LITTLE NORTH SANTIAM WATERSHED ANALYSIS

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The analysis portion of this document was done in 1997. This is an iterative document and will be updated periodically as new information becomes available. The data in this document was the best available at the time the analysis was completed. Management opportunities for this watershed must be considered in light of the checkerboard land ownership patterns of the BLM administered lands and the legislative mandates of Forest Service and BLM administered lands.

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Maps

<u>The following GIS Maps are located in the Appendix at the back of the document.</u>

Executive Summary

The executive summary focuses on key components and findings of the analysis.

Major Findings and Recommendations

Terrestrial

Finding: The Northwest Forest Plan (NFP) allows for regeneration harvest in General Forest Management Area (GFMA) and in Connectivity (CONN) Land Use Allocations on Bureau of Land Management (BLM) lands in the western half of the watershed.

Finding: The amount and quality of older forest habitat are limited in the western half of the Little North Santiam (LNS) watershed. Older forest habitat is most limiting in Kiel Creek sub-watershed (SWB), next is Sinker Creek SWB, then Canyon Creek SWB, and finally Evans Creek SWB.

Recommendation: Implement density management prescriptions in Riparian Reserves, District Designated Reserve (DDR), and Late-Successional Reserve (LSR) to develop and maintain older forest stand characteristics in younger age classes.

Recommendation: Use an interdisciplinary approach to re-evaluate connectivity diversity blocks and the location of the best 25 to 30 percent older forest in and immediately adjacent to the LNS watershed.

Finding: There is a scarcity of standing dead/down coarse woody debris habitat in the western half of the watershed, especially larger material in the early stages of decay.

Recommendation: Implement NFP standards and guidelines for green tree retention for the recruitment and development of standing dead/down coarse woody debris and to contribute to the development of older forest stand characteristics. Protect existing material and leave additional green trees in future harvest units to make up for deficiencies in current conditions.

Finding: The total road density in the lower portion of the watershed is 5+ miles per square mile, which is considered to be high. Road densities are expected to increase in the western half of the watershed.

Recommendation: Close and/or rehabilitate roads to reduce road densities. Highest priorities would be Evans, Sinker, Kiel, and Canyon Creek SWBs in that order.

Special Status and Special Attention Species

Finding: Habitat for certain special status/special attention species associated with older forest habitat and standing dead/down logs is limited in the western half of the watershed.

<u>Recommendation</u>: Protect the best 100 acres of older forest around known spotted owl site centers on federal lands. Coordinate management around known spotted owl sites with adjacent private landowners and the state.

Finding: There is habitat suitable for nesting bald eagles present in the LNS watershed. There are sightings during the nesting season which are suggestive of a potential nest site in the vicinity.

Finding: There are suitable cliffs for nesting peregrine falcons present, particularly in the eastern half of the watershed.

Finding: Suitable habitat is present in the LNS watershed for 4 survey and manage animal species.

Finding: Certain special status/special attention/survey and manage and other plant species of concern have been documented or are highly likely to occur in this watershed.

<u>Recommendation</u>: Survey for priority animal species in the watershed. Special emphasis should be placed on the bald eagles, peregrine falcon, and survey and manage invertebrates.

Finding: Noxious and invasive weeds will continue to be a concern over time because of the increased human use of the watershed, especially in the lower elevations and any travel corridors.

<u>Recommendation</u>: Continue eradication and monitoring for noxious and invasive weeds over time to prevent extensive outbreaks.

Aquatic

Finding: Streamflow in the LNS may be overallocated during periods of lowflow, up to 20 percent of the time.

<u>Recommendation</u>: Study actual water availability during low flow periods. Assess impacts of future water withdrawals on instream flows and aquatic organisms. State agencies such as the Oregon Department of Environmental Quality (DEQ) may be best suited to organizing the task.

Finding: Climatic trends are apparent and can be broken down into three distinct periods. The first period, 1932 through 1944, experienced lower than average precipitation and discharge most years; the second period, 1945 through 1975, received greater than average precipitation and discharge most years; while the third period, 1976 through 1994, was again lower than average for precipitation and discharge.

Recommendation: Consider climatic trends in future studies and projects in the watershed.

Finding: The precipitation/discharge relationship appears to have changed after about 1979. There is a statistically significant difference (P=0.00) between pre and post 1979 precipitation/discharge relationship. Precipitation after 1979 produced less discharge on an annual basis than prior years. The change in precipitation/discharge relationship appears to be climate related.

Recommendation: An in-depth study could be conducted to determine the actual cause if it persists.

Finding: At the end of the lowest recorded discharge period, there was an estimated 21 days of groundwater storage left in the basin before the LNS River became dry. Ground water storage available for streamflow in an average year is estimated to be 50 days at the end of the lowflow period.

Finding: The DEQ has listed the LNS River as having moderate dissolved oxygen, bacteria, and viruses, lowflow, and sediment problems. The LNS River is not in the state's water quality limited stream list (303d Report). However, the North Santiam River (NSR) is listed in the 303d Report as not meeting water temperature criteria downstream from its confluence with the LNS River.

Recommendation: Promote public/private partnerships to study and improve water quality and to identify problem areas (i.e., North Santiam Watershed Forum, joint MOU partnership agreement with U. S. Forest Service (USFS), et al.). Establish limits of acceptable change criteria for water quality in the watershed with the DEQ.

Finding: Water temperature data collected in the LNS River show high summer temperatures in the downstream reaches. Temperatures were above growth threshold for salmon and near the lethal limit during some summer periods. Streams which may be adding significantly to temperature increases include Fawn, Fish, Sinker, Big, Cougar, Moorhouse, Chamberlain, and Wonder creeks.

Recommendation: Expand water temperature sampling network to locate temperature sources. Improve or promote riparian shade on stream segments with open canopies.

Finding: Analysis of water quality data from the City of Salem indicates water quality in the LNS River is statistically better than in the NSR, except for fecal coliforms. Fecal coliforms were significantly higher in the LNS River than the NSR during the summer low flow period. Water quality degrades in a downstream direction from the USFS boundary.

Recommendations: Expand fecal coliform sampling network to locate sources of fecal bacteria.

Reduce sources where possible. For example, provide sanitation facilities in high use dispersed recreation areas in the summer or repair faulty septic systems.

Finding: Water quality may not always meet state standards for fecal coliforms and alkalinity. City of Salem data indicate values above the state standards during some monthly sampling events. Five fecal coliform samples would have to be collected in a month where a reading exceeds the state standard to verify that the standard is not met.

Recommendation: Recommend the City of Salem modify water quality sampling strategy to determine whether state standards are met.

Finding: Storm turbidity sampling indicates Canyon, Sinker, Kiel, Evans, and Fawn creeks have the highest turbidity levels. The creeks are listed in order of severity, with Canyon Creek being the worst.

Recommendation: Determine sources of turbidity in Canyon, Sinker, Kiel, Evans, and Fawn creeks and design enhancement projects to reduce inputs in streams where possible.

Finding: Equivalent clearcut acreage is high in Sinker Creek and moderate in Kiel, Elkhorn, Evans, Canyon, and Battle Axe Creek sub-watersheds.

Finding: Water available for runoff impacts are high in Kiel, Sinker, Canyon, and Evans creeks.

Recommendation: Minimize management actions that would increase the Equivalent Clearcut Acreage (ECA) or Water Available for Runoff (WAR) levels in the **sub-watersheds** with the highest existing impacts. Take future forecasting of ECA and WAR into account when planning long-term timber sale activities. Plan restoration activities in **sub-watersheds** that have the highest ECA and WAR values.

Finding: Anadromous fish populations (winter steelhead and spring chinook) are declining in the LNS watershed.

Recommendation: Implement riparian restoration projects on federal lands including underplanting, manual release, and thinning of existing stands in the Canyon Creek, Evans Creek, Kiel Creek, and Sinker Creek **sub-watersheds.**

Finding: Instream habitat conditions in tributaries in the western half of the watershed are generally poor, with long-term improvement anticipated on federal lands as a result of management under the NFP. Habitat conditions in stream segments on private lands managed in accordance with the Oregon Forest Practices Act are likely to continue to decline. Habitat conditions in streams on federal lands in the eastern half of the watershed are fair to good and will improve under the NFP.

Recommendation: Implement riparian restoration projects on federal lands including underplanting, manual release, thinning of existing stands in the Canyon Creek, Evans Creek, Kiel Creek, and Sinker Creek **sub-watersheds**.

Finding: Large woody debris (LWD) recruitment potential is generally poor in west side tributaries. Improvement is likely on BLM land, whereas decline is likely on private lands. LWD recruitment potential in east side tributaries is generally good and is expected to improve.

Recommendation: Implement road reduction projects on federal lands including road closure, obliteration, and grade restoration in **sub-watersheds** where appropriate. Implement LWD placement projects on federal lands in the lower 0.5 mile of Elkhorn Creek and the lower 0.7 mile of Sinker Creek.

Human Uses

Finding: The LNS watershed is an important place to many people living within and outside the watershed. If populations in the central Willamette Valley continue to rapidly increase, the demand for all of the resources within the watershed will grow along with the potential for conflict associated with that demand.

Finding: There are serious concerns about the potential impacts human activity such as logging, roads, etc., have on water quality. Additional water quality sampling is necessary but often time consuming and expensive. It may not be possible unless landowners and other interested parties in the watershed can work together to develop a comprehensive water quality monitoring and enhancement strategy.

Recommendation: Examine feasibility of developing partnerships with interested parties in a water quality monitoring and enhancement strategy for LNS watershed.

Finding: There are several areas with rural interface concerns in the LNS watershed. The BLM has worked with adjacent landowners to address concerns related to public use of BLM-administered lands; however, more work is still needed.

Finding: In the west half of the watershed, it is assumed that timber harvesting on private industrial forest lands will continue and be visible from the Little North Fork Road and LNS River. Intermixed with these private industrial lands, the BLM has very little control over the scenic quality in the watershed. Special consideration should be given to those BLM lands which have high sensitivity for both rural interface and visual resource concerns.

Recommendation: Many of the same management practices that e used to mitigate potential impacts associated with timber harvest activities would tie-in with rural interface and visual resource concerns. Below is a list of mitigating actions that could be taken depending on the proposed action and the site specific characteristics.

C Get adjacent landowner input early in planning process for areas with a potential for high sensitivity to better determine areas of concern.

  Early in project planning, consider reducing visual or other disturbance factors in designing the size, shape, and location of the timber harvest units or project. Consider small patch cuts, thinning, or uneven aged management to better maintain forest cover.

C Where possible, utilize green retention trees and Riparian Reserves to buffer the visual impacts from view. Consider leaving additional trees for added buffering where needed.

* Where possible, consider using alternative reforestation site preparation prescriptions to broadcast burning.

Finding: Once the prerequisites of the Opal Creek legislation are met, the east half of the LNS watershed would continue to be predominately natural appearing. Additional timber harvesting would be limited; observable evidence of past management activities related to timber harvest and road building will decrease over time.

Finding: There are opportunities for primitive recreation site and trail development on public lands within and outside of the interim boundaries for Elkhorn Creek National Wild and Scenic River. Where feasible, further blocking up public ownership in this area through land acquisition or exchange with interested private landowners would enhance trail development potential.

Finding: Use levels during the peak use periods during the summer months often exceed the capacity of existing developed recreation facilities. Opinions are mixed concerning the need for expanded recreation facilities. There is potential for expansion of existing recreation facilities and the development of new facilities in watershed. Where possible, the recreation providers in the watershed along with other interested parties need to work together in developing a strategy for managing recreation use and providing recreation facilities and services.

<u>Recommendation</u>: As funding and time allows, look for opportunities for expanding existing developed recreation facilities as well as developing new recreation facilities.

<u>Recommendation</u>: Look for opportunities for increasing public ownership in areas with high recreational and other resource values by working with private landowners that are interested in exchange or acquisition. Enhance public access to the LNS River for trail development potential near Elkhorn Creek.

Finding: Recreation Opportunity Spectrum (ROS) settings in the greatest demand for Statewide Comprehensive Outdoor Recreation Plan (SCORP) Region 8 are semi-primitive and primitive.

The east half of the LNS watershed offers the greatest potential for meeting these demands. Lands in the west half of the LNS watershed will continue to provide recreational opportunities in the rural and roaded modified settings.

Finding: There is a lack of visitor orientation and interpretive information in the LNS watershed given the level of use that occurs and the educational opportunities the watershed offers. Interpretation in the Opal Creek Scenic Recreation Area (SRA) will be addressed in the management plan. This may help facilitate discussions about needs in the rest of the watershed.

Finding: Public use issues in LNS watershed also relate to vandalism, trespass, unsafe firearm use, illegal dumping, long-term occupancy, and a variety of other issues. If use continues to grow at a faster rate than individual agency resources can manage, cooperative management and projects will become more important.

Recommendation: Clean up all known abandoned vehicle and garbage dump sites on BLM lands. Evaluate the feasibility of increasing BLM law enforcement and other staff patrolling BLM lands. Work with adjacent landowners and interested parties on holding an annual cleanup along Little North Fork Road and the LNS River.

Recommendation: Opportunities should be identified and pursued for increasing cooperation among interested parties on recreation-related issues such as recreation maintenance and development, visitor orientation and interpretive information (including road signing), visitor management, and law enforcement. One potential project already being discussed is constructing a visitor orientation information kiosk (including such things as a map, general use information, and leave-no-trace-use ethics) for the watershed and surrounding areas. Initial partners include BLM, USFS, ODF, North Santiam Economic Development Corporation, and North Santiam Tourism Coalition.

The Opal Creek SRA Management Plan will address many of the recreation issues mentioned above for the eastern portion of the watershed. Where possible, connections and relationships to the western portion of the watershed should be considered and incorporated into the Opal Creek SRA planning process.

CHAPTER 1 - INTRODUCTION

Watershed analysis is ecosystem analysis at the watershed scale. This is one of the principal analysis for implementation of the Aquatic Conservation Strategy (ACS) as described in the *Northwest Forest Plan Record of Decision (ROD) for Amendments to Forest Service and Bureau of Land Management Planning Documents Within the Range of the Northern Spotted Owl* (USDA, USDI 1994) and one of the principle means used to meet ecosystem management objectives identified in the *Salem District Resource Management Plan/Final Environmental Impact Statement (RMP/FEIS)*. The purpose of watershed analysis is to provide a federal agency with a comprehensive and systematic analysis of a landscape to guide planning and management of federal lands and analyze cumulative effects of past, present, and future activities on all lands.

By developing and documenting a scientifically based understanding of the processes and interactions occurring within a watershed, an interdisciplinary team (IDT) will attempt to establish geomorphically and ecologically appropriate Riparian Reserves (RR) and provide a common framework for evaluating and managing the federal land within the landscape. The watershed analysis will serve as a basis for developing site-specific proposals and monitoring and restoration needs for a watershed. Cooperation with other landowners is necessary since the analysis addresses the entire watershed. However, the analysis is designed as a tool for federal agencies. It is not intended, nor will it be used to dictate, influence, or judge management direction of other owners on the management of their lands.

Watershed analysis is an ongoing, dynamic process. It is intended to be revised and updated as conditions, assumptions, or resource plans change and new information becomes available. This document summarizes a large quantity of information and detailed analysis of complex issues and interrelationships. Full reports and any new information will be added to the Little North Santiam Watershed Analysis file maintained in the Cascades Resource Area, Salem District Office.

Watershed analysis is not a decision-making process, but rather a stage-setting process. The results can be used to:

* Assist in developing ecologically sustainable programs to produce water, timber, recreation, and other commodities as well as developing restoration projects.
* Facilitate program and budget development by identifying and setting priorities for social, economic, and ecological needs within and among watersheds.
* Establish a consistent, watershed-wide context for project-level National Environmental Policy Act (NEPA) analysis, management activities evaluation, Endangered Species Act implementation, and water quality issues.

The document is organized based on the *Ecosystem Analysis at the Watershed Scale, Federal Guide for Watershed Analysis*, August 1995.

A major step in the watershed analysis process is the identification of issues that are relevant to the management of federal lands in the Little North Santiam (LNS) watershed. The issues were used to develop key questions which focus and drive the analysis of particular types and locations of cause-and-effect relationships and discern conditions as they relate to values, uses, and key ecosystems components and processes.

In this watershed analysis, the Issues and Key Questions section (Chapter 3) has been grouped into four areas: terrestrial, special status/special attention species (SSSA), aquatic, and human resources. The terrestrial area analyzes the vegetation, soils, wildlife species and habitat. The SSSA area analyzes plants and wildlife species, both terrestrial and aquatic, designated in the Northwest Forest Plan (NFP) as needing special protection. The aquatic area looks at the hydrology, riparian areas, fisheries, and aquatic habitat. The human resources area encompasses commodity forest products, transportation, and recreation. While there is considerable overlap and interaction among the various ecosystem components and processes in a natural system, these broad categories serve as an organizational aid to facilitate analysis of complex systems.

On a broad scale, much of the future condition of the LNS watershed was decided in the NFP and the Opal Creek legislation. The analysis stratified the watershed into 11 sub-watersheds. These are defined by vegetation cover and geomorphology and have also identified watershed specific opportunities and recommendations designed to achieve the goals of the NFP and the Opal Creek legislation (see Chapter 7, “Major Findings & Management Recommendations”).

Executive Summary - Overview of the what and whys of analysis and findings of this particular watershed analysis.

Chapter 1 - Introduction. Focuses on how watershed analysis will be done.

Chapter 2 - Characterization of the Watershed. Identifies dominant processes and/or features of the watershed affecting ecosystem functions or conditions and needing more detailed analysis in subsequent steps.

Chapter 3 - Identification of Issues and Key Questions. Focus the analysis on the key elements of the ecosystem that are most relevant to management questions/ objectives, human values, and resource considerations.

Chapter 4 - Historic Conditions. A historical perspective of the past influences and processes that occurred in this watershed.

Chapter 5 - Current Conditions. What the current condition of the resources of the watershed are, described according to terrestrial, special status species, aquatic, and human uses.

Chapter 6 - Future Condition and Potential Trends. What are the possible future trends of ecosystem processes with implementation of resource management plans and assumptions on private land management? This incorporates the synthesis and interpretation of all available data and information about the watershed.

Chapter 7 - Major Findings and Management Recommendations. Guidelines for ecosystem management within this watershed based on the findings in the analysis.

Chapter 8 - Monitoring, Data Gaps, Limitations. A list of where information gaps were found during the analysis, what information should be collected, and over what time frame.

Appendices. Includes additional reports by specialists, tables, charts, and maps that are not specific to the issues but may provide other useful information as well as information cited in the analysis.

Scoping/Public Input

The issue identification and scoping process took two different approaches. The first approach involved scoping through the IDT within the Cascade Resource Area and with their counterparts at the Detroit Ranger District, Willamette National Forest (NF). The second approach involved sending questionnaires to watershed landowners, local, county, state, federal agencies, and organizations interested in natural resource management. These individuals, agencies, and organizations were encouraged to complete our questionnaire and return it to our office. Continuing public involvement was dependent on returning the questionnaire. In addition, two open houses were held, one in Mill City and one in Salem. (See Appendices for summary of the comments received and copies of the scoping letters and questionnaire.)

Not all issues initially identified were carried through the analysis process. Some issues were deferred due to lack of information. Other issues were not addressed because they were not covered by federal law or jurisdiction.

Management Direction: Federal Land Use Allocation (LUA)

Under the standards and guidelines of the RMP and the ROD of the U.S. Forest Service (USFS), Willamette NF, there are seven LUAs for federal lands. The LUAs represented within the LNS watershed are General Forest Management Area (GFMA), Connectivity (CONN), Late Successional Reserve (LSR), Wilderness, Wild and Scenic River (WSR) Corridor, and RR. Other special LUAs include Opal Creek Scenic Recreation Area (SRA) (not final), and DDR.

A brief description and number of acres follow. More detailed objectives and management actions/direction for these LUAs are discussed on pages 7 to 22 of the RMP and are within the *Supplemental Environmental Impact Statement/Record of Decision for Amendments to Forest Service and Bureau of Land Management Planning Documents Within the Range of the Northern Spotted Owl (SEIS/ROD).*

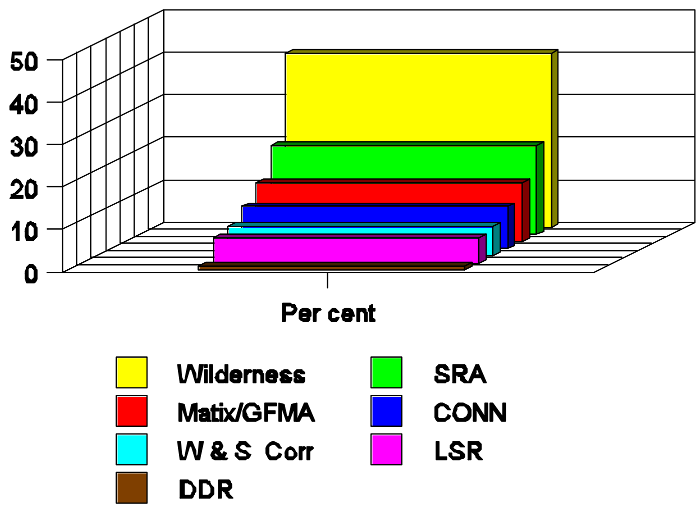
When discussing these LUAs, the inclusion of RR acres sometimes presents a better overall picture of the functions and processes occurring on that particular area of the watershed. The following discussion reflects both riparian acres as a separate allocation and then includes them into the other allocations for a different view.

Within all the LUAs, RR have been identified along all standing and flowing water, intermittent stream channels, and ephemeral ponds and wetlands. Their purpose is to contribute to the attainment of the ACS Objectives as stated in the NFP. The reserves were designed to help maintain and restore riparian structures and functions, benefit fish and riparian-dependent non-fish species, enhance habitat conservation for organisms dependent on the transition zone between uplands and riparian areas, improve travel and dispersal corridors for terrestrial animals and plants, and provide for greater CONN of late-successional forest habitats. The width of the protection buffers varies depending on stream class and site potential. All non-fish bearing streams have a minimum width that is the average height of one site potential tree. All fish bearing streams have a minimum width that is the average height of two site potential trees. Since not all of the streams are mapped, some adjustments will be made as site-specific areas are mapped. For this watershed analysis, site tree height was designated as 220 feet for lands less than 1500-foot elevations, 200 feet for between 1500- and 3000-foot elevations, and 180 feet for all elevations above 3000 feet. RR for all federal lands in LNS account for 20,310 acres or 41.14 percent of federal land.

No recommendations to reduce interim RR widths in any sub-watershed in LNS Watershed will be made as a result of this analysis. Future site-specific analysis may indicate a need to increase reserve widths depending on the analysis team's findings.

Portions of seven sections within the LNS watershed were designated as LSR under the NFP (refer to LUA map). This is a portion of the Opal Creek LSR (RO 209) which totals 3,133 acres. (North Willamette LSR Assessment). Besides these mapped LSRs, there are 10 areas for known spotted owl sites, eight of which are protected. These eight core areas are to be managed as LSRs. Management objectives are to protect and enhance old-growth forest conditions. Total LSR acres outside RR are 1,997 acres. The total with RR are 3,197 acres.

Figure 1. Federal LUA's



Contained within the LNS watershed are portions of CONN blocks identified during the resource management planning process. Outside RR this allocation totals 2,562 acres. According to the Salem District RMP, this allocation allows timber management, but late-successional forests are to be maintained. Intensive management practices are permitted on a 150-year rotation while the remaining 25 to 30 of each block is in older forest condition at any one point of time. Regeneration harvest will retain 12 to 18 green trees per acre.

The remaining federal ownership in the watershed is in a variety of other LUAs. Of these, the GFMA, including 3,556 acres outside RR, are to be managed to produce a sustainable supply of timber and other forest commodities while emphasizing ecosystem management.

Opal Creek Wilderness and Opal Creek Scenic Recreation Area Act of 1996 (The Act)

On September 30, 1996, the U.S. Congress passed The Act. The Act created a process to establish the SRA. The Act also designated Elkhorn Creek as a National WSR.

Establishment of the SRA requires certain conditions to be met within two years of the Act’s passage. Most of the private lands in the east half of the watershed are either patented mining claims, many of which are now owned by the Friends of Opal Creek, or timber lands owned by the Rosboro Timber Company. The Act requires the USFS to acquire the Rosboro lands through exchange and that most of the lands owned by Friends of Opal Creek be donated back to the USFS. The Act also requires that public access be provided around Jawbone Flats. During that two-year period, the USFS interim management policy is to manage those lands identified in the Act consistent with the guidance specified in the Act.

After these prerequisites are met, the Act requires that within one year the USFS is to form an advisory council and complete a management plan for the Opal Creek SRA. The Act also calls for the USFS to work with state and local historic preservation organizations to develop interpretive activities that provide a balanced and factual interpretation of the cultural, ecological, and industrial history of forestry and mining in the Opal Creek SRA.

The legislation also requires the completion of an economic development plan, identifying projects that benefit communities in the vicinity of Opal Creek. Fifteen thousand dollars has been authorized but still require appropriation once the plan is completed.

Table 1: LUAs of Federal Land with/without RR

LUAs	RR	Outside Riparian	Total Acres
LSR	1,200	1,997	3,197
Matix/GFMA	3,124	3,556	6,680
CONN	2,154	2,562	4,716
SRA	3,653	6,699	10,352
Wilderness	8,361	11,857	20,218
Elkhorn Creek WSR Corridor	1,520	1,968	3,488
District Designated Reserve (DDR)	296	419	715
Total	20,308	29,058	49,366

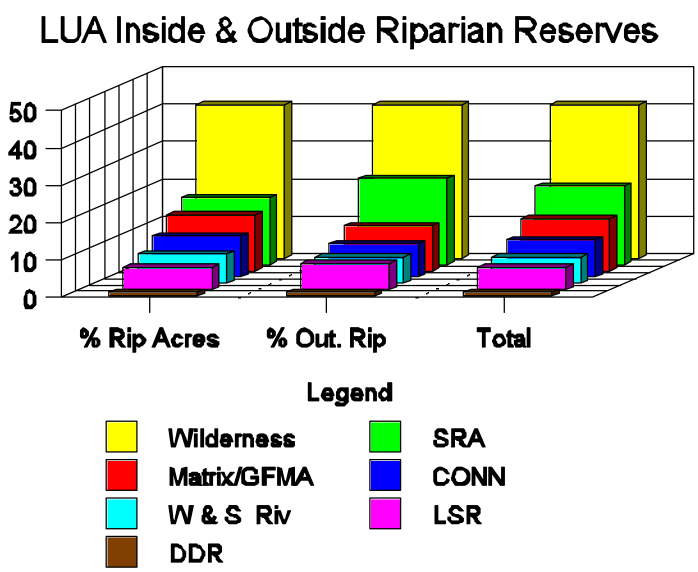


Figure 2. LUAs (Federal lands-RR acres included in each allocation)

CHAPTER 2 - CHARACTERIZATION

The characterization identifies the dominant physical, biological, and human processes or features of the watershed that affect ecosystem functions or conditions. This narrative is intended to give the reader a quick overview of this watershed and these processes and features. A more detailed condition analysis is in the Current Conditions chapter.

The LNS watershed is located in northwest Oregon in Marion County, 30 miles east of Salem. The watershed covers 72,157 acres which includes 36,144 acres of USFS land, 13,222 acres of Bureau of Land Management (BLM) land, with the remainder in state, city, and private ownership. Federal ownership in this watershed is considered major, more than 68 percent. Major industrial landowners also own significant blocks of land within the watershed.

The LNS flows into the NSR which, in turn, flows into the Santiam River, 20 miles to the west near Jefferson. The Santiam River flows into the Willamette River near Albany. The Willamette River Basin (WRB) is part of the Columbia River subregion.

The LNSR watershed includes the LNSR and its tributaries which include (but are not limited to) Opal Creek, Battle Ax Creek, Cedar Creek, Elkhorn Creek, Evans Creek, Fawn Creek, Sinker Creek, Canyon Creek, and Kiel Creek. The northern boundary is the ridge extending from Big/Little Green Mountain to House Mountain northeast to Silver King Mountain and Battle Axe Lookout, while the southern boundary extends past French Creek Ridge, Rocky Top, and Mt. Horeb and follows along No Name Ridge. The watershed is divided into 11 smaller sub-basins which will be used for future cumulative effects analysis and specific project analysis.

To the north is the Abiqua River Basin and its numerous tributaries. To the south and the east is the NSR drainage with its numerous tributaries, small communities, and high rural interface zones.

The LNS watershed (5th field) drains approximately 113 square miles or 72,157 acres of the west slope of the Oregon Cascade Mountains. The watershed is contained within the larger North Santiam watershed which covers 1,800 square miles (4th field). The watershed is located in the WRB, the largest river basin in Oregon, and drains 11,100 square miles. The WRB is part of the Columbia River subregion. A large percentage of the state's population and major cities is located in the WRB, including Portland, Salem, and Eugene. The U.S. Geologic Survey (USGS) has divided the WRB into hydrologic units and assigned each a hydrologic unit code.

The LNS watershed analysis area (WAA) originates at an elevation of 5560 feet at Battle Axe and drops to an elevation of approximately 600 feet at the confluence of the NSR. In the upper elevations, the streams are confined and consist of steep canyons and rocky cliffs. Lower in the watershed, the stream valley widens somewhat, streams are less confined, and the gradients decrease. The USFS manages the upper, mostly forested reaches, while the lower reaches are managed by the BLM and private landholders. Private lands in the WAA are mostly private timber company lands, with a minor component of small private land holdings and home development scattered along the LNS River.

The Cascade Range, which contributes the majority of drainage area for the Willamette River, extends for over 625 miles from northern California well into British Columbia in Canada. The general physiography of the Cascades is dominated by a string of potentially active volcanic peaks. These relatively recent craggy summits overlie a complex geologic sequence of older volcanic and sedimentary rocks. The overall form of the north-south treading Cascades reflects the line of subduction of the Pacific oceanic plates as they move under the North American continental plate. This plate commotion has modified the Cascades by basin and range faulting to the east and episodic mountain building and volcanism throughout their history and extent. The surface expression of these rock sequences has been altered through time by the numerous rivers that drain the wet western flanks and by intensive periods of mountain glaciation. This area has a complex geologic history that has produced a fairly uniform landscape of U-shaped glaciated valleys with broad outwash filled bottoms that are separated by steep shallow-soiled headlands and sharp rocky ridges.

Concentrations of gold, silver, copper, and lead minerals have been the center for mineral exploration and mining activity since the late 1800s. These concentrations extend from Mt. Hood into the Umpqua NF. They cross the LNS watershed in the north around Nasty Rock and Burnt Mountain and extend southward across the LNS to Phantom Natural Bridge and Dog Tooth Rock. The LNS lies at the heart of one of these concentrations, with extensive gold prospecting activity around the turn of the century. Numerous other areas along mineralized fracture zones occur throughout the landscape, especially in areas such as Gold Creek.

The Willamette Valley at the west end of the watershed supports a limited woodland of Oregon white oak and Douglas-fir, with bigleaf maple, Oregon ash, and red alder in the riparian areas. This area is mainly used for farmlands or small rural homesites. From the edge of this valley bottom land up to approximately 3,000 feet, the western hemlock zone (Franklin and Dyrness 1988) is dominated by Douglas-fir, western hemlock, and western red cedar. Above 3,000 feet, the cooler Pacific silver fir zone is composed of Pacific silver fir, noble fir, Douglas-fir, and western hemlock. Due to its proximity to the Willamette Valley, the extreme west end of the Santiam watershed basin exhibits some ecological characteristics of the Willamette Valley Province. The vast majority of the watershed is typical of the western Oregon Cascades Province. The watershed is rich in older forest habitat. All the water, soil, plants, animals, land, and people within this diverse area make up the watershed ecosystem.

The array and landscape pattern of plant communities and their seral stages are a result of natural processes and human-caused disturbances. Fire is the major short-term natural process. Human-caused disturbances are most commonly logging, fire, agriculture, mining, recreation facilities, and residential development.

Native wildlife species and habitats are typical of the western Oregon Cascades Province. The western portion of the watershed is primarily rural residential and agricultural with a few of the habitats and species typical of the Willamette Valley Province.

There are approximately 690 miles of stream in the WAA. BLM manages lands containing 19 percent of these streams, the USFS 47 percent, state of Oregon 3 percent, and private landowners 31 percent.

Precipitation occurs mostly in the winter. Snow is the dominant precipitation in the upper elevations and rain in the lower elevations. The WAA exhibits high winter flows and low summer flows typical of the Cascade Range drainages. Average discharge over 65 years of record is 751 cfs or 543,900 acre-ft. per year. Maximum measured discharge was 36,000 cfs on December 22, 1964, and the minimum recorded discharge was 13 cfs on August 30, 1961. Snow may supplement spring flows April through June (USGS 1996). This signifies the importance of snow accumulation and melt in the upper elevations in moderating runoff and storing water in the WAA. No major dams or reservoirs exist in the WAA, and most of the summer flow is derived from groundwater.

Significant water quality issues have been identified within the LNS watershed and downstream in the NSR drainage. In the DEQ publication, *1988 Oregon Assessment of Non-Point Sources of Water Pollution* (ODEQ 1988), also known as the 319 report, water quality in the LNS was listed as being moderately impacted (with data). The causes were listed as landslides, erosion, decline in the alluvial water table, animal waste, human waste, and riparian vegetation and bank disturbance. The uses impacted are municipal water supplies and fish and other aquatic organisms. DEQs 303d list and report of water quality limited waterbodies (ODEQ 1996) do not list the LNSR. However, the NSR is listed water quality limited for summer temperatures from the mouth to the LNSR.

Water quality data have been collected by agencies (City of Salem) and other groups and are analyzed later in this document.

Beneficial uses of water in the watershed include irrigation, domestic use, fisheries, aesthetics, power, and miscellaneous other uses resulting in 71 cfs and 41 aft of water rights. The discharge is greater than 70 cfs 80 percent of the time. The remaining 20 percent of the time the stream may be over allocated.

The LNS watershed was designated by FEMAT as a Tier 1 Key Watershed contributing directly to conservation of at-risk anadromous salmonids, bull trout, and resident fish species. Winter steelhead trout and spring chinook salmon are the anadromous fish native to the Willamette River above Willamette Falls. LNS is considered a key production area for the above-mentioned species. Resident populations of rainbow and cutthroat trout are found throughout the watershed. Warm water fish species are found in LNSR, generally in the waters near the town of Mehama.

The LNS watershed is an important place to many people. Along with the inherent biological values, it provides a variety of resources that are utilized by people. These include timber products, municipal water, recreation opportunities, and educational opportunities.

The Willamette Valley has a long history of human habitation. Evidence suggests the Willamette Valley may have had human inhabitants as early as 10,000 years ago. Sites dating to about 8,000 years ago occur along the South Santiam River with artifacts indicative of hunting. At the time of Euro-American exploration and settlement, the Kalapuya Indian groups lived in the Willamette Valley and, along the Santiam and Molalla Rivers, Indians lived on the slopes of the western Cascades. The Kalapuya were known to have burned in the Willamette Valley to maintain habitat for favored plant and game animal species.

American settlers and gold prospectors entered the LNS country in the early 1850s, and some placer mining may have started by about 1853. The first lode claims were filed in 1860. Eventually, hundreds of claims were filed, and a number of mines producing gold, silver, lead, and zinc were in operation. The biggest years of production started about 1915.

Settlement for farming and entry for logging also occurred starting in the 1860s. However, land in this area was valued for mineral and timber resources with permanent agrarian settlement affecting a much smaller portion of the watershed, primarily along the river.

Federal actions in the watershed started with the General Land Office (GLO) surveys. Lower portions of the watershed came under the Oregon and California Railroad lands grant (O&C) and eventually came to the BLM in 1946. Upper portions of the watershed were managed by GLO rangers until 1905, after which management transferred to the new USFS. Roads, trails, and lookouts were built by the Civilian Conservation Corps (CCC) during the 1930s, opening up the country to easier access.

Today, land in the LNS watershed is used primarily for timber production, agriculture, and recreation. Industrial forest production is the predominant private land use in the watershed, and agricultural use is very limited and small in scale. There is a fairly large number of year-round and vacation residences, most of which are adjacent to or near the LNSR. The Elkhorn Valley Golf Course also extends for over a mile along the LNSR.

The majority of USFS-administered lands have had limited harvesting due to political considerations. Presently, all of the lands are in LSR or wilderness designations. By contrast, the BLM administration and private ownerships have had a history of intensive forest management. The USFS-administered lands have a long history of mining, although this has been on a small scale; tunnels and mine tailings are numerous.

Current recreation use is moderate to high compared to other areas in the Santiam River Basin. Several USFS and BLM recreation sites/campgrounds are located along the LNSR throughout the watershed. The Opal Creek sub-basin, on the Willamette NF, is a popular educational and hiking area. Elkhorn Creek, on both USFS and BLM land, has been designated as a Wild & Scenic River. LNS River is already designated as a State Scenic River.

The recreational experience offered by the LNS watershed is Roaded Natural (RN). This is predominately natural forested environment, with moderate evidence of human modification associated with timber harvest and road construction activities. There are many developed recreation facilities in the watershed. Use of the watershed for dispersed activities is moderate to high. Primary dispersed recreational activities include dispersed hiking and camping, fishing, hunting, target practice, off-road vehicle use, horseback, and mountain bicycle riding.

The proximity of the LNS watershed to many well populated communities in the Willamette Valley makes the watershed a popular recreation area with a high level of repeat visitation. The LNSR and Cedar Creek offer opportunities for swimming, tubing, fishing, and recreational mining. The two developed overnight areas and four developed day-use areas along the river are often above capacity during the peak-use weekends between Memorial Day and Labor Day weekends. There is also a significant amount of dispersed day and overnight use along the river, most of which occurs on USFS lands in the east half of the watershed. The lack of sanitation, water, and trash facilities is a concern in some of these areas.

The trailhead to the Opal Creek drainage receives the highest use in the Detroit Ranger District. It is often visited by individuals seeking opportunities for environmental education about old-growth habitats and a variety of other topics. Access to the rest of the east half of the watershed is limited primarily to trails that feature scenic overlooks of the Cascade mountain range, waterfalls, and geologic formations. Several of the trails also offer opportunities for solitude.

Access to the upland public lands in the west half of the watershed is limited in several areas due to gates on private lands. The public land that is accessible offers opportunities for dispersed camping, hunting, target shooting, and off-highway driving.

The majority of the roads in the watershed are surfaced by rock and passable by the average vehicle. There are also several lesser maintained roads and spur roads that offer more challenging driving experiences. Public vehicle access to public and private industrial landowners in LNS is limited by gates.

The east half of the LNS watershed contains the Opal Creek drainage, an area which has received a significant amount of public interest and media attention over the last several years related to protecting the old growth forest habitat in the drainage. Recent legislation passed by the U.S. Congress provides for the protection of much of the east half of the watershed, provided certain requirements related to land exchanges and transfers are met. The completion of a management plan for the area is also required.

Respondents to a scoping questionnaire indicate that water resources, recreation resources, and the opportunity for experiencing old-growth forest habitat are important values. The need for balanced resource management including timber harvest was also mentioned.

OWNERSHIP

Table 2. Ownership Acreage and Percentages in LNS Watershed.

OWNER	ACRES	PERCENT OF TOTAL
BLM	13,222	18.3
USFS	36, 144	50.1
STATE	1,869	2.6
PRIVATE - INDUSTRIAL	16,613	23.0
PRIVATE - NON INDUSTRIAL	4,309	6.0
TOTAL	72,157	100.0

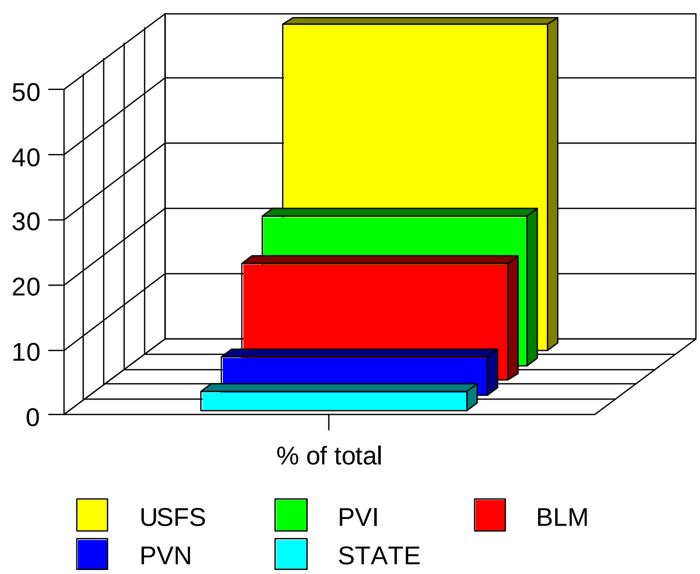


Figure 3. Ownership Percentages in the LNS Watershed

CHAPTER 3 - ISSUES AND KEY QUESTIONS

The watershed analysis team began the process by identifying the following components as significant issues. These issues are addressed by asking key questions. These questions focus the analysis on cause-effect relationships and on conditions as they relate to the ecological processes occurring in the watershed. The questions have been grouped into four categories:

- Terrestrial

- Special Status/Special Attention Species

- Aquatic

- Human

An attempt to answer these questions is made by gathering the information available (Current Condition) or identifying information gaps. Considerable overlap and interaction occur among these ecosystem components. For instance, sedimentation is an erosional process, but it affects the water quality. The grouping into categories was used as an organizational aid for facilitating analysis and promoting easier reading.

Several hundred letters and questionnaires were mailed to residents of the LNSR watershed, natural resource interest groups and individuals, private companies, and community leaders. The responses to the questionnaires as well as those solicited from watershed analysis team members and specialists form the basis for the issues and key questions which will help focus the analysis.

TERRESTRIAL

SOILS

Issues: *Water quality is listed by the Oregon Department of Environmental Quality (DEQ) as being moderately impacted by sediment, low dissolved oxygen, bacteria, and viruses. The potential causes include landslides and erosion. Water quality is one of the key issues in the basin. Erosion, stream channel routing, and riparian condition are all components which contribute to the existing water quality.*

The other main issue is long-term soil productivity. Soil productivity is significantly influenced by the nutrient capital in the soil. The majority of the nutrient capital is in the surface horizon of *the*

soil. Erosion or other soil movement would reduce the nutrient capital at that site and reduce the capacity of the site to grow trees.

Key Questions:

- *Where are the major sources of sediment from erosion, landsliding, road runoff, or other management activity located? Where are they likely to occur? What are the processes that affect sediment from erosion, landsliding, road runoff, or other management activity?*

- *What areas have the greatest potential for landslides or erosion?*

- *What are the historical and current conditions and trends of the dominant erosion processes prevalent within the watershed?*

- *What are the natural and human causes of change between the historical and current erosion processes in the watershed? What are the influences and relationships between erosion processes and other ecosystem processes?*

VEGETATION

Issue: *Landscape patterns and processes are necessary for assessing hydrologic condition and wildlife habitat.*

Key Questions:

- *What are the current landscape patterns of plant communities and seral stages in the watershed (riparian and nonriparian)? What disturbance processes caused these patterns (fire, wind, mass wasting, floods)?*

- *What are the current conditions and trends of the prevalent plant communities and seral stages in the watershed (upland, riparian, aquatic)?*

- *What are the historical and landscape pattern of plant communities and seral stages in the watershed (upland, riparian, aquatic)? What processes caused these patterns (fire, wind, mass wasting, flood)?*

- *What are the natural and human causes of change between historical and current vegetative conditions? What are the influences and relationships among other vegetation and seral patterns and other ecosystem processes in the watershed (e.g., hydrologic maturity, channel stability, shade disturbance, species movements, soil and erosion processes)?*

WILDLIFE/BOTANY

Issues:

- *Condition (quality and quantity) and trend of wildlife habitat in the LNS watershed, including late successional/old growth (LS/OG) habitat, seral stage distribution, stand structure, riparian habitat, special habitats and linkages /flows within and surrounding the watershed.*

Key Questions:

- *What are the present seral stage amounts, distribution and vegetation patterns within the watershed? How do current seral stage amounts and distribution, special habitats, and vegetation patterns influence the condition of wildlife habitat?*

- *How will land use objectives and management guidelines of the USFS, BLM, and privately managed lands influence wildlife habitat condition and trend?*

SPECIAL STATUS/SPECIAL ATTENTION SPECIES (SSSA)

Issues: *SSSA species occurrence, habitat condition, and trend.*

Key Questions:

- *Which SSSA (including T&E) wildlife and plant species are known or suspected to occur in the watershed? How do current habitat conditions contribute to habitat for SSSA?*

- *How will land use objectives and management guidelines of the USFS, BLM, State of Oregon, and privately managed lands influence future habitat for SSSA species?*

AQUATIC

Hydrology, Water Quality

Hydrology

Issues:

The DEQ (in the 319 report) lists low flows and flooding as problems in the LNSR. Demands for water are increasing with private water-rights, municipal rights, and fisheries concerns.

Questions:

* *What are the historic or reference flow regimes on the river? What are the current flow regimes, and what is the trend?*

* *How have the management practices affected the rivers flow regime?*

* *What is the status of water availability on the river?*

Water Quality

Issues:

C *Water quality is listed by the DEQ as being moderately impacted by sediment, low dissolved oxygen, bacteria, and viruses. The beneficial uses impacted are a municipal water supply, fish, and other aquatic organisms. Water quality is the key hydrology issue in the basin.. The potential causes are landslides, erosion, a decline in the water table, animal and human waste, and riparian and bank disturbances. Erosion, stream channel routing, and riparian condition are all components which contribute to the existing water quality. Increasing pressure from development, mining, forestry, and recreation has the potential of further affecting water quality.*

Questions:

* *What is the current water quality condition on the river? What is the trend in water quality?*

* *Is the current level of water quality supporting beneficial uses?*

* *How has human development and uses affected water quality on the river?*

* *What opportunities exist for improving water quality through changes in management and*

site specific projects?

* *How have riparian and stream channel conditions affected water quality?*

FISH

Issue: *Declining runs of wild anadromous fish.*

Questions:

C *What is the distribution of anadromous fish, by species?*

C *What stocks of anadromous fish are recognized as "at risk?"?*

Issue: *Resident fish populations.*

Questions:

C *What resident fish exist in the watershed?*

Issue: *Aquatic habitat degradation.*

Questions:

C *What is the general condition of aquatic habitats in the watershed?*

C *Are there restoration opportunities in degraded aquatic habitats? If so, where are they located?*

HUMAN

Issue: *Recreation.*

Key Questions:

C *What is the role of the watershed in providing recreational activities?*

C *What type of access and transportation currently exists and what is needed?*

C *What is the status of roadless areas?*

Issue: *Other human uses.*

Key Questions:

- C *What are the major human uses, including tribal uses and treaty rights?*
- C *Where do these uses occur within the watershed?*
- C *What are the current conditions and trends of the relevant human uses within the watershed?*
- C *What are the major historical human uses in the watershed?*
- C *What are the causes of change between historical and current human uses?*
- C *What are the influences and relationships between human uses and other ecosystem processes in the watershed?*

Not all issues initially identified were carried through the analysis process. Some issues were deferred due to lack of information. Other issues were not addressed because they are not covered by federal law or jurisdiction.

CHAPTER 4 - HISTORIC CONDITIONS

Ecosystems are not static, but vary over space and time. This dynamic nature exemplifies the need for us to consider ranges of conditions under natural disturbance regimes, rather than single points in time. A key assumption of this concept is that when natural systems are "pushed" outside the range of natural variability, maintenance of biological diversity and ecological function is at substantial risk.

The following narrative explains how ecological conditions have changed over time because of human influences and natural disturbances. This information is used to explain existing conditions and predict potential trends.

Geologic History

The LNSR, located on the west slope of the Cascade Range, is part of the North Santiam sub-basin, which is a component of the WRB. The Cascade Range, which contributes the preponderance of drainage area for the Willamette River, extends for over 625 miles from northern California well into British Columbia in Canada. The general physiography of the Cascades is dominated by a string of potentially active volcanic peaks. These relatively recent craggy summits overlie a complex geologic sequence of older volcanic and sedimentary rocks. This plate commotion has modified the Cascades by basin and range faulting to the east and episodic mountain building and volcanism throughout their history and extent. The surface expression of these rock sequences has been altered through time by the numerous rivers that drain the wet western flanks and by intensive periods of mountain glaciation.

Located within the Western Cascades physiographic region, the LNS watershed is composed of older Tertiary lava flows, tuff, and intrusive rocks. Dates on parts of this formation are mostly 17 to 32 million years old. The sedimentary portion of the assemblage forms a prominent escarpment along the north boundary of this watershed from Knob Rock east to Trappers Butte (Walker and Duncan 1989).

Flow breccias of olivine andesite, basaltic andesite, and some basalt form a crescent-shaped cap on the higher elevation main ridges that extend northwest from Martin Buttes to Mount Beachie, then north to Silver King Mountain, and west towards Whetstone Mountain and along the ridge line to Henline Mountain and beyond. Erupted mostly from widespread, northwest-trending dikes and dike swarms and related plugs and lava cones, their dates range from about 10 to 17 million years ago or middle to late Miocene.

The surface expression of these rock formations has been extensively modified by erosion with mountain glaciation. During the earliest and most extensive glacial periods, valley glaciers traveled down the LNS Canyon and some of its tributaries. The younger and more recent glaciations had smaller, coalescing valley glaciers occupying the predominant stream valleys.

They formed cirques, bowl-shaped depressions with sheer rock headwalls, found in the higher elevations along the southern boundary of the watershed. Tarns, small ponds that occupy cirque depressions, are found at Opal Lake and Elkhorn Lake.

Large scale slump/earthflow instability has not been a significant factor in slope development or stream channel morphology in this area, except for a few localized reaches. This complex geologic history has produced a fairly uniform landscape of U-shaped glaciated valleys with broad outwash filled bottoms that are separated by steep shallow-soiled headlands and sharp rocky ridges.

Concentrations of gold, silver, copper, and lead minerals lay like widely spaced beads on an unclasped necklace that is strung down the western front of the Cascade Range. Historically, each bead has been the center for mineral exploration and mining activity since the late 1800s. This necklace extends from Mt. Hood into the Umpqua NF. The line of the chain crosses the LNS watershed in the north around Nasty Rock and Burnt Mountain and extends southward across the LNS to Phantom Natural Bridge and Dog Tooth Rock. The LNS lies at the heart of one of these beads with extensive gold prospecting activity around the turn of the century. The bead to the south is located in the Quartzville mining district.

Disturbance Regimes and Ecological Effects

There are many disturbance factors that operate within this watershed. These factors include wind, fire, floods, insects, disease, and humans. Today, humans are the agents of greatest disturbance in the landscape. When human population levels were low, fire was the primary disturbance force. It was used to manipulate the ecosystem for beneficial uses through planned ignitions and occurred naturally, primarily from lightning. Whether planned or not, fire affected a broad range of ecosystems from a few acres to many thousands.

Native Americans recognized the benefits of fire and became accomplished practitioners of prescribed fire. The Kalapuya Indians burned the Willamette Valley for thousands of years prior to Euro-settlement. This use of fire to manipulate their environment extended up major river drainages such as the Santiam River and extended into the foothills of the Cascades and coast range (Boyd 1985). The use of fire maintained an oak-savannah ecosystem, which began changing back to a forested ecosystem (if not plowed) after settlers eliminated the Indian-prescribed burning culture with their removal to reservations in the 1850s.

Fire is the primary natural disturbance factor over the landscape and causes the greatest ecological effects over space and time. Understanding fire ecology terminology is helpful in understanding forest ecology from a historical perspective. Fire regime is a generalized description of the role fire plays in an ecosystem. It is the combination of fire frequency, predictability, intensity, seasonality, and extent characteristics of fire in an ecosystem. There are many descriptions, but the one used here is based on fire frequency and fire intensity (Agee 1981, Heinselman 1981). Fire frequency is the return interval of fire. Fire intensity/severity is the ecological impact of a fire, such as mortality of plant or animal species, changes in species composition, and other ecosystem characteristics.

Wind also has the capacity to disturb large areas of the landscape and, on a historical basis, has done so approximately every 25 years (Teensma 1987). The last extensive large wind event in Oregon was the Columbus Day Storm of 1962, which blew down 11 billion board feet of timber in Oregon and Washington, 98 percent of which was west of the Cascade crest. Other major wind events occurred in December 1996, March 1963, February 1958, April 1957, November 1953, January 1921, and January 1880 (Lynott and Cramer 1966, Hemstrom and Logan 1986). Wind has more influence on coastal forest dynamics than on the forests of the Cascades. Wind is also associated with patch-size disturbances over the landscape as are insects and disease. These three disturbance factors add small complex changes over large spatial and temporal scales and have direct and indirect influences on fire ecology.

The LNS watershed occupies the dry to wet western hemlock plant association (73%), the Pacific silver fir plant association (26%), and mountain hemlock plant association (1%). There are multiple fire regimes in these zones based on the physical factors of elevation, aspect, orientation of land forms on the landscape, climate and weather patterns. These factors have significant effects on fire behavior (fire regimes) and, therefore, fire history (Teensma 1987).

The multiple fire regimes are: (1) infrequent severe surface fires (more than 25-year intervals); (2) long return interval crown fires and severe surface fires in combination (100-300 year return intervals); and (3) very long interval crown fires and severe surface fires in combination (over 300-year rotation return intervals). The source of fire ignitions comes from lightning and humans.

Occurrence or patterns of lightning fires are mainly determined by regional climate, land forms, elevation, aspect, and fuel type. Map A gives a reference to regional annual lightning fire patterns. Lightning is the primary source of wildfire ignitions in the Pacific Northwest. Human-caused ignitions are a result of industrial activities (logging, welding, road building, etc.), arson, carelessness (debris burning, escaped prescribed burns, campfires), and structural fires in the forested landscape. In the LNS watershed, lightning starts occur primarily in the higher elevation east portion (low occurrence) and human-caused ignitions occur in the lower elevation west portion of the watershed.

