 1930's, livestock were basically left on the Forest year-round. More typically, season-long grazing extended up to eight months.

Early accounts by stockmen reflect that much of the watershed had open stands of ponderosa pine with a herbaceous understory making cattle movement easier and exceptionally open views readily available. Fire suppression has resulted in an increase in understory trees and shrubs. At the turn of the century, common use by all classes of livestock such as cattle, sheep, horses and swine was evident in the watershed. Records indicate that sheep grazed the watershed as permitted livestock after the establishment of the Fremont National Forest in 1907 up until the 1940's. However, trespass use by cattle and horses was common and led to problems with heavy use on the range. A drift fence, constructed in 1927, separated the Chewaucan Cattle & Horse Allotment and the Sycan Sheep & Goat Allotment and to help reduce trespass use. Trespass use, mainly by horses drifting over from the Klamath Indian Reservation remained a problem. The Weyerhaeuser Company at one time owned the large block of private land in the north central portion of the watershed. Weyerhaeuser leased their holdings to permittees to graze sheep up until the early 1940's, when the shift was made to the management of cattle grazing on these lands, which continues to this day through private land leases administered by U.S. Timberlands Company.

STEP 5. SYNTHESIS AND INTERPRETATION

The purpose of Step 5 is to compare current and reference conditions of specific ecosystem elements and to explain significant differences, similarities, or trends - and their causes. Information from the previous four steps is interpreted. The interactions of biological, physical and social processes are explained. The capability of the system to achieve key management plan (Fremont LRMP) objects is discussed.

I. Watershed and Aquatics

The main purpose of this chapter is to address the four key questions by summarizing current conditions within the entire watershed, then comparing these conditions with the desired conditions described in Step 4. For each element, ratings will be given (see desired conditions for ratings) along with a discussion of the factors contributing to current conditions as well as any trends in conditions.

Key Question 1): Is the upland portion of the watershed/subwatershed producing hydrological conditions (water and sediment outputs) that contribute to properly functioning riparian areas?

Key Question 2): Is vegetation in riparian areas contributing to appropriate channel types and hydrologic regime?

Key Question 3: Are the channels providing adequate fish habitat?

Key Question 4: How are the above subwatershed conditions influencing redband trout viability?

Upland Plant Communities and their Effect on the Amount of Water and Sediment Reaching Riparian Areas

Forest soil face ground cover decline. The shift away from open park land to dense stands is due to fire suppression across Oregon (Loy et al. 2000). The suppression reflects our transplanted values from humid eastern and European forest. So it has been difficult to see past our transplanted values. Yet in the past few decades there has been a growing realization about western forest structure; with the review of historic fire regimen, open and closed forest reference conditions have been identified (www.frcc.gov; Hann, et al. 2003). The local forests were mostly open forest. The forests were mostly grasses, forbs, and sagebrush steppe shrubs. It is a ground cover that responds well to iterative fire and annual summer drought.

On the up side, rangeland sagebrush steppe map units are sustaining their ground cover. And sediment risks are low. Ground cover decline in the forest or more completely the balance of ground and crown cover in east side pine forests are more at issue.

Recent attention to fires regimes and the roles of fires helps us to see beyond our transplanted values. Now we can better see the current decline in effective ground cover in forested soil map units. And we can see how the decline hampers the soil ability to catch, store, and release water for plant growth and stream flow over the dry season.

Like much of eastern Oregon, the Lower Sycan watershed faces the shift away from open park land to dense stands (Loy et al. 2000). The forest ground cover decline is more pronounce in the western potion of the Lower Sycan watershed, where meadow drying and loss to forest thickets is advanced.

In relatively sunny and dry eastern Oregon the shift to dense stand extends the annual summer drought and desiccates the forest. Water evaporated from plant varies with the surface area; additional cone shaped pine tree canopies increase overall evaporation. An average pine is about 110 foot tall and has a 40 percent crown with 15 foot radius. The pine's cone shape surface area is *about 3.1 times larger than surfaces area* of a 15 foot radius grassy area.

Across an acre the historic 20 percent pine crown cover evaporates 44 percent of the water. At the current 60 percent pine crown cover evaporation has increased 1.59 across the acre. This current elevated evaporation rate consumes soil moisture earlier in the summer. A 60 day soil water supply for May and June growth can be used up in 38 days. The current crown cover yields a shorter growing season and severe fire prone condition by early summer.

The shift to dense crown cover also limits nutrient supplies for forest growth because the ground cover drives the nutrient cycle in east side pines (Busse, et al., 1996, Johnson, et al., 1998). Comparing sites with and without ground cover over 30 years, sandy eastside pine soil carbon and nitrogen improved with understory ground cover for measurable gains in pine growth with ground cover (Busse's et al. (1996). Iterative ground fire restarts and recycles nitrogen throughout the forest ecosystem (Johnson, et al., 1998). Forest nutrient studied are beginning to explain why native people, like myself, saw the enhanced hunting or song bird conditions 30 years after ground fires.

Rather than cycling nutrient throughout the forest ecosystem with ground fires, dense stands risk nitrogen losses. The dense stand can better heat the soil and volatized the soil's nitrogen stores (DeBano, et al., 1998, Johnson, et al., 1998). With crown fires in dense stands, nitrogen is apt to pollution the air. The decline in ground cover leads to a decline in nitrogen and carbon inputs and the rise in stand density is apt to increase the losses as air pollution.

Summery of Synthesis and Interpretations

The shift from open to closed eastside pine forest effects soil moisture, which in the past fed streams, is consumed earlier for a longer summer drought, dryer riparian habitats, and less water for pools and fish refuges. And fire's effects on ecosystems are shifting from regenerative roles to polluting roles much like urban centers, which diminish recovery. Still, ground cover does recover after wildfires. In the adjacent 1992 Lone Pine burn area ground cover recovery has progressed through a flush of forbs such as lupine to relatively abundance of western needlegrass (Malaby, 2002). But the pines recovered with replanting and a heavy snow year.

Road Density, Location, and Drainage Network

There are 1,034 miles of roads and trails in the Lower Sycan Watershed, resulting in a density of 4.5 mi/mi^2 and using the criteria in Step 4 page 4 results in a rating of functioning inappropriately. Table 5-1. The majority of this density comes from the 784 miles of non maintained or natural surface roads and trailsl. When we look at the number of roads that are within 300 ft of a drainage channel we find there are 176 miles total and onty11.3 miles along perennial streams. This is due largely by the lack of perennial streams in the watershed The Sycan above the Sprague is the area with most miles at 8.6 mi miles of road along perennial streams.

The soils in the watershed as mentioned earlier are porous, thus the amount of surface runsff is reduced. However this does lead to ground water inputs which emerges as cool spring water (46°) in over 65 location in the lower watershed.

Table 5-1 Road density per square mile and the function rating. Lower Sycan Watershed, Oregon.

HUC_6_NAME	Road Density	Condition
Merritt Creek	4.7	Functioning Inappropriately
Silver Dollar Flat	5.1	Functioning Inappropriately
Snake Creek	2.2	Functioning at risk
Sycan Above Sprague	4.8	Functioning Inappropriately
Unnamed 2	4.5	Functioning Inappropriately
Grand Total	4.5	Functioning Inappropriately

Table 5-2 Road miles within 300 foot of stream channels by degree slope and subwatershed. Lower Sycan Watershed, Oregon

Sum of miles	SLOPE_CODE							
HUC_6_NAME	5	10	15	20	25	30	100	Grand Total
Merritt Creek	20.9	15.6	5.9	1.6	0.5	0.1		44.8
Silver Dollar Flat	2.3	5.8	2.2	0.2				10.5
Snake Creek	1.1	2.9	1.2	1.0	1.2	1.5	3.5	12.4
Sycan Above Sprague	29.2	13.1	4.6	1.9	0.4	0.2	2.5	52.0
Unnamed 2	24.0	25.2	4.5	0.8	1.5	0.1	0.7	56.8
Grand Total	77.4	62.7	18.3	5.6	3.7	1.9	6.7	176.4

Riparian Vegetation and Stream Channels

Lower Sycan River: The following table summarizes current and desired conditions for vegetation types and associated bank stability within riparian area. Ratings given within these tables are based on a comparison of current and desired conditions. For reach locations refer to Figure 3-7 - Reach locations for June 2001 stream survey Lower Sycan River. Reaches 3 and 4 are functioning inappropriately due to the low bank stability and lack of willows in the riparian area. Reach 6 is at risk for the same reasons. Reaches 1,2,5,7 and 8 are functioning appropriately.

Table 5 - 3 Riparian Vegetation and associated bank stability. Lower Sycan Watershed, Oregon
.

	Dominant Vegetation Class	Over Story	Under Story	Bank Stability	
Reach 1	Grassland/Forbs	Fir, Silver/Noble	Shrub Seedling	94%	appropriately
Desired	Willow			>90	
Reach 2	Grassland/Forbs	Fir, Silver/Noble	Shrub Seedling	99%	appropriately
Desired	Willow			>90	
Reach 3	Grassland/Forbs	Grassland/Forbs	Grassland/Forbs	82%	inappropriately
Desired	Willow			>90	
Reach 4	Grassland/Forbs	Grassland/Forbs	Grassland/Forbs	55%	inappropriately
Desired	Willow			>90	
Reach 5	Grassland/Forbs	Ponderosa pine	Grassland/Forbs	98%	appropriately
Desired	Willow			>90	
Reach 6	Grassland/Forbs	Ponderosa pine	Grassland/Forbs	90%	At risk
Desired	Willow			>90	
Reach 7	Grassland/Forbs	Ponderosa pine	Grassland/Forbs	99.6%	appropriately
Desired	Willow			>90	
Reach 8	Lodgepole pine	Lodgepole pine	Grassland/Forbs	98.4%	appropriately
Desired	Willow			>90	

Rosgen Stream Type(s)

All of the reaches 1- 8 are functioning appropriately in terms of there stream type. Reach 1 is a B stream type and the surveyed reaches up stream are stream type C.

Habitat for Aquatic Species

Habitat conditions are summarized based on the following parameters: large woody debris, pools, spawning gravel fines, stream temperature, and fish passage. Information in the LWD, Pools and Large Pools columns represent the 50th and 75th percentile for natural and near natural streams in the northern Great Basin (ICBEMP, 1997).

Table 5-4 Habitat ratings Lower Sycan June 2001 Sycan Rivar Oregon.

Condition

Reach	Reach Length (miles)	Owner	Reach	LWD/ Mile	Pools/ Mile	Large Pools/ Mile	Spawning Gravel Fines (%)	Stream Temperature		Fish Passage (Culvert)
				50% / 75%	50% / 75%	50% / 75%		(°C)	(°F)	
1	2.8	USFS	1 Desired	4 / 15	16 / 31	0 / 3	< 20	17.8	64.0	Passage
			1 Current	.7	43	na	18	30		Passage
			1 Rating	FI	FA		FA	FI		
2	2.64	USFS	2 Desired	1 / 4	4 / 8	0 / 1	<20	17.8	64.0	Passage
			2 Current	1.14	24	na	15			Passage
			2 Rating	FR	FA		FA			
3	21.01	USFS	3 Desired	1 / 5	6 / 11	0 / 1	<20	17.8	64.0	Passage
			3 Current	0	63	na	14			Passage
			3 Rating	FI	FA		FA			
4	1.32	Private	4 Desired	1 / 6	6 / 12	0 / 1	<20	17.8	64.0	Passage
			4 Current	0.8	18	na	22	28		Passage
			4 Rating	FI	FA		FR	FI		
5	3.09	USFS	5 Desired	1 / 4	4 / 9	0 /1	<20	17.8	64.0	Passage
			5 Current	1	21	na	26			Passage
			5 Rating	FR	FA		FR			
6	1.84	USFS	6 Desired	1 / 6	6 / 12	0 / 1	<20	17.8	64.0	Passage
			6 Current	0.5	16	na	28			Passage
			6 Rating	FI	FA		FR			
7	5.46	USFS	7 Desired	1 / 7	7 / 14	0 / 1	<20	17.8	64.0	Passage
			7 Current	1.65	20	na	32			Passage
			7 Rating	FR	FA		FI			
8	7.71	USFS	8 Desired	1 / 6	6 / 12	0 / 1	<25	17.8	64.0	Passage
			8 Current	0.65	20		40			Passage
			8 Rating	FI	FA	na	FI			

FA – Functioning Appropriately, FR – Functioning Appropriately but-at-Risk, FI – Functioning Inappropriately
NA – Information Not Available; ** - Habitat element not applicable for this reach; + - Rating modified based on reach characteristics
Habitat Abbreviations and Explanations: LWD – Large Woody Debris; Large Pools – Pools > 2.6 feet deep; % Spawning Gravel Fines - <6.4mm

Large wood is limited in the Lower Sycan all reaches are below standards. The numbers of pools per mile were all above the 75% standard an accurate count of large pools per mile was not available of analysis. Reaches 1-3 are functioning appropriately in regards to spawning gravel fines, reach 4 – 8 had high percentages of fines. The percent increases as you move upstream. Water temperature is high and has been addressed in the Upper Klamath Basin TMDL and Water Quality Management Plan. Redband trout have been observed in these high water temperatures and are in a healthy condition. It appears that these fish have adapted to these conditions.

