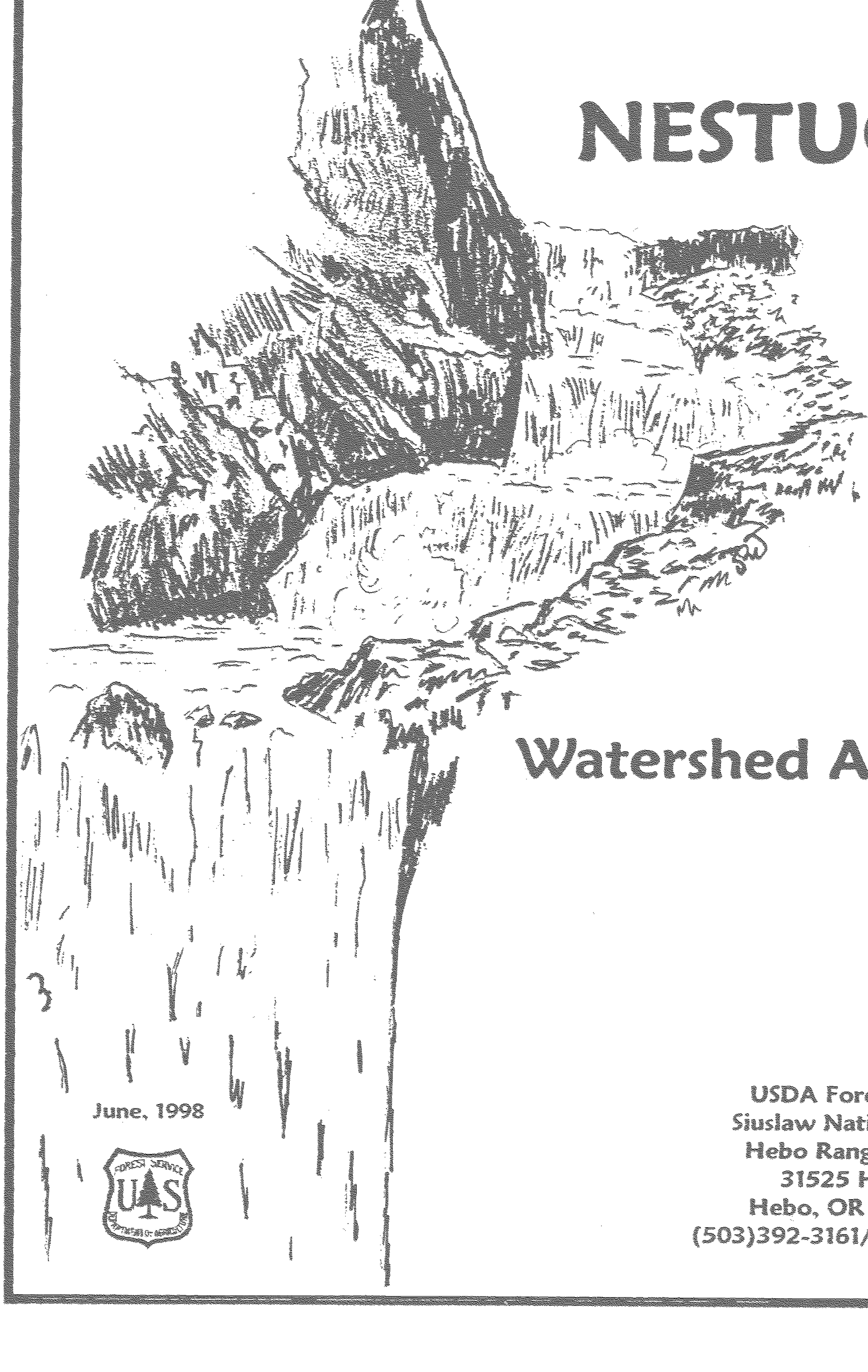
LITTLE NESTUCCA



Watershed Analysis

June, 1998

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Little Nestucca Watershed cover
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Information used in the development of these maps is available upon request at the Siuslaw National Forest.

Little Nestucca Watershed Analysis

Chapter 1: Introduction

A. Background

Watershed analysis is one of the key components of the Northwest Forest Plan. The analysis is intended to support the ecosystem management objectives of the Plan's standards and guidelines. Watershed analysis identifies important resource and information needs (data gaps), and describes ecological processes and interactions. It is also a key component of the Aquatic Conservation Strategy (ACS) developed for the Northwest Forest Plan (NFP) (USDA-USDI, 1994). The analysis is intended to facilitate watershed planning that:

- achieves Aquatic Conservation Strategy objectives
- provides the basis for restoration and monitoring programs
- provides the foundation from which Riparian Reserves can be delineated.

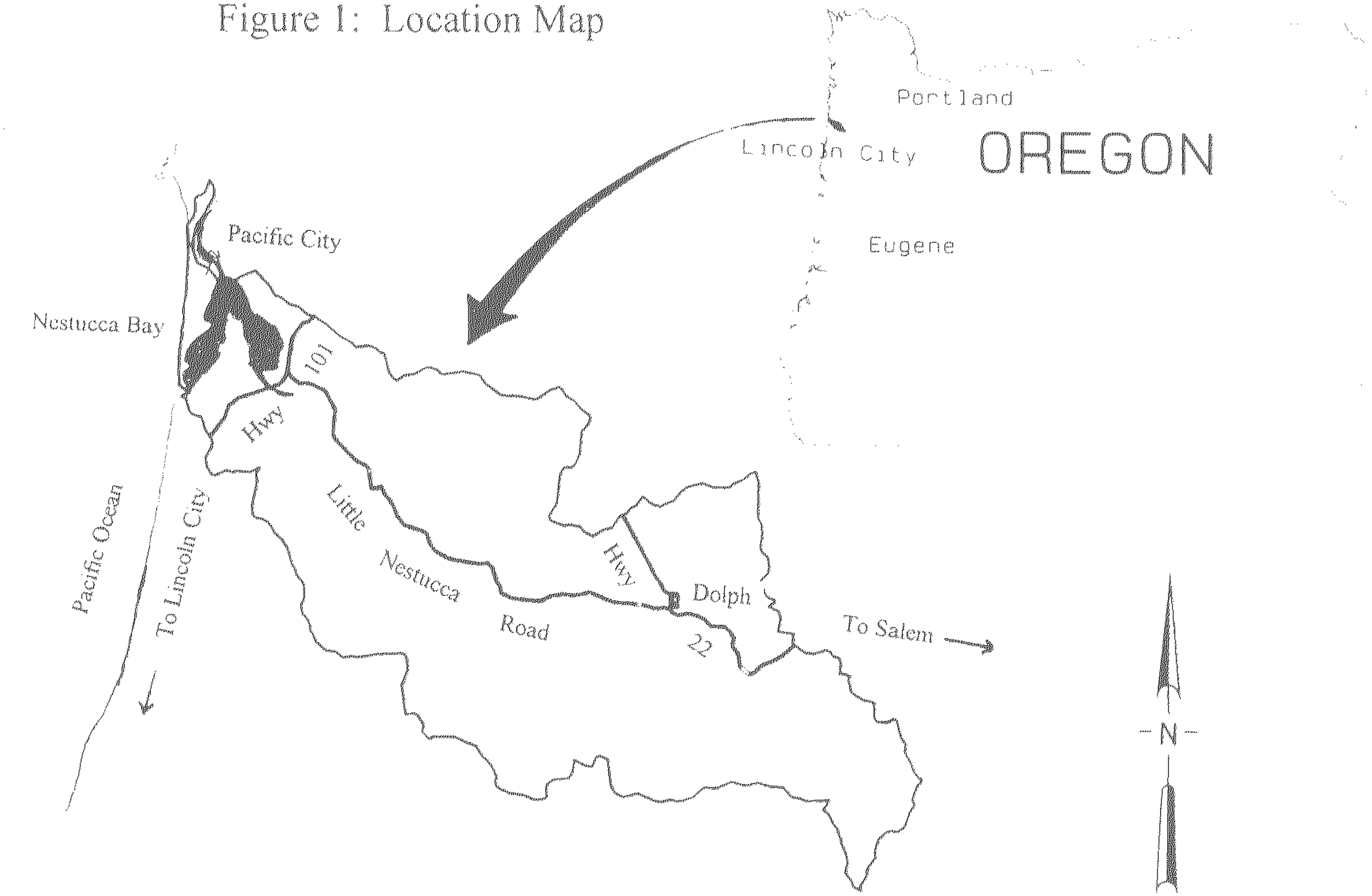
The Little Nestucca watershed refers to, and takes guidance from, other planning documents that provide a larger context for this area. The Record of Decision (ROD) for the Northwest Forest Plan (1994) provides management direction for all federally managed forest land within the range of the northern spotted owl. The Late-Successional Reserve Assessment (LSRA) for Oregon's Northern Coast Range Adaptive Management Area (USDA-USDI, 1997) provides management guidelines for late successional reserves designated in the NFP. Standards and guidelines from the Siuslaw Land and Resource Management Plan (1990) that have not been amended by the NFP also apply to this area.

This watershed analysis follows the steps and guidelines outlined in "Ecosystem Analysis at the Watershed Scale, Federal Guide for Watershed Analysis", version 2.2 (1995).

B. Location and Size

The Little Nestucca watershed covers 40,760 acres on the west side of the northern Coast Range. The watershed is 12 miles northeast of Lincoln City, north of State Highway 18 and primarily south and west of State Highway 22. Portions of Yamhill, Polk, Tillamook and Lincoln Counties are within the boundaries of the watershed. The Little Nestucca River drains directly into the Pacific Ocean through Nestucca Bay (Figure 1), where it joins the "Big" Nestucca River.

Figure 1: Location Map



C. Land Ownership

Forest land managed by the federal government covers 19,118 acres (47%) of the watershed. National Forest land comprises 18,892 acres and the Bureau of Land Management, 226 acres. The majority of the Nestucca Bay National Wildlife Refuge is located in the estuary of the Nestucca and Little Nestucca Rivers. Private land, mostly agricultural land that is located along the lower mainstem and wide valley of the Little Nestucca River, covers 10,000 acres (25%) of the watershed. Private industrial forest lands cover 9894 acres (24%). The Oregon Department of Forestry manages 800 acres (2%), mostly in the upper watershed, and Oregon State Parks has 564 acres (1%), primarily located along the coast. The Van Duzer Corridor along Highway 18 crosses the southeastern part of the watershed (Table 1-1, Map 1).

Table 1-1: Ownership in the Little Nestucca Watershed

Ownership	*Acres*	*Percent of Watershed*
National Forest	18,892	46.3
Bureau of Land Management	226	0.6
Private industrial forest	9,894	24.3
Private ownership	9,770	24.0
Oregon Dept. of Forestry	800	2.0
Oregon State Parks	564	1.3
National Wildlife Refuge	490	1.2
Oregon Dept. of Transportation	124	0.3
TOTAL	40,760	100.0

D. Land Allocations and Northwest Forest Plan Objectives

Table 1-2 and Map 2 display the distribution of land allocations within the watershed.

Table 1-2: Land Allocations for Federally Managed Lands within the Little Nestucca Watershed

Land Allocation	*LSR*	*Pure AMA*	*Percent of Watershed*
Late-Successional Reserve	11,186		27
Adaptive Management Area		7,932	19
Reserved Pair Area (Owls)	966	2,672	9
Bald Eagle Management	285	100	<1
Critical Habitat for Owls	4,667	1,838	16
Riparian Reserves	6,747	5,650	30

1. Late-Successional Reserve

The objective of the Late-Successional Reserve (LSR) allocation is to protect and enhance conditions of late-successional and old-growth forest ecosystems. There are two LSRs on the Hebo Ranger District: #R0269, at the southern end of the district, and #R0807, which extends over large blocks of the district from north to south and surrounds the Administratively Withdrawn lands in the Cascade Head Experimental Forest. The boundary of LSR R0269 was established primarily to protect northern spotted owl habitat. The boundary of LSR R0807 was established primarily to protect marbled murrelet habitat and may change as more is learned about the species (USDA USDI, 1997). LSR R0807 covers 7,416 acres, or 40% of the federally managed land in the Little Nestucca watershed. Fourteen percent of the Hebo Ranger District portion of R0807 is within the Little Nestucca watershed; seven percent of the entire LSR R0807 is within the Little Nestucca watershed.

2. Riparian Reserves

Approximately 12,400 acres of the federal lands are within Riparian Reserve, as defined by the Northwest Forest Plan. Riparian Reserves overlie all other land use allocations. Outside of late-successional reserves, 71% of the federal land base is in Riparian Reserves.

Riparian Reserves include those portions of a watershed directly linked to streams and rivers; that is, the portions of a watershed required for maintaining hydrologic, geomorphic and ecological processes that directly affect standing and flowing water. In addition to benefiting aquatic resources, Riparian Reserves were established to maintain and restore native plant and animal communities in riparian areas and wetlands, to benefit other riparian-dependent species, and to retain corridors and networks for the dispersal of late-successional forest species between LSRs.

3. Adaptive Management Area

The Little Nestucca Watershed is located within the Northern Coast Range Adaptive Management Area. Approximately 7,970 acres (19% of the watershed) are within the "pure" Adaptive Management Area allocation (AMA) outside of the Late-Successional Reserve. The Northern Coast Range AMA emphasis is management for the restoration and maintenance of late-successional forest habitat (ROD D-15). For more information on the management guidelines for this AMA, refer to the Northern Coast Range Adaptive Management Guide (USDI USDA 1997).

E. Issues and Key Questions

Issues and Key Questions were developed to guide and focus the analysis.

Issue 1. What is the condition of the National Forest and Bureau of Land Management land and how can it be managed to function as a late-successional ecosystem?

Background: Late-successional ecosystems buffer microclimates during seasonal climatic extremes, intercept moisture from clouds and fog, store carbon, provide nutrient and hydrological cycling and provide sources of beneficial arthropod predators and organisms. These functions are not well developed in younger natural forests and managed plantations. The Northwest Forest Plan directs the Forest Service and the Bureau of Land

Management to manage Late-Successional Reserves (LSRs) to provide late-successional forest habitat supporting populations of species associated with late-successional forests and to ensure the conservation of late-successional species diversity (ROD, B-4, 5). Within LSRs, late-successional habitat will be maintained and enhanced. Within the Northern Coast Adaptive Management Area (outside of LSRs), late-successional habitat will be restored and maintained. Habitat for late-successional dependent species has been significantly altered through timber harvest and road building.

Management would focus on maintaining and improving late-successional ecosystem function and habitat characteristics while restoring connectivity with late-successional habitat outside the watershed. Maintenance, enhancement and restoration objectives should result in multispecies and multilayered stands; moderate to high canopy closure; moderate to high accumulations of large logs, snags and trees with cavities, broken tops and large deformed limbs; and moderate to high accumulations of fungi, lichens and bryophytes (ROD, B-5).

Key Questions:

a. Where would silvicultural activities be beneficial in promoting late-successional characteristics?
b. What areas should be treated first, and for what reason?

Issue 2. What is the condition of aquatic habitat and riparian areas in this watershed?

Background statement: Concern about declining salmon populations in the Pacific Northwest is reflected in the Northwest Forest Plan's Aquatic Conservation Strategy, and more recently, in Oregon's Coastal Salmon Recovery Initiative. Aquatic habitat protection and restoration at the watershed scale is critical. Prior to designing restoration projects, it is important to understand what the limiting factors are, what has happened in the past to degrade potentially good habitat, and what can be done to improve conditions.

Key Questions:

a. Where is the current high quality habitat located?
b. Where is the potential high quality habitat located?
c. What disturbances have degraded potential high quality habitat?
d. Are there water temperature concerns within this watershed?
e. What kinds of areas best contribute large woody debris to the stream channel?
f. What types of riparian sites have the highest potential to grow trees for future large woody debris?
g. Where can beavers provide good habitat?

Issue 3: How can stable roads be provided to the extent needed to meet public and agency needs?