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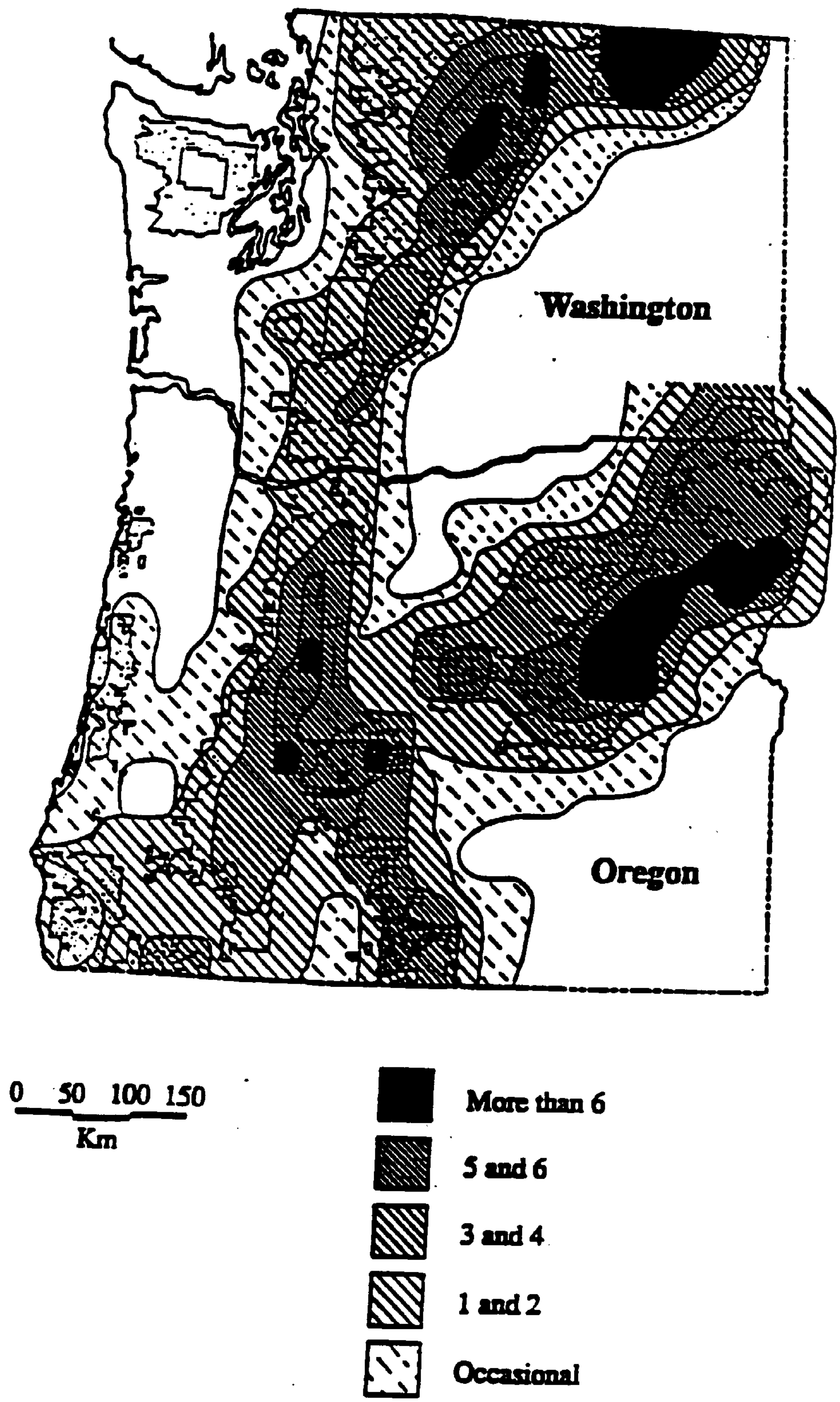
Map A. Regional Annual Lightning Patterns on National Forests of Oregon and Washington. These patterns are an index to lightning fire activity and show number of storms per 40,000 ha per year. (From Morris 1934)



Fire effects resulting from these fire sources are varied. An infrequent severe surface fire burns on the soil surface, and active burning does not involve the tree crowns. This fire regime would slopes). The effect could include maintaining Douglas-fir as primary tree species by removing thin barked trees and promoting thick barked trees, maintaining low amounts of downed wood due to fuel consumption with more frequent burning, and maintaining brush species that sprout and can live under a tree canopy. This fire regime is less dependent on changes in weather patterns (drought) than other fire regimes.

Crown fires and severe surface fires every 100-300 years are more dependent on changes in weather patterns. In this instance, the forest ecosystem accumulates fuel over time. Wind and disease interact more often and contribute to patch dynamics. Legacy trees from the previous disturbance and natural mortality help create a multi-storied canopy. Intolerant tree species dominate the lower canopy. As the stand ages, more sunlight reaches the forest floor, and the shrub and herb layer diversifies. Under normal conditions, fire starts cannot develop enough energy to do extensive damage to the landscape. This is due to the energy required to evaporate the high amounts of internal water in the combustion phase of burning carbon-based fuels. With drought conditions and less water to evaporate, fire energy levels are much higher, and the outcome is greater fire effects over a wider geographical area. Fire effects may include (1) total tree mortality; (2) elimination of the duff and litter layers; (3) reduction of the downed woody component, especially logs in later stages of decay; (4) increased erosion and sedimentation of water courses; and (5) formation of snags.

A number of fire history studies have been done on the H.J. Andrews Experimental Forest (HJA) on the Blue River Ranger District, Willamette NF (Teensma 1987, Swanson and Morrison 1980). The HJA is approximately 45 air miles SSE of the LNS watershed. The results from the HJA studies correlate well with the LNS. Table 3 and Figures 4 & 5 (Teensma 1987) give a picture of overall fire frequency, fire frequency based on elevation, and fire frequency based on aspect.

Table 3. **Natural Fire Rotation by Period.**

Cultural Period	Interval (range of dates)	Estimated by Ratio	Estimated by Planimeter	Average
Pre-Anglo	1435-1830	102	89	96
Transition	1831-1850	36	30	33
Pre-fire Suppression	1851-1909	102	71	87
Suppression	1910-1986	768	587	587
"Natural Fires"	1435-1909	95	80	88
Immediate Pre-Anglo	1772-1830	86	69	78
Total for Length of Record	1435-1986	108	91	100

Mean Fire Return Interval, Stand-replacing (or partial stand-replacing) Fires
(bars connect elevations with MFRI that are not significantly different)

Elevation Range, in Meters (feet)

	< 762 (< 2,500)	762-914 (2,500-2,999)	914-1,066 (3,000-3,499)	1,067-1,219 (3,500-3,999)	1,220-1,371 (4,000-4,499)	> 1,371 (> 4,500)
MFRI (yrs)	209	170	186	171	126	82

Mean Fire Return Interval, All Fires
(bars connect elevations with MFRI that are not significantly different)

Elevation Range, in Meters (feet)

	< 762 (< 2,500)	762-914 (2,500-2,999)	914-1,066 (3,000-3,499)	1,067-1,219 (3,500-3,999)	1,220-1,371 (4,000-4,499)	> 1,371 (> 4,500)
MFRI (yrs)	153	121	123	109	82	73

Figure 4. Comparison of Mean Fire Rotation Intervals by Elevation.

Mean Fire Return Interval, Stand-replacing (or partial-stand-replacing) Fires
(bars connect aspects with MFRI that are not significantly different)

Aspect	Ridge	South	West	SW	East	NE	SE	North	NW	Valley
MFRI (years)	116	124	178	162	154	159	151	198	207	227

Mean Fire Return Interval, All Fires
(bars connect aspects with MFRI that are not significantly different)

Aspect	Ridge	South	West	SW	East	NE	SE	North	NW	Valley
MFRI (years)	74	94	105	107	110	121	122	132	148	150

Figure 5. Comparison of Mean Fire Return Intervals by Aspect.

Fire effects resulting from these fire sources are varied. An infrequent severe surface fire burns on the soil surface, and active burning does not involve the tree crowns. This fire regime would typically occur in places prone to lightning starts and low fuel accumulations (ridges and south slopes). The effect could include maintaining Douglas-fir as primary tree species by removing thin barked trees and promoting thick barked trees, maintaining low amounts of downed wood due to fuel consumption with more frequent burning, and maintaining brush species that sprout and can live under a tree canopy. This fire regime is less dependent on changes in weather patterns (drought) than other fire regimes.

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A number of fire history studies have been done on the H.J. Andrews Experimental Forest (HJA) on the Blue River Ranger District, Willamette NF (Teensma 1987, Swanson and Morrison 1980). The HJA is approximately 45 air miles SSE of the LNS watershed. The results from the HJA studies correlate well with the LNS. Table 3 and Figures 4 & 5 (Teensma 1987) give a picture of overall fire frequency, fire frequency based on elevation, and fire frequency based on aspect.

Fire history research has done three things. It has shown that fire has occurred more often than earlier believed; that fire has not been as severe on the landscape in the Cascades as in other areas; and that older growth stands have multiple age classes that are not easily discernable. This information helps collaborate aerial photo interpretation (1956) and written historical records about the watershed (survey notes, 1871, 1893, 1943, etc.).

Historically, this watershed was well timbered with some prairie. The west end prairie ecosystem (lower elevations) was influenced by aboriginal burning as were main river corridors (Santiam River, LNS). In all likelihood, the agricultural land of today was prairie at the time of settlement. The aboriginal burning of the landscape prior to settlement influenced the ecology of the foothill forests and valley floors. Indians burned the prairie/forest ecotones to provide safety from warring tribes, better game forage, and ease of travel. The oak savannah (prairie) was burned to maintain foodstuffs, game management, safety, and ease of travel.

Some aspects of the watershed were not influenced by Native Americans. Looking at the 1956 photos, there was a correlation to the results of Teensmas' fire history study in the HJA. Some of the correlations follow: (1) High ridge tops and south slopes burned more often; this corresponds to young age classes at these locations where tree species are dense and more uniform in age; (2) East, west aspects at high/mid-elevation are next in fire frequency. Forest age, composition, and structure are more diverse and complex than on ridge tops and south slopes; (3) North slopes, valley bottoms, riparian areas, and lower elevations have the longest fire frequency. This part of the forest is older with the greatest age class distribution, highest species composition, and greatest structural diversity. This forest is considered stable in that it can absorb a great deal of disturbance before its basic character changes.

On a watershed basis, the matrix forest cover type was older forest. Age distribution ranged from the Pacific silver fir zone at 500-700 years old to early seral stages of brush and young conifers with every conceivable variation in between. 1893 surveys by George Pershin of the townships in this watershed describe many different forest conditions. For T. 9 S., R. 5 E., he writes "Land mountainous 79.88 chs. soil 4th rate, some 3rd rate, timber irregular large part scattering, dense undergrowth of Laurel, vine maple, alder, huckleberry and devils club." At Section 26 of T. 8 S., R. 4 E., he wrote "Timber on burns mostly dead, remainder medium. Fir, hemlock, yew, and cedar. Undergrowth laurel and vine maple." Pershin's general of T. 8 S., R. 4 E., Sec. 24-36 is as follows: "Most of the timber in the south two rows was destroyed by fire many years ago, but is now rapidly recovering itself with a young growth of fir and hemlock."

From a historical perspective, the watershed was more complex and resilient than it is now. Disturbance did not have an adverse effect but added or maintained complexity and diversity.

Timber harvest has changed the forest to a less complex system. Fire has been virtually eliminated from the ecosystem. Since 1910, the fire return interval has increased from 95-114 years to over 585 years because of the current fire suppression policy. Species diversity has been simplified from many tree species to monocultures of Douglas-fir. Age class distribution has gone from 2.3 age classes per site (Teensma 1987) to one. Older forests are now young to early mid-age (50-100 years). Structural complexity is minimal. Areas that maintained the oldest, most complex ecosystems (primarily riparian areas) were logged first and support our transportation network.

What implications does disturbance have on the present watershed forest? Species composition is more uniform in age and species. Disease could cause greater widespread problems. Fire has large expanses of uniform fuel types to burn in. If burning conditions are met and an ignition source is available, larger than normal fire size could occur. Fire would also have a larger burning window because of dryer conditions created by pre-commercial thinning or manual release. The federal policy of dispersed smaller clearcuts has created drier conditions in the remaining older forests. This makes them more susceptible to fire than under natural conditions. The opening of the canopy has also accelerated the blow down of timber.

Fire left a legacy of structural diversity with multiple age classes, snags, and downed wood. This gave rise to multi-layered canopies, nesting sites (snags), travel corridors (downed logs), foraging sites (snags, downed logs), germination sites (downed logs), nutrient/water storage (downed logs), mycorrizal activity (downed logs), and an establishment phase that lasted 20-100 years. It has been hypothesized that long establishment periods (brush>hardwoods>conifers) helped control root rots. Timber harvest in the past eliminated a majority of the structural diversity components. Where fire gave diversity and complexity, yielding stability, timber harvest gave the forest simplicity and instability.

The ecosystem selected tree species that could survive disturbance. From the fire aspect, Douglas-fir develops thick bark, attains great height, and a deep rooting habit. These characteristics allow tree survival of light to moderate intensity fires. The Douglas-fir forests of today do not have the characteristics to sustain a moderate intensity fire due to thin bark.

Plant Communities

There is very little documentation on the historical presence, abundance, and distribution of today's rare plant and fungal species in western Oregon. For this analysis, a widely accepted assumption that species presence and distribution are directly related to the presence and distribution of suitable habitat has been made.

Before fire suppression and European settlement, when the west end of the watershed had more land in oak savannahs and the foothills and higher elevations were more dominated by mature coniferous forests, there was more available habitat for the species we describe as rare today. Species such as Bradshaw's lomatium, howellia, Nelson's sidalcea, golden paintbrush, peacock lockspur, and Willamette daisy inhabited the Willamette Valley prairies and wetlands. As the

Willamette Valley turned into an urban and agricultural center, the amount of available habitat for these species decreased dramatically.

Today, oak savannahs and undisturbed low elevations wetlands are among the rarest habitats in LNS watershed. It follows that species that require those habitats have also become rare.

Oregon's native vegetation evolved with fire. Some rare species are more dependent on fire as a natural disturbance than others. Those species which require fire to create and maintain optimal habitat conditions have lost habitat as a result of fire suppression. It's believed that tall bugbane and Bradshaw's lomatium plus several other rare Willamette Valley and Cascade foothill species have lost habitat from fire suppression.

The rare species which occupy higher elevation forested habitats include (but are not limited to) cold-water corydalis, noble polypore fungus, and fir club-moss. It is reasonable to believe that these species were more abundant when there was more high quality suitable habitat available. High quality habitat for these species is mature forested habitats with a high degree of connectivity, minimal fragmentation and soil disturbance, and a natural fire frequency.

Habitat for the native vegetation began to degrade with fire suppression. The logging boom in the 1940s and timber activity up to the present time progressively degraded the habitat. This was done by fragmenting the forest, altering hydrological processes through road construction, creating seed beds for exotic species by disturbing soil, and by providing travel corridors and seed vectors for exotic plant species. Human activity along the roads and in the clearcuts has provided excellent opportunities for invasive plant species to infest the ecosystem. This has reduced the quality and amount of available habitat for native vegetation.

Wildlife Habitat

Historically, disturbance in LNS watershed has been dominated by fires and windstorms that left varying quantities of standing dead and down wood, important components of wildlife habitat. Fires left a mosaic of forest types and seral stages across the landscape resulting in greater within stand diversity. Induced high contrast edge habitat was uncommon, and there was less habitat isolation in the lower half of the watershed. Large blocks of older forest dominated much of the watershed. The watershed was unroaded until recent times, and direct influences from human disturbance was minimal. Fragmentation was less, and connectivity of habitats was higher, resulting in better wildlife dispersal capabilities across the landscape.

There has been a greater departure from historic conditions in the western half of the watershed. Here, timber harvest activities during the last 50 years have resulted in higher intensity, more frequent disturbance regimes. With the harvest of trees, older forest and standing dead and down log components of wildlife habitat have decreased. As a result, within stand diversity has decreased, and between stand diversity has increased. Timber harvest and road construction have increased induced high contrast edge and isolation of remaining patches in the lower half of the watershed. Harvest patterns along property boundaries have disrupted travel corridors and decreased connectivity of habitats. This has resulted in poorer wildlife dispersal capabilities, especially for the less mobile species. In the western half of the watershed, the predominate matrix has been transformed from late seral to early/mid seral stage conifer stands. As a result of commercial forestry, the regeneration period has been shortened, resulting in a proportionately higher amount of mid seral stages across the western half of the watershed. In addition, portions of the western half have been converted to rural residential home sites and farm lands. Much of the extensive stands of older forest remain intact in the eastern end of the watershed. Road densities are low, and there has been much less disturbance due to timber harvest.

This departure from historic disturbance regimes has impacted the abundance and distribution of wildlife species in the LNS watershed, especially the western half. Species whose optimum habitat is older forest and standing dead/down log components of wildlife habitat have been adversely impacted. These species include the clouded salamander, Oregon slender salamander, pileated woodpecker, and the spotted owl. Species whose primary habitat is edge and open areas in the forest environment have tended to be favored. These species include black-tailed deer, mountain quail, great horned owl, red-tailed hawk, and golden eagle.

Some species which were present during historic times have been greatly reduced or extirpated due to direct human impacts. These species include the fisher, wolverine, gray wolf, and the western rattlesnake. Non-native species not present in the watershed until recent times may have displaced some native species. These species include the bullfrog, starling, house sparrow, opossum, and eastern cottontail. These non-native species are much more abundant in the western half of the watershed.

Fisheries

Historically, only winter steelhead trout and spring chinook salmon could migrate over the Willamette Falls into the upper Willamette Valley. The majority of these fish spawned in the Santiam and McKenzie River sub-basins. Both species utilized LNS for spawning and rearing.

The Santiam sub-basin provided the majority of the winter steelhead production and about one-third of the spring chinook salmon production in the Willamette Basin (Wevers, et al. 1992). Up to two-thirds of the Santiam sub-basin steelhead production occurred in the upper portions of the North and South Santiam rivers. The remaining production occurred in the lower foothill tributaries including the LNS. LNS may have produced large numbers of steelhead historically, but these runs have been substantially reduced since the 1950s.

Anadromous and resident salmonids existed in streams that would have had an abundance of large persistent wood. Log jams were likely common, particularly in the flat gradient (<2%) sections. Woody debris provided instream cover and helped dissipate flood flows. Channels would have had a diversity of substrate types, for spawning and invertebrate production, as floods routed landslide debris throughout the system. Stream channels would have been more complex, with water flowing around boulders and large pieces of wood. Side channel and off channel habitats were common in low gradient areas.

Riparian areas in the lower portion of the watershed were likely composed of mixed hardwoods and conifers. Above the point where the valley begins to constrict, riparian areas would have been dominated by older coniferous forests, with some alder and maple along the stream corridor.

Stream temperatures were likely cool in the summer. Spring chinook entered the Santiam sub-basin in May and held in large mainstem and tributary pools until they spawned in fall. They required deep, cold water pools for holding during summer months. Periodic fires, often followed by landslides, would have had a negative effect on salmonids due to increased sedimentation and increases in water temperature. However, due to the biotic diversity brought about by fire in the landscape, there were likely places where some fish could escape the impacts of these events.

Much of the most productive habitat in the Santiam sub-basin has been blocked by dams on the North and Middle Santiam rivers. Detroit Dam and the downstream Big Cliff Dam, constructed in 1953 on the North Santiam, and Foster and Green Peter dams, constructed in 1953 on the South and Middle Santiam rivers, have blocked anadromous fish passage to historic upstream spawning and rearing areas. As a result of these dams, wild anadromous fish production is restricted to lower mainstem and tributary streams, such as the LNS.

Hatchery production of spring chinook was increased as mitigation for the dams on the North Santiam. Hatchery stocks are derived primarily from native Willamette stock. Spring chinook fry and fingerlings were released in the LNS in 1958, 1959, 1983, and 1984. STEP releases of spring chinook fry were made in the LNS from 1984-1987. Because released fish were fry and fingerlings, with very low expected adult returns, it is doubtful that they made a significant genetic contribution to the existing stock (J. Haxton, personal communication). No releases of winter steelhead (*O. mykiss*) have been made in the LNS basin. Skamania stock summer steelhead (*O. mykiss*) were first introduced into the LNS in 1966. Releases were made below river mile (RM) 17 to minimize potential impacts on naturally produced winter steelhead, which are found primarily above RM 17. Summer steelhead releases were discontinued in 1994 due to concerns about competition with wild stocks. STEP releases of native Willamette stock winter steelhead fry were made in the LNS in 1984 and 1987 but probably made very little, if any, genetic contribution for the same reasons stated for spring chinook.

Historically, upstream migration of anadromous fish in the LNS was blocked by Salmon Falls at RM 15.9. A fish ladder was installed at the falls in 1958. Steelhead are now suspected to migrate as far as a barrier falls at RM 23.9 near Jawbone Flats. In the years following the opening of the fish ladder at Salmon Falls, chinook were commonly seen upstream of the falls. Currently, chinook are rarely found upstream of Salmon Falls, although they are capable of ascending the fish ladder.

Prehistoric Human Uses

Evidence suggests the Willamette Valley may have had human inhabitants as early as 10,000 years ago. Excavated sites dating to about 8,000 years ago occur along the South Santiam River with artifacts indicative of hunting. Sites along the LNSR have not been excavated, but the few artifacts found on the sites' surfaces suggest that activities at these sites included hunting and butchery. Obsidian is a common stone material found on these sites. Since obsidian is common in eastern Oregon but much less common in western Oregon, these sites may have been used by people living east of the mountains for fall deer hunting. The linear patterning of sites may also indicate the route of an aboriginal trail from eastern Oregon to the Willamette Valley. The sites may also represent camps along a trade/transportation route for obsidian which was an important trade commodity. A summary of recorded sites can be found in Appendix F1.

At the time of Euro-American contact in the early 1800s, Kalapuya Indian groups lived in the Willamette Valley and along its major tributaries, including all of the Santiam River drainages. The Kalapuya are known to have used burning in the Willamette Valley to manage desired vegetation and game animals. Molalla Indians lived on the slopes of the western Cascades.

Historic Human Uses

American settlers and gold prospectors entered the LNS canyon in the early 1850s, and some placer mining may have started by about 1853. The first lode claims were filed in 1860. Eventually, hundreds of claims were filed, and a number of mines producing gold, silver, zinc, and lead were in operation. The biggest years of production started after 1915. Many of these claims were eventually patented.

Settlement for farming and entry for logging also occurred starting in the 1860s. Generally, however, land in this area was valued for mineral and timber resources with permanent agrarian settlement affecting a much smaller portion of the watershed, primarily along the river itself.

Federal actions in the watershed started with the GLO surveys. Western portions of the watershed were granted to railroads as part the O&C railroad land grant and were eventually returned back to federal ownership and became managed by the BLM. Lands in the eastern portion of the watershed were managed by GLO rangers until 1905 when the lands were transferred to the newly established USFS. Roads, trails, and lookouts were built by the CCC during the 1930s, opening up the country to easier access. Three CCC camps had crews that operated in the LNS watershed. Both the LNS and the Breitenbush/Santiam camps were established on USFS-administered land and operated from April 1933 to April 1934. The third camp was on private forest land at Mill City and operated from April 1935 through May 1941. A summary of recorded sites can be found in the appendix.

Chapter 5 - Current Conditions

Introduction

The LNS watershed is located within the western Oregon Cascades Physiographic Province. Elevations range from 600 feet near the cities of Lyons and Mehama in the western portions to 5560 feet (Battle Ax), the highest point, located on the east end of the watershed. Prominent peaks and elevations include Silver King (5242), Battle Ax (5560), Beachie (5180), and Marten Buttes (5040) on the east side; Rocky Top (5014) and Mount Herob (4212) on the south side; and House Mountain (3708), Lookout Mountains (4432), Henline (4660), Nasty Rock (4663), and Whetstone (4969) on the north side of the watershed.

The LNS was stratified into 11 SWBs which are delineated on Map No. 7. SWB acreages are displayed in Table No. 16 in the Aquatic, Water Quality, and Hydrology section. Tributaries of the LNS include Battle Ax, Opal, Gold, Henline, Dry, and Elkhorn creeks in the eastern half, and Evans, Sinker, Canyon, and Kiel creeks in the western half of the watershed.

Terrestrial

Soils

Where are the major sources of sediment from erosion, landsliding, road runoff, or other management activity located? Where do they occur and where are they likely to occur? What are the processes that affect sediment from erosion, landsliding, road runoff, or other management activity? Where have they occurred, and where are they likely to occur?

Soil development is influenced by the geology, climate, vegetation, organic matter, topography, time, and disturbance such as fire, floods, and landslides. These factors working together produced the soils present in the watershed and continue to alter soil characteristics. Past glaciation in the watershed has influenced soil development, forming steep slopes and poorly sorted shallow soils prone to downslope movement in the upper elevations. Historic fires and volcanic events covering most of the watershed have also affected soil development. Loss of organic matter, vegetative cover, and soil nutrients have periodically affected productivity and soil erosion. Forest management practices and the exclusion of fire have altered soil erosion rates and soil productivity in the past 100 years. Fragile soil conditions on federal land have been identified through the Timber Productivity Capability Class (TPCC) inventory on BLM lands and the Soil Resource Inventory on Willamette NF lands. Map No. 5 shows the locations of fragile soil conditions.

Soils in the western lower elevation portion of the watershed are relatively young and somewhat poorly developed. They consist of mostly well drained clay loams over clay soils that formed in glacial till or colluvium underlain by tuffaceous igneous rock. Some soils developed in volcanic ash or have low base saturations which affect productivity. The winters are wet and mild, summers moist, and soils generally have some moisture throughout the year depending on cover. Mid-elevation soils consist of young well drained and moderately well drained loams and cobbly loams over cobbly clay loams or cobbly loams. These soils formed in glacial till, colluvium, or volcanic ash over basic tuffaceous igneous rock. Soils in the eastern upper elevation areas are also relatively young, have poor horizon development, have low base saturation, or have formed in ash. The winters are cold and wet, while summers are moist and cool. The cooler climate resulted in slower soil formation and less soil development. Soils consist of well drained and moderately well drained shallow to moderately deep cobbly or stony loams.

General soil stability in the watershed was assessed by grouping soils into classes depending on slope and age of forest cover. Three categories were used: stable, potentially unstable, and unstable. Stable soils occur on less than 60 percent slope, or on 61 to 75 percent slopes with a forest cover greater than 10 years in age. Potentially unstable soils have slopes of 60 to 75 percent and forest cover 10 years old or less, or slopes of 76 to 90 percent and a forest cover greater than 20 years old. Unstable soils have slopes greater than 90 percent, or slopes of 76 to 90 percent and forest cover less than 20 years old. Acres of soils in each stability class are listed in Table 4 by SWB. Map 6 shows slope hazard for the watershed as a whole.

Table 4. General Soil Stability by SWB (in acres).

SWB	Unstable Acres	Potentially Unstable Acres	Stable Acres
Elkhorn Creek	653	1310	6507
Cedar Creek	275	652	5041
Dry Creek	253	640	5124
Henline Mountain	230	459	2106
Evans Creek	228	179	4727
Canyon Creek	174	43	4382
Gold Creek	120	528	6087
Opal Creek	109	367	6295
Battle Axe Creek	104	268	4928
Sinker Creek	32	79	6024
Kiel Creek	31	26	9804

1996 Flood Damage Assessment

Northwest Oregon experienced extreme rainfall during February 3-9, 1996. While some mass movement is natural, heavy snowpack in the mountains combined with record high air temperatures and rainfall resulted in rapid snowmelt. This set the stage for catastrophic flooding and landslides. The impacts were highly variable across the landscape due to the range in magnitude, duration, and intensity of rainfall over northwest Oregon. This variability resulted in widely different flood flows and effects from watershed to watershed. The LNS watershed was less severely impacted than other Cascade watersheds.

An assessment of damage to BLM lands was conducted by watershed in two phases following the storm of 1996. Phase 1 was an extensive inventory of landslides, while Phase 2 focused on regional issues and was completed on only the most severely impacted watersheds, which did not include the LNS. A Phase 1 analysis was completed on 60 percent of BLM lands in the LNS watershed, and results are presented in Tables 5 and 6. The assessment found no landslides greater than 10,000 cubic feet in size; however, private and USFS lands were not inventoried. The assessment gives a general idea of the types of problems in the watersheds and areas that may benefit from restoration activities.

Table 5. 1996 Damage Assessment for Erosion Events on BLM Lands in the North Santiam Watershed Smaller Than 10,000 Cubic Feet in Size.

Affected Item	Landslides	Gullies/Surface Erosion	Channel Migration	Large Woody Debris
Stream Channel	10	0	1	0
Road Prism	7	7	0	0
Road Culvert	2	3	1	0
Facilities	0	0	0	0
Other	0	3	0	0

Table 6. Location of Landslides in the North Santiam Watershed Resulting from the 1996 Flood.

Young Harvest Units	Old Harvest Units	Road Prism	Road Culverts	Mature Forest	Non-Harvest Forests
0	4	7	0	2	0
Young Harvest Units = 0 to 15 year old harvest units Old Harvest Units = 15 to 30 year old harvest units Mature Forests = Greater than 30 years since harvest Non-Harvest Forests = No past harvest activity within the stand.					

Table 5 indicates the features that were affected by mass movement. In the LNS watershed, streams, road prisms and culverts were the features most affected by landslides, while road prisms and culverts were most affected by gullying and surface erosion. Table 6 indicates road prisms had the highest occurrence of landslides, followed by old harvest units and mature forests.

Vegetation Patterns/Seral Stage

What is the present seral stage distribution and vegetation pattern within the watershed? How does this relate to adjacent and larger ecosystems? How do current seral stages, amounts and distribution, special habitats, and vegetation patterns influence the landscape structure, functions, and processes? What are the predominate matrices, patches, and fragments? How will land use objectives and management guidelines in the ROD, the RMP, Opal Creek legislation, and on privately managed lands influence future landscape structures, functions, and processes?

Information on vegetative conditions was derived from a variety of sources. BLM Forest Operations Inventory (FOI) records (1993) were used to depict vegetative conditions on BLM lands. Vegetative condition on USFS land was obtained from the FS Database. Vegetative condition on private lands was determined from aerial photograph interpretation using 1988 and

1993 coverages from Oregon Department of Revenue forest cover maps and from the Western Oregon Digital Imagery Project (WODIP). This information was developed for the evaluation of seral stage distribution and habitat conditions across the watershed. Estimates of vegetative cover and stand conditions are expressed as existing in the summer of 1995. Harvest and other management activities conducted since then were not evaluated in this analysis.

Approximately 88 percent of the LNS watershed are conifer types consisting mostly of Douglas-fir and western hemlock. About seven percent consist of nonforest types that include roads, quarry developments, rural residential, and agricultural lands in the watershed. Meadows, rock cliff/talus, and other natural openings in the forest environment are also included as nonforest types. A relatively small percentage (5 percent) are hardwood types consisting primarily of red alder and big-leaf maple. Map 10 shows the locations of conifer, hardwood, and non-forest types in the watershed. The watershed can be stratified into three plant association groups: western hemlock, mountain hemlock, and Pacific silver fir series.

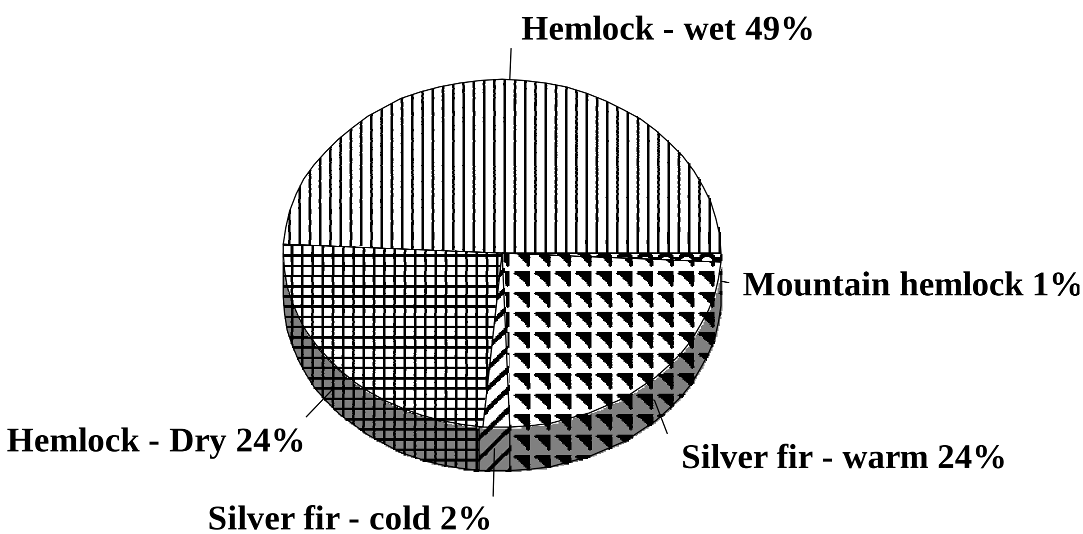

Figure 6. Plant Association Series.

Plant associations describe the potential dominant plant community (a combination of tree and shrub and/or herb layers) that would inhabit a site over time without any disturbance (Hemstrom and Logan 1986). A plant association defines a biological environment in terms of the species' composition, productivity, and response to management. Knowledge of the presence and distribution of indicator understory species further refines the biological environment, allowing us to more accurately assess site potential.

Plant associations with similar attributes have been aggregated into groups. These plant associations groups have been arranged into "sub-series" based on the broad environmental conditions in which they are found. This is a key stratification in identifying the range of structural and compositional characteristics that can be expected under natural conditions on a given site. Table 7 characterizes the relationship between series, sub-series environments, and plant associations found in this watershed.

Table 7. LNS Watershed Plant Association Series, Sub-Series, & Indicator Species.

Series	Sub-Series Environments	Understory Indicator Species in Plant Associations
Western Hemlock	Wet	dwarf Oregon grape/oxalis; Oregon oxalis; swordfern
Western Hemlock	Dry	dwarf Oregon grape; dwarf Oregon grape-salal; rhododendron-dwarf Oregon grape; rhododendron-salad; rhododendron/twinflower; vanilla leaf; dwarf Oregon grape/vanilla leaf; twinflower; rhododendron-Alaska huckleberry/dogwood bunchberry; rhododendron/beargrass
Pacific Silver Fir	Warm	vine maple/coolwort foamflower; Oregon oxalis; coolwort foamflower; rhododendron-Alaska huckleberry/dogwood bunchberry; Alaska huckleberry/dogwood bunchberry; big huckleberry/ Oregon grape; rhododendron-dwarf Oregon grape
Pacific Silver Fir	Cold	big huckleberry/beargrass; rhododendron/beargrass
Mountain Hemlock		grouse huckleberry; rhododendron; big huckleberry/beargrass; luzula

The western hemlock series is the most dominant series present in the watershed, occupying 73 percent of the landscape. The western hemlock series occur along the lower slopes and up the major riparian area of the watersheds. The silver fir series is found in the higher elevation zones, while the mountain hemlock is found on the highest ridges along the upper edges of the watershed.

In addition, mixed hardwood stands consisting mostly of big leaf maple and red alders with some Oregon white oak and Oregon ash comprise a minor component at low elevations and in riparian zones of larger order streams.

Age class distribution is an important component in describing the overall structure of the watershed as an ecosystem (Map 8). Age class distribution in the LNS has been categorized into age class bands corresponding to vegetative seral stage development. Old growth is considered 200 years and older, mature is 75 to 200 years, closed sapling is 35 to 74 years, open sapling/brush is 15 to 34 years, and grass/forb is 0 to 14 years of age. See Map 9, Seral Stage Map, and Figures 7, 8, & 9, Seral Stage Amounts by Ownership, below.

Seral Stage	Acres
Old Growth	17,302
Mature	16,667
Closed Sapling	6,943
Open Sapling/Brush	4,038
Early-Grass/Forb	1,682
Nonforest	2,734

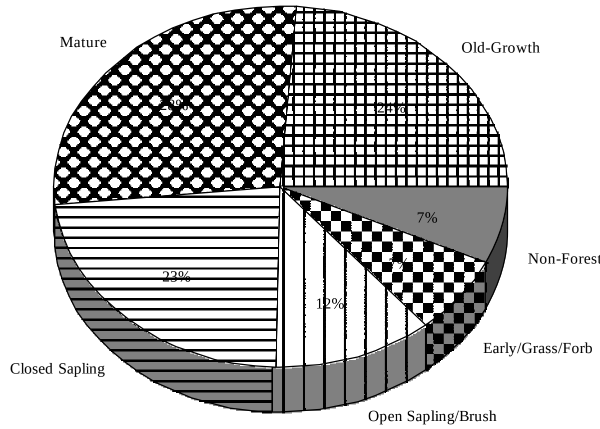

Figure 7. Seral Stage for Federal Ownership.

Seral Stage	Acres
Old Growth	69
Mature	2,573
Closed Sapling	10,310
Open Sapling/Brush	4,298
Early-Grass/Forb	3,308
Nonforest	2,233

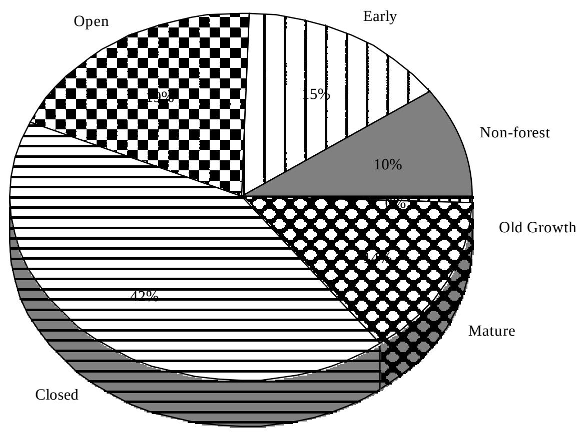

Figure 8. Seral Stage for Other Ownership.

Seral Stage	Acres
Old Growth	17,371
Mature	19,240
Closed Sapling	17,253
Open Sapling/Brush	8,336
Early-Grass/Forb	4,990
Nonforest	4,967

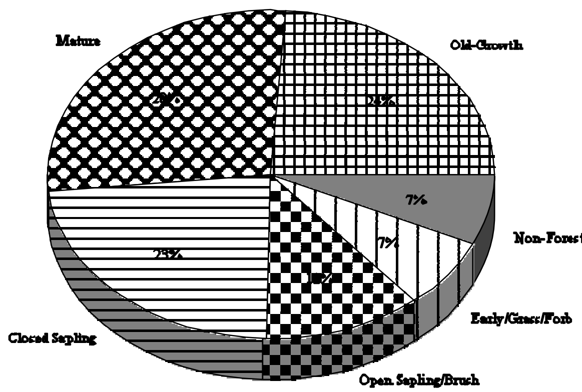

Figure 9. Seral Stages for All Lands.

The structure and pattern of vegetation or habitats within an ecosystem, such as a watershed, can be characterized in terms of patches, corridors, and a background matrix. The patterning of patches, matrix, and corridors across the landscape strongly influences the ecological characteristics, processes, and energy flows (Forman and Gordon 1986).

The term ‘matrix’ in landscape ecology is defined as the most connected portion of the landscape, the vegetation type that exerts the most control over landscape function (Forman and Gordon 1986, Diaz and Apostol 1992). Patches are definable vegetative types that differ in their habitat characteristics from their surroundings. Patches vary in size, shape, type, heterogeneity, and the vegetative types that surround them. The LNS exhibits considerable differences in the predominate matrix and patches, depending on location within the watershed. In the lower end, closed sapling pole stands in mid-successional stages between 30 and 70 years of age are the dominate matrix, while grass/forb, open sapling/brush, and mature forests form a patch network and secondary matrices. In the middle portion, the amount of mature forest increases and becomes the predominate matrix, while grass/forb and open sapling/brush are the dominate patches. In the upper end, mature/older forests comprise the predominate matrix. Older forests over 200 years of age are scarce in the lower half of the watershed, while forest stands in early grass/forb stages of succession are scarce in the upper end of the watershed This age class distribution follows a harvest pattern from the lower to mid elevations in the watershed over time, with the upper end remaining mostly unharvested.

Mature and older forest comprise 50 percent of the watershed. The vast majority of mature/older forests are located in the upper end of the watershed in the Battle Ax, Gold, Opal, Cedar, and Henline SWBs where they comprise the predominate matrix. Large stands of mature/older forest are found in the Elkhorn and Dry Creek SWB in the middle portion of the watershed. There is little old-growth forest in the lower half of the watershed. There are some isolated stands on BLM lands in the upper reaches of Evans Creek in the Evans Mountain CONN, and there are some stands in Kiel Creek which are approaching the old-growth condition. The largest existing patches of mature forest in the lower half of the watershed are in portions of Fawn, Fish, Salmon Creek drainages of the Evans SWB; the Big Creek CONN and the Canyon Creek drainage of the Canyon Creek SWB; and Little Sinker and Sinker Creek drainages of the Sinker SWB.

Seral stage amounts and distribution were further analyzed on federal lands and categorized by LUA. See Table 8, Seral Stage by LUA on federal lands, below. Mature/older forests comprise 69 percent of the federal ownership in the watershed. Most of the mature/older forest is in wilderness areas, SRA, WSR, DDR, and LSR. Seventy-nine percent of these LUAs are in older forest conditions compared with 24 percent in CONN and 24 percent in GFMA. Approximately 24 percent of the federal ownership in the watershed is in old-growth forests more than 200 years of age.

Table 8. Seral Stage Acreage by LUA.

Seral Stage	GFMA	%	CON N	%	SRA	%	WILD	%
Early/grass/forb	764	11%	227	5%	388	4%	135	1%
Open Sapling/brush	982	15%	761	16%	379	4%	1,243	6%
Closed Sapling	3,165	47%	858	18%	436	4%	1,950	10%
Mature	1,506	23%	2,234	47%	3,443	33%	6,858	34%
Old-Growth	51	1%	279	6%	5,353	52%	8,811	44%
Non-forest	212	3%	357	8%	353	3%	1,221	6%
Total	6,680		4,716		10,352		20,218	

Seral Stage	LSR	%	DDR	%	WSR	%	Total
Early/grass/forb	89	3%	33	5%	46	1%	1,682
Open Sapling/brush	556	17%	103	14%	14	0%	4,038
Closed Sapling	408	13%	80	11%	46	1%	6,943
Mature	797	25%	339	47%	1,490	43%	16,667
Old-Growth	1,298	41%	0		1,510	43%	17,302
Non-forest	49	2%	160	22%	382	11%	2,734
Total	3,197		715		3,488		49,366

The drainages and their associated riparian/streamside vegetation provide corridors for wildlife movement. They flow from the eastern higher elevations through the LNS to the Willamette Valley Province to the west. The higher elevation ridge top areas connecting the peaks on the southeast, east, and northeast boundaries of the watershed also serve as flow corridors. The flow of more mobile species of wildlife is from higher elevation to lower elevation in the fall/winter and to higher elevation in the spring. This corresponds to a poorly defined east/west flow across the watershed, presumably along drainages and ridgetops. Vegetation in natural corridors has been altered over time due to fire, past harvest patterns, and roads.

The proposed OCW and Scenic Recreation Area, Elkhorn WSR, Cedar Creek LSR, and the western portions of the Bull of the Woods Wilderness Area form a contiguous block in the upper (east) end of the LNS watershed. This area is connected with the Table Rock Wilderness/LSR complex to the north in the Molalla watershed and the Bull of the Woods Wilderness/LSR complex to the east in the Clackamas watershed. The area between the middle portion of the LNS watershed and the Table Rock LSR is primarily in private ownership, except for the Evans

Mountain CONN, which consists of BLM lands in the Evans SWB extending north into the Molalla River watershed. Detroit Reservoir is located 5 miles to the southeast of the watershed. Blocks of older forest designated as LSR are located to the south and east of Detroit Reservoir in the LNSR and Breitenbush drainages. Immediately to the south of the watershed is the LNSR Corridor, Mill City, and Gates. The Quartzville/Crabtree LSR in the South Santiam watershed begins 7 miles to the south of the LNSR Corridor. The Willamette Valley Physiographic Province and the cities of Mehama and Lyons are located just outside the watershed, immediately to the west. Silver Falls State Park, which contains some large blocks of older forest, lies 3 to 5 miles to the northwest. Limited connectivity between the LNS and Silver Falls State Park is provided by private lands and scattered BLM lands in Abiqua Creek.

Special Habitats

A special habitat is a habitat that has a function not provided by plant communities and successional stages (Brown et al. 1985). Special habitats are usually nonforest types such as meadows, wetlands, rock outcrops, cliffs, and talus slopes.

The predominate special habitats in the LNS are those associated with rock outcrops, cliffs, dry ridgetop meadows, and talus slopes. These features are abundant throughout the upper half of the watershed. Some of the more significant special habitats of this type are in the vicinity of Henline Mountain, Nasty Rock-Burnt Mountain, Whetstone Mountain, Battle Ax-Mount Beachie, Phantom, Rocky Top, Mount Herob, and House Mountain. In addition to rock outcrops, cliffs, dry meadows, and talus slopes, there are a limited number of small ponds and wet areas in the vicinity of these peaks. Most of these areas are relatively undisturbed because of their location and the ruggedness of the terrain.

There are a number of special habitats associated with small lakes in the LNS. The most significant lakes include Opal and Elkhorn Lakes, which have wet areas associated with them. These areas tend to have high human use due to their proximity to roads and popularity for camping and hiking.

Standing Dead and Coarse Woody Debris (CWD)

Data from inventory plots and stand exams were used to estimate the amount and condition of standing dead and down CWD across the watershed. Estimates of the amount and condition of standing dead were used to estimate existing percent of potential cavity dwelling wildlife populations. Estimates show that the LNS is between the 40 to 50 percent level; however, there is considerable variation in the amount and quality of standing dead material across the watershed. In the lower portions of the watershed, standing dead material is scarce, and estimates indicate that the habitat for cavity dwelling wildlife populations is limited. The standing dead component was found to consist mostly of smaller material in more advanced stages of decay. In the upper portion of the watershed, the existing percent of potential cavity dwelling wildlife habitat approaches 80 percent, which is highly viable.

Estimates of the amount and condition of CWD was compared to the NFP standard of 240 lineal feet per acre of hard material over 20 inches in diameter. The amount and condition of down logs follow a similar pattern to standing dead material, with the good quality material in the upper end and a lack of high quality material in the lower portions. Estimates show that there is less than 30 percent of the NFP standard in the lower portions of the watershed. In many cases, most of the larger material is in the more advanced stages of decay.

The amount and quality of standing dead and CWD were found to be limited in the lower half of the watershed, especially larger material in the earlier stages of decay. This large, harder material will persist longer than softer material in advanced stages of decay. This material is important for nutrient capital and future habitat for cavity dwelling wildlife species.

Habitat Quality

Harvest patterns and natural disturbance in the past have created a mosaic of seral stages across the watershed. Where an older forest patch is surrounded by younger age classes, the edges of the patch exhibit environmental conditions that are different from the interior of the patch. As the amount of open area and edge increases, habitat quality declines for species associated with older forest and improves for species that are associated with edge and open areas. The amount of interior older forest in relation to the amount of total older forest habitat gives some indication of the quality of existing older forest habitat and the influence of edge effects. Edge on existing older forest was modeled to determine the amount of interior older forest and the influence of the edge effects. As a result of this analysis, it was found that 65 percent of the existing 36,500 acres of older forest is considered to be in the interior forest condition. The majority of remaining interior older forest is found in the upper half of the watershed. Extensive stands of interior forest are found in the Gold, Opal, Elkhorn, Cedar, Dry, Battle Ax, and Henline SWBs. The largest patches of interior forest in the lower half of the watershed are found in Fawn Creek (Evans SWB); Little Sinker (Sinker SWB); Big Creek and Canyon Creek (Canyon Creek SWB).

Road locations were then mapped to estimate the effect of roads on existing interior older forest habitat. This analysis indicates that much of the older forest in the lower half of the LNS is further fragmented due to edge effects created by existing roads. By contrast, there has been little fragmentation of older forest stands in the upper half of the watershed due to roads. Edge effects here are primarily due to non-forest types and some past harvesting.

Inputs from the age class analysis were used to calculate the habitat effectiveness for cover quality (Hec) using the Wisdom model (Wisdom et al.). There is an estimated 33 percent optimal cover, 18 percent thermal, and 25 percent hiding cover in the LNS. The Hec is currently at .50 which is viable for elk. Cover quality in the watershed follows a similar pattern as interior forest habitat, with the upper end in a highly viable condition. Cover quality declines toward the lower end, where the Hec is near .30, which is limiting for elk.

Roads and Transportation

How are roads influencing water quality, watershed condition, native plant communities and wildlife habitat quality, and effectiveness?

The existence of roads has obvious physical effects on the ecosystem. The land area taken up in roads does not contribute to forest habitats. Runoff from roads causes changes in water quality that affects aquatic and semi-aquatic vegetation and wildlife. The existence of roads causes edge effects and micro climatic changes that affect plant communities and wildlife. In addition, open roads and road maintenance activities cause disturbance effects resulting from increased traffic and human intrusion. Roads also facilitate the spread of noxious weeds and exotic species.

There are approximately 328 miles of road on all ownerships within the watershed. The average total road density across all ownerships in the LNS watershed is estimated at three miles per section. Road densities range from a low of less than one mile per section in the Battle Ax, Opal, Gold, and Henline SWBs, to a high of over five miles per section in the Evans and Sinker SWBs. Maps 11 & 12 (Transportation and Generalized Road Control) show the location of the roads by ownership and control.

There are several gates in the watershed which limit public access in the lower to middle portions of the watershed. Approximately two percent of the total road miles in the watershed are effectively closed. An additional 17 percent are at least seasonally closed with gates. Open (accessible) road densities across the watershed are presently estimated at 2.35 miles per section, which is considered to be moderate. However, open road densities vary widely across the watershed. Open road densities are high in the Kiel, Sinker, and Evans SWBs and low in the Battle Ax, Opal, Gold, Henline, and Elkhorn SWBs.

Inputs from the road density analysis were used to derive habitat effectiveness for open road densities (HEr) indices using the Wisdom model. The HEr index is a measure of the impact of roads on elk habitat quality. The average HEr for the entire watershed is currently at or near 0.45, which is viable for elk. The HEr is marginal to limiting in the Evans, Sinker, Kiel, and Canyon Creek SWBs.

Of the 328 total road miles in the watershed, 136 miles are on federal lands (41%). Average total road density on federal lands is estimated at 1.75 miles per section. Open (accessible) road densities on federal lands average 1.5 miles per section, which is considered to be low to moderate. The HEr for federal lands is currently at or near .6, which is viable for elk. Open road densities on federal lands are highest in the Evans and Sinker SWBs.

Special Status/Special Attention Species

What SSSA are known or suspected to occur in the watershed? How will land use objectives and management guidelines in the ROD, Salem District RMP, Willamette NFP, Opal Creek legislation, and on privately managed lands influence future habitat for these species?

Plants

There are two known populations of BLM special status plant species in the LNS watershed. Based on a literature review of the habitat requirements of the SSS known to occur in the province, a list of potential species has been identified for the LNS Watershed and its special habitats (Appendix D). This list includes Federal Endangered, Federal Threatened, Federal Proposed Threatened, and Bureau Sensitive Species.

Aster gormanii, Gorman’s aster, is a Bureau Species of Concern and a candidate for federal listing as a Category 2 species (USFWS 1993). It is also a candidate for listing by the Oregon State Department of Agriculture and is considered by the Oregon Natural Heritage Data Base (1993) to be threatened throughout its range. As of 1994, 63 populations have been reported in the region, all restricted to a narrow geographic range within the western Cascades and high Cascades physiographic provinces. This range is 50 miles north to south and 30 miles east to west. This known range is characterized by steep and rugged topography, and it is unlikely that the range will be extended significantly. Many potential sites have not been inventoried due to this rugged habitat. A Salem BLM District/Willamette NF management plan was developed to maintain healthy, reproducing populations of the species at a variety of sites within its range.

NFP Survey and Manage Species

The NFP lists fungi, lichens, bryophytes, and vascular plants to be given consideration through survey and management standards and guidelines (ROD pp. C4-C6, Table C-3 pp C49-C61).

Four strategy ratings apply to survey and manage species

1. Manage known sites (beginning in 1995).
2. Survey prior to ground disturbing activities and manage newly discovered sites (for 1999 project implementation and beyond).
3. Conduct extensive surveys for the species to find high priority sites for species management.
4. Conduct general regional surveys to acquire additional information and to determine necessary levels of protection.

Species with strategy ratings 1 or 3 demand the most immediate attention. Guidelines for survey and manage species with a strategy 1 rating are in draft form.

Fungi

Out of the 234 fungi species listed in the NFP, one strategy 1 fungi is documented from Opal Creek area surveys while many others may potentially occur here based on potential distribution and habitat (Appendix D). Ten of the strategy 3 and 4 species have been documented.

***Polyozellus multiplex*, blue chanterelle:** is a deep blue to black cluster of compressed and fused caps. It is rare in the Pacific Northwest. The species is mycorrhizal with true fir and spruce. Distribution and specific locations in this region are not well known (ROD, Appendix J2, pp 161-162).

Lichens

Eighty-one lichens are listed in the NFP. Four with strategy 1 ratings are documented in the LNS Watershed. The Opal Creek area provides a unique habitat for a wide diversity of lichens. Fifteen lichens have been found that are strategy 3 and 4 species (Appendix D).

***Pseudocyphellaria rainierensis*, Rainier pseudocyphellaria lichen:** is an epiphytic species inhabiting moist old-growth coniferous forests in Oregon and Washington, primarily on the west slope of the Cascades. It has been found in the Opal Creek Area of the LNS Watershed which is centrally located within the species range. This population is within either the proposed Opal Creek SRA or the proposed OCW, so timber management will not be a disturbance factor, and mitigation measures will not be needed. Any older stands would be surveyed prior to project implementation for sites which would have a protection buffer (ROD, Appendix J2, pp 228-232).

For the next three lichen species, additional locations have been reported but not entered into the survey and manage database as of this time (John R. Davis, pers. comm.).

***Pilophorus nigricaulis*, nail lichen:** occurs on talus rock patches within old-growth stands with low fire frequencies. Only two other known sites are in Oregon and three in Washington. Species distribution and ecology are poorly known (ROD, Appendix J2, pp 237-238).

***Leptogium rivale*, skin lichen:** is a truly aquatic lichen and will die if desiccated. It is found on rocks in low to mid elevation streams where they provide habitat for aquatic invertebrate populations. This species is known from two mid-order streams in the HJA and one stream in Montana. Siltation is the primary disturbance factor for suitable habitat. The limited dispersal ability and rarity influenced the classification as strategy 1 (ROD, Appendix J2, 239-240). RRs and LSR designations in this watershed will provide habitat for this species.

***Hypogymnia oceanic*, seaside tube lichen:** is a rare oceanic influenced lichen which has been found widely from southeast Alaska and coastal British Columbia. It has been found in the HJA with the assumption that the maritime microclimates in old-growth mimic those in its primarily coastal distribution (ROD, Appendix J2, pp 243-246). LSRs and wilderness designations in this watershed provide suitable habitat for this species.

Exotic and Introduced Species of Concern

Noxious weeds and exotic species may threaten native plant communities and wetlands, replace forage for wildlife, create fire hazards, reduce recreational enjoyment, compete with crops and poison livestock. Noxious weeds usually do not become established in native plant communities until there is disturbance. Some weed species become established after a disturbance and may become extremely tenacious.

Noxious weeds spread primarily along roads, through the spreading of infested gravel, and through other ground-disturbing activities such as the yarding of timber.

There are no known sites of Priority 1 (potential new invaders) noxious weed species in the LNS watershed. Four known populations of meadow knapweed, a Priority II noxious weed (eradication of new invaders), were found on BLM lands during a 1997 survey of 55 miles of roads in the watersheds. Priority species definitions are discussed in the *Salem District 1992-1997 Noxious Weed Control Program Environmental Assessment*.