Watershed Summary

Comparing 1993 hydrographs from the USFS 27 road crossing and the crossing at Drew's Road indicates most of the runoff season's sustained flow is generated from Sycan Marsh and above. The marsh buffers runoff by acting as a reservoir. The marsh traps sediment and Channels constructed in the marsh over the past century handicap the ability of the marsh to buffer runoff events which helped maintain stable channels below the marsh. As the marsh is buffering runoff, the watershed below the marsh is producing the very large short term flood discharges that have a negative effect on the Sycan in the analysis area. During peak flows of 1993, two-thirds of the peak discharge was generated below the marsh while very little of the sustained flow originated below the marsh. Merritt Creek watershed below the marsh. It also has long reaches of entrenched channel which lost contact with the floodplain. In the effort for Merritt Creek to reestablish a floodplain it must move large volumes of sediment which is delivered to the Sycan. The lack of floodplain increases peakflow that contribute to erosion and sedimentation on Merritt Creek and the Sycan. This may be one of the factor for the increase in fine sediment seen in the spawning gravels as you move upstream in the Sycan from Coyote Bucket to the mouth of Merritt Creek.

The aquatic habitat of the Sycan within the analysis area presents an interesting scenario of a river mostly confined within a narrow canyon and a very consistent gradient of less 0.4% until it drops into the Coyote Bucket and the lower gorge section has an average gradient of 3% with much steeper areas within these two gorges. Such a low gradient stream usually exists in broad valleys that allow the stream to meander which creates ample aquatic habitat in the form of undercut banks and lateral scour pools. Within the confines of the canyon, from the Marsh down to the Sprague River Valley, the Sycan has very limited opportunity to develop sufficient sinuosity to develop meander bends large enough to provide high quantities of fish cover habitat. Sinuosity for the lower river is 1.26 which is at the low end of the scale for C type channels.

The channel and aquatic habitat in this river are influenced by the high peak and low baseflow of the hydrograph, the narrow canyon and floodplain, the bedrock control, and riparian vegetation. These floods occur as a result of rain on snow with frozen ground result in the highest flows Large woody debris plays a very minor role in this system. The high peakflows and low gradient combine to float large woody debris out of the channel and on to the floodplain and the marsh also traps wood, thus there is very limited upstream inputs. Trees that fall partially into the channel, and are well anchored above the floodplain, can scour a lateral pool or build a bank at that point. Healthy riparian vegetation holds and organizes stream sediments in channels like the Sycan to form aquatic cover and habitat complexity that is missing .

With sufficient baseflow the river could provide a substantial quantity of cover habitat developed by turbulence and pool depth. The climate and geology of the watershed, however, only provide for a baseflow on the order of ten cubic feet per second (cfs). High peak flows, recently over 3000 cfs, are not conducive to development of stable habitat. Ten cfs spread over a channel scoured out by 3000 cfs limits habitat.

Where sufficient cover and water quantity do exist, very healthy redband trout are present. The redband trout in the lower Sycan are part of the Upper Klamath Lake Basin population This is the largest and most functional adfluvial redband trout population of Oregon’s interior basins This is comprised of 10 subpopulations that vary in life history, genetics, disease resistance and status. The fish in the lower Sycan are part of the Lower Sprague subpopulation. (ODFW 2005) Fish spawn from the mouth of the Sycan up to the Sycan Marsh. Most of the spawning is in the lower river with a strong spring influence. The fish migrate up into to the Sycan in the winter and spawn in the spring and migrate back downstream to suitable summer habitats. The large size, good condition factor and small population of mature redband trout in the lower Sycan implicate hiding cover and summer habitat (low flows and high water temperatures) as limiting factor of the redband population. Other fish present are marbled sculpin, pacific lamprey, Pit-Klamath brook lamprey, tui chub, speckled dace and Klamath largescale sucker. Merritt are

intermittent stream is the only other stream in the Lower Sycan Watershed that has a record of fish populations present. A limited survey by ODFW of Blue Creek May 5 2005 found no fish present.

Blue Creek in diverted at the USFS boundary which prevent water from flowing down the channel. However the diversion channels do connect in Blue Creek Meadows and there is a continuous flow to the confluence at least early in the year. Upstream of the diversion has been ditched and fish habitat is poor. Substrate is pumice, banks are un-vegetated and the channel is deeply incised. Conditions improve upstream with vegetated banks instream structure and good water quality. (Terry Smith USFS and Bill Tinniswood ODFW personal communication)

We did not obtain any information on the conditions of Snake which has its headwaters in the Balck Hills ares on USFS and flows for 13 miles to its confluence with the Sycan about 2 miles above the Sprague river at Drews road.

The Sycan river exists USFS property below coyote Bucket continues through a narrow steep canyon for about miles, then the gradient decreases the valley bottom widens, and the river begins to meander as it enters the Sprague River Valley.

In the 1800,s the this section Sycan River was likely characterized by a narrow meandering channel developed in a broad , well vegetated floodplain corridor. Due to the fine textured nature of the streambank and floodplain soils, riparian vegetation likely played a major role in maintain The narrow and deep channel morphology and high resistance to planform adjustment provided by riparian vegetation resulted in stream types that were hydraulically efficient and maintained a high sediment transport capacity. This stream type is best described as an E stream type according to the Rosgen classification system. WATER CONSULTING INC. 2001)

Based on review of the 1941 and 2002 aerial photo series, and field investigation of both the project area and reference reach channel conditions, it is apparent that major changes in the pattern and profile of the Sycan River occurred prior to 1941 and likely resulted from vegetation removal due to grazing and/or direct removal, and stream straightening. WATER CONSULTING INC. 2001)

The Sycan River has degraded. However, due to the influence of the Sprague River confluence, the Lower Godawa Spring Reach of the Sycan River has not incised to the degree evident on the Upper Brown Spring Reach located north of Drew's Road. Presently, the Upper Brown Spring Reach channel is incised approximately four to eight feet into the historical floodplain and is in a relatively early stage of evolution. A majority of the reach is classified as a highly entrenched, high width/depth ratio F4 stream type displaying extremely high bank erodibility and
impaired sediment transport capacity (Table 5-5). Although early floodplain formation inside of the F4 channel is evident in several locations, bank erosion continues to be a concern. WATER CONSULTING INC. 2001)

Table 5-5 Existing and potential channel dimensions . Sycan River Upper Browns Spring Reach, Oregon.

Bankfull Variable	Existing Dimensions	Potential Dimensions	Deviation from Potential Conditions
Bankfull Discharge (cfs)	700	700	-
Cross-sectional Area (ft^2)	310 (300 - 320)	280	+30
Width (ft)	84	50 (45 - 55)	+34
Hydraulic Depth (ft)	3.4	5.5 (5.0 - 6.0)	-1.6
Width/Depth Ratio	25	10 (8 - 12)	+15
Sinuosity	<2.0	2.4	-0.4

While the Lower Godawa Springs Reach is evolving in a process similar to that described for the Upper Brown Spring Reach, it is in a much earlier stage of evolution. The reach has not vertically incised into the valley fill to the degree evident on the Upper Brown Spring reach. This is most likely due to the influence

of the base level of the Sprague River confluence. Localized inclusions of incised F4 type channel are present in sections
due to abandonment of historic meanders and shortening of the stream profile. However, stream entrenchment is due more to over-widening than channel incision. WATER CONSULTING INC. 2001)

Field evidence and review of aerial photography from 1941 and 2002 suggested that the existing channel is much less sinuous than the potential channel pattern. The presence of historical oxbow meanders and floodplain swales indicate that the Lower Godawa Spring Reach was likely a more sinuous, narrow and deep channel with a broad, well-vegetated floodplain prior to significant disturbance WATER CONSULTING INC. 2001)

Historical channel length estimates were made for the Lower Godawa Spring Reach using aerial photogrammetric methods and field mapping in March 2002 (Table 7). Stream length associated with this reach of the Sycan River has been reduced by as much as 26 percent, or 5,800-ft from potential conditions. WATER CONSULTING INC. 2001)

Excessive instream deposition and channel braiding were also observed in the Lower Godawa Spring Reach. It is presumed that sediment produced from the degradational processes described for the Upper Brown Spring Reach is depositing in the Lower Godawa Spring Reach due to the channel's poor sediment transport capacity and
backwater influence imposed on the reach by the Sprague River during flood flows. Field data from longitudinal profiles and cross-sections collected on Lower Godawa Spring Reach indicated that the channel width/depth ratios ranged from 24 to over 60 . The increased channel area likely results in the active channel conveying flows that exceed the bankfull discharge. Flow confinement has accelerated streambank erosion and rates of downstream meander migration, initiated localized channel avulsions, and resulted in the steepening of the channel profile from Drew's Road Bridge downstream to the confluence with the Sprague River.
(WATER CONSULTING INC. 2001)

II. Vegetation

Key Questions:

1. How have landscape patterns of plant communities and seral stages changed over time?

2. What caused the changes in the landscape patterns of plant communities and seral stages? What effect have the changes had on the watershed's ability to withstand catastrophic events?

3. What rare or designated sensitive plants occur in the watershed?

4. Why and to what extent are noxious weeds invading sites within the watershed, and what strategies can be used to slow or prevent the spread of noxious weeds?

Forested Uplands

The two main contributors to the difference between current and reference conditions of the forested communities are timber harvest methods, and the alteration of the natural fire regime. Effects of insects and diseases are tightly connected to these two overwhelming forces.

1. Timber Management

Fire protection and widespread harvest of valuable large ponderosa pine has led to a change in landscape patterns, species composition, stand structure, and resistance to insects and diseases. What were extensive, open and park like stands of ponderosa pine have turned into dense, multistory structures with weakened overstories and high fuel levels. Conifer seedlings and shrubs have replaced grass species that co-evolved with frequent fires. Mixed conifer stands have closed into more homogenous structures with a species composition shift to white fir. Fine fragmentation has shifted to coarse and blocky due to the intensive forestry practices of even-aged management, namely overstory removals and clear-cutting. Seral stage distribution has shifted from one of being within stand to aggregations among stands.

With the pressure of fire protection and early grazing practices, dense understories began to develop under ponderosa pine canopies. These understories were pine and juniper at the lower/drier end and white fir at the upper/wetter end. Conifers have steadily encroached into meadows and riparian areas causing negative effects to other resources. Following WWII, harvest intensity ran the spectrum from removal of single "high risk" trees (in order to capture the mortality) to whole stands overstory removal. The fine scale fragmentation inherent within these stands was being replaced with a coarser "blocky" fragmentation. Early seral components within the larger historic stands were becoming their own stands. Species composition was changing from pure ponderosa to a mixed assortment heavy to the shade tolerant white fir with unregulated stocking. Due to the opportunistic nature of capturing mortality, many stands were being entered two and three times. Few stands can be walked today without seeing old skid trails leading to large ponderosa pine stumps. Soil compaction is being observed in some areas, with basalt derived soils at highest risk. Volcanic derived soils seem more resistant but they also can be compacted.