Background statement: Several factors have converged to make management of the Forest Service road network a critical issue. First, funds available for road maintenance have declined significantly during the last few years. Second, roads have been identified as the most significant source of increased sedimentation in streams related to land management. Roads also alter the hydrology of a watershed by re-routing surface and subsurface flow and acting as an extension of the stream network (FEMAT report, 1993, p. V-16; Jones and Grant, 1996). Lack of maintenance will only make the potential for plugged culverts, water diversion, increased sedimentation, and landslides greater in the future. Any watershed restoration plan needs to address the impact that roads may be having on the aquatic ecosystem. Third, a stable road network is still needed to provide access for administrative land management and for the public.

Key Questions

a. Which roads are likely to fail?
b. Which roads have a high potential for resource impacts?
c. Are there any recreational opportunities in this watershed that would influence which roads should be maintained in the long term?
d. What are the long-term and short-term access needs in the watershed? Should the Access and Travel Management (ATM) plan be modified? If so, how?

Issue 4: How can road and silvicultural treatments be coordinated for the benefit of fish and wildlife?

Background statement: Roads are needed to provide access to stands that are recommended for treatment. Many of the older stands are located along roads that were built prior to the mid-1970s, and before standards for road construction were greatly improved. These older roads often have a higher risk of failure, and are candidates for closure and/or road obliteration. There is a need to coordinate silvicultural treatments and the closure of high-risk roads in order to avoid logistical conflicts between the management goals of treating plantations and other stands, and closing roads in order to protect and enhance watershed health.

Key Questions:

a. Which stands have the highest priority to treat in order to facilitate closures of roads with problems?
b. What criteria can be used to determine if road closure should proceed immediately or be deferred in order to allow silvicultural treatments?

Chapter 2. Characterization

A. Context of Watershed

The distribution of LSRs within the AMA and the connectivity between LSR R0807 and other LSRs is addressed in the LSR Analysis for Oregon's Northern Coast Range Adaptive Management Area (USDA-USDI, 1997). Located in the center of the Hebo Ranger District, the portion of LSR R0807 within the Little Nestucca watershed serves as the only connection between late-seral forest at Cascade Head to the south and the "Big" Nestucca watershed to the north.

Within the watershed, much of LSR R0807 is within young managed plantations (less than 45 years old) or the Mt. Hebo plantation; some of the late-seral stands were commercially thinned about 20 years ago. Blocks of late-successional habitat exist in the LSR, providing habitat for marbled murrelets and a spotted owl pair. North of the Little Nestucca watershed, there are fewer sites known to be occupied by murrelets and owls, probably due to lack of habitat.

The Little Nestucca River drains directly into the Pacific Ocean through Nestucca Bay (Figure 1), where it joins the "Big" Nestucca River. The Little Nestucca watershed has a high proportion of low-gradient stream miles, and low-gradient stream reaches are found farther upstream than in most of the Coast Range. There are also more floodplains and wetlands in the upper part of the watershed than is commonly seen in the Coast Range. Thus, it is likely that more of the stream network can be utilized by fish than is commonly seen in other Coast Range watersheds.

B. Physical Characteristics of the Watershed

1. Climate

Most of the Little Nestucca watershed is in the coastal climate zone (USDA, 1998), which typically has high rainfall and moderate temperatures. Most of the rain comes between the months of October and June. Fog and low clouds are common in both summer and winter. Prolonged freezing temperatures are rare.

The eastern part of the watershed is in the northern coastal crest climate zone (USDA, 1998). This zone also has high rainfall, and moderate temperatures. Fog is less common during the summer months.

2. Geology and Geomorphology

The bedrock consists of sedimentary rock that has been intruded by numerous volcanic dikes and sills. Most of the sedimentary rock is a fine-grained, massive to well-bedded siltstone with some fine layers of volcanic ash, known as the Yamhill Formation. A block of Tyee Formation, a well-bedded sandstone that is bordered by faults, is located in the eastern half of the watershed. The Salmon River Formation is a basaltic sandstone that contains scattered locations of seashell fragments. In this watershed it is only found along the bottom of Bear Creek and "the gorge" of the Little Nestucca River (Snavely, et al., 1996). Map 3 shows the geology of the watershed.

Bedrock has an obvious influence on landforms in this watershed. The more erodable siltstone of the Yamhill Formation underlies gently rounded hills and short, gentle slopes. The Tyee Formation underlies more pronounced, sharper ridges. This picture is complicated by the presence of the basaltic dikes and sills, which are more resistant to erosion. Basalt is found at the top of the higher ridges and peaks, such as Gauldy Ridge, Neskowin Ridge on the southern border of the watershed and the unnamed ridge west of Bear Creek. Resistant sills of basalt that are found on the midslope along Bear Creek impede the hillslope from eroding back, and create an incised canyon in the Salmon River Formation at the bottom of the canyon. The interbedded basalt within more erodable sedimentary rock has created resistant steps in streams, leading to the development of numerous waterfalls within this watershed. Map 4 is a shaded relief map of the watershed, and shows landforms.

Ancient earthflows are common in this watershed, especially on the Yamhill Formation. Because most of the watershed is underlain by gentle topography, debris slides and torrents are not as common here as in other parts of the Coast Range. Only 18 debris torrents were found on historic air photos that pre-dated the 1996 February flood. Twenty-one debris slides that were related to the 1996 flood were mapped from air photos in this watershed. Most of the debris torrents found in this watershed were related to roads or harvested areas (See Table 2-1).

Table 2-1: Number and Origin of Debris Torrents by Subwatershed

*Year**	*Number of Road-Related Debris Torrents*	*Number of Harvest Related Debris Torrents*	*Debris Torrents in Natural Areas*
Fall Creek Subwatershed			
1977	1	2	
1996	1		
Bear 1 Creek Subwatershed			
1969	1		
1977	3	1	
1996		3	
Austin/McKnight Subwatershed			
1977	1		
1996	6		3
Sourgrass Creek Subwatershed			
1996	4		
Upper Little Nestucca Subwatershed			
1996	1		
Stillwell/Hiack Subwatershed			
1969	1		
1996	1		1
South Fork Little Nestucca Subwatershed			
1977	2		
1996	1		
TOTAL	23 (70%)	6 (18%)	4 (12%)

*Year of aerial photo when the debris torrent first appears.

3. Relationship of Geology to Sedimentation

The bedrock in the Little Nestucca is varied. The majority of the area is covered by fine-grained sedimentary rock, mostly silts and sandstones of the Yamhill, Nestucca, and Tyee Formations. Intrusions of basaltic rock punctuate the landscape, and cover a smaller area. The fine-grained formations, especially the Yamhill and Nestucca Formations are easily eroded, and produce silt, sand and gravel. These gravels are not durable, and break down easily compared to the basaltic rock. Although much less of the landscape is covered by basaltic intrusions, they are an important source of more durable pebbles and cobbles, and small boulders. Because most of the watershed is underlain by easily erodable bedrock, this area probably has a naturally high sediment production rate, as compared with other parts of the Coast Range.

4. Stream Characteristics

The Little Nestucca watershed has a high proportion of low-gradient stream miles, and low-gradient stream reaches are found farther upstream than in most of the Coast Range.

Thus, it is likely that more of the stream network can be utilized by fish than is commonly seen in other Coast Range watersheds.

There are more floodplains and wetlands in the upper part of the watershed than is commonly seen in the Coast Range. One possible explanation is that the easily erodable Yamhill Formation has allowed more lateral erosion by streams, and more floodplain development. A second explanation involves a theory first proposed by Niem (1976) for the history of rivers in the Coast Range. Prior to the tectonic uplift of the Coast Range, the western edge of Oregon was a flat coastal plain. Rivers that originated in the Cascades flowed directly west to the ocean. As the Coast Range rose, these rivers were cut in two, and the parts of the rivers that were left on the east side of the Coast Range reversed direction and began to flow into the Willamette Valley. The western segments of these rivers were cut off from their headwaters, so today's headwaters were once located in the middle of a larger stream. A possible eastern link to the upper Little Nestucca may be the Rogue River, a tributary to the South Yamhill River located south of the Van Duzer corridor. Both river segments have low-gradient, sinuous reaches and wetlands almost to the top of the headwaters. A ridge with 160-200 feet of relief divides the headwaters of the two streams.

A wide, unconfined valley and a low-gradient, highly sinuous reach of the Little Nestucca River is located in the headwaters of the watershed on state forest and private land T6S, R9W, Section 10 (See Maps 3 and 5). Directly downstream from this valley is a basalt sill that creates a 56 foot waterfall. The basalt sill is apparently a local control on gradient. The stream is eroding through a basalt at a much slower rate than the surrounding Yamhill Formation, so the headward erosion into this valley has been impeded. As the river cannot cut down, its energy is expended by lateral cutting and developing highly sinuous meanders. The banks appear to be stable.

5. Water Quality

There is limited data on water quality within the Little Nestucca watershed. At this time, the Little Nestucca River is not listed as a water quality limited stream. A 1988 statewide non-point source assessment cited impairment of beneficial uses in the Little Nestucca due to habitat modification, sediment and temperature.

Temperature data for three locations on the Little Nestucca River and four tributaries is available for 1996 and 1997. Four tributaries, Bear, Fall, Austin and Sourgrass Creeks stay below 64°F throughout the summer months. Warmer temperatures are found in the mainstem of the Little Nestucca in the upper and middle reaches. See Tables 2-2a and 2-2b for specific details. Figure 2 shows the locations of temperature monitoring sites.

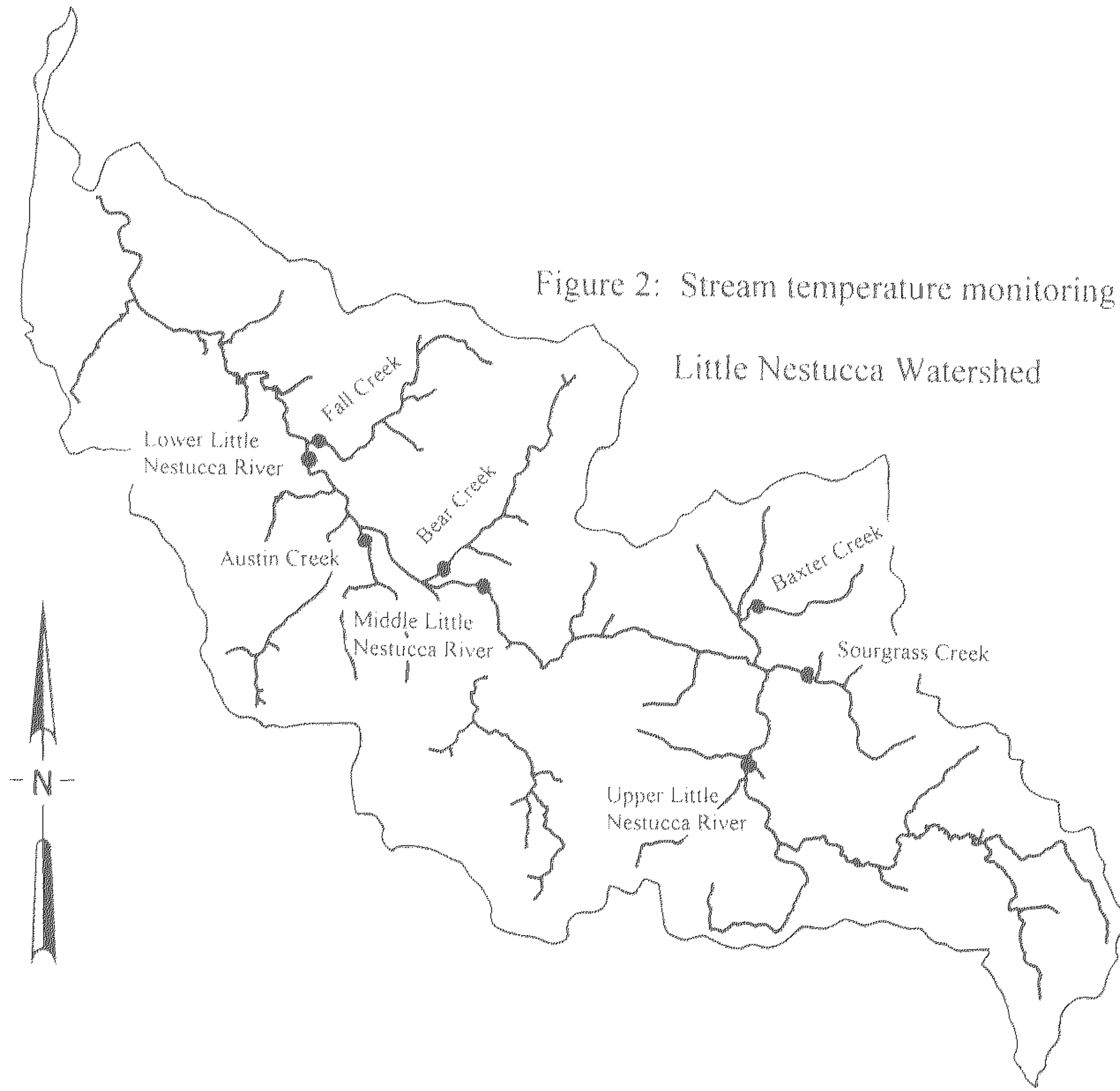


Figure 2: Stream temperature monitoring sites

Little Nestucca Watershed

Table 2-2a: 1996 Temperature Data for Little Nestucca Watershed

Location	*Highest Daily Temp (F)*	*Date*	*Number of Days above 64F (7-day average)*
Middle Little Nestucca	67.3	7/14/96	9
Upper Little Nestucca	70.2	7/14/96	22
Austin	64.1	7/14/96	0
Bear	63.2	7/14/96	0
Sourgrass	60.9	7/14/96	0

Table 2-2b: 1997 Temperature Data for Little Nestucca Watershed

Location	*Highest Daily Temp (F)*	*Date*	*Number of Days above 64F (7-day average)*
Middle Little Nestucca	66.7	8/14/97	21
Upper Little Nestucca	66.1	8/6/97	13
Austin	64.1	8/9/97	0
Bear	no data		
Sourgrass	60.4	8/14/97	0
Fall Creek*	59.8	8/25/97	0
Lower Little Nestucca*	65.2	8/5/97	3

*Data for Fall Creek and Lower Little Nestucca courtesy of the Nestucca Watershed Council.

6. Soils and Soil/Climate Zones

In general, the soils in this watershed are deep to very deep gravelly clays and clay loams. They have high water holding capacities and are very productive. The high level of biological activity produces a high amount of organic matter in the soil. Soil temperatures in the part of the watershed located in the coastal climate zone do not vary much between summer and winter (isomesic). Soil temperatures in the northern coastal crest climate zone can vary up to 5°C between summer and winter (mesic) (USDA, 1998).

C. Vegetation Patterns

Vegetation patterns at the scale of this analysis largely reflect the climate, geology, and soils previously discussed. A complex mix of environmental conditions such as soil fertility, pathogens, and seed source all affect vegetation patterns at the site specific level. The broadest characterization of vegetation, **series**, denotes the tree species that would dominate the site given hypothetical climax conditions. The watershed has the two major series that occur on the Siuslaw National Forest, the western hemlock series and the Sitka spruce series. Douglas-fir and red alder, alone or in combination, can dominate stands in either series. The Sitka spruce series dominates the maritime Coastal Fog Soil/Climate Zone. The computer model used to generate the subseries environments map (Map 6) indicates that much of the Interior Zone is also dominated by the Sitka spruce series. This pattern is atypical of most coastal watersheds and probably reflects the model's interpretation of a topography that allows maritime climatic influence to extend relatively far inland. The western hemlock series dominates the Valley Margin Soil/Climate Zone (USDA, 1995).