There are several known occurrences of the Priority III noxious weeds such as Canadian thistle, St. Johnswort, tansy ragwort, and Scotch broom in the LNS Watershed. Established infestations are widespread throughout the landscape. The 1997 survey found that Scotch broom infestations were extensive throughout the watershed.

In addition to noxious weeds, there are several exotic species in the watershed. Although these species are not classified as noxious, they compete with the native vegetation and often have negative ecological impacts. In areas where the soil has been disturbed, such as road cuts, gravel pits, and clearcuts, exotic species have become common. Nonnative species are found in almost every type of habitat throughout western Oregon.

Animals

Special Status Species

As part of the LNS analysis, the occurrence of wildlife species in the watershed was analyzed. A list of vertebrate wildlife species was compiled using USFS and BLM wildlife databases, the Oregon Natural Heritage Program (ONHP) database, and various wildlife field guides and texts along with knowledge of the habitats present gained through air photo interpretation, GIS information, and field reconnaissance. The resulting list is included in Appendix D-1. This list of wildlife species was then cross referenced with ONHPs December 1995 publication, the Regional Forester's Sensitive Animal List for the Willamette NF and Salem District's sensitive species list to determine federal, state, USFS and BLM status of each species with status. The resulting list of special status species which are known or highly likely to occur in the LNS watershed and their habitat preferences is included in Appendix C-2. This list includes 1 federal endangered, 2 federal threatened, and 16 species which are USFS and/or BLM sensitive species. Species which are documented to occur in the watershed are denoted with a (D) in Appendix D2.

NFP Survey and Manage Species

The red tree vole, a Survey and Manage strategy one species, is suspected to occur in the LNS watershed. The red tree vole is considered to be a late-successional associate, and there is suitable habitat present in all SWBs, primarily below 3500 feet elevation. The LNS watershed was screened according to the *Interim Guidance for Red Tree Voles*. The LNS was found to be viable with 68 percent of the watershed in federal ownership of which 75 percent is suitable habitat for the red tree vole. The great gray owl, a protection buffer species, is known to occur in the watershed. There is one sighting in each of the Elkhorn and Kiel SWBs. Sightings are more frequent in the east side of the watershed toward the crest of the Cascades. A nesting pair has been identified to the north of the watershed. The silver-haired bat and Pacific western big-eared bat, which are identified as needing of additional protection in the NFP, occur in the watershed. Also, the long-eared myotis and long-legged myotis, which were also identified as needing of additional protection, are suspected to occur in the watershed.

Little is known about the occurrence of SSSA invertebrate species in the LNS watershed. A list of suspected or possible SSSA invertebrate species that could occur in the watershed is in Appendix D3. There are three Survey and Manage Strategy mollusk species that could reasonably occur in the LNS watershed. The Oregon megomphix is found in moist conifer/hardwood forests in association with big-leaf maple logs and litter. Two tail-droppers (slugs), *Prophysaon coeruleum* and *Prophysaon dubium*, are associated with hardwood logs and litter in moist conifer/hardwood forests. The Siskiyou caddisfly, a Bureau sensitive species, has been documented to occur in the LNS.

Threatened and Endangered Species

Threatened and endangered species habitat was analyzed separately in the watershed analysis process. There are two federally threatened and one endangered species which are documented to occur in the LNS. The peregrine falcon and bald eagle have been documented in the upper end of the watershed. The northern spotted owl has been documented throughout the watershed, especially in the upper half.

Bald Eagle

There have been a number of sightings of bald eagles in the upper end of the watershed. The closest known nest site is located in the vicinity of Detroit Reservoir, five miles to the south and east of the watershed. Bald eagles have been observed along the NSR corridor to the south, from Detroit Reservoir downstream to Mill City and Stayton; especially in the vicinity of Big Cliff Dam. Most of the sightings from the LNS are in the vicinity of Opal Creek and the Henline area. It is unknown if these birds are different from the birds observed along the North Santiam or the nesting birds at Detroit Reservoir. Bald eagles have large home ranges and are known to move long distances, so are likely to be present as migrants and non-residents in the LNS. There are no known nest sites. However, there is a lack of concentrated survey effort to establish the status of the bald eagle in the watershed. There are sightings during the nesting season which are suggestive of a potential nest site in the vicinity. Suitable nest sites are abundant in the LNS. The most promising locations are along the ridge that separates the LNS from the North Santiam from the confluence to the upper end of Opal Creek (Isaacs, pers. comm.).

Peregrine Falcon

The peregrine falcon has been documented in the watershed with scattered sightings in the vicinity of Rocky Top, Battle Ax, and Elkhorn Ridge. The closest known nest site is seven miles to the east of the watershed. The peregrine falcon is likely to occur as a migrant and has been documented late in the nesting season and through fall migration. There are numerous cliffs that qualify as suitable habitat in terms of cliff height and structure in the upper half of the watershed, especially in the Henline, Dry, Elkhorn, Opal, Gold, and Battle Ax SWBs. There are fewer numbers of suitable cliffs in the Cedar and Evans SWBs. There is little suitable habitat for peregrine falcons in the lower portions of the watershed, with House Mountain being the best possibility. There are no large bodies of water in the LNS; however, there is significant riparian habitat along the LNS and its tributaries. Prey is available such as the band-tailed pigeon and passerine birds. There are no known nest sites in the watershed. However, there is a lack of survey information from this portion of the Cascades Range of Oregon. The upper half of the watershed is suitable habitat due to the presence of suitable cliffs and riparian habitat (Pagel, pers. comm.).

Northern Spotted Owl

The overall habitat conditions for northern spotted owls were analyzed across the entire watershed. Age classes and forest types were classified as suitable for nesting, foraging, dispersal, or non-suitable habitat for the spotted owl. Non-suitable habitat was further classified as either capable or non-capable of becoming suitable habitat over time. The results are displayed on Map 13, Spotted Owl Habitat Map, and Table 9, Spotted Owl Habitat by Ownership.

Table 9. Spotted Owl Habitat by Ownership

Spotted Owl Habitat Class	BLM/FS		PRIVATE/STATE		TOTAL	
	Acres	%	Acres	%	Acres	%
Nesting	23,244	47	781	4	24,025	33
Foraging	10,725	22	1,861	8	12,586	17
Dispersal	6,943	14	10,310	45	17,253	24
Capable	5,720	12	7,606	33	13,326	19
Non-capable	2,734	5	2,233	10	4,967	7
TOTALS	49,366		22,791		72,157	

Approximately 50 percent of the watershed is considered to be suitable habitat for nesting and/or foraging (suitable), 24 percent is dispersal, and 26 percent is non-habitat. Of the non-suitable habitat, 73 percent is capable of becoming suitable habitat over time.

The eastern half of the watershed was found to be highly viable for nesting spotted owls, especially the Opal and Gold SWBs. Suitable habitat was found to be marginal to limiting in the Sinker, Evans, and Canyon Creek SWBs. The Kiel SWB has the least amount of suitable habitat of any SWB in the watershed at six percent.

Spotted owl habitat on federal lands was further analyzed and categorized by LUA.

Table 10. Spotted Owl Habitat on Federal Lands by LUA.

Spotted Owl Habitat Class	GFMA	%	CONN	%	SRMA	%	WILD	%
Nesting	1,153	17%	1,970	42%	5,574	54%	10,398	51%
Foraging	404	6%	543	11%	3,222	31%	5,271	26%
Dispersal	3,165	47%	858	18%	436	4%	1,950	10%
Capable	1,746	27%	988	21%	767	8%	1,378	7%
Non-Capable	212	3%	357	8%	353	3%	1,221	6%
Total	6,680		4,716		10,352		20,218	

Spotted Owl Habitat Class	LSR	%	DDR	%	WSR	%	Total	%
Nesting	1,680	53%	315	44%	2,154	62%	23,244	47%
Foraging	415	13%	24	3%	846	24%	10,725	22%
Dispersal	408	13%	80	11%	46	1%	6,943	14%
Capable	645	20%	136	19%	60	2%	5,720	12%
Non-Capable	49	2%	160	22%	382	11%	2,734	5%
Total	3,197		715		3,488		49,366	

Approximately 69 percent of federal lands in the watershed is considered to be suitable habitat, 14 percent is dispersal, and 17 percent is non-suitable habitat. Of the non-suitable habitat present on federal lands, 68 percent is capable of becoming suitable habitat over time.

The amount of suitable habitat is 23 percent in GFMA, 54 percent in CONN, and 66 percent in LSR. The amount of suitable habitat approaches 80 percent in SRMA and wilderness areas.

The watershed is viable for dispersal of spotted owls. The LNS watershed provides dispersal to/from the Molalla River watershed to the north, the Clackamas River to the east and north, and the upper North Santiam to the southeast. USFS lands in the Battle Ax, Gold, Opal, and Henline SWBs are directly connected. They are a part of the large wilderness/LSR complex in the western Oregon Cascades, where the majority of dispersal between known spotted owl sites takes place. The SWBs in the lower portion of the watershed are located to the west of the major wilderness/LSR complex and are comprised of mostly BLM and private lands.

Dispersal of spotted owls is severely limited by the Willamette Valley to the west and the NSR corridor and the cities of Lyons, Mehama, Gates, and Mill City to the south. To the south, nine miles across the NSR corridor is the Quartzville LSR (RO213). The lower half of the LNS has minor importance for dispersal to/from Silver Falls State Park and Abiqua Creek to the north and west.

Immediately to the north, there is a large LSR in the Molalla River drainage, which surrounds the Table Rock Wilderness. This is actually a part of the same wilderness/LSR network as the LNS LSR and the Bull of the Woods wilderness (RO209). There is an LSR surrounding the Jefferson Wilderness (RO214) near the crest of the Cascades which is 18 miles to the east. This LSR extends from the Jefferson Wilderness to the south, east of Detroit Reservoir. Another LSR extends along the Clackamas River and connects the Jefferson Wilderness with the Roaring River LSR (RO207) and Salmon-Huckleberry LSR/ Wilderness complex to the north (see North Willamette LSR Assessment for more connectivity).

There are 9,200 acres of USFS lands in the watershed which were designated as Critical Habitat for the spotted owl (CHU-12). These areas are located mostly in the Opal SWB, with some in the Battle Ax, Gold, and Cedar SWBs. Most of these lands are located in wilderness and SRMA designated under the Oregon Resources Conservation Act of 1996.

Once the overall habitat conditions were analyzed across the watershed, each individual known spotted owl site (KOS) was analyzed. The KOS is established by buffering the site center with the provincial home range radius for the spotted owl. The provincial home range radius for the western Oregon Cascades province is 1.2 miles. Once the KOSs were established, the habitat within each was classified as either suitable, dispersal, or non-suitable habitat for the spotted owl. The results were used to estimate viability of each site. A known owl site (KOS) which has an intact 70 to 100-acre core area and the equivalent of over 40 percent suitable habitat within its provincial home range radius is considered to be viable.

There are 10 spotted owl site centers located in the watershed. Of the 10 KOSs with site centers in the watershed, eight were found to be viable. These eight sites are all located in the upper half of the watershed in wilderness, SRMA, LSR, and WSR. The two sites in the lower half of the watershed were found to be limiting or possibly non-viable, due to a lack of suitable habitat. Neither of these two sites have an unmapped LSR (core area) associated with them. Both of these sites were discovered within the last five years. Surveys indicate that they are not consistently occupied.

There are seven spotted owl site centers located just outside of the upper end of the watershed. Due to their location, surrounding topography, and past harvest patterns, the LNS contributes significant habitat to one of these seven sites. Four of the seven sites are located to the north and east toward the Molalla and Clackamas rivers, where connectivity between the major wilderness/LSR complex is important. The other three are located to the south and east toward Detroit Reservoir and the North Santiam River (NSR) corridor.

Barred owls have not been documented nesting in the LNS, but pairs have been observed in Kiel SWB and the lower end of Elkhorn SWB. There are no known sightings in the upper end of the watershed.

Current acres of capable habitat, suitable habitat, and number/condition of KOSs in the LNS was calculated, and the results are shown in Table 11.

Table 11. Current Status of the Spotted Owl and Its Habitat within the LNS Watershed.

	Total WA	Total Protected (%)	Total Unprotected (%)
Acreage within Boundary	72,157	37,910 (53%)	34,250 (47%)
Acreage of Federal	49,366	37,910 (77%)	11,365 (23%)
Federal Spotted Owl Habitat Capable Acres	46,623	35,750 (77%)	10,800 (23%)
Total Suitable Spotted Owl Habitat	36,611	29,850 (82%)	6,700 (18%)
Federal Suitable Spotted Owl Habitat	33,969	29,850 (88%)	4,060 (12%)
Total Spotted Owl Sites	10	8	2
Spotted owl sites (>40%)	8	8	0
Spotted owl sites (30-40%)	1	0	1
Spotted owl sites (20-30%)	0	0	0
Spotted owl sites (<20%)	1	0	1

Fish

1. What is the distribution of anadromous fish?

2. What stocks of anadromous fish are recognized as "at risk"?

3. What resident fish exist in the watershed, and what is their distribution?

Salmonid Species Assessment and Distribution

Much of the most productive habitat in the Santiam sub-basin has been blocked by dams on the North and Middle Santiam rivers. Detroit Dam and the downstream Big Cliff Dam, constructed in 1953 on the North Santiam, and Foster and Green Peter dams, constructed in 1968 on the South and Middle Santiam rivers, have blocked anadromous fish passage to historic upstream spawning and rearing areas. As a result of these dams, wild anadromous fish production is now restricted to lower mainstem and tributary streams, such as the LNS (see Map 14).

Hatchery production of spring chinook (*Oncorhynchus tshawytscha*) was increased as mitigation for the dams on the North Santiam. Hatchery stocks are derived primarily from native Willamette stock. Spring chinook fry and fingerlings were released in the LNS in 1958, 1959, 1983, and 1984. STEP releases of spring chinook fry were made in the LNS from 1984-1987. Because released fish were fry and fingerlings, with very low expected adult returns, it is doubtful that they made a significant genetic contribution to the existing stock (J. Haxton, personal communication). No releases of winter steelhead (*O. mykiss*) have been made in the LNS basin. Skamania stock summer steelhead (*O. mykiss*) was first introduced into the LNS in 1966. Releases were made below river mile (RM) 17 to minimize potential impacts on naturally produced winter steelhead, which are found primarily above RM 17. Summer steelhead releases were discontinued in 1994 due to concerns about competition with wild stocks. STEP releases of native Willamette stock winter steelhead fry were made in the LNS in 1984 and 1987 but probably made very little, if any, genetic contribution for the same reasons described for spring chinook.

Historically, upstream migration of anadromous fish was blocked by Salmon Falls at RM 15.9. A fish ladder was installed at the falls in 1958. Steelhead are now suspected to migrate as far as a barrier falls at RM 23.9 near Jawbone Flats. In the years following the opening of the fish ladder at Salmon Falls, chinook were commonly seen upstream of the falls. Currently, chinook are rarely found upstream of Salmon Falls, although they are capable of ascending the fish ladder.

Winter Steelhead Trout

Status: Depressed (Proposed for federal listing as threatened, February 1998)

The Santiam River sub-basin provides the majority of the winter steelhead production in the Willamette Basin. Runs of Willamette Basin early-run and late-run winter steelhead have been declining since the late 1980s and are at or near record low numbers. In 1996, a record low number of 1,322 late-run winter steelhead were counted at Willamette Falls. The 1997 Willamette Falls count of late-run winter steelhead showed considerable improvement at 3,925 fish. Early-run fish are primarily of hatchery origin, while native fish make up the late-run. In February 1994, the National Marine Fisheries Service (NMFS) received a petition to list Willamette River winter steelhead under the Endangered Species Act. In August 1996, the NMFS determined that Upper Willamette River steelhead did not warrant listing (Federal Register, 1996). Early-run winter steelhead are not suspected to exist in the LNS.

The LNS, managed as a wild steelhead fishery by the Oregon Department of Fish & Wildlife (ODFW), is considered a key area for late-run, wild fish production. ODFW spawner surveys in two LNS tributaries (Sinker and Elkhorn creeks) indicate wild steelhead spawner escapement has been declining since the late 1980s (Table 12), with an increase in 1997. Sport catch data for the LNS (Table 13) also indicate a declining trend starting in 1988.

Table 12. Winter Steelhead Redds Per Mile and Miles Surveyed in Sinker and Elkhorn Creeks, 1987-1996.

YEAR	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
SINKER CR.	38.6	*	8.6	*	*	15.7	12.9	19.5	1.4	1.4	7.1
MILES SURVEYED	0.7	*	0.7	*	*	0.7	0.7	0.7	0.7	0.7	0.7
ELKHORN CR.	31	*	13.8	*	10	11	12	11	7	0	10
MILES SURVEYED	1.0	*	0.8	*	1.0	1.0	0.5	1.0	1.0	1.0	1.0

* Not surveyed

Table 13. Estimated Winter Steelhead Sport Catch in the LNS, Run Years 1982-83 through 1993-94.

RUN YEAR	82-83	83-84	84-85	85-86	86-87	87-88	88-89	89-90	90-91	91-92	92-93	93-94
SPORT CATCH	48	35	157	236	161	187	130	77	66	18	48	28

Steelhead are found in approximately 26.8 miles of streams in the watershed. Most of the habitat is in the mainstem, although three tributaries (Sinker, Elkhorn, and Evans creeks) are known or suspected to support steelhead populations in the lower reaches.

Spring Chinook Salmon

Status: Depressed (Proposed for federal listing as threatened, February 1998)

Spring chinook escapement in the LNS is declining as indicated by spawner survey data (Table 14) and snorkel survey data (Table 15).

Table 14 . LN S Spring Chinook Redds Per Mile and Miles Surveyed, 1991-1996.

YEAR	1991	1992	1993	1994	1995	1996
REDDS PER MILE	3.0	0	5.0	2.7	3.0	0
MILES SURVEYED	3.0	3.0	3.0	3.0	3.0	19.6

Table 15. LNS Spring Chinook Snorkel Survey Counts, 1971 and 1992-1996.

YEAR	1971	1992	1993	1994	1995	1996
LIVE ADULTS	236	15	10	0	0	1
DEAD ADULTS	6	1	0	0	0	0
JUVENILES	100	52	21	1044	5	11
MILES SURVEYED	7.5	4.5	4.5	4.5	5.6	4.5

Resident Trout

Status: Unknown

Resident cutthroat trout (*O. clarki*) are found throughout the watershed, particularly upstream of anadromous barriers. Presence of rainbow trout (*O. mykiss*), probably introduced, has been reported in some tributaries, generally above barrier falls. Opal Creek and Opal Lake are known to contain introduced populations of brook trout (*Salvelinus fontinalis*).

AQUATIC

Hydrology and Water Quality

* *What is the current water quality condition on the river? What is the trend in water quality?*

* *Is the current level of water quality supporting beneficial uses?*

* *How has human development and uses affected water quality on the river?*

* *What opportunities exist for improving water quality through changes in management and site specific projects?*

* *Where are the major sources of sediment from erosion, landsliding, road runoff, or other management activity located? What areas have the greatest potential for landslides or erosion?*

* *How have riparian and stream channel conditions affected water quality?*

Introduction

The LNS watershed (5th field watershed) drains approximately 113 square miles or 72,157 acres of the west slope of the Oregon Cascade Mountains and is a contained within the larger North Santiam watershed which covers 1,800 square miles (4th field watershed). In turn, the North Santiam watershed is located in the WRB (2nd field watershed), which is the largest river basin in Oregon, draining 11,100 square miles. A large percentage of the state's population and major cities are located in the WRB including Portland, Salem, and Eugene. The USGS has divided the WRB into hydrologic units and assigned each a hydrologic unit code. The LNS drainage is contained in the 1709000505 Hydrologic Unit. The LNS watershed has been divided into 11 sub-watersheds (SWB): Kiel Creek Frontal, Canyon Creek Frontal, Sinker Creek Frontal, Evans Creek Frontal, Dry Creek Frontal, Elkhorn Creek, Henline Mountain., Cedar Creek, Gold Creek Frontal, Battle Axe Creek, and Opal Creek (Map 7). SWB acreages are listed in Table 16.

Table 16. LN S SWB Acreages.

SWB	Acreage
Battle Axe Creek	5,299
Canyon Creek Frontal	8,737
Cedar Creek	5,968
Dry Creek Frontal	6,018
Elkhorn Creek	8,471
Evans Creek Frontal	5,135
Gold Creek Frontal	6,955
Henline Mountain	2,796
Kiel Creek Frontal	9,862
Opal Creek	6,779
Sinker Creek	6,136
Watershed Total	72,157

The headwaters of the LNS WAA area originate at elevations of 4500 to 5500 feet, dropping to an elevation of approximately 600 feet at the confluence of the NSR (Figure 10). A majority of the elevation is lost in the first few miles from the headwaters. In the upper elevations, the streams are confined by steep canyons and rocky cliffs, while lower in the watershed the stream valley widens, streams are less confined, and the gradients decrease. Geology in the watershed consists mostly of igneous rocks, with pyroclastics in the western lower elevations, and andesites in the eastern, higher elevations. Alluvium is found in flood plains around the main channel.

The watershed is characterized by a temperate climate. Summers are fairly warm, hot days are somewhat rare, and the winters are cool. Winter snow and freezing temperatures are common at higher elevations, while cool temperatures and rain dominate lower elevations in the sub-watershed. Precipitation ranges from 60 inches a year in the lower elevations to near 130 inches on the higher peaks, with most of the precipitation falling November through May.

There are approximately 667 miles of stream in the WWA. Miles of stream by stream order and sub-watershed are shown in Table 17. Stream densities in the sub-watersheds vary from 6.8 miles per square mile in Battle Axe Creek to 4.3 miles per square in Cedar Creek (Figure 11). Maps 15 and 16 show stream order and stream flow for the watershed.

Little North Santiam River Profile

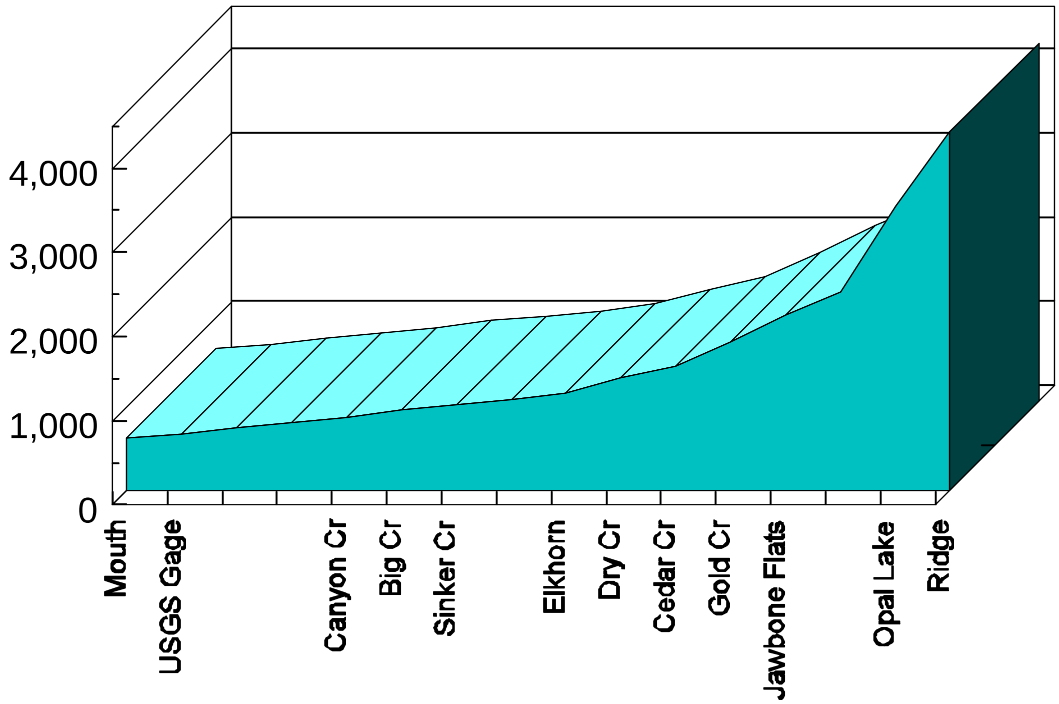

Figure 10. River Profile in Feet Above Sea Level.

Table 17. Stream Orders by SWB (in miles).

SWB	1st Order	2nd Order	3rd Order	4th Order	5th Order	6th Order	Lakes	Total
Battle Axe	35.5	11.8	5.1	3.8	0	0	0.3	56.7
Canyon Creek	42.7	24.3	12.4	2.6	0	3.1	1.5	86.7
Cedar Creek	22.5	10.0	3.1	4.6	0	0	.9	41.1
Dry Creek	28.6	13.6	4.8	2.0	3.8	0	0.7	53.6
Elkhorn Creek	42.2	15.8	5.0	5.4	3.6	0	0.5	72.5
Evans Creek	30.6	11.8	5.0	2.6	2.8	0	0.5	53.2
Gold Creek	33.9	15.6	3.8	2.2	3.3	0	0.5	59.3
Henline Mnt.	14.9	5.0	3.1	0.4	2.2	0	0	25.7
Kiel Creek	46.9	19.6	7.1	1.6	0	8.7	0.8	84.7
Opal Creek	45.6	10.7	8.8	3.6	0	0	1.2	70.1
Sinker Creek	32.9	12.0	9.5	4.2	0.1	2.4	2.0	63.1

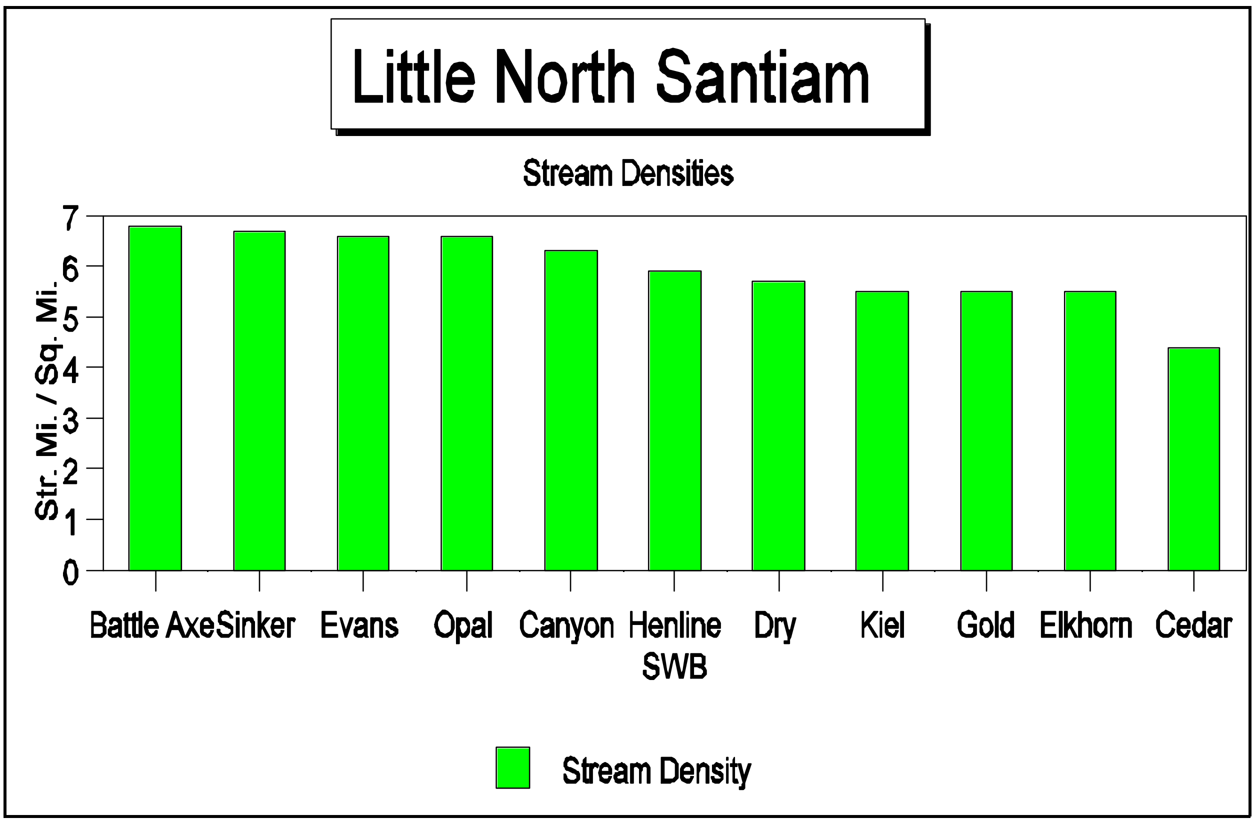

Figure 11: **Stream Density by SWB**

Stream flows

A USGS stream gage is located on the LNSR two miles upstream from the confluence with the NSR. It has been an active station since 1932. The average annual total stream discharge on the LNS for the period of record is 540,700 acre-feet or 746 cubic feet per second (cfs) (USGS 1995). The maximum measured discharge was 36,000 cfs on December 22, 1964, while the minimum was 13 cfs on August 30, 1961. Precipitation and average monthly discharge totals for the period 1932 to 1994 are displayed together in Figure 12. The precipitation data is from an Oregon state climate station located at Detroit Dam while discharge data is from the LNS gage. The WAA exhibits high winter flows and low summer flows typical of the Cascade Range drainages, with 65 percent of the flow occurring November through March. A large percentage of the precipitation is also received during this period.

No major dams or reservoirs exist in the WAA, and most of the summer flow is derived from groundwater.

A graph of annual high and average exceedence flows are displayed in Figure 13 along with non-exceedence values for low flows. The graph was developed from discharges for the 55 years of record. The two exceedence graphs for average and annual high flows show the percentage of

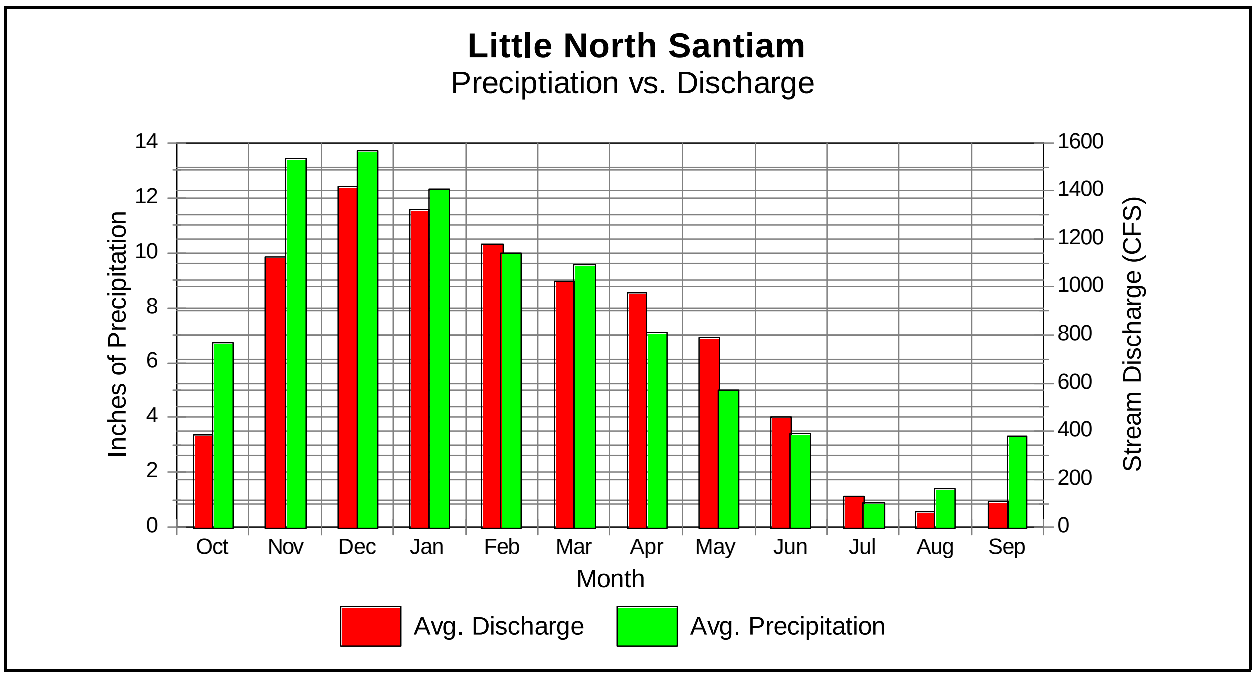

Figure 12. **Precipitation and Discharge.**

time flows are greater than a given value. It is read by choosing a percent value on the x-axis and moving up to either the average or high flow lines then across to the discharge level. For example, on the average exceedence flow line, 95 percent of the time (x-axis) discharge is greater than 33 cfs (y-axis) and greater than 2,490 cfs (y-axis) only five percent of the time (x-axis) on an annual basis. The average exceedence flows are based on mean daily flows. On the high flow exceedence line, 50 percent of the time (x-axis) annual high flows are above 8,680 cfs (y-axis), while only one percent of the time are annual high flows above 20,100 cfs. High flow values were based on the highest annual one day discharges for the period of record. The lowflow non-exceedence graph is read in a different way. The lowflow graph indicates the percentage of time

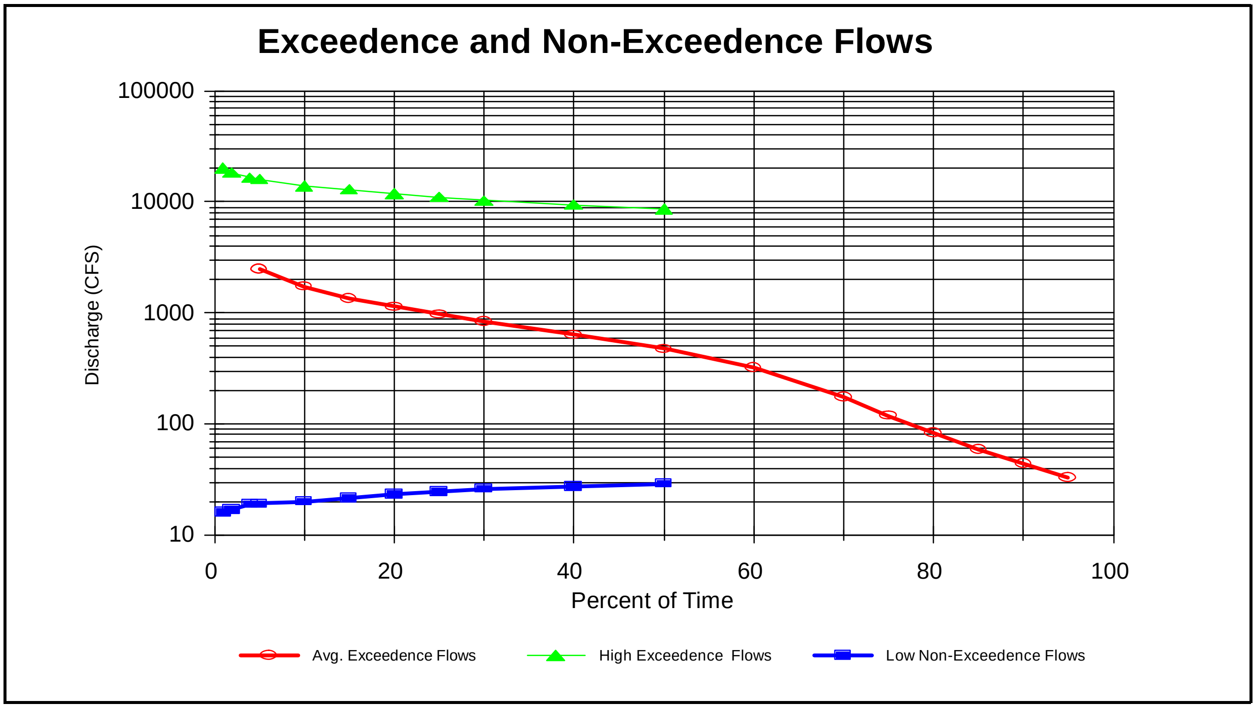

Figure 13. **Exceedence and Non-Exceedence Flows.**

flows are less than the indicated discharge. For example, 50 percent of the time lowflows are less than 29 cfs, while low flows are less than 16 cfs only one percent of the time. Low flow values were calculated from the lowest one day annual discharges for the period of record. The average exceedence values have implications for water right allocations on the LNSR and are discussed below in the water rights section.

A residual mass curve was developed for the sub-watershed using precipitation and stream discharge to look at climatic trends and variation over time. This type of trend analysis can be useful for separating climatic variation from changes in the precipitation/runoff relationship. The graph is produced by totaling the cumulative differences from the mean of a set of data. A downward sloping line indicates years of lower than average values, while an upward sloping line indicates years with above average values. Figure 14 shows the residual mass curve for precipitation and discharge for the period of streamflow record, 1932 through 1994. Precipitation and discharge were included together on the same graph to allow comparison.

A climatic trend can be seen in the graph, with three distinct periods of precipitation and discharge in the basin. A lower discharge and precipitation period from 1932 to 1944, indicated by a downward sloping line, a higher precipitation and discharge period from 1945 to 1975, and another below average period from 1976 to 1994. The precipitation and discharge lines track each other fairly well until the mid-1980s where years with higher than average precipitation (upward sloping lines) do not result in an increase in discharge.

There are several theories that might explain the difference. A change in the timing of precipitation, like an increase in the percentage of summer precipitation, could result in less runoff and increased losses due to evapotransporation. Several consecutive years of lower than average precipitation may reduce the volume of groundwater storage, resulting in less runoff from groundwater during lowflow periods and less total runoff volume. Lowered groundwater storage volume may result in a delayed response to one year of above annual precipitation during a series of drought years, with the increased rainfall replenishing groundwater rather than moving to streams and showing up as runoff. It is not uncommon to have a one or more year delay between precipitation and groundwater response (Fetter 1980). Consumptive uses have increased in the recent past as more people move into the watershed. However, the number of new residents are not enough by themselves to explain the changes in the precipitation/runoff relationship shown on the graph.

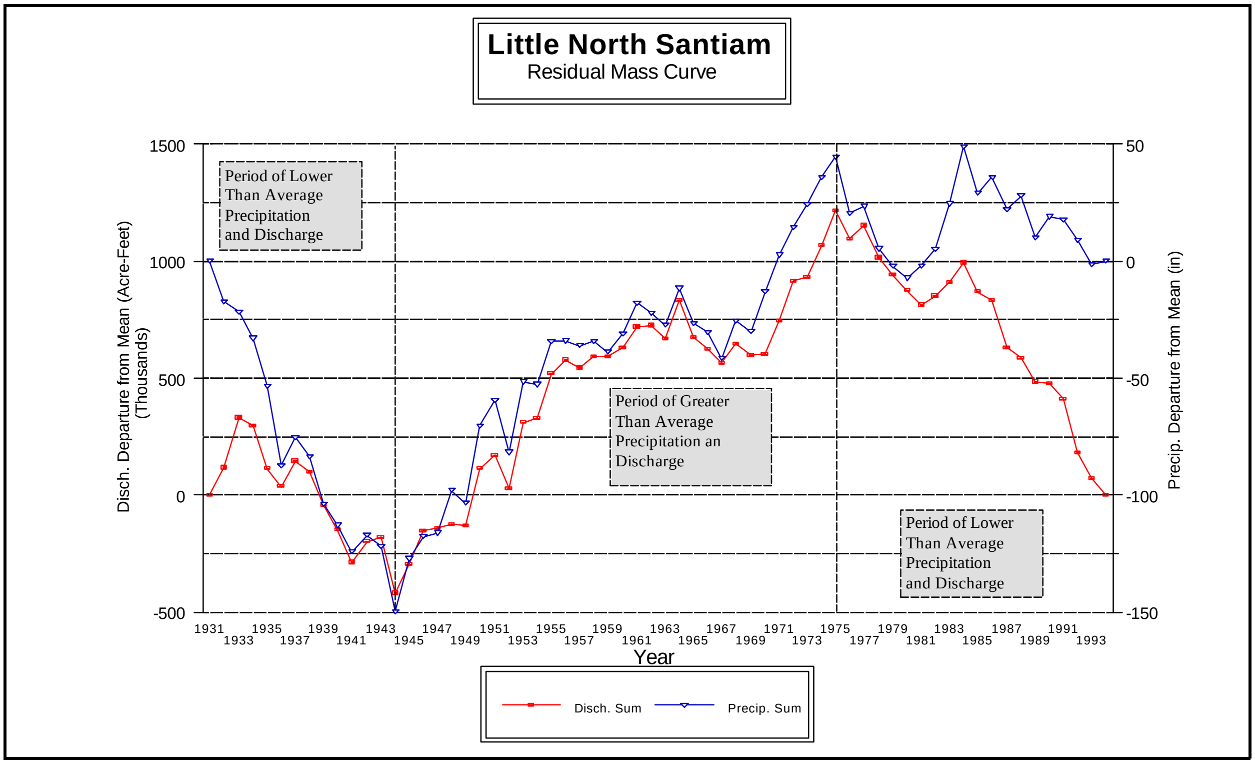

Figure 14.. Residual Mass Curves.

Total stream discharge was graphed as a function of precipitation and is shown in Figure 15. The graph shows the cumulative sum of precipitation and resulting cumulative discharge for the period 1932 through 1994. A consistent relationship between precipitation and discharge would result in a straight line, while a change in the relationship would result in a change in the line's slope. A change in the precipitation discharge relationship requires several years to result in a discernable change in the slope of the line. At first glance the line appears fairly straight. However, on closer examination a possible change in slope can be seen in the period 1979 through 1994. To test the theory that there was a change in the precipitation/runoff relationship, the statistical method analysis of covariance was used. The data was divided into periods similar to the periods described above, 1932 to 1944, 1945 to 1978, and 1979 to 1994. The slope of each period was then compared with the other two.

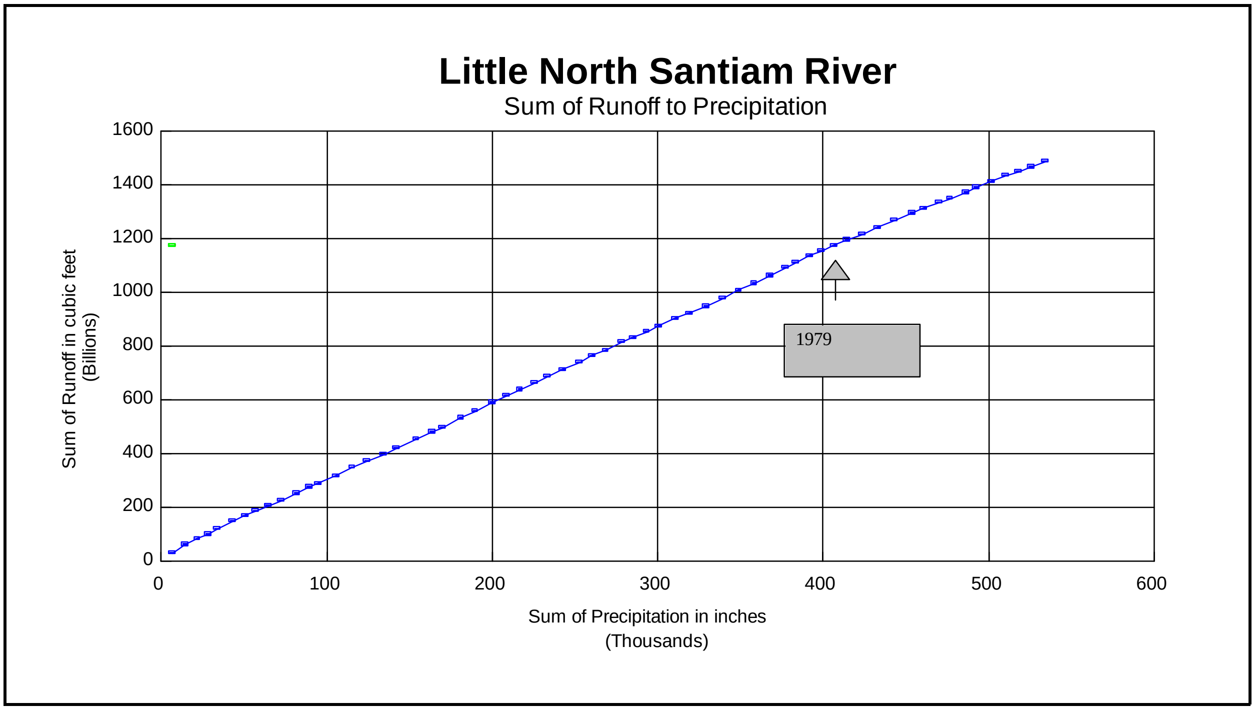

Figure 15.. Sum of Runoff to Precipitation.

Results indicate the period from 1979 through 1994 is statistically different from the previous two periods (P=0.00). The reduced slope of the line suggests a given quantity of precipitation results in less stream discharge from 1979 through 1994 than before the period. The change in the precipitation discharge relationship is also supported by the residual mass curve shown in Figure 15.

Annual stream hydrographs were used to analyze low flows and groundwater storage in the watershed. Using annual hydrographs for the period of record, a groundwater recession curve was developed. A groundwater recession curve is a generalized curve which describes the contribution of groundwater to streamflow and displays groundwater storage and release in a basin. Since groundwater discharge characteristics in a watershed are constant, the slope of the recession curve remains the same and does not change from year to year. Discharge above the recession curve is from precipitation, snowmelt, and other temporary storage such as lakes, while discharge displayed below the recession curve is from groundwater. The total area below the recession curve indicates the basin groundwater storage, which varies from year to year depending on precipitation and groundwater recharge. A manual method described by Barns (1939) was used to separate the hydrograph into periods of groundwater recharge and discharge and to develop the groundwater recession curve. Two years were used for comparison, 1961 which was an extremely lowflow year and 1991 which was an average year (Figures 16 and 17). Groundwater recharge and discharge periods are identified on the graphs along with the groundwater recession curve. On an average year in the watershed, the groundwater recharge due to storms occurs into early May, then groundwater discharge occurs until the next wet season. The hydrograph also shows snowmelt augments flows somewhat after the rainy season and play a role in keeping flows up in the spring. In 1961, the extremely dry year, total groundwater available for runoff (WAR) from the beginning of the groundwater discharge period was estimated to be $3.2x10^9$ cubic feet, and by the end of the lowflow period there was 21 days of baseflow remaining before the stream became dry. To compare this to an average year, in 1991 there was estimated to be $6.8x10^9$ cubic feet of groundWAR, and the stream had 50 days of baseflow remaining before becoming dry at the end of the lowflow period.

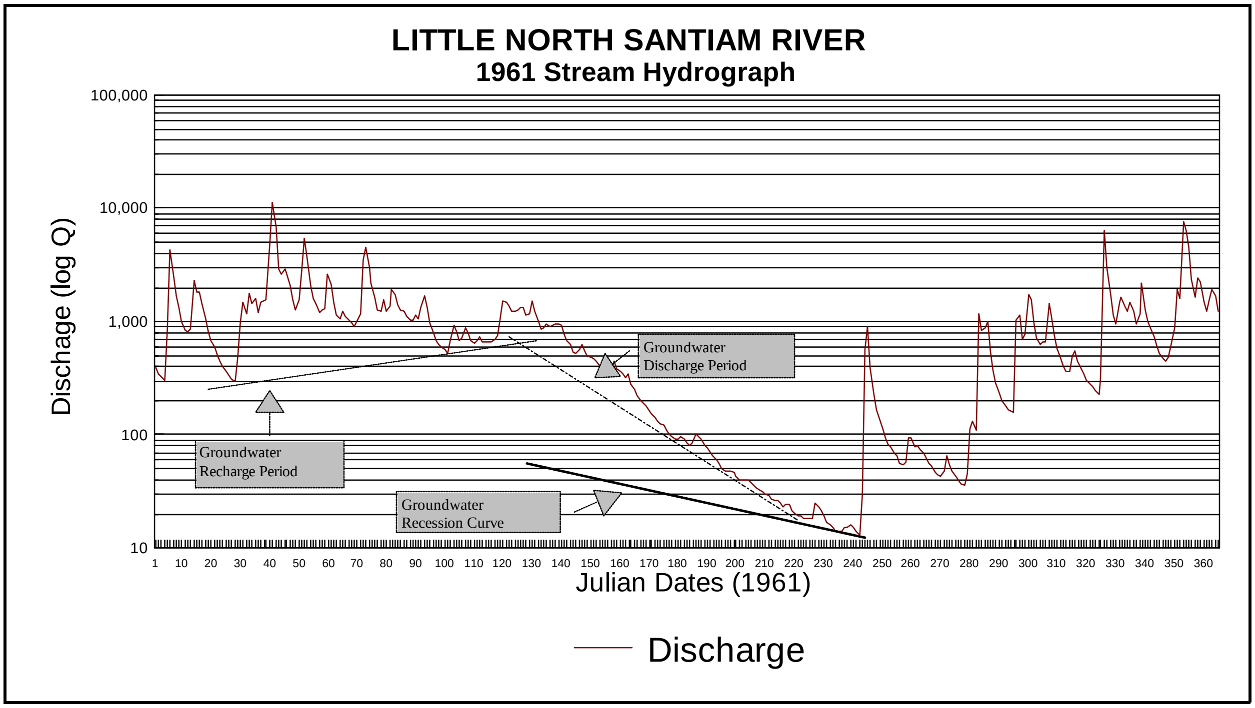

Figure 16. **1961 Little North Santiam Stream Hydrograph**

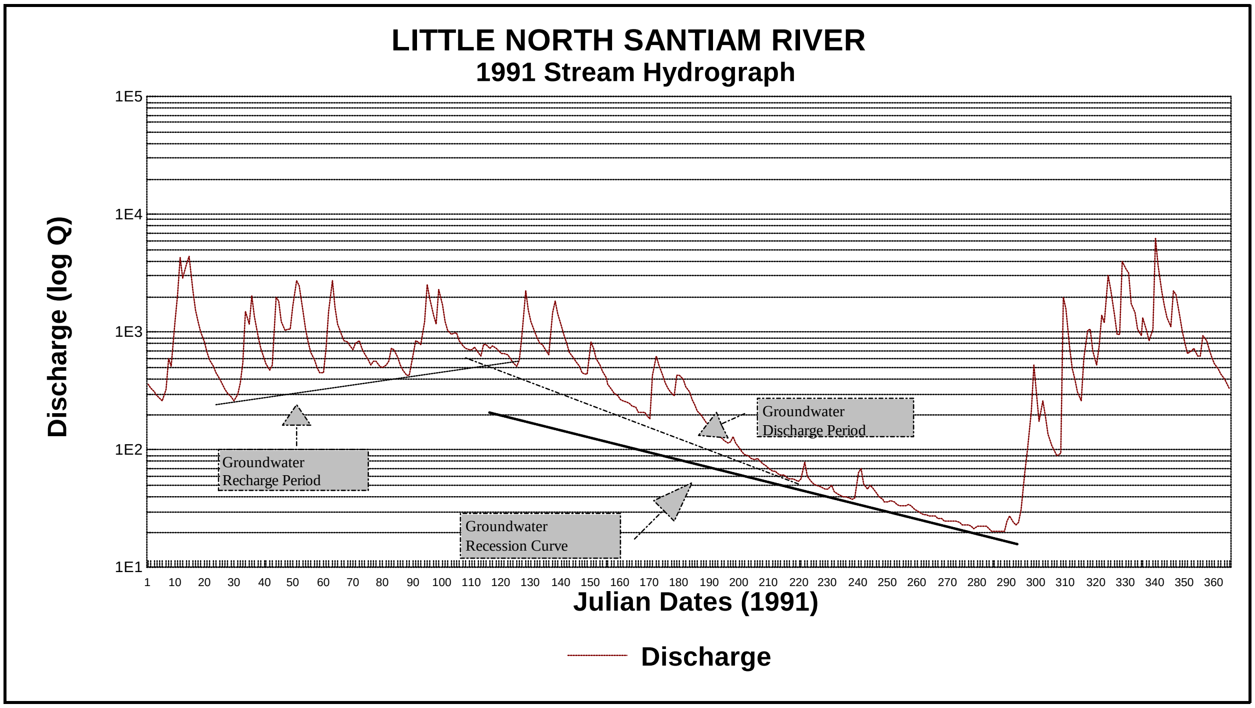

Figure 17. **1991 Little North Santiam Stream Hydrograph.**

Water Rights

A summary of water rights by type of use on the LNSR is presented in Table 18. The totals were based on information collected on the Oregon State Water Rights Information System (WRIS). The totals are for rights listed on the LNSR and do not include water rights below the confluence with the NSR. However, on the NSR below the confluence, a large number of water rights exist for municipal (City of Salem), domestic, agricultural, and others.

Streamflow in the LNSR may be over allocated during some low flow periods. The water rights total for the basin, not including storage, is 60 cfs. Referring back to the total annual exceedance flows in Figure 13, discharge is greater than 60 cfs approximately 85 percent of the time on an annual basis. The remainder of the time flows are below 60 cfs. Water rights represent potential usage and not actual usage, which can vary by day or season. Water demands increase during the dry summer months as more water is needed for irrigation and other uses. Therefore, during this period, which also corresponds to the period of lowest discharge, demand could potentially exceed supply. The USGS publication *Statistical Summaries of Streamflow Data in Oregon: Volume 1* summarizes low flows in the LNS as dropping below 60 cfs for a duration an average of 60 to 90 days one out of every two years over the period of record. Since instream flows for fisheries constitute 52 cfs of the total, instream flows are potentially most affected when flows drop below 60 cfs. Water rights in Oregon are prioritized by the date of acquisition, the oldest rights receiving the highest priority. Water right priorities in the basins are not detailed further in this watershed analysis.

Table 18. Water Rights Summary for the LNS River.

Totals by Use									
	Irrig.	Fish	Agri.	Indust.	Municipal	Domestic	Recreation	Misc.	Total
CFS	4.5	52.43*	.01	2.81	0	0.5	.5	1	60.89
AFT	4.1	34.4	0	0	0	0	0	7.75	40.93

*Fish and Wildife Service instream water right, certificate # 30117.

Water Quality

In the ODEQ publication, *1988 Oregon Assessment of Non-point Sources of Water Pollution* (ODEQ 1988), also known as the 319 report, water quality in the LNSR was listed as being moderately impacted (documented with supporting data). Problems identified include low dissolved oxygen, bacteria and viruses, low flows, and sediment. The causes were listed as landslides, erosion, decline in the alluvial watertable, animal waste, human waste, and riparian vegetation and bank disturbance. The uses impacted are municipal water supplies and fish and other aquatic organisms. *Oregon Department of Environmental Quality's 1994/1996 303(d) List Of Water Quality Limited Waterbodies*, also known as the 303(d) report, is a compilation of waterbodies where existing required pollution controls are not stringent enough to achieve the state's water quality standards. States are required to develop this list under the 1972 Federal Clean Water Act. The LNSR is not listed in the report; however, the NSR is listed as being water quality limited from the junction of the LNS with the NSR downstream due to high summer water temperatures.