2. Insects and disease

Recent symptoms of poor forest health are being blamed on the combination of multiple entries, unregulated densities and transitions to shade tolerant species. Increases in the virulence of annosus and armillaria root diseases are linked to soil compaction, unregulated density and an increase of host species (white fir). Dwarf mistletoes have expanded, in part, due to the creation of multi-storied stands of a single species (results of partial overstory removals).

Frequent fires functioned as a control to dwarf mistletoe infections. Fire prevention has allowed mistletoes to spread unchecked. The degree of change is linked to the number of fire cycles skipped. Therefore, expansion is most notable in ponderosa pine and high energy mixed conifer communities. Bark beetle mortality is directly related to the size class and high densities that are occurring in these post-fire dependent stands. Recent large outbreaks of fir engraver are directly related to dense white fir conditions, which are occurring at a landscape scale.

3. Fire Ecology

The alteration of the natural fire regime has affected ponderosa pine types at the regional scale. A fire management strategy in effect during most of the 20th century that included prevention, detection, and suppression altered a reference condition fire ecology which had promoted the development of the open parklike stands. The speed at which stands have shifted from single to multistory structures seems remarkable until one realizes that on average, based on historical fire return interval, up to 10 fire cycles have been deferred in ponderosa pine communities. With the change in stand structure and density comes a

change in how these ecosystems are reacting to natural disturbance events. Due to the absence of "maintenance fires", wildfires today are more likely to produce "stand replacement" events. Newly developed shrub/seedling understories increase fuel loadings and create ladders into canopy crowns. Under such conditions, large, stand replacing fires are far more common than they ever were historically. The damage to the soil profile from such an event is severe and at a landscape scale. Soils may take only two to three years to recover from a light fire. An intense, hot fire that burns through the deep duff and "cooks" the soil may take centuries to recover (Pyne 1996).

Fire prevention strategy and livestock grazing has driven the most drastic changes within ponderosa pine stands. Understories of "second growth" ponderosa have developed in the absence of frequent under burns. These multistory stands are taxing the growing space provided on most sites. Only where fire has been carefully prescribed under the natural fuels program have stands been maintained in a single story structure, which was historically the norm.

Since the fire return interval in lodgepole pine forests is relatively long compared to the other forest types within the lower Sycan Watershed, fire exclusion has probably had the least effect in this type. However, the watershed has not experienced large-scale disturbance in at least the past 80 years. Fire behavior and intensity in lodgepole, as in other plant associations, is driven by fuel loading and continuity which are largely determined by the spatial scale of the insect disturbance. In the past, the watershed probably would have experienced at least 1 fire per century averaging several thousand acres.

Higher elevation mixed conifer and lodgepole pine have not been as radically altered by fire suppression, as have the ponderosa pine and lower elevation mixed conifer. What was historically a somewhat patchy, coarse fragmentation, is today very homogenous. Stands are slowly becoming less structurally diverse, broken only by plantations and overstory removal units. In fact, not accounting for structural stage distribution, some clear-cut harvested areas resemble what a fragmentation pattern may have looked like in mixed conifer types. Mid seral structure is slowly disappearing. The future mid seral stands are still sapling-sized plantations and define the lag time in seral distribution.

4. Open Forest Communities

The open pine associations such as ponderosa pine-juniper/mountain mahogany-bitterbrush-big sagebrush/fescue, ponderosa pine-quaking aspen/bluegrass and ponderosa pine/mountain big sagebrush/bluegrass have been affected by the interrupted fire regimes that once kept their understory vegetation in a park-like condition. Ponderosa pine communities with a big sagebrush understory were maintained in an early to mid seral condition that favored herbaceous species and a highly dispersed pine overstory. This herbaceous/forb understory ecosystem has been largely replaced with mature brush species and conifers in varying degrees of regeneration. Turn of the century grazing also attributed to this increase in seedling survival by reducing herbaceous plants ability to compete and provided favorable seedbed conditions through trampling and litter displacement. Understory forested vegetation in the ponderosa pine type exceeds historic density.

Historically, aspen communities were naturally maintained by fire and possible beaver activity as both acted to stimulate vegetative regeneration. Utilization of aspen suckers in reference times would have been restricted to native herbivores in small concentrations. Current utilization levels by domestic livestock are likely higher than levels associated with ungulate browse in reference times. Conifer encroachment into aspen stands would not have been an issue in reference times due to natural disturbance.

5. Old Growth, LOS and Historic Range of Variability and Old Growth Core

As reported in Step 4, the best information available on the historic vegetative types in the Lower Sycan Watershed comes from the 1946 and 1947 Timber Type Maps. This information can be compared with

current condition to determine if current single-storied LOS is within the historic range of variability of such structure.

The Fremont National has never mapped the late seral ponderosa pine and pine associated types. This represents a data gap in the analysis. The harvest layer is also not complete. This results in a lack of data to compare historic late/old seral stages in a historical and current context with a high level of confidence. However, based on the level of agreement between 1946-47 timber types and current GIS ecoclass acreages, an adequate comparison of historic and current conditions in some areas can be made.

From the data and inspection of current stand conditions, it can be concluded that the ponderosa pine forested types are below the historic range of variability for LOS single storied stand structure. This conclusion is based on the age classes of the understory vegetation that are not presently old enough to have been a significant component of the pre-1900 stands. Hopkins describes historical old growth ponderosa pine stands (pre-1900) as having approximately 20 – 30 trees per acre in the 17 inch and larger diameter classes with fewer than 5 seedlings per acre and less than one downed log per acre. Numerous spike topped trees occurred in these stands.

6. Lodgepole

Lodgepole pine is above historic range of variability for late condition. This would be expected in areas where fire suppression has been effective. Stands at higher elevations are approaching a stage of high susceptibility to Mountain Pine Beetle attack. Upon reaching 120-150 years in age, lodgepole pine stands are generally thinned from above by the beetles and in the absence of fire, the larger diameter trees remain as snags for an average of 11 to 20 years and then collapse into tangles of jackstrawed down wood. Such conditions provide excellent habitat for several woodpeckers and American marten.

Invasive Species

Relatively few invasive plants have invaded the Lower Sycan Watershed since European settlement. The current weed density in the watershed is low compared to other parts of the Fremont-Winema National Forests, with large areas remaining weed free. The lack of invasive species in the watershed may be because of the presence of pumice soils. In general, few invasive species sites on the Fremont-Winema have been found in areas with pumice. Lack of major wildfires (less than 1,000 acres have burned in the past xx years) may also be a factor. On the Forests, the largest infested acreages occur in past wildfires, followed by timber sale units. However, the greatest number of weed sites on the Forests occur along roadsides, and roads and vehicle traffic appear to be the major source of weed spread. Roads also appear to be causing weed spread in the Lower Sycan Watershed, since the majority of the sites occur along roadsides.

The watershed is most at risk to spread of musk thistle and Canada thistle from other areas of Bly and Chiloquin Districts where they are more abundant. The large scablands in the watershed are also potentially at risk to invasion of medusahead, which is present elsewhere on Bly District.

Inventory and treatment of noxious weeds has occurred in the watershed since 2002 and is funded through 2006. The ability to conduct treatments after 2006 will depend on outyear funding.

Invasive species prevention is currently being implemented on the Forests. Guidelines have been developed to minimize the introduction of invasive species, minimize conditions that favor the spread of invasive species, and minimize conditions that favor the establishment of invasive species (see Fremont-Winema National Forests Invasive Species Prevention Practices, June 2005).

Threatened, Endangered, and Sensitive Plants

No historical information is available to assess potential changes in the distribution and abundance of *Calochortus longebarbatus var. longebarbatus* and *Mimulus tricolor* since European settlement. It is assumed that the species had a similar distribution to the current condition.

Almost all of the meadows and grassy openings that comprise *Calochortus longebarbatus* var. *longebarbatus* habitat in the watershed are currently in allotments grazed by cattle and these sites have likely been grazed for decades. The effects of livestock grazing on this species since European settlement are unknown. Monitoring on Chiloquin District found no statistical difference between grazed and control plots during a 5-year period (Goldenberg, 1997). Observations and studies in California have suggested a negative affect (Goldenberg, 1995). Although thought to have low palatability, *Calochortus longebarbatus* var. *longebarbatus* may be grazed along with closely growing grasses, reducing vigor and seed output. Alternatively, grazing may reduce competition from grasses and potentially help maintain *Calochortus* populations (Wooley, 1996). The degree of impact caused by grazing may be related to the time and duration that livestock are allowed on the site, with more damage caused by early season use (Kaye and Rittenhouse, 1990). In addition to herbivory, trampling, soil disturbance, compaction, and altering the composition of associated vegetation by livestock could have impacted *Calochortus longebarbatus* var. *longebarbatus* habitat. Habitat for *Calochortus longebarbatus var. longebarbatus* also have been affected by lack of fire since European settlement. In the absence of fire, tree encroachment into dry meadows may have reduced the amount of suitable habitat present in the watershed.

Mimulus tricolor habitat in the watershed has also been grazed by livestock for decades, although the occupied section of the river will be excluded from grazing in the future. The effects of past grazing on *Mimulus tricolor* are unknown. Because of its low stature, it is unlikely livestock eat *Mimulus tricolor*, however trampling may damage plants and reduce seed production. Alternatively, livestock may help create bare, open microsites which can be inhabited by the species. Changes in the hydrology of the river caused by activities at Sycan Marsh may also have altered *Mimulus tricolor* habitat, although the effects are unknown.

III. Terrestrial Species and Habitats

1. Northern Goshawks

Goshawk habitat quantity and quality has declined where open, parklike late and old seral (LOS) pine stands have been replaced by dense, multi-story LOS stands. Increases in lodgepole pine LOS may influence goshawk territory locations. This may reflect a loss of suitable habitat in ponderosa pine and mixed conifer habitats rather than a preference for lodgepole pine. Goshawk appear to be utilizing the dense overstory, high canopy coverage, LOS lodgepole pine stands for nesting activities. Insect infestations in lodgepole pine and resultant salvage activities as well as general timber harvest activities are reducing the availability of this habitat for nesting goshawks. Habitat security has declined since the 1940's in association with increased disturbance from higher road densities, increased commercial logging activity, and greater recreational use.

Foraging habitat quantity and quality has declined where open, parklike LOS pine stands have been replaced by dense, multi-story LOS stands. Habitat for goshawk prey species and foraging has improved where the removal of LOS forest has increased the area of open, early seral forest cover types in small (< 4

acres) patches and edge habitat around larger openings. Habitat quality has declined since the 1940's with increased disturbance from higher road densities, increased commercial logging activity, and greater recreational use. Potential forest regeneration treatments on private lands and smaller openings created by future uneven-aged treatments on National Forest lands could continue to create edge habitat for goshawk prey species and more suitable prey and hunting habitat for goshawks. Road closures and obliterations would help reduce habitat fragmentation.

Nesting habitat conditions were more suitable prior to 1945 when contiguous open LOS forest matrix and interior habitat dominated the landscape. The preponderance of open, parklike ponderosa pine LOS forest cover and more area in mature aspen clones provided a greater abundance of and more suitable habitat conditions for goshawk nesting. A greater abundance of prey species associated with LOS forest cover and dead wood would have been present, especially species associated with the high cone production characteristic of open, large tree ponderosa pine forest. The smaller scale horizontal and vertical structural diversity created from natural disturbance within the forested landscape provided diverse habitat for prey species at more of a micro scale than the macro scale regeneration units present today. Younger stands of lodgepole pine were less suitable goshawk habitat than the more abundant LOS stand structure seen presently. Habitat security would have been relatively high with lower road densities and less incidence of human use or timber harvest activity.

2. Primary Excavators

All subsheds have probably experienced a decline in primary excavator populations in the last 50 years, although localized shifts in distribution to reflect blowdown, fire or insect outbreak events have undoubtedly occurred. Habitat quantity and continuity have declined during this period while suitability has increased with large tree mortality in late and old forest cover.

Loss of dead wood and subsequently smaller populations of cavity excavators, with more restricted distribution, means less predation on insect populations. Strong populations of woodpeckers can actually help suppress epidemic outbreaks of insects that cause extensive forest mortality.