D. Disturbances Characterizing the Watershed

1. Human Impacts

This historical account is not a comprehensive history of the area, but was compiled from information provided in *A History of Little Nestucca Country* (Rock 1949), a series of interviews conducted by Carol Johnson for this watershed analysis, and conversations between Carol Bickford and several longtime residents (see references). Figure 3 shows locations mentioned in the narrative.

a) Settlement by American Indians

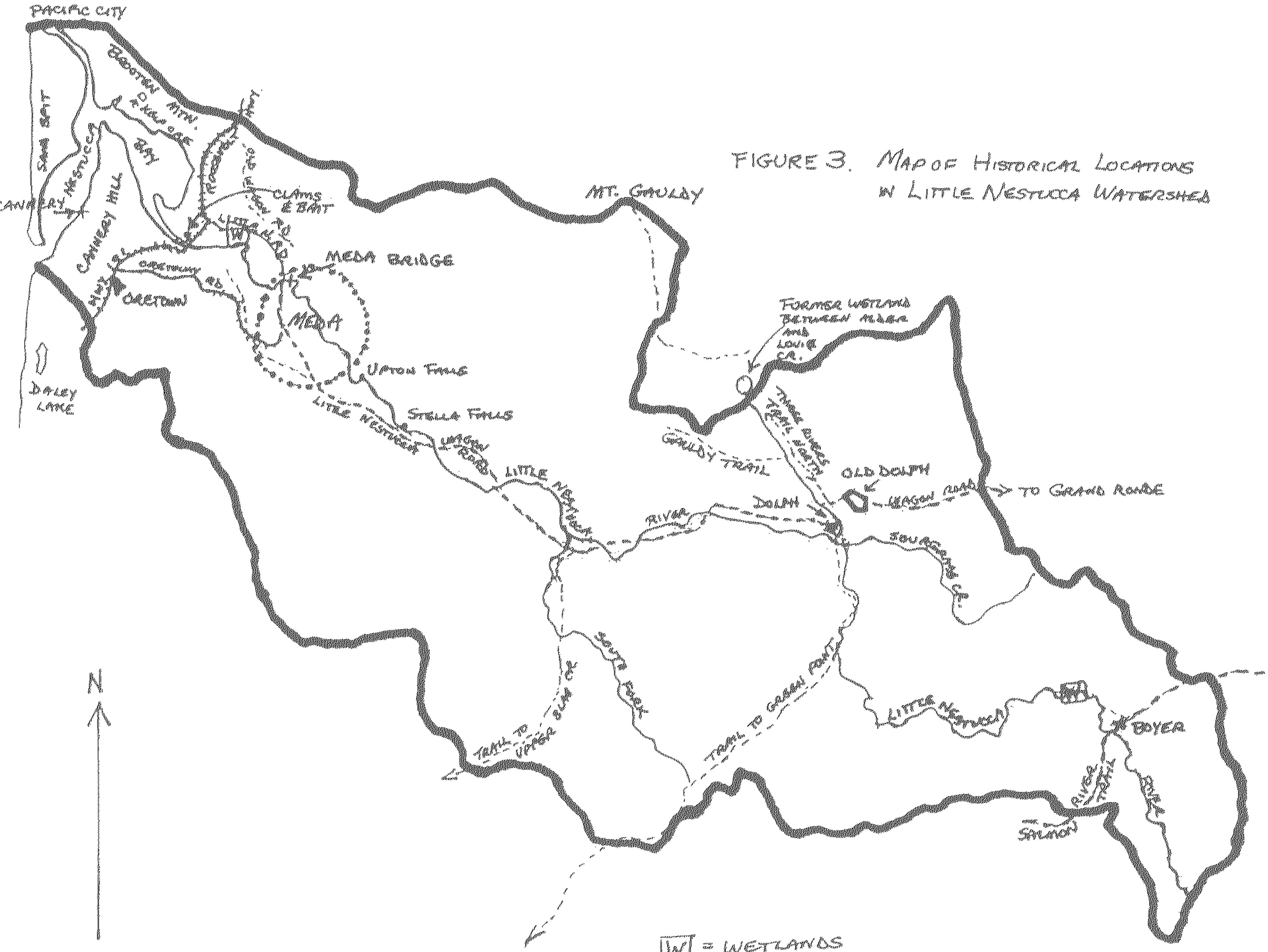
In the 1800s, the area around Nestucca Bay was hunted and fished by the "Staga ush" tribe, comprised primarily of Tillamook Indians. Around 1855, the area was set aside as an Indian reservation. Most coastal Indians lived along the rivers and bays during the warmer months and moved to the uplands in the winter. There were several Indian encampments in the Pacific City area, including a ceremonial/burial ground. An encampment along the Little Nestucca in the Meda area was used when the salmon were going upstream. Up until the early 1870s, the Indian gathering place for games, including horse racing, was near Oretown. In 1876, the Nestucca Indian Reservation was thrown open to settlement by European Americans and the tribe was forced to move to part of the Grand Ronde Agency at the mouth of the Salmon River.

b) Access routes

In the late 1800s, a narrow gauge train went as far west as Sheridan. Settlers traveled by team and wagon to the Grand Ronde Agency and, during the rainy season, stayed until the Yamhill River subsided enough to ford. Horses were obtained from the Indians about two and a half miles west of Grand Ronde. From there, settlers followed the original Indian trail to Three Rivers, where they took the Gauldy Trail, which came out of the Coast Range at Meda. The old Indian Trail followed ridge tops to avoid fording rivers and crossing muddy swamps. Provisions were packed by oxen, mule or horse. The trail was strewn with logs and went through forests of large trees. Travelers built rain shelters from strips of bark which had fallen from the tree tops.

In July of 1882, the first wagon road from Dolph to Oretown was opened. The Little Nestucca Clay Wagon Road was built by volunteer labor and became a toll road with a gate at old Dolph. From Dolph westward, the road followed the Little Nestucca River, crossing the river in several places over swift water and boulder-filled fords. Five miles west of Dolph was a stopping place at the Steinmasal home, near the convergence of the South Fork Little Nestucca with the Little Nestucca River. From there, the road zigzagged over large flat rocks and through deep mud to the Maritzen home at Estella or Stella Falls (also called Second Falls, later blasted and modified as the fish way above

FIGURE 3. MAP OF HISTORICAL LOCATIONS IN LITTLE NESTUCCA WATERSHED



W = WETLANDS IN 1880

Squaw Creek). Farther on, the road passed Upton Falls (also called First Falls, later modified by fish weirs and a concrete wall) and several homesteads before emerging from heavy timber and crossing open country en-route to Oretown.

The original town of Dolph and the second Dolph (at the present junction of the Little Nestucca Road and Highway 22) no longer exist. In 1904, old Dolph (on a hill northeast of the junction) had a general store, a hotel, a livery stable and a tavern (on the Tillamook County side of town). The town of Dolph was moved (bulldozed) because vehicles needed a better, less steep road. In 1945, new Dolph, at the junction of the current Little River Road and Highway 22, had a store, post office, service station and hotel (which was abandoned after being hit by log trucks several times).

A trail between the Little Nestucca Road and Upper Slab Creek (Neskowin Creek) followed the gentler terrain along the South Fork of the Little Nestucca River. There were three homesteaders who used this trail to access their property; the USFS maintained it in the mid 1900s. Another trail led south from Dolph along the Little Nestucca, southwest along Hiack Creek and over Neskowin Ridge out of the watershed to Green Point and old Highway 101 (Scenic Highway).

Before 1887, a plank road was built from Oretown to Nestucca Bay over Cannery Hill. In 1894, a road was built between the river and Oretown. The first road north to Cloverdale from the Little Nestucca River was used until 1927, when the Little Nestucca River Road was constructed in its present location from the Meda Bridge along the northern edge of the estuary and associated wetlands. At low tide, the beaches were used as roads to Ocean Park (later Pacific City), Woods, the Nestucca Bay clam beds and the salmon cannery. Boats were used to cross the rivers and the bay. At one time, cream was hauled by boat from farms along the Little Nestucca to Woods. Highway 101 (formerly the Roosevelt Road) was built in the 1930s. The new Highway 101 bridge across the Little Nestucca was built in the early 1980s.

Approximately 0.6 mile of the Little Nestucca River in the western portion of T5S, R10W, S15 was straightened when the Little River Road was paved (probably in the 1950s). In 1932, the dike building phase of the Highway 22 road alignment eliminated a wetland between Alder Creek, a tributary of Three Rivers, and Louie Creek, which flows into the Little Nestucca River near Dolph Junction. At high flows, this wetland drained into both creeks and the water was deep enough to allow fish to swim from one drainage to the other.

The settlement of Boyer, located at the upper end of the Little Nestucca watershed, had a post office between 1910 and 1915. John and Julia Boyer operated the Salmon River Trail as a toll road between 1908 and 1920. The route may have been used by European Americans as early as 1851 for herding cattle between the Yamhill River Valley and the lower Salmon River. The road later became Highway 18 and the Van Duzer Corridor, which was dedicated in the early 1930s.

c) Industries

(1) *Fishing*

When the settlers arrived, the bay and rivers were "alive with salmon". The first commercial fishing operation was at Upton Falls on the Little Nestucca River. At first, fish were hauled by horse teams to the Willamette Valley and sold for cash or traded for supplies. Many men and boys became driftnet fishermen. In 1887, a salmon cannery was built on the west side of Cannery Hill and operated until 1919 (with a brief reopening in 1926). Chinese laborers processed the fish and were housed in barracks located near the cannery. When it was in operation, fishing boats would go two miles up the Little Nestucca River to fish for the cannery. The decline of the commercial catch after 1918 made it difficult to maintain a profit. In 1927, a statewide election voted to close Nestucca Bay and streams to driftnetting in favor of sportfishing. Driftnetting continued on an illegal basis until the early 1970s. Commercial fishermen also fished from dories off Cape Kiwanda. In the early 1930s, the dorymen supplied lingcod and rockfish to local mink farms. (Chum salmon were also fed to mink to give them a shiny pelt.) By the mid-1900s, dorymen had returned to commercial salmon fishing. The Pacific City dory fleet went from nine boats in the 1950s to over 400 boats in the 1960s and 1970s. The number of dories decreased through the mid 1990s, when restrictions were placed on salmon fishing. The few dorymen that remain fish for chinook salmon, Pacific halibut, lingcod, rockfish, crab and, occasionally, tuna.

Clam beds at Nestucca Bay were heavily harvested. The clam beds no longer extend as far up the Little Nestucca, but the tidal flats at the bay are still used by recreational clammers. Freshwater bivalves were abundant in the Little Nestucca River near its junction with the South Fork. Freshwater clams and mussels are sensitive to water quality.

(2) *Farming*

In 1889, Upton built a water wheel on the Little Nestucca to water his crops; he raised hops, which was made into hop yeast. There was a fox farm at Meda between 1925-1936. Porter started a mink farm in 1936 or 1937.

A few farms were started on the slopes above the valley floor. Scattered openings and orchards from these early homesteads still remain. In 1916-1917, dikes were built along the Little Nestucca River from Meda to its junction with the Big Nestucca. Dairy farms were then able to expand their pastures into former estuary and wetlands along the river. Tide gates were installed at the mouth of sloughs and ditches in the 1930s by the Bureau of Reclamation and in the mid 1970s by the Tillamook Soil and Water Conservation District.

The first cheese factory at Oretown started operations in 1898; its successor was still operating in 1949-1950. In 1915, the population of Oretown was 50. The economy was based on salmon fishing and the salmon cannery, dairy farming, general farming, poultry and stock raising, and two cheese factories. Another cheese factory started at Meda in 1901; in 1927, it closed and consolidated with one between Oretown and Cloverdale. In the 1890s, Meda also had a post office and its own school district. Meda was and remains a general area rather than a specific site.

In 1915, the population of Dolph was 28. The economy was based on general farming, poultry and stock raising, dairy farming and a cheese factory.

(3) *Logging*

Because early transportation and roads were not conducive to getting timber to market, the sawmills were moved to the timber. There were mills near Dolph, up Fall Creek, near Meda, up Squaw Creek, in Oretown and in Pacific City. As early as the late 1880s, there was a sawmill near Oretown that used logs furnished from around Meda. The first logging in Pacific City occurred in the 1930s. In the 1940s, there was an alder mill near Dolph.

In the early 1940s, old growth spruce, limbless for four to five log lengths, were harvested for use in building aircraft and for pilings used in piers and tunnel construction. Some of the spruce were four to eight feet in diameter. In the 1940s and 1950s, private lands logged most of the timber in patches less than 100 acres. Some operations on flatter ground in the Squaw, Austin, and lower Fall Creek subwatersheds would cut two large trees in a day. A road was cleared into each fallen tree, a large yoke was secured to both ends and the log, functioning as a wheel, was rolled along the road and out of the forest.

Squaw and Austin Creeks had some of the largest burnt snags (left from the 1845 fire) and some of the largest timber in the watershed. The Squaw Creek area was logged by Spaulding Pulp and Paper Company, and, during the war years, by Doernbecker Furniture Company. Since the mid 1980s, Simpson logged a lot of the regrowth in the Kellow/Squaw Creek area, but replanted Douglas-fir instead of Sitka spruce, which originally dominated the area. With the rising demand for wood in 1953-1955, the U.S. Forest Service (USFS) started logging more extensively. National Forest lands on Gauldy were logged from the late 1950s through to the 1970s. Most of the Austin country was logged during the war, removing spruce and hemlock. Spruce and hemlock were logged in the Austin area during the 1940s; the majority of the mature timber remaining was logged by Longview Fiber and the USFS in the 1970s.

(4) *Minerals*

Gold was discovered in the black sand on the beach but was not worth extracting. Kelp ore was mined near Brooten Mountain beginning in 1904. In 1910, there was enough gravel on the bay beach near the mouth of the bay at low tide to haul off in sacks for personal use. Two privately owned rock pits are currently in operation in the lower Little Nestucca valley. A rock pit on National Forest land is located near Mt. Gauldy.

(5) *Other Products*

Salal berries were canned for winter fruit after being heated in the oven to get the worms out. Cultivated blackberries went wild and spread rapidly. Women, children and some men picked the berries, which were purchased by companies, packed in barrels and shipped east. At least as early as the 1940s, cascara bark, blackberries and huckleberries were harvested and sold. Sword fern, moss and salal were gathered and sold to florists.

Wild foxglove had established prior to the mid 1930s. Gathering of the leaves became profitable for women and children. Foxglove was packed for sale in gunny sacks worth $5 per sack.

d) Recreation and Tourism

In addition to ocean beach related activities (hiking, camping, picnicking), the main recreation of the area has long been fishing. Tourists from the Willamette Valley started camping at Neskowin as early as 1872. Until roads connected Neskowin to the Salmon River Roads, tourists came to the beach via the Little Nestucca River road. The locals from the Little Nestucca area used to frequent Fletcher Lake near the present Camp Winema. Both Neskowin and Camp Winema are outside of the Little Nestucca Watershed boundaries.

Recreation sites within the watershed include Bob Straub State Park at the end of Nestucca Spit, two bayside boat ramps administered by Tillamook County Parks, a County Parks parking area close to the Little Nestucca River, and a dispersed site campground on National Forest land along the Little Nestucca River.

Kelp ore (a soft sandstone) was first mined from Brooten Mountain (east of Pacific City) in 1904 as a cure-all. Kelp ore baths at the Brooten Mountain (south side) and Kiawanda (Woods) sanitariums became popular with tourists. The baths were closed in the 1920s because of complaints and legal actions by the medical community.

2. Physical Disturbance Processes

a) Weather Related Disturbances/Events

- Winter 1884 - Man froze to death on Gauldy Trail.
- January 19, 1909 - Nestucca Bay froze all the way across. Largest tide for 14 years.
- November 23, 1915 - Large tidal wave caused damage at Neskowin, carried away a cannery tank and left water one foot deep over the dock at Nestucca Bay.
- January 3, 1939 - Sou'wester storm blew down several barns. Large waves caused major damage and dune erosion at Neskowin.
- During World War II - Silver Thaw caused a lot of timber damage.
- 1949 - An earthquake in Alaska caused a small tidal wave and some flooding.
- Columbus Day Storm 1962 - The Fall Creek area sustained the largest amount of blowdown in the watershed.
- March 1964 - The Alaskan earthquake caused a tidal surge, which caused some flood damage.
- August 1981 - the temperature hit 108°F in Pacific City.
- 1983 - The Douglas-fir needles were desiccated but survived low temperatures of 5-10 Fahrenheit for 2-3 weeks.

b) <u>Disturbance Regime Blocks</u>

Fire and wind are the dominant natural disturbance processes that affect landscape vegetation patterns in this watershed. The Assessment Report for Federal Lands in and Adjacent to the Oregon Coast Province (Forest-Wide Assessment, USDA 1995) identifies three disturbance regime blocks: the Coastal Fog Zone, the Northern Interior Zone (Hebo Block), and the Valley Margin Zone. As can be inferred by their names, these disturbance blocks correspond to the soil/climate zones, demonstrating the strong influence of topography, climate and vegetation on disturbance processes and landscape pattern. The processes are described in the Forest-Wide Assessment (pp. 18-31).

c) <u>Fire disturbance history</u>

Small Scale: The Indians in the Oretown/Meda area burned each year to clear brush for hunting. The farmers burned each fall to clear their lands of bracken fern. Farmers eventually switched to tilling the land as a more effective way to reduce the bracken fern.