Three Basin Rule

Water quality on the LNSR is protected under a special provision of the Oregon Administrative Rules titled the *Three Basin Rule* (OAR 340-041-0470). The rule was developed to preserve and improve existing high quality waters for municipal water supplies, recreation, and aquatic life in the Clackamas, McKenzie, and NSR sub-basins. New and increased waste discharges are prohibited by the rule except under limited conditions. More information on the rule can be obtained from the ODEQ.

Water Quality Monitoring Plan

The City of Salem and USFS entered into joint water quality monitoring effort in December of 1996 to coordinate monitoring efforts in the NSR Basin. The plan is outlined in: *Joint Water Quality Monitoring Plan between the City of Salem, Oregon and the Willamette National Forest, Detroit Ranger District December 1996*. The purpose of the effort is to determine if and how the water quality within the basin is changing over time and assess the short term spatial and temporal distribution of water quality.

Salem City Water Quality Data

The City of Salem has collected water quality data on both the NSR and LNSR since 1985. Physical, chemical, and biologic data are collected once a month at several established sampling sites on the rivers, with eight sites on the LNS and nine sites on the North Santiam and its tributaries. The location of selected water quality sites on the LNS and NS rivers near their confluence is shown with river miles in Table 19. City data from 1985 to 1994 was used in this watershed analysis to characterize water quality on the two rivers.

Table 19. Selected City of Salem Water Quality Station Locations.

Station Number	River	Approximate River Mile (from mouth)	Notes
2	North Fork Santiam	42	3 miles upstream from the LNS confluence. Started 1985
3	LNS	0.5	Collection began in 1985
11	LNS	3	Collection began in 1989
6	LNS	7	Collection began in 1985
5	LNS	12	Collection began in 1985
4	LNS	14	Collection began in 1985
10	LNS	17	Collection began in 1985
13	LNS	19	Collection began in 1991

The stations were compared using all of the available data with no seasonal breakout and dividing the data into seasons then comparing to look for differences that might only appear seasonally. Following an initial examination, the data was divided into three 4-month "seasons." Three divisions were chosen rather than four to group low flow months into one season and to keep the number of observations in each group high enough to ensure that any statistical differences that might appear would be reliable. The breakdown of the three seasons were: fall-winter (November through February), winter-spring (March-June), and summer-fall (July-October).

The method used to compare data between sites was the *Wilcoxon Matched pairs Signed Ranks Test*, which is a non-parametric statistical test of differences. Non-parametric test are less powerful than parametric tests when looking for differences between data; however, when the city data were graphed they did not fit a bell shaped curve and so required non-parametric analysis. The statisical program *SPSS for Windows* tm version 6.1 was used to analyze the data. Stations were compared with each other in turn by calling data collected at each monthly sampling event a matched pair of data between two stations.

There are limitations and assumptions that need to be made when using this approach. Water quality at a given cross section in a natural river is highly variable and can fluctuate not only over a short period of time but also within a cross section at any given point. Pollutants and other constituents that affect water quality can move through a system in pulses or waves and depending on several physical factors can take many miles of mixing before they are mixed across the whole cross section.

Another factor that can affect data collected on rivers is the order and time of day samples are taken. Sampling from the upstream stations first and working in a downstream order can have the advantage of sampling the same relative section of water as it flows downstream, depending on flow velocities and distance between stations. While this assumption depends on many variables, it can provide a basis for drawing conclusions when analyzing data. The data provided by the City of Salem sampled from downstream stations first, working upstream, and is a limitation. The time of day a station is sampled can also have an effect on the parameter measured. For example, water temperature will be higher in the afternoon than in the morning, and a station consistently measured in the morning will probably show a significantly lower temperature than a station always measured in the afternoon. This holds true for many of the physical parameters which are interrelated including temperature, oxygen, pH, and carbon dioxide to name a few. While there are drawbacks to any system of data collection, the assumption was made that the chemical and biological water quality data collected by the City of Salem covered enough sampling events that variations due to individual pulses or waves of water constituents would be overshadowed by actual trends in the data over time.

Several water quality parameters were compared between stations including turbidity, solids, alkalinity, and fecal coliforms. Other water quality parameters were available including nitrates, ortho-phosphates, copper, iron, and zinc, but values were very low, usually below measurable thresholds, so were not used to compare stations. Results of the analysis are presented in Appendix E2. The tables are read by going to a station listed across the top, then moving down the table to the row for a station listed along the left side. If the station listed along the top of the table had significantly higher values of the parameter at the 95 percent confidence level (P = 0.05) than the station listed on the left side, a capital **"S"** appears in the box. Stations where the difference was found to be significant only at the 90 percent confidence level (P = 0.10) have a lower case **"s"** entered in the box. Empty boxes indicate the data did not show a significant difference between stations for that water quality parameter. For example, in the turbidity full year table, station 3 (top line) had significantly higher turbidities than all other stations except stations 2 and 11. The stations were arranged on the table so the stations furthest downstream are toward the left or top, moving upstream as you go across or down the list.

Turbidity is a measure of opaqueness or cloudiness produced in water by suspended particulate matter. The turbidity tables above indicate levels increase on the LNS as you move downstream from the headwaters. Stations 4, 10, and 13 which are on USFS lands were not significantly different in turbidity than one another and are lower in turbidity than stations downstream of the USFS boundary. This indicates turbidity levels increase downstream from USFS lands. Station 2 which is on the NSR had higher turbidity than all stations on the LNSR during all seasons, implying the LNS has lower turbidity than the NSR all year.

Total solids are a measure of mineral and organic materials suspended and dissolved in water. Alkalinity is the ability of water to neutralize acids, or the ability of water to resist a shift in pH, and usually reflects the activity of magnesium, sodium, potassium, and calcium carbonates. Results for total solids and alkalinity showed a similar pattern to turbidity, with an increase in the levels as you travel downstream on the LNSR. However, unlike turbidity, solids and alkalinity on USFS lands increased in a downstream direction. The NSR had significantly higher levels of total solids and alkalinity than all stations on the LNSR during all seasons. The state standard for alkalinity is 20 parts per million which is considered the chronic limit for aquatic life. Many of the sampling events found concentrations above 20 ppm on both the LNS and Santiam rivers. Natural sources may provide the largest contribution to alkalinity, and further study is needed to determine natural versus human inputs.

Fecal coliforms are enteric bacteria that represent those members of the total coliform group found in the intestines and feces of warm-blooded animals. Like the other water quality parameters, levels of fecal coliforms increase as you go move downstream in the LNSR. Stations 10 and 13, the two stations highest up in the watershed and on USFS land, were not significantly different from each other and significantly lower than all other stations. Unlike the other parameters discussed, the NSR at station 2 had lower fecal coliform levels than stations 3 and 11 on the lower end of the LNS, looking at the full year and July-October lowflow season. Since station 2 was not shown to be significantly higher than stations 3 or 11 during any season, it is suspected that the LNS has similar concentrations of fecal coliform compared to the North Santiam except during the summer and fall when the LNS has higher levels of coliforms. Several sampling events resulted in fecal coliform readings which were potentially higher than the ODEQ's standard for contact recreation of 200 fecal coliforms per 100 milliliters based on a minimum of 5 samples in a 30-day period (OAR 340-41-445 (2)(e)). Water quality data were only collected once a month, so it is unknown whether readings which were above 200 coliforms per milliliter were isolated events or actual violations of water quality standards.

To summarize, the LNSR was significantly lower than the NSR in alkalinity, turbidity, and solids but not fecal coliforms. The LNS was significantly higher in fecal coliforms than the NSR during lowflows. Concentrations of constituents increase in the LNS in a downstream direction. Alkalinity levels are high in both rivers, and fecal coliforms may be above state standards during some periods.

Temperature Data

Summer and fall water temperatures were collected on the LNSR using data loggers placed at river miles 3, 10, and 15 beginning in 1995. River mile 3 is located near the LNS County Park, river mile 10 at Elkhorn Park, and river mile 15 near Salmon Falls. Data from 1995 and 1996 are summarized in this watershed analysis using 7-day maximum averages. The 7-day maximum average takes the maximum recorded temperature for each date and averages it with the maximum recorded readings from the 3 days prior and the 3 days after the date. Each average was then plotted on a graph (Figures 18 and 19). The 7-day maximum average was used rather than straight daily maximums because aquatic organisms are more succeptable to disease and other environmental stress when water temperatures are elevated over a period of time. Seven-day maximum averages also remove some of the fluctuation that can appear in graphs of daily maximums.

The water temperature graphs show all three sites were above the 20 degree Celsius growth threshold for salmon in mid-summer. The temperatures recorded at river mile 3 approached the 25 degree Celsius lethal limit for salmon both years. Because the data is a 7-day running average, it is apparent that water temperatures are high for extended periods of time in the summer. At temperatures near or above the 20 degrees Celsius threshold, salmon are forced to seek refuge in cooler water in places such as deep pools or cooler tributaries.

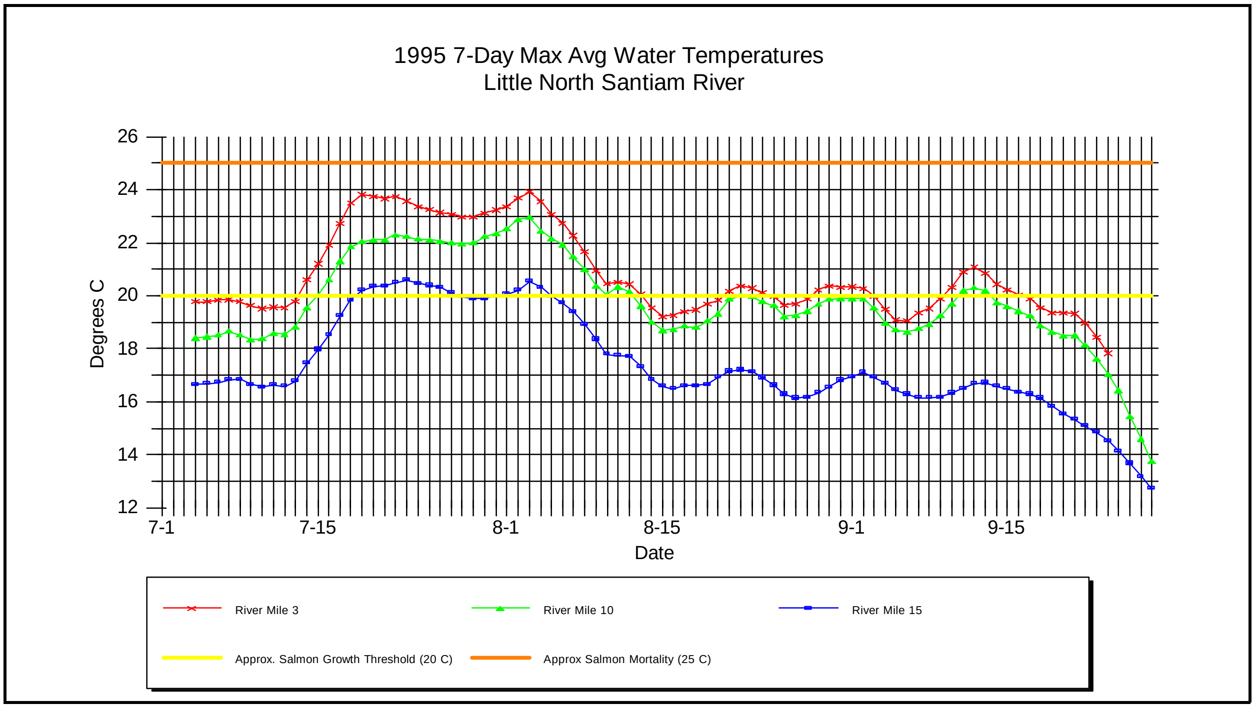

Figure 18 . 1995 Seven Day Maximum Average Water Temperatures

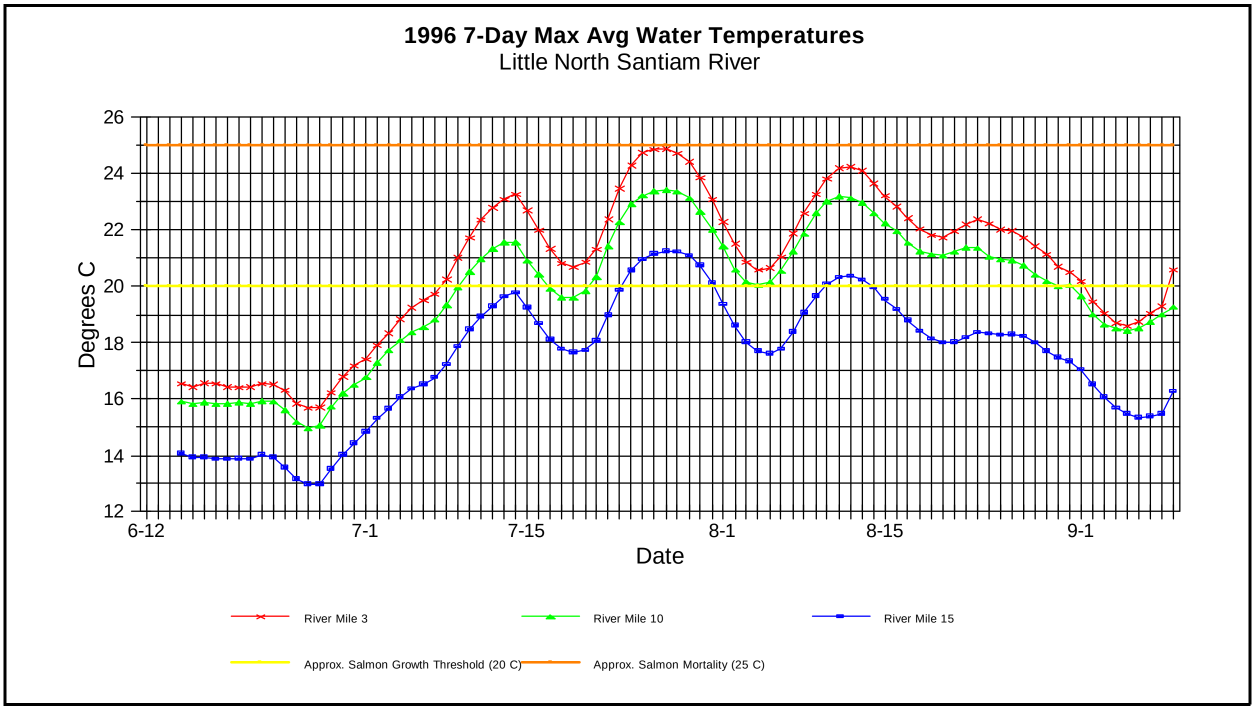

Figure 19. 1996 Seven Day Maximum Average Water Temperatures

A review of the temperature graphs shows a larger temperature increase occurring between river miles 15 and 10, than between river miles 10 and 3. If temperatures were increasing evenly along the LNSR, a smaller increase would be expected between river mile 15 and 10, which are five miles apart, than between river mile 10 and 3, which are seven miles apart. However, the actual temperature increase between the upper stations (mile 15 and 10) is nearly twice as much as the difference between the lower stations (10 and 3). Several drainages between river mile 15 and 10 may be contributing to the increase in temperature including Fawn Creek, Fish Creek, Sinker Creek, Big Creek, Moorehouse Creek, Chamberlain Creek, Wonder Creek, and Cougar Creek. Elkhorn Creek is also between the stations, but a temperature recorder on the tributary shows lower temperatures than the LNS, so it actually has a cooling effect on temperatures.

Stream Cover

Canopy cover is an important factor for controlling stream temperatures. Temperatures can increase or decrease along a stream course depending on the amount of shade provided by the riparian canopy. Timber harvest and stream sluicing can cause openings in the canopy, affecting stream temperatures. Canopy cover greater than 70 percent is considered a closed canopy while a canopy cover of less than 40 percent is considered an open canopy. Stream shade in the each SWB was estimated from 1996 aerial photographs and is summarized below in Table 20 in order of highest to lowest percent of open canopy, or lack of stream shade.

Table 20. Stream Canopy Cover in Order of Least Shade to Most Shade.

SWB	Less than 40 Percent Cover Over Channel (percent)	Greater than 70 Percent Cover Over Channel (percent)
Kiel Creek	23.8	73.8
Sinker Creek	10.2	86.4

Evans Creek	9.8	64.7
Canyon Creek	9.0	78.6
Dry Creek	8.5	87.3
Henline Mountain	0	75.0
Cedar Creek	0	78.6
Battle Axe Creek	0	83.0
Gold Creek	0	85.5
Opal Creek	0	92.2
Elkhorn Creek	0	95.5

Sinker Creek, Evans Creek, and Canyon Creek SWB's are all located between river mile 15 and 10 where water temperature recorders were located and stream temperatures increases were greatest. These SWB's are potential sources of summer high stream temperatures; however, further investigation is needed to determine where problems exist.

Storm Turbidities

Turbidities were measured on the LNS and major tributaries during a number of storms in 1996 and 1997 to look for potential sources of turbidity. Grab samples were collected, and turbidities measured in the office. The tributaries that exhibited the greatest number of high turbidity readings during storms compared with the other tributaries were Canyon Creek and Sinker Creek. Table 21 summarizes results of the storm turbidity sampling.

Table 21. Storm Turbidity Monitoring Results.

Stream	**SWB**	**Number of High Storm Turbidities**	**Highest Turbidity Recorded (NTU's)**
Canyon Creek	Canyon Creek Frontal	6	69
Sinker Creek	Sinker Creek Frontal	4	98
Kiel Creek	Kiel Creek Frontal	2	51
Evans Creek	Evans Creek Frontal	2	130
Fawn Creek	Evans Creek Frontal	1	53

The streams listed in the table above warrant further investigation to narrow down potential sources of turbidity.

Stream Stability

An estimate of stream stability was accomplished using stream gradients and forest canopy ages adjacent to the stream. Table 22 lists miles of stream by SWB in an unstable or potentially unstable condition.

Table 22. Unstable Stream Miles by SWB.

SWB	Unstable Streams Miles	Potentially Unstable Stream Miles
Elkhorn	6.0	9.0
Evans Creek	2.5	0.3
Canyon Creek	2.4	0.1
Henline Mountain	2.3	4.5
Dry Creek	2.2	4.6
Gold Creek	1.1	4.0
Opal Creek	0.8	4.0
Battle Axe Creek	0.6	1.3
Cedar Creek	0.6	2.4
Sinker Creek	0.2	0.7
Kiel Creek	0.2	0.1

The information in the table above is a first cut in determining SWB's which may have the greatest potential for channel problems including landslides into streams and channel and bank erosion. As discussed above, Canyon Creek, Sinker Creek, and Evans Creek had high storm turbidity readings, and stream stability could potentially contribute to the problem.

Road Summary

While surface erosion on exposed hillslopes usually decreases within a few years of disturbance as the slope revegetates, road surfaces can continue to erode as long as the road is in use. Cutslopes and fillslopes revegetate after road construction; however, the running surfaces produce fine-grained sediments over the life of the road. Roads can disrupt sub-surface flow, re-route surface flow and, in effect, act like stream channel extensions during storms, contributing runoff and sediment to streams. The amount of sediment and runoff reaching streams depends on the location, amount of traffic, and construction of the road. For this analysis, roads within 200 feet of a stream were assumed to affect runoff and sediment additions to streams. The actual effect varies depending on whether a road section crosses a stream or drainage ditch or just parallels it. Table 23 is a summary of road information by SWB. The SWB's are listed in order of most to least riparian roads. Road crossings were not analyzed, but total riparian road miles can provide an index SWB's with the highest potential channel network expansion from roads during storms.

Table 23. Road Summary By SWB (in descending order of riparian road miles).

SWB	Riparian Road Miles	Upland Road Miles	Total Road Miles	Unstable Road Miles	Potentially Unstable Road Miles	Road Density (mi/mi^2)
Canyon Creek	11.0	30.8	41.8	0.1	0.1	4.8
Evans Creek	9.6	21.6	31.3	0.3	0.3	5.5
Cedar Creek	7.3	13.1	20.5	<.1	0.5	2.2
Sinker Creek	7.1	18.4	25.5	<.1	<.1	5.7
Kiel Creek	7.1	30.6	37.7	<.1	<.1	5.0
Dry Creek	5.0	11.8	16.9	0.7	<.1	2.6
Gold Creek	3.7	4.2	7.8	0.2	<.1	0.7
Opal Creek	3.1	6.5	9.7	0.2	<.1	0.9
Elkhorn Creek	2.6	13.8	16.4	0.6	0.1	1.5
Battle Axe Creek	2.1	1.0	3.1	<.1	<.1	0.4
Henline Mountain	1.1	1.5	2.6	0.5	0.1	0.6

The SWB's which had the highest storm turbidities; namely Canyon Creek, Evans Creek, Sinker Creek, and Kiel Creek (see Table 21) all had more than seven riparian road miles and road densities approaching five miles per square mile or greater. Roads can contribute significantly to stream sediment and flows, and SWB reconnaissance may provide useful site specific information on problem roads.

Cumulative Effects

Past management activities were analyzed to determine cumulative effects in the LNS Watershed. Cumulative effects analysis looks at management activities collectively regardless of ownership. Several indices are used to assess cumulative effects. These indices are tools which can be used with other watershed information to make professional judgments regarding the relative hydrologic health of a watershed. Given the complexity of watershed responses to disturbance and the variable nature of weather, absolute thresholds do not work well in describing cumulative effects. However, the risk of negative long-term changes to a watershed can be grouped high, moderate, or low categories using the values resulting from analysis. Two indices were used in this watershed analysis to assess relative watershed health: equivalent clearcut acreage and WAR.

Equivalent Clearcut Acres (ECA)

ECA evaluates the total acreage in a clearcut-like condition within the SWB's by multiplying the number of acres by a factor depending on the age of the clearcut. ECA analysis recognizes that the most recent harvest activity causes the most impact, decreasing over time to a point called hydrologic recovery. Hydrologic recovery occurs when overstory canopy cover is 70 percent or greater, and evapotranspiration and runoff characteristics have recovered to preharvest conditions. The calculation of ECA assumes a hydrologic recovery which varies depending on elevation and stand characteristics. Three zones were used for analysis: the rain predominated zone from 0 to 1500 feet in elevation, the transient snow zone (TSZ) from 1500 to 3000 feet where snow deposits and melts often during the winter, and the snow predominated zone above 3000 feet, where snow is more prevalent throughout the winter. A recovery period of 20 years was used for stands in the rain zone, 30 years if the stand was hardwood dominated. The transient snow recovery period was assumed to be 30 years, 40 years if the stand was hardwood dominated, and 40 years was used for the snow zone, 50 years if hardwoods dominate the site. Alternative harvest treatments produce different hydrologic responses and therefore are analyzed differently in the calculation of ECAs. Roads are considered as clearcut acres, as are residential and agricultural areas. Impacts to SWB's with ECA values below 15 percent are considered low, while 15 to 20 percent is considered moderate, and above 20 percent high. Figure 20 shows the existing ECAs by SWB.

Sinker Creek Frontal had the highest ECA values and was the only SWB over 20 percent with Kiel, Elkhorn, Evans, and Canyon Creek SWB's close behind.

Hydrologic recovery is also shown in Map 17. The maximum erosion designations show those areas harvested in the past five years or other areas considered clearcut areas (as mentioned above). Transition areas are forests between five years of age and the period of hydrologic recovery. Hydrologic recovery areas are those forests which have reached or passed their recovery period.

<u>WAR</u>

TSZ are areas where snow normally accumulates and melts several times a winter, often melting rapidly. Openings in the forest canopy in these areas increase the amount of snow accumulating on the ground and provides more runoff when a rain on snow event occurs. The cumulative effect of increases in runoff can be large, causing flooding, stream channel, and bank damage.

The potential for rain on snow flow enhancement was estimated using the procedure outlined in *Standard Methodology for Conducting Watershed Analysis* (Washington Forest Practices Board 1992). The SWB was analyzed using a weighting system based on the dominant precipitation type (rain, transient snow, snow) and the percent of the area with canopy cover in three different categories (open, sparse, small or large dense). The equations given in the Washington publication were modified using data from northern Oregon Cascade climate stations. Using this method, the change in WAR from a rain on snow event was calculated. Return periods are the 24-hour precipitation amounts expected at a given level of frequency, for example, once in two years for the 2-year return period or once in 10 years for the 10-year return period. The plus (+) sign denotes a given return period precipitation event with the addition of a heavier snow pack on the ground than average and a warmer storm than average. This situation is often responsible for the severe flood events experienced in the Pacific Northwest. The units are in percent change of inches available for runoff from a fully forested condition. However, these values do not correlate directly with streamflow. It appears that hydrologic change becomes visible when the percent change over fully forested condition approaches seven percent. Cumulative impacts below seven percent are considered low, while 7 to 10 percent values are considered moderate, and above 10

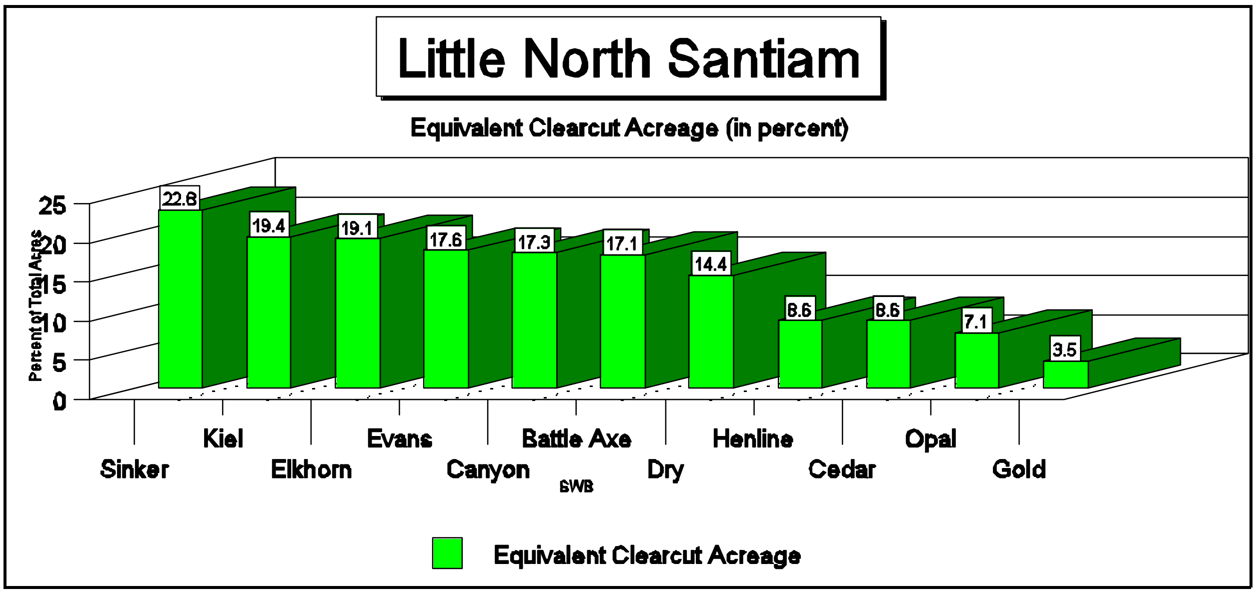

Figure 20. **Equivalent Clearcut Acreage (in percent).**

percent high. Figure 21 summarizes the percent increase in WAR under current conditions compared with the SWB in a fully forested condition. Changes in the more frequent storm events (2+, 10+) affect channel maintenance and dynamics, while changes in the less frequent events (25+, 50+, 100+) can have profound effects on stream floodplains and flood related damage.

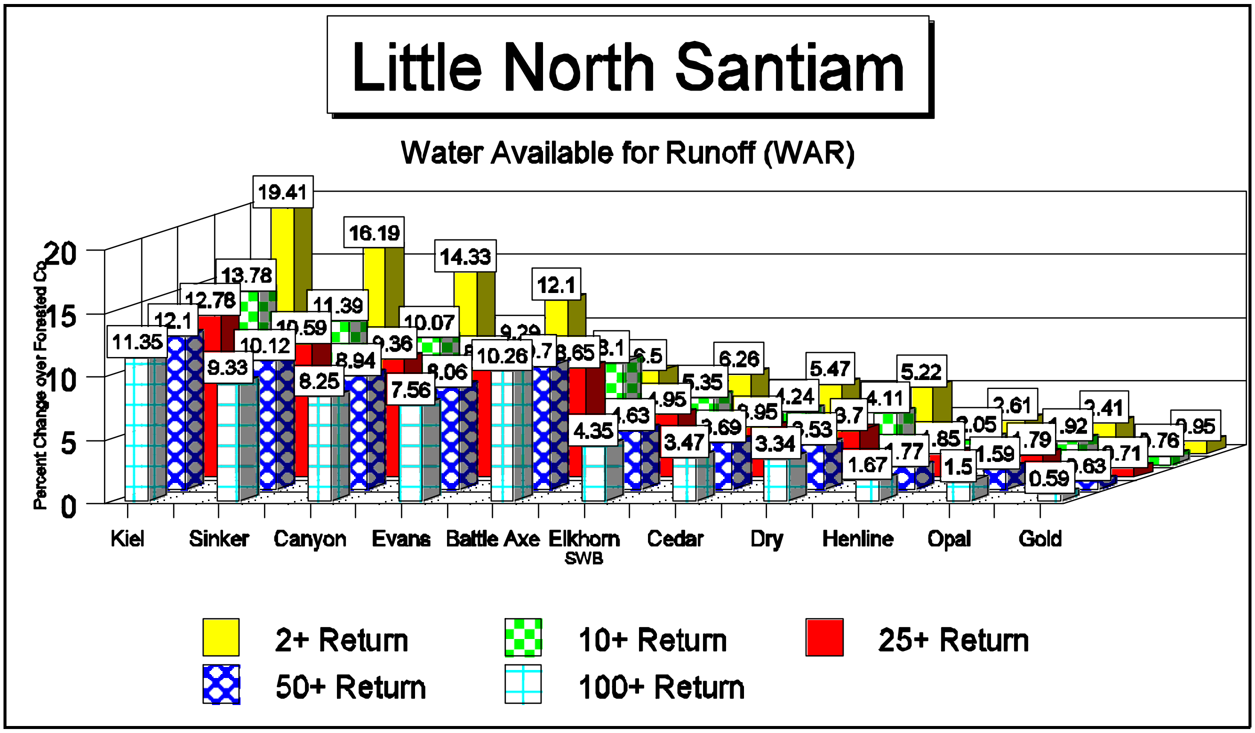

Figure 21. Water Available for Runoff.

The WAR results are similar to results of other analysis in this section showing Canyon, Kiel, Sinker, and Evans Creek SWB's as being the most heavily impacted by past management. All four SWB's had one or more categories in the high impact category, with a greater than 10 percent increase over fully forested conditions.

Fisheries

1. *What is the general condition of aquatic habitats in the watershed?*

Fish Habitat Condition

The mainstem LNS and many of its tributaries were surveyed in 1940 by U.S. Fish and Wildlife Service (USF&W) personnel and in 1949 and 1959 by the Oregon Fish Commission (Willis et al. 1960; McIntosh et al. 1994). Most of the information contained in the survey reports is in narrative form and appears to be focused on investigation of the potential for increasing the range of anadromous fish distribution.

The USFS conducted surveys on two streams in the LNS watershed. Cedar Creek was surveyed in 1992 and Opal Creek in 1993.

ODFW has conducted habitat inventories on several streams in the basin. Surveyed streams are shown in Table 24. Changes resulting from the flood of February 1996 have not yet been evaluated.

Generally, instream habitat conditions are fair to good in the mainstem LNS, and poor to fair in most of the surveyed tributaries based on benchmarks established by ODFW for the various habitat parameters included in the surveys (see Appendix E 4). Appendix E3 is a summary table of habitat conditions in the surveyed reaches listed in Table 24, below.

Table 24. Surveyed Streams in the LNS Watershed.

STREAM NAME	MILES SURVEYED	# OF REACHES	YEAR SURVEYED
BIG CREEK	2.2	1	1994
CANYON CREEK	1.9	2	1994
ELKHORN CREEK	7.1	5	1994
FAWN CREEK	2.0	4	1995
JEETER CREEK	1.5	1	1995
KIEL CREEK	2.8	3	1995
L. N. SANTIAM R.	22.2	5	1991
OPAL CREEK	4.7	8	1991

Pool Habitat

Pools are a critical habitat element for many fish species, anadromous salmonids in particular. Deep pools provide cover from predators for juvenile and adult fish, holding areas for adult spring chinook and summer steelhead in the mainstem rivers, rearing areas for juveniles, refuge from the velocities of high flows, and often provide cooler water during times of elevated water temperatures. Pools in higher order, constrained channels tend to be large and deep and are anchored geomorphically. Such pools may be relatively insensitive to effects of management activities, as their formation and maintenance are more determined by flow and geology (USDA-USFS 1994). Effects of management activities and high flow events are likely to be greatest in low gradient, unconfined reaches of tributaries where bedload deposition and aggradation can occur.

Most of the surveyed reaches of the mainstem LNS and Opal Creek rate "good" for pool frequency, percent pool area, and pool quality (avg. residual pool depth). Most of the surveyed reaches of other tributaries rate "poor" to "fair" for pool frequency and percent pool area. Fawn and Jeeter creeks rate "very poor" for percent pool area and pool quality, while Kiel Creek rates "very poor" for percent pool area and pool frequency.

Spawning Gravel Quantity and Quality

Instream gravels are highly mobile during high flow events. Where stable instream structure is lacking, gravels may be completely flushed out of the channel to floodplains and downstream areas. High flows can cause bank erosion and landslides that can be either detrimental or beneficial for spawning areas. Erosion and slides can negatively impact spawning gravels by depositing fine sediments in gravels but may also be beneficial by introducing new gravels into channels that are gravel limited. Effects of high flows in the spring and fall of 1996 on spawning gravels in the LNS watershed have not been evaluated.

Gravel Quantity: In the mainstem LNS and Opal Creek most of the surveyed reaches rate "fair to good" for gravel quantity (percent gravel substrate, estimated in riffles), while all of the surveyed reaches of Fawn Creek rate "good." Jeeter Creek and two reaches of Opal Creek rate "poor" for gravel quantity, while all of the surveyed reaches of other tributaries rate "fair."

Gravel Quality: All of the reaches of the mainstem LNS and Opal Creek rate "excellent" for gravel quality (percent fines, i.e, silt, sand, and organics present in surface layers of spawning gravels), as do the lower two reaches of Elkhorn Creek. Both reaches of Canyon Creek, the uppermost reach of Elkhorn Creek, and three reaches of Fawn Creek rate "poor" for gravel quality. The remaining surveyed reaches received ratings of "fair" gravel quality.

Off-Channel Habitat

Off-channel habitats include secondary channels and backwater areas. Both can be critical rearing areas for salmonid fry and also provide refuge for fish from the velocity of high flows. Secondary channels are most likely to develop in unconstrained and moderately constrained, low gradient reaches. Streams that have been channelized and/or subjected to large woody debris (LWD) removal and streams constrained by roads within the riparian zone often have less off-channel habitat than their gradient and level of confinement would allow in a natural state.

The lowest reaches of Elkhorn, Opal, and Canyon creeks, one reach of Fawn Creek and one reach of the mainstem LNS have secondary channel percentages (percent of total stream habitat) of 10 or greater, generally considered "good." Secondary channel habitat in Jeeter Creek and the upper reach of Canyon Creek is close to 10 percent. All of the other surveyed reaches contain considerably lower percentages of secondary channel habitat; however, as noted above, natural gradient and confinement factors can limit the ability of streams to form secondary channels.

In-Channel LWD

LWD in streams helps to dissipate stream energy, retain gravels, nutrients, and organic debris, aid in pool formation and maintenance, increase stream sinuosity, create diverse habitat for fish and other aquatic organisms, and slow the nutrient cycling process. Besides providing instream and overhead cover for aquatic organisms, LWD also provides a nutrient base and/or preferred substrate for many genera and species of aquatic invertebrates. High flow events transport much of the LWD downstream, particularly in mainstem channels. Mainstem channels typically contain lower levels of LWD than tributary channels. Due to the greater channel width and higher stream energy of mainstems, generally only the larger pieces are retained. LWD in tributary streams may be flushed downstream by high flows or debris torrents or it may remain if flows are not high enough to float the larger pieces. Landslides that occur during storms are a primary source of new instream LWD.

ODFW survey methods record the number of pieces of LWD (>15cm in diameter and >3m in length) per 100 meters of stream, as well as the number of "key pieces" of LWD (>50cm in diameter and >active channel width in length) per 100 meters of stream.

<u>LWD</u>: The mainstem LNS contains the lowest levels of LWD of all the surveyed streams in the basin; however, that is probably more a function of stream size than of stream health. Only the upper two reaches of Fawn Creek and the upper reach of Kiel Creek rate "good" for LWD levels. All of the other tributary reaches rate "poor" and "fair." Jeeter Creek and the two lowest reaches of Opal Creek rate "very poor" for LWD levels.

"<u>Key Pieces</u>": The upper two reaches of Fawn Creek, two reaches of Elkhorn Creek, and two reaches of Opal Creek rate "good" for "key pieces," while all of the other tributary reaches rate "poor" and "fair." Jeeter Creek, both reaches of Canyon Creek, and the lowest reaches of Fawn and Opal creeks rate "very poor" for "key pieces."

LWD Recruitment Potential

Recruitment of LWD into a particular stream reach occurs when instream wood is moved from an upstream reach or when stream adjacent trees fall into the channel. The ultimate source of instream LWD is the adjacent riparian forest . The potential for suitable LWD input is partially dependent on the size and health of trees in the riparian zone. Trees in young stands (less than 40 years of age) may be too small to affect stream processes. Trees in the 40- to 80-year age classes may have adequate size; however, these stands are vigorous, and little mortality is likely to occur for several decades. Map 18 shows the federal riparian vegetation age class. Coniferous trees are generally more beneficial to streams than deciduous trees due to much lower decay rates in the aquatic environment. Map 19 shows the vegetation type in stream buffers.

In the LNS watershed, about 33 percent of the riparian areas (within 30 meters of stream channels) have high potential for LWD recruitment to streams (dominant age-class >120 years), 15 percent have moderate potential (conifer dominated, 80-120 years), and 52 percent have low potential (conifers <40, hardwoods and non-forest). The high percentage of riparian acreage with low potential is mainly due to the large number of acres with young conifer stands. Riparian areas with young conifer stands are common in most of the sub-watersheds but are particularly prevalent in the Canyon Creek, Evans Creek, Kiel Creek, and Sinker Creek sub-watersheds (Table 25). The Opal Creek, Gold Creek, and Cedar Creek sub-watersheds have the highest potential for LWD recruitment.

Table 25. LWD Recruitment Potential Within 30m of Stream Channels, by SWB.

SWB	Low		Moderate		High		Total Acres
	Acres	Percent	Acres	Percent	Acres	Percent	
Battle Axe Cr.	462	35	507	38	359	27	1,328
Canyon Cr.	1,483	74	159	8	372	18	2,014
Cedar Cr.	375	39	129	13	457	48	961
Dry Cr.	389	31	466	37	405	32	1,259
Elkhorn Cr.	866	51	229	14	583	35	1,678
Evans Cr.	920	74	39	3	292	23	1,251
Gold Cr.	160	11	328	24	892	65	1,380
Henline Mtn.	120	20	264	43	224	37	608
Kiel Cr.	1,886	>99	55	<1	69	<1	2,010
Opal Cr.	271	16	142	9	1,227	75	1,640
Sinker Cr.	1,232	83	38	3	207	14	1,476

ODFW survey methods record estimates of the number of riparian conifers >20 inches diameter at breast height (dbh) and >35 inches dbh within 30 meters of each side of a stream. The riparian surveys are conducted as belt transects 5 meters wide at the start of each reach and repeated every 30 stream habitat units. The numbers recorded should be considered estimates, at best, due to the nature of the sampling. ODFW stream surveys conducted prior to 1994 did not include riparian surveys. For riparian conifers >20 inches dbh, most of the surveyed reaches rated "poor." Reach 3 of Elkhorn Creek and reach 3 of Fawn Creek rated "good," and reaches 4 and 5 of Fawn Creek rated "excellent." For riparian conifers >35 inches dbh, most of the surveyed reaches rated "poor." Reach 3 of Elkhorn Creek rated "fair," reaches 2 and 3 of Fawn Creek rated "good," and reach 4 of Fawn Creek rated "excellent."

Stream Gradient and Habitat Potential

The capability of a stream to support fish is influenced by many factors, one of which is gradient. In natural stream systems, low gradient (0-4%) reaches typically support more diverse fish communities and provide the majority of fish production. Low gradient reaches are areas where the channel widens, LWD accumulates, and water velocities are lowered. Floodplains, which dissipate the energy of high flows and provide critical calm water habitat for juvenile fish during floods, are often associated with unconfined, low gradient reaches. Low gradient reaches are sensitive to increases in sediment and temperature and decreases in LWD.

Low gradient reaches are rare in the LNS watershed, except in the mainstem where the lower four reaches have gradients of 1 percent or less. In the tributaries using the reaches defined by ODFW, only the lower reach of Elkhorn Creek and three reaches of Opal Creek have gradients of less than 4 percent, although several tributaries have short sub-reaches of low gradient channel. In the unsurveyed tributaries, Sinker, Little Sinker, and Fish creeks have gradients of less than 4 percent in the lower quarter mile.

Human Uses

What are the major human uses in the LNS watershed? Where do they generally occur in the watershed? What are the current conditions and trends of the relevant human uses in the watershed? What makes this watershed important to people?

Human use is the predominant disturbance factor in the LNS watershed today. It is therefore important to have some understanding of the types and extent of human uses in the watershed. Much of the influence human use has had on ecological processes in the watershed is discussed in the terrestrial and aquatic sections of this chapter. This last section will more fully describe past and present human uses in the watershed, the current social environment, and concerns associated with those uses.

General Socio-Economic Environment

Before discussing specific human uses in the LNS watershed, it is important to provide a general socio-economic context surrounding and including the watershed. The entire LNS watershed falls within Marion County.

The LNS watershed is located near the middle of Marion County. The 1996, Regional 3 Economic Profile, prepared by the Oregon Employment Department, was the major source of the socio-economic information used to address the socio-economic environment for the LNS watershed. Region 3 includes Marion, Polk, and Yamhill counties. Information from a recent demographic study on the North Santiam Canyon was also used.

The closest incorporated communities to the LNS watershed are Lyons, in Linn County, and Mill City. Some of the North Santiam Canyon communities like Mill City fall within Linn and Marion counties, though the zone of influence tends to be dominated by Marion County. Both communities have a population of under 2,000 people. There is a small unincorporated community named Elkhorn located in the LNS watershed along the LNSR. Both Stayton and Salem are larger communities in Marion County which are within a 15 to 45 minute commuting distance.

Population and Demographics

Migration into Marion County is the driving force in expected population increases, given the county’s proximity to the I-5 travel corridor, a high quality of life, and continued growth in construction and high tech manufacturing, The population of Marion County was 252,800 in 1994 and is expected to increase 11 percent to 280,438 by the year 2000. From the year 2000 to 2010, an increase of 14 percent is expected for a total population of 319,729. While most of the increases in population would be expected to occur near the more urban areas of Salem, some additional residential pressure will still be felt in nearby rural areas.

The median population age for Marion County is increasing as the "baby boomers" of the 1950s and 1960s become older. The U.S. Census figures rank Oregon's population as fourth nationally; the oldest median age of 35.8 years and 39.6 years for Marion County. In Region 3, numbers from the 1980 and the 1990 show that the "age 65+" group has grown more than twice as fast as any age group in total population.

Census data also indicate that ethnic diversity is increasing in Marion County. Between the 1980 and 1990 survey, those identifying themselves in a non-white category increased 71 percent, for an overall total of 5 percent for the county. The largest growth occurred in the Asian/Pacific Islanders and the Hispanic categories. Increases are partially related to shifts in self-identification from white to the non-white category.

Economy

Marion County's economy and employment have historically been tied to state government, agricultural, and lumber/wood industries. Marion County's overall industry is relatively strong with growth in the manufacturing of mobile homes and in high tech industries. Food processing and agricultural industries also continue to be strong. However, most of the increase in manufacturing activity has centered around the larger population centers in Marion County.

The timber industry in Marion County has experienced significant changes in the last several years which has resulted in employment decreases. Part of this is due to a reduction in the timber supply on federal forests. In addition, between 1979 and 1987, the mechanization of mills and other increases in efficiency resulted in a 40 percent reduction in the number of workers required for a given level of production. The loss of these timber-related jobs has resulted in either the relocation of timber workers or a shift to a different type of job, often requiring commuting outside the North Santiam Canyon. Today, the economies of the smaller rural communities around the LNS watershed are still tied closely to the timber industry, with 8 of the 10 leading employers in the North Santiam Canyon being timber-related.

While the lumber/wood fiber industry will continue to play an important economic role in the North Santiam Canyon, communities are working to diversify their economies. Participants from the 13 communities in the North Santiam Canyon formed the North Santiam Canyon Economic Corporation to help develop and implement an overall strategic plan for their future. Some of the common objectives include increasing the number of family wage jobs (both through existing business expansion and new business development), improving infrastructure, improving education and workforce job skills, maintaining and improving quality of life, and improving human resource services.

One of the major challenges that many of the canyon communities face is the on-site infrastructure needs (i.e., water and sewer) of many new businesses. With state and federal low interest loans, grants, and technical assistance, some of the communities have been working to upgrade their infrastructure and inventory lands with development potential. Business opportunities being discussed in the canyon include retrofitting old timber mills for other manufacturing activities, increasing tourism/retail businesses, value-added wood manufacturing, cottage industries, telecommuting, and locally based special forest product co-ops**.**

The NSR is one of the major water sources for the City of Salem. Salem has concerns about the potential impacts of land uses and additional development in the NSR drainage and its major tributaries, including the LNSR. This has been and will continue to be a major issue that the canyon communities, major watershed landowners, and the City of Salem will need to address together.

Today, the LNS watershed's major potential for contributing to Marion County's socio-economic health is tied most closely to providing wood products, meeting water supply needs, and providing outdoor recreation and eco-tourism opportunities. The extent to which the watershed provides for each of these resources is discussed in more detail in the following sections of this analysis.

Forest Products

Federally Managed Lands

Approximately 68 percent of the lands in the LNS watershed is managed by federal agencies. The BLM manages approximately 18 percent (13,222 acres) in the western half of the LNS watershed. The USFS manages the other 50 percent (36,144 acres) in the eastern half of the watershed.

BLM-administered Lands: Timber management activities on BLM-administered lands is tied to the LAU specified in the Salem District RMP. Approximately 5,600 acres of BLM-administered lands located outside of RR fall within a GFMA or CONN LUA. Under the guidance of the RMP, regeneration and thinning harvest is expected in both the GFMA and CONN LUAs over the next decade. Timber management activities on federal lands would meet or exceed the requirements of the Oregon State Forest Practices Act (FPA).

Land Use Allocation	Outside Riparian Reserves		Inside Riparian Reserves	Total
	Percent	**Acres**	**Acres**	**Acres**
Matrix/GFMA	50%	3,556	3,124	6,680
Connectivity	36%	2,562	2,154	4,716
LSR	1%	30	44	74
Elkhorn Creek WSR	7%	473	564	1,037
District Directed Reserves	6%	418	297	715
Total	**100%**	**7,039**	**6,183**	**13,122**

Note: Elkhorn WSR Corridor Acres are estimated based on interim boundaries.

Table 26: Land Use Allocations for BLM Lands in the LNS Watershed.

USFS-administered Lands: The USFS manages 50 percent (36,144 acres) of the lands in the LNS watershed as part of the Detroit Ranger District, Willamette NF. The majority of these lands are located in the eastern half of the watershed. A majority of the lands (25,800 acres) managed by the USFS will become the OCW and the Opal Creek SRA once the conditions of the Opal Creek legislation are met. The remaining lands fall under a LSR or within the Elkhorn National WSR corridor. Timber management activities on lands managed by the USFS in the LNS watershed would be prohibited or very limited, depending on the management objectives for each individual area.

Special Forest Products

Interest in the harvesting of Special Forest Projects (SFPs) is growing in the North Santiam Canyon. The North Santiam Economic Development Corporation (NSEDC) worked with Musselman and Assoc., Inc., a consultant firm, to develop an efficient methodology for determining the volume of a given SFP present in a given area and its market value. NSEDC hopes to have the model field tested on some of the lands in the North Santiam Canyon. This might help land managers more accurately determine the amount and value of SFPs in a given area. NSEDC would also like to develop a marketing strategy that would encourage and assist individuals interested in collecting and selling SFPs from the North Santiam Canyon.

BLM-administered Lands: The collection of SFPs for both personal and commercial use is allowed on most BLM-administered lands in the LNS watershed in compliance with the Salem District RMP. Currently there is no formal inventory data on the type and amount of SFPs on BLM-administered lands the LNS watershed. When possible, information about SFPs are gathered during stand exams. Permits for the collection of SFPs are issued in response to requests. Based on past permits issued, some of the SFPs collected on BLM-administered lands in the LNS watershed include mosses, mushrooms, transplants, burls, edible plants and floral and greenery, and non-sawtimber wood products like firewood. The collection of moss is the most popular commercial SFP. Authorized and unauthorized collection of similar SFPs most likely occurs on private forest lands as well.

USFS-administered Lands: On lands managed by the USFS, the collection of SFPs is not allowed in Bull of the Woods Wilderness or the proposed OCW. Outside of those areas, the most common SFPs collected are fir boughs or bear grass.

Industrial Timber Lands

Industrial forestry is the predominant private land use in the western half of the LNS watershed. Approximately 23 percent (16,613 acres) of the lands in the watershed are managed by private timber companies or individuals for the primary purpose of providing commercial timber products.

Most private industrial forest companies seek to meet the economic objectives of their firm, while managing their lands on a sustained yield basis. However, changes in economic factors and differences in individual company policy can significantly affect harvesting levels and practices in the short and long term. For this reason, general assumptions about the management of private industrial forest lands in the LNS watershed must be made. These assumptions are based on observed past and present management practices. For the purposes of this analysis, it is assumed that unless otherwise stated, private industrial forest lands in the LNS watershed will continue to be managed for commercial timber products on a sustained yield basis, with an average rotation age of 50 to 60 years.

Management practices among individual private woodlot owners also vary. For this reason and because there is such a small percentage of small woodlot owners in the watershed, it is assumed that these lands would be managed in a similar manner as that of private industrial forest lands. Private industrial and small woodlot owners are required to meet standards and guidelines provided in the Oregon FPA. These assumptions would be subject to any new information gathered at a future time.

State of Oregon Administered Lands

The Oregon Department of Forestry (ODF) manages approximately 3 percent (1,857 acres) of the land in the LNS watershed. Located in the western half of the watershed, the lands ODF manages are in fairly small parcels (less than 320 acres) and are intermixed with BLM and private lands (see Ownership Map). These lands are managed to provide a continued source of revenue to counties and the state general fund on a sustained yield basis. They also provide for other public uses when appropriate. For the purposes of this analysis, it is assumed that state lands would be managed in a similar manner as private industrial forest lands with an average rotation age of 50 to 60 years. Management of state lands is also required to comply with the Oregon State FPA.

Major Concerns

With the increasing regulation and restriction of forest management activities on both private and public forest lands, private industrial forest landowners are concerned about being able to manage their lands according to the company's objectives, This is a general concern that applies to many areas, not just the LNS watershed. Because of the mixed ownership pattern in the western half of the LNS watershed, access rights across BLM lands and other lands are also a concern. Other general concerns are associated with public use problems such as illegal dumping, equipment damage, vandalism, fire danger, long-term occupancy, and the unauthorized removal of forest products. Because of these problems, access to private lands along LNSR has been or is in the process of being gated off. Many of these same access and public use concerns are applicable to the other land owners in the watershed.

There are also individuals and organizations concerned about the impacts of timber harvest on overall forest and ecosystem health. The NFP attempted to address many of these concerns for both BLM and USFS lands. Based on the comments received in the questionnaire that was sent out at the beginning of the LNS watershed analysis, water quality is of particular concern since many residents of Stayton and Salem utilize water from the NSR of which the LNSR is a major tributary.

Mineral Uses

Mining activity on public lands in the LNS watershed is associated with recreational mining (primarily the LNSR and Cedar Creek) and rock quarries for road building. Currently there are no large commercial mining operations in the LNS watershed.

In the eastern half of the LNS watershed, a continuous strip of placer mining claims are located along or adjacent to the LNSR from the Willamette NF boundary to the terminus of Cedar Creek located near Shady Cove Campground. Many of these placer claims are located near popular dispersed recreation sites. Placer claims also extend along Cedar Creek upstream from Shady Cove Campground to just beyond the Bornite Project site. Activities on these claims include gold panning, sluicing, and dredging. Two of the claims, one at Three Pools Day Use area and the other at Shady Cove Campground, are owned by the Willamette Valley Miners Association and are open to the public for gold panning and prospecting.

As directed by the Act, subject to valid existing rights, all lands within the proposed wilderness and scenic recreation area are withdrawn from (1) any form of entry, appropriation, or disposal under the public land laws; (2) location, entry, and patent under the mining laws; and (3) disposition under the mineral and geothermal leasing laws. During the interim, the area has been segregated from mineral entry, essentially closing the area to the staking of any new mining claims; however, ownership of existing valid claims may be transferred to another individual. Any existing claim that falls invalid becomes segregated from the mining laws and cannot be reclaimed. Recreational prospecting will still be allowed. Guidelines for that use will be developed as part of the Opal Creek SRA Management Plan.

Bornite Project

The Bornite Project, a proposed underground copper mine, is located approximately three miles southeast of Shady Cove Campground along Cedar Creek. This project was proposed to the USFS in 1991 by Plexus Corporation (now known as Kinross Copper Corporation) and approved in the Decision Notice for the Environmental Impact Statement in April 1993. Since that time, Kinross has attempted to obtain the necessary permits needed to operate the mine as described in the EIS completed for the project. In the fall of 1993, it was discovered that a ruling by the ODEQ disallowed any discharge of waste water from commercial sites into streams within the North Santiam drainage. As a result of this finding, the Three-Basin Rule was established to better define the ruling. In 1994, Kinross began lobbying for a rule change to allow the mine to operate with modifications to the waste water discharge systems. No rule changes were made and subsequently in the fall of 1996, Kinross Copper Corporation filed a lawsuit against the state of Oregon in the Multnomah County Circuit Court, contending that the state violated its constitution by essentially condemning the company’s property without just compensation by not allowing the development of the mine. Kinross Copper Corporation’s motion was denied, and as of December of 1997 the case is now before the Oregon Court of Appeals.

Amalgamated Mill Site Clean-up Project

The Amalgamated Mining Company built the Amalgamated Mill in the 1930s and reportedly operated the site into the 1940s. The mill was primarily used to process metal sulfides and some silver and gold. The building which housed the processing activities was partially crushed by snow in 1949 and subsequently destroyed by fire. During production, mined rock transported to the site was crushed, and the desired minerals were extracted with a froth flotation process. The finely ground waste materials (tailings) were discarded downhill from the mill into a tailings pile situated on an unlined, uncovered rock bench carved out of the underlying rock by blasting. Log cribbing (wooden retaining wall) prevented the tailings from migrating toward Battle Axe Creek. The primary hazards associated with these tailings were the presence of high concentrations of heavy metals including lead, cadmium, copper, and zinc.