Trends in the vegetation characteristic of the landscape lead to conclusions for several species. Excavators associated with open late/old ponderosa pine forest cover, such as white-headed and Lewis woodpeckers, have undoubtedly experienced a decline in habitat suitability/availability and bird distribution and abundance. This decline is a result of forest succession from an open pine to a denser understory and/or mixed conifer dominated forest with a large component of lodgepole pine or white fir. Stand succession and fire suppression have also increased stand density to the detriment of these species, which prefer more open understory stand structure. For black-backed woodpeckers, habitat availability and suitability have declined in ponderosa pine and mixed conifer habitats. This decline can be attributed to the loss of LOS pine forest and to forest succession in remaining LOS forest from ponderosa pine to a more mixed conifer forest. Black-backs prefer true pine types and large contiguous stands rather than fragmented patches of LOS forest cover interspersed with early to mid seral disturbance patches. Maximum and mean patch size and interior habitat in LOS ponderosa pine and mixed conifer habitat have declined since 1945. Habitat availability and suitability have increased in lodgepole pine habitats with the increase in LOS forest cover. Overstory mortality occurring in large diameter pine and fir in recent years from drought, overstocked stands, and an increase in disease and insect activity in all stand types have created additional snag habitat. This has improved nesting habitat conditions and foraging opportunity. Sanitation and salvage logging, however, have limited the availability and abundance of this habitat.

Sanitation and salvage harvest prescriptions and underburning will likely continue to reduce dead wood habitats, but if sufficient snags and down wood are protected and additional amounts of down wood are created through insects, disease and fire, most dead wood associated MIS and other species should maintain stable populations.

3. Mule Deer

Seasonal big game ranges and migration corridors on private and public lands have been altered considerably within the past 50 years. Agents of change, including commercial timber harvest, fire suppression, wildfire, plant succession, livestock grazing, transportation corridors for public and industrial access and recreational developments have cumulatively altered the landscape. Drought, insects, and disease in recent years continue to cause additional modifications to all seasonal ranges and migration corridors in all ownerships.

Prior to Euro-American settlement, big game ranges were partially maintained by wildfires (both Native American ignited and natural ignitions) that created a mosaic of successional stages from early to climax. This provided the vigorous supply of winter browse, cover and early green-up grasses and forbs that is necessary for reproduction and survival.

Fire suppression since 1910 has acted as a habitat change agent and created an unnatural condition that has benefited browse species such as antelope bitterbrush and curl-leaf mountain mahogany in the short-term. However, in the long term, this same protection from wildfire has created even-aged decadent stands of

bitterbrush and mahogany with reduced reproduction and vigor. Fire suppression has also allowed western juniper to establish in areas where juniper was historically a minor component of the landscape. In the absence of natural wildfires, juniper has expanded at the expense of the understory shrubs and native herbaceous species. These two factors are thought to be important factors that are limiting deer herds from reaching or maintaining management objective levels. Historical fire regimes maintained stands in a mosaic of plants of various age classes and allowed vigorous growth and seedling establishment.

About 1930, deer numbers began to increase. By the mid 1940's range damage due to deer overuse was noted. The Interstate Herd was estimated at 14,000 to 14,600 deer in 1946. The Siler Lake herd was estimated at 12,500 in 1959. Reasons for the increase beginning in 1930 are not clear, but contributing factors probably include predator reductions, decreases in cattle and sheep grazing, weather variations, protection from hunting, and shifts in the fire regime leading to increased production of shrubby forage.

Livestock grazing, drought cycles, and insect outbreaks have negatively affected deer habitat. Intense livestock overgrazing in the early 1900s by domestic sheep, cattle and horses created severe competition with mule deer for early green-up grasses and forbs and winter browse. Drought cycles that occurred periodically further limited grass/forb production and browse seedling establishment. Insect infestations contributed to the decline of browse species by limiting flower and seed production and affecting the overall vigor of plants

There has been a loss of riparian deciduous vegetation (willows, aspen and shrubs) and lowering of water tables in riparian zones as a direct result of overgrazing through the early 1900s. This in combination with insect infestations and resultant timber salvage operations has altered the abundance and distribution of fawning habitat and forage. The gradual current recovery of riparian vegetation, which is occurring around many stream and spring areas under present livestock management, should benefit deer.

The current amount of effective cover is likely greater than it was historically based on vegetation and disturbance regime changes. Distribution of cover, however, is poor resulting in large areas where cover is limited, thus negatively affecting habitat. It can be assumed that more frequent fires historically allowed more herbaceous forage habitat in ponderosa pine habitats. Fire suppression throughout the twentieth century has caused a transition in stand structure from more open to more dense understories. This has increased hiding cover and reduced forage in historically open habitats. During the same period, timber harvest activities have reduced cover in higher elevation lodgepole pine and mixed conifer habitats. This has resulted in highly fragmented, patchy areas of cover where large, relatively unbroken tracts of cover existed historically. While forage areas were created by timber harvest activities, a continued creation of openings by harvest has not occurred on a large scale since the late 1980s. Many man-created forage areas have since reforested and are transitioning to a state of cover. Generally, thinning prescriptions within these openings allow for short term retention of forage but act to retard the transition to cover. Eventually, canopy cover begins to retard forage production and at the same time, tree density in the thinned stands is generally inadequate to provide cover. In this case, the value of the stand as mule deer or other big game habitat is minimized. Fire suppression has also precluded creation of short-term forage areas. If current trends continue, loss of forage would become even more pronounced in the next several decades as large-scale wildfires and insect outbreaks become the sole creators of forage habitat. Prescribed fire, understory thinning, and commercial harvest are tools that can be used to restore foraging habitat on a more predictable schedule. However, restoration of forage generally corresponds to a reduction in hiding, thermal and sometimes fawning/calving habitat. Maintenance of effective mule deer habitat at optimum or even minimum levels can conflict with management of forested stands for optimum sustainability. At some point, if historic forest stand conditions are promoted on a wide enough landscape scale, ODF&W and Klamath Tribes management objectives for mule deer population numbers would be impacted; however, based on current funding rules and regulations, it may be some time before this could occur, and we would likely see management objectives met before they began to decline.

Big game security has been reduced by increases in road densities in the past 50 years. Road prisms have reduced the amount of available habitat and vehicle traffic has displaced big game from areas adjacent to open roads. Roads have also increased vulnerability to harvest and poaching, further reducing big game security. Road closures and obliterations could increase habitat availability and security.

IV. Human Uses

Key Questions:

1. How should the watershed provide for future human uses and needs?

2. How will roads be managed to meet present and future uses and protect all resource values?

3. What logging and grazing methods may be necessary to meet resource and vegetation goals and objectives, and provide commercial products?

4. How should the watershed be managed to ensure that Treaty Rights and Trust Resources are protected?

Timber

Timber harvesting conducted both on private lands and on the National Forest, particularly harvest of large ponderosa pine, following the end of World War II has left a visible impact on the forest landscape through out much of the watershed. Besides the removal of large trees, road building and other logging related ground disturbances are apparent.

Up until World War II, timber harvest had been limited, with most of the timber going to local markets. The style of cutting focused on removal of scattered large trees and tended to leave a natural appearing forest when harvest was completed. After World War II, the increased demand for wood products triggered an accelerated harvest scenario that slowly began to change the appearance of the natural landscape.

Harvest levels on the National Forest lands held steady or increased, peaking in the 1980's. In the 1990's, management guidelines directed the planning and implementation of timber sales toward an objective of maintenance and enhancement of LOS. This has triggered a shift in the type of harvest from overstory removal or regeneration or uneven aged management, to understory thinnings (both precommercial and commercial). Timber harvesting in the past 10 years has reached a relatively stable rate, well below the levels of recent decades. Timber management activities are currently focused on large tree culturing. Smaller diameter trees than were harvested in past decades are being cut. Most harvests occur on gentle slopes. Outputs are expected to remain steady for the next several years.

Grazing

During the latter part of the nineteenth century, homesteaders who had settled at the lower elevations of the watershed would move their cattle, sheep and horses seasonally up into the higher reaches of the drainage

basin. During the early part of the twentieth century, sheep and cattle grazed heavily throughout the watershed. It wasn't just their vast numbers, but the fact that they grazed year around that had an effect on the watershed's vegetation. After the Taylor Grazing Act of 1934 and World War II, domestic grazing declined. Gradually sheed herding gave way to cattle production and today cattle are the dominant commercial grazing animal in the watershed.

Impacts from earlier grazing activity can still be seen today, especially in the condition of some of the streambanks and riparian areas at the lower elevations. Also, plant species composition has been altered to some extent by intensive grazing. Grazing, however, does not seem to have had an impact upon the presence of those food plants that are traditionally of interest to the American Indian people.

Range management in this area has changed significantly over the past 30 to 40 years. Reduced animal numbers and pasture rotations have led to an overall improvement in range conditions and riparian habitat. Partnership agreements with permittees have benefited both the permittee and the resources. Improvements continue to occur, utilizing grazing as the disturbance agent in some plant communities.

Recreation

The increased demand for recreation on the National Forests has affected this area. More and improved campgrounds, trail construction, universal accessibility, and improved roadways have been provided in response to the demand for increased recreation. Recreation is currently one of the Forest Service's primary emphasis items. This trend is expected to continue, and as such, will affect future activities in the Upper Sycan Watershed.

Subsistence Hunting

The Klamath Tribes traditionally, and currently, use the area for subsistence hunting of mule deer. Tribal reliance on mule deer increased along with increases in the mule deer herd during the 1950's and 60's. Some of these increases in herd size can be tied to improved mule deer habitat as a result of wildfire suppression. Any significant increase in the use of prescribed fire, especially when combined with understory thinning, has the potential to impact both cover and forage components of mule deer habitat. The Tribal Game Commission has consistently expressed concern about the effect that the reintroduction of fire could have on mule deer habitat.

STEP 6. RECOMMENDATIONS

Step 6 provides recommendations based on the analysis presented in the previous 5 steps. This step also identifies monitoring activities that are needed in association with these recommendations. Data gaps and limitations of the analysis are also documented. Recommendations are designed to identify management activities that are responsive to needs identified in this watershed scale analysis. Specifically, management actions which address differences between current and reference conditions, where there is a need to provide restoration, maintenance, or protection of ecosystem components in order to sustain the health and productivity of natural resources. Any actions or projects, which utilize the information presented in this Watershed Analysis, will be analyzed on a site-specific basis by an interdisciplinary team and will include both public involvement and disclosure of decision as prescribed by the National Environmental Policy Act (NEPA).

I. Watershed and Aquatics

-

Uplands

1. Upland Plant Communities and their Effect on the Amount of Water and Sediment Reaching Riparian Areas

Most Oregonians want to restore National Forest after severe wildfires (Milstien, 2005). Although three-quarters of Oregonians favor logging of wildfire areas and planting of seedlings, it is inefficient. Higher economic values are gained by logging unburned forest to achieve natural thinning of mostly open forests. And thinned pine trees provide a locally adapted and affordable seed supply. Thinning and ground fire practices can better mimic reference stand structures and seral stages see www.frcc.gov; Mooney, 2005. Then ground fire will be an asset to soil conservation.

Forest structure should be rebalanced iteratively to recover ground and crown cover associated with about 80 percent open forest in fire regimen reference conditions. Rebalanced or reference forest conditions are needed to recover soil moisture for: June forest tree growth; moderated summer drought; wetter riparian habitats; and pools for fish refuges. They are also needed to re-gain positive fire's effects, rather than produce nitrogen pollution.

Bly and Chiloquin Ranger District projects have begun to rebalance the forest for road side grass water ways and aspen and hunter camp spring recovery. But the work needs to be expanded for landscape scale forest functions. Open forest will better sustain the local soil biology and conservation. By rebalancing the forests, we show that we learned the "Dust Bowl" lessons: soil erosion is moderated by well-rooted ground cover that helps soils to catch, store, and release water for plant growth and stream flow over the dry season.

Data Gaps

Rebalancing native forest structures for ample ground cover response will take iterative efforts to identify the range of "honeycomb like" forests openings. In large burns like Lone Pine burn (Malaby, 2002) ample ground cover occurs, but in small openings the response is muted. Finding the reference or range of opening for ground cover response for nutrient (Busse's et al. 1996, Johnson, et al., 1998) and snow catch (Church 1912) will require some testing, especially with wildfire regimes closer on 15 year cycles and nutrient recovery closer to 30 years.