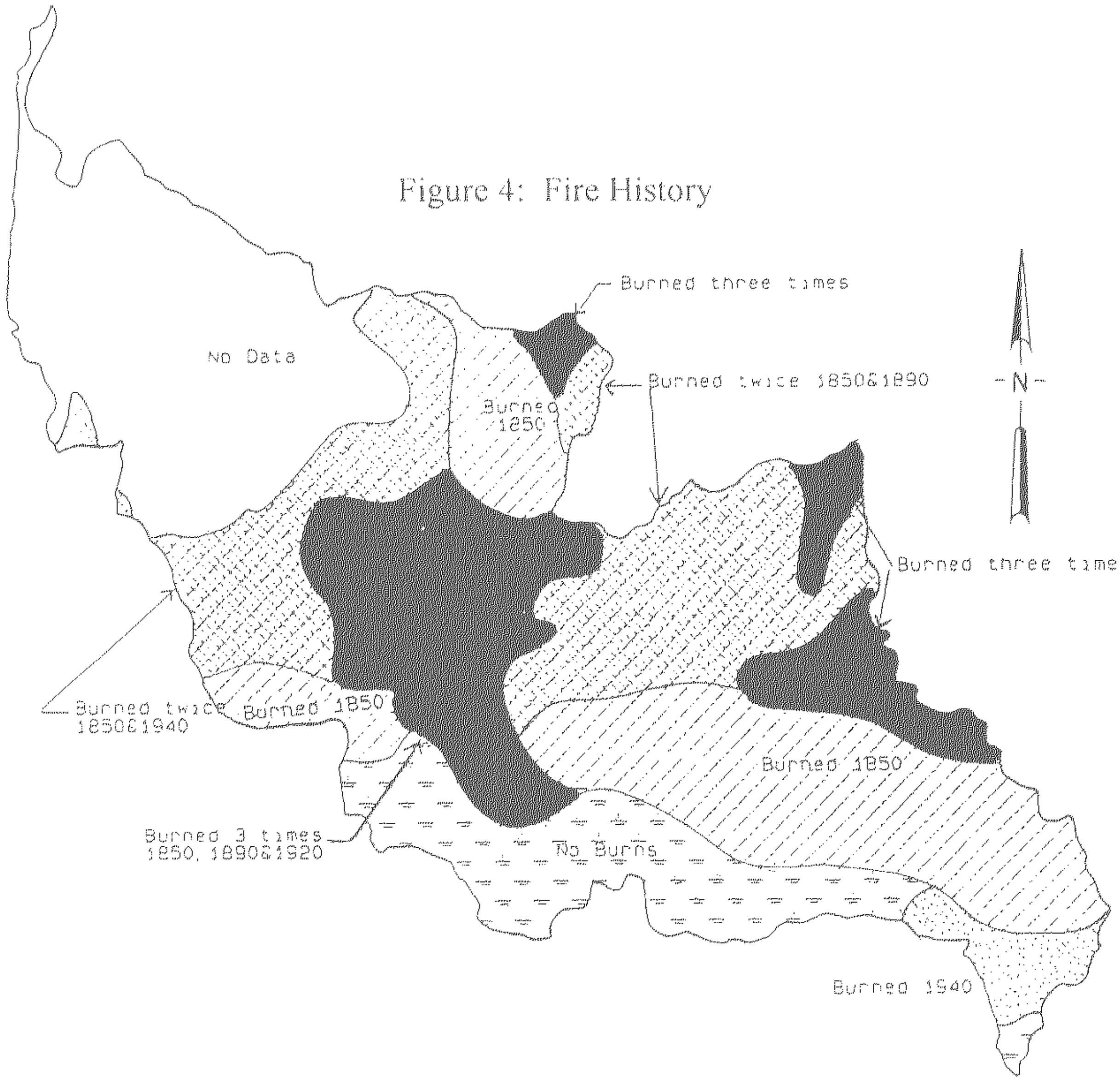
Large Scale: Much of the watershed was burned in the fire of 1845. There was also a large fire in the watershed in 1890. Because burned timber was of little interest to people filing timber claims, the federal government established timber reserves in 1907 to reclaim the blackened hillsides. In the 1930s and 1940s, burned snags covered the hillsides around Meda and east of the South Fork confluence with the Little Nestucca.

Figure 4 is a composite of four fire history maps taken from Teensma (1991). The four maps were compiled from various sources and represent our best information regarding age of vegetation during the years 1850, 1890, 1920 and 1940. As the map indicates, much of the watershed has burned two or three times since European settlement, a frequency that is probably much higher than pre-settlement times. Fire's more obvious effects on the landscape pattern has been largely erased by extensive logging. Because the oldest, most valuable stands were harvested first, the landscape pattern that has emerged from logging is a partial outcome of fire history. Less obvious effects such as the effect of repeated fire on soil fertility might emerge if intensive sampling were done. The ages of remaining natural stands in the watershed support the general pattern of the fire history composite. The occurrence of hardwood stands coincides fairly well with the areas that have burned three times since 1850; probably because repeated fires eliminated much of the conifer seed source and allowed alder to colonize relatively large areas.

d) <u>Wind</u>

Although wind is a common intermediate disturbance throughout the assessment area, it is especially significant in the Coastal Fog Zone, where yearly winter windstorms are responsible for creating small patches of blowdown scattered throughout this zone. Most patches are less than one half acre in size and few exceed ten acres in size. Infrequently, severe windstorms cause the blowdown of large tracts; the most notable event in the watershed was the Columbus Day Storm of 1962. Damage from the storm can be estimated from acres of harvest during the years 1963 and 1964 as all other work was halted in an effort to salvage the damaged stands (Kiser 1997). One hundred and eight-

Figure 4: Fire History



eight acres were harvested in the watershed during those years, mainly in the Fall Creek subwatershed.

Interrelated factors influencing wind behavior and the potential for windthrow include such factors as topography, surface of the forest canopy, the stand border, stand orientation, soil, rooting depth, root rot, exposure, stand density and windfirmness of trees (Harris and Ruth 1979; USDA 1953; USDA 1964). A GIS model for predicting the probability of wind damage has been developed for the Siuslaw National Forest. It is a relatively simple model given the complex of factors involved and is based on a combination of four weighted factors: distance from ocean, aspect, species composition and slope position. The blowdown risk map produced for this analysis shows that the high risk areas are concentrated in the western half of the watershed: close to the ocean, on ridges or high on the northeast side of ridges (lee side of prevailing southwest winds), in stands composed predominantly of western hemlock or Sitka spruce.

Windthrow is frequent in the Hiack area due to its susceptibility to strong winter winds from the east, which are funneled from the Willamette Valley toward the coast via the South Fork of the Yamhill River Valley.

3. Biological Disturbance Processes

a) Disease

At this time, insect and disease levels in this watershed are at endemic levels, except for **Swiss needle cast** (*Phaeocryptopus gaeumannii*) which has become increasingly evident within the watershed, particularly in managed stands. The spring 1997 aerial survey (Table 2-3) conducted by the Oregon Department of Forestry shows large areas of discolored trees, presumed to have Swiss needle cast. The areas that appear to have the worst infestation are generally to the west of Mt. Gauldy, but noticeably infected stands occur throughout the watershed. Research into this disease is ongoing and at present it is not known whether outbreaks are cyclical or whether it will have a long-term effect on the distribution of Douglas-fir in the Coastal Fog Zone. With the current emphasis on underplanting shade tolerant trees rather than establishing new plantations, the amount of Douglas-fir being planted has greatly decreased on federal land, even without Swiss needle cast concerns.

At endemic levels, other diseases and insects kill trees individually and in small groups. The most common causes of these small scale "disturbances" are the root diseases and bark beetles. Common root diseases that can be expected in the watershed include **laminated root rot** (*Phellinus weirii*), **shoestring root rots** (various species of the genus *Armillaria*), **black stain root disease** (*Leptographium wageneri*), and **annosus root rot** (*Fomes annosus*). In the coast range, black stain root disease and shoestring root rots are mainly diseases of young plantations (<25 years) or off-site trees. Laminated root rot, the most destructive root rot in the Coast Range, is comparatively rare on federal portions of the watershed. Annosus root disease has the potential to become a problem in stands that are composed predominately of western hemlock. Annosus root rot spreads through root contact and by airborne spores landing on fresh wounds or stumps. Because of the role of stumps and wounds in spreading the disease, repeated thinning entries will increase the incidence of the disease. Hemlock is most likely to develop butt rot rather than being killed by the disease; losses are small in trees less than 120 years. Particular care needs to be taken to ensure the long-term health of hemlock-dominated stands, particularly if multiple harvest entries are planned as part of a strategy for developing late-successional characteristics. See Hadfield (1986) for management recommendations.

Table 2-3: Swiss needle cast infection, Little Nestucca watershed (McWilliams 1997)

	Stand Type[2]		
Infection Level[1]	*Plantations Acres*	*Natural Stands Acres*	*Total*
Light	11,682	2,274	13,956
Heavy	2,291	1,019	3,310
Total Acres	13,973	3,293	17,266

Based on the spring 1997 aerial survey conducted by OR Dept. of Forestry

[1] Degree of infection based on degree of discoloration
[2]Map classified stands as "younger" and "older", which are basically plantations and natural stands.

b) <u>Insects</u>

Two most common bark beetles of concern are the **Douglas-fir beetle** (*Dendroctonus pseudotsugae*) and **Spruce beetle** (*Dendroctonus rufipennis*). Mortality caused by bark beetles is often associated with root disease. Major beetle outbreaks probably followed large fires and blowdown events in the past, significantly adding to the net effect of the initial disturbance. On December 4, 1951, a severe storm blew down an estimated 3.7 billion board feet of timber in the Coast Range. An additional 455 million board feet of timber was killed by Douglas-fir bark beetle during the first summer following the storm (Ruth and Yoder 1953). Rapid salvage of blowdown has been a major factor in keeping beetle populations at relatively low levels. The creation of downed wood as part of the late-successional management strategy has raised concerns about increasing beetle-caused mortality. Distributing down wood over the landscape in shaded understories has the potential for maintaining higher endemic levels of the beetle or even triggering outbreaks. Guidelines, which may be refined through further research, have been developed and are being implemented to limit beetle risk from down wood creation (Hostetler and Ross 1996).

The **western hemlock looper** (*Lambdina fiscellaria lugubrosa)* has been periodically destructive to forests in northwestern Oregon and presumably within the watershed. The earliest recorded outbreak occurred between 1889 and 1891, destroying a "vast amount" of timber in Tillamook, Clatsop and Grays Harbor (WA) Counties. Another major Tillamook County outbreak covering several townships and destroying an estimated 500 million fbm [foot board measure] of western hemlock and Douglas-fir occurred in 1918-21. Outbreaks in the early 1960s were minimized by prompt spraying (Furniss and Carolin 1980).

In the early summer of 1949 or 1950, there was an infestation of **tent caterpillars**. All the alder trees had their leaves eaten during the infestation but few trees dies. The infestation lasted for two years.

E. Seral Stage Distribution

The current seral stage distribution reflects disturbance processes discussed above (Table 2-4). The most significant disturbances at a landscape level are logging (a subset of which reflects salvage of windthrow) and fire. Practically all of the "early", "young" and "pole" classes resulted from logging activity. The age limits on the "mature" and "late" classes were mainly determined by the last occurrence of wildfire.

Table 2-4: Current Seral Stage Distribution

SERAL STAGE[1]	*Current in Entire Watershed Ac. (%)*	*Current on Federal Lands Ac. (%)*
Early	5,168 (13%)	2,217 (12%)
Grass	2,240 (5%)	0 (0%)
Hardwood	3,080 (8%)	1,678 (9%)
Young Conifer	5,583 (14%)	2,917 (15%)
Young Conifer Mix	5,856 (14%)	2,064 (11%)
Young Hardwood Mix	1,839 (5%)	297 (2%)
Hardwood Mix Pole	455 (1%)	96 (1%)
Conifer Mix Pole	2,125 (5%)	1,198 (6%)
Conifer Pole	2,476 (6%)	1,537 (8%)
Mature Hardwood Mix	2,620 (6%)	853 (4%)
Mature Conifer Mix	2,520 (6%)	1,539 (8%)
Mature Conifer	4,944 (12%)	4,171 (22%)
Late	652 (2%)	405 (2%)
Nonforest (rock, sand, water)	1,202 (3%)	14 (0%)
Total	40,760	18,986

[1]See Appendix 1 for seral stage definitions

F. Biological Resources

1. Wildlife

a) Habitat diversity

Habitat diversity within the Little Nestucca Watershed includes sand spit, bay, tidal flat and estuary, basalt outcrops, waterfalls and beaver ponds, alder dominated stands, late-seral coniferous forest, and young managed coniferous stands. The larger wetlands and homestead pastures are found near the bay, up the South Fork and near the headwaters of the Little Nestucca River. In between, the river winds through a rocky gorge flanked by red alder and large spruce. Red alder draws interspersed with conifer stands are more prevalent on the north side of the river and east to the lower slopes of Mt. Hebo. Unmanaged stands south of the Little Nestucca, on Salal Point and in Bear Creek (Mt. Gauldy) tend to be dominated by older conifer and exhibit late-successional characteristics, such as large diameter trees with large limbs, snags, large down logs and a canopy with two or more layers.

b) Federally Listed Wildlife Species

The vegetation and topography of the Little Nestucca Watershed provide key habitat features for four birds federally listed as threatened species (marbled murrelet, Aleutian Canada goose, northern bald eagle and northern spotted owl) and two birds federally listed as endangered species (peregrine falcon and brown pelican). Potential habitat for the federally threatened western snowy plover exists, but there are no recent records of plovers on the Nestucca Bay sand spit. Brown pelicans forage in Nestucca Bay and peregrine falcons hunt in the estuary and wetlands.

The diked pastures (now part of the Nestucca Bay Wildlife Refuge) along the eastern edge of the bay are wintering grounds for western, dusky and Aleutian Canada geese.

Bald eagles nest and perch on slopes above the bay and forage in the bay and along the Little Nestucca River. There is one active bald eagle nest near Nestucca Bay and a Bald Eagle Recovery Plan site on the Little Nestucca.

Northern spotted owls have been documented in the watershed, although the nearest nest tree is approximately one half mile outside of the watershed boundary. National Forest and Bureau of Land Management (BLM) lands in the southwestern portion of the watershed are within a proposed Reserved Pair Area for spotted owls.

The Little Nestucca River serves as a flight corridor for marbled murrelets, funneling the birds along the river canyon and up smaller tributaries with trees having suitable structure for nesting. There are eleven known occupied murrelet sites in the Little Nestucca River Watershed; more occupied sites would likely be confirmed if surveys were conducted in the remaining unsurveyed suitable habitat in the watershed.

c) Plants Requiring Special Consideration

Thirteen populations of a former sensitive species, *Poa laxiflora* (loose-flowered bluegrass), have been documented within the Little Nestucca Watershed. Five of these populations are to be managed under the Conservation Strategy adopted by the Siuslaw National Forest in 1993.

The only local (near Hebo Ranger District) population of *Filipendula occidentalis* (queen-of-the-forest), a Federal Species of Concern, is located on basalt cliffs in the Little Nestucca River canyon. The population is on private land adjacent to the National Forest.