By 1991, the log cribbing had deteriorated and was allowing the tailings to slough towards and into Battle Axe Creek, a major tributary to the LNSR, and a water source for the City of Salem. In the fall of 1991, Hart Crowser, under a USFS contract, conducted a time-critical removal action to move the tailings away from the banks of the creek. The tailings pile was then covered with plastic and secured until a more permanent remedy could be completed. Between 1992 and 1995, the USFS and Persis Corporation (the identified Potentially Responsible Party and parent company to Shining Rock Mining Company) began negotiating for possible solutions to handle the material. In April 1996, Persis entered into ODEQs Voluntary Cleanup Program to facilitate the timely remediation of the tailings at the Amalgamated Mill site. ODEQ and the USFS, working with Persis, evaluated a number of potential remedial alternatives ranging from on-site disposal in an encapsulated fill, to removal off-site at an approved landfill facility. An extended public comment period was held from June 20 until September 20 in 1996. Subsequent to the closing of the comment period, the U.S. Congress, through the federal appropriations process, provided $750,000 for the off-site removal of the waste materials. Final alternative selection was made based on the combination of federal and private funding to haul the material off-site.

On March 19, 1997, the USFS signed the Record of Decision for the Amalgamated Mill Site Cleanup project, and hauling the tailings to an eastern Oregon landfill was selected as the appropriate action. Project work began in early May of 1997, and final cleanup and reclamation of the site was completed in July of 1997. Initial estimates calculated tailings and waste materials at approximately 5,500 cubic yards; however, the final quantity exceeded 7,000 cubic yards. The area received seeding and regeneration planting in October of 1997.

Jawbone Flats/Patented Claims Listed in Opal Creek Legislation

As identified in the Act, there are several patented mining claims and mill sites listed that are owned by Friends of Opal Creek (Friends), a non-profit organization created for the preservation and education of old-growth forests and ecosystems. These claims, patented in 1991 and originally owned by the Shiny Rock Mining Company, were donated to the Friends in December 1993. The Act identifies the following claims: Ruth #2, Morning Star, and Santiam #1, be donated the United States not later than 2 years after the date of enactment (September 30, 1996). This also included the patented mining claims known as the Times Mirror Claims (Eureka #6, #7, #8, and #13). For the remaining claims (Ruth #1, Princess, Black Prince, and King #4), a binding agreement must be executed between the Secretary of Agriculture and Friends, specifying the terms and conditions for the disposition of these claims. Finally, an access easement across the three mill sites (Hewitt, Poor Boy, and Starvation) (a.k.a. Jawbone Flats) must also be established within this 2-year time frame.

Major Concerns: Respondents to the watershed scoping questionnaire frequently expressed concerns about the potential impacts of the Bornite project and any future commercial mining activities to water quality, recreation, and visual resources. There is also a limited amount of concern about the impacts of recreational mining.

Recreational miners and valid claim holders are concerned about maintaining their mining rights. Currently, conflicts between recreational mining and other recreational use is limited; however, claim holders are concerned with the growing problems associated recreation use (littering, sanitation, etc.) on or adjacent to their claims.

Transportation and Travel

Roads play an important role in the level and pattern of human use in a watershed. North Fork County Road and Gates Hill Road provide the main access into the watershed. Most of the secondary roads leading from these two main roads are associated with timber management activities and are rock surfaced.

Gates on private lands limit vehicle access to public lands in the western half of the watershed either seasonally or year round (see Map 23). The BLM has also gated off areas where long-term occupancy, fire hazards, illegal dumping, and unsafe shooting have been a problem. This trend is likely to continue, if negative impacts associated with public use are not reduced.

Much of the eastern half of the watershed is roadless. The Opal Creek Legislation requires that a transportation plan be completed for the area. While existing primary roads (2207 and 2209) some secondary roads (201 and 225) in this portion of the watershed will continue to be maintained, there may be some modifications to vehicle travel as a result of the transportation plan.

Major Concerns: Balancing resource protection with providing vehicle access to public lands will continue to be a challenge in the LNS watershed. This is especially true where public lands are intermixed with private lands.

Water Uses

Water uses and concerns within and downstream from the LNS watershed are described in the aquatic section of this chapter.

Residential and Agricultural Uses

Most of the residential dwellings in the LNS watershed are located along or near the LNSR below the Willamette NF boundary and are a mix of year-round and vacation homes. Commercial farming and livestock raising are limited in this watershed.

Past and recent timber harvest activities on private, state, and BLM-administered lands are observable in the western half of the watershed. Forest management activities on BLM-administered lands located adjacent to or near private non-forest uses, especially residential dwellings, can create potential concerns for the BLM and the residential property owners. In an effort to address these concerns early in the project planning process, areas with a potential for high sensitivity were identified in the RMP as Rural Interface Areas (RIAs). RIAs include areas where there are residential dwellings or zoning within ½ mile of BLM-administered lands.

The three primary county private land zoning classifications in the LNS watershed are forest conservation use, rural residential use, and park use. Forest conservation use is the predominate zoning (see county zoning map) and restricts lot division to no less than 80 acres; however, variances can be obtained. Most of the lands zoned for rural residential use are located in the lower portion of the LNS watershed near the LNSR. The park use zoning is for the Elkhorn Valley Golf Course.

The LNS watershed has 1,727 acres of BLM-administered lands located within a RIA ½-mile buffer (see Rural Interface map). The expected intensity of forest management activities within a RIA is guided by the underlying LUA. The potential intensity of forest management activities on lands with a LUA of GFMA would be higher than those with a CONN LUA. Significant timber harvest activities in RR are generally low. Since RR are intermixed with both the GFMA and CONN, they may help buffer some of the potential impacts of a project, depending on the specific proposal and site characteristics.

Most of the RIAs in the LNS watershed have the potential for high sensitivity depending on the project type, size, and location. Consideration of RIA issues early in the project planning process is very important in this watershed.

Major Concerns: The concerns of residential owners in the LNS watershed that are adjacent to or near public lands are focused in the protection of their quality of life related to water quality, visual resources, and disturbance (noise, dust, log truck traffic, smoke, etc.) associated with timber harvest activities. They are also concerned about the ongoing negative impacts associated with high levels of recreation use such as litter, dumping, vandalism, and theft.

Visual Resources

Though not a direct human use, the view in or from a particular area is an important resource to both those living in or visiting an area. The LNS watershed is an area with high scenic values. The watershed is dominated by a forested setting with a mix of seral stages, interspersed with water and geologic features. The west half of the LNS watershed has been modified to a greater extent by human use, associated with residential activities, timber management activities, power line corridors, and recreational activities. While one or more of these modifications are evident from a specific location in the western half of the watershed, they tend to blend in with the form and texture of the natural landscape. The eastern half of the watershed has had fewer human caused modifications and is much more natural appearing.

BLM-administered Lands: Given that BLM-administered lands are intermixed with private forest lands, the BLM has only a limited amount of control over the viewshed as a whole. Regardless of visual resource management (VRM) on BLM-administered lands, timber management activities will be observable on private forest lands. A VRM classification system was used to inventory all BLM-administered lands in the Salem District RMP. Within the VRM system, there are four classes, with scenic values on Class I lands being the most outstanding and protected, and scenic values Class IV lands being lower and in areas generally less seen with less modification restrictions. The RMP provides guidance for each VRM classification. Below is a summary of the VRM classes on BLM-administered lands in the LNS watershed (also see Map 20, Visual Resource Class with ½ mile Rural Interface Zone).

Class I	Class II	Class III	Class IV
11 acres	1,846 acres	8,727 acres	2,550 acres

Table 27. VRM Classifications in the LNS Watershed.

<u>Class I Lands</u>

"Provide for natural ecological changes in VRM Class I areas. Some very limited management activities may occur in these areas. The level of change to the characteristic landscape should

be very low and will not attract attention. Changes should repeat the basic elements of form, line, color, texture, and scale found in the predominant natural features of the characteristic landscape."

Class I lands in the LNS watershed are made up of several isolated waterfalls (see VRM Classification Map) and make up less than 1 percent of BLM-administered lands. There is no developed access to the waterfalls. All of the falls are located within a RR, which should provide an adequate buffer from any adjacent projects. Each will have to be evaluated on an individual basis should a nearby project be proposed.

<u>Class II Lands</u>

" Manage VRM Class II lands for low levels of change to the characteristic landscape. Management activities may be seen but should not attract the attention of the casual observer. Changes should repeat the basic elements of form, line, color, texture, and scale found in the predominant natural features of the characteristic landscape. "

Approximately 14 percent of BLM-administered lands in the LNS watershed are classified as Class II. Most of the Class II lands are those that are observable from the LNSR, Little North Fork Road, Elkhorn Creek, or developed public or private recreation facilities.

A general field review of the watershed indicates that the sensitivity level of the Class II lands would be fairly high depending on the individual characteristics of a proposed project. Design features such as green tree retention or buffers are very important for projects on Class II lands. The impacts on visual resources associated with any proposed project on Class II lands will need to be evaluated for each project.

Many of lands classified as Class II are observable from residences and may be located within RIAs as well. Below is a list of lands which fall into both a Class II and RIA zone. These lands should be given special consideration for any project planning.

Class II Lands in RIAs

1. Township 9 South, Range 2 East, Sections 9 and 11
2. Township 9 South, Range 3 East, Sections 1, 7, 8, 9, and 10
3. Township 8 South, Range 4 East, Section 31

<u>Class III Lands</u>

" Manage VRM Class III lands for moderate levels of change to the characteristic landscape. Management activities may attract attention but should not dominate the view of the casual observer. Changes should repeat the basic elements of form, line, color, texture, and scale found in the predominant natural features of the characteristic landscape."

The majority (68 percent) of the BLM-administered lands in the LNS watershed are classified as VRM Class III. A brief field review of some of the Class III lands was conducted and indicates that the overall sensitivity of Class III lands in the LNS watershed varies depending on several factors. Most of the critical viewpoints in this watershed are similar to those associated with the Class II lands but are generally not as observable. Many of the Class III lands are also intermixed with private industrial forest lands where timber management activities may be readily observable. A proposed project's impacts to visual resources on Class III lands will also vary depending on the specific project design features and a number of mitigating factors such as the presence and location of RR, roadside vegetation buffers, and vegetation buffers around residences. Again, impacts to visual resources on Class III lands should be evaluated at the project level.

Class IV Lands

"Manage VRM Class IV lands for moderate levels of change to the characteristic landscape. Management activities may dominate the view and be the major focus of viewer attention. However, every attempt should be made to minimize the effect of these activities through careful location, minimal disturbance, and repeating the basic elements of form, line, color, and texture."

Approximately 18 percent of the BLM-administered lands in the LNS watershed are classified as Class IV lands. Class IV lands generally have a low visual sensitivity and fall into the "seldom seen" category in the Salem District VRM inventory. In this watershed, Class IV lands are not observable from any critical viewpoints and are often adjacent to private industrial forest lands in which forest management activities are clearly evident. Access to some of these public lands is limited due to gated or closed roads. While sensitivity on Class IV lands is low, the impacts of any proposed projects to visual resources should still be evaluated.

USFS-administered Lands imber harvest and other human uses are much less visually evident in the eastern half of the LNS watershed. Less than 2,000 acres of the 36,000 acres of land managed by the USFS have been harvested since 1953. Most of the harvesting activities occurred in the Cedar Creek, Dry Creek Frontal, and portions of the Elkhorn Creek SWB's. Most of the other stand level disturbance visually evident in the eastern half of the watershed is attributed to fire.

When the Opal Creek legislation becomes final, only those activities which enhance the management objectives or are necessary for visitor safety will be allowed. In the interim, the viewshed in the eastern half of the watershed will be managed consistent with the guidance the Opal Creek legislation provides related to visual resources.

Recreational Uses

The LNS watershed offers a wide spectrum of scenic settings in the forested foothills of the Cascade Mountain Range for variety of developed and dispersed recreation opportunities. The LNS watershed's proximity to the population centers of Salem and Portland make it an important recreation resource in the Willamette Valley. The Opal Creek drainage is also regionally and nationally known for the educational and scientific opportunities it offers.

The mix of public and private lands and recreation facilities in the watershed makes the coordination of visitor management and providing visitor services information complex and challenging. Other than standard county road signs and recreation site entrance signs there is little visitor orientation information about the recreation facilities and opportunities available in the watershed. This is especially true during the summer weekend peak use periods when the ODF office is closed.

To more clearly describe the recreational experience the LNS watershed offers, the Recreation Opportunity Spectrum (ROS) planning system was used to inventory the recreation resources on private and public lands in the watershed. In classifying recreation opportunities, ROS considers access, remoteness, naturalness, facilities and site maintenance, social encounters, visitor impacts, and visitor management. There are seven major categories which progress from the most primitive to the most developed. These consist of primitive, semi-primitive non-motorized, semi-primitive motorized, RN, roaded modified, rural, and urban (see Appendix F2). The LNS watershed offers several of the settings including primitive, semi-primitive non-motorized, RN, roaded modified and rural.

Because the eastern half of the LNS watershed is almost contiguous USFS-administered lands, it was described separately from the western half of the watershed.

Western Half of the LNS Watershed

The lower 18-mile segment of the LNSR extends from the Willamette NF boundary to its confluence with the NSR just south of State Highway 22. The LNSR is the focal point for recreation in the western half of the watershed, offering a variety of developed and dispersed recreation opportunities.

National WSR Status

The 18-mile segment described above was found to be eligible for inclusion into the National WSR System in the BLM's Salem District RMP. The segment was given a potential "recreational" classification, and the Outstandingly Remarkable Values (ORVs) identified were scenic, recreation, and fisheries. Because the BLM administers 18 percent of the lands in the interim 1/4-mile river corridor, a suitability assessment or study was not completed in the Salem District RMP. Until a suitability assessment or study is completed, the BLM will continue to protect the ORVs and free-flowing values on BLM-administered lands within the interim boundary to the extent authorized by law.

Rural Recreation Setting and Activities

Most of the lands along the lower segment of the LNSR fall under the rural ROS setting. Rural settings are often characterized by an environment that is culturally modified to the point that it is a dominant feature with moderate social interaction expected. The primary cultural modifications along the LNSR are associated with residential dwellings, timber harvest activities, utility corridors, and public facilities (county roads, forest roads, developed recreation sites, and fire stations). Though the cultural modifications are very evident, they tend to blend with the natural landscape, offering a modified but diverse scenic rural setting for those living in and visiting the LNS watershed. The majority of the lands along the LNSR are privately owned, limiting public river access to BLM and county-administered lands and facilities.

The primary recreation activities along the lower segment of the LNSR are water based including swimming, fishing, tubing, sunbathing, and a limited amount of non-motorized boating. Picnicking, camping, hiking, photography, scenic driving, and recreational placer mining are also popular activities. Golfing and more developed athletic activities are also available at private facilities.

The Marion County Sheriff's Department has been helpful in providing law enforcement support through a cadet program. Under the cadet program, officers-in-training patrol the high visitor use areas in full uniform and patrol vehicles. This program has helped provide increased presence in the watershed. The continuation of this program is dependant on the annual availability of funding.

Developed Recreation Facilities

All of the developed recreation facilities described below are located along the LNSR and are directly accessed from North Fork County Road (Map 22). These facilities are very popular and heavily used during the peak use season from Memorial through Labor Day weekend.

Traditional funding for recreation facilities maintenance is declining at the federal, state, and local levels. This will make looking for partnership opportunities and alternative funding sources very important in the future.

Marion County Parks: As of July 1, 1997, the Marion County Public Works Department began managing the three county parks in the LNS watershed. The parks were previously managed by the Regional Park and Recreation Agency, a partnership between the City of Salem, Marion County, and Polk County. The Public Works Department hopes to develop a management strategy for these and several other county parks in the near future. No use fees are charged at any of the sites.

All three sites are open April through October and feature popular swimming and picnicking areas. North Fork and Bear Creek Park provide paved parking, vault restrooms, picnic sites, and river access trails. Salmon Falls is a little more primitive providing gravel parking, river access, and vault restrooms. Salmon Falls also has a fish ladder structure at the falls. Although access to the ladders is blocked and prohibited, problems with individuals swimming through the ladder's chambers has been a management concern for several years.

BLM Recreation Sites

Canyon Creek and Elkhorn Valley Recreation Sites are managed by the BLM, Salem District, and are open mid-May through mid-September. Both sites have vault restrooms, potable water, river access, picnic sites, and paved parking. A volunteer campground host aids park staff in the operation of both recreation sites.

Elkhorn Valley Recreation Site has 22 family camp units and is the only developed overnight facility in the western half of the LNS watershed. Elkhorn also has a 2-mile trail system, some of which has river frontage. Planned improvements include installing a chlorinated water system with spigots at key locations in the park and providing electricity for lighting to the restrooms and to the host site by the spring of 1998. There is room for facility expansion in the park at Area C, a previously developed area that was decommissioned several years ago. Several years ago another location was seriously damaged, and there was not sufficient funds to repair the site. The structures in Area C were transferred to the damaged site so it could remain. The site could be rebuilt as individual units or as a group-use area. There may also be potential for future development on BLM-administered lands on the other side of the LNSR. Additional expansion of the site would also be possible if adjacent private landowners ever express an interest in an exchange or acquisition.

Dispersed Use

Dispersed recreation opportunities along the LNSR are fairly limited in the western half of the watershed. Marion County has several long pullouts buffered with an island of vegetation along North Fork County Road; these are used by the public as parking and river access to the LNSR. There are no restroom, water, or trash services in the pullouts. Overnight use is prohibited, although a limited amount does occur. Marion County has closed some of the pullouts and is evaluating the long-term status of the remaining ones.

Roaded Modified Recreation Setting and Activities

Most of the remaining lands in the western half of the LNS watershed (excluding Elkhorn Creek National WSR) fall under the roaded modified setting. Roaded modified settings are often characterized by a forest or other natural environment, with obvious modifications such as logging, mining activities, road access, and some facility development. Moderate social interaction is expected.

The natural setting on private and public lands has been significantly modified in many areas by timber harvest activities and high road densities. Public access to parts of the watershed are limited by private and BLM gates (see Map 23). Road gating has occurred as a result of repeated problems with garbage dumping, unsafe firearm use, vandalism, equipment damage, vehicle abandonment, long-term occupancy, and unsafe fire use. There are small pockets of RN (less than 500 acres); however, they are not large enough to warrant a distinction from the dominant Roaded Modified setting.

There are no developed facilities in the roaded modified setting in the LNS watershed. Use of the roaded modified lands is moderate. Dispersed campsites can be found at many of the old timber harvest landings and at the end of short spur roads in areas that are open to vehicular access. Buck Lake, a small lake located on BLM-administered lands in the southeast portion of the watershed, also receives dispersed camping and day-use. Problems with litter and vehicle abandonment have made it necessary to block vehicle access to the lake, but walk-in access is welcome.

In addition to some of the recreational activities described for lands in the rural setting above, lands in the roaded modified setting also receive uses such as hunting, target shooting, horseback riding, and off-highway vehicle (OHV) use. No quantifiable visitor information is available, but observation indicates that use is moderate in areas that are accessible by vehicle. Under the Salem District RMP, OHV use on lands in the western half of the watershed would be limited to existing roads and designated trails. Though there are historically used trails, there are currently no designated trails, so OHV use off existing roads is not allowed.

Eastern Half of the LNS Watershed

The eastern half of the LNS watershed is predominately managed by the USFS, Detroit Ranger District. Protecting and preserving the Opal Creek and Battle Axe drainage has been the subject of significant public and political interest since the 1970s. The Opal Creek drainage has been advertised by the media as having some of the oldest forests in Oregon; however, much of the drainage is mature forest rather than old growth. The Cedar Creek drainage has also been the site of recent controversy with the proposed but currently delayed Bornite Copper Mine (see mining section page 55). The eastern half of the watershed also provides a scenic and predominately natural and unmodified setting for a variety of recreational opportunities.

Opal Creek Wilderness and Opal Creek Scenic Recreation Area Act of 1996

As described by the Opal Creek Legislation, the proposed OCW contains approximately 12,800 acres. Some of those lands (6,378 acres) are currently part of Bull of the Woods Wilderness and would be incorporated on the OCW when the conditions of the legislation are met. The proposed Opal Creek SRA contains approximately 13,000 acres which encompasses much of the remaining USFS lands in the LNS watershed including the upper segment of the LNSR, Elkhorn Creek, and the Little Cedar Creek drainages (see LUA Map). Until the conditions of the legislation are met, the USFS interim policy is to manage the lands identified in a manner consistent with the guidance specified in the Act.

Oregon State Scenic Waterway and National WSR Status

In 1985, a 7-mile segment of the LNSR extending from the confluence of Opal Creek and Battle Axe Creek to the Willamette NF boundary was designated an Oregon State Scenic Waterway. The primary objectives of this program are to "Protect the free-flowing character of designated rivers; protect and enhance scenic, aesthetic, natural, recreation, and scientific and fish and wildlife quality along scenic waterways; and to protect private property rights." A management plan or specific management recommendations have not been developed by the state for the LNSR. However, they would like to participate in any future planning efforts related to the river.

The same river segment was found to be eligible for inclusion into the National WSRs System by a resource assessment completed by the USFS. The ORVs identified were scenic, recreation, historic, and fisheries. The potential classifications for the segment were "Scenic" from the headwaters to Gold Creek; "Wild" from Gold Creek to Shady Cove Campground; and "Recreational" from Shady Cove Campground to the Willamette NF boundary. A USFS resource assessment also found a 4-mile segment of Opal Creek, flowing from the headwaters at Opal Lake to the confluence of Battle Axe Creek and the LNSR, to be eligible with a potential classification of "Wild." The ORVs identified were scenic and water quality. A suitability study has not been completed for either river segment.

Trail Fee Demonstration Project

In 1997, the Willamette NF was selected to participate in a fee demonstration project which involves charging trailhead parking fees. The fees collected would be used for trail maintenance and construction. Many of the trailheads in the eastern half of the LNS watershed are part of this pilot project. To provide trail users with information about the project and to gain more visitor use data, information boards with trail registration cards were installed in the summer of 1997.

RN Recreation Setting and Activities

RN settings are often characterized by a forested or other natural environment that is mostly natural appearing as viewed from sensitive roads and trails. Social interaction is moderate but with some chance of privacy expected.

Most of the lands classified as RN are located within the proposed Opal Creek SRA. Cascading waterfalls, river rapids, deep pools, and volcanic cliffs surrounded by a mix of mature and old-growth forest provide a scenic backdrop for a variety of recreational activities. Most of the forest seral stage diversity is a result of past wildfires rather than timber harvest activities. Very few cultural modifications other than roads, recreation facilities, and historic buildings (Pearl Creek Guard Station) are observable. On site controls of recreational use are associated with signing and visitor contact by USFS recreation and law enforcement staff. Roads 2209, 2207, and 201 are the three main access roads to the eastern half of the LNS watershed. There are also several rock surfaced and unsurfaced spur roads leading to dispersed campsites.

Some of the most popular recreational activities in the proposed Opal Creek SRA include swimming, hiking, fishing, camping, gold placer mining, tubing, sunbathing, photography, and nature study.

Developed Recreation

The USFS is also experiencing funding reductions which limit the maintenance of facilities to the levels of use they currently receive. Such funding reductions will continue to be of concern for the future maintenance of existing recreation facilities and the development of new facilities. The USFS is using concessionaires to operate larger campgrounds. This allows the USFS to use the money saved to provide services to campgrounds that are not large enough to be profitable for the private sector. Shady Cove is one of those smaller campgrounds.

USFS Parks: There are two developed recreation sites in the proposed Opal Creek SRA. Shady Cove Campground has 13 family camp units and is the one of only two developed overnight recreation sites in the LNS watershed. Three Pools was previously a dispersed camping area but was made a day-use area in the early 1990s; both have vault restrooms but no potable water source. They are open all year, with the main use season being mid-May through mid-September. Weekend use, during the peak summer season, often exceeds capacity.

Pearl Creek Guard Station: The Pearl Creek Guard Station was built in the early 1930s by CCC crews to serve as a housing and stopping off place for USFS staff. Restoration work was done on the station in August of 1993, and it was occupied by a USFS seasonal staff person in the summers of 1994 and 1995; however, on-site interpretive information about the station is limited. That person was responsible for assisting in the management of Shady Cove and Three Pools and making contact with visitors in the eastern half of the watershed. Due to budgetary constraints and safety concerns, the guard station has not been occupied since 1995. Since that time, there has been some vandalism to the building.

Private Facilities: Approximately 3.5 miles past a locked gate along Road 2209 there is an old mining camp known as Jawbone Flats. Jawbone Flats has several small cabins and is currently owned by a non-profit organization called "Friends of Opal Creek" and is maintained as an environmental educational retreat.

Dispersed Recreation

LNSR/Cedar Creek: Like the lower portion of the LNSR, the upper portion also attracts relatively high levels of dispersed day and overnight use. Most of the use occurs along several spur roads off of USFS Road 2207. Approximately 39 dispersed campsites were identified in an inventory taken in 1988. Of those sites, 11 had high user impacts (loss of vegetation, tree damage, litter, soil compaction, and erosion), 25 had moderate impacts and three had low impacts.

Though not part of the proposed Opal Creek SRA, recreation use along Cedar Creek is similar to the use occurring along the LNSR. The 1988 inventory identified 13 dispersed campsites in the Cedar Creek area. Of those sites, one had high user impacts, six had moderate impacts and six had low impacts.

Several of the dispersed sites in both areas are also popular with day users. Most of the dispersed sites along both rivers are over 150 feet from the streambank, helping to reduce potential impacts to water quality. Multiple river-access trails leading from campsites to the river are commonly found.

A new dispersed campsite inventory was started in the LNS and Cedar Creek areas in the summer of 1997. Preliminary results from the inventory indicate that both the number of dispersed sites and the level of user impacts have increased, and that very few of the 1988 sites were abandoned. Many of the sites recently surveyed are receiving levels of use similar to that of the developed sites without any facilities such as restrooms, fire rings, potable water, or trash receptacles. Patrols and visitor contacts by USFS law enforcement and recreation staff do provide some on-site presence and control.

In 1996, a USFS intern completed a recreational use assessment report based on field observations of use along the LNSR. The report indicated that visitors to this area tend to be younger (ages 15-24) and more local in origin with repeat visitation being high. It also indicated that while there may be a need for new facility development, contact with dispersed campers indicates that at least some prefer the more undeveloped and unregulated experience currently provided.

Elkhorn Lake: Elkhorn Lake is a small but popular dispersed camping area in the proposed Opal Creek SRA. One to three parties can be found camping near the lake during the peak use season. The 1988 inventory identified 10 dispersed campsites with four rated as having high user impacts, five with moderate impacts, and one with low impacts. A field review of the lake was conducted in August of 1997, and no significant changes in the level of impacts or number of sites were observed. Without any developed facilities, sanitation, litter, and fire hazards are still a concern. Patrols by USFS staff are also conducted at Elkhorn Lake.

Elkhorn National WSR: The Opal Creek Legislation also designated a 6.4-mile segment of Elkhorn Creek a National WSR to be managed by the USFS and the BLM. A 5.8-mile segment extending from the Willamette NF boundary on the common section line between Sections 12 and 13, Township 9 South, Range 4 East, Willamette Meridian, to its confluence with Buck Creek (see LUA map) will be managed under a "Wild" classification. The last 0.6-mile segment extending from the confluence with Buck Creek to the point where the segment leaves federal ownership will be managed under a "Scenic" classification (see Ownership and Classification Table).

Table 28. Elkhorn Creek National WSR Ownership and Classifications.

Ownership	Scenic Classification	Wild Classification	Total
BLM	0.6	2.4	3.0
USFS	0.0	3.4	3.4
Total	0.6	5.8	6.4

There are no developed recreation facilities near Elkhorn Creek, and dispersed use is low. Access to much of the wild segment of the river is limited due to extremely steep slopes. The scenic section of the river is more accessible and offers greater potential for primitive recreation facility and trail development. A management plan for the river will be completed jointly by the USFS and the BLM as part of the proposed Opal Creek SRA planning process.

North Fork Trail: The North Fork Trail is the only trail located within the proposed Opal Creek SRA, and is one of the more popular trails in the LNS watershed. The forested 4.2-mile trail can be accessed from either end at Shady Cove Campground or Road 201 (See Recreation Map) and parallels the LNSR most of the way. This trail has the potential for expansion east of Shady Cove along the LNSR.

Opal Creek Gate and Other Trailheads: Road 2209 is gated approximately 5.5 miles from where it begins. Over 60 vehicles are often observed on the weekends during the summer, making this the most popular trailhead in the USFS Detroit Ranger District. The trailhead provides parking to visitors using the Kopetski Trail and several other trails in the LNS watershed.

Preliminary trailhead registration information indicates that Opal Creek is the primary destination from this trailhead. However, other destinations such as Twin Lakes, Whetstone Mountain, Beachie Creek, and Battle Axe Creek were also mentioned. The majority of visitation is day use. However, some of the visitors stay overnight Shady Cove Campground, Elkhorn Valley Recreation Site, and other locations within and outside of the watershed. Most of the trailheads for trails in the proposed OCW are located in the proposed Opal Creek SRA.

Public Access Around Jawbone Flats: Road 2209 provides access to several trails including the Kopetski Trail, the Battle Axe Trail, and the Beachie Saddle Trail. Currently, visitors must pass through Jawbone Flats to access these trails. As part of the legislation, the USFS has identified an alternate public access route to the south of Jawbone Flats that would only involve 300 yards of new trail construction and a foot bridge crossing over Opal Creek. Shortly after crossing Opal Creek the new trail would connect back up with Road 2209.

Semi-Primitive and Primitive Recreation Settings and Activities

Semi-primitive (non-motorized) settings are often characterized by a predominantly natural environment of moderate to large size. Evidence of humans and human controls is present but low. Motorized use is not permitted. Chances for social interaction is low. The lands adjacent to trails in the proposed OCW and around Opal Creek Lake are considered to be semi-primitive. These trails offer a more primitive access to the proposed OCW leading visitors through a mix of mature and old-growth forest with panoramic views of surrounding cascade mountain peaks and drainages.

Primitive settings are often characterized by an unmodified natural environment of fairly large size. Evidence of humans and human-induced restrictions and controls is essentially absent, and motorized access is not permitted. Chance of social interaction is low. Most of the lands in the LNS watershed with a primitive setting would be located in the proposed OCW in areas where there are no trails.

Most of the recreational use in the proposed OCW is associated with hiking, exploring, and photography. Trailhead registration data indicate that most of the users are repeat visitors from Oregon and more specifically from the Willamette Valley. There is a component of out-of-state use which is primarily associated with the Opal Creek drainage.

Non-Conforming Uses: Given that the majority of the proposed OCW was previously not designated wilderness, non-conforming uses or features (i.e., roads near or leading into OCW from southern boundary) should be identified and addressed in the planning process.

Limits of Acceptable Change: Currently, visitor use in the proposed OCW is relatively low. However, with the high demand for semi-primitive and primitive settings, it is likely that use could significantly increase in the future. Gathering baseline data on visitor use and wilderness conditions and establishing limits of acceptable change standards and monitoring guidelines would help wilderness managers recognize when uses are in danger of compromising wilderness values.

Dispersed Use

Opal Creek Area and Kopetski Trail: The trailhead for the Kopetski Trail is located off of Road 2209 approximately 2.5 miles past the locked gate. From the trailhead, the Kopetski Trail continues for one mile to Jawbone Flats and then heads south along Opal Creek for approximately two miles. Along the trail, visitors can experience first hand old-growth forest habitat and the crystal clear waters and deep pools of Opal Creek. The trail is moderate to difficult and is rocky and narrow in places. There is potential for extending the trail south to connect up with Opal Lake and other trails in the southern portion of the watershed.

In 1996, a USFS intern completed a recreation use study for the Opal Creek drainage. The visitor use data from that study indicate that over 79 percent of the survey respondents were day users (trailhead registration cards from the summer of 1997 also support more day use than overnight use). The survey did not ask for overnight use locations, but the average length of stay was one to two nights. Hiking was listed as the most common recreational activity in the survey, and environmental education, camping, bicycling, and fishing were also mentioned.

Over 58 percent of the respondents also indicated that they were first-time visitors. Observation and visitor contact by USFS staff indicate that the Opal Creek drainage receives a higher level of first and one-time visitors than other areas in the eastern half of the LNS watershed.

Opal Lake and Trail: A 0.5-mile trail off of Road 2207 provides access to Opal Lake. Eight dispersed campsites were identified in the 1988 inventory. Of those sites only one had high user impacts, three had moderate impacts, and four had low impacts. One section of the trail leading to the lake goes through a wet area. Relocating this section of the trail is necessary to better meet ACS Objectives.

Henline Falls Trail is only 0.25-mile long and provides fairly easy access to a scenic overlook where Henline Creek shoots over a cliff into a deep pool below. This is one of the most popular trails in the LNS watershed, and visitation is primarily day use.

Other Trails

There are several other trails which fall entirely or partially within the proposed OCW (see Recreation Map). All of these trails receive fairly light use and have fairly primitive single-track trail design and maintenance standards.

Henline Mountain Trail is a steep 2.7-mile trail that provides hikers with panoramic views of the surrounding peaks and valleys on a clear day. Fire rings on the overlook at the top indicate that there may be infrequent overnight use.

Whetstone Trail is a steep and rugged 8.1-mile trail that offers hikers views of Mt. Hood and the Opal Creek drainage from an old lookout at the top of Whetstone Mountain.

Elkhorn Ridge/Phantom Natural Bridge Trail varies in length depending on the route taken. It can be accessed from either Road 201 or Road 2223 and ties into the French Creek Trail near Road 2223. The trail offers views of Mt. Jefferson and Opal Creek and features Phantom Natural Bridge, a naturally formed basalt rock bridge.

French Creek Trail is a 7.7-mile trail that runs along the southern boundary of the watershed and offers opportunities for remoteness and solitude.

The Battle Axe Mountain Trail runs along 5 miles of an old road bed and provides access to the

Ruth Mines and the old Battle Axe lookout. Visitors wishing to access this area must walk through Jawbone Flats on Road 2209.

Beachie Saddle Trail is a 2.7-mile scenic forested trail which overlooks the West Humbug and the Opal Creek drainages**.**

Estimates For LNS Water Visitor Use

There is no quantitative field-based recreation visitation data available for the LNS watershed. Limited field observation indicates that visitation to this watershed is moderate, with the peak use season being high. Much of this use is concentrated along the LNSR and in the Opal Creek drainage.

The western half of the LNS watershed includes all of the BLM’s LNS Special Recreation Management Area and part of the Cascades Extensive Recreation Management Area. Based on the Statewide Comprehensive Outdoor Recreation Plan (SCORP) use estimates for Region 8, visitation on BLM-administered lands in the western half of the watershed is estimated at 29,205 people per year. More field-based use data is needed.

Current Recreation Demands

Besides estimating current and projecting future visitation levels, SCORP also analyzed the supply and demand relationship between ROS settings and recreational activities. While the same activity can occur in several different ROS settings, an individual’s experience is expected to vary by setting. The SCORP report compared a category of currently "Used" ROS setting to a "Preferred" amount of use for several recreational activities in each ROS setting. Those activities that show a higher "Preferred" than "Used" suggest that there may be an inadequate supply of that setting for a particular activity in Region 8. The SCORP data indicate that there is a shortage of both primitive and semi-primitive settings for most of the recreational activities in Region 8. This is also true for most of the other regions in Oregon.

Under the Opal Creek Legislation, the eastern half of the LNS watershed has the opportunity for meeting some of the current and growing demand for semi-primitive and primitive settings. While the lands directly adjacent to the LNS River are heavily used, much of the uplands remain relatively remote.

SCORP data indicate that the “Used” category outweighs the “Preferred” category for most recreation activities in the rural and RN settings. However, given the convenience and the high quality recreation opportunities the LNS River provides, it will continue to play an important role in meeting demands for several water-based recreation activities both within and outside of Region 8. As long as the supply of primitive and semi-primitive is unmet, many of the activities will continue to take place in rural, roaded modified and RN settings.

The SCORP report also found that the top three barriers to participation in outdoor recreation activities were lack of time, distance to area too far, and too many people. Given the proximity of the LNS watershed to relatively large and growing communities, the recreation opportunities this watershed offers will become increasingly important and more difficult to maintain. As knowledge of the area grows, management will become more important to preserving a high quality experience within these settings.

Major Concerns

Maintaining public vehicle access to public lands will always be of concern to many visitors; however, until cost effective alternatives become available, road closures on public and private land are likely to continue.

Some of the major concerns to private and public landowners in the watershed are associated with the negative impacts of recreational use. These include littering, reckless driving, loitering near and jumping off bridges, vandalism, unsafe firearm use, underage drinking, excessive parties, and long-term occupancy. Existing developed overnight and day-use facilities are not adequate to meet the current use. This makes sanitation and other impacts related to dispersed camping a concern.

A limited amount of interagency coordination between the federal, state, local, and private landowners in the watershed has occurred to address some of these concerns; however, there are opportunities for improvement.

Chapter 6 - Potential Conditions And Future Trends

Management Objectives and Direction

Contained within the LNS watershed are portions of CONN Blocks totaling 4,708 acres identified during the RMP process. These blocks are located on BLM lands in T. 9 S., R. 3 E., sections 4, 8, 9, 10, and 17 {Big Creek CONN Block}; T.9 S., R. 3 E., sections 13, 23, 24; and T. 9 S., R. 4 E., sections 19, 29, and 30 {Evans Creek CONN Block}; T. 9 S., R. 3 E., section 1; and T. 9 S., R. 4 E., section 31 {Elkhorn CONN Block}. In addition, the Packsaddle CONN Block in the vicinity of Mount Herob (T. 9 S., R. 4 E., section 17) continues south out of the LNS watershed toward the NSR Corridor. According to the Salem District RMP, these lands are to be managed on a 150-year rotation with greater green tree retention. These blocks are designed to maintain 25 to 30 percent in older forest conditions through time (Maps 2 & 3).

Opal Creek Legislation - Described in Chapter 1.

LSR and Wilderness - Portions of the Cedar Creek SWB are LSR according to the NFP. This LSR is part of a larger Wilderness/LSR complex that includes the new OCW and Bull of the Woods. It is being addressed for CONN and late-successional concerns in the North Willamette LSR Assessment.

The Opal Creek legislation designates 6.4 miles of Elkhorn Creek with an average of 640 acres on each side of the river segment as a boundary. BLM will be using a temporary 1/2 mile buffer on the river. Of this 6.4 miles, 5.8 miles of Elkhorn Creek from the intersection with Willamette NF boundary (T. 9 S., R. 4 E., Sections 12 and 13) to its confluence with Buck Creek will be managed under a “Wild Classification.” 0.6 mile from the confluence of Buck Creek to where Elkhorn leaves federal ownership (T. 9 S., R. 3 E., Section 1) will be managed under a “Scenic Classification.”

The remaining federal ownership in the LNS watershed is in the GFM which includes 6,668 acres. According to the NFP, these lands are to be managed for timber production and for a range of other values. A full range of silvicultural activities are allowed on these lands.

Refer to the FSEIS ROD and Salem District RMP for more details regarding standards and guidelines for the different LUA, etc.

Terrestrial

Potential Future Conditions and Trends

Soils

Soil stability in the western portion of the watershed will decrease over time as conifer stands reach harvestable age and are removed. New and minimally maintained roads on steeper slopes may increase erosion or mass movement during larger precipitation or rain on snow events. Stability in the eastern sub-watersheds will remain the same due to the lack of forest harvest which maintains tree roots and soil root strength and the limited number of new roads added to the area. Natural and human-caused landsliding and erosion will continue to occur throughout the watershed as a result of past management, future management, and climatic conditions.

Soil compaction reduces site productivity by reducing the ability of roots to penetrate and restrict the movement of water and air through soil horizons. Compacted soils can require many years to ameliorate naturally; however, the use of winged soil rippers or other such devices can bring compacted soils to near their original densities in many cases. Future roading and harvesting will increase soil compaction in the watershed but will be mitigated somewhat by the use of mechanical methods to reduce compaction on closed roads and skid trails.

Vegetation Patterns/Seral Stages

Current vegetation patterns and seral stages were grown and modeled for 80 years into the future. Certain assumptions were made regarding rotation ages on private/state lands managed under the FPA and federal lands managed under the NPF and existing federal law.

As is the case for the current conditions, the LNS watershed exhibits a great degree of divergence in future trends and conditions between the eastern and western halves of the watershed. For the purposes of this analysis, the western half of the watershed includes the Kiel, Canyon Creek, Sinker, and Evans SWBs. The eastern half includes the Dry, Elkhorn, Henline, Cedar, Gold, Opal, and Battle Ax SWBs.

In the LNS watershed (all ownerships), the current proportion of forest/non-forest types is expected to remain at 88 percent conifer types, 7 percent non-forest types, and 5 percent hardwood types. Hardwood types tend to be associated with riparian areas along larger streams. Non-forest types in the LNS watershed consist primarily of rocky areas, rock outcrops, cliffs, and rural residential areas.

Currently, 52 percent of the watershed is in older forest habitat (all ownerships). The vast majority of older forest is in the eastern half of the LNS watershed. Future trends indicate that the divergence in the amount of older forest in the eastern versus the western halves of the watershed would increase slightly under current management. See Figure 22 showing the amount of older forest in the western and eastern halves over time. In the eastern half of the watershed, older forest is expected to increase from 70 percent to 85 percent over the next 80 years as wilderness, LSR, SRMA, and WSR continue to develop. In the western half of the watershed, the amount of older forest is expected to remain at 20 percent. However, the distribution of older forest habitat would change and follow RR in the future. Further analysis of future conditions in the western half indicates that older forest would likely be most scarce in Kiel and Sinker SWBs, each with less than 14 percent older forest, followed by Canyon Creek SWB at 19 percent and Evans SWB at 40 percent. See Figure 23 showing the amount of older forest in the western portion of the watershed by SWB over time.

The amount of older forest habitat on federal lands is expected to increase under the NFP as RR, wilderness, LSR, SRMA, and WSR continue to develop. Currently, 69 percent of the federal lands are older forest habitat. Under current management, federal lands in the watershed have the potential to support 80 percent within 80 years. In the western half of the watershed, the amount of older forest on federal lands is expected to increase from 35 percent to 50 percent within 80 years.

The amount of older forest habitat on private/state lands is expected to decrease under current FPA guidelines. Assuming an average 60-year rotation on private/state lands, approximately a third of the acreage would be distributed between each of the 20-year age classes (0 to 20; 21 to 40; and 41 to 60 years of age).

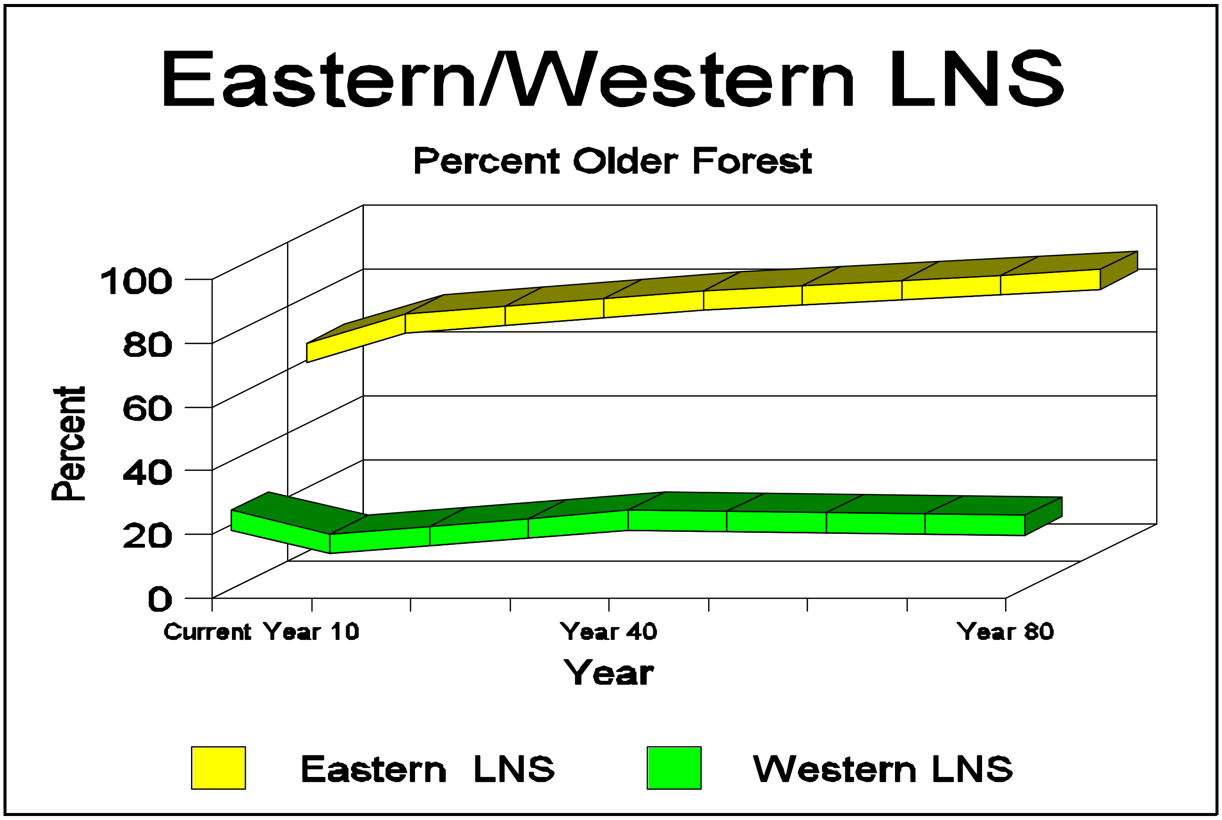

Figure 22. **Percent Older Forests in Eastern and Western LNS**.

The LNS will continue to exhibit considerable differences in the predominate matrix and patches from the western to the eastern end of the watershed. Ultimately, the predominate matrix across all ownerships in the western portion of the watershed would be fairly evenly distributed between

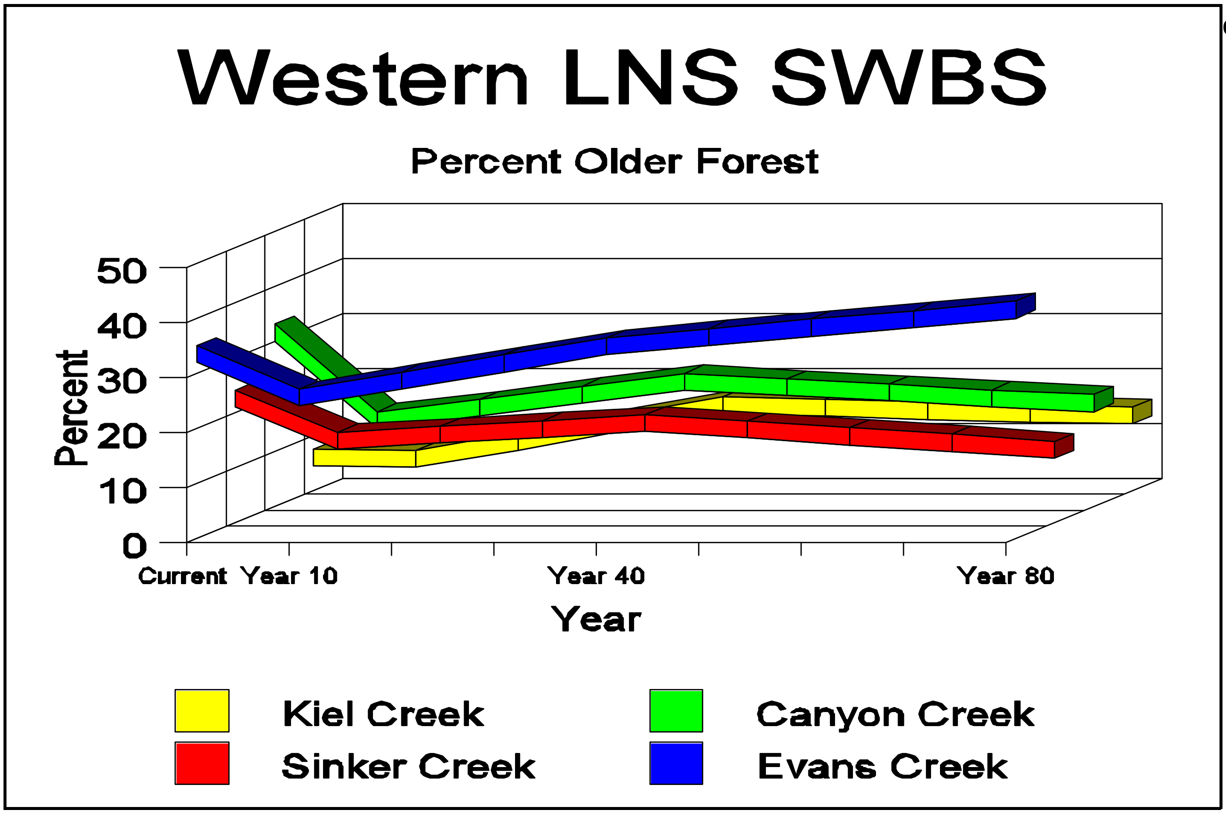

Figure 23. **Percent Older Forest in Western LNS by SWB**

early and mid seral stages 0 to 60 years of age. The patch elements and secondary matrices would continue to be mid to older forests 60 to 200 years plus. In the future, the distribution of older forest habitat in the western portion would follow RR on federal lands. FPA stream buffers on private/state lands would contribute some older forest elements in the long term.

The predominate matrix in the eastern portion of the watershed will continue to be older forest. There will be a scarcity of early to mid seral stages in the eastern portion. Modeling shows less than 5 percent would be in early grass/forb stages at any given time in the future.

Special Habitats

Condition and quality of special habitats in the LNS watershed are expected to remain approximately the same as current conditions. The predominate special habitat features in the LNS are those associated with rock outcrops, cliffs, dry ridgetop meadows, and talus slopes. The majority of these special habitats are located in the eastern portion of the watershed in wilderness, SRMA, LSR, and WSR. There are also a limited number of small lakes, ponds and wet areas, primarily in the eastern portion of the watershed.

Standing Dead and CWD

The LNS will continue to show considerable variation in the amount and quality of standing dead material across the watershed. In the eastern portions of the watershed, the amount of standing dead is expected to remain highly viable at or above 80 percent of potential cavity dwelling wildlife populations. In the western portions of the watershed, the amount of standing dead is expected to approach 40 percent of potential cavity dwelling wildlife populations as older forest develops in RR, and green tree retention guidelines are implemented. There would be an increase in standing dead on private/state lands as relatively new FPA requirements for standing dead continues to be implemented. In addition, FPA buffers would help contribute to the standing dead resource on private lands.

The amount of CWD is expected to follow similar patterns over time as standing dead material. Over the long term, the amount of CWD is expected to increase on federal lands as older forest develops, and green tree retention guidelines are implemented. The FPA requirements for down logs and buffers would help contribute CWD on private/state lands.

Habitat Quality

The amount of interior older forest habitat is expected to increase on federal lands as older forest habitat develops. The amount of interior forest habitat on private/state lands is expected to decrease as older forest is harvested. Future harvest and road construction will continue to alter the quality of interior older forest across the western portion of the watershed.

HEc in the eastern end is in a highly viable condition. Cover quality declines toward the western end where the Hec is currently near .30, which is limiting for elk. HEc for the watershed as a whole would remain the same as current conditions.

Roads and Transportation

Road densities are expected to increase in the western portion of the watershed as additional roads are constructed for harvest. Here, the habitat effectiveness index derived from open road densities (HEr) currently averages 0.30, which is limiting for elk. Road densities are very low in the eastern portion of the watershed and are expected to remain low in the future.

Special Status/Special Attention Species

Plants

Aster gormanii, a SSSA plant known to occur in the LNS watershed, is associated with rocky steep openings in Pacific silver fir and mountain hemlock forests. It is found at the higher elevations in the watershed, and most of the populations are found in reserved lands or on sites with little potential for management so persistence is likely.

Potential habitat for the blue chanterelle, *Polyozellus multiplex*, and the lichens, *Pseudocyphellaria rainierensis* and *Hypogymnia oceanic*, is in the eastern portion of the watershed. Known sites for these species are located in the Opal Creek area. Without major natural disturbances in the eastern end, the overall habitat for these species would increase in the future.

The nail lichen, *Pilophorus nigricaulis*, is associated with rocky talus slopes found within old-growth patches. This habitat type is also found in the eastern end of the watershed and would be protected. Surveys in older forest stands proposed for management activities in the western portion of the watershed could locate new sites protected by buffers.

The skin lichen, *Leptogium rivale*, is an aquatic dependent species. The wilderness, RR, SRMA, WSR, and LSR would provide potential habitats for this species in this area. Because it is found in the eastern portion of the watershed, the species should be well protected, and the potential increases as RR grow. A major landslide type disturbance that caused excessive siltation could cause a site specific loss, while a major drought period could have a detrimental effect over a much larger area.

Willamette Valley species habitat conditions will probably continue to degrade due to lack of protective or active management mechanisms on private lands at the western elevations.

Exotic and Introduced Species of Concern

The spread of noxious and introduced species will continue to be a concern because the LNS is a major recreation and travel corridor. The 1997 summer survey will be used to identify potential sites and eradicate them if possible and to monitor trends into the future.

Animals

Habitat conditions for older forest species over the entire watershed are expected to improve slightly in the long term as wilderness, RR, LSR, SRMA, and WSR develop. In the western portion of the watershed, there would be a shift in the distribution of older forest to federal lands;

however the total amount of older forest would remain the same. Habitat conditions for early and mid seral stage species is expected to remain approximately the same in the western portion of the watershed and decline over time in the eastern portion. Habitat for priority species that utilize standing dead and/or down logs is expected to improve in the long term with increased retention requirements on federal, state and private lands.

Threatened and Endangered Species

Suitable habitat for the peregrine falcon and bald eagle are expected to remain the same as current conditions. The majority of suitable habitat for these two species is located in the eastern portion of the watershed in wilderness, SRMA, LSR, and WSR.

Suitable habitat for the spotted owl is expected to follow the same trends as described previously for older forest habitat and species. Overall, spotted owl habitat condition is expected to improve in the eastern end of the LNS watershed and remain the same in the western end.

The eastern portion would continue to function as suitable habitat and provide dispersal habitat as an important element of the large wilderness/LSR network in the western Oregon Cascades where the majority of dispersal between known spotted owl sites takes place.

The western portion is located west of the major wilderness/LSR network and has minor importance for dispersal to/from Silver Falls State Park and Abiqua Creek to the north and west. Dispersal of spotted owls is limited by the Willamette Valley to the west and the NSR corridor to the south. In the future, the distribution of suitable and dispersal habitat would follow RR on federal lands. At any given time, one-third of private/state lands would qualify as dispersal habitat. Dispersal habitat will be difficult to maintain in the western portion due to the higher percentage of private/state lands.