A related topic is carbon sequestration. It may be the most over looked aspects of recovering a reference open park land forest. Generally carbon sequestration depend more on the grassy ground vegetation than tree crowns. Yet the balance of ground and crown plant species for carbon sequestration is unclear. But it is unlikely to be the current dense tree stands. Because mollisol and dark Andisol soils in the Lower Sycan watershed accumulated organic carbon with grass-steppe ground vegetation.

Like the Dust Bowl recovery, rebalancing native forest structures will require us as a people to see past our transplanted values, so it will be difficult. It may be the most difficult for our urban majorities who live with imported forest that they water to transplanted humid conditions.

To reduce the risk of catastrophic fire and associated soil erosion, sedimentation, and increased flows, especially in the ponderosa pine and mixed conifer sites, forest understories should be thinned. Refer to the map *Figure 5.1 - Upper Sycan River Watershed Upland Vegetation*, following page (5-1), for locations of areas with canopy closures, which exceed historical conditions. This will promote conditions for low intensity fires to re-occur, either naturally or controlled, throughout the watershed and reduce the potential for epidemic insect and disease outbreaks.

In the dry meadows, aspen stands, and other non-forested areas, conifers (including juniper) that became established after the advent of fire suppression should also be considered for thinning. Aspen stands will continue to decline across the subwatershed with the absence of fire. Thus, the use of prescribed fire, as well as thinning of conifers, is recommended to restore these sites (when thinning conifers within these stands, fall the trees in an array that provides a barrier to livestock grazing--this enhances the likelihood for sprout reproduction to regenerate).

Where junipers have encroached, thinning may be required to promote the growth of native grasses, forbs, and shrubs. In these areas, trees should be selectively cut. Limbs should be scattered on the ground to prevent erosion and provide a better environment for the growth of ground vegetation. Removal of boles would be acceptable under some conditions. Although juniper encroachment has been slow, and primarily isolated to the western portion of the watershed, curtailment is necessary so junipers do not eventually dominate a larger portion of the western watershed--leading to even more adverse effects on water quality.

Where possible, skid trails and landings should be eliminated throughout the watershed to alleviate past soil impacts, beginning with those areas where understory treatments will occur.

Recommendations to enhance and manage watershed conditions for the desirable hydrologic regime (snowmelt hydrograph) coincide with maintaining favorable conditions for northern goshawk. For example, desired conditions for uplands, described in Chapter 4, state that openings (early-seral condition) can account for approximately 5-20% of the forest lands within subwatershed/watershed--based on research which has shown detectable changes in stream flow when 20-30% of a watershed is in a cutover condition (Troendle 1982). This corresponds with management recommendation for northern goshawk, which call for maintaining about 35-50% of the forested stands in a late-seral condition (mature and old), roughly 35-50% being in a mid-seral condition (young and mid-aged), and the remaining 5-20% in openings and early-seral condition (Reynolds et al. 1991). Furthermore, these recommendations state that openings/early-seral condition areas be less than 4 acres in size. Again, these recommendations correspond with those for maintaining a desirable hydrological regime. When the objective is to reduce the highest flows and spread runoff over a longer period of time, small openings (2-8 tree heights across) on low energy slopes, tend to deposit snow in concentrations where melt is delayed (Satterlund and Adams 1992). This may be considered desirable since it is believed that the effects of the increased drainage network throughout the Upper Sycan River Watershed, from roads and detrimental soil compaction, have modified or desynchronized the flow regime (modified the timing, magnitude, and frequency of peak flows).

2. Road Density, Location, and Drainage Network

To reduce the adverse effects of roads on aquatic resources, road miles should be progressively decreased through obliteration or permanent closure. In the Lower Sycan River Watershed, to reach the desired road density of 1.7 mi/mi² and a functioning appropriately rating will require obliterating approximately 640 miles of road.

An inventory of all roads within the analysis area should be completed to determine which roads were necessary for recreation, access, and a sustainable flow of goods and services, as well as to identify those unneeded or substandard roads for decommissioning. From this information roads and trails can identified as unneeded or causing environmental damage. Emphasis for obliteration or or repair should be placed on those roads within 300' of streams and those with the steep slopes Table 3-9. The remaining roads should be properly drained to reduce the hydrological connection to stream channels, resulting in less water and sediment flowing down roads and their ditches.

3. Riparian Vegetation and Stream Channels

In all reaches where conifer encroachment is common, mechanically thin encroaching conifers and/or allow prescribed fire to creep into riparian areas. This will reduce conifer densities and maintain growth of riparian grasses, shrubs, and trees. Implement grazing management that promotes the growth of willow and improves width-to-depth ratios along C and E stream types.

Along the Sycan River, the topography of the river canyon functions as the allotment boundary separating two allotments, however, no fences exist along the river. It is recommended that a fences beconstructed so livestock are not able gain access into the river canyon. This will keep livestock from finding their way down into the river corridor, where they can spend a good part of the grazing season.

Management which promotes late-seral vegetation will improve habitat conditions for beaver. Reintroduction of beaver should occur once sufficient vegetation exists to support beaver populations, may improve habitat condition in the Sycan

Implement recommendations in the upland and riparian vegetation sections described in this analysis. Emphasis should be placed on implementing grazing practices that promote the growth of sedge, rush, and willow – plants required for high bank stability and low width-to-depth ratios in low gradient systems. If structures are utilized along the eroding meanders, they should only be ulitized only after be analysis bya team of qualified hydrologist, ecologists geomorphologist and fisheries biologist. These actions will aid in maintaining or producing the desired stream types.

Even though ***total*** pool numbers are at desired levels in reaches surveyed, additional ***large*** pools are needed – in many of these reaches – to meet desired conditions. Although the small size of most of these streams may be limiting the amount of large pools, the abundance of late seral vegetation is promoting continued recovery. This recovery will improve channel integrity and lower width-to-depth ratios, conditions that promote deep and complex pools that have an abundance of undercut banks for fish cover. To accomplish this, grazing strategies that promote the growth of late-seral vegetation will need to be maintained or promoted. Also, managing for beaver and their dams would increase deep pool habitat and cool water refugia (Reach 1 of Watson Creek serves as an example of how beaver dams can influence the number of large pools).

Higher stream temperatures can be found in the mid to lower portions of Paradise Creek, Watson Creek, and the Sycan River all of which are located within, or downstream of, low gradient meadow or forest/meadow reaches. These are the areas that require the most attention within the watershed, because they have been affected by at least one factor influencing stream temperatures – stream channels that are slightly wider than desired, loss of riparian and upland shade, lower stream flows caused by increased evapotranspiration, etc. With continued improvement in riparian and stream channel conditions, shading and a narrowing of stream channels could result in slightly lower stream temperatures, however it is unknown as to whether or not current state standards can be achieved in all streams.

Implement recommendations found in the riparian vegetation and Rosgen stream type sections of this chapter.

DATA GAPS AND MONITORING ACTIVITIES:

-

- Merritt Creek should be surveyed to determine the condition or the stream channel and riparian areas . And appropriate management emblemented.
- The habitat conditions on Snake Creek need to be documented.
- Habitat conditions in Mill Creek and Bob's Creek need documentation. A 1.8 mile section of Mill Creek has perennial flow.
- Data is needed on the level of soil impacts that have occurred within the watershed.

II. Vegetation

Key Questions:

1. How have landscape patterns of plant communities and seral stages changed over time?

2. What caused the changes in the landscape patterns of plant communities and seral stages? What effect have the changes had on the watershed's ability to withstand catastrophic events?

3. What rare or designated sensitive plants occur in the watershed?

4. Why and to what extent are noxious weeds invading sites within the watershed, and what strategies can be used to slow or prevent the spread of noxious weeds?

Forested Uplands

GENERAL

The watershed should be managed to approximate the historic range of variability. This would include reducing stocking levels, reducing juniper encroachment, and reducing white fir encroachment. This would lead to healthy stands which are more able to resist the episodic events which lead to stand replacement.

In the Ponderosa Pine and Pine Associated types emphasize return of at least 35% of the stands to a single-story LOS condition. In doing so, retain the entire existing LOS component. Locate treated stands to surround existing old growth as much as possible to increase the percentage of core old growth. Thin mid seral ponderosa pine to favor the development and protection of large diameter ponderosa pine.

Some existing Forest Plan designated old growth stands are currently isolated without good connectivity corridors to other stands. Where this is the case designate corridors averaging four hundred feet in width and encourage prescriptions that result in development of future LOS as rapidly as possible, i.e. fewer healthy pines than full occupancy of the sites might warrant if the goal were the maximization of fiber production. Establish connectivity corridors and manage to connect the existing designated old growth stands. Prescriptions in identified connectivity corridors should be consistent with criteria in LRMP Amendment #2. Connectivity corridors should be stands in which medium diameter trees or larger are common, and canopy closures are within the top one third of site potential.

Where white fir climax stands occur leave all LOS components. Unless evidence of severe overcrowding is overwhelming these stands will most likely survive as is for long periods and adequate large tree replacements will enter the stands from the understory.

The lodgepole stands may be approaching densities that make them highly susceptible to attack by bark beetles. Resources to conduct density reductions will be better used in the ponderosa pine types than in lodgepole, however, the lodgepole stands would benefit from density reductions. In lodgepole pine stands where mountain pine beetle attack is imminent, a regeneration harvest would be most effective as these stands will soon start to die. If mortality occurs, initiate appropriate salvage activity, with full consideration given to recovery of commercial value, maintaining desired levels of old growth/over mature dependent species habitat, and managing fuel loadings at an acceptable level of risk.

Utilize understory thinning in areas that are above historic density levels. This includes primarily ponderosa pine and mixed conifer stands.

Where conifers have become established in aspen stands an opportunity exists to fall the conifers in arrays of barriers to grazing that will most likely allow sprout reproduction to regenerate. Remove competing conifers from aspen stands. If regeneration is required, stimulate aspen clones to regenerate with prescribed fire or mechanical means. Protect young aspen by providing slash barriers, pasture management, or exclusion fencing as a last resort. Remove or reduce conifers from areas of encroachment, including dry meadows and riparian areas

Identify declining black cottonwood clones. Analyze the need to improve the hydrologic integrity to support cottonwood restoration. Establish new areas of cottonwood utilizing material from the nearest existing clone, following guidelines in the *Fremont-Winema Native Species Guide*

Focus on an adaptive management approach when manipulating LOS mixed conifer stands on low energy aspects, and high elevation LOS lodgepole. Focus management efforts on those eco-tones where ponderosa pine is already present to some degree. These fringe pine sites often require some culturing efforts to facilitate the development of ponderosa pine.

PRESCRIPTIVE

Management Zones. Relevant to any silviculture prescription is consideration of calculated "Classic" upper (UMZ) and lower (LMZ) management zones for that plant association (Table ???). These stocking guides were developed to approximate a "safe" region of stand density where stocking related mortality processes are minimized. Classic stocking guides are used as target management objectives to maximize stand growth and as a benchmark to compare alternatives. Use of this data cannot be expected to eliminate all insect and disease problems. Impacts of diseases (except dwarf mistletoe), and of insects other than mountain pine beetle and perhaps western pine beetle, may be independent of density. Stands with mixed species should be managed by using the guides for ponderosa pine single species prescribing the fewest number of trees per acre (P.H. Cochran 1994). This data has been further tempered to reflect stocking capacity for local pant associations (Hopkins 1979) and enables the Southern Oregon/Northeastern California (SORNEC) variant of the Forest Vegetation Simulator Model to approximate stand growth (Dixon 1992). Due to variations in local site index and other resource objectives, alternative management zones can be developed and implemented. Monitoring is an essential task when managing stands outside the "Classic" management zones. Table 6-1. illustrates the outcomes of the classic stocking regime compared with two alternatives with elevated management zones.