Several Survey and Manage species of mosses, liverworts, lichens and fungi have been documented in adjacent watersheds (Salmon River and Neskowin Creek) and are likely to be found in the Little Nestucca Watershed.

2. Fish

The Little Nestucca watershed contains approximately 71 miles of fish-bearing streams, of which 39 miles support anadromous fish. Common salmonid fish species include chinook (*Oncorhynchus tshawytscha*), coho (*O. kisutch*), and chum salmon(*O.Keta*), and steelhead (*O. mykiss*) and cutthroat trout (*O. clarki*). Numerous other fish species, including sculpins (*Cottus sp.*), lamprey (Petromyzontidae), and sticklebacks (Gasterosteidae), also inhabit the basin. Fish habitat within the basin is currently below its potential throughout the watershed.

Coho salmon and steelhead trout have been petitioned for listing under the Endangered Species Act (ESA) coast wide. Due to the Oregon Coastal Salmon Restoration Initiative (OCSRI), coho salmon currently remain listed as a candidate species. The decision on listing winter steelhead trout has been postponed until February 1998.

Coho, chum, and steelhead populations are depressed in the Little Nestucca Drainage. Chinook salmon appear to be maintaining fairly healthy populations. Good data on sea-run cutthroat trout are not available but anecdotal information suggests that this run is also depressed throughout the basin.

Austin, Squaw, Kellow, Bear, and Fall Creek are designated core areas for coho salmon under the OCSRI and Fall Creek is also a core area for chum salmon.

Chapter 3. Current and Reference Conditions

A. Condition of Terrestrial Ecosystem

1. Vegetation Patterns

a) Plant Associations, Plant Association Groups and Subseries Environments

Long-term, stable plant populations can be characterized by **plant associations** (PAs) based on the hypothetical climax tree species and the dominant shrub and/or herb layer. Plant associations have been developed for the Siuslaw National Forest (Hemstrom and Logan, 1986) in order to use vegetation as an indicator of potential species composition, site productivity and management response. Used alone, the climax tree species denotes the **series**. The two major series on the Siuslaw National Forest, the western hemlock series and the Sitka spruce series, occur in the watershed. Douglas-fir and red alder, alone or in combination, can dominate stands in either series (Table 3-1). At the scale of this analysis, with an emphasis on modeling at the landscape level, it is more useful to characterize vegetation in terms of **plant association groups** (PAGs). Models are used to predict the location of PAs by using data on environmental conditions and a geographical information system (GIS). PAGs are the result of lumping PAs into groups that can be accurately distinguished at the scale of environmental data available in the GIS (USDA 1995).

Table 3-1: Douglas-fir and red alder dominated natural stands (acres)

	ACRES			
SERIES	*D-F*[1]	*R A*[2]	*R A/D-F*[3]	*D-F/RA*[4]
Spruce	1,956	1,959	661	318
Hemlock	1,758	1,102	192	106

[1]DF def.: Seral classes MATCON & LATE, layer 1/species 1=PSME, crown closure ≥50%
[2]RA def.: Seral class HDWD
[3]R A/D-F def.: Seral class MATHWMIX, layer 1/species 1=PSME
[4]D-F/R A def.: Seral class MATCONMIX, layer 1/Species=PSME, crown closure ≥50%

Under the concept of **Subseries environments,** PAGs are grouped into six categories described by the series name and the moisture gradient in which they are found e.g. hemlock wet, hemlock moist, etc. (USDA, USDI 1997). The distribution pattern of subseries environments (Map 6) is similar to PAGs as they both use the same series designations; in this watershed, seven PAGs correspond to six subseries environments. (Table 3-2). The use of moisture gradients reflects the relationship between plant associations, precipitation and soil moisture storage capacity.

Table 3-2 Distribution of Subseries Environments & PAGs Within the Watershed

SOIL/CLIMATE SERIES (DISTURBANCE REGIME BLOCK)	*SERIES*	*SUBSERIES ENVIRONMENT (Acres)*	*PAGs COMPRISING THE SUBSERIES ENVIRONMENTS (Acres)*
Coastal Fog Zone 23,142 Acres (includes 894 acs. w/o data)	S. Spruce	Spruce Wet (14,832) Spruce Moist (5,933) Spruce Dry (533)	Spruce/salmonberry (14,832) Spruce/swordfern (5,156) Spruce/menziesia (777) Spruce/salmonberry-salal (533)
	W. Hemlock	Hemlock Dry (80) Hemlock Moist (450) Hemlock Wet (420)	Hemlock/salal (80) Hemlock/swordfern (450) Hemlock/salmonberry (420)
Interior Zone (Northern Interior Hebo) 9,844 Acres (includes 52 acs. w/o data)	S. Spruce	Spruce Wet (3,873) Spruce Moist (2,938) Spruce Dry (89)	Spruce/salmonberry (3,873) Spruce/swordfern (2,369) Spruce/menziesia (569) Spruce/salmonberry-salal (89)
	W. Hemlock	Hemlock Dry (580) Hemlock Moist (1,145) Hemlock Wet (1,167)	Hemlock/salal (580) Hemlock/swordfern (1,145) Hemlock/salmonberry (1,167)
Valley Margin 7,774 Acres (includes 23 acs. w/o data)	S. Spruce	Spruce Wet (856) Spruce Moist (238) Spruce Dry (51)	Spruce/salmonberry (856) Spruce/swordfern (200) Spruce/menziesia (38) Spruce/salmonberry-salal (51)
	W. Hemlock	Hemlock Dry (14) Hemlock Moist (1,496) Hemlock Wet (5,096)	Hemlock/salal (14) Hemlock/swordfern (1,496) Hemlock/salmonberry (5,096)

The Coastal Fog Zone is primarily composed of the Spruce Wet and Spruce Moist subseries environments with drier subseries occurring primarily on ridgetops and some southwest facing slopes. Within the watershed, approximately 96% of the Coastal Fog Zone is within the Sitka spruce series with the spruce/salmonberry PAG alone accounting for approximately 67% of the zone. The western facing slopes on the more inland portion of the zone are dominated by spruce/swordfern (approximately 23% of the zone).

The computer model indicates that the Interior Zone in this watershed is also dominated by the spruce series (approximately 70%) which probably reflects gentle topography that allows the maritime climatic influence to extend relatively far inland, especially along the Little Nestucca River. Rainfall is also highest in this zone of the watershed. The actual extent of the Spruce Series in this zone has not been field verified. The general distribution of PAGs mirrors that of the Coastal Fog Zone with the majority of area occupied by spruce/salmonberry except for west facing slopes dominated by spruce/swordfern.

The Valley Margin Zone represents a rather abrupt transition to a landscape dominated by the western hemlock series. The Little Nestucca bends along the western edge of the zone as the ridges change to a general north-south orientation, effectively ending the maritime influence. In this watershed the spruce/salmonberry PAG (11% of the zone) extends for a ways in valley bottoms along the western margin of the zone. After the first series of ridges the terrain generally flattens and can be characterized as foothills. Approximately 85% of the zone is in the western hemlock series with a distribution that somewhat mirrors that in the spruce series, i.e. the generally moderate terrain is dominated by western hemlock/salmonberry (approximately 66% of the zone) with the bulk of the remaining area (19%) occupied by western hemlock/swordfern occurring on south and southwest facing slopes.

b) Seral stages

Table 3.3 displays changes in percentages of land in three basic seral stage classifications, "young conifer", "mature conifer" and "hardwood". The table is useful to indicate general trends in the watershed rather than to display exact numbers. Seral stage distribution was only available for three points in time. The 1914 data is based on a map compiled by the State Forestry Board in 1914. A mid 1900's seral stage map was derived from a series of county-wide vegetation maps (described in Appendix 1) completed between 1940 and 1956.

"Young conifer" is defined as ages 1 through 80 years and "mature conifer" as 80+ years. Hardwood includes stands of any age that were typed as having 50% or more red alder. These broad categories were used because of wide differences in vegetation typing done on the three inventories available for analysis. Because previous inventory data is incomplete, percentages are relative to the amount of forest land (i.e. doesn't include non-forest land such as farmland, water, etc.) that was typed during a given inventory rather than representing a percentage of the entire watershed. See Appendix 1 for assumptions made in interpreting seral stages, etc. Since the 1940's, when intensive timber management began, there has been a decrease in mature conifer distribution and patch size and an increase in young conifer. Acreage in hardwoods has increased by about 5,000 acres. Practically all of this increase is apparently in mixed hardwood/conifer stands as there has been virtually no net change in "pure" hardwood stands (>80% alder) since the mid 1900's. The acreage currently in pure hardwood is approximately 3,000 acres.

Table 3-3 Changes in Forest Land Seral Stage Distribution

SERAL STAGE[1]	**1914 (acres and percent of area typed)**	**Mid 1900's (acres and percent of area typed)**	**Current (acres and percent of area typed)**
Young Conifer	18,705 (54%)	16,853 (48%)	21,208 (57%)
Mature Conifer	16,155 (46%)	15,367 (44%)	8,116 (22%)
Hardwood	untyped	3,047 (9%)	7,994 (21%)
Total area typed as forest land	34,860	35,267	37,318

See Appendix 1 for definitions

2. Plantations

Plantations are the obvious choice for silvicultural activities to promote late-successional characteristics. Direction for LSR's (ROD, B-6) includes: "Stand management in Late-Successional Reserves should focus on stands that have been regenerated following timber harvest or stands that have been thinned." Development of managed stands differ from natural stands in a number of ways. The plantations are still young (less than 50 years). The plantations occur in relatively small patches (20-100 ac.) as contrasted to the large fires that initiated the natural stands. Dense planting was intended to ensure survival and re-establishment of conifers to a given stocking level. The higher stocking levels were also planned as part of the management regime that contributed to intermediate thinning entries to increase total yields of timber. The species selected for regeneration was the shade intolerant Douglas-fir, because of it's high timber value. Clearcutting and planting of Douglas-fir became the predominant regeneration system. Shade-tolerant species (western hemlock and western red cedar) seeded in naturally. Precommercial thinning of very young stands in the 1960's and 1970's favored the faster growing Douglas-fir as crop trees over the slower growing shade tolerant trees. The natural stands regenerated over large burned areas; regeneration was patchy and developed slowly over time, often at low densities. Scattered clumps and individual overstory trees often remained alive.

Map 10 shows the distribution of plantations on Federal land (Table 3-4).

Table 3-4. Acres of Plantations by Age Class

Age Class (yrs.)	*All Owners*	*USFS*	*BLM*
1-10	3,841	1,669	46
11-20	3,887	2,610	0
21-30	3,191	1,592	0
31-40	8,768	2,978	114
41-50	3,218	283	94
TOTAL	22,905	9,132	214

3. Role of hardwoods in late-successional habitat

Although there are several "hardwood", i.e. deciduous, tree species in the watershed, the only species that occurs in extensive stands is red alder. "Hardwood" stands as used in this discussion are of natural origin and include "pure" hardwood stands in which at least 90% of the trees are red alder and hardwood/conifer stands in which at least 65% of the stand is red alder. Red alder stands represent a successional stage that can occur following a fire or other disturbance if there is exposed mineral soil and an alder seed source. Various successional scenarios are possible depending on the amount of conifer that successfully makes it through the alder canopy. See Newton and others (1968), Newton and Cole (1994) and Hemstrom and Logan (1986) for discussions on successional pathways and their implications. Given red alder's classification as an early seral species and management direction to accelerate the development of late-successional characteristics, red alder stands provide an opportunity for treatment. Although red alder growth slows down at about age 30, stands persist up to about 150 years (Hemstrom and Logan). Mixed hardwood/conifer stands have higher wildlife diversity than "pure" stands of either type (McComb 1994) and the large-limbed conifers often found in these stands may already be providing murrelet nesting habitat. Red alder's ability to fix nitrogen and contribute large amounts of leaf litter to the soil is well known. Alder stands may also inhibit the spread of *Phellinus*. Alder's role in general stream nutrient dynamics is unknown (Hibbs and others 1994). Alder's rapid decay makes it a poor source of large woody debris in streams. Red alder is an important source of food and building material for beavers.

Alder stands are commonly associated with riparian areas and much of the alder in the watershed occurs in streamside stringers. Larger blocks of alder occur in areas heavily dissected by streams, such as headwater areas, as well as some drier upslope areas. Approximately 3,080 acres of pure hardwood stands occur in the watershed with 1,678 acres occurring on federal land. 2,620 acres are classified as Mature Hardwood Mix in the watershed with 853 acres occurring on federal land. The largest block of "pure" hardwood occurs in the northeastern portion of the watershed.

4. Treatment Potential of Mature Conifer Stands

Age and current stand condition are primary considerations in evaluating natural conifer stands for treatment. Age alone can disqualify a stand for treatment. Stands 80 years or older will not be considered for treatment in RPAs (ROD, D-16). It is unlikely that any natural conifer stands in this watershed will receive silvicultural treatment if it is in a RPA. In LSR's, stands over 110 years of age will not be considered for treatment (ROD, D-15). There is no age restriction per se on land solely designated AMA, although late-successional habitat is to be restored and maintained.

Stand condition, to some degree, needs to be considered in the context of land allocation. In **LSR**, silvicultural treatments must be "beneficial" (ROD, C-12) i.e. clearly advance late-successional conditions (REO, 1996). In this assessment area, suitable stand conditions for the northern spotted owl are generally attained in conifer dominated stands that are 80 years old or greater (USDI, 1995). Because of this it is important, prior to considering thinning, to demonstrate that a natural stand in the LSR is not developing adequately and becoming valuable to late-successional species (REO, 1996). In the LSRA (p. 87) stands suitable for treatment are described as "dense and/or uniform conifer stands." Stands in the watershed that warrant treatment consideration are the generally pure Douglas-fir stands with little or no understory development (shade tolerant conifers, vine maple), few large-limbed trees and deficient in snags and down wood.

Many of the mature conifer stands in the LSR have been identified as either occupied by murrelets or suitable habitat for murrelets. Data indicates that most of these stands are probably over 100 years of age (100 to 150 years). The characteristics that contribute to the suitable habitat designation make it unlikely that treatment would be "beneficial" as it is already contributing to connectivity and providing important habitat components.

However, site specific analysis for road closure and other activities may reveal other opportunities for thinning. Stands that are particularly worth taking a closer look at include those that were commercially thinned in the 1970's. Approximately 2,300 acres (33%) of the remaining natural stands on Federal land in the watershed were thinned in the early 1970's in an effort to salvage commercial trees nearing mortality and improve tree growth of the remaining stock. Thinning removed many of the trees that were most apt to contribute down wood and snags in the short term, possibly exacerbating an existing shortage in the stand. Opening the crowns may also have encouraged a dense shrub layer, retarding the development of multiple canopy layers. The degree of benefit from harvest treatment is largely dependent on current stand density, conifer reproduction in the understory and whether the proposed treatments would outweigh the removal of additional trees from the stand.

Mt. Hebo Plantation Approximately 200 acres in the northeast corner of the watershed (T. 5 S., R. 9 W., Sec. 14 & 15), all within the LSR, are part of the Mt. Hebo Plantation. This portion was planted in 1915, mostly with Douglas-fir although some western red cedar and Port Orford cedar may have been planted within the watershed as well. The stock used for the plantation was "offsite", i.e. from distant locations and not genetically adapted to the site. Trees in other portions of the plantation clearly show the effects of being offsite by being relatively short and having sparse crowns. Many of the stands in this area, however, tend to look healthier (on aerial photos), perhaps because much of it was commercially thinned in the 1970's. However, it is likely that most of the thinned stands are uniformly composed of Douglas-fir with little structural diversity in terms of CWD, understory development or large, "wolfy" trees.

In prioritizing natural stands in the LSR for thinning, it is important to consider the stand's age. Stands that could benefit from treatment but are nearing 110 years need to be treated first or the opportunity will be lost.