Of the 10 known spotted owl sites with site centers in the watershed, 8 were found to be viable. These eight sites are all located in the eastern portion of the watershed and are expected to remain viable in the long term. The two sites located in the western portion of the watershed are considered non-viable and are not expected to be viable anytime in the future.

Future conditions of spotted owl habitat and KOSs on federal lands were estimated, and the results are shown in Table 29.

Table 29. Potential Future Status of the Spotted Owl and its Habitat Within The LNS Watershed.

	Total WA	Total Protected (%)	Total Unprotected (%)
Acreage within Boundary	72,157	37,910 (53%)	34,250 (47%)
Acreage of Federal	49,366	37,910 (77%)	11,365 (23%)
Federal Spotted Owl Habitat Capable Acres	46,550	35,750 (77%)	10,800 (23%)
Total Suitable Spotted Owl Habitat	42,145	36,200 (86%)	5,945 (14%)
Federal Suitable Spotted Owl Habitat	41,640	36,200 (87%)	5,440 (13%)
Total Spotted Owl Sites*	10	8	2
Spotted owl sites (>40%)	8	8	0
Spotted owl sites (30-40%)	0	0	0
Spotted owl sites (20-30%)	0	0	0
Spotted owl sites (<20%)	2	0	2

Fish

Instream habitat conditions for fish are expected to show long-term improvement on federal lands as wilderness, RR, LSR, and WSR continue to develop. Improvement in the eastern half of the watershed is expected to occur more rapidly than in the western half of the watershed. Habitat conditions on lands managed under the FPA may decline.

Future conditions of anadromous fish stocks in the LNS are difficult to predict due to the complexity of conditions that determine their relative abundance (instream habitat conditions, ocean survival, harvest levels and protection status under the ESA and/or the CSRI).

AQUATIC

Hydrology

Peak flows, low flows, and annual water yields will continue to fluctuate depending on precipitation and temperatures. The nature of precipitation in the area was shown to cycle between wetter than average periods and dryer than average periods approximately every 20 years. People will continue to move into the western portions of the watershed. They may have some effect on peak flows as more roads and houses are built and precipitation is routed into streams as storm flow rather than being allowed to infiltrate. The potential over allocation of stream flow during low flow periods may produce conflicts of interest between instream aquatic needs and human residents as more dwellers extract water from the LNSR, tributary streams, and groundwater for consumptive uses and irrigation.

Stream flow in forested basins is affected by evapotranspiration. Forest harvest has reduced evapotranspiration for years after harvest, so continued harvesting would be expected to affect water yields and peak flows. Harvesting may also affect snow accumulations and melt. However, the magnitude of responses will vary by season and year. Seasonal variations in soil moisture will produce different responses in runoff from a storm. So, a storm in the fall, with dry soils, will result in a given runoff response, where the same size storm received in the middle of winter, with saturated soils, may result in a higher runoff response and higher peak flows. Yearly fluctuations in precipitation can also affect stream flow and is compounded if several years of below or above average precipitation in a row are encountered.

Roads also affect stream flows and yields but in a different way than harvesting. While harvesting affects evapotranspiration, roads influences hillslope flow paths by converting subsurface flow to surface flow, and allowing it to enter the stream much more quickly. The combination of harvesting and roads in small watersheds has been shown to increase peak flows, produce higher storm volumes, and produce earlier rises in stream flow response to storms (Jones et al. 1996).

Harvesting and road building in the eastern half of the watershed on USFS lands will probably remain a minor component of forest management given current management direction. Under the *Salem District BLM RMP* and Oregon FPA, the western half of the watershed which is composed of a mix of private and BLM ownership will continue to be harvested on a rotational basis and additional roads built to increase access. On federal lands, road densities will probably decrease as unneeded roads are decommissioned and removed. Private land road densities may remain stable or increase as stands of trees are harvested in future rotations.

Future cumulative impacts in the LNS SWB's were modeled using current conditions and several assumptions about future harvesting. Trees in the SWB's were aged in increments of 10 years beginning at the present time and ending 80 years in the future. Private lands were assumed harvested within a 10-year period when they reached 60 years old or older in the previous 10-year period. Harvest on federal ownership during a 10-year period was spread evenly among general forest management category lands; the amount based on the estimated decadal harvest within the watershed. Results of the cumulative effects modeling of ECAs are illustrated in Figures 24 and 25. ECA is a general tool used to assess watershed cumulative effects. Values above 20 percent are considered high, while values of 15 to 20 percent are moderate, and less than 15 percent low. For a more in-depth discussion of ECA, refer to the hydrology-cumulative effects section in Chapter 5 - Current Conditions.

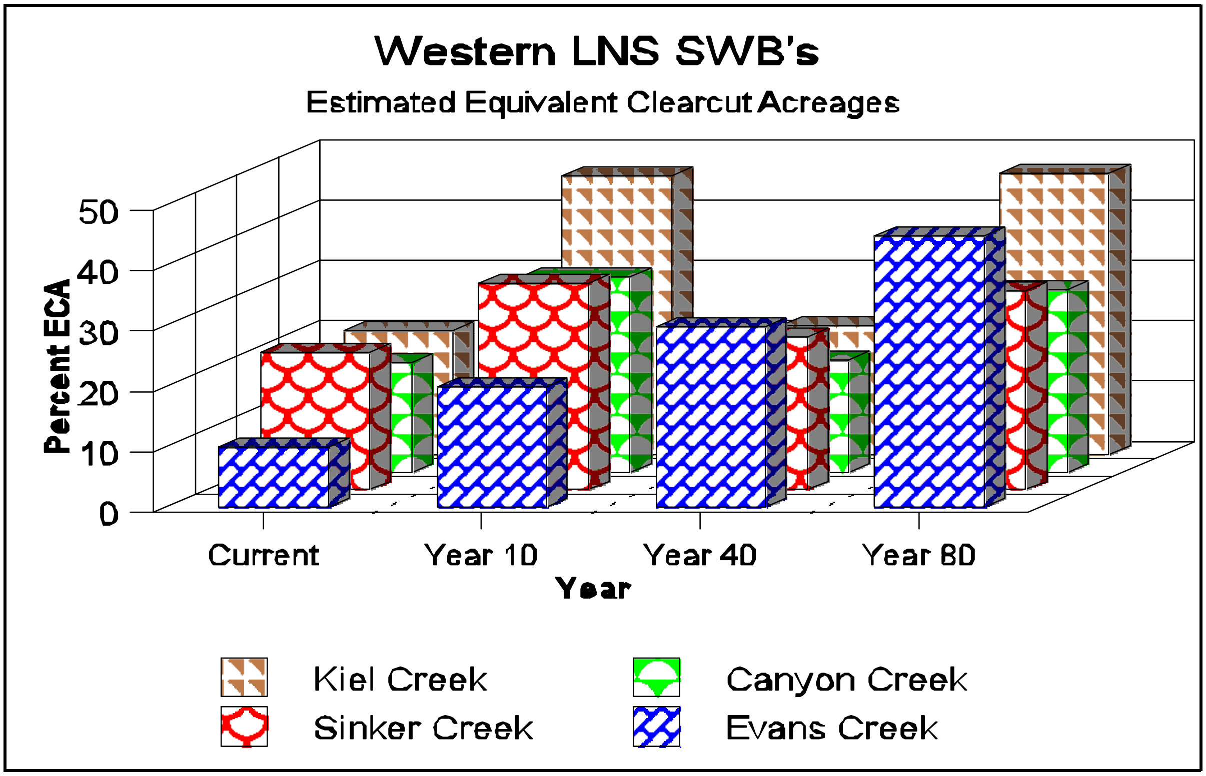

Figure 24. Estimated Future Equivalent Clearcut Acreage, Western SWB's

The four western SWB values for ECA are all in the moderate or barely within the high range of ECA. Forecasting into the future, however, the Evans Creek SWB is predicted to continually increase ECA through the next 80 years, while the other three western SWB's show a cyclic increase in 10 years, a decrease at 40 years, and another increase in 80 years. Results of the modeling effort show all four western SWB's in the high category in years 10, 40, and 80 with the exception of Canyon Creek in year 40 which dropped into the moderate category with 18 percent ECA. Modeled values of ECA in the eastern SWB's remained fairly constant over 80 years. All remained in the low to moderate range except Elkhorn Creek, which is estimated to be in the high category currently and again in 40 years. The patterns seen in SWB's are the result of the distribution of conifer age classes and assumption that harvest on private and federal lands will be the same in the future as they are currently.

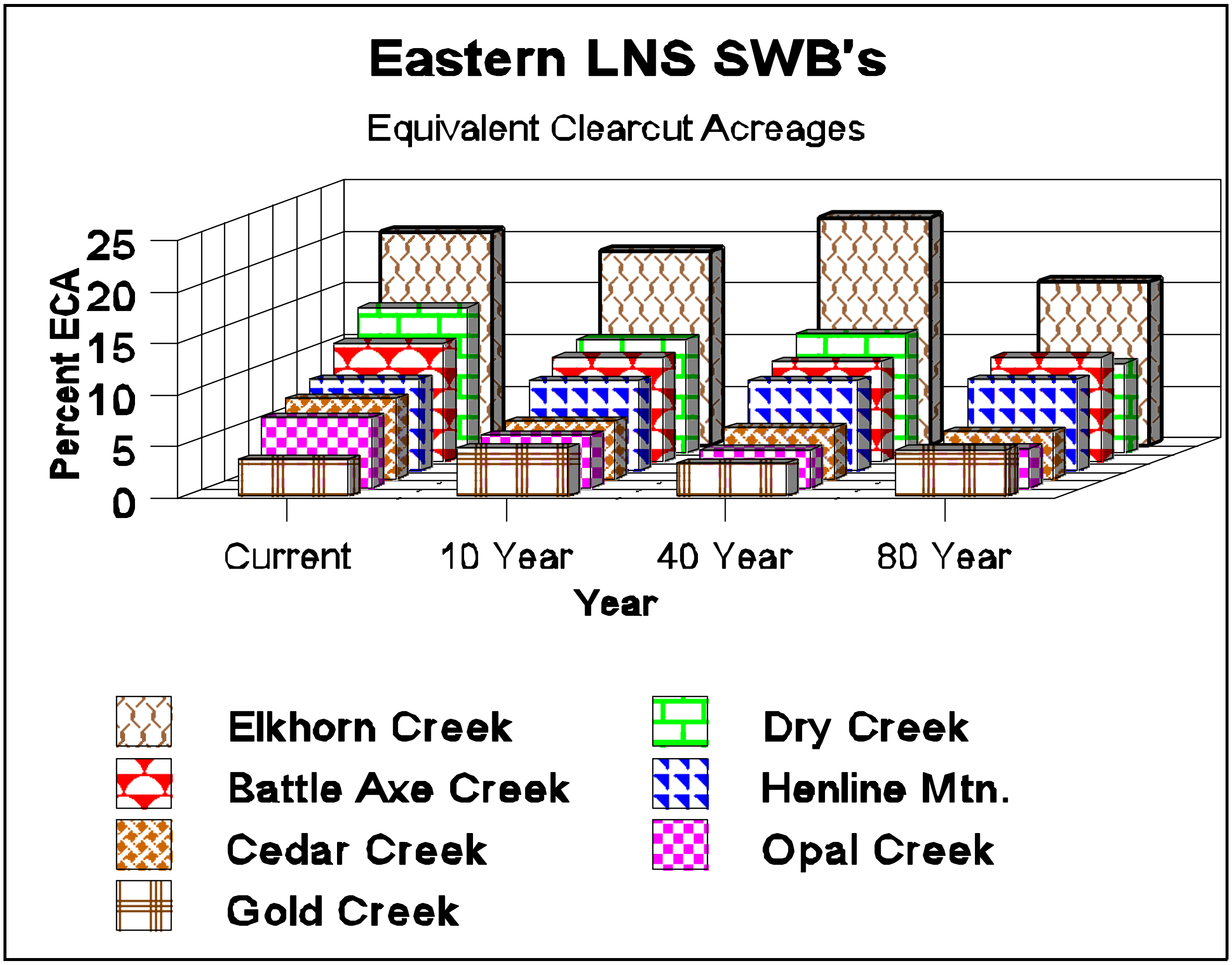

Figure 25. Eastern LNS SWB's Equivalent Clearcut Acreage

WAR analysis is another method used to estimate SWB cumulative impacts. WAR analysis has an advantage over ECA in predicting cumulative impacts. This is because it takes into account harvest in different elevation bands and the effect of various return period storms. For a more detailed discussion of WAR analysis, see the hydrology current conditions section. Modeling of WAR values was accomplished using the same assumptions used for ECA. Results are shown in Figures 26, 27, and 28. WAR values of 7 to 10 percent are considered indicative of moderately impacted watersheds, while values greater than 10 percent are considered high. Referring back to the hydrology current conditions section, Figure 21, the trend in Kiel, Canyon, Sinker, and Evans Creek SWB's is going to be toward higher WAR values in the future. Values for the 10-, 40-, and 80-year scenarios are fairly equal but higher than present values (hydrology current condition section Figure 21). Modeling results in these four western SWB indicate values in the high impact range in all of the years graphed. The remaining seven eastern SWB are estimated to remain fairly stable and in the low impact range for cumulative effects.

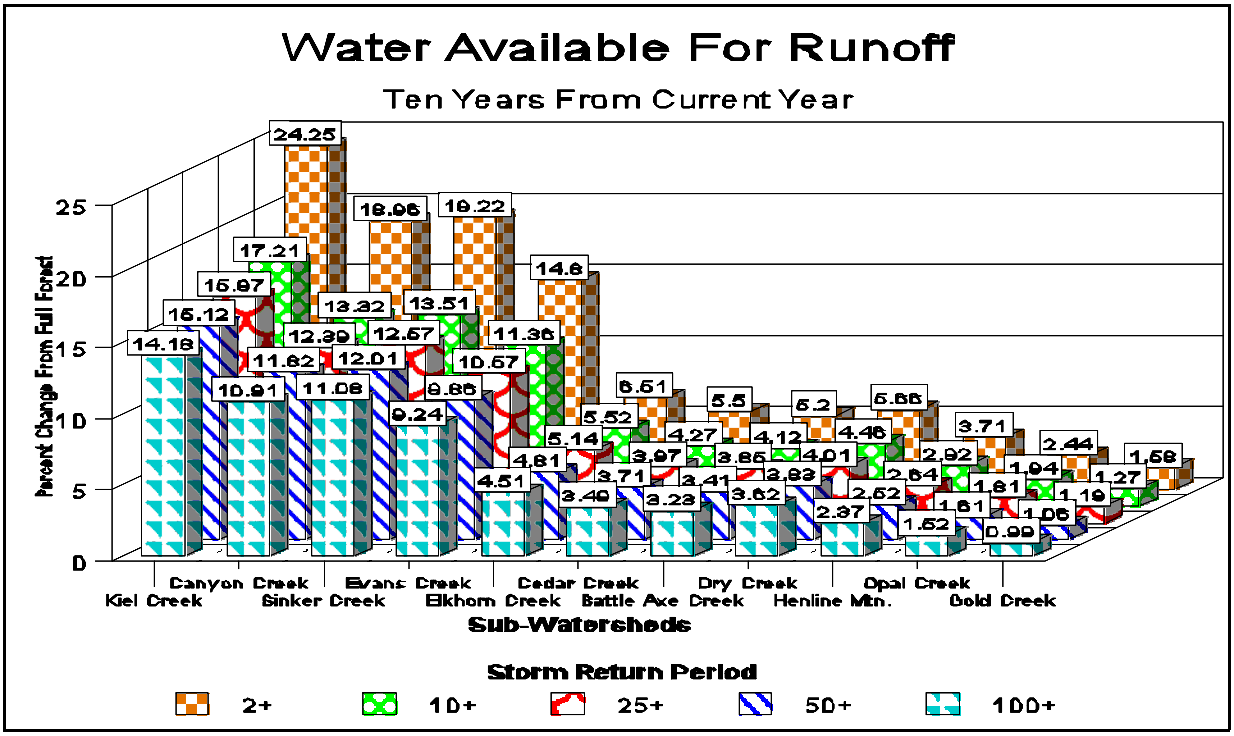

Figure 26.. Estimated Water Available for Runoff - 10 Years from Current Year.

The modeling results above may be useful in planning long-term future timber harvesting in sub-watersheds to reduce or concentrate impacts in areas with higher or western estimated future cumulative impacts.

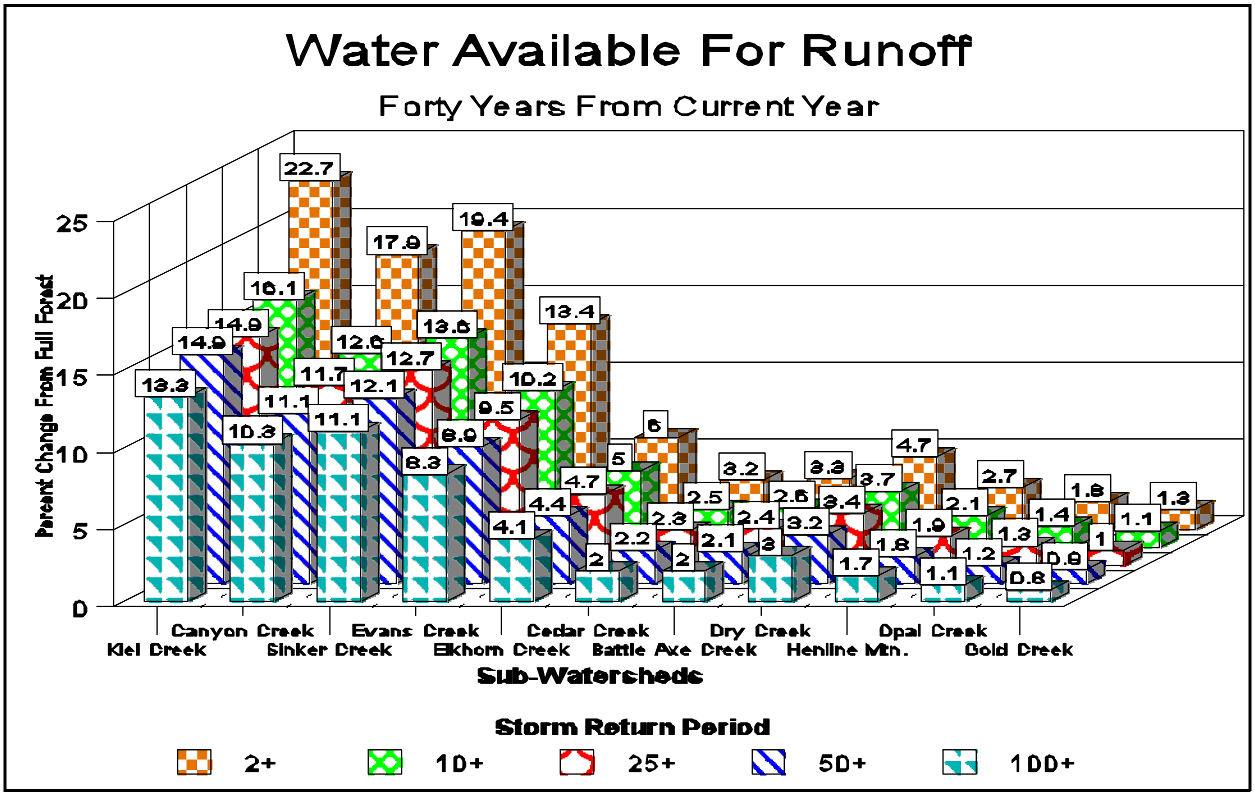

Figure 27. **Estimated Water Available for Runoff - 40 years from Current Year**

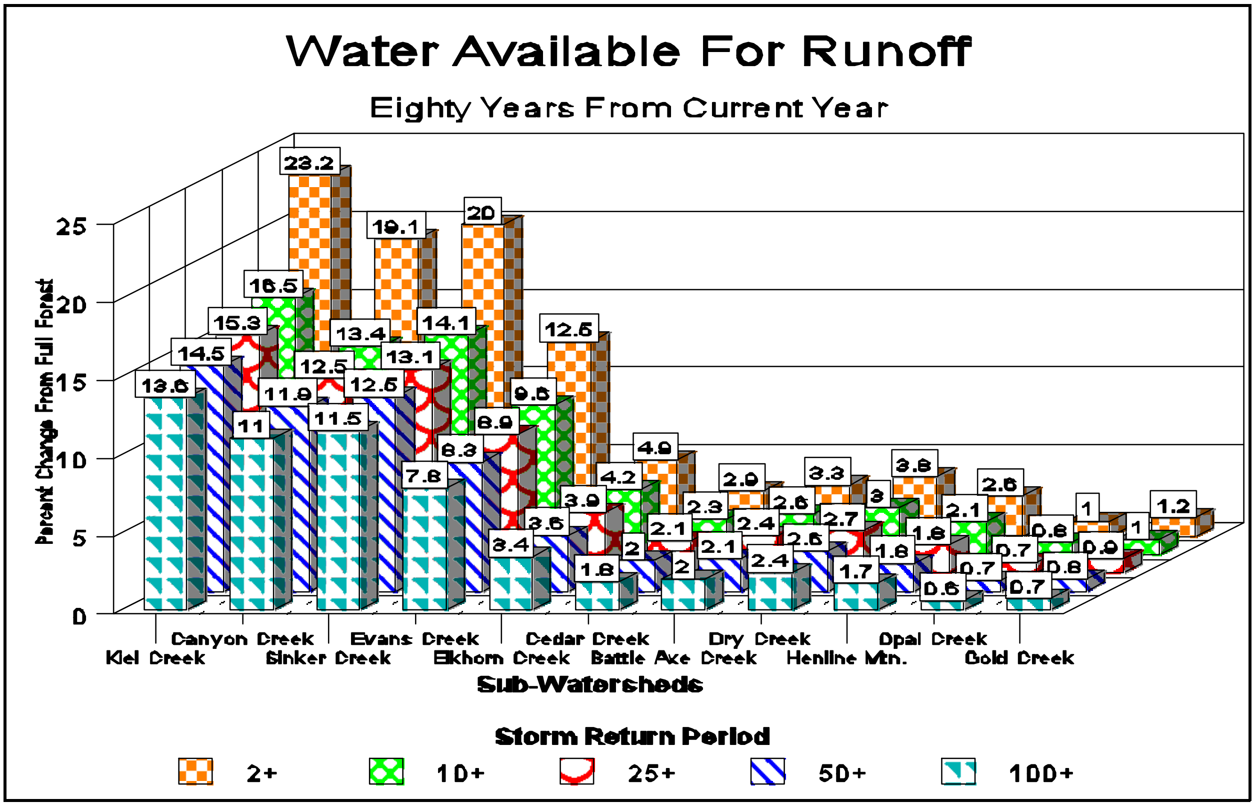

Figure 28. Estimated Water Available for Runoff - 80 Years from Current Year

Water Quality

Water quality in the watershed will continue to be affected by residential, recreational population growth, and commercial activities. With the current management guidelines, the trend in USFS-controlled SWB's will be stable or improving as forest stands mature. The western SWB's will continue to see industrial forest and residential pressure affecting water quality. However, improved Oregon FPA protection measures, Oregon's Three Basin Rule, and requirements on federal agencies under the *NFP* will work to improve overall water quality within the watershed over time. Natural and human-influenced events, such as fire and landslides, will continue to affect water quality in the watershed but will be cyclic in nature.

The closure of unneeded roads, regrowth of riparian overstory vegetation, and designation of RR on federal lands will reduce sediment inputs and water temperature enrichment to LNS tributaries.

Fish

Instream habitat conditions for fish are expected to show long-term improvement on federal lands as riparian areas develop under the reserve system of Wilderness, RR, LSR, and WSR.

Improvement in the eastern watershed is expected to occur more rapidly than in the western watershed due to the greater federal landbase. Habitat conditions on lands managed under the Oregon FPA are likely to continue to decline.

Human Uses

Socio-Economic

The population of Marion County is expected to increase 11 percent from approximately 252,800 in 1994 to 280,438 in the year 2000 and another 14 percent by the year 2010 to 319,729. The major socio-economic contributions the LNS watershed provide will most likely continue to be related the timber industry, meeting water supply needs, and providing outdoor recreation and eco-tourism opportunities. With Marion County's proximity to I-5, it is a prime location for future business development. This is beginning to pay off even now as firms and businesses look further south of the Portland area into the Willamette Valley for relocation and expansion. Though the smaller rural areas may not see as rapid rate of growth, some economic development would be expected. In addition, growth in neighboring urban areas would also provide employment opportunities for those willing to commute from the canyon communities.

Forest Products

Industrial Timber Lands and State of Oregon Administered Lands

It is expected that demand for wood products will most likely remain fairly high unless a desirable and cost effective substitute becomes available. Some of this demand will be met through the importation of wood products; however, domestic wood products will also be an important component of supply. This, along with county zoning guidelines, makes it likely that the predominant land use on private lands in the LNS watershed will continue to be industrial forestry. A general rotation age of 50 to 60 years is expected. Harvesting levels and practices may vary depending on individual company policy, as well as economic and regulatory factors. Similar trends are expected for small woodlot lands and lands managed by the state of Oregon.

BLM-administered and Other Federally Managed Lands

BLM: Wood products will continue to be provided from BLM-administered lands consistent with the Salem District RMP. The majority of wood products will come from lands in the GFMA and CONN LUAs. Based on guidance in the Salem District RMP, a preliminary estimate predicts that approximately 370 acres in GFMA and 135 acres in CONN would be regeneration harvested over the next decade. Very little wood products are expected from management activities on lands within RR.

USFS: If the Opal Creek Legislation is implemented, management activities producing commercial timber products would be very limited on USFS lands. If the legislation is not implemented, the same trend would be expected given the underlying LSR LUA.

SFPs

Demand for SFPs has potential for growth. Efforts such as the inventory and modeling system described in the existing condition may also increase the marketability of SFPs both on private and public forest lands. Until staffing is increased within federal agencies, meeting increases in demand will be difficult.

Residential and Agricultural Uses

Much of the population growth in Marion County will occur around existing population and economic centers such as Salem and nearby communities. The LNS watershed is close enough to the I-5 corridor that some growth in residential activity would be expected in the watershed.

As population grows, management activities on BLM-administered lands adjacent to residential lands will continue to be a concern. If the current zoning guidelines remain in place, the conversion of industrial forest lands to residential uses would be slow and concentrated around lands already zoned for rural residential use. Sensitivity would increase as the number of residences around BLM-administered lands increases.

Transportation and Travel

Road access to public lands in the western half of the LNS watershed is expected to decrease as roads are gated off or decommissioned to reduce road densities. Road access in the eastern half of the LNS watershed is likely to remain similar with some changes to minor roads leading into or adjacent to the proposed OCW.

Water Uses

Water uses and conflicts over water uses will continue to grow as residential and commercial growth occurs in the communities. Given that the LNS watershed feeds into a major municipal water source, maintaining water quality will become increasingly more important and challenging. Managing point and non-point source pollution and developing a comprehensive water monitoring program in watersheds like the LNS may become important management priorities for many of the communities in the Salem and North Santiam Canyon area.

Mineral Uses

Rock quarries for road building and maintenance along with recreational mining will continue to be the primary mining activity on public lands in the LNS watershed. No significant increases in the recreational mining or the initiation of commercial mining activities are expected.

Visual Resources

It is expected that modifications associated with timber harvest on private and public lands would continue to be observable in the western portion of the watershed. Increases in green tree retention required by the Salem District RMP along with mitigating design features will help to reduce impacts to visual resources on BLM-administered lands. As the seral stage in RR mature, they may help buffer the effects of timber management activities in the watershed.

The eastern portion of the watershed will become more natural appearing as evidence of past management activities disappear. Opportunities for enhancing the visual resources may be identified and implemented as part of the Opal Creek SRA Management Plan.

Recreational Uses

As the population in Marion County and the rest of the Willamette Valley increases, so will the demand for high quality recreation opportunities. In addition, because of time and economic constraints, recreational opportunities close to communities will become more popular. The LNS watershed offers many of the high demand activities in the high demand settings within a day’s trip of large population centers. The gating off of private lands in the LNS watershed and other neighboring watersheds is increasing which will only add to the demand for dispersed recreation opportunities on public lands which are accessible by vehicles. Unless actions are taken to prepare and provide for this growing demand, undesirable impacts associated with recreational use and overcrowding are likely to increase.

Chapter 7 - Findings And Management Recommendations

The preceding chapters serve as the foundation and rationale leading to this chapter. These recommendations should be considered because of the data available for this watershed, which varies qualitatively and quantitatively. The recommendations presented here are set forth in the context of the NFP, SEIS/ROD, and the RMP/FEIS. All recommendations fall within this existing direction. These recommendations can be used to help guide development of site-specific projects including timber sales, habitat restoration, access and travel management planning and biodiversity enhancement. The findings and recommendations for SSSA species are not considered separately but with the Terrestrial and Aquatic sections.

Terrestrial Ecosystems and Special Status/Special Attention Species

Findings:

Finding 1: The amount and quality of older forest habitat are limited in the west half of the LNS watershed. The analysis of current conditions shows 20 percent older forest in the west half of the watershed with Kiel SWB at 6 percent, Sinker SWB at 19 percent, Canyon Creek SWB at 30 percent, and Evans SWB at 31 percent. For federal lands, the amounts are higher with Kiel SWB at 17 percent, Sinker SWB at 46 percent, Canyon Creek SWB at 37 percent, and Evans SWB at 42 percent.

The western half of the watershed (all ownerships) has the potential to support 20 percent older forest habitat within 80 years under current management. Further analysis of future conditions indicate that older forest would likely be most scarce in Kiel and Sinker SWBs, each with less than 14 percent older forest, followed by Canyon Creek SWB at 19 percent and Evans SWB at 40 percent. In the future, older forest habitat would follow RR on federal lands.

There are large blocks of contiguous older forest in the east half of the watershed. The largest amounts of older forest are found in the Battle Ax, Gold, and Opal SWBs. In the eastern half of the watershed, older forest is expected to increase from 70 percent to 85 percent over the next 80 years as forest in wilderness, LSR, SRMA, and WSR mature.

Finding 2: The NFP allows decadal regeneration harvest in GFMA and in CONN LUAs on BLM lands in the western half of the watershed.

Finding 3: There is a scarcity of standing dead/down CWD habitat in the western half of the watershed, especially larger material in the early stages of decay. Estimates show that the amounts on federal lands are below *NFP* standards. Over the long term, they are expected to approach *NFP* standards as older forest develops in RR, and green tree retention guidelines are implemented. There would be an increase on private/state lands as relatively new FPA requirements continue to be implemented. In the eastern half of the watershed, the amount of standing dead/down CWD is expected to remain highly viable at or above *NFP* standards.

Finding 4: Habitat for certain SSSA associated with older forest habitat and standing dead/down logs is limited in the western half of the watershed. These species include the spotted owl, Oregon slender salamander, pileated woodpecker, and various bat species (see Appendix D).

Of the 10 known spotted owl site centers in the watershed, eight were found to be viable at the present time. All of these viable sites are located in the eastern half of the watershed. The two sites located in the western half of the watershed are possibly non-viable and are not expected to be viable anytime in the future. In addition, suitable habitat in the LNS watershed appears to contribute significantly to the viability of one of seven known spotted owl sites located just outside the watershed.

The western half of the watershed was found not to be critical for the dispersal of spotted owls within the Cascade physiographic province. The eastern half was found to be an important element of the large wilderness/LSR network, where the majority of dispersal between known spotted owl sites takes place. Currently the entire watershed is viable for dispersal of spotted owls. Future trends indicate that dispersal will be difficult to maintain in the long term in the western portion of the watershed.

Certain special status and survey and manage plant species are associated with older forest habitats or special habitats found within these ecosystems. Because of the status of the federal lands in the eastern portion of the watershed, these habitats will continue to persist. The lack of older forests in the western portion would limit the available habitat for these species.

Finding 5: The average total road density across the LNS watershed is estimated at just under three miles per square mile; which is considered moderate. However, the total road density in the western portion of the watershed is 5+ miles per square mile, which is considered high. Total road densities are highest in Sinker, Evans, Canyon Creek, and Kiel SWBs. There is a significant percentage of roads which are at least seasonally closed, particularly on private lands. Open road densities in the western portion of the watershed average four miles per square mile, which is considered high. Open road densities are highest in the Evans, Sinker, Kiel, and Canyon Creek SWBs. Road densities on federal lands average less than non-federal lands, high in the western portion of the watershed. On federal lands, total road densities are highest in Canyon Creek, Evans, and Kiel SWBs; open road densities are highest in Evans and Sinker SWBs. Road densities are expected to increase in the western portion of the watershed, as additional roads are constructed for harvest.

Road densities are very low in the eastern portion of the watershed and are expected to remain low in the future.

Finding 6: There is habitat suitable for nesting bald eagles present in the LNS watershed. There are sightings during the nesting season which are suggestive of a potential nest site in the vicinity. Suitable nest sites are abundant in the LNS, with the most promising locations along the ridge that separates the LNS from the North Santiam from the confluence to the eastern end of Opal Creek.

Finding 7: There are suitable cliffs for nesting peregrine falcons, particularly in the eastern half of the watershed. The peregrine falcon is highly likely to occur as a migrant and has been documented late in the nesting season and through fall migration.

Finding 8: Suitable habitat is present in the LNS watershed for four survey and manage animal species. Suitable habitat for the red tree vole occurs throughout the watershed at elevations below 3500 feet. The LNS watershed was screened using the Interim Guidance for the Red Tree Vole. The watershed was found to contain more than 10 percent federal ownership (68%), of which more than 40 percent is suitable habitat (75%). Therefore, surveys for red tree voles would not be required.

Three survey and manage mollusk species could possibly occur in the LNS watershed (see Appendix D). The Oregon megomphix and two tail-droppers (slugs), *Prophysaon coeruleum* and *Prophysaon dubium,* are associated with hardwood logs and litter in moist conifer/hardwood forests.

Six species identified in the ROD as species in need of additional protection have been documented or are highly likely to occur in the LNS watershed. They are the great gray owl, black-backed woodpecker, silver-haired bat, long-legged myotis, long-eared myotis, and pacific western big-eared bat.

Twelve additional Bureau and/or USFS Sensitive species have been documented or are highly likely to occur in the LNS watershed. These include the Oregon slender salamander, tailed frog, red-legged frog, harlequin duck, Northern goshawk, wolverine, and marten among others (see Appendix D).

Finding 9: One BLM and USFS sensitive plant species, *Aster gormanii*, is documented in the high elevation rocky habitats of this watershed. Also, one fungi and four lichen survey and manage species strategy 1 have been documented in the LNS watershed. The blue chanterelle, *Polyozellus multiplex,* the Rainier pseudocyphellaria lichen, *Pseudocyphellaria rainierensis,* the nail lichen, *Pilophorus nigricaulis*, the skin lichen, *Leptogium rivale*, and the seaside tube lichen, *Hypogymnia oceanic*, have been found in the Opal Creek portion of the watershed in association with late-successional forests, and streams and openings within these ecosystems. At least nine other species from the survey and manage list are suspected to occur in the watershed. The likelihood is that many more survey and manage species are present.

Finding 10: Noxious and invasive weeds will continue to be a concern over time because of the increased human use of the watershed, especially in the western elevations and any travel corridors.

Recommendations:

Recommendation 1: (Findings #1, 2, 3, 4, 8) Using an interdisciplinary approach, re-evaluate CONN diversity blocks and the location of the best 25 to 30 percent older forest in and immediately adjacent to the LNS watershed.

Recommendation 2: (Findings #3, 4, 8) Implement NFP standards and guidelines for green tree retention for the recruitment and development of standing dead/down CWD and to contribute to the development of older forest stand characteristics. Protect existing material and leave additional green trees in future harvest units to make up for deficiencies in current conditions.

Criteria: For **GFMA and CONN**, leave trees should be over 12 inches d.b.h and represent the current range of conifer species and include larger diameter trees. In GFMA, leave 10 to 12 green trees per acre; and in CONN leave 16 to 22 trees per acre for recruitment of standing dead/down CWD and development of a large green tree component in future stands. Create enough large, hard standing material to meet the 40 percent level of potential cavity dwelling wildlife populations. For CWD, it is anticipated that natural decay/falldown and blowdown of green tree retention will meet or exceed NFP requirements for down CWD.

For **RR, DDR, LSR**, standing dead/down CWD requirements should approximate those cited in the LSR assessment for the area. Treatment objectives in these allocations would be for growth and/or stand structure enhancement for the purposes of accelerating older forest development in younger age classes. Landscape level considerations include CONN for species, past management, and natural disturbances such as fire, insects, and disease. Fifteen percent cover is the old-growth stage structure CWD goal. This is a long-term goal that varies over the landscape and represents all decay classes of down wood. Twenty-five percent of that cover is represented by sound wood. This represents from three to four percent cover which is three to four times the NFP goals for the Matrix. If decayed logs are deficient, compensation in sound logs can be achieved over time. Snags levels range from 10 to 50 trees per acre of which 50 percent are in the soft stage and 50 percent are the largest available. Small snags will not persist as long as large snags nor provide the same wildlife habitat. Therefore, small trees are not an effective substitute, and leaving trees to grow and become snags later is appropriate in early to mid seral stands.

Recommendation 3: (Finding #4) Protect the best 100 acres of older forest around known spotted owl site centers on federal lands. Coordinate management around known spotted owl sites with adjacent private landowners and the state.

Recommendation 4: (Finding #5) Close and/or rehabilitate roads to reduce road densities. Highest priorities would be first Evans, then Sinker, then Kiel, then Canyon Creek SWBs.

Recommendation 5: (Findings #1, 2, 3, 4, 8, 9) Implement density management prescriptions in RR, DDR, and LSR to develop and maintain older forest stand characteristics in younger age classes. Desirable stand characteristics include larger trees for a large green tree component and recruitment of large standing dead/down CWD in future stands, multi-layered stands with well developed understories, and multiple species that include hardwoods and other minor species.

Criteria: Priorities for density management to accelerate the development of older forest conditions would be highest in RR and second in DDR and LSR.

Objectives in all stands would be to develop and maintain older forest conditions, meet ACS, and maintain existing habitat for the spotted owl.

In young stands less than 30 years of age having less than commercial diameters, additional criteria for identifying and implementing projects include:

a. Use a range of residual tree densities. Consider creating small isolated openings, less than 1/4 acre in size, over less than 5 percent of the area, and leaving 10 percent unthinned.
b. Stocking control: Highest priority are overstocked even-aged stands in excess of 250 dominant/co-dominant trees per acre or 20 percent over target levels of 200-250 tpa.
c. Species composition control: favor minor species including hardwoods by increasing growing space around them.
d. Retain developing understories that do not interfere with the development of dominant and co-dominant trees in the stand.
e. Standing dead/down CWD recruitment: retain enough green tree capital for recruitment in future stands.
f. Identify stands for treatment through stand exams, riparian surveys and/or stocking surveys.
g. These projects could be implemented through jobs-in-the-woods or accomplished collaterally with timber stand improvement projects in Matrix lands.

In 30 to 70 year old aged stands where dominant trees are generally less than 18 inches dbh, there are real opportunities to accelerate tree diameter growth through stocking control. Criteria for identifying projects include:

a. Maintain 40 to 50 percent crown closures. Use a wide range of residual tree densities.

Heavy thinning with as low as 25 to 50 trees per acre should occur over 5 to 15 percent of the area. Consider creating small isolated openings, less than 1 acre in size, over 5 to 15 percent of the area, and leaving 10 percent unthinned.

b. Stocking control: There is a large range of tree sizes attainable in the 30 to 70 year age range. Typical tree sizes without previous stocking control can range from 7 inches dbh and 51 feet tall at age 30 to 14 inches dbh and 105 feet tall at age 70. With one thinning at age 13, tree sizes would average 8 inches dbh and 54 feet tall at age 30 to 16 inches dbh and 107 feet tall. With thinnings at ages 13, 37, 49, and 65 at densities maximizing stand growth, the average tree sizes could be expected to reach 20 inches dbh and 111 feet tall at age 70. These tree sizes can be further increased at densities that maximize individual tree growth rather than stand growth such as the 25 to 50 tree per acre treatments. Highest priority are overstocked even-aged stands of over 40 Relative Density (Curtis 1982). See Appendix C-2, Density Management Stand Tables and Acres Available for Treatment.

c. Species composition control: favor minor species including hardwoods.

d. Retain developing understories where present by reducing overstory stocking to allow for their growth.

e. In heavy thinning treatments understories can be developed by natural regeneration or planting.

f. Standing dead/down CWD recruitment: retain enough green tree capital for recruitment in future stands. Consider creating smaller standing/down dead material to meet standing dead/down CWD criteria as outlined in Recommendation #3.

g. Openings created by *Phellinus weirii* infections can be treated where canopy closure is less than 40 percent. Timber harvesting followed by site preparation may occur. Native disease resistant conifer and/or hardwood species can be planted.

h. Identify stands for treatment through stand exams, riparian surveys and/or stocking surveys.

i. These projects can best be implemented through commercial timber sales in conjunction with those in adjacent matrix lands. Logs may be removed provided standing dead/down CWD recruitment goals are met.

In mature stands 70 to 150 years of age where late successional characteristics are lacking, treatment to create these types of structures could occur. A primarily objective would be to create standing dead/down CWD. No treatment would occur in stands over 80 years of age in DDR and LSR. Criteria for identifying projects include:

a. Maintain an average 60 to 70 percent crown closure. Variable density management treatments could occur in stands previously managed for timber production to create more natural, late successional conditions.

b. Highest priority are single story overstocked even-aged stands that lack late successional structure such as standing dead/down CWD, large cull trees, and multilayered canopies.

c. Species composition control: favor minor species including hardwoods.

d. Retain developing understories where present by reducing overstory stocking to allow

for their growth.
e. In variable density management treatments, understories can be developed by natural regeneration or planting.
f. Create enough large, hard material to achieve standing dead/down CWD criteria (see Recommendation #3). Large material could be created adjacent to streams for recruitment as CWD and/or placed in streams.
g. Openings created by *Phellinus weirii* infections can be treated where canopy closure is less than 40 percent. Timber harvesting followed by site preparation may occur provided standing dead/down CWD debris recruitment goals are attained. Native disease resistant conifer and/or hardwoods can be planted.
h. Identify stands for treatment through stand exams and/or riparian surveys.
i. These projects can best be implemented through commercial timber sales in conjunction with those in adjacent Matrix lands. Logs may be removed provided standing dead/down CWD recruitment goals are met.

Recommendation 6: (Finding No. 10) Continue eradication and monitoring for noxious and invasive weeds over time to prevent extensive outbreaks.

Recommendation 7: (Finding Nos. 6, 7, 8, 9) Survey for priority animal species in the watershed. Special emphasis should be placed on the bald eagles, peregrine falcons, and survey and manage invertebrates.

Aquatic and Special Attention/Special Status Species

Findings

Hydrology

Finding 1: Streamflow in the LNS) may be overallocated during some periods of time. Water rights on the LNSR total 70 cubic feet per second (cfs) and 41 acre feet (aft), not including rights downstream in the NSR such as the City of Salem municipal water right. Discharge is greater than 70 cfs approximately 80 percent of the time. The remaining time the stream may be over allocated.

Finding 2: Climatic trends are apparent and can be broken down into three distinct periods. The first period, 1932 through 1944, experienced western than average precipitation and discharge most years. The second period, 1945 through 1975, received greater than average precipitation and discharge most years. The third period, 1976 to present, was again western than average for precipitation and discharge.

Finding 3: The precipitation/discharge relationship appears to have changed after about 1979. There is a statistically significant difference (P = 0.00) between pre and post 1979 precipitation/discharge relationship. Precipitation after 1979 produced less discharge on an annual basis than prior years.

Finding 4: At the end of the lowest recorded discharge period, there was an estimated 21 days of groundwater storage left in the basin before the stream became dry. Ground water storage available for streamflow in an average year is estimated to be 50 days at the end of the low flow period.

Water Quality

Finding 5: The ODEQ has listed the LNSR as having moderate dissolved oxygen, bacteria, and viruses, low flow, and sediment problems. The LNSR is not in the state's water quality limited stream list. However, the NSR is listed as not meeting water temperature criteria downstream from its confluence with the LNSR.

Finding 6: Water temperature data collected in the LNSR show high summer temperatures in the downstream reaches. Temperatures were above growth threshold for salmon and near the lethal limit during some summer periods. Streams which may be adding significantly to increases include Fawn, Fish, Sinker, Big, Cougar, Moorhouse, Chamberlain, and Wonder Creeks.

Finding 7: Analysis of water quality data from the City of Salem indicates water quality in the LNSR is statistically better than the NSR, except for fecal coliforms. Fecal coliforms were significantly higher in the LNSR than the NSR during the summer low flow period. Water quality decreases in a downstream direction from the USFS boundary.

Finding 8: Water quality may not always meet state standards for fecal coliforms, and alkalinity. City of Salem data indicate values above the state standards during some monthly sampling events. Five fecal coliform samples would have to be collected in a month where a reading exceeding the state standard to verify that the standard is not met.

Finding 9: Storm turbidity sampling indicates Canyon, Sinker, Kiel, Evans, and Fawn Creeks have the highest turbidity levels. The creeks are listed in order of severity, with Canyon Creek being the worst.

Cumulative Impacts

Finding 10: Equivalent clearcut acreage is high in Sinker Creek and moderate in Kiel, Elkhorn, Evans, Canyon, and Battle Axe Creek SWB's.

Finding 11: WAR impacts are high in Kiel, Sinker, Canyon, and Evans Creeks.

Fisheries

Finding 12: Anadromous fish populations (winter steelhead and spring chinook) are declining in the LNS watershed.

Finding 13: Instream habitat conditions in tributaries in the western half of the watershed are generally poor, with long-term improvement anticipated on federal lands as a result of management under the NFP. Habitat conditions in stream segments on private lands managed in accordance with the OFPA are likely to continue to decline. Habitat conditions in streams on federal lands in the eastern half of the watershed are fair to good and will improve under the NFP.

Finding 14: LWD recruitment potential is generally poor in west side tributaries. Improvement is likely on BLM land, whereas decline is likely on private lands. LWD recruitment potential in east side tributaries is generally good and is expected to improve.

Recommendations

Hydrology

Recommendation 1 (Finding 1): Study actual water availability during lowflow periods. Assess impacts of future water withdrawals on instream flows and aquatic organisms.

Recommendation 2 (Finding 2): Consider climatic trends in future studies and analysis of the watershed.

Recommendation 3 (Findings 3 & 4): The change in precipitation/dishcharge relationship appears to be climate related; however, a more in-depth study could be conducted to determine the actual cause if it persists.

Water Quality

Recommendation 4 (Finding 5): Promote public/private partnerships to study and improve water quality and to identify problem areas. Establish limits of acceptable change criteria for water quality in the watershed.

Recommendation 5 (Finding 6): Expand water temperature sampling network to locate temperature sources. Improve or promote riparian shade on stream segments with open canopies.

Recommendation 6 (Finding 7): Expand fecal coliform sampling network to locate sources of fecal bacteria. Reduce sources where possible; for example, provide sanitation facilities in high use dispersed recreation areas in the summer or repair faulty septic systems.

Recommendation 7 (Finding 8): Modify water quality sampling strategy to determine whether state standards are met.

Recommendation 8 (Finding 9): Determine sources of turbidity in Canyon, Sinker, Kiel, Evans, and Fawn Creeks and design enhancement projects to reduce inputs in streams where possible.

Cumulative Impacts

Recommendation 9 (Findings 10 & 11): Minimize management actions that would increase the ECA or WAR levels in the SWB's with the highest existing impacts. Take future forecasting of ECA and WAR into account when planning long-term timber sale activities. Plan restoration activities in SWB's that have the highest ECA and WAR values.

Fisheries

Recommendation 10 (Finding 12): Implement riparian restoration projects on federal lands including underplantings, manual release, thinning of existing stands in the Canyon Creek, Evans Creek, Kiel Creek, and Sinker Creek SWB's.

Recommendation 11 (Finding 13): Implement road reduction projects on federal lands including road closure, obliteration, and grade restoration in SWB's where appropriate.

Recommendation 12: (Finding 14): Implement LWD placement projects on federal lands in the western 0.5 mile of Elkhorn Creek and the western 0.7 mile of Sinker Creek.

Human Uses

What are the major human uses in the LNS Watershed. Where do they generally occur in the watershed? What are the current conditions and trends of the relevant human uses in the watershed? What makes this watershed important to people.

Findings

Finding 1: The LNS watershed is an important place to many people living within and outside the watershed. Water resources, outdoor recreation resources, and the need for old-growth forest habitat were often mentioned by respondents to the scoping questionnaire. Private and public timber resources, water resources, and tourism opportunities also make this watershed economically important to people in many of the surrounding communities. If populations in the central Willamette Valley continue to rapidly increase, the demand for all of these resources will grow, along with the potential for conflict associated with that demand.

Finding 2: In the western half of the LNS watershed, 86 percent (5,602 acres) of BLM-administered lands outside RR have a Matrix LUA. Some level of timber harvest would be expected on lands with this allocation. In the scoping questionnaire, many respondents expressed concerns about the potential impacts of timber harvest to water quality. Concerns about the potential impacts to water quality from commercial mining, recreational use, and residential septic systems were also mentioned. Water quality data is already being gathered on the mainstem of the LNSR by the City of Salem. However, to obtain a more accurate picture of the watershed, more sampling in the tributaries is needed. Such accuracy is often time consuming and expensive; it may not be possible unless landowners and other interested parties in the watershed can work together to develop a comprehensive water quality monitoring and enhancement strategy.

Finding 3: There are several areas with rural interface concerns in the LNS watershed. Some concerns are associated with the potential negative effects of recreational use near or private property such as littering, vandalism, theft, and noise and shooting. The BLM has worked with adjacent landowners to address concerns related to public use of BLM-administered lands; however, more work is still needed. Timber management practices are also of interest and concern to residents living near or adjacent to BLM-administered lands. In addition to the water quality concerns discussed in Finding 2, other concerns include loss of mature forest, impacts to scenic quality, and short-term noise and dust disturbance during logging and hauling activities.

Finding 4: In the west half of the watershed, it is assumed that timber harvesting on private industrial forest lands will continue and be evident from the LNF Road and LNSR. Intermixed with these private industrial lands, the BLM has very little control over scenic quality in the watershed. On BLM-administered lands, the VRM Class I waterfalls would be adequately buffered by RR. VRM Class II lands are expected to have high sensitivity, with the critical viewpoints being the LNSR and North Fork County Road.

Finding 5: Once the prerequisites of the Opal Creek legislation are met, the majority of the USFS lands in the LNS watershed will become part of the OCW, SRA, or the Elkhorn Creek National WSR. The remaining USFS lands will be managed as a Late-Successional Reserve. With timber harvest activities limited in the east half of the LNS watershed, the viewshed would become more natural appearing. Observable evidence of past management activities related to timber harvest and road building will decrease.

Finding 6: There are opportunities for primitive recreation site and trail development on public lands within and outside of the interim boundaries for Elkhorn Creek National WSR. Where feasible, further blocking up of public ownership in this area through land acquisition or exchange with interested private landowners would enhance trail development potential.

Finding 7: Use levels of developed recreation facilities often exceed the capacity of the existing developed recreation facilities during the peak summer use periods. As the population in the surrounding communities continues to grow, overcrowding problems will only become more acute. Several dispersed areas are receiving concentrated levels of overnight and day use with no sanitation facilities, drinking water, or trash receptacles. Some of the more highly used areas are along the eastern portion of the LNSR and Cedar Creek. Some visitors support the need for more facilities, while others feel the development of the dispersed areas would be undesirable to the recreational experience they are seeking.

There is potential for expansion of existing recreation facilities and the development of new facilities in the watershed. The biggest limiting factors are funding for both the development of new sites and the continued operation of any new sites along with existing facilities. Where possible, the recreation providers in the watershed, along with other interested parties, need to work together in developing a strategy for managing recreation use and providing recreation facilities and services. Any dispersed site planning should take into consideration the proximity of many of the dispersed sites to existing mining claims along the eastern portion of the LNSR and Cedar Creek.

Finding 8: The recreational settings in the greatest demand for SCORP Region 8 are semi-primitive and primitive. The east half of the LNS watershed offer the greatest potential for meeting these demands. Lands in the west half of the LNS watershed will continue to provide recreational opportunities in both the rural and roaded modified settings. Dispersed recreational activities such as hunting, OHV use, motorcycle riding, fishing, and target shooting will also continue in the west half of the LNS watershed. Public lands closed to motorized vehicle access provide additional opportunities for non-motorized activities such as mountain biking and horseback riding.

Finding 9: There is a lack of visitor orientation and interpretive information in the LNS watershed given the level of use that occurs and the educational opportunities the watershed offers. Interpretation in the Opal Creek SRA will be addressed in the management plan. This may help facilitate discussions about needs in the rest of the watershed.

Finding 10: In the past, there have been meetings between landowners in the watershed and Marion County Sheriff's department to discuss public use issues in LNS watershed related to vandalism, trespass, unsafe firearm use, illegal dumping, long-term occupancy, and a variety of other issues. If use continues to grow at a faster rate than individual agency resources can manage, cooperative management and projects will only become more important.

Recommendations

Recommendation 1 (Findings 1, 3, 4): Many of the same management practices can be used to mitigate potential impacts associated with timber harvest activities in areas with rural interface and visual resource concerns. Special consideration should be given to those BLM-administered lands which have high sensitivity for both Rural Interface and Visual Resource concerns. Below is a list of mitigating actions that could be taken depending on the proposed action and the site specific characteristics.

* Get adjacent landowner input early in planning process for areas with a potential for high sensitivity to better determine areas of concern.

* Early in project planning, consider reducing visual or other disturbance factors in designing the size, shape, and location of the timber harvest units or project. Consider small patch cuts, thinning, or uneven aged management to better maintain forest cover.

* Where possible, utilize green retention trees and RR to buffer the visual impacts from view. Consider leaving additional trees for added buffering were needed.

* Where possible, consider using alternative reforestation site preparation prescriptions to broadcast burning.

Recommendation 2 (Findings 1, 2, 3): Examine feasibility of developing partnerships with interested parties in a water quality monitoring and enhancement strategy for LNS watershed.

Recommendation 3 (Findings 6, 7): As funding and time allows, look for opportunities for expanding existing developed recreation facilities as well as developing new recreation facilities.

Recommendation 4 (Finding 8): The USFS may want to consider utilizing "Limits of Acceptable Change" or some other monitoring system to help set use criteria for the proposed OCW.

Recommendation 5 (Findings 6, 7): Look for opportunities for increasing public ownership in areas with high recreational and other resource values by working with private landowners that are interested in exchange or acquisition. An example would include enhancing public access to the LNSR or for trail development potential near Elkhorn Creek.

Recommendation 6 (Findings 7, 8, 9, 10): Opportunities should be identified and pursued for increasing cooperation among interested parties on recreation related issues such as recreation maintenance and development, visitor orientation and interpretive information (including road signing), visitor management, and law enforcement. One potential project already being discussed is constructing a visitor orientation information kiosk (including such things as a map, general use information, and leave no trace use ethics) for the watershed and surrounding areas. Initial partners include BLM, USFS, ODF, North Santiam Economic Development Corporation, and North Santiam Tourism Coalition.