Table 6-1. Management Zones by Forested Plant Associations Within the Lower Sycan Watershed Expressed as Stand Density Index (SDI)

Plant Association (Hopkins)	Acres	SDImax	SI	UMZ	LMZ
Ponderosa Pine					
CP-S1-21	4,210	284	76	114	76
CP-H3-11	4,353	284	78	119	80
CP-C2-11	938	284	76	114	76
CP-S2-11	4,522	284	77	116	78
CP-S2-17	3,466	284	77	116	78
	17,489				
Mixed Conifer					
CW-S3-13	1,653	332	80	146	98
CW-S1-17	1,558	310	80	146	98
CW-C3-11	2,819	410	77	168	113
	6,030				
Lodgepole Pine					
CL-G3-15	11,741	326	73	170	114
CL-G4-15	7,616	263	66	170	114
CL-C1-11	88	263	51	170	114
CL-H1-11	573	428	79	170	114
CL-S2-15	27	263	67	170	114
	20,045				

Where:
Stand Density Index (SDI)= The number of trees per acre when the quadratic mean diameter of the stand is 10 inches DBH.
Site Index (SI) = Mean values determined by Hopkins for Pant Associations of the Fremont National Forest. Site index is based on average height of dominants at age 100 years. Values for mixed conifer are for ponderosa pine. (Hopkins 1979)

SDImax= Stand Density Index values of maximum (normal) stocking as determined by SORNEC (Dixon 1992).
UMZponderosa= SDImax [-0.36 + 0.01(SI)] (P.H. Cochran 1994)
LMZ = .67(UMZ) (P.H. Cochran 1994)

Table 6-2. Comparison of three stocking regimes[1]

Parameters	CLASSIC	ELEVATED	EXTREME
Management Zones	LMZ= 27%SDI_{MAX} UMZ= 41% SDI_{MAX}	LMZ= 35%SDI_{MAX} UMZ= 55% SDI_{MAX}	LMZ= 50%SDI_{MAX} UMZ= 75% SDI_{MAX}
Decades as LOS[2]	12	11	11
Average % Crown Cover During LOS[3]	19	24	32
Volume Harvested MBF/Ac (# entries)	13 (4)	13 (3)	9 (2)
Average SDI	104	131	182
Average Basal Area ft^2/acre	82	102	140
Years with 3+ snags per acre > 11”	30	60	110

[1]Data calculated with the Forest Vegetation Simulator (FVS) modeling a “bare ground” projection (210 years) of a ponderosa pine plant community with an SDI_{max} of 284 and a site index of 68.
[2]LOS conditions assumed when the stand mean diameter reaches 18 inches DBH.
[3]Percent crown cover calculated with the FVS Canopy Extension Model.

As the next section will describe, activities within stands of various conditions of these three basic stocking regimes would be implemented at various places across the watershed. The Silviculturist with the Interdisciplinary Team would identify site-specific issues and recommend an array of stocking guidelines to address those issues. Site-specific stand conditions would help guide the preferred course of prescription. Such issues are:

- Site Index or carrying capacity. The lower the site, the riskier elevated and extreme stocking levels become.
- Plant association or ecotones of plant associations within a larger plant association. A single cutting unit may have several stocking regimes within them.
- Structural requirements of the stand to provide habitat for any one or a variety of featured wildlife species. Elevated stocking regimes provide more snags through time.
- Current stand health. Presence of annosus root disease within a mixed conifer plant association may dictate a classic stocking regime requirement.
- Early through mid-mid seral conditions will generally be prescribed to classic stocking guidelines. Elevated stocking would occur with the later seral stages.

Early Seral Stage Stands

All Plant Associations

These stands are primarily products of regeneration management activities, which required artificial or natural regeneration practices that established the current stocking levels. Plantations consist of mostly ponderosa pine from seedling to sapling size trees, planted at 10 to 12 foot spacing. Various levels of residual trees were left within these units. Lodgepole pine and white fir residuals are a common component within most plantations. Tree ages range from 3 to 25 years. Stocking varies, but most sites are carrying in excess of 250 to 500 trees per acre. Most plantations less than five years old have yet to be certified and are receiving periodic stocking exams and animal damage control treatments.

Manage these stands so they will continue to develop into mid seral stage structures. Favor the ponderosa to maintain growth and vigor to grow into the later seral stages and reduce risk of mortality from bark beetles. At that point more options can be considered. Seed tree areas were designed for removal of the seed trees once the seedlings were established. If the seed trees need to be retained for their values as "large trees", do so with caution if infected with dwarf mistletoe (DMT). Precommercial treatments must be designed so that the stand is merchantable when the UMZ is reached. The resulting spacing must be wide enough so that the average stand diameter is at least 12 inches BH when the stand reaches the UMZ, estimated to be 22 to 24 feet depending on site conditions.

Mid Seral Stage Stands

Ponderosa Pine Plant Associations

The previously mentioned early seral plantations will begin to trickle into this category of stand stage structure. A full spectrum of these stands occur, from early-mid, dense post and pole stands, to late-mid stands that are beginning to take on LOS characteristics. The presence of ladder fuels is a concern in many stands. Many of these stands are exhibiting the symptoms of various forest health problems such as mountain pine beetle, and heavy mistletoe infection, while others are healthy having been precommercial thinned and receiving one or two prescribed underburns. Almost all these stands were created in response to understory reinitiation from fire prevention and various degrees of removal of the reference period pine overstory. Many of these stands are also occurring as trees encroach onto meadows, aspen stands, and riparian areas.

As with the early seral stands, management should focus on predictable development of these stands to grow into healthy LOS structures. For these fire dependent ecosystems, maintenance of the high canopy and controlling understory reinitiation are the two fundamental management concerns. The mid seral stage is where the high canopy becomes defined. Historically, frequent fires burned and thinned trees, defining the spatial distribution of the trees that make up the canopy. This distribution tended to be clumpy with patches of younger cohorts scattered about. Active management can help "set the stage" for mid seral structure to grow into LOS. Opening up the canopy will trigger understory reinitiation, so a reintroduction of prescribed underburning should be emphasized. Without management, these stands become susceptible to mortality agents before they become LOS or will become high risk in the early-late stages. Generally, this is not what happened historically.

Mixed Conifer Plant Associations
These stands tend to be the results of overstory removals where the large ponderosa overstory was removed from even-aged advanced regeneration of white fir, ponderosa pine, and in some cases lodgepole pine. Many of these stands were precommercial thinned for the fast growing white fir to get to a target size when a clear-cut harvest would have then been prescribed. Meandering, ponderosa plantations were created within many of these stands when the overstory removal and mistletoe cleaning would leave portions understocked. The two main objectives of such management were to conserve scarce high elevation ponderosa pine seed and to capture future volume growing on the fir.

The drought of the early 1990's triggered extensive mortality across the Fremont N.F. Many of the fir stands suffered mortality or top kill from fir engraver beetle. Annosus root disease pockets were becoming evident. These pure fir stands, predisposed by drought, have little or no resilience to these mortality agents.

Manage these stands so that a stable species distribution becomes established. Favor any existing pine species while replacing a portion of the white fir with ponderosa pine. Develop an uneven-aged system to favor shade intolerant species. Few stands will benefit from culturing the fir component. Stocking is usually adequate for fir, and the bole damage created by a thinning operation would usually not be suitable. Focus on getting more species established.

Late or Old Seral Structure (LOS) Stands

Ponderosa Pine Plant Associations
The one main criterion that makes these stands LOS is that large trees (>21"DBH) are considered common across the site. Common can mean as few as five or six large trees per acre. Other attributes connected with LOS function (i.e.- snags, large woody debris, canopy layers, etc.) vary within stands and between stands. The presence of certain attributes may make a stand function as LOS with only a few large trees per acre present (Hopkins 1993). These stands vary in amounts of management activity that have occurred in them. Most stands have had some overstory removed in them. Many stands have had prescribed underburning occur. Most stands have had their LOS structures degraded

Under current management direction, LOS structures are to be maintained and protected. Management should cause "No Net Loss of LOS" (Eastside Forest Plan Amendment 1994). The management of aggregations of stands that form larger blocks of LOS is critical. This philosophy implies mimicking historical landscapes.

Objectives for management are similar to those of the mid seral pine stands. For these fire dependent structures to persist, maintenance of the high canopy and controlling understory reinitiation is critical. For many stands, fire has been used to check fuels build-up. This tool should continue to be used to check unwanted understory conifers. Understory competition is the most immediate hazard to LOS stands. Dense understories tax the site's growing potential as well as cause the stand replacement fires detrimental to the whole watershed. For stands with few and scattered large trees, management should try to maintain those trees and focus on development of the mid and early components of that stand.

Many stands can begin restoration with prescribed underburning alone. When setting priorities for restoration treatment through cutting, careful calculation of stand density and overstory condition is essential. Calculate SDI as an accumulation of the SDI of each diameter class. Assess the condition of the overstory canopy. This can be very subjective. What is the age of this layer? How much of this layer exhibits 5, 10, or 20 year mortality risk? How many trees greater than 21 inches exist, and how are they distributed across the stand?

Prescribe LOS restoration when:

- Dominant and codominants are ponderosa pine >18 inches DBH, > eight per acre with more soon to grow into that class.
- UMZ is exceeded due in large part to a lower and middle strata.
- High canopy is relatively healthy and not actively declining.
- For a timber sale, be able to harvest at least 1500 board feet per acre at conventional ground based systems costs. The more expensive the logging, the more volume per acre will be required to support it.
- Stands are adjacent to blocks of functional "old growth" and an opportunity exists to enlarge that block through treatment.

Stands with highly decadent overstories should be low priorities to restore. With the intent of direction as "no net loss of LOS", priorities should focus on stands that will respond to density control. These decadent stands will serve other resource functions while in decline.

Mixed Conifer Plant Associations

White fir is much more abundant in these stands, and is often present in the overstory. These stands compose some of the best PFA habitat in the watershed. On low energy slopes (north and east aspects) above 6000 feet elevation, white fir may occupy 90% of the overstory canopy and have dense fir layered below. Evidence shows long fire return intervals. These are difficult stands to diagnose due to subtle shifts in ecotones and disturbance processes. On the higher energy slopes (south and west aspects) and below 6000 feet elevation, most stands have or show evidence of having supported various levels of ponderosa pine overstory, maintained by a frequent fire regime

It is the LOS occupying the high-energy slopes where management can benefit restoring and maintaining viable LOS structure, and should considered high priority for silvicultural treatment. These stands have departed historic patterns as radically as on ponderosa pine sites.

The low energy stands pose several complexities. Where elsewhere we think of white fir as an unwanted invader, here it is a historic and persistent component. LOS on these sites is rich in diversity across multiple dimensions (species, seral stage, etc.). Dynamic disturbance processes at a small scale maintained such diversity. Today's stands are losing this diversity in seral stage distribution but at a much slower rate compared to the fire dependant stands. Any management geared to balance diversity must recognize the need. Past efforts at managing white fir with shelterwood systems have failed. Mimicking historical disturbance on these sites will require an adaptive management approach to prescribing treatments. For the immediate future, management activities within low energy stands should be low priority on any large scale.

Lodgepole Pine Plant Associations

These stands evolved under extremely variable fire return intervals. It needs to be recognized that we do not have sufficient knowledge to predict insect outbreaks or the occurrence of stand replacing fires in this area. On average, these high elevation stands tend to be hard to burn and tend to resist massive bark beetle outbreaks at predicted densities, but these processes are always present. Though not spectacular (on average), they have driven how these stands look today in very subtle ways. These stands tend to be low in wood fiber productivity but do offer unique wildlife habitat and are located in sensitive headwater regions. White-bark pine is an uncommon species found in these stands. Fire exclusion has caused only subtle changes to these stands. The early and mid seral structures, which were historically scattered throughout, is slowly disappearing. Stands are becoming more crowded which may be excluding both white-bark and penstemon.

Management should take a cautious, adaptive management approach when addressing the LOS lodgepole in this watershed. Prescriptions need to be site specific and take into account site potential, affected

species, and the role of fire. These are marginally productive sites so management needs to be linked to other resource needs.

Western Juniper and Hardwoods

Western Juniper
It has been clearly demonstrated that western juniper is an invader on most forested sites were it currently grows. Encroaching populations should be discriminated against while older "refugia" populations can be retained. Use of prescribed burning is an important tool for maintenance of stands where there is potential for juniper invasion. Mechanical means may be the only option to remove juniper from a site, followed by subsequent burning.