In the **AMA,** management is directed towards treatment that would be neutral or beneficial to the development of late-successional conditions. Part of the purpose is to learn ways in which products may be harvested while still maintaining species viability. Silvicultural treatments designed to maintain or enhance existing habitat while providing products could be tested. The mid-seral and mature stands likely to benefit most from treatment would typically be younger (70-90 years), generally dense and/or uniform Douglas-fir stands, with one or more of the key components of mature stands missing. The majority of natural conifer stands (i.e. mature stands) within the AMA have been identified as suitable murrelet habitat. As such they would be a low priority for treatment aimed at benefiting late-successional characteristics.

5. Successional Pathways

The red alder successional pathway is more the exception than the rule within the watershed, at least at this particular point in time. Virtually all of the younger stands have resulted from clearcutting and have been intensely managed to prevent alder from dominating the site. Generally, successional changes in these stands reflect plant distribution as it responds to changes that occur during stand structural development. Successional changes in these stands can be described as (1) establishment, (2) thinning, (3) maturation, (4) transition, and (5) shifting gap (Environmental Protection Agency and others, 1993). There is a marked bimodal distribution between plantations (establishment/thinning stages) and natural stands (maturation) within the watershed.

The managed stands are all within the establishment or thinning (also called "stem exclusion" or "self-thinning") phase. Establishment is rapid in managed stands because they are planted. Other species, primarily red alder, western hemlock and Sitka spruce continue to seed in over a period of years. In the past, species other than Douglas-fir were selected against during precommercial thinning. Even with this management strategy, western hemlock makes up a large proportion of many of the older (30+ years) plantations in the watershed. The establishment phase in plantations is roughly ages 1-15. The thinning stage begins around age 15. In this stage, conifers dominate the site and understory vegetation will often die off or become very suppressed; additional trees are "excluded" from the stand and existing trees begin to die from competition.

The natural stands in the watershed are primarily in the maturation stage and presumably became established after large fires. This stage typically begins between 80 and 140 years. Natural stands in the watershed, based on scattered stand exam data, appear to range from about 70 years to 150 years. The oldest stands we have data on, approximately 150 years old, occur in the general vicinity (within a mile or two) of the south side of Mt. Gauldy. Based on fire history maps, remaining natural stands in the vicinity of Hiack Creek are probably the same age. During this stage there is a slowed rate of height growth and crown expansion. Heavy limbs begin to form and gaps between crowns become larger and more stable or expand from insect and disease mortality. Large dead and fallen trees begin to accumulate, and seedlings and saplings of shade tolerant tree species may begin to appear. It is difficult to characterize the natural stands in the watershed as their condition is closely tied to initial stocking levels, species composition, the presence of disease, etc. However, it is safe to say that there is a close correlation with age and the older the stand the more "mature" characteristics it acquires. Many natural stands within the watershed were commercially thinned in the early and mid-1970s. These thinnings were generally light, but probably helped maintain or increase diameter growth and crown width of dominant and codominant trees. Cable corridors introduced wider spacing in places. Most of the trees removed were in the suppressed and intermediate crown classes, which would have contributed the majority of snags and down wood in the near term. The understory of these thinned stands varies from brush dominated to dense thickets of western hemlock saplings.

6. Reference Conditions

The emphasis for stands on federal lands in this analysis area is "for restoration and maintenance of late-successional forest habitat" (USDA and USDI, 1994). This basically sets the long term reference condition. The components of late-successional forest habitat are described in Franklin and Spies (USDA, 1991) and more specifically in the LSRA (pp 70-80). Table 3-5 is taken from the LSRA (pp. 71-73) and describes stand conditions expressed in terms of trees, logs, or snags per acre by species and size class for live trees, and by size class for snags and down logs. Data is based on plot information from the Siuslaw National Forest Vegetation Resource Survey (USDA, 1987) and the 1984 Siuslaw National Forest Ecology Intensive Survey (Hemstrom and Logan, 1986). The information in the table was based solely on plots from the Hebo Ranger District. Since the structural and compositional data in Table 3-5 represents the averages of stands in mature condition, management activities should not target it as an average stand condition. It does however, provide a reasonable representation of the differences in species and trees per acre by subseries environments.

7. Future Trends

The trends described below are based on the assumptions that management direction will continue to emphasize the restoration and maintenance of a late-seral landscape and that a large scale disturbance(1000+ acres) such as wildfire will not occur. Given these assumptions, the percentage of stands less than 80 years old will steadily decline on federal lands. The majority of plantations on federal land will be thinned (pre-commercial or commercial) at least once before the age of 80. Plantation stocking levels will be more variable across the landscape and a conifer understory will begin to appear in many of the plantations. Natural conifer stands will probably remain close to their present development trajectories although entries may be made to increase levels of down wood and snags as well as some thinning or creation of small openings for underplanting. Within 80 years, alder dominated stands will largely disappear outside of floodplains, slides and other areas prone to periodic disturbance. Stands that are currently pure alder will revert to brush or brush with scattered conifer, although management direction will probably stress regenerating alder and/or conifers on these sites. Stands that are currently mixed alder and conifer will have very large, scattered conifer with understories that may run the spectrum from salmonberry to multi-layered conifers.

The effects of the Swiss needle cast epidemic may result in a shift away from Douglas-fir to western hemlock or mixed conifer stands when managers are faced with regeneration choices, particularly on private land where most regeneration cutting is expected to occur. If Swiss needle cast becomes increasingly severe, it will cause attrition of Douglas-fir across all land ownerships within the Coastal Fog Zone and a large portion of the Interior Zone. Most likely as the disease is better understood, the acreage in Douglas-fir plantations will persist to some degree as favorable site conditions are recognized (Hansen 1996).

Table 3-5. Structure and Composition of the Mature Condition of Late-Successional Stands by Subseries Environments

(information is expressed in numbers of trees, logs or snags per acre; all data was rounded to the nearest whole number)

	Western Hemlock - Dry (18 plots)					Western Hemlock - Moist (21 plots)					Western Hemlock - Wet (36 plots)				
Species	Small	Medium	Large	Giant	Total	Small	Medium	Large	Giant	Total	Small	Medium	Large	Giant	Total
Bigleaf maple											1	<1			1
Douglas-fir	20	25	6	<1	51	28	23	6	<1	58	9	10	6	<1	25
Red alder	2	<1			2	7	1			9	13	2			15
Sitka spruce		<1	<1		<1	1	<1	0	<1	1	2	1	<1	<1	2
Western hemlock	19	10	2.2	<1	31	25	11	2	<1	37	23	11	3	<1	36
Western red cedar	4		<1	<1	4	4	<1	<1	<1	4	5	1	<1	<1	6
Total Live Trees	45	36	8	1	89	64	36	9	1	109	53	24	9	1	86
Hard conifer snags	15	2	1	<1	17	14	2	<1	<1	16	4	1	<1	<1	6
Soft conifer snags	2	2	3	1	8	3	3	2	1	8	1	1	1	1	3
Hard log	23	6	1		30	14	2	1	<1	18	10	2	1	<1	13
Soft log	5	2	2	1	10	7	5	5	1	18	3	6	2	1	11
	Sitka Spruce - Dry (13 plots)					Sitka Spruce - Moist (39 plots)					Sitka Spruce - Wet (33 plots)				
Douglas-fir	8	13	10	<1	31	3	6	3	<1	11	9	5	5	<1	20
Red alder	11	1	<1		13	8	1	<1		8	8	2	<1		10
Sitka spruce	6	7	3	<1	16	8	11	9	2	29	3	3	4	2	11
Western hemlock	19	6	2		27	33	17	4	<1	53	12	7	3	<1	22
Western red cedar	1	1	<1		2	<1				<1	2	<1	<1	<1	3
Total Live Trees	46	28	16	<1	89	51	34	15	2	102	34	16	12	2	64
Hard conifer snags	4	1	<1	<1	5	9	2	1	<1	12	5	1	1	<1	7
Soft conifer snags	1	2	3	1	6	1	1	2	1	5	1	1	2	1	4
Hard log	6	2	<1		9	12	4	2	<1	18	8	3	3	1	16
Soft log	4	2	3	1	9	8	4	5	1	18	3	5	2	1	11

Size classes: Small = 9.0 to 20.9 inches diameter at breast height (dbh)
Medium = 21.0 to 31.9 inches dbh
Large = 32.0 to 47.9 inches dbh
Giant = 48.0+ inches dbh

Data Sources: 1987 Vegetation Resource Survey - 109 plots
1984 Siuslaw Ecoplot Intensive Survey - 51 plots

Snags = dead standing conifers 10 feet tall or taller, with dbh in the above size classes.

Hard snags = snags in decay classes I, II and III (Cline 1977)

Soft snags = snags in decay classes IV and V (Cline 1977)

Logs = pieces greater than 20 feet long, having the large end of the log in the above size classes.

Hard logs = logs in decay classes I, II and III (Fogel, Ogawa and Trappe 1973)

Soft logs = logs in decay classes IV and V (Fogel 1973)

8. Conditions for Wildlife

a) Late-Seral and Interior Forest Conditions and Compatibility with LSRA Goals

Due primarily to the amount of logging in the watershed, much of the late-successional habitat has been fragmented into small patches between three and 60 acres in size. Larger patches have lots of edge and little interior forest (the portion of the stand beyond changes in understory vegetation, species composition, microclimate and stand dynamics which occur at the interface with adjacent stands). The amount of interior coniferous forest was estimated as the acres of mature forest at least 200 feet from the adjacent stand edge. Less than four percent of the watershed currently functions as interior forest, as opposed to twenty five percent in the early 1940s (Map 7). **In the 1940s, the Little Nestucca Watershed had twenty one patches of interior forest averaging 450 acres in size. In 1997, there are thirty seven patches of interior forest averaging 40 acres in size.** The majority of the remaining interior forest is on National Forest lands. Of the area that was interior forest in the 1940s, eighteen patches remain; the average size of these patches is 47 acres. Since the 1940s, nineteen patches of interior forest have developed; the average size of these patches is 35 acres.

In the early 1940s, the area south of the Little Nestucca River (Sourgrass, Hiack/Stillwell, South Fork, Austin and Squaw Creeks blocks) was almost contiguous mature conifer with 5100 acres of forest interior in seven patches connected by narrow corridors of mature conifer. The Kellow/Bowers Creek block southwest of Meda had one patch of interior forest over 1000 acres in size. The Fall Creek/Upper Bear Creek block had 2100 acres of interior forest in two patches connected by a narrow corridor of mature conifer.

In 1997, interior forest patches are concentrated in Upper Bear Creek (one patch of 280 acres) and Hiack/Stillwell Creeks (eleven patches ranging in size from nine acres to 180 acres). Bordering Hiack Creek is a 170 acre mature conifer patch with 46 acres of interior forest designated as AMA. Although fragmented by roads built for previous commercial thinning and clearcut harvest, this patch provides high quality late-successional habitat near designated LSR. Bordering the South Fork of the Little Nestucca is a 180 acre mature conifer patch with 58 acres of interior forest; all of it is within a Recovery Plan site for bald eagles (USDI 1986) and a proposed Reserved Pair Area for spotted owls. The remainder of the interior forest patches is entirely within the LSR and/or RPA designations (Map 7).

(1) *Conditions for spotted owls and marbled murrelets*

Critical habitat has been designated for both spotted owls and marbled murrelets within the Little Nestucca Watershed (Map 7). The Hiack/Stillwell block is within the 3000 acre Critical Habitat Unit (CHU) OR-42 for spotted owls. Approximately 1220 acres in the Louie/Baxter Creek block are in CHU OR-41. Approximately 1480 acres of CHU OR-43 are within the Austin/Squaw Creek/Kellow block (Map 2). All lands in the LSR allocation within the Little Nestucca Watershed are in Critical Habitat Unit OR-02-b for the marbled murrelet. Within the boundaries of designated critical habitat units, critical habitat applies only to areas which have one or more primary constituent elements as defined by USDI Fish and Wildlife Service regulations (USDI, 1992 and 1996).

Single spotted owls have been found in the watershed on an inconsistent basis. The nearest known nest is in the Kellow/Bowers Creek block one quarter mile outside the watershed boundary (Neskowin Creek Watershed). Other nests are in the Van Duzer Corridor State Wayside (Salmon River Watershed) and in the Cascade Head Experimental Forest (CHEF). A Reserved Pair Area (RPA) incorporating all federal land allocations was designated for three owl activity centers within the CHEF and one in the Kellow/Bowers block. This multi-site RPA was delineated according to guidelines established in the ROD. To attain the number of suitable acres required in the ROD, acres in the Austin/Squaw Creek and South Fork portion of the Little Nestucca Watershed were incorporated into the RPA (Map 2). Approximately 220 acres of BLM plantations (less than 10 years old and 30 to 40 years old) fall within the proposed RPA. Within the RPA, suitable habitat (mature conifer over 80 years old) is reserved from timber harvest (ROD, D-16).

Marbled murrelets nest throughout most of the Little Nestucca Watershed. Suitable nesting structure is provided in late-seral stands in the older age classes and occasionally in mid-seral stands (65 to 80 years old) with mistletoe-infected western hemlock. The block of land north and east of the powerlines along Highway 22 (primarily the Louie and Baxter Creek drainages) is less likely to be used by murrelets because of tree age, tree structure and topography; no murrelets were detected in nearby similar habitat during surveys conducted in 1992. The eleven sites occupied by murrelets are in the Hiack/Stillwell Creek block, in upper Bear Creek, in suitable habitat along Fall Creek and within one quarter mile of the Little Nestucca River. The primary murrelet flight corridors appear to be along the Little Nestucca to Fall Creek, Bear Creek, the South Fork, Cedar Creek and Stillwell Creek. The areas south of the Little Nestucca are also easily accessed by flying up Neskowin Creek and its tributaries, especially Lewis and Sloan Creeks. More occupied sites would likely be confirmed if surveys were conducted in the remaining unsurveyed suitable habitat in the watershed. Any new occupied murrelet sites found in the non-LSR portion of the AMA will be managed as LSR within one half mile of the site (ROD, C-3 and 10).

(2) *Connectivity and Compatibility with LSRA goals*

Links between patches of late-successional habitat enable plant and animal species to disperse across the landscape and maintain genetic diversity. For spotted owls, connectivity exists across landscapes which meet the conditions for dispersal habitat (50 percent of the landscape in forest stands with a mean diameter at breast height of eleven inches or larger and a canopy closure of 40 percent). Much of the federal land in the Little Nestucca Watershed meets the criteria for spotted owl dispersal habitat; however, less mobile late-seral associated species will remain isolated until more favorable conditions develop. As discussed in the LSRA for Oregon's Northern Coast Range AMA (USDA USDI, 1997), the largest blocks of late-successional habitat are located on the Hebo Ranger District, which links BLM lands in the southeastern portion of the AMA with BLM lands in the northern portion of the AMA. The least fragmented blocks of late-successional habitat are in the southern portion of the Hebo Ranger District and in CHEF/CHSRA. Habitat south of the Little Nestucca River, including the RPA, is closely linked with the late-seral block in CHEF. North of the Little Nestucca River late-seral blocks occur in Upper Bear Creek and northwest to Salal Point.

The activity center for the Van Duzer Corridor State Wayside owl pair is within a mile and a half of late-successional habitat on National Forest land in the Hiack/Stillwell block. The Hiack Creek block is the owls' only link to larger patches of late-seral forest outside of the Van Duzer Corridor.

b) <u>Wildlife species diversity</u>

The diversity of species within the watershed is primarily determined by habitat diversity. Habitat alteration and fragmentation by fire, settlement and timber harvest result in an increase in species which prefer openings (Lehmkuhl and Ruggiero, 1991). Within the Oregon Coast Range, most wildlife species are more strongly associated with early or late-seral conditions than with mid-seral conditions (McGarigal and McComb, 1993).