The Opal Creek SRA Management Plan will address many of the recreation issues mentioned above for the eastern portion of the watershed. Where possible, connections and relationships to the western portion of the watershed should be considered and incorporated into the Opal Creek

SRA planning process.

Recommendation 7 (Findings 5, 9, 10): Clean up all known abandoned vehicle and garbage dump sites on BLM lands. Evaluate the feasibility of increasing BLM law enforcement and staff patrolling on BLM lands. Work with adjacent landowners and interested parties on holding an annual cleanup along LNF Road and the LNSR.

Chapter 8 - Monitoring, Data Gaps, and Limitations

1. Lack of information on Special Status /Special Attention animal species occurrence in the LNS watershed, especially the bald eagle, peregrine falcon, and potential survey and manage invertebrates.

2. Lack of information on presence and abundance of nonvascular plants and fungi.

3. Interdisciplinary re-evaluation of older forest stands in CONN for the purposes of identifying the best 25 to 30 percent to retain in the short term (Recommendation 1).

4. Transportation management objectives identifying specific roads to be closed or rehabilitated (Recommendation 5).

5. TPCC type classification on private land.

6. New soil survey for Marion County (planned by NRCS)

Inventory/Monitoring Needs

1. Survey for priority plant species in the watershed. Special emphasis should be placed on survey and manage nonvascular plants and fungi.

2. Continue cooperative efforts with adjacent private landowners and the state to survey and manage known spotted owl sites in the western portion of the watershed.

3. Survey for special habitats in the watershed for the purpose of creating an accurate GIS layer of special habitats.

4. Continue monitoring of noxious and invasive weeds.(Recommendation #6)

Data Gaps:

1. Extensive riparian surveys and fish habitat surveys have covered nearly every tributary and river in the western half of the watershed. Time did not permit complete analysis of these surveys which will have to be incorporated into a later iteration of this analysis. From these surveys, functioning condition could be assessed. Classification according to the Rosgen scheme could be used to predict sensitivity to disturbance, recovery potential, sediment supply,

streambank erosion potential, and vegetation controlling influence (USDI/BLM 1993) (Rosgen 1996).

2. Fish distribution surveys in many tributaries would reduce reliance on assumption that third order and larger streams are fish bearing (known to overestimate miles of fish-bearing streams).

3. Habitat inventory needed on Sinker Creek, below barrier falls (RM 0.7).

4. Water quality monitoring of tributaries with high sediment loads.

Appendix A. Acronyms

The following list of Acronyms are used in this document.

ACS	Aquatic Conservation Strategy
Act (The)	Opal Creek Wilderness & Opal Creek Scenic Recreation Act of 1996
AWHC	Available Water Holding Capacity
BLM	Bureau of Land Management
CCC	Civilian Conservation Corps
CONN	Connectivity
CWD	Coarse Woody Debris
DBH	Diameter at Breast Height
DDR	District Designated Reserve
DEQ	Department of Environment Quality
ECA	Equivalent Clearcut Acres (or Acreage)
FEMAT	Report of the Forest Ecosystem Management Assessment Team
FPA	Forest Practices Act (State of Oregon)
GFMA	General Forest Managment Area
GLO	General Land Office
HEc	Habitat Effectiveness for cover quality
HEf	Habitat Effectiveness for forage quality
HEr	Habitat Effectiveness for open road densities

HEs Habitat Effectiveness for size and spacing

HJA H. J. Andrews Experimental Forest

IDT Interdisciplinary Team

KOS Known Owl Site

LNS Little North Santiam

LSR Late Successional Reserve

LUA Land Use Allocation

LWD Large Woody Debris

NEPA National Environmental Policy Act

NMFS National Marine Fisheries Service

NF National Forest

NFP Northwest Forest Plan

NSR North Santiam River

ONHP Oregon Natural Heritage Program

O & C Oregon and California Railroad land grants

OCW Opal Creek Wilderness

ODF & W Oregon Departmtment of Fish & Wildlife

ODF Oregon Department of Forestry

PCT Precommercial Thinning

PFC Potential Future Condition

PSQ Probable Sale Quantity

RIA Rural Interface Area

RMP/FEIS Salem District Resource Management Plan/Final Environmental Impact Statement

RN Roaded Natural

ROD Northwest Forest Plan Record of Decision

ROS Recreation Opportunity Spectrum

RR Riparian Reserves

SCORP Statewide Comprehensive Outdoor Recreation Plan

SEIS/ROD Supplemental Environmental Impact Statement/Record of Decision for Amendments to Forest Service and Bureau of Land Management Planning Documents Within the Range of the Northern Spotted Owl

SFP Special Forest Products

SRA Scenic Recreation Area (Opal Creek)

SSSA Special Status/Special Attention Species

SWB Subwateshed

TPCC Timber Productivity Capability Class

TSZ Transient Snow Zone

USFS U. S. Forest Service

USGS U. S. Geologic Survey

VRM Visual Resource Management

WAA Watershed Analysis Area

WAR Water Available for Runoff

WODIP Western Digital Imaging Project

WRB Willamette River Basin

WSR Wild and Scenic River

APPENDIX B - SCOPING LETTER AND HISTORICAL PERSPECTIVE

DEAR CONCERNED CITIZEN

The U. S. Bureau of Land Management, Cascades Resource Area, and the U.S. Forest Service, Detroit Ranger District are in the initial stages of a watershed analysis for the Little North Santiam River. We are interested in public issues and comments that pertain to this particular watershed. Your involvement in federal land management activities is an integral step in the watershed analysis process.

The 72,000+ acre Little North Santiam watershed starts at the headwaters of the Little North Santiam River on the Willamette/Mt. Hood National Forest boundary and ends at the confluence of the Little North Santiam and the North Santiam River (reference map enclosed). The Opal Creek and Elkhorn Creek sub-basins are in this watershed. The Little North Santiam watershed has been identified as a Tier 1 Key Watershed in the Northwest Forest Plan for directly contributing to the conservation of habitat for at-risk fish stocks. We would like to know if you want to be part of our mailing list for this process. Please use the enclosed historical perspective and questionnaire to help us determine what you see as the major issues and concerns in this watershed. In addition, please identify issues that are important for us to consider in planning for future management activities on federally managed lands, primarily issues associated with public lands. .

Under ecosystem management and watershed analysis, consideration of issues at the watershed level is essential. Management at this scale considers all known ecosystem components, social and economic values, and broad requirements of agency land use plans. Synthesis of this data will help give direction to future proposed actions and restoration opportunities for maintenance and enhancement of resources on public lands within the watershed.

Analysis considers resource conditions in the entire watershed, regardless of land ownership or jurisdictional boundaries. Management objectives for federally managed lands are based on ecosystem condition and anticipated objectives of other landowners. The watershed analysis process is not intended, nor will it be used to dictate, influence, or judge management direction on non-federally managed lands. It is our ultimate goal to work collaboratively with those sharing the watershed and with other interested parties to ensure the continued health of the forest ecosystem along with meeting management objectives outlined in the forest plan. We will use the response to this letter to build our mailing list. Please return the questionnaire to the Salem District BLM office and/or contact John DePuy at (503) 315-5919 if you wish to remain on the list. Please complete and return the questionnaire by April 20, 1996. No response is necessary if you are not interested in receiving information or participating in the watershed analysis process.

Sincerely yours

Richard Prather, Cascades Resource Area Manager, U. S. Bureau of Land Management

Bill Funk, Detroit District Ranger, U. S. Forest Service

LITTLE NORTH FORK WATERSHED
HISTORICAL PERSPECTIVE

On April 2, 1994, President Clinton convened the Forest Conference in Portland, OR, to address the human and environmental needs served by the federal forests of the Pacific Northwest including northern California. The conference ended with the President directing his cabinet to craft a balanced, comprehensive, long-term policy for management of all public lands within the range of the spotted owl.

In February, 1994, the Final Supplemental Environmental Impact Statement for Management of Habitat for Late-Successional and Old-Growth Related Species Within the Range of the Spotted Owl (FSEIS) was released to the public. The FSEIS, containing the "Forest Plan", described various alternatives for the management of public lands and selected Alternative 9 as the 'Preferred Alternative". After reviewing the FSEIS and other pertinent information the Secretaries of Agriculture and Interior, finalized the process by issuing a document called the "Record of Decision."

The Record of Decision (ROD) for Amendments to Forest Service and Bureau of Land Management Planning Documents Within the Range of the Northern Spotted Owl was signed by Secretary of Agriculture Epsy and Secretary of the Interior Babbit on April 13, 1994. This document formally adopted Alternative 9 as the future land management strategy with some modification.

A key component of all these documents is the Aquatic Conservation Strategy. This Strategy has four components. They are riparian reserves, key watersheds, watershed analysis, and watershed restoration. The Little North Santiam has been identified in the "Forest Plan" as a Tier 1 Key Watershed for directly contributing to the conservation of habitat for at-risk fish species. All Key Watersheds require watershed analysis before further resource management activity can be undertaken on federally managed lands.

The U. S. Bureau of Land Management, Cascade Resource Area, in cooperation with the U. S. Forest Service, Detroit Ranger District, are in the beginning stages of the Little North Santiam watershed analysis. Input from the public is essential to this process and many opportunities will be provided throughout the process for public involvement.

APPENDIX C TERRESTRIAL

C1. Soils of the Little North Santiam Watershed

Little North Santiam Watershed Soils

Soils Groups	Acres	% of watershed	Description
Keel, Hummington, Highcamp	38,369	53.17	Cryic cold soils
Winopee, Dinzer, Talapus	8,759	12.14	Cryic cold soils
Peavine, Honeygrove, Orford	10,445	14.48	Silty clay loams, Clay loams
Klickatat, Kinney, McCully	13,920	19.29	Gravelly, cobbly loams
Chehalis, Cloquato, Newberg	2		Hydric soils
Malabon, Coburg, Salem	662	0.92	Silt loams
	72,157	100.00	

65.31 % of the watershed (nearly 2 out of 3) lie in the cryic soil temperature zones, which are defined (for the purpose of this analysis) as the snow dominated zones and field studies conducted by William Power have shown to be nitrogen limiting.

Cryic/Udic Soil Temperature/Moisture Zones

Cryic soil groups of Little North Santiam Watershed. 38,369 acres or 53.17 % of watershed)

Soil Series	Texture	Effective soil depth	Available water holding capacity (AWHC) (inches)	Site index
Keel	Gravelly silt loam	20 - 40 inches	5 - 8 inches total 5 - 6 top 20 inches	130
Hummington	Very gravelly loam	20 - 40 inches	7-11 total 5 top 20 inches	145
Highcamp	very gravelly loam	40 - 60 inches	3.5 - 9 total 2.5 top twenty inches	110

Cryic soil groups of Little North Santiam Watershed. (8,760 acres or 12.14 % of watershed)

Soil Series	Texture	Effective soil depth	AWHC (inches)	Site index
Talapus	Very gravelly loam	60+ inches	5 - 10 inches total 2 1/4 - 3 1/2 top 20 inches	98
Winopee	Loamy sand - gravelly sand - gravelly loam	40 - 60 inches	7-19 total	? (Hardpan at 40 inches)
Dinzer	very gravelly loam	60+ inches (solum 12 - 24 inches)	3.5 - 9 total 2.5 top twenty inches	?

Mesic/Udic Soil Temperature/Moisture Zones (10,445 acres/14.48%)

Soil Series	Texture	Effective soil depth	AWHC (inches)	Site index
Peavine	Silty clay loam	20 - 40 inches	5 - 7 inches total 3 -3 1/2 top 20 inches	160
Honeygrove	Silty clay loam	60+ inches	8 - 10 total; 2 3/4 - 3 1/4 first 20 inches	155 - 165
Orford	silty clay loam over silty clay	60+ inches	9- 10 1/2 total 3 1/2 - 4 top twenty inches	175

Mesic/Udic Soil Temperature/Moisture Zones (13,920 acres/19.29%)

Soil Series	Texture	Effective soil depth	AWHC (inches)	Site index
Klickatat	Stony loam - gravelly clay loam	40 - 60 inches	3 - 5 inches total 1 1/2 - 2 top 20 inches	145
Kinny	Cobbly loam over cobbly clay loam	40 - 60 inches	8 - 12 total; 3 - 4 1/2 first 20 inches	150 - 180
McCully	gravelly loam over silty clay over clay	40 - 60 inches	6 - 10 total 3 - 3 1/2 top twenty inches	162

Mesic/Xeric Soil Temperature/Moisture Zones for Soils on Floodplains (2 acres/0.0033 % of watershed)

Soil Series	Texture	Soil depth	AWHC (inches)	Site Index
Chehalis	Silty clay loam	60+	10 - 13 total; 3 3/4 - 4 1/4 top 20 inches	130

Cloquato	Silt loam	60+	9 - 11 total; 4 - 4 1/2 top 20 inches	125
Newberg	Fine sandy loam	60+	6 - 9 total; 2 1/2 - 3 inches top 20 inches	147

Mesic/Xeric Soil Temperature/Moisture Zones for Soils on alluvial stream terraces (662 acres / 0.92% of watershed)

Soil Series	Texture	Soil depth	AWHC (inches)	Site index
Malabon	Silty clay loam	60+	10 - 12 total; 3 1/2 - 4 top 20 inches	166
Coburg	Silty clay loam	60+	10 - 12 total; 3 1/2 - 4 top 20 inches	None given
Salem	Gravelly silt loam	60 +	3 - 8 inches total; 2 - 3 1/2 top 20 inches	155

APPENDIX C2. DENSITY MANAGEMENT STAND TABLES AND TOTAL ACRES AVAILABLE FOR TREATMENT

Density Management Stand Tables: ages 0 to 70 years

The following tables approximate growth that could be achieved through density management treatments at various ages. The source is U.S. Forest Service General Technical Report PNW-135, Jan 1982, Yield Tables for Managed Stands of Coast Douglas-fir by Robert O. Curtis, Gary W. Clendenen, Donald L. Reukema and Donald J. Demars. The assumptions are an average site index for Douglas-fir of 105 at 50 years (King); initial planting of 400 trees per acre, density management at age 13 to 300 trees per acre and subsequent density management treatments at ages 37, 49, and 65 to an approximate 40 relative density (Curtis). Actual results would vary depending on site specific prescriptions and environmental conditions.

Site Index 105, King					
No Treatment					
		Basal Area			Relative
Age	Trees/Acre	/Acre	DBH	Ht	Density
1	400				
30	392	104	6.98	51.5	39
40	348	157.1	9.09	68.9	52
50	301	197.4	10.96	83.1	60
60	261	230.1	12.7	95.1	65
70	230	256.4	14.31	105.3	67
Density Management					
Treatment at Age 13					
		Basal Area			Relative
Age	Trees/Acre	/Acre	DBH	Ht	Density
1	400				
13	300				
30	296	111.4	8.3	53.6	39
40	279	172.1	10.64	70.9	53
50	250	218.7	12.66	85	61

60	223	255.1	14.5	97.1	67
70	197	280.1	16.16	107.2	70
Density Management					
Treatments at ages 13,37,49,65					
		Basal Area			Relative
Age	Trees/Acre	/Acre	DBH	Ht	Density
1	400				
13	300				
30	296	111.4	8.3	53.6	39
37	286	155.7	9.99	66.1	49
Treat 37	200	115.3	10.28	66.6	36
40	199	134.2	11.12	71.9	40
49	192	181.1	13.15	85.6	50
Treat 49	129	139.1	14.06	86	37
50	129	144.4	14.34	87.5	38
60	127	190.6	16.61	100.2	47
65	125	210.4	17.6	105.6	50
Treat 65	90	171.6	18.72	106	40
70	89	193.5	19.95	111.2	43

Total Acres Available for Treatment: ages 10 to 150 years

The following table summarizes **total** conifer/hardwood acres in BLM administered riparian reserves and District Designated Reserve, and USFS administered Late Successional Reserve by age class. Acres actually available for treatment would be considerably less based on the criteria outlined in Chapter 7, Recommendation #5.

CONIFER STANDS					
			Area in Acres by Age Class		
Allocation			10 to 30 yrs	30 to 70 yrs	70 to 150 yrs
BLM	Riparian Reserves		447	1803	1192
			10 to 30 yrs	30 to 80 yrs	
BLM	DDR		7	111	

USFS	LSR		205	515	851
HARDWOOD STANDS					
			20 yrs plus		
BLM	Riparian Reserves		519		
BLM	DDR		101		

APPENDIX D SSSA Species

D1. Special Attention/Special Status Plants Searched for in the LNS Watershed

SPECIES & STATUS	HABITAT	ELEVATION (FT)	BEST I.D. SEASON
FEDERAL ENDANGERED (FE)			
LOMATIUM BRADSHAWII (Rose) Math. & Const. Bradshaw's lomatium	WV Linn, Mari WET MEADOWS GRAVELLY STREAMBEDS	<750	APRIL-MAY
FEDERAL THREATENED (FT)			
HOWELLIA AQUATILLIS A. Gray howellia	WV Clac, Mari, Mult SHALLOW PONDS & MARSHES	<200	MAY
SIDALCEA NELSONIANA Piper Nelson's sidalcea	WV Linn, Mari	<2000	JUNE-JULY
FEDERAL PROPOSED THREATENED (PT)			
CASTILLEJA LEVISECTA Greenm. golden paintbrush	WV Linn, Mari, Mult WET OR VERNALLY WET MEADOWS	<1000	APRIL-AUGUST
FEDERAL CATEGORY 1 CANDIDATES (FC1)			
DELPHINIUM PAVONACEUM Ewan peacock larkspur	WV clac, Mari, mult	<1500	MAY-JUNE
ERIGERON DECUMBENS Nutt. VAR. *DECUMBENS* Willamette daisy	WV Clac, Linn, Mari GRASSLANDS	<1000	JUNE-EARLY JULY
BUREAU SENSITIVE (BS)			
ASTER CURTUS Cronq. white-topped aster	WV Clac. Linn, Mari, Mult.		
ASTER GORMANII (Piper) Blake Gorman's Aster	WC Clac, Linn, Mari OPEN OR SPARSLEY TIMBERED, ROCKY RIDGETOPS & MEADOWS	>3500	LATE JULY-AUGUST
CIMICIFUGA ELATA Nutt. tall bugbane	WV, WC, Clac, Linn, Mari, Mult MOIST WOODS	<2000	JUNE-MID JULY
CORYDALIS AQUAE-GELIDAE Peck & Wilson cold-water corydalis	WC Clac, Linn, Mari, Mult COLD SPRINGS & STREAMS	>1000	MID JUNE-JULY

SPECIES & STATUS	**HABITAT**	**ELEVATION (FT)**	**BEST I.D. SEASON**
DELPHINIUM LEUCAPHAEUM Greene white rock larkspur	WV Clac, Mari, Mult	<1000	MAY-EARLY JUNE
DELPHINIUM OREGANUM How. Willamette Valley larkspur	WV Linn, Mari	LOW	
HORKELIA CONGESTA Douglas ssp. *CONGESTA* shaggy horkelia	WV Linn OPEN SANDY OR ROCKY FLATS TO OPEN WOODS	LOW	APRIL-JUNE
LUPINUS SULPHUREUS Douglas ssp. *KINKAIDII* (Smith) Phillips Kincaid's lupine	WV Linn, Mari WILLAMETTE VALLEY	<1500	MAY-JULY
MONTIA HOWELLII S. Watson Howell's montia	WV, WC Clac, Linn, Mult ROCKY RIVER BANKS ESP. IN DISTURBED SITES	<2500	APRIL-EARLY MAY
OXYPORUS NOBILISSIMUS W.B. Cooke giant polypore fungus, fuzzy sandozi	WC Clac, Linn OLD GROWTH NOBLE FIR		
ROMANZOFFIA THOMPSONII Marrala ined. Thompson's mistmaiden	WC Linn, Mari SEEPY ROCK WALLS WITH FULL SUNLIGHT	>2600	APRIL-EARLY MAY
ASSESSMENT SPECIES (AS)			
BOTRYCHIUM MINGANENSE Vict. gray moonwort	WC Linn		
BOTRYCHIUM MONTANUM W.H. Wagner mountain grape-fern	WC Linn, Mari		
CALAMAGROSTIS BREWERI Thurb. Brewer's reedgrass	WC Clac, Mari STREAMBANKS, LAKE MARGINS, & MOIST MEADOWS	>4000	
CICENDIA QUADRANGULARIS (Lim.) Griseb (*Microcala quadrangularis*) timwort	WV Linn MARSHY MEADOWS	300-1700	MAY-JUNE
HUPERZIA OCCIDENTALIS (Clute) Beitel (*Lycopodium selago*) fir club-moss	WC Clac, Linn, Mari DENSE MOIST WOODS HUMID AREAS EXPOSED CLIFFS & TALUS	>1000	JULY-AUGUST
HYPOGYMNIA OCEANICA Goward lichen	WC Mari		

SPECIES & STATUS	**HABITAT**	**ELEVATION (FT)**	**BEST I.D. SEASON**
LOPHOZIA LAXA (Lindb.) Grolle liverwort	WC Linn		
LYCOPODIELLA INUNDATA (L.) Holub (Lycopodium inundatum) bog club-moss	WC Clac, Linn SPHAGNUM BOGS MUDDY ELK WALLOWS	>3000	
LYCOPODIUM COMPLANATUM L. ground cedar	WC Clac, Mari, Mult MOIST FORESTS	>3000	
MIMULUS TRICOLOR Hartw. Ex Lindl. three-colored monkeyflower	WV Linn, Mari VERNAL POOLS FLOODPLAINS	<1000	MAY - JUNE
NEPHROMA OCCULTUM Wetm. Lichen	WC Clac, Linn		
OPHIOGLOSSUM PUSSILUM Raf. (O. vulgatum) L. misapplied adder's tongue	WC Clac, Linn WET MEADOWS BOGS	2000	
PANNARIA RUBIGINOSA (Ach.) Bory lichen	WC Mari		
POLYSTICHUM CALIFORNICUM (D.C. Eat.) Diels California sword-fern	WC Linn BASE OF CLIFFS & OUTCROPS IN SHADE	MID	
SCHEUZERIA PALUSTRIS L. Var. AMERICANA Fern. scheuchzeria	WC Clac, Linn, Mari BOGS LAKE MARGINS	3400-4000	JUNE-JULY
STEREOCAULON SPATHULIFERUM Vainio lichen	WC Linn		
STREPTOPUS STREPTOPOIDES (Ledeb.) Frye & Rigg krushea	WC Clac, Mult		
TAYLORIA SERRATA (Hedw.) Bruch & Schimp. In B.S.G. moss	WV, WC Clac, Mari WETLANDS		
WOLFFIA COLUMBIANA Carst. Columbia water-meal	WV, WC Clac, Linn, Mult		

SPECIES & STATUS	**HABITAT**	**ELEVATION (FT)**	**BEST I.D. SEASON**
TRACKING SPECIES (TS)			
ALLIUM CAMPANULATUM S. Watson Sierra onion	WC Linn DRY SOILS	HIGH	JUNE-JULY
ARABIS FURCATA S. Watson cascade rockcress	WC Clac, Mari CLIFFS, TALUS ALPINE & SUBALPINE MEADOWS	MID-HIGH	MAY-JULY
BERGIA TEXANA (Hook.) Seub. Texas bergia	WV Mult		
CASTILLEJA RUPICOLA Piper cliff paintbrush	WC Linn, Mari, Mult CREVICES IN ROCKS	>500	JUNE-AUGUST
CYPERUS ACUMINATUS Torr. & Hook short-pointed cyperus	WV Linn		
CYPERUS SCHEINITZII Torr. Schweinitz cyperus	WV? Mult?		
CYPRIPEDIUM MONTANUM Douglas mountain lady's-slipper	DRY TO FAIRLY MOIST, OPEN TO SHRUB- OR FOREST-COVERED VALLEYS OR MOUNTAIN SIDES.	LOW-MID	MAY-AUGUST
DOUGLASIA LAEVIGATA A.Gray smooth-leaved douglasia	WC Clac, Mari, Mult, Linn ROCK CREVICES ON WET CLIFFS	MID-HIGH	JUNE-JULY
ELMERA RACEMOSA (S. Watson) Rydb. VAR. *PUBERULENTA* C.L. Hitchc. hairy elmera	WC Linn ROCKY PLACES	>5000	AUGUST
ELODEA NUTTALLII (Planchon) H. St. John Nuttall's waterweed	WV, WC Mult		
EPILOBIUM LATIFOLIUM L. broad-leaved willow-herb	WC Linn		
EPILOBIUM LUTEUM Pursh yellow willow-herb	WC Clac, Linn		
ERIGERON CASCADENSIS Heller cascade daisy	WC Linn, Mari	MID-HIGH	JUNE-JULY
EUONYMUS OCCIDENTALIS Torr. Western wahoo	WV, WC Clac, Mult		
GYMNOMITRION CONCINNATUM (lightf.) Corda liverwort	WC Mult		

SPECIES & STATUS	**HABITAT**	**ELEVATION (FT)**	**BEST I.D. SEASON**
HERBERTUS ADUNCUS (Dicks.) S.F. Gray liverwort	WC Mult		
*HETERANTHERA DUBIA (*Jacq.) MacMill. Water star-grass	WV Mult.		
HIERACIUM CANADENSE Mischx. Canadian hawkweed	WV Mult		
HIERACIUM LONGIBERBE How. Long-bearded hawkweed	WC Mult		
HYPOGYMNIA DUPLICATA (SM. Ex Ach.) Rass. lichen	WC Mult		
ISOPYRUM STIPITATUM A. Gray dwarf isopyrum	WV Mari CASCADES SHADY PLACES	LOW-MID	FEBRUARY-MAY
JUNCUS KELLOGGII Engelm. Kellogg's dwarf rush	WV Mari DAMP OR WET PLACES FROM OPEN FIELDS TO MONTANE MEADOWS AT MID ELEVATIONS	LOW-MID	APRIL-JULY
JUNCUS TORREYI Cov. Torrey's rush	WV Mult.		
LATHYRUS HOLOCHLORUS (Piper) C.L. Hitchc. thin-leaved peavine	WV Clac, Linn, Mari WILLAMETTE VALLEY FENCEROWS LOAMY,MOIST SOIL	<1500	JUNE
LECIDEA DOLODES Nyl. lichen	WC Linn		
LYCOPODIUM ANNOTINUM L. stiff club-moss	WC Clac, Mari, Mult SPHAGNUM HUMMOCKS IN MOIST SHADY BOGS	MID	JULY-AUGUST
MERTENSIA BELLA Piper Oregon bluebells	WC Linn, Mari		
MIMULUS PULSIFERAE A. Gray candelabrum monkeyflower	WV Linn BARS ALONG STREAMS		APRIL-JUNE
MONTIA DIFFUSA (Nutt.) Greene branching montia	WV, WC Clac, Linn, Mari, Mult MOIST WOODS RECENTLY BURNED AREAS	<3500	APRIL-JULY
MYRICA GALE L. Sweet gale	WC, Mult		
PARVISEDUM PUMILUM (Benth.) Clausen sierra mock-stonecrop	WV Mult?		

SPECIES & STATUS	**HABITAT**	**ELEVATION (FT)**	**BEST I.D. SEASON**
PILOPHORUS NIGRICAULIS Sato lichen	WC Linn, Mari, Mult		
POA LAXIFLORA Buckl. Loose-flowered bluegrass	WC Clac, Mult.		
POLYGONUM PUNCTATUM Elliott dotted smartweed	WV Mult		
SCAPANIA GYMNOSOMOPHILA Kaal. liverwort	WC Mult		
SCIRPUS CYPERINUS (L.) Kunth. woolgrass	WV Linn, Mult.		
SCIRPUS PENDULUS Muhl. (S.lineatus) drooping bulrush	Linn		
SIDALCEA CAMPESTRIS Greene meadow sidalcea	WV Clac, Linn, Mari, Mult FENCEROWS & ROADSIDES	<1000	LATE JUNE-JULY
SIDALCEA CUSICKII Piper Cusick's checker-mallow	WV Linn	<4000	MAY-JULY
SILENE SUKSDORFII Robins. Suksdorf's silene	WC Mari ALPINE & SUBALPINE SCREE SLOPES	>4000	JULY-SEPT
SYNTHYRIS STELLATA Pennell (includes S. Missurica ssp. Hirsuta starry synthyris	WC Mult		
VACCINIUM OXYCOCCUS L. Var. INTERMEDIUM wild bog cranberry	WC Clac, Linn, Mari, Mult. SPHAGNUM BOGS	LOW-MID	MAY-JULY
VERBENA HASTATA L. Blue verbena	WV, WC Clac, Mult		

D. 2 Survey and Manage Species known to occur in the Cascade Resource Area

This list is adapted from Appendix B-1 Managment of SEIS Special Attention Species in the Salem District ROD and Management Plan. Only species known to occur in the Cascade Resource Area are listed.

SPECIES	**SURVEY STRATEGIES**			
	1	**2**	**3**	**4**
FUNGI **CHANTERELLES**				
CANTHARELLUS CIBARIUS			X	X
CANTHARELLUS SUBALBIDUS			X	X
CANTHARELLUS TUBAEFORMIS			X	X
CHANTERELLES - GOMPHUS				
GOMPHUS CLAVATUS			X	
**GOMPHUS FLOCCOSUS*			X	
GOMPHUS KAUFFMANII			X	
RARE CHANTERELLE				
CANTHARELLUS FORMOSUS	X		X	
POLYOZELLUS MULTIPLEX	X		X	
RARE CORAL FUNGI				
RAMARIA STUNTZII	X		X	
PHAEOCOLLYBIA				
PHAEOCOLLYBIA CALIFORNICA	X		X	
PHAEOCOLLYBIA KAUFMANII	X		X	
PHAEOCOLLYBIA SPADICEA			X	
TOOTH FUNGI				
HYDNUM REPANDUM			X	
HYDNUM UMBILICATUM			X	
NOBLE POLYPORE (RARE AND ENDANGERED)				
OXYPORUS NOBILISSIMUS	X	X	X	
RARE RESUPINATES AND POLYPORES				
**GYROMITRA INFULA*			X	X
RARE CUP FUNGI				
ALEURIA RHENANA				

PARASITIC FUNGI				
HYPOMYCES LUTEOVIRENS			X	
CAULIFLOWER MUSHROOM				
SPARASSIS CRISPA			X	
LICHENS				
RARE NITROGEN-FIXING LICHENS				
PANNARIA RUBIGINOSA	X		X	
PSEUDOCYPHELLARIA RAINIERENSIS	X	X	X	
NITROGEN FIXING LICHENS				
LOBARIA OREGANA				X
LOBARIA PULMONARIA				X
LOBARIA SCOBICULATA				X
NEPHROMA BELLUM				X
NEPHROMA HELVETICUM				X
NEPHROMA LAEVIGATUM				X
NEPHROMA RESUPINATUM				X
PANNARIA SAUBINETII				X
PELTIGERA COLLINA				X
PELTIGERA PACIFICA				X
PSEUDOCYPHELLARIA ANOMAL.A				X
PSEUDOCYPHELLARIA ANTHRASPIS				X
PSEUDOCYPHELARIA CROCATA				X
STICTA FULIGINOSA				X
STICTA LIMBATA				X
PIN LICHENS				
CALICIUM VIRIDE				X
CHAENOTHECA FURFUACEA				X
CYPHELIUM INQUINANS				X
RARE ROCK LICHENS				
PILOPHORUS NIGRICAULIS	X		X	
RIPARIAN LICHENS				
CETRELIA CETRARIOIDES				X
RAMALINA THRAUSTA				X

**USNEA LONGISSIMA*				X
AQUATIC LICHENS				
LEPTOGIUM RIVALE	X		X	
RARE OCEANIC INFLUENCED LICHENS				
HYPOGYMNIA OCEANIC	X		X	
BRYOPHYTES				
**ANTITRICHIA CURTIPENDULA*				X
PTILIDIUM CALIFORNICUM	X	X		X
VASCULAR PLANTS				
ALLOTROPA VIRGATA	X	X		
**CORYDALIS AQUAE-GELIDAE*	X	X		

D. 3 Noxious Weeds to Search for in the LNS WAA

H = Hitchcock & Cronquist. Flora of the Pacific Northwest. W = Weeds of the West.

PRIORITY I SPECIES - POTENTIAL NEW INVADERS *known populations in the Cascade Resource Area			
SCIENTIFIC NAME	**COMMON NAME**	**BEST ID. SEASON**	**COMMENTS**
CARDUUS PYCNOCEPHALUS	Italian thistle	May - June	H. Pg.188
CARTHAMUS LANATUS	distaff thistle		W. Pg. 80.
CARTHAMUS LEUCOCAULOS	whitestem distaff thistle		
CENTAUREA SOLSTITIALIS	yellow starthistle		W. Pg. 94
CENTAUREA VIRGATA	squarrose knapweed		W. Pg. 97
CHONDRILLA JUNCEA	rush skeletonweed	mid July - Frost	H. Pg. 500
CENTAUREA CALCITRAPA	purple starthistle		W. Pg. 87
CENTAUREA IBERICA	Iberian starthistle		W. Pg. 86
CARDUUS TENUIFLORUS	slenderflower thistle		W. Pg. 79
LYTHRUM SALICARIA	purple loosetrife	Aug. - Sept.	H. Pg. 303
SILYBUM MARIANUM	milk thistle	Late April - Early June	H. Pg. 549
PRIORITY II SPECIES - ERADICATION OF NEW INVADERS			
****CENTAUREA DIFFUSA***	diffuse knapweed	July - Sept.	H. Pg. 498 T12S R3E SEC. 14
****CENTAUREA MACULOSA***	spotted knapweed	July - Oct.	H. Pg. 499 T7S R4E Sec. 2 T12S, R3E Sec. 9, 30
****CENTAUREA PRATENSIS***	meadow knapweed	July - Oct.	H. Pg. 499 T1-S R2E Sec. 23 T9S R3E Sec. 25 T10S R1E Sec. 8 & 14 T12S R1E Sec. 15
****ULEX EUROPARUS***	gorse	April - Sept.	H. Pg. 278 T2S R6E Highland Butte
PRIORITY III SPECIES - ESTABLISHED INFESTATIONS			
****CIRSIUM ARVENSIS***	Canada thistle	July - Aug	H. Pg. 503
****CIRSIUM VULGARE***	bull thistle	July - Sept	H. Pg. 503

***CYTISUS SCOPARIUS**	Scotch broom	May - June	H. Pg. 260
***HYPERICUM PERFORATUM**	St. Johnswort	June - July	H. Pg. 295
***SENECIO JACOBAEA**	tansy ragwort	July - Sept	H. Pg. 545

D.4 Plant Species List for the LNS WAA

Compiled May 1997 from Botanical Clearance Surveys & from area botanical monitoring. Also from information gathered by Roy Gerig, et al and John Davis, Bruce McCune (OSU Lichen/Bryophyte Study Group 10/94).

Vascular plant nomenclature based on Hitchcock & Cronquist 8th printing 1991.
Names in parenthesis are from National Plant Codes, National Plants Database March 1994
** S&M 1,2,3
* S&M 4

Scientific Name	**Common Name**	**PLANTS**
Conifer Trees		
Abies amabilis	Pacific silver fir	ABAM
Abies grandis	Grand fir	ABGR
Abies procera	Noble fir	ABPR
Pseudotsuga menziesii	Douglas-fir	PSME
Taxus brevifolia	Pacific yew	TABR2
Thuja plicata	Western redcedar	THPL
Tsuga heterophylla	Western hemlock	TSHE
Tsuga mertensiana	Mountain hemlock	TSME
Deciduous Trees(>8m tall)		
Acer macrophyllum	Bigleaf maple	ACMA3
Alnus rubra	Red alder	ALRU2
Alnus sinuata (A. viridis ssp. sinuata)	Sitka alder	ALSI3
Castanopsis chrysophylla	Golden chinkapin	CACH6
Fraxinus latifolia	Oregon ash	FRLA
Populus trichocarpa (P. balsamifera spp. trichocarpa)	Black cottonwood	POTR15
Prunus spp.	Cherry	PRUNU
Quercus garryana	Oregon white oak	QUGA4
Shrubs		
Acer circinatum	Vine Maple	ACCI
Amelanchier alnifolia	Pacific serviceberry	AMAL2
Arctostaphylos columbiana	Hairy manzanita	ARCO3
Berberis aquifolium (Mahonia aquifolium)	Tall Oregon grape	BEAQ
Berberis nervosa (Mahonia nervosa var. nervosa)	Dwarf Oregon grape	BENE2
Cornus sericea spp. occidentalis (C. stolonifera)	Creek dogwood	COSEO
Cornus nutalli		
Corylus cornuta	California hazle	COCO6
Cytisus scoparius	Scot's broom	CYSC4
Gaultheria shallon	Salal	GASH
Gaultheria ovatifolia	Slender wintergreen	GAOV2
Holodiscus discolor	Oceanspray	HODI
Ilex aquifolium	English holly	ILAQ80
Lonicera cilosa	Honeysuckle	LOCI

Oemleria cerasiformis	Indian plum	OECE
Oplophanax horridum	Devil's club	OPHO
Paxistima myrsinites (Pachystima myrsinites)	Oregon boxwood	PAMY
Philadephus lewisii	Mock orange	PHLE
Rhamnus purshiana	Cascara buckthorn	RHPU
Rhododendron macrophyllum	Rhododendron	RHMA
Ribes sanguineum	Winter current	RISA
Rosa gymnocarpa	Baldhip rose	ROGY
Rubus laciniatus I	Evergreen blackberry	RULA
Rubus leucodermis	Black raspberry	RULE
Rubus nivalis	Snow bramble	RUNI
Rubus parviflorus	Thimbleberry	RUPA
Rubus petadus	Creeping raspberry	RUPE
Rubus spectabilis	Salmonberry	RUSP
Rubus ursinus	California dewberry	RUUR
Salix sp.	Willow	SALIX
Sambucus racemosa	Red elderberry	SARA2
Spirea douglasii	Spirea	SPDO
Symphoricarpos albus	Snowberry	SYAL
Symphoricarpos mollis	Trailing snowberry	SYMO
Vaccinium parvifolium	Red huckleberry	VAPA

Ferns & Allies

Adiantum pedatum	Maidenhair fern	ADPE
Athyrium filix-femina	Lady fern	ATFI
Blechnum spicant	Deer fern	BLSP
Dryopteris austriaca	Spreading wood-fern	DRAU5
Equisetum sp.	Horsetail	EQUIS
Polypodium glycyrrhiza	Licorice fern	POGL8
Polystichum munitum	Sword fern	POMU
Pteridium aquilinum	Bracken fern	PTAQ

Herbs

Achillea millefolium	Yarrow	ACMI2
Achlys triphylla	Vanilla leaf	ACTR
Actaea rubra	Baneberry	ACRU2
Adenocaulon bicolor	Pathfinder	ADBI
Anaphalis margaritacea	Pearly-everlasting	ANMA
Anemone deltoidea	Windflower	ANDE3
Anemone oregana var. oregana	Oregon anemone	ANORO
Asarum caudatum	Wild ginger	ASCA2
Aster gormanii	Gorman's aster	
Aquilegia formosa	Columbine	AQFO
Boykinia elata (Boykinia occidentalis)	Slender boykinia	BOEL
Calypso bulbosa	Fairyslipper orchid	CABU
Campanula scouleri	Scouler's harebell	CASC7
Cardamine	Bittercrest	
Castilleja gracillima	Slender paintbrush	CAGR16
Castilleja	Paintbrush	
Centaurium umbellatum	Common centaury	CEUM

Centaurium muhlenbergii	Mulhenberg’s centaury	CEUM2
Chimaphila umbellata	Prince's pine	CHUM
Circaea alpina	Enchanter's nightshade	CIAL
Cirsium arvense I	Canadian thistle	CIAR4
Cirsium vulgare I	Common thistle	CIVU
Conyza canadensis	Canadian horseweed	COCA5
Coptis laciniata	Goldthread	COLA3
Corallorhiza maculata	Spotted coral-root	COMA4
Daucus carota I	Queen Anne's Lace	DACA6
Dicentra formosa	Bleeding heart	DIFO
Digitalis purpurea I	Foxglove	DIPU
Disporum spp.		DISPO
Disporum smithii	Fairy-lanterns	DISM2
Eburophyton austiniae (Cephalanthera austiniae)	Phantom orchid	EBAU
Epilobium sp.	Willow-herb	EPILO
Epilobium angustifolium I	Fireweed	EPAN2
Epilobium glaberrium	Willow-herb	
Erigeron philadelphicus	Fleabane	ERPH
Erythronium oreganum	Fawn lily	EROR4
Fragaria spp.	Wild strawberry	FRAGA
Galium spp.	Bedstraw	GALIU
Galium oreganum	Oregon bedstraw	GAOR
Gentiana affinis	Pleated gentian	GEAF
Geum macrophyllum	Large-leaved avens	GEMA4
Goodyera oblongifolia	Rattlesnake orchid	GOOB2
Hieracium albiflorum	Hawkweed	HIAL2
Hieracium scouleri	Scouler's hawkweed	HASC2
Hydrophyllum tenuipes	Waterleaf	HYTE
Hypericum perforatum I	Klamath weed(common St. John’s wort)	HYPE
Hypericum scouleri	Scouler’s St. John’s-wort	HYSC5
Hypochaeris radicata	Hairy cat’s ear	HYRA
Iris tenax	Oregon iris	IRTE
Lactuca muralis (Mycelis muralis)	Wall lettuce	LAMU
Lathyrus	Peavine	
Leucanthemum vulgare I (Chrysanthemum leucanthemum)	Ox-eye daisy	LEVU
Linnaea borealis	Twinflower	LIBO3
Listeria cordata	Twayblade	LICO
Lotus crassifolius	Big deer vetch	LOCR
Lysichiton americanus (Lysichitum americanum)	Skunk cabbage	LYAM3
Madia gracilis	Slender tarweed	MAGR3
Maianthemum dilatatum	False lily of the valley	MADI
Mimulus guttatus	Monkeyflower	MIGU
Mitella ovalis	Oval-leaved mitrewort	MIOV
Monotropa uniflora	Indian pipe	MOUN3
Montia perfoliata	Miner’s lettuce	MOPE3
Montia sibirica var. sibirica (Claytonia sibirica)	Candyflower	CLSIS
Nemophila parviflora	Small-flowered nemophila	NEPA
Oenantha sarmentosa	Water-parsley	OESA
Osmorhiza chilensis	Sweet-cicely	OSCH
Oxalis oregana	Oregon oxalis	OXOR

Petasites frigidus	Coltsfoot	PEFR5
Plantago lanceolata	Narrowleaf plaintain	PLLA
Plantago major var. major I	Common plantain	PLMAM
Pleuricospora fimbriolata	Fringed pinesap	PLFI2
Prunella vulgaris	Heal-all	PRVU
Psorlea physodes		PSPH
Ranunculus	Buttercup	RANUN
Ranunculus occidentalis	Western buttercup	RAOC
Rumex acetosella I	Sheep sorrel	RUAC3
Rumex occidentalis	Western dock	RUOC3
Saxifraga	Saxifrage	SAXIF
Senecio jacobaea I	Tansy ragwort	SEJA
Senecio triangularis	Triangle-leaf groundsel	SETR
Smilacina racemosum spp. amplexicaule (Maianthemum racemosa)	False solomonseal	SMRAA
Solidago canadensis	Canadian goldenrod	SOCA6
Stachys spp.	Hedge-nettle/Betony	STACH
Stellaria claycantha	Northern starwort	STCA
Synthyris reniformis	Snow-queen	SYRE
Tanacetum bipinnateum	Dune tansy	TABI
Taraxacum spp.	Dandelion	TARAX
Tellima grandiflora	Fringe-cup	TEGR2
Thalictrum spp.	Meadowrue	THALI2
Tiarella trifoliata	Threeleaf foamflower	TITR
Tolmiea menziesii	Pig-a-Back plant	TOME
Trientalis latifolia (T. borealis ssp. latifolia)	Starflower	TRLA6
Trifollium spp.	Clover	TRIFO
Trillium ovatum	Pacific trillium	TROV2
Vancouveria hexandra	Inside-out-flower	VAHE
Veratrum viride	False hellebore	VEVI
Verbascum thapsus	Common mullein	VETH
Veronica spp.	Speedwell	VERON
Veronica chamaedrys	Germander speedwell	VECH
Vinca major	Bigleaf periwinkle	VIMA
Viola glabella	Stream violet	VIGL
Viola sempervirens	Redwoods violet	VISE3
Whipplea modesta	Whipplevine	WHMO
Xerophyllum tenax	Beargrass	XETE

Grasses, Sedges & Rushes

Agrostis exarata	Spike bentgrass	AGEX
Bromus spp.	Brome grass	BROMU
Carex spp.	Sedge	CAREX
Holcus lanatus I	Common velvet grass	HOLA
Juncus spp.	Rushes	JUNCU
Juncus effusus	Common rush	JUEF
Luzula parviflora	Small-flowered woodrush	LUPA4
Scirpus microcarpus	Small flowered bulrush	SCMI2

Mosses

Antitrichia curtipendula	Antitrichia moss	ANCU3
Hylocomium splendens	Stairstep moss	HYSP70
Kindbergia praelonga		KIPR
Rhytidiadelphis spp.	Gooseneck moss	RHYTI2

Liverworts

Conocephalum conicum	Coneheads	CONOC3
Marchantea polymorpha		

Lichens

Alectoria sarmentosa	Witch’s hair lichen	ALSA9
Baeomyces rufus	cap lichen	BARU5
Bryoria capillaris	Horsehair lichen	BRCA14
Bryoria oregana	Oregon horsehair lichen	BROR6
Cavernularia hultenii	Hulten's pitted lichen	CAHU60
Cetraria chlorophylla	Greenleaf Tuckerman's lichen	CECH4
Cetraria orbata	Tuckermann's lichen	CEOR6
Cetraria rangiferina		
Cladonia bellidiflora	Cup lichen	CLBE4
Cladonia chlorphaea	Cup lichen	CLCH3
Cladonia ecmocyna	Cup lichen	CLEC
Cladonia fimbriata	Cup lichen	CLFI2
Cladonia ochrochlora	Cup lichen	CLOC60
Cladonia subsquamosa	Cup lichen	CLSU15
Cladonia transcendens	Transcend cup lichen	CLTR60
Cladonia verruculosa	Cup lichen	CLVE4
Graphis scripta	Pencilmark lichen	GRSC3
Hypogymnia apinnata		
Hypogymnia enteromorpha	Tube lichen	HYEN60
Hypogymnia imshaugii	Imshaug's tube lichen	HYIM60
Hypogymnia inactiva	Inactive tube lichen	HYIN2
**Hypogymnia oceanica	Seaside tube lichen	HYOC4
Hypogymnia physodes	Tube lichen	HYPH60
Hypogymnia rugosa	Tube lichen	HYRU3
Hypogymnia tubulosa	Tube lichen	HYTU60
Hypotrachyna sinuosa	Sinuous hypotrachyna lichen	HYSI60
Japewia tornoensis	Japewia lichen	JATO
Leptogium gelatinosum	Gelatinous skin lichen	LEGE60
Leptogium lichenoides	Skin lichen	LELI60
**Leptogium rivale	Skin lichen	LERI2
Lipolycarpum sp.		
*Lobaria oregana	Oregon lung lichen	LOOR60
*Lobaria pulmonaria	Lung lichen	LOPU60
Menegazzia terebrata	Honeycomb lichen	METE7
Mycoblasus sanguinarius	Blood lichen	MYSA5
*Nephroma bellum	Kidney lichen	NEBE60
*Nephroma helveticum	Swiss kidney lichen	NEHE4
*Nephroma laevigatum	Kidney lichen	NELA3
*Nephroma resupinatum	Kidney lichen	NERE60
Ochrolechia oregonensis	Oregon crabseye lichen	OCOR60
Ochrolechia laevigatum	Crabseye lichen	OCLA3
*Pannaria saubinetii	Saubinet’s matted lichen	PASA4

Parmelia hygrophilla	Shield lichen	PAHY4
Parmelia saxatilis	Shield lichen	PASA60
Parmelia sulcata	Shield lichen	PASU63
Parmeliopsis hyperota	Bran lichen	PAHY61
Peltigera britannica	British felt lichen	PEBR21
*Peltigera collina		PECO60
Peltigera leucophlebia	Felt lichen	PELE61
Peltigera membranacea	Felt lichen	PEME60
Peltigera neopolydactyla	Felt lichen	PENE12
*Peltigera pacifica	Pacific felt lichen	PEPA48
Pertusaria subambigens	Pore lichen	PESU14
Pilophorus acicularis	Nail lichen	PIAC60
Pilophorus clavatus	Nail lichen	PICL3
**Pilophorus nigricaulis	Nail lichen	PINI2
Placopsis gelidia	Bull'seye lichen	PLGE2
Platismatia glauca	Ragged lichen	PLGL60
Platismatia herrei	Herre's ragged lichen	PLHE60
Platismatia norvegica	Norwegian ragged lichen	PLNO60
Platismatia stenophylla	Ragged lichen	PLST6
Poridia crustulata		
**Pseudocyphellaria rainierensis	Rainier psedocyphellaria lichen	PSRA3
*Pseudocyphellaria anomala	Pseudocyphellaria lichen	PSAN60
*Pseudocyphellaria anthraspis	Pseudocyphellaria lichen	PSAN61
*Pseudocyphellaria crocata	Pseudocyphellaria lichen	PSCR60
Psoroma hypnorum	Bowl lichen	PSHY60
Sphearophorus globosus	Globe ball lichen	SPGL60
Stereocaulon intermedium	Intermediate snow lichen	STIN61
Stereocaulon tomentosum (P-race)	Tormentose snow lichen	STTO60
*Sticta fuliginosa	Spotted felt lichen	STFU60
*Sticta limbata	Spotted felt lichen	STLI60
Sticta weigelii	Weigel's spotted felt lichen	STWE60
Thelotrema lepadinum	Barnacle lichen	THLE3
*Usnea longissima	Beard lichen	USLO50
Usnea plicata		
Usnea wirthii	Wirth's beard lichen	USWI
Xylographa abietina	Xylographa lichen	XYAB

<u>Fungi</u>

Amanita gemmata	Gemmed amanita
Amanita muscaria	Fly agaric
Amanita aspera	Yellow-veiled amanita
Armillariella mellea	Honey mushroom
Boletus calopus	Bitter boletus
Boletus mirabilis	Admirable bolete
Bovista colorata	Golden puffball
*Cantharellus cibarius	chanterelle
Cantharellus infundibuliformis	Funnel or winter chanterelle
*Cantharellus subalbidus	White chanterelle
Chroogomphus tomentosus	
Clavaria fusiformis	
Clitocybe cyathiformis	
Coltricia cinnamomea	Fairy stool

Cortinarius cotoneus	Scaly cortinarius
Cortinarius violaceus	Violet cortinarius
Cortinarius sp.	
*Dentinum repandum (Hydnum r.)	Hedge hog
*Dentinum umbilicatum (Hydnum u.)	
Gleophyllum sepiarium	Rusty gilled polypore
Gomphidius glutinosus	
*Gomphus clavatus	Pig's ear gomphus
*Gomphus flocossus	
*Gomphus kauffmanii	shaggy chantrelle
Gymnopilus liquiritiae	
*Gyromitra californica	Umbrella false morel
Hygrocybe coccinea	Tighteous red waxy cap
Hygrocybe marginata	Orange gilled waxy cup
Hygrocybe punicea	Scarlet waxy cap
Hygrophorosis aurantiaca	False chantrelle
Hygrophorus bakerensis	Brown almond waxy cap
Hypomyces lactifluorum	Lobster mushroom
*Hypomyces luteovirens	
Laccaria bicolor	Lackluster laccaria
Laccaria laccata	
Lactarius kauffmanii	
Lactarius rubrilacteus	Bleeding milk cap
Lactarius olympianus	
Lactariaus pallescens	
Lactarius pseudomucidus	Shiny milk cap
Lactarius uvidus group	Purple staining milk cap
Laetiporus sulphureus	Chicken of the woods
Lepiota rubrotincta	Red-eyed parasol
Naematoloma sp.	
Otidea sp.	
Phaeolus schwenitzii	Dyer's polypore
Pleurocybella porrigens (Pleurotus p.)	Angel wings
Polyporus elegans	Elegant polypore; black-foot
Polyporus arcularis	Fringed polypore
**Polyozellus multiplex	Blue chantrelle
Ramaria	
Ramaria ariospora	red coral mushroom
Rozites caperata	the gypsy
Russula sp.	
Russula emetica	The sickener
Russula laurocerasi	Almond russula
Russula pectinatoides	
Russula placita	Pleasing russula
Russula xerampdina	Fishy smelling russula
*Sparassis crispa	Cauliflower mushroom
Selaginella watsonii	
Tricholoma sejunctum	
Tricholoma terreum	Earthy tricholoma; mouse trichloma
Tricholoma virgatum	
Tricholomopsis decora	
Tricholomopsis rutilans	King's coat; plums and custard

D. 5 Lichens found on Opal Creek Field Outing by Oregon State University Lichen/Bryophyte Study Group,

10/22/94. Participants: John Davis, Chiska Derr, B. G. Jonsson, Bruce McCune, Peter Neitlich, Tom Rambo, Jim Riley, and Steve Sillett.

The following lichen species were found in the old-growth forest surrounding Opal Creek. Locations were: T8S R5E Sec 33 & 29. The list does not contain all species that were present.

ROD Survey and Manage Stratey 1 and 3 species:

Hypogymnia oceanica
Leptogium rivale
Pilophorus nigricaulis
Pseudocyphellaria rainierensis (1,2,3)

ROD S & M Strategy 4 species:

Lobaria oregana
Lobaria pulmonaria
Nephroma bellum
Nephroma helveticum
Nephroma laevigatum
Nephroma resupinatum
Pannaria saubinetii
Peltigera collina
Peltigera pacifica
Pseudocyphellaria anomala
Pseudocyphellaria anthraspis
Pseudocyphellaria crocata
Sticta fuliginosa
Sticta limbata

Usnea longissima (lower part of watershed)

Other lichens

Alectoria sarmentosa
Baeomyces rufus
Bryoria capillaris
Bryoria oregana
Bryoria pseudofuscescens
Cavernularia hultenii
Cetraria chlorophylla
Cetraria orbata
Cetraria rangiferina
Cladonia bellidiflora
Cladonia chlorophaea
Cladonia ecmocyna
Cladonia fimbriata
Cladonia ochrochlora
Cladonia subsquamosa
Cladonia transcendens
Cladonia verruculosa
Graphis scripta
Hypogymnia apinnata
Hypogymnia enteromorpha
Hypogymnia imshaugii
Hypogymnia inactiva
Hypogymnia physodes
Hypogymnia rugosa
Hypogymnia tubulosa
Hypotrachyna sinuosa
Japewia tornoensis
Leptogium gelatinosum
Leptogium lichenoides
Lipolycarpum sp.
Mycoblastus sanguinarius
Ochrelechia oregonensis
Ochrelechia laevigatum
Parmelia hygrophila
Parmelia saxatilis
Parmelia sulcata
Parmeliopsis hyperopta
Peltigera britannica
Peltigera leucophlebia

Peltigera membranacea
Peltigera neopolydactyla
Pertusaria subambigens
Pilophorus acicularis
Pilophorus clavatus
Placopsis gelida
Platismatia glauca
Platismatia herrei
Platismatia norvegica
Platismatia stenophylla
Porpidia crustulata
Psoroma hypnorum
Sphaerophorus globosus
Stereocaulon intermedium
Stereocaulon tomentosum (P- race)
Sticta weigelii
Thelotrema lepadinum
Usnea plicata group
Usnea wirthii
Xylographa abietina

D.6 Vertebrate Wildlife List - LNS

The following is a list of vertebrate species known or suspected to occur in the LNS watershed. Occurrence codes for are based on records in the Salem District Wildlife Observation Database (WOBS), Forest Service wildlife database, Oregon Natural Heritage Program (ONHP) and on extrapolation from literature specific to the Pacific Northwest region as a whole. This list is intended to be modified as new information is acquired.