Aspen Management
Quaking aspen can be found growing throughout the Lower Sycan Watershed. It grows in small, scattered populations, associated with springs, streams, or perched water tables. Aspen's main method of regeneration is asexual. When the parent clone is distressed (fire for instance), it sends a signal throughout its root system to begin sprouting root suckers. Throughout most of the stands lifecycle, it is a fireproofed island surrounded by lands courting frequent fires. As the aspen mature and fuels accumulate, fire will sweep through to trigger regeneration. Aspen tend to be relatively short-lived as an individual tree, but the clone can persist for centuries through asexual reproduction.

Being highly associated with fire to regenerate the species, aspen stands are generally in decline due to fire exclusion and conifer encroachment. Browse from cattle and big game will also keep regeneration from becoming established. Once the parent clone is dead, that patch of aspen is lost. Management should seek to allow aspen stands to proliferate within the means of its ecologic processes and resource constraints. Prioritize treating clones of lowest vigor.

Black Cottonwood
A genetic base of current cottonwood populations (clones) has been identified within the watershed. In general, cottonwood is in decline. Several high elevation stands have been identified and their ecologic niche is not well understood. Since cottonwood health is dependant upon competing conifers, animal browse, and water relations, silvicultural and hydrological issues need to be addressed when planning to restore these stands.

KNOWN DATA GAPS:

- Current stand exam information including snags, down wood, disease centers and fire history,
- Stand exam data, interpreted, automated and linked to a spatial layer in GIS,
- Accurate vegetation condition class layer in GIS,
- Logging plan including economic analysis of logging alternatives for watershed,

Non-Forested Uplands

Return natural openings and meadows that have been altered by tree invasion to approximate historic range of variability. Where conifers are encroaching on dry meadows (typically lodgepole pine), remove conifers to reverse this trend. Forested vegetation management recommendations modeled after Northern Goshawk habitat requirements that facilitate detection and capture of prey by goshawks favor the maintenance of open understory and small patch openings. Maintaining these systems will benefit hydrologic function and retain forage/habitat quality. Prescribed fire and thinning can be used to meet these objectives. Restore meadow and forest openings to near reference conditions with consideration to Goshawk PFA requirements. However, these standards should not deter the manager from restoring a meadow or forest opening to historic conditions greater than 2 acres.

Implement prescribed burning in bluegrass dry meadows, hairgrass moist meadows and big sage bunchgrass communities in the watershed. Burning meadows and big sagebrush sites will reduce litter accumulations and decadent shrub cover, promote nutrient cycling, limit conifer encroachment and promote plant vigor.

Manage for fair to good range condition and static to upward trend on non-forested vegetation communities. Communities in fair to good range condition reflect proper range management. Plan for deferred rotation grazing where possible in all allotments in the watershed. Deferment reduces plant physiologic impacts particularly on bluegrass-dry meadow systems.

Monitor domestic ungulate browse and effects on aspen regeneration in the watershed. Current levels of aspen utilization by livestock are unknown.

KNOWN DATA GAPS:

- Specifics regarding browse on aspen
- Riparian classification and seral status

Fire

In Ponderosa Pine and Pine Associated types (excluding Lodgepole):
(see also Non-forested Uplands Recommendations #1 and #2, immediately above)

1. Use prescribed fire alone and mechanical methods in combination with prescribed fire to meet objectives of reducing density and altering structure of stands.

2. To the extent that fuel amounts, fuel arrangement and management objectives allow, conduct management ignited prescribed fire activities at frequencies and intensities similar to the natural fire regime appropriate to the site.

3. Fire prescriptions should be fairly conservative until vegetative mosaics, fuel loading and continuity have been modified enough that a more liberal fire prescription is possible.

4. Consider landscape level treatments to create a network of areas with reduced crown fire potential.

5. Remove ladder fuels and reduce stand density to a level at which a fire is unlikely to spread in the tree canopy.

6. Utilize prescribed fire and mechanical methods to protect Forest improvements (i.e. plantations, TSI areas, structures and cultural resources) from unacceptable fire effects.

In Lodgepole Pine and climax White Fir types:

1. Prescribed fire alone or in combination with mechanical methods should not be used for the purpose of maintaining stand structure.

-

Invasive Species

1) Because only a handful of weed sites are present, the Upper Sycan Watershed should be a priority for continued inventory, monitoring, and treatment, as well as implementation of prevention measures. This area can be kept relatively weed free for little expenditure.

Threatened, Endangered, and Sensitive Plants

1) Implement a burning/thinning program to remove encroaching trees and maintain meadow habitat for *Calochortus longebarbatus* var. *longebarbatus*.

2) Complete a conservation assessment for *Mimulus tricolor*. Little is known about the habitat requirements and potential management considerations for this species on the Fremont-Winema.

3) Begin monitoring *Mimulus tricolor* to assess trend, and the affects of removing livestock grazing from the Sycan River corridor.

III. Terrestrial Species and Habitats

1. Northern Goshawk

Manage to protect active and historic nest stands and treat replacement nest stands, PFA's, and foraging areas to develop and/or restore preferred habitat conditions for goshawk nesting and rearing and to provide prey species habitat needs.

To increase the probability of successful goshawk fledgling production, maintain solitude in and immediately adjacent to active nest areas during the breeding, nesting, and fledgling period from March 1 through August 31, or until young fledge as documented by monitoring.

In stands with overstocked understories and high fuel loadings, thin from below with variable spacing to promote large tree growth, crown development, understory herb and shrub development, and open stand conditions for hunting and prey availability.

2. Primary Excavators

In all stands of ponderosa pine and pine associated forest, design future timber harvest treatments to maintain and restore snags and green replacement trees to provide for current and future snag densities consistent with what the vegetation is capable providing, which should be consistent with densities that occurred historically.

Manage snags and green tree replacements in dispersed clumps rather than individual trees uniformly scattered over the landscape. Manage snags and green tree replacements in the same species composition as was represented in the stand historically.

Green tree replacements should be cultured in early and mid-seral stands to develop future large diameter snags at the desired species composition and distribution for the full stand rotation.

3. Mule Deer

Manage forage, cover, and road densities on mule deer ranges to provide habitat conditions necessary to meet Oregon Department of Fish and Wildlife (ODF&W) and Klamath Tribe herd objectives over the long term. Manage road densities to meet the 2.5 miles per square mile (or less) Forest Plan standard.

Design forest thinning treatments to provide a variety of spacing conditions, including no cut or minimal cut leave patches of dense structure. Treated stands should retain an interspersion of cover and forage where leave patches intended to provide thermal and/or hiding cover are 2 - 26 acres in size (Hershey 1997).

Manage bitter brush and other shrubs so that 1/3 of the area is left untreated, and 2/3 of the area is managed for a variety of age classes from 0 – 30 years old.

KNOWN DATA GAPS:

A goshawk habitat description specific to this Forest has not been developed

Snag density and distribution across the watershed

Actual open road densities within the watershed

IV. Human Uses

Key Questions:

1. How should the watershed provide for future human uses and needs?

2. How will roads be managed to meet present and future uses and protect all resource values?

3. What logging and grazing methods may be necessary to meet resource and vegetation goals and objectives, and provide commercial products?

4. How should the watershed be managed to ensure that Treaty Rights and Trust Resources are protected?

1. In order to insure that the trust responsibilities of the United States to the Klamath Tribes are fully met within the Upper Sycan WS, incorporate the consultation procedures, as defined in the February 19, 1999 MOA, in all project planning. Specifically, include the Klamath Tribes in the initiation, development and implementation stages of all management decisions which have the potential to impact the Interstate Mule Deer herd, downstream fish populations in the Klamath Basin, cultural resources or other Treaty Right Resources. During site-specific NEPA analysis, seek to gain an understanding of traditional cultural practices that occur within the project area (such as the use of culturally significant plants). Recognize that different meanings and relationships to landscape may exist within traditional cultures than in the general public. Utilize the consultation process to gather not only current science-based information from Tribal staff, but also relevant tribal tradition-based knowledge and expertise.

2. Design and implement project work with full consideration of potential support of medium to long term family wage jobs for local work forces. For example contracts could be designed which include provisions for on going work items over several consecutive annual operating seasons. Vegetation treatments must consider the economic viability of potential wood product removal. The likelihood that small wood removal will generate trust fund dollars is diminished. Sales should be designed to accomplish as much as possible. Contracts that encompass both sale and service contracts should be developed.

3. Human uses should continue to focus around outdoor recreation activities such as camping, firewood gathering, fishing, hunting, horseback riding, off-highway vehicle (OHV) riding, mountain bike riding, cabin renting, snowmobiling and cross-country skiing.

4. Recreation activities involve camping at developed (Currier Cabin) and dispersed campgrounds (forest camps) Pike's Crossing and Rock Creek, hiking on trails (Hanan Trail) in the high country and in Sycan River canyon and seasonal hunting and fishing. The needs of the campers at Currier Cabin rental should be closely adhered to while at the same time providing the forest users at the forest camps and on the trails as much of a primitive recreation experience as possible. Opportunities in the Currier Cabin developed site need to be examined and changed and added to as needed. The idea of accessibility needs to be applied to this developed site. Consider the creation of an interpretive site (or area) in the Currier Cabin area. Provide a localized vegetative landscape condition that demonstrates pre-settlement/historic conditions in conjunction with information on ecosystem sustainability.

5. The trail system in place meets present day demands. However, future increased need would require an expansion of current facilities.

6. Interpretive activities such as signing, talks, tours and self-discovery should be facilitated as a means of adding to the experience of the forest user.

7. Designation of Off Highway Vehicle (OHV) routes use should be considered. On-the-ground surveys should be used to evaluate proposed locations.

8. Improve habitats for deer and elk to increase hunting opportunities for these species in the future.

REFERENCES

Agee, Daniel M. 1993. "Modal clitics in San Jeronimo Mazatec." SIL Mexico Workpapers 10: 1

Bedell, T. E. 1991. Introduction and philosophy. In: Watershed management guide for the interior northwest. Oregon State University Extension Service. EM 8436. pp 1-3.

Bedell et al. 1993. Western Juniper. Its impact and management in Oregon rangelands. OSU Extension Service EC 1417. 15 pp.

Behnke, R.J. 1981. Systematic and zoogeographic interpretation of Great Basin trouts. In: R.J. Naiman and D.L. Soltz (eds.), Fishes of North American Deserts. John Wiley and Sons, New York. pp 95-124.

Behnke, R.J. 1992. Native trout of western North America. American Fisheries Society Monograph 6.

Beschta, R.L., R. E. Bilby, G. W. Brown, L. B. Holtby, and T.D. Hofstra. 1987. Stream temperatures and aquatic habitat: fisheries and forestry interactions. In: Salo, E.O. and T. W. Cundy (Eds.), Streamside Management: Forestry and Fishery Interactions. Proceedings of a Symposium, University of Washington Institute of Forest Resources Contribution 57:191-232.

Beschta, R.L., and W. S. Platts. 1986. Morphological features of small streams: Significance and function. Water Resour. Bull. 22(3):369-379.

Beschta, R.L. 1990. Effects of fire on water quantity and quality, p 219-232. In: Natural and Prescribed Fire in Pacific Northwest Forests. Oregon State University Press.

Behnke, R.J. 1981. Systematic and zoogeographic interpretation of Great Basin trouts. In: R.J. Naiman and D.L. Soltz (eds.), Fishes of North American Deserts. John Wiley and Sons, New York. pp 95-124.

Behnke, R.J. 1992. Native trout of western North America. American Fisheries Society Monograph 6.

Bjornn, T.C., and D.W. Reiser. 1991. Habitat requirements of salmonids in streams. American Fisheries Society Special Publication. 19:83-138.

Bradley, Reginald A. 1915. Erosion on the Fremont National Forest. Fremont National Forest.

Brown, G. W. 1983. Forestry and Water Quality. Oregon State University Bookstore, Corvallis. 142 pp.

Burroughs E. R., Jr. and J. G. King. 1989. Reduction of soil erosion on forest roads. General Technical Report INT-264. Intermountain Research Station. 21 p.

Burton et al. 1992. Integrated Riparian Evaluation Guide. USDA, Forest Service, Intermountain Region.

Busse, M.D., P.H. Cochran, and J.W. Barrett. 1996. Changes in Ponderosa Pine Site Productivity fallowing Removal of Understory Vegetation. Soil Sci. Soc. Am. J. 60:1614-1621.