Black-tailed deer and Roosevelt elk prefer a combination of early-seral and forest edge habitats. Early settlers recorded that they got lost on the many elk trails in the Dolph and Gauldy area. Hide hunters almost eliminated elk by the 1920s. Elk were reintroduced to the area in 1950 through 1951 by the state wildlife agency. Oregon Department of Fish and Wildlife (ODFW) released elk on National Forest lands in the watershed in 1972, 1979, 1980, 1983, 1985 and 1986. In recent years, special hunts have been authorized in the Mt. Gauldy and Meda areas to reduce the size of elk herds, especially those causing damage to farmers' fences and competing with dairy cows for pasture forage. Management of National Forest and BLM lands towards late-seral forest conditions will likely result in lower population densities of elk and deer over time.

(1) *Species associated with older conifer dominated forests*

Spotted owls depend on older conifer dominated forest for their entire life cycle, whereas marbled murrelets and bald eagles use coniferous stands primarily for nesting. Another species associated with conifers, in particular Douglas-fir, is the red tree vole, which was identified in the Northwest Forest Plan as a "Survey and Manage" species. Between patches of mature forest, connectivity and suitable habitat for the red tree vole should be provided at the fifth field watershed scale (USDA and USDI, 1996b). Red tree voles are associated with mid to upper slopes.

Several neotropical migrant birds with declining populations, notably Vaux's swift, the western tanager and the varied thrush, are associated with conifer dominated forests (Andelman and Stock, 1994). Other coniferous forest species include the brown creeper and the red-breasted nuthatch (bark foragers), the red crossbill and pine siskin (coniferous seed eaters), and spotted owl prey species such as flying squirrels and Douglas squirrels (McGarigal and McComb, 1993).

(2) *Species associated with hardwood dominated forests*

Red alder dominated communities on National Forest lands in the watershed are concentrated in riparian areas on the southern slopes of Mt. Gauldy and in the area of Louie and Baxter Creeks. Alder forest associates that are likely to be in the Little Nestucca Watershed include three Federal Species of Concern (taxa whose conservation status is of concern to the USFWS but for which further information is still needed): the white-footed vole, the Yuma bat and the long-legged bat. The white-footed vole is strongly associated with riparian alder, especially in small stream habitats (Gomez 1992; Maser, Mate, Franklin and Dyrness 1981). The Yuma bat tends to occupy bridges and buildings in riparian areas; the long-legged bat uses snags and trees (Cross 1996).

Neotropical birds with declining populations include the hardwood forest associated western wood pewee and Wilson's warbler (Andelman and Stock 1994).

Survey and Manage molluscs are associated with the leaf litter of the hardwood component in moist forests, especially big leaf maple. Two species of terrestrial snails (Puget oregonian and Oregon megomphix) and three species of slugs (evening field slug, blue gray tail dropper, pappillose tail dropper) are suspected to occur in the Oregon Coast Range.

(3) *Species associated with coarse woody debris (CWD)*

For many species, snags and down wood, known collectively as coarse woody debris (CWD), are key habitat features in one or all seral stages. Both snags and down wood provide a substrate for species foraging on invertebrates, fungi and lichens and function as cover, travel corridors, den and nest sites for birds, large and small mammals, amphibians and reptiles. Down wood retains moisture, providing the necessary microclimate for amphibians. Carey and Johnson (1995) found that the abundance and diversity of small mammal populations correlates to the amount of cover provided by understory vegetation and, especially, down wood. Nesting cavities are excavated in dead or dying trees by species such as the pileated woodpecker. Cavities are later used by secondary cavity nesters. Requirements for nest hole size, snag diameter and snag height differ by species. Chickadees will nest in snags that are a minimum of nine inches in diameter and ten feet tall, while minimums for Vaux's swifts and pileated woodpeckers are 25 inches in diameter and 40 feet tall (Brown, 1985).

Due to past fire history and previous harvest or salvage practices, the large snag and down wood component is lacking throughout much of the watershed. Restoration of the CWD component is crucial to the development of foraging habitat for predators such as the spotted owl.

(4) *Species associated with special habitats*

(a) Amphibians (Species break for torrent salamander)

The topography and disturbance history of the Little Nestucca Watershed could be reasons for the break in distribution of two species of torrent salamanders. *Rhyacotriton variegatus* (southern torrent salmander), a Federal Species of Concern is found south of the Little Nestucca River, while *R. kezeri* (Columbia torrent salamander) is found north of the river. Torrent salamanders are primarily aquatic, preferring splash zones of small streams and waterfalls or water seeping through moss-covered gravel (Nussbaum, Brodie and Storm 1983).

Two other Federal Species of Concern, the red legged frog and the tailed frog, occur in the watershed. Red-legged frogs are found in riparian areas and on forest floors throughout the Hebo Ranger District. Tailed frogs are frequently found in streams in the area.

(b) Species dependent on the Nestucca Estuary

Based on aerial photo interpretation of slough patterns and local residents' memories of vegetation patterns from the 1920s to 1950s, the Nestucca estuary was approximately four times larger than it is today (late 1990s). Although the tidal influence still extends 2.5 miles up the Little Nestucca, the construction of dikes and tidegates have changed between 800 and 900 acres of estuary/salt marsh to fresh or brackish water wetland with shrubs, rushes and sedges (approximately 100 acres), spruce/alder swamp (approximately 50 acres), partially flooded pasture (approximately 170 acres of the Nestucca Bay National Wildlife Refuge) and pasture for several large dairies (approximately 560 acres). The dikes along the Little Nestucca were originally built between 1916 and 1917. More dikes were added or improved in the 1930s. Tidegates were installed in the 1930s and as recently as 1986. There are currently at least seven tidegates and four and a half miles of dikes (levees) along the estuary and Little Nestucca River. Spruce and alder have grown on and stabilized the dikes in several areas, especially on the north side of the river. Spruce was cleared to create the pasture south of the Little Nestucca close to the upper extent of tidal influence.

The beach, bay, tidal flats, estuary and wetlands support a diversity of animal species, such as brown pelicans, cormorants, wintering waterfowl and shorebirds, great blue herons, great egrets, black-shouldered kites, bald eagles, peregrine falcons, river otters, harbor seals and sea lions. The Nestucca Bay National Wildlife Refuge was set up to protect the Aleutian Canada goose, a federally threatened species. Nestucca Bay has historically supported at least one pair of bald eagles, which nest in trees overlooking the bay and estuary.

(c) Beaver

Beavers inhabit the entire Little Nestucca River system from its headwaters to the bay. Most of the beaver dens are simple burrows dug into the river or stream bank (sometimes a dike or levee), although they may occasionally build a lodge entrance to their bank burrow. Coastal beavers forage within 600 feet of their burrows. Their primary diet is the bark of red alder and willow, although they also eat the bark of conifers (Douglas-fir and western hemlock). In addition, they eat salal, salmonberry, ferns, sedges and young skunk cabbage. Beaver dams and canals form ponds and water ways through which they can float their food to their burrows. Beaver dams are built with debarked sticks shoved into mud on the stream bottom and supplemented with more mud, sticks and other vegetation; culverts sometimes serve as a control point in the stream where dams can be easily constructed (Maser, Mate, Franklin and Dyrness, 1981). The ponds created by beaver dams provide habitat for fish, waterfowl, amphibians and other riparian-dependent species. In the mid 1900s, beavers were trapped around levees, tidegates and culverts in the lower Little Nestucca Watershed. The extent to which beavers in the watershed were trapped for their fur is not known.

(5) *Other species requiring special consideration*

Two other Federal Species of Concern, fringed myotis bats and Pacific western big-eared bats, have been documented in the Cascade Head Scenic Research Area (CHSRA) within three miles of the Little Nestucca Watershed. Although big-eared bats are typically associated with caves, they may use buildings (a more likely scenario in this watershed). Fringed bats use snags and trees; they have been found most often in Southwestern Oregon (Cross, 1996).

9. Conditions for plants

a) <u>Species and habitats of special concern</u>

No threatened or endangered plants are known to occur in the Little Nestucca Watershed. Of the thirteen documented populations of *Poa laxiflora* (loose-flowered bluegrass), five are managed under the Conservation Strategy adopted by the Siuslaw National Forest in 1993. This strategy provides adequate protection to the species and permitted its removal from the USFS Region Six (R-6) Sensitive Species List. *P. laxiflora* is associated with open canopies and high water tables; it occurs in both alder and conifer dominated stands in riparian areas or in seeps and benches typical of slump topography.

The only local (near Hebo Ranger District) population of *Filipendula occidentalis* (queen-of-the-forest), a Federal Species of Concern, is located on basalt cliffs in the Little Nestucca River gorge. The population is on private land adjacent to the National Forest.

b) Survey and manage species

Although no Survey and Manage plant species have been documented in the watershed, several species of mosses, liverworts, lichens and fungi have been documented in similar habitats in the nearby CHSRA and Van Duzer Corridor State Wayside (Salmon River and Neskowin Creek Watersheds). Many of these species are associated with Decay Class Four and Five logs and snags. Large old logs and snags are important components of late-successional habitat and need to be retained intact within forest stands. The main threats to these components are road building, logging corridors and logging without full suspension; potential damage from these actions includes knocking over snags, scraping the moss, fungi and bark off of CWD, and fragmenting, pulverizing and scattering CWD.

c) Noxious and invasive plants

As identified in the LSR Analysis, noxious and invasive plants threaten native plant communities, particularly in areas maintained in early seral stages. They are successful competitors because of dispersal mechanisms which promote their rapid spread. Except for shade tolerant species, such as English ivy and holly, competition for light will limit the spread of many exotic species under a developing forest overstory until another disturbance occurs. Because some seeds can remain viable in the soil for as long as 90 years, noxious and invasive weeds are difficult to permanently eliminate.

Noxious weeds have been in the watershed for a long time. Some of the noxious weeds are native to the area. Many head of cattle were poisoned by the wild parsnip and larkspur which grew in the swamps. Tansy ragwort became established in the 1940s, probably arriving in hay imported from the Willamette Valley. Tansy has been partially controlled by the introduction of cinnabar moths and flea beetles.

European beach grass and Scots broom were planted in the 1930s to stabilize the sand dunes. While European beach grass is confined to dune areas, Scots broom has spread along roadsides and into pastures. Other species of particular concern are Canada and bull thistle, Japanese knotweed, teasel, curly leaf dock, evergreen and Himalayan blackberry and Reeds canary grass, which quickly dominates wetland areas. The estuary and wetlands are potentially threatened by purple loosestrife and cordgrass *(Spartina sp.)*, although none has yet been found in the watershed. Gorse is a serious potential problem in open areas.

B. Condition of aquatic habitat and riparian areas

1. Location of current high quality habitat

Individual habitat components control overall habitat conditions. Weighting these components is difficult because limiting factors for each reach, indeed each habitat unit, can vary. Research in the Coast Range of Oregon suggests that a common limiting factor for depressed salmonids is over-wintering habitat. This section will focus on the habitat components associated with over-wintering habitat: backwater/low velocity areas, deep pools, and large woody debris (LWD).

Overall habitat condition was rated according to amount of large woody debris present, number of pools greater than 3 feet deep, and availability of off-channel and low-velocity habitat. Each parameter was assigned a value of 1 (low) to 3 (high) based on its value (Appendix 2). Each stream reach was then assigned an "over-wintering habitat score" by averaging the values assigned to each parameter. These habitat scores were weighted according to stream length and a weighted average score for each watershed was developed. Table 3-6 presents the results of this analysis.

Table 3-6. Habitat Condition Scores

Watershed	*Miles Surveyed*	*Weighted Score*
Bear	7.5	1.5
Austin/McKnight	7.5	1.4
Louie/Baxter	3.5	1.2
Sourgrass	4.2	1.1
Stillwell/Hiack	7.9	2.0

a) Backwater/Low Velocity Habitat

Backwater and low velocity areas are extremely important habitats for certain life stages of salmonids during high flows (Nickelson and others, 1992a, Bjornn and Reiser, 1991). Off channel habitat is associated with low gradient, unconfined stream channels, large woody debris (LWD), and biologic (beaver) activity. Unconfined stream channels develop side channels, meander bend cutoffs that leave the old channel as an alcove, oxbow or levee ponds, and flooded tributary mouths that provide off channel habitat. Large woody debris forms dams and slack water areas that provide low velocity and off channel habitat. Beavers build large ponds that, while they persist, typically provide large areas of low velocity habitat.

Beaver ponds, dam pools, and side channels were classified as backwater/low velocity habitats for this watershed analysis. The current lack of backwater/low velocity habitat in the Little Nestucca WA area is most likely related to the lack of LWD throughout the area. Louie/Baxter and Sourgrass subwatersheds were classified as *not properly functioning*. Stillwell/Hiack and Bear were evaluated as *properly functioning* primarily due to large beaver dam complexes located near their headwaters. Much of the habitat found in these beaver ponds is above barriers to anadromous fish. Austin/McKnight was rated *at risk of not properly functioning*. Complexes of large woody debris form most of the off channel habitat in the Austin/McKnight subwatershed. (see Appendix 2 for definitions of terms).

b) Pool Quality

Pool quality was rated using the criteria listed in Appendix 2. With the exception of the Bear subwatershed all the evaluated watersheds were not properly functioning. The Bear subwatershed was rated as at risk of not properly functioning in regards to pool quality. Large deep pools are most commonly associated with LWD accumulations in the channel types found on the portion of the Little Nestucca WA area managed by the Forest Service. It is possible that increased fine sediment inputs have filled pools; however, there are no readily apparent connections to landslides or road densities.

c) Large Woody Debris (LWD)

The reference condition for this watershed is based on the standards and guides outlined in the ROD and is applicable to channels with less than 4% gradient. The reference conditions appear to be most applicable to 4th order and smaller streams in the Little Nestucca WA area. The volume of wood in relation to stream surface area is expected to decrease with increased stream size. Larger streams have an increased capacity to move bigger pieces and larger amounts of wood, and LWD is usually deposited in concentrations. Because smaller streams, on the other hand, have less power to transport woody debris, LWD is moved downstream randomly and tends to be spread uniformly along the channel.. Areas where LWD is likely to accumulate include: at junctions with tributaries, at the upper end of low gradient unconstrained channels, on the outside of meander bends in low gradient channels, and at channel constrictions.

LWD loads and ratings for each of the subwatersheds in the Little Nestucca WA area that have recent quantitative habitat inventories are displayed in Appendix 2. No subwatersheds in the Little Nestucca currently meet the reference conditions for LWD. Austin/McKnight and Stillwell/Hiack subwatersheds, which account for almost 50% of the total surveyed miles, were rated as "At Risk" regarding LWD. The remainder of the surveyed Little Nestucca WA area is "not properly functioning" in regards to LWD.

2. Location of potential high quality habitat

Fish production within river basins is seldom spatially uniform. Along with the spatial "patchiness" of fish production, habitat needs vary depending on season and the maturity of fish. Fish production is usually concentrated into areas where geomorphic conditions are conducive to the formation of high quality habitat. High quality habitat varies depending on species and fish maturity. Areas that have low gradients and are relatively well connected to their floodplains typically have many of the channel attributes that constitute good habitat. Riffles provide habitat for post-emergent coho and steelhead and young trout. Pools, especially complex pools, provide summer and winter habitat for larger steelhead and trout, and young of the year coho. Side channels, floodplains, and beaver ponds provide low velocity winter habitat for coho and steelhead. Channels with less than 4% gradient are typically pool-riffle bed channels. Unconstrained and moderately constrained channels are associated with developed floodplains. Low gradient, unconstrained channels also tend to accumulate wood that forms complex pools. Consequently, low gradient relatively unconstrained channels have high fish production potential.

Less than 22% of the streams in the Little Nestucca watershed analysis area have gradients less than 4% and less than 18% have low gradient and are relatively unconstrained. However, of the area accessible to anadromous salmonids, nearly 77% of it is less than 4% gradient; only about 65% is less than 4% gradient and unconstrained. Different fish species will spatially segregate to use different portions of this habitat. For instance, below Sourgrass Creek, use of the mainstem of the Little Nestucca River is dominated by chinook, while tributaries and the mainstem above Sourgrass to the falls are shared by chinook, coho, steelhead, and cutthroat trout.