HABITAT & OCCURRENCE KEY:

V=Willamette Valley & Cascades Foothills
H=High Elevation Habitats
I=Introduced, L=local, B=Breeding (Birds), NB=Non-breeding (Birds),
BU= Breeding Status Uncertain(Birds), OU=Occurrence Uncertain

FEDERAL/STATE STATUS:

LE=Federal Endangered, SE=State Endangered,
LT=Federal Threatened, ST=State Threatened,
SoC=Species of Concern (former Category 2 Candidates),
SC=State Critical, SV=State Vulnerable, SU=State Undertermined Status, SP=State Peripheral, FS=Forest Service Sensitive, BS=Bureau Sensitive, BA=Bureau Assessment, BT=Bureau Tracking, SM=ROD Survey and Manage, B=ROD Buffer or Extra Protection Species

LITTLE NORTH SANTIAM - WILDLIFE LIST - HERPTILES

SPECIES	SPCODE	FEDERAL	STATE	BLM/FS	SA-ROD	OCC
Northwestern salamander	AMGR					
Long-toed salamander	AMMA					V-OU
Pacific giant salamander	DIEN					
Cascade torrent salamander	RHCA		SV	BT		L
Clouded salamander	ANFE		SU	BT		L
Oregon slender salamander	BAWR		SU	BS		
Ensantina	ENES					
Dunn's salamander	PLDU					
Western redback salamander	PLVE					L
Roughskin newt	TAGR					
Pacific tree frog	HYRE					
Tailed frog	ASTR	SoC	SV	BS		L
Red-legged frog	RAAU	SoC	SU	BS/FS		
Foothill yellow-legged frog	RABO	SoC	SV	BS		OU
Cascades frog	RACA	SoC	SV	BS		H-L
Bullfrog	RACAT					V
Northwestern pond turtle	CLMA	SoC	SC	BS/FS		V-OU
Northern alligator lizard	ELCO					
Southern alligator lizard	ELMU					V-L
Western fence lizard	SCOC					V-L
Western skink	EUSK					L
Rubber boa	CHBO					
Racer	COLCO					V
Ringneck snake	DIPU					V
Gopher snake	PIME					V
Northwestern garter snake	THOR					

SPECIES	SPCODE	FEDERAL	STATE	BLM/FS	SA-ROD	OCC
Common garter snake	THSI					
Western rattlesnake	CRVI					L-OU

LITTLE NORTH SANTIAM - WILDLIFE LIST - BIRDS

SPECIES	SPCODE	FEDERAL	STATE	BLM/FS	SA-ROD	OCC
Common loon	GAIM			BA		OU
Pied-billed grebe	POPO					OU
Eared grebe	PODNI					OU
Western grebe	AEOC					NB
Great blue heron	ARHE					B
Green-backed heron	BUST					V-B
Canada goose	BRCA					B
Wood duck	AISP					B
Green-winged teal	ANCR					NB
Mallard	ANPL					B
Northern pintail	ANAC					NB
Cinnamon teal	ANCY					OU
Blue-wingedTeal	ANDI					OU
Northern shoveler	ANCL					NB
Gadwall	ANST					NB
American wigeon	ANAAM					NB
Ring-necked duck	AYCO					NB
Lesser scaup	AYAF					NB
Harlequin duck	HIHI	SoC	SU	BS/FS		B
Common goldeneye	BUCL					NB
Barrow's goldeneye	BUIS		SU	BT		NB
Bufflehead	BUAL		SU	BA		NB
Hooded merganser	LOCUC					B
Common merganser	MERME					B
Ruddy duck	OXJA					OU
Turkey vulture	CAAU					B
Osprey	PAHA					B
Bald eagle	HALE	LT	ST	LT		BU
Northern harrier	CICY					NB
Sharp-shinned hawk	ACST					B
Cooper's hawk	ACCO					B
Northern goshawk	ACGE	SoC	SC	BS		H-B NB

SPECIES	SPCODE	FEDERAL	STATE	BLM/FS	SA-ROD	OCC
Red-tailed hawk	BUJA					B
Rough-legged hawk	BULA					NB
Golden eagle	AQCH					BU
American kestrel	FASP					B
Merlin	FACO			BA		NB
Peregrine falcon	FAPE	LE	SE	LE		BU
Ring-necked pheasant	PHCO					V-IL
Blue grouse	DEOB					H-B
Ruffed grouse	BOUM					B
Wild turkey - Merriam	MEGA					V-IL
Northern bobwhite	COVI					V-IL
California quail	CACAL					V-B
Mountain quail	ORPI					B
Virginia rail	RALI					B
American coot	FUAM					B
Sandhill Crane	GRCATA		SV	BT/FS		NB
Killdeer	CHVO					V-B
Greater yellowlegs	TRME			BA		V-NB
Solitary Sandpiper	TRSO			BT		V-NB
Spotted sandpiper	ACMA					B
Western sandpiper	CAMAU					V-NB
Least sandpiper	CAMI					V-NB
Dunlin	CAALP					V-NB
Common snipe	GAGA					V-B
Ring-billed gull	LADE					NB
California gull	LACAL					NB
Herring gull	LAAR					NB
Rock dove	COLI					NB
Band-tailed pigeon	COFA					B
Mourning dove	ZEMA					V-B
Common barn-owl	TYAL					V-B
Western screech-owl	OTKE					V-B
Great horned owl	BUVI					B
Northern pygmy-owl	GLGN		SU	BT		B

SPECIES	SPCODE	FEDERAL	STATE	BLM/FS	SA-ROD	OCC
Northern spotted owl	STOC	LT	ST	LT		B
Great gray owl	STNE		SV	BT	B	BU
Barred owl	STVA					B
Short-eared owl	ASFL					V-NB
Northern saw-whet owl	AEAC					B
Common nighthawk	CHMI					B
Vaux's swift	CHVA					B
Rufous hummingbird	SERUF					B
Belted kingfisher	CEAL					B
Lewis’ woodpecker	MELE		SC	BT		NB
Acorn Woodpecker	MEFO			BT		V-OU
Red-breasted sapsucker	SPRU					B
Red-naped Sapsucker	SPNU					H-OU
Downy woodpecker	PIPU					V-B
Hairy woodpecker	PIVI					B
Northern Three-toed woodpecker	PITR		SC	BS		H-OU
Black-backed woodpecker	PIAR		SC	BS	B	H-BU
Northern flicker	COAU					B
Pileated woodpecker	DRPI		SV	BT		B
Olive-sided flycatcher	COBO	SoC		BS		B
Western wood-pewee	COSO					B
Willow flycatcher	EMTR					B
Hammond's flycatcher	EMHA					B
Dusky flycatcher	EMDU					H-BU
Pacific-slope flycatcher	EMDI					B
Western kingbird	TYVE					NB
Horned lark	ERAL		SC	BT		NB
Purple martin	PRSU		SC	BT		V-BU
Tree swallow	TABI					B
Violet-green swallow	TATH					B
N.rough-winged swallow	STSE					V-B
Cliff swallow	HIPY					V-B

SPECIES	SPCODE	FEDERAL	STATE	BLM/FS	SA-ROD	OCC
Barn swallow	HIRU					V-B
Gray jay	PECA					H-B
Steller's jay	CYST					B
Scrub jay	APCO					V-B
Clarke's nutcracker	NUCO					H-NB
American crow	COBR					V-B
Common raven	CORCO					B
Black-capped chickadee	PAAT					V-B
Chestnut-backed chickadee	PARU					B
Bushtit	PSMI					V-B
Red-breasted nuthatch	SITCA					B
White-breasted nuthatch	SICAR					V-B
Brown creeper	CEAM					B
Bewick's wren	THBE					V-B
House wren	TRAE					B
Rock wren	SAOB					H-OU
Winter wren	TRTR					B
American dipper	CIME					B
Golden-crowned kinglet	RESA					B
Ruby-crowned kinglet	RECA					NB
Western bluebird	SIME		SV	BT		B
Mountain bluebird	SICU					H-NB
Townsend's solitaire	MYTO					H-B
Swainson's thrush	CAUS					B
Hermit thrush	CAGU					H-B V-NB
American robin	TUMI					B
Varied thrush	IXNA					B,V-NB
Cedar waxwing	BOCE					B
Northern shrike	LAEX					V-NB
American pipit	ANSP					NB
European starling	STVU					IB
Solitary vireo	VISO					V-B

SPECIES	SPCODE	FEDERAL	STATE	BLM/FS	SA-ROD	OCC
Hutton's vireo	VIHU					V-B
Warbling vireo	VIGI					B
Orange-crowned warbler	VECE					B
Nashville warbler	VERU					NB
Yellow warbler	DEPE					V-B
Yellow-rumped warbler	DENCO					H-B NB
Black-throated gray warbler	DENI					B
Townsend's warbler	DETO					H-B V-NB
Hermit warbler	DEOC					B
MacGillivray's warbler	OPTO					B
Common yellowthroat	GETR					B
Wilson's warbler	WIPU					B
Western tananger	PILU					B
Black-headed grosbeak	PHME					B
Lazuli bunting	PAAMO					V-B
Rufous-sided towhee	PIER					B
Chipping sparrow	SPPA					B
Vesper Sparrow	POGR		SC	BT		V-BU
Savannah sparrow	PASA					V-BU
Fox sparrow	PAIL					V-NB
Song sparrow	MELME					B
Lincoln's sparrow	MELI					H-B V-NB
Golden-crowned sparrow	ZOAT					V-NB
White-crowned sparrow	ZOLE					B
Dark-eyed junco	JUHY					B
Red-winged blackbird	AGPH					V-BU
Western meadowlark	STUNE					V-NB
Brewer's blackbird	EUCY					V-B
Brown-headed cowbird	MOAT					V-B
Northern oriole	ICGA					V-B
Purple finch	CARPU					B

SPECIES	SPCODE	FEDERAL	STATE	BLM/FS	SA-ROD	OCC
Cassin's finch	CARCA					H-BU
House finch	CARME					V-B
Red Crossbill	LOCU					H-B
Pine siskin	CAPI					H-B V-NB
American goldfinch	CATR					V-B
Lesser goldfinch	CAPS					V-B
Evening grosbeak	COVE					B
House sparrow	PADO					I-B

LITTLE NORTH SANTIAM - WILDLIFE LIST - MAMMALS

SPECIES	SPCODE	FEDERAL	STATE	BLM/FS	SA-ROD	OCC
Virginia opossum	DIVI					V-I
Pacific water shrew	SOBE					
Dusky shrew	SOMO					H
Pacific shrew	SOPAC					
Water shrew	SOPAL					OU
Trowbridge's shrew	SOTRO					
Vagrant shrew	SOVA					
Shrew-mole	NEGI					
Coast mole	SCOR					
Townsend's mole	SCTO					V
Big brown bat	EPFU					
Silver-haired bat	LANO				B	
Hoary bat	LACI					
California myotis	MYOCA					
Long-eared myotis	MYEV	SoC		BS	B	
Little brown myotis	MYLU					
Long-legged myotis	MYVO	SoC		BS	B	
Yuma myotis	MYYU	SoC		BS		
Pacific western big-eared bat	PLTO	SoC	SC	BS/FS	B	L
Coyote	CALAT					
Gray fox	URCI					
Red fox	VUVU					V
Black bear	URAM					
Raccoon	PRLO					
Wolverine	GUGU	SoC	ST	BS/FS		H
River otter	LUCA					
Pine Marten	MAAM		SV	BS		H
Fisher	MAPE	SoC	SC	BS		OU
Striped skunk	MEMEP					V
Ermine	MUER					
Long-tailed weasel	MUFR					
Mink	MUVI					

SPECIES	SPCODE	FEDERAL	STATE	BLM/FS	SA-ROD	OCC
Spotted skunk	SPPU					
Mountain lion	FECO					
Bobcat	LYRU					
Elk	CEEL					
Black-tailed deer	ODHE					
Mountain beaver	APRU					
Northern flying squirrel	GLSA					
Western gray squirrel	SCIGR					V
California ground squirrel	SPBEE					
Golden-manteled squirrel	SPLA					H
Townsend's chipmunk	TATO					
Douglas squirrel	TADO					
Camas pocket gopher	THBU					V
Western pocket gopher	THMA					H
Beaver	CASCAN					
Bushy-tailed woodrat	NECI					
Dusky-footed woodrat	NEFU					V
Deer mouse	PEMA					
Red tree vole	PHLO				SM	
Western red-backed vole	CLCA					
Gray-tailed vole	MICAN					
Long-tailed vole	MILO					
Creeping vole	MIOR					
Water vole	MIRI					H
Townsend's vole	MITO					V
Muskrat	ONZI					V
House mouse	MUMU					V-I
Norway rat	RANO					V-I
Pacific jumping mouse	ZATR					
Porcupine	ERDO					
Nutria	MYCO					V-I

SPECIES	SPCODE	FEDERAL	STATE	BLM/FS	SA-ROD	OCC
Pika	OCPR					H
Snowshoe hare	LEAM					H
Brush rabbit	SYBA					V-L
Eastern cottontail	SYFL					V-I

D7. SSSA WILDLIFE SPECIES KNOWN OR SUSPECTED-LNS WAA

	SPECIES & STATUS	HABITAT DESCRIPTION
	HERPETOFAUNA	
D	RHYACOTRITON CASCADAE **BT/SV** Cascade torrent salamander	Documented to occur in LNS. Prefers small cold streams and springs with water seeping through moss-covered gravel. Most common in mature and old-growth conifer forests below 4000 feet.
D	ANEIDES FERREUS **BT/SU** clouded salamander	Documented to occur in LNS. Prefers the spaces between loose bark on down logs in forests, forest edges, and clearings created by fire.
D	BATRACHOSEPS WRIGHTI **BS/SU** Oregon slender salamander	Documented to occur in LNS. West slope of Cascades. Prefers down logs and woody material in more advanced stages of decay. Most common in mature and old-growth conifer forests.
D	ASCAPHUS TRUEI **SOC/BS/SV** tailed frog	Documented to occur in LNS. Cold, fast-flowing permanent springs and streams in forested areas. Has a very narrow temperature tolerance.
D	RANA AURORA **SOC/BS/FS/SU** red-legged frog	Documented to occur in LNS. Common in marshes, ponds, and streams with little or no flow, from the valley floor to about 2700 feet in mountain forests. Can occur in seasonal waters if wet until late May or June.
S	RANA CASCADAE **SOC/BS/SV** Cascades frog	No documented sites in LNS. Historic locations to the east at higher elevations. Found in higher elevation bogs, ponds and stream edges associated with moist meadows.

	BIRDS	
D	HISTRIONICUS HISTRIONICUS **SOC/BS/FS/SU** harlequin duck	Documented to occur in LNS. An uncommon summer resident. Found in whitewater mountain rivers and streams during nesting season. Winters on rocky coasts.
S	BUCEPHALA ISLANDICA **BT/SU** Barrow's goldeneye	Likely to occur in LNS. Has been documented in North Santiam River to the south. Uncommon to rare migrant and winter visitor in open water areas.
S	BUCEPHALA ALBEOLA **BA/SU** bufflehead	Likely to occur as a migrant and winter visitor in open water areas. Has been documented in North Santiam River to the south.
D	HALIAEETUS LEUCOCEPHALUS **LT/ST** bald eagle	Documented to occur in LNS during the nesting season. Suitable habitat present in LNS. Detroit reservoir to south and east. Rare summer resident in Cascades. Uncommon winter resident in Willamette Valley. For nesting and perching, prefers large old-growth trees near major bodies of water and rivers.
S	ACCIPITER GENTILIS **SOC/BS/SC** Northern goshawk	Highly likely to occur in LNS. Rare Summer resident in Cascades. Prefers mature or old-growth forests with dense canopy cover at higher elevations. Winters at lower elevations.
S	FALCO COLUMBARIUS **BA** merlin	Highly likely to occur in LNS during Migration and winter. Fields, open areas and edges.
D	FALCO PEREGRINUS **LE/SE** peregrine falcon	Documented to occur during the nesting season and fall migration. Suitable cliff habitat for nesting is present in LNS. Possibly a breeding species in LNS. Likely to occur as a transient/migrant and winter visitor Found in a variety of open habitats near cliffs or mountains. Prefers areas near larger bodies of water and rivers.
S	GRUS CANADENSIS **BT/FS/SV** sandhill crane	Suspected as a rare spring/fall overhead migrant in LNS.
S	TRINGA MELANOLEUCA **BA** greater yellowlegs	Suspected to occur rarely in the lower end of LNS. A common transient and uncommon winter resident in Willamette Valley. Wetlands, flooded fields, and mud flats.
S	TRINGA SOLITARIA **BT** solitary sandpiper	Suspected to occur rarely in the lower end of LNS. Uncommon spring/fall migrant and transient in Willamette Valley. Wetlands, flooded fields, and small water bodies.
D	GLAUCIDIUM GNOMA **BT/SU** Northern pygmy owl	Common permanent resident in LNS. Coniferous/mixed forests and edges.

D	STRIX OCCIDENTALIS CAURINA **LT/ST** Northern spotted owl	Permanent resident in LNS, especially the upper end. (10 known sites). Prefers mature and old-growth conifer forests with large down logs, standing snags in various stages of decay, high canopy closure and a high degree of vertical stand structure.
D	STRIX NEBULOSA **BT/B/SV** great gray owl	Documented to occur in LNS from two locations. Primarily an east side species. On the west side, associated with natural and manmade openings, mostly at higher elevations.
S	MELANERPES LEWIS **BS/SC** lewis' woodpecker	Formerly a common summer resident and uncommon winter visitor in Willamette Valley. Today it is a rare transient and migrant. Oak woodlands and hardwood forests.
D	PICOIDES ARCTICUS **BS/B/SC** black-backed woodpecker	Documented to occur in the upper end of LNS. Primarily an eastside species. On the westside, it's found in mature/older forests with abundant snags at higher elevations.
D	DRYOCOPUS PILEATUS **BT/SV** pileated woodpecker	Common permanent resident in LNS. Prefers to nest in old-growth and mature forests. Also forages in younger forests containing mature or old-growth remnants. Requires larger snags and down wood.
S	CONTOPUS COOPERI **SOC/BS** olive-sided flycatcher	Uncommon summer resident in more open coniferous forest and edge with prominent tall snags or trees that serve as foraging and singing perches.
S	EREMOPHILA ALPESTRIS **BT/SC** horned lark	Suspected in extreme western edge of LNS. Rare and local summer resident in Willamette Valley. Uncommon in winter. Open fields, grassy areas.
S	PROGNE SUBIS **BT/SC** purple martin	Suspected as a rare summer resident in LNS. Documented to occur in the North Santiam to the south and west. Typically occurs along rivers and other water bodies. Nests colonially in cavities in old buildings, abandoned woodpecker holes, and nest boxes.
D	SIALIA MEXICANA **BT/SV** western bluebird	Documented in to occur in LNS. Uncommon permanent resident in Willamette Valley and adjacent foothills. Open areas with standing snags, or small farms with diversified agriculture. Nests in natural woodpecker cavities or artificial nest boxes.
S	POOECETES GRAMINEUS **BT/SC** vesper sparrow	Suspected to occur in extreme western portion LNS. Rare and local summer resident in Willamette Valley. Very rare in winter. Dry, grassy areas.

	MAMMALS	
D	LASIONYCTERIS NOCTIVAGANS **B** silver-haired bat	Documented to occur in LNS. Associated with cliff/cave and snag habitat. Forages in a variety of forest habitats and riparian areas.
S	MYOTIS EVOTIS **SOC/BS/B** long-eared myotis	Highly likely to occur in LNS. Associated with snags and cave habitat. Prefers older forests. Forages over water and riparian areas.
S	MYOTIS VOLANS **SOC/BS/B** long-legged myotis	Highly likely to occur in LNS. Associated with cliff/cave and snag habitat. Prefers older forests. Forages over water and riparian areas.
S	MYOTIS YUMANENSIS **SOC/BS** yuma myotis	Highly likely to occur in LNS. Associated with cliff/cave and snag habitat. More closely associated with riparian areas than the other myotis. Prefers older forests. Forages over water and riparian areas.
D	PLECOTUS TOWNSENDII **SOC/BS/FS/B/SC** pacific western big-eared bat	Documented to occur in LNS. Feeds on flying insects in a variety of habitats in forested areas. Primary habitat is caves, rock outcrops, buildings and abandoned mines.
D	GULO GULO **SOC/BS/FS/ST** wolverine	There is one record of wolverine in the LNS near Opal lake. Found in higher elevation mountainous and isolated coniferous forests.
S	MARTES AMERICANA **BS/SV** pine marten	Suspected to occur in LNS. Mature and old-growth forests containing large quantities of standing snags and downed logs, in the upper end of LNS. Prefers wetter forests, often near streams.
S	PHENACOMYS LONGICAUDUS **SM** red tree vole	Highly likely to occur in the LNS. This arboreal vole prefers mature/older forests with closed canopies.

KEY

Occurrence:
S = Suspected
D = Documented

Status:
LE = Federal endangered
LT = Federal Threatened
SOC = Species of Concern & Bureau Sensitive
BS = Bureau Sensitive
BA = Bureau Assessment
BT = Bureau Tracking
FS = Forest Service Sensitive
SM=ROD Survey and Manage

B=ROD Buffer or extra protection species
SE = State Endangered
ST = State Threatened
SC = State Critical
SV = State Volunerable
SU = State Uncertain
SP = State Peripherial

D8. SSSA Invertebrate Species -LNS

SPECIES	SPCODE	BLM/FS STATUS	ONHP LIST	GEOGRAPHIC RANGE or HABITAT NEEDS
MOLLUSKS Oregon megomphix	MEHE	SM/BS	1	CR,WV,WC: Moist conifer/hardwood forest, bigleaf maple logs/litter at low/mid elevations
Blue-gray tail dropper (slug)	PHCO	SM/BS	1	CR,WC: Moist conifer/hardwood forest in moss logs,litter at mid/high elevations
Papillose tail-dropper (slug)	PHDU	SM/BS	1	CR,WV,WC: Moist conifer/hardwood forest in moss, logs, litter at low/mid elevations
EARTHWORMS Oregon giant earthworm	DRMA	SOC/BS	1	WV: Associated with undisturbed vegetation and uncultivated soils at low elevations
INSECTS Beer's false water penny beetle	ACBE	SOC/BS/FS	3	WC: Rocky or gravelly stream margins
Cascades apatanian caddisfly	APTA	SOC/BS	2	WC,EC: Found in small streams on coarse gravel and cobble in areas of low current at mid/high elevations
Vertree's ceraclean caddisfly	CEVE	SOC/BS	3	CR,WV: Found in large streams and river systems at low/mid elevation
Mt. Hood brachycentrid caddisfly	EOGE	SOC/BS/FS	3	WC: Cold spring fed streams at mid/high elevations
Mt. Hood farulan caddisfly	FAJE	SOC/BS	3	WC,EC: Small spring fed streams associated with older forests
Tombstone Prairie farulan caddisfly	FARE	SOC/BS/FS	3	WC: Small spring fed streams with moderate to fast currents on coble and wood at high elevations
Tombstone Prairie oligophlebodes caddisfly	OLMO	SOC/BS/FS	3	WC: Small to large streams at high elevations

One-spot rhyacophilian caddisfly	RHUN	SOC/BS/FS	3	WC,EC: Clear streams at high elevations
Siskiyou caddisfly	TISI	SOC/BS	3	WC: Collection sites widely scattered thru OR and includes Little North Fork of North Santiam

KEY: **WV**=Western Valleys **WC**=Western Cascades **EC**=Eastern Cascades **CR=**Coast Range
SOC = Species of Concern & Bureau Sensitive
BS = Bureau Sensitive
FS = Forest Service Sensitive
SM=ROD Survey and Manage

APPENDIX E AQUATIC

E.1 ECA Values for LNS WAA by SWB and Precipitation Zones

SWB NAME	ECA ACRES (0 YRS.)	ECA % (O YRS.)	ECA ACRES (10+ YRS.)	ECA % (10+ YRS.)	ECA ACRES (40+ YRS.)	ECA % (40+ YRS.)	ECA ACRES (80+ YRS.)	ECA % (80+ YRS.)
BTTL AXE	610	11.5	537	10.1	511	9.7	534	10.1
TRZ	5	0.6	22	2.5	5	0.6	21	2.4
SNOW	605	13.7	515	11.7	506	11.5	513	11.6
CNYN CREEK	1592	18.2	2834	32.4	1627	18.6	2641	30.2
RAIN	456	17.3	486	18.4	514	19.5	446	16.9
TRZ	963	18.1	2054	38.5	876	16.4	1906	35.7
SNOW	173	22.6	295	38.6	237	31.1	289	37.9
CEDA R CREEK	467	7.8	336	5.6	296	5.0	273	4.6
RAIN	0	0.0	0	0.0	0	0.0	o	0.0
TRZ	192	8.5	121	5.4	109	4.9	119	5.3
SNOW	275	7.4	215	5.8	187	5.0	154	4.2
DRY CREEK	847	14.1	662	11.0	700	11.6	521	8.7
RAIN	85	12.9	137	20.7	76	11.6	119	18.1
TRZ	261	9.3	218	7.7	196	7.0	180	6.4

SNOW	501	19.7	307	12.1	428	16.9	222	8.7
ELKHR CREEK	1747	20.6	1588	18.7	1862	22.0	1341	15.8
RAIN	75	13.6	64	11.6	71	12.9	61	11.1
TRZ	549	15.3	477	13.3	659	18.4	466	13.0
SNOW	1123	25.8	1047	24.2	1132	26.1	814	18.8
EVANS CREEK	1136	22.1	1454	28.3	979	19.1	1214	23.6
RAIN	322	29.4	424	38.7	307	28.0	364	33.2
TRZ	487	16.9	725	25.1	365	12.7	609	21.1
SNOW	327	28.3	305	26.5	307	26.6	241	20.9
GOLD CREEK	251	3.6	327	4.7	220	3.2	314	4.5
TRZ	18	0.6	102	3.6	21	0.7	102	3.6
SNOW	233	5.7	225	5.5	199	4.9	212	5.2
HNLN CREEK	245	8.8	244	8.7	243	8.7	244	8.8
RAIN	0	0.0	O	0.0	0	0.0	0	0.0
TRZ	72	4.9	72	4.9	72	4.9	73	4.9
SNOW	173	13.2	172	13.3	171	13.1	171	13.1
KIEL CREEK	2018	20.5	4556	46.2	2115	21.4	4597	46.6
RAIN	1260	22.4	2651	47.2	1428	25.4	2615	46.6
TRZ	690	17.0	1863	45.8	662	16.3	1941	47.7
SNOW	68	37.3	42	23.3	25	13.8	41	22.6
OPAL CREEK	461	6.8	349	5.1	250	3.7	254	3.8
TRZ	5	0.4	9	0.8	5	0.4	9	0.8

SNOW	456	8.2	340	6.1	245	4.4	245	4.4
SINKR CREEL	1396	22.8	2098	34.2	1550	25.3	2021	32.9
RAIN	541	32.5	560	33.6	671	40.3	483	29.0
TRZ	693	18.0	1165	30.2	734	19.0	1087	28.2
SNOW	162	26.6	373	61.3	145	23.8	451	74.0
LNS WTRS D	10770	14.9	14985	20.8	10353	14.3	13954	19.3
RAIN	2739	22.4	4322	35.3	3067	25.1	4088	33.4
TRZ	3935	12.2	6827	21.9	3704	11.9	6513	20.9
SNOW	4096	14.3	3836	13.4	3582	12.5	3353	11.7

E2. Statistical Summary of Significant Differences in Water Quality Between Stations

Turbidity:Full Year **(Station on top has significantly higher values than station on side if "S" appears in box)**

STATION	2	3	11	6	5	4	10	13
2								
3	S							
11	S							
6	S	S	S					
5	S	S	S	S				
4	S	S	S	S	S			
10	S	S	S	S	S	s		
13	S	S	S	S	S			

Turbidity: November-February **(Station on top has significantly higher values than station on side if "S" appears in box)**

STATION	2	3	11	6	5	4	10	13
2								
3	S							
11								
6	S	S	S					
5	S	S	S	S				
4	S	S	S	S	S			
10	S	S	S	S	S			
13	S	S	S	S	S			

Turbidity: March-June **(Station on top has significantly higher values than station on side if "S" appears in box)**

STATION	2	3	11	6	5	4	10	13
2								
3	S							
11	S							

6	**S**	**S**	**S**					
5	**S**	**S**	**S**	**S**				
4	**S**	**S**	**S**	**S**	**S**			
10	**S**	**S**	**S**	**S**	**S**			
13	**S**	**S**	**S**	**S**	**S**			

Turbidity: July-October **(Station on top has significantly higher values than station on side if "S" appears in box)**

STATION	2	3	11	6	5	4	10	13
2								
3	**S**		**S**					
11								
6	**S**	**S**	**S**					
5	**S**	**S**	**S**	**S**				
4	**S**	**S**	**S**	**S**	**S**			
10	**S**	**S**	**S**	**S**	**S**			
13	**S**	**S**	**S**	**S**	**s**			

Total Solids: Full Year **(Station on top has significantly higher values than station on side if "S" appears in box)**

STATION	2	3	11	6	5	4	10	13
2								
3	**S**							
11	**S**							
6	**S**	**S**	**S**					
5	**S**	**S**	**S**	**S**				
4	**S**	**S**	**S**	**S**	**S**			
10	**S**	**S**	**S**	**S**	**S**			
13	**S**	**S**	**S**	**S**	**S**	**S**	**S**	

Total Solids:November-February **(Station on top has significantly higher values than station on side if "S" appears in box)**

STATION	2	3	11	6	5	4	10	13
2								
3	S							
11	S							
6	S	S	S					
5	S	S	S	S				
4	S	S	S	S	S			
10	S	S	S	S	S			
13	S	S	S	S	S	s	S	

Total Solids:March-June **(Station on top has significantly higher values than station on side if "S" appears in box)**

STATION	2	3	11	6	5	4	10	13
2								
3	S							
11	S							
6	S	s						
5	S	S	S	S				
4	S	S	S	S	S			
10	S	S	S	S	S			
13							S	

Total Solids:July-October **(Station on top has significantly higher values than station on side if "S" appears in box)**

STATION	2	3	11	6	5	4	10	13
2								
3	S							
11	S	S						
6	S							
5	S	S	s	S				
4	S	S	S	S	S			
10	S	S		S				

13	S	S	S	S	S	S	S	

Alkalinity: Full Year **(Station on top has significantly higher values than station on side if "S" appears in box)**

STATION	2	3	11	6	5	4	10	13
2								
3	S							
11	S	s						
6	S	S						
5	S	S	S	S				
4	S	S	S	S	S		S	
10	S	S	S	S	S			
13	S	S	S	S	S	S	S	

Alkalinity: November-February **(Station on top has significantly higher values than station on side if "S" appears in box)**

STATION	2	3	11	6	5	4	10	13
2								
3	S							
11	S							
6	S							
5	S	S	S	S				
4	S	S	S	S	S			
10	S	S	S	S	S			
13	S	S	S	S	S	S	S	

Alkalinity:March-June **(Station on top has significantly higher values than station on side if "S" appears in box)**

STATION	2	3	11	6	5	4	10	13
2								
3	S							
11	S	S						

6	**S**	**S**						
5	**S**	**S**	**S**	**S**				
4	**S**	**S**	**S**	**S**	**s**			
10	**S**	**S**	**S**	**S**	**s**			
13	**S**	**S**	**S**	**s**				

Alkalinity: July-October **(Station on top has significantly higher values than station on side if "S" appears in box)**

STATION	2	3	11	6	5	4	10	13
2								
3								
11								
6	**s**							
5	**S**	**S**	**S**	**S**				
4	**S**	**S**	**S**	**S**	**S**		**S**	
10	**S**	**S**	**S**	**S**	**S**			
13	**S**	**S**	**S**	**S**	**S**	**S**	**S**	

Fecal Coliforms: Full Year **(Station on top has significantly higher values than station on side if "S" appears in box)**

STATION	2	3	11	6	5	4	10	13
2		**S**						
3								
11		**S**						
6	**S**	**S**	**S**					
5	**S**	**S**	**S**					
4	**S**	**S**	**S**	**S**	**S**			
10	**S**	**S**	**S**	**S**	**S**	**S**		
13	**S**	**S**	**S**	**S**	**S**	**s**		

Fecal Coliforms:November-February **(Station on top has significantly higher values than station on side if "S" appears in box)**

STATION	2	3	11	6	5	4	10	13
2								

3								
11								
6	**S**		**S**					
5	**S**	**S**						
4	**S**	**S**	**S**	**S**	**S**			
10	**S**	**S**			**s**			
13	**S**	**S**	**S**	**s**	**S**			

Fecal Coliforms:March-June **(Station on top has significantly higher values than station on side if "S" appears in box)**

STATION	2	3	11	6	5	4	10	13
2								
3								
11		**s**						
6	**S**	**S**						
5	**S**	**S**						
4	**S**	**S**	**S**	**S**	**S**			
10	**S**	**S**	**S**	**S**	**S**	**s**		
13		**S**	**S**	**S**				

Fecal Coliforms:July-October **(Station on top has significantly higher values than station on side if "S" appears in box)**

STATION	2	3	11	6	5	4	10	13
2		**S**	**S**					
3								
11		**S**						
6		**S**	**s**					
5		**S**						
4	**S**	**S**	**S**	**S**	**S**			
10	**S**	**S**	**S**	**S**	**S**	**S**		
13	**S**	**S**	**S**	**S**	**S**	**s**		

Appendix E - 3 Summary of stream habitat parameters in the LNS WAA

P= poor; F= fair; G= good; E= excellent

Stream Name	Reach	Year Surv.	Length (miles)	Avg. A.C. Width (ft)	Pool Area (%)	Chan. Wid./ Pool	Key Pcs. LWD/ Mile	Rip. Conif./1000'	
								>20"	>35"
Big Cr.	1	1994	2.21	25	P	F	G	P	P
Canyon Cr.	1	1994	1.21	21	F	F	P	P	P
Canyon Cr.	2	1994	0.68	16	P	F	P	P	P
Elkhorn Cr.	1	1994	0.46	80	F	F	P	P	P
Elkhorn Cr.	2	1994	3.42	47	P	G	F	P	P
Elkhorn Cr.	3	1994	2.42	38	P	F	E	G	F
Elkhorn Cr.	4	1994	0.51	26	P	F	E	*	*
Elkhorn Cr.	5	1994	0.29	20	P	F	F	*	*
Fawn Cr.	1	1995	0.75	18	P	F	P	P	P
Fawn Cr.	2	1995	0.36	17	P	F	G	P	G
Fawn Cr.	3	1995	0.33	12	F	F	P	G	G
Fawn Cr.	4	1995	0.16	11	P	P	E	E	E
Fawn Cr.	5	1995	0.45	12	P	F	E	E	P
Jeeter Cr.	1	1995	1.54	20	P	P	P	P	P
Kiel Cr.	1	1995	0.91	27	P	P	G	P	P
Kiel Cr.	2	1995	1.23	16	P	P	F	P	P
Kiel Cr.	3	1995	0.66	19	P	P	G	P	P
L.N.F. Santiam	1	1991	5.69	107	G	G	P	*	*
L.N.F. Santiam	2	1991	4.16	91	G	G	P	*	*
L.N.F. Santiam	3	1991	2.78	127	G	G	P	*	*

Stream Name	Reach	Year Surv.	Length (miles)	Avg. A.C. Width (ft)	Pool Area (%)	Chan. Wid./ Pool	Key Pcs. LWD/ Mile	Rip. Conif./1000'	
								>20"	>35"
L.N.F. Santiam	4	1991	2.04	64	G	F	P	*	*
L.N.F. Santiam	5	1991	7.51	49	G	G	P	*	*
Opal Cr.	1	1991	0.31	53	G	G	P	*	*
Opal Cr.	2	1991	1.16	37	G	G	F	*	*
Opal Cr.	3	1991	0.34	48	F	G	F	*	*
Opal Cr.	4	1991	0.30	24	G	G	E	*	*
Opal Cr.	5	1991	0.99	31	F	G	G	*	*
Opal Cr.	6	1991	0.61	21	F	G	P	*	*
Opal Cr.	7	1991	0.30	31	G	G	E	*	*
Opal Cr.	8	1991	0.72	18	F	F	P	*	*

*: Riparian survey not conducted
~: Unable to calculate

Appendix - E4 - ODFW Benchmarks of Stream Habitat Parameters for “Desirable” (good) and “Undesirable” (poor) Conditions (measurements that fall between “desirable” and “undesirable” are considered “fair”).

“Good” habitat conditions are based on values from surveys of reference areas with known productive capacity for salmonids and from the 65th percentile of values obtained in surveys of late successional forests. “Poor” habitat conditions are based on values associated with known problem areas and from the lower 25th percentile of combined data for each region.

Percent pool area (pool quantity): “desirable” - >35%; “undesirable” - <10%.
Channel widths per pool (pool frequency): “desirable” - <8; “undesirable” - >20
Avg. residual pool depth (pool quality):
Low gradient streams (<3%) or small (<7m feet active channel width)
“desirable” - >0.5m
“undesirable” - <0.2m
High gradient streams (>3%) or large (>7m feet active channel width)
“desirable” - >1.0m
“undesirable” - <0.5m
Gravel quantity (percent area in riffles): “desirable” - ≥35; “undesirable” - <15
Gravel quality (percent of fines, ie. silt, sand & organics present in surface layers of spawning gravels): “desirable” - <10; “undesirable” - >25
Off-channel habitat(percent area of secondary channels): “desirable” - ≥10; “undesirable” - <10
Large woody debris:
# of pieces per 100m stream length (minimum size 15cm diam. & 3m length)
“desirable” - >20; “undesirable” - <10
of “key pieces” per 100m stream length (minimum size >50cm diam. & >active channel width in length)
“desirable” - >3; “undesirable” - <1
Riparian conifers within 30m of stream on both sides:
>20 in. dbh per 1,000 ft. of stream length: “desirable” - >300; “undesirable” - <150
>35 in. dbh per 1,000 ft. of stream length: “desirable” - >200; “undesirable” - <75

APPENDIX F HUMAN RESOURCE COMPONENTS

F 1. Summary of Recorded Cultural Sites in LNS WAA

T. 8 S., R. 2 E.

SHS 834 Silver Falls Timber Co. logging camps and railroad logging grades. These camps may have included Chinese construction workers and were in use during the 1920's and ‘30's.

T. 9 S., R. 2 E.

SHS 695 Elkhorn County Road. In 1893, this road was built to connect Mehama and the post office in Elkhorn, established in 1892 . Past Elkhorn, this route was designated “Miner’s and Settler’s Trail” on GLO survey maps. In 1913, the road was extended to the Silver Star Mine and continued beyond that mine as a trail to Battle Axe Mountain and on eastward.

SHS 800 Cox to Shaw Wagon Road. Named for early settlers, Cox and Shaw, this road links to the county road on the south side of the Little North Fork. It was extended to the Elkhorn school in 1886.

SHS 834 Silver Falls Timber Co. logging camps and railroad logging grades. These camps may have included Chinese construction workers and were in use during the 1920's and ‘30's.

SHS 868 Cabin recorded in a General Land Office (GLO) note dated to 1928.

OR-08-51 (SHS 604) Polly Creek cabin use dates from the late 1930's into the early 1940's. It probably reflects the “subsistence lifestyle” of the Great Depression era.

Mehama (outside the watershed analysis area) was named for Mehama Smith, wife of James X. Smith who laid out the townsite and operated the North Santiam River Ferry. The town’s first post office was established in March, 1877, shortly after the town was laid out.

T. 8 S., R. 3 E.

OR-08-144 (SHS 840) Logging camp of the C & H Logging Company which held a timber patent on the site and surrounding area from the O & C Administration between 1941 and 1945.

SHS 600 Wm. W. Downing of Portland attempted to homestead this site area in 1918 and built a cabin. The effort failed and the homestead entry was canceled in 1923.

SHS 691 This trail to Lookout Mountain Lookout was built in the 1930's possibly by the CCC workers at Little North Fork or Mill City camps. It was maintained by the Clackamas-Marion Fire Protection Agency and in use until the early 1950's.

SHS 693 Mapped by GLO surveyors in 1892, this trail ran between Silverton and the Abiqua Basin area. It was believed by the surveyors to be an old Indian trail.

SHS 834 Silver Falls Timber Co. logging camps and grades from the 1920's and ‘30's. These camps may have included Chinese construction workers. In the near vicinity of SHS 834 camps in this township, two homestead attempts were made but failed. These date from 1919-1925 and 1929-1935.

SHS 838 This site consists of railroad logging grades inside and outside the watershed and a logging camp outside the watershed. These logging facilities were built by the Silver Falls Timber Co. which extensively logged the area using railroad transport from 1912 through 1938. Logs were hauled to Bethany, near Silverton. Many of the grades were later built over into roads and are in use today. A large forest fire in 1929 caused irreparable losses to the company which nevertheless struggled on until the Great Depression finally finished it in 1938.

Lookout Mountain Lookout was built in 1938 probably by CCC crews from the Mill City camp and operated and maintained by the Clackamas-Marion Fire Protection Agency. The first lookout was perched on a 34 ft. tower. This lookout was improved by CCC crews in 1940 and remained in use until 1965 when it was removed and replaced with a 40 ft. tower lookout.

House Mountain Lookout was built by the CCC’s in 1937 for the Clackamas-Marion Fire Protection Agency. This lookout had an 82 ft. tower and remained in use until 1965.

T. 9 S., R. 3 E.

OR-08-IA-3 is a complete obsidian knife blade that occurred as an isolated find.

9-3-15-ASE is the mid-section from an obsidian knife that occurred as an isolated find.

OR-08-131 (35MA60) is a small disturbed lithic scatter site with chert and jasper flake material predominating. One obsidian flake was identified.

SHS 617 This site is identified as the King cabin in a 1910 GLO note. King made a homestead attempt between 1912 and 1913, which failed. Goldie M. Trine (later married Josephsen) filed a homestead claim for the same parcel in 1914 and built a house in 1916. This attempt ultimately failed also. Smith, Davis, and Hauptman had cabins on homestead attempts in the area between 1912 and 1914 as well, but these attempts also failed.

SHS 620 The Sprague homesite was built in 1942 in trespass on public land. A permit for the home was issued in 1944 and renewed in 1954.

SHS 691 This trail to Lookout Mountain Lookout was built in the 1930's possibly by the CCC workers at Little North Fork or Mill City camps. It was maintained by the Clackamas-Marion Fire Protection Agency and in use until the early 1950's.

SHS 692 This trail runs between House Mountain and Mill City. It was probably built by the CCC’s in the 1930's and provided access to House Mountain Lookout.

SHS 695 Elkhorn County Road. In 1893, this road was built to connect Mehama and the post office in Elkhorn, established in 1892 . Past Elkhorn, this route was designated “Miner’s and Settler’s Trail” on GLO survey maps. In 1913, the road was extended to the Silver Star Mine and continued beyond that mine as a trail to Battle Axe Mountain and on eastward.

SHS 698, Elkhorn Trail, was first shown on a GLO map in 1874. The trail provided access to the North Santiam Mining District and Elkhorn from the 1860's until the 1893, when it was replaced by the Elkhorn County Road. The road may follow the trail grade in some locations.

SHS 699 Creek Trail served as a miners' access trail from the 1860's to 1874. It ran along the north side of the Little North Fork.

SHS 845 Wolfe and Holland Sawmill, built in 1938, included a log pond and mill. Remnants of the mill pond and its brow logs are still visible. This mill is on private land. The Hallin Lumber Co. had a timber patent on the adjacent public (BLM) land in 1938 and possibly had the logs cut at this mill.

SHS 864 The Looney cabin was built by William Looney of Gates who mined in the area in 1917.

SHS 865 Cabin site whose structure was built a few years before 1936. In 1936, the cabin was occupied by a family who rented the private property immediately south of the tract.

SHS 866 Plotted as an "old cabin" on a 1938 GLO survey note. This and the cabin, SHS 865, are probably representatives of the local residents response to economic hardship during the Great Depression. Many people moved out onto public land and made a "subsistence living" for themselves and their families by gardening, hunting, berry picking, raising a few animals, and harvesting and selling their own production and minor forest products.

OR-08-76 (SHS 621) called Elkhorn cabin, was probably built shortly after 1900. It was apparently abandoned as a regularly occupied site in the mid-1930's although evidence of more recent use is present. A nearby old growth fir had blazes and barbed wire embedded in the bark.
There are no homestead entries for this tract nor any mention of the cabin in GLO survey notes. The cabin may represent a squatter's activities or may have been a rest station/overnight stop along Elkhorn Trail.

T. 8 S., R. 4 E.

USFS 102 is an isolated flake of obsidian.

USFS 18-04-149 (35MA49), Shady Cove archeological site, is a lithic scatter site with flakes of different materials.

USFS 18-04-232, MDR, is a lithic scatter consisting of obsidian flakes.

USFS 40249 is an isolated flake of obsidian.

USFS 18-04-335 (35MA112), Michael’s Memory, is a lithic scatter site with flakes of different materials.

USFS 18-04-038H, Crown Mine, was developed around 1910 and continued in operation until at least 1933. The mine had 1,000 feet of tunnel, a compressor and drilling equipment and a cabin.

USFS 18-04-039, Wolz Mine (also called Bonanza Mine?), consisted of an open cut and two short adits in 1939. Initial date of development is not known.

USFS 18-04-040H, Silver Star Mine, developed by 1931, included the mine tunnel and a cabin.

USFS 18-04-233, Black Eagle Camp, is a mining camp, remains of which include a road bed, tailings pile and two foundation areas for structures. Black Eagle Mine was owned by the Black Eagle Mining and Milling Company in 1916 and facilities at the mine consisted of 1,000 feet of tunnel, a sawmill, power plant, bunkhouses and a concentrating mill.

Silver King Mine was developed most extensively in the 1920's. Facilities at the mine included tunnels, blacksmith and machine shops, bunk and cookhouses, a water powered generator, air compressor and several smaller buildings. There were about 15 men working at the mine during its peak production.

Silver King Group consists of 12 claims where gold, silver and zinc were mined. The claims were located prior to 1916.

SHS 694 was a trail connecting Silverton to the Ogle Mountain mines via Lookout Mountain and Henline Mountain. It was plotted on an 1893 GLO survey map.

SHS 698, Elkhorn Trail, was first shown on a GLO map in 1874. The trail provided access to the North Santiam Mining District and Elkhorn from the 1860's until the 1893, when it was replaced by the Elkhorn County Road. The road may follow the trail grade in some locations.

Elkhorn post office was opened on March 21, 1892 with William D. Morehouse as postmaster. This post office succeeded an earlier one called Ivie which had been established in the area in 1890. In 1892, Elkhorn Valley had become a small community with a school house. The post office was the only other community building. The post office closed in June, 1917. The town is supposedly named after the many elk what once wintered in the valley.

Henline Mountain Lookout was built in 1934, probably by CCC crews. The lookout was used until 1963 and removed in 1967. Henline Mountain was named for an early settler who had an interest in a nearby mining enterprise.

USFS 18-04-438, Pearl Creek Guard Station (built CCC crews?).

T. 9 S., R. 4 E.

OR-08-27 (35MA17) is a lithic scatter site consisting of obsidian (40%) and cryptochrystalline (60%) flaking debris. Two cobble choppers and two utilized flakes were recorded on the site.

OR-08-117 (35MA54) is a lithic scatter site with both obsidian and cryptochrystalline materials present.

USFS 58 is described as a prehistoric campsite with artifacts. The site’s specific location within the township is unverified.

USFS 40143 is an isolate consisting of three obsidian flakes.

SHS 867 Trail from Gates dating to 1917.

Rocky Top Lookout, built in 1936 and in use until 1963, was maintained and operated by the Clackamas-Marion Fire Protection Agency.

Mt. Horeb was named in 1873 by David Smith, a local biblical enthusiast.

T. 8 S., R. 5 E.

USFS 40061 is an isolated obsidian flake.

USFS 76 is a unverified find of an obsidian projectile point fragment and a scrapper and a biface fragment of cryptocrystalline.

USFS 40076 are two obsidian flakes occurring as an isolated find.

USFS 18-04-086, Stone Ridge site, is a lithic scatter site.

USFS 40189 is a cryptocrystalline flake found as an isolate.

USFS 40097 is four obsidian flakes.

USFS 18-04-158 (35-MA-50) is a lithic scatter site.

USFS 18-04-159, Whetstone Trail Archeological Site, is a lithic scatter.

USFS 18-04-160, Whetstone Trail Archeological Site II, is a lithic scatter.

USFS 18-04-163, Stoney Ridge Meadows Archeological Site, is a lithic scatter.

USFS 18-04-182, Jaws Archeological Site, is a large lithic scatter.

USFS 18-04-190, Beachie Battle Two, is a lithic scatter with obsidian and cryptochrystalline flakes.

USFS 665NA21 (35MA40), is a lithic scatter site.

USFS 40098H is a historic rock cairn.

USFS 18-04-145H, Gold Creek Flats Mine, includes a group structures, dumps and other features related to a mining camp. Mine development on Gold Creek started in about 1900 and continued into the 1950's.

USFS 18-04-146H, North Santiam Historic Mill site, consists of the remains of a sawmill and machinery. It may date to the early 1940's.

USFS 18-04-147H, Dolores #10 Historic Cabin, includes the remains of a cabin with a woodstove and other debris.

USFS 18-04-148H, North Santiam Explosives Shack, includes the remains of a shack.

USFS 18-04-164H, Gold Creek Fork Historic Mining Camp, includes the remains of a mining camp. Mine development on Gold Creek started in about 1900 and continued into the 1950's.

USFS 18-04-165H, Gold Creek Historic Road, consists of the remains of a road related to mining activities in the Gold Creek area.

USFS 18-04-173H, Upper Camp Amalgamated Mines, was developed in the early 1930's. These mines were also called the Ruth Mines.

USFS 18-04-174H, Poor Boy Mill Site, consists of the remains of a sawmill site, date unknown.

USFS 18-04-175H, Lower Camp Amalgamated Mines and Jawbone Flats Miners Camp, were developed and in use during in the early 1930's. These mines were also called the Ruth Mines.

USFS 18-04-176H, Lower Battle Axe Road, consists of the remains of a road.

USFS 665 EA 78H, Whetstone Mountain Lookout, was built in 1933 by CCC crews probably from the Little North Fork camp. It was removed about 1965. Whetstone Mountain was named because of the prevalence of a rock type popular for sharpening knives.

SHS 582 Trail along the northeast edge of the watershed linking to the Baty Butte-Silver King portion of the South Fork Trail System. Portions of this long trail system originated aboriginally.

Bluejay Mine. A number of mines called the Bueche Group were developed along Battle Axe Creek starting in 1929.

T 9. S., R. 5 E.

USFS 01 is a reported lithic scatter which has not been field verified.

USFS 03 is a reported lithic scatter which has not been field verified.

USFS 04 is a reported lithic scatter which has not been field verified.

USFS 18-04-085, Cedar Basket Trees, consists of cedar trees with stripping scars from aboriginal collection of cedar bark.

USFS 18-04-104, Battle Creek Point, is a lithic scatter site.

USFS 126 is an obsidian flake found as an isolate.

USFS 40187 is an obsidian flake found as an isolate.

USFS 40188 is an obsidian flake found as an isolate.

USFS 18-04-188 (35MA81), Battle Axe Headwaters, is a lithic scatter site.

USFS 18-04-189, Beachie Battle One, is a scatter of obsidian and cryptochrystalline flakes.

USFS 18-04-309 (35MA101), Beachie Saddle, is a lithic scatter site.

USFS 18-04-343 (35MA8), Shannons First, is a lithic scatter site.

USFS 18-04-402 (35MA34), Phantom’s Shadow, is a lithic scatter with obsidian and cryptochrystalline flakes.

USFS 18-04-412 (35MA131), Cedar Saddle, is a lithic scatter site.

35MA115 is a lithic site on Martens Butte.

35MA117 is a lithic site on Martens Butte.

USFS 39 is a reported rock platform whose specific location has not been verified.

USFS 61 is the reported remains of a cabin whose specific location has not been verified.

Battle Axe Lookout site was first used in about 1918 when an alidade was located on Battle Axe Mountain. This site was used in World War I as a lookout for enemy fire bombs or air attacks. In 1922, a cupola style lookout was built and remained in use until 1953 when it was replaced. Battle Axe Mountain either was named for its shape or for a brand of chewing tobacco used by North Santiam miners and woodsmen in the 1890's.

Martens Buttes were named in the 1940's or ‘50's because trappers caught many martens there.

F 2. Recreation Opportunity Spectrum (ROS)

The Recreation Opportunity Spectrum (ROS) is the planning framework that was used to inventory both private and public lands in the Thomas Creek Watershed. Three major components that affect visitor use and preference are setting, activity, and desired experience. Visitors participating in the same activity may be seeking different settings and experiences. For example, one camper may desire a wilderness setting to experience solitude and challenge. Another camper may want highly developed facilities that offer more comfort and social opportunities. To meet these different needs, ROS is a system that is divided into seven major classes that provide a spectrum of opportunities, ranging from more primitive to more developed.

Primitive: Characterized by an unmodified natural environment of fairly large size where evidence of humans and human-induced restrictions and controls is essentially absent and motorized access is not permitted. Very low social interaction.

Semi-Primitive / Non-Motorized: Characterized by a predominantly natural environment of moderate to large size where evidence of humans and human controls is present but low. Motorized use is not permitted. Social interaction is low.

Semi-Primitive / Motorized: This class is similar to the previous one, however, motorized use is allowed.

Roaded Natural: Characterized with a predominantly natural environment with moderate evidence of human modification and control, that are in harmony with a natural setting. Moderate social interaction

Roaded Modified: Forest or other natural environment, with obvious modifications such as logging or miniing, etc., road access and limited facility development, within an open space context. Moderate social interaction.

Rural: Characterized by an environment that is culturally modified to the point that it is dominant feature. Cultural modifications are usually associated with agricultural activities, residental activities, and utility corridors. Moderate social interaction.

Urban: This class is similar to rural however facility development is intensified and the environment though natural appearing is often landscaped. Modifications are designed to enhance specific recreational activities.

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