Carlson, G.T., 1979. Soil Resource Inventory Winema National Forest. USDA Forest Service, Pacific Northwest Region, Portland.

Church, J.E., 1912. The conservation of snow: its dependence on forest and mountains. *Sci. Amer. Supp.* 74:152-155.

Collom, Tom. Oregon Department of Fish and Wildlife, Klamath Falls, OR. Personal communication.

DeBano, L.F., D.G.Neary, and P.F. Ffolliott, 1998. Fire's Effects on Ecosystems. John Wiley and Sons, Inc., New York, New York.

Decker, L. M. and D. C. Erman. 1992. Short-term seasonal changes in composition and abundance of fish in Sagehen Creek, California. Transactions of the American Fisheries Society 121:297-306.

Elmore, W., and R.L. Beschta 1987. Riparian areas: perceptions in management. Rangelands 9(6): 260-265.

Eglitis, A., H. Maffei and M. Schafer. 1993. Forest health on the Fremont, an assessment of the existing conditions and a plan for restoration. White paper developed in cooperation with Forest Pest Management and the Fremont National Forest.

Everest, F.H., R. L. Beschta, J. C. Scrivener, K. V. Koski, J. R. Sedell, and C, J. Cederholm. 1987. Fine sediment and salmonid production. In: Salo, E.O. and T. W. Cundy (Eds.), Streamside Management: Forestry and Fishery Interactions. Proceedings of a Symposium, University of Washington Institute of Forest Resources Contribution 57:98-142.

Fausch, K.D., and T.G. Northcote. 1992. Large woody debris and salmonid habitat in a small coastal British Columbia stream. Can. J. Fish. Aquat. Sci. 49:682-693.

Faglin, G. S. 1991. Influence of logging and road construction on trout streams. Medicine Bow National Forest. 106 p.

Forest Service. 1989. Land and Resource Management Plan for the Fremont National Forest, Lake and Klamath Counties, Oregon. USDA Forest Service, Pacific Northwest Region, Portland, Oregon.

Friedrichsen, T, 20003. Silver Lake Watershed Assessment. USDA Forest Service, Silver Lake Range District, Fremont-Winema National Forest, Silver Lake, Oregon. Page 13 to 25.

Furniss, M.J., T.D. Roelofs, and C.S. Yee. 1991. Road construction and maintenance. American Fisheries Society Special Publication. 19:297-323.

Goldenberg, Douglas. 1995. Interim Conservation Strategy for *Calochortus longebarbatus v*ar.*longebarbatus* on the Winema National Forest. Unpublished.

Goldenberg, Douglas. 1997. 1997 Monitoring Results of *Calochortus longebarbatus* var. *longebarbatus.* Winema National Forest. Unpublished.

Gucinski, H., M.J. Furniss, R.R. Ziemer, and M.H. Brookes (eds.). 2001. *Forest roads: A synthesis of scientific information.* Gen. Tech. Rep. PNW-GTR-509. Portland, OR.

Hann, Wendel, Havlina, Doug, Shlisky, Ayn, et al. 2003. Interagency and The Nature Conservancy fire regime condition class website. USDA Forest Service, US Department of the Interior, The Nature Conservancy, and Systems for Environmental Management [frcc.gov]

Hopkins, W.E. 1979a. Plant Associations of the Fremont National Forest, R6-ECOL-79-004. USDA Forest Service, Pacific Northwest Region, Portland, Oregon.

Hopkins, W.E., 1979b. Plant Associations of South Chiloquin and Klamath Ranger Districts Winema National Forest, R6-ECOL-79-005. USDA Forest Service Pacific Northwest Region, Portland, Oregon.

Hopkins, W.E.; Goheen, D.J.; Goheen, E.M.; and Forry, K. 1988. Evaluation of annosus root disease on ponderosa pine in the Fremont National Forest: R6-Ecol-79-004. USDA-Forest Service, PNW. Portland OR.

Hopkins, W.E. 1993. Personnel conversation. USDA-Forest Service, PNW, Area 4. Bend OR.

Hopkins Bill, 1999. Description of Historical Ponderosa Pine Stands, Personal Communication during presentation to SE Oregon RAC Workshop May 1999.

Inland Native Fish Strategy -- INFISH (Amendment to Land and Resource Management Plan). August 1995. USDA Forest Service.

Interior Columbia Basin Ecosystem Management Project (ICBEMP). 1997. Evaluation of the EIS Alternatives by the Science Interaction Team: Volume II. USDA Forest Service and USDI Bureau of Land Management. Gen Tech. Rep. PNW-GTR-406. Portland, OR: U.S.D.A., Forest Service, Pacific Northwest Forest and Range Experiment Station: p. 537-1094.

Johnson, D.W., R.B. Susfalk, R.A. Dahlgren, and J.M. Klopatek. 1998. Fire is more important than water for nitrogen fluxes in semi-arid forest. Environmental Science and Policy 1: 79-86.

Kaye, Thomas, and Bruce Rittenhouse. 1990. Revised by Robert L. Wooley, 1994. Conservation Strategy for *Calochortus longebarbatus* var. *longebarbatus*. Fremont National Forest. Unpublished.

Loy, W. (editor); S. Allen, A. Buckley, and J. Meacham (authors). 2000. Atlas of Oregon, Second Edition. University of Oregon Press, Eugene, Oregon, p 118 to 186.

McNabb, D.H. and F.J. Swanson. 1990. Effects of fire on soil erosion, p 159-176. In: Natural and Prescribed Fire in Pacific Northwest Forests. Oregon State University Press.

Malaby, S. 2002. Summery of the 1999 results from the Lone Pine Study Area Winema National Forest. A Forest botany monitoring report, Fremont-Winema National Forests, Lakeview, Oregon.

Miller Richard F. February 1997. Juniper expansion and fire history in the Chewaucan River Basin. Final Report: USFS Fremont National Forest;Paisley Ranger District.

Milstien, M. 2005. Poll: Restore scored forests, a survey finds three-quarters of Oregonians favor the logging of wildfire areas and planting of seedlings, an issue long debated. In the Monday, August 29, 2005, edition, Oregonian Newspaper, Portland, Oregon.

Mitchell, R.G.; R.H. Waring; G.B. Pitman 1983. Thinning lodgepole pine increases tree vigor and resistance to mountain pine beetle. For. Sci. 29:204-211.

Mooney, S. 2005. Historic, Current, and Post-Implementation Structural Stages for the Williamson River and Upper Klamath Basin and Ninemile North Project, personal communication.

National Land Cover Data Set, 1992. Uniter States Geological Service. Department of interior. http://landcover.usgs.gov/

Noss, R. F., M. A. O'Connell, and D. D. Murphy. 1997. The Science of Conservation Planning: Habitat Conservation Under the Endangered Species Act. Island Press, Washington, D. C., and Covelo, California. 246 pp.

Olson, R. and W. A. Hubert. 1994. Beaver: water resources and riparian habitat manager. 48 p.Oregon Natural Heritage Data Base. 1989.

Oregon Department of Fish and Wildlife. 2005. Personal commutation, Klamath Falls, Oregon

Orr, E.L., and W.N. Orr, 1999. Geology of Oregon, Fifth edition. Kendall / Hall Publishing Co. Dubuque, Iowa. Pages 79 to101.

Platts, W.S. 1991. Livestock grazing. American Fisheries Society Special Publication 19:389-423.

Pyne, S. J. 1996. Nouvelle Southwest. *In:* Covington, W. and Wagner, P. K., editors. *Conference on Adaptive Ecosystem Restoration and Management: Restoration of Cordilleran Conifer Landscapes of North America: Flagstaff, AZ, June 6-8, 1996.* General Technical Report RM-GTR-278. USDA Forest Service, Rocky Mountain Forest and Range Experiment Station, Fort Collins, CO.

Reeves, G. H., J. D. Hall, T. D. Roelofs, T. L. Hickman, and C.O. Baker. 1991. Rehabilitating and modifying stream habitats. American Fisheries Society Special Publication 19:519-557.

Reid L.M., and R.R. Zimmer. 1994. Evaluating the biological significance of intermittent streams. Summary of workshop held at the Humbolt Interagency Watershed Analysis Center, May, 1994. 15 p.

Reiser, D. W. and T. C. Bjorn. 1979. Influence of Forest and Rangeland Management on Anadromous Fish Habitat in Western North America, Habitat Requirements of Anadromous Salmonids. 54 p.

Riegel, G., Weixelman, D.A., D.C. Zamudio, and K.A. Zamudio, 2002. Draft South-central Oregon Riparian Field Guide Area Ecologist Gregg Riegel's Fremont data set in on going riparian field guide survey provides vital plant species and soil pattern for soil productivity estimates for wetlands. USDA Forest Service, Pacific Northwest Region, Portland, Oregon.

Rosgen, D. L. 1991. Handouts from the Applied Fluvial Geomorphology Training Session. Wildland Hydrology, Pagosa Springs, CO.

Rosgen, D. L. 1994. A classification of natural rivers. Catena, an Interdisciplinary Journal of Soil Science-Hydrology-Geomorphology, Vol. 22, No. 3. p. 169-198.

Rosgen, D. L. 1996. Applied River Morphology. Wildland Hydrology. p. I-XI.

Scharpf, R.F. 1993. Diseases of Pacific Coast Conifers. USDA Forest Service, Agric. Handbook 521Steens, H.K., 1976. The U.S. Forest Service History. University of Washington Press.

Strahler, A.N. 1964. Part II Quantitative Geomorphology of Drainage Basins and Channel Networks, In Handbook of Applied Hydrology, Ven Te Chow Editor. McGraw-Hill, Inc. p4-52 to 4-54.

Swanston, D. N. 1991. Natural processes. American Fisheries Society Special Publication 19:139-179.

Steen, Harold K. 1976. The U.S. Forest Service. Seattle and London: University of Washington Press. 356 p.

Steen, Harold K. 1992. The origins and significance of the National Forest System. In: Steen, Harold K., ed. Origins of the national forests: a centennial symposium. Durham, NC: Forest History Society. 3-9.

Troendle, C.A. and C.F. Leaf. 1981. Effects of timber harvest in the snow zone on volume and timing of water yield. In: Interior West Watershed Management. Cooperative Extension, Washington State University, Pullman, WA (Symposium, Spokane, WA, April 8-10, 1980), pp. 231-243.

Troendle, C.A. 1982. The effects of small clearcuts on water yield from the Deadhorse Watershed, Fraser, Colorado. In: Proceedings 50th Annual Western Snow Conference (Conference in Reno, NV, April 19-23, 1982). Colorado State University, Fort Collins, CO.

Volland, L.A. 1976. Plant Communities of the Central Oregon Pumice Zone, R6 Area Guide 4-2. USDA Forest Service Pacific Northwest Region, Portland, Oregon.

Volland, Leonard A. Guidelines for Forage Resource Evaluation within Central Oregon Pumice Zone. USDA Forest Service, Pacific Northwest Region; R6-ECOL-177. January 1985.

Water Consulting Inc. 2001. Project proposal prepared for the USF&W on the lower Sycan River. Memograph.

WEPP Version 2001.10.10. 2001. Water Erosion Prediction Project, Disturbed WEPP Results based on WEPP Version 2000.100. http://fsweb.moscow.rmrs.fs.fed.us/fswepp USDA Forest Service, Rocky Mountain Research Station, Moscow Forest Science Laboratory, Moscow, Idaho.

Wenzel, D.L. 1979. Soil Resource Inventory, Fremont National Forest. USDA Forest Service, Pacific Northwest Region, Portland, Oregon.

Wemple, Beverly. 1994. Hydrologic Integration of Forest Roads with Stream Networks in Two Basins, Western Cascades, Oregon. 88 p.

Willers, B. 1991. Trout biology. A Natural History of Trout and Salmon. New York, NY. Lyons & Burford Publishers.

Wooley, Robert L. 1996. Amendment to the Conservation Strategy for *Calochortus longebarbatus* var. *longebarbatus*. Fremont National Forest. Unpublished.

Ziemer, R.R. 1998. Monitoring watersheds and streams. In Conference on Coastal Watersheds.USDA Forest Service Pacific Southwest Station, General Technical Report 168:129-134. San Francisco, California.