Potential fish habitat can be approximated using channel morphology (Washington Forest Practices Board, 1993). For anadromous fish, unconstrained or moderately constrained areas with less than 4% channel gradient have the potential to provide good winter habitat and areas less than 8% channel gradient have the potential to provide good summer habitat (Map 8). Resident trout can tolerate higher gradients and rely less on pool habitat, and in general, reaches with less than 12% channel gradient provide good habitat. About 65% of the analysis area accessible to anadromous fish is potential good quality habitat (Table 3-7); of that 65%, none of it currently meets all the criteria for properly functioning streams (Appendix 2).

Table 3-7. Miles of potentially high quality habitat by watershed.

Subwatershed	*High Quality Miles*	*Percent of total*
Lower Little Nestucca	17.2	29.2%
Stillwell/Hiack	9.8	16.7%
Upper Little Nestucca	8.8	15.0%
Austin/Mcknight	7.9	13.5%
S Fk Little Nestucca	5.3	9.1%
Sourgrass	3.8	6.5%
Louie/Baxter	3.0	5.1%
Bear1	1.8	3.0%
Fall	1.1	1.8%
TOTAL	58.7	

3. Disturbances that have degraded potential high quality habitat

a) Sediment

Current habitat conditions are a result of past disturbances, both natural and human. These disturbances affect stream channels by changing the quantity, timing and quality of stream inputs such as sediment, large woody debris, nutrients, and heat. Human disturbance can also alter the character of natural disturbance processes such as stream flow.

Human activities have increased the rate and changed the character of sediment inputs to the basin. Removing riparian vegetation, certain logging practices, and road construction and maintenance have likely altered the sediment budget of the Little Nestucca. In the Little Nestucca the natural disturbance processes which most affect channel conditions are earthflow movements, channel migration, and wind. This is a direct result of the geomorphology of the Little Nestucca Basin which differs from nearby basins. Because of the gentle topography, debris torrents are not an important natural disturbance factor. However, much of the terrain has been shaped by a long history of earthflow movements.

Natural earthflow movements introduce large quantities of predominately fine sediment over long periods of time (Swanston, 1991). This sediment introduction can be either chronic, in the case of a continuously active earthflow, or episodic, in the case of relatively stable earthflows which only flow following initiating events, such as large earthquakes or large storms. No known chronically moving earthflows have been identified in the Little Nestucca.

Channel migration can both redistribute and contribute sediment to stream channels. Stable channels migrating within alluvium will redistribute sediments along their course. In stable channels, bank cutting in one area is compensated by bar, bank, or floodplain building below until the channel reaches tidal influence. When stream channels migrate against and erode colluvial slopes, sediments are introduced into the stream system. Natural channel migration rates vary by stream size, type, and character of sediment. Roughness elements, such as LWD, can accelerate channel migration.

Removal of riparian vegetation through logging and clearing for farming or residential use decreases bank stability which can increase bank erosion and channel migration. Approximately 75% of the streams in the Little Nestucca have had some logging within 50 feet of stream channels. In addition, cleared agricultural or residential land currently borders approximately 40 miles of streams within the Little Nestucca watershed.

Some logging methods also increase the rate of sediment introduction into stream channels. Where logging across stream channels, without buffers and suspension occurred, soil from the hill slopes was dragged directly into stream channels (1950s survey). Skyline logging can also cause hill slope gully formation and channeling when only one end of large logs are suspended

Road construction and maintenance can affect the character and timing of sediment introductions. Mid-slope roads, in particular, can continuously 'bleed' fine sediments off their surface when driven over or maintained during wet periods. Poorly constructed or poorly maintained roads can also fail catastrophically. In the Little Nestucca drainage there have been approximately 23 road related debris torrents over the last 35 years. Roads located below or upon earthflow formations can cause earthflows to move faster and introduce sediment at higher than natural rates. There are no identified areas in the Little Nestucca where this occurs; however there are numerous areas where roads cross earthflows.

b) Large Woody Debris

Earthflows, blowdown and channel migration are the three major types of disturbances which introduce LWD into streams in the Little Nestucca drainage. Land management can influence all of these processes to some degree. Rot and movement downstream are the two major natural processes in the reduction of LWD in streams in the Little Nestucca. The Drift (Siletz) Watershed Analysis (USDA and USDI, 1996. pp. 32-35) has additional discussion of Large Woody Debris Dynamics.

Forested earthflows introduce LWD by gradual movement of hill-slopes toward stream channels. Earthflows which have been clearcut have little, if any, LWD to contribute to stream channels. As the stands on these earthflows regenerate, they begin to offer some LWD for recruitment. Roads which change the rate that earthflows move also change the rate of LWD introduction. Roads on earthflows adjacent to stream channels reduce the amount of LWD available to the stream by removing the road prism from the recruitment area.

Windstorms introduce LWD in pulses as blowdown. In natural stands, blowdown in the riparian area is usually limited to scattered trees that have, for one reason or another, some predisposition to blowdown. Riparian stands adjacent to clearcuts or roads, however, often experience 'catastrophic' blowdown during wind storms. This change in the temporal distribution of LWD inputs often led land managers to remove the 'excess' material that wound up in stream channels (Baker, 1997). This has led to the 'double jeopardy' of losing the recruitment source through clearcutting and losing much of the in-channel debris through salvage.

Channel migration, in conjunction with blowdown, is a slow, persistent process which introduces LWD consistently through time. Channel migration is probably most important in alluvial deposits and along earthflows. Ditching, diking, and bank armoring retard channel migration in the immediate vicinity of the treatment. Culverts, bridge abutments, and other structures which constrict stream-flow also retard channel migration. Increased flows and the removal of riparian vegetation can increase the rate of channel migration. In the case of 'bank stabilization', the LWD source has often already been cleared for road, agriculture or residential use. In other areas without vegetation , such as clearcuts, increased channel migration brings in little LWD.

Downstream transport of LWD is a function of its size and position in the watershed. The larger the stream, the larger wood must be to remain in the stream channel. The introduction and loss of LWD balance out over long (300+ years) periods. However, the stochastic nature of disturbance affects the amount at any moment in time. Land management over the last hundred years has altered the equilibrium. Fishery biologists in the last several decades have recommended and even required removal of LWD in an effort to ensure fish passage to all available habitat.

The effect of salvage logging, stream clean-out and reduction in the amount of LWD available for recruitment has severely reduced the amount of instream LWD present and likely to be present in the next 100 years.

c) <u>Nutrient Cycling</u>

Litter and organic material introductions from streamside vegetation and deposition of marine nutrients from anadromous fish carcasses are two main mechanisms of nutrient introduction into streams in the Little Nestucca. Changes in the species composition of riparian areas and reductions in the amount of anadromous fish returning have likely altered the nutrient dynamics of the Little Nestucca system. Bilby and Bisson (1996) found that organic matter introduction in an old-growth riparian area can be almost double that of a clearcut shortly after harvest. Bilby et al. (1996) found that up to 40% of the Nitrogen and Carbon in a headwater stream in Washington was derived from coho salmon carcasses.

It is likely that nutrient inputs into headwater streams in the Little Nestucca have substantially declined because of the decline in returning anadromous salmonids. (Fish/Mile 1950s and weight. Fish/Mile 1990s and weight)

4. Condition of riparian vegetation

Potential for debris recruitment is dependent on the size of stands in areas likely to input LWD into stream channels. These areas included unstable upland areas, headwalls, and riparian and upland areas near stream channels. In channels with steep walls and little or no floodplain, wood can enter channels from upslope areas. In areas with flatter slopes and wide floodplains or terraces, wood is most likely to come from areas closer to the channel. Because streams migrate across their floodplains, particularly in the presence of landslides, all the vegetation on the floodplains and terraces is potential wood for the stream channel.

Riparian vegetation condition within 200 feet of stream channels was approximated using GIS information. Because riparian areas were not consistently delineated during photo interpretation, the resulting data shows trends but probably does not represent the "real" condition of riparian areas.

Within the Little Nestucca Watershed the riparian vegetation in about 30% of natural stands is predominantly large (>21" dbh) trees. Another 54% has large trees as a minor portion of the stand. Less than 1% of managed stands within 200 feet of channels is predominantly composed of large trees and 5% has large trees as a minor component of the stand. Overall, approximately 35% of forested stands has large trees.

Appendix 4 displays the percentage of each watershed in large and small tree (<21" dbh) components for natural, managed, and managed and natural stands combined. The species distribution of trees in these riparian stands will differ as a function of elevation, slope, aspect, and soil conditions. The vegetation analysis section should be consulted for species specific information.

5. Areas that have the best potential to grow trees in riparian zone.

Because the dominant natural processes which introduce LWD into stream channels are earthflows, channel migration and blowdown, sites which are important for LWD production are related to these processes. Human disturbance in the watershed changed the frequency and magnitude of these natural processes. Sites which, under natural conditions, provided the best areas for growing trees may now be disturbed so often that tree establishment is difficult, if not impossible. Consequently, sites where LWD production should be concentrated must take into account the disturbance processes as they are currently functioning.

Using the three natural processes outlined above the best recruitment areas for LWD are:

- On the toes of earthflows adjacent to stream channels.
- On the outsides of meander bends.
- On the south and west edges of stream channels.

These sites all pose problems for tree establishment.

Earthflows must be stable enough to allow trees to grow to sufficient size to act as long term LWD. Earthflow movements in the Oregon and Northern California can vary from one inch to nine feet per year (Swanston, 1991). Where there is evidence of regular movement of an earthflow, management must consider where trees will be when they attain sufficient size to act as LWD. This may mean that vegetation management may need to be concentrated many feet up the slope rather than immediately adjacent to stream channels. Careful study of the dynamics of each individual earthflow should be carried out in an attempt to predict its movement.

The outside of meander bends may be difficult places to establish trees. Because the majority of stream energy, and associated debris, is concentrated in the outside third of a meander bend, trees in this area are more susceptible to physical damage. The inside of meander bends, commonly called point bars, is an area where stream energy is far lower. Trees in these areas are far less likely to be physically damaged in high flow events, even though they may be located just outside the bankfull channel. As the stream migrates away from point bar areas, it is also migrating away from trees growing at the former channel margin. In small streams with valley floors less than 100 feet wide, this will probably not preclude these trees from being incorporated into the stream channel. In large streams with broad valleys, channel migration is unlikely to exceed 5 feet per year. Thus, trees growing on the inside of meander bends are still able to attain sufficient size to function as stable LWD.

Blowdown events in the Little Nestucca typically come from the south or southwest (Ruth and Yoder, 1953), however swirling and eddying can alter this at the site level. Determining the likely direction of blowdown at a site can give guidance as to which riparian areas are most likely to contribute LWD. Although trees planted on the south and west side of creeks are those most likely to enter stream channels, the south and west sides of streams receive the least amount of light.

6. Role of beavers in providing good aquatic habitat.

Beavers can dramatically affect fish habitat conditions. Over-winter survival of salmonids is significantly higher in beaver ponds than many other pool types (Bryant, 1984; Nickelson and others, 1992a). In the absence of large woody debris, beaver ponds provide the majority of off-channel rearing habitat. Beaver ponds also trap and store sediment and reroute channels (Swanston, 1991). Stream temperature can be increased in beaver ponds, probably because of the removal of riparian vegetation and increased surface area of water exposed to solar radiation (Bryant, 1984; Swanston, 1991).

In the Little Nestucca beaver ponds are typically (60%) associated with low gradient (<4%), low order (<4) stream reaches. Stream channel widths range from 6 to 15 feet wide. There are about 31 miles of fish bearing streams in the Little Nestucca that meet these criteria.

The majority of beaver ponds found in recent surveys are located above anadromous habitat. These ponds are probably very important for the production of resident cutthroat trout.

Conflicts between human and beavers typically occur where beavers have plugged culverts or are damaging "desirable" vegetation. Where roads are built across moderately sized stream channels beaver often capitalize on this 'easy' dam opportunity.

C. Condition of roads

1. Long and short-term needs for access to watershed

a) Timber harvest and other administrative needs

Most of the Forest Development roads in the watershed were built for the purpose of timber harvest. Many of these roads will still be needed in the near future to access plantations that need to be thinned. As plantations are treated, and no further work is anticipated for a number of decades, these spur roads will become candidates for closure and/or decommissioning. The Access and Travel Management (ATM) Guide for the Siuslaw National Forest has identified which roads will be maintained as long-term access to the watershed. These roads are listed below under the section titled "Future trends of roads."

b) Public access and recreation

There is an average of 5000 vehicles per day on Highway 22 (ODOT, 1995). This number is expected to increase 140% by 2015, in keeping with projected population growth. It is assumed that 5-10% of this number consists of people who are visiting forest recreation sites or touring the forest. A much smaller fraction (approximately 0.3%) of this traffic consists of people who actually spend a day within the forest (USDA-USDI, 1997).

There is one developed campsite in T5S, R10W, Section 26 (NE 1/4) near the Little Nestucca River. It is not currently maintained. Building a hiking trail to the 56' waterfall on the Upper Little Nestucca River has been discussed, but the idea has been shelved because of lack of funds.

2. Location of roads with highest probability of failure

Most of the roads with the highest risk of failure are located in the Bear Creek and Fall Creek subwatersheds (Table 3-8) (Map 9). The western part of the Austin/McKnight subwatershed also has a higher density of high risk roads, although that observation is not reflected in the table. The roads with a moderate and low risk of failure are fairly evenly distributed throughout the Little Nestucca watershed.

Table 3-8: Miles of High Risk Roads by Subwatershed (numbers are approximate)

Subwatershed	*High risk road miles**	*Total Miles*	*% high risk road miles*
Austin/ McKnight	1.12	25.96	4
Bear	8.62	14.65	59
Fall	5.26	12.65	42
Lower Little Nestucca	2.65	14.98	18
Louie/Baxter	0	7.43	0
South Fork Little Nestucca	3.23	16.83	19
Sourgrass	2.99	12.71	24
Stillwell/Hiack	3.39	25.44	13
Upper Little Nestucca	0	4.02	0

*High risk roads are defined as the roads with a risk score of 3.5 or greater in the Roads Database (Appendix 3)

3. Roads with Undersized Culverts

Culverts with significant drainage areas were analyzed to see if they were large enough to handle a 100-year storm event. Analysis was done using the methodology and analysis in the Siuslaw Road Obliteration and Upgrade Guide (1995). Methodogy, equations, and a table showing the culverts that were analyzed are contained in Appendix 4.

Roads that pose a risk of debris torrents due to undersized culverts and streams that would be affected are listed in Table 3-9.

Table 3-9: Roads with Undersized Culverts

Road Number	*Number of Undersized Culverts*	*Stream at Risk*	*Subwatershed*
1200	2	Headwaters of S.Fk. Little Nestucca River	South Fork Little Nestucca
1287	1	Headwaters of Kautz Creek	South Fork Little Nestucca
1200	4	Hiack Creek	Hiack/Stillwell
1201	2	Stillwell Creek	Hiack/Stillwell
2281	1	Sourgrass Creek	Sourgrass
2235	2	2 tributaries to Sourgrass Creek	Sourgrass
2213	2	Headwaters of Baxter Creek	Louie/Baxter

Table 3-9 (cont.)

Road Number	*Number of Undersized Culverts*	*Stream at Risk*	*Subwatershed*
2273	2 (on private land)	Baxter	Louie/Baxter
2284	1	Headwaters of Louie Creek	Louie/Baxter
1586	1	Headwaters of Judson Creek	Austin/McKnight
1500	1	Headwaters of Bear Creek	Bear 1
1633	3	Squaw Creek	Lower Little Nestucca

4. Future Trends of Roads

The future management strategy for roads will be according to the Siuslaw National Forest Access and Travel Management (ATM) Guide. Primary roads will be maintained at a level that will encourage use by low-clearance vehicles (e.g. passenger cars). Secondary roads are divided into two categories, low-clearance and high clearance. Secondary low-clearance roads will allow use by low-clearance vehicles, while secondary high-clearance roads will allow use by high clearance vehicles (e.g. 4WD vehicles) but may discourage low-clearance vehicles.

Only Roads 1200 and 2281, which are located in the southern half of the Little Nestucca Watershed, are designated as primary forest roads by the Access and Travel Management (ATM) Guide. Roads 1633, 1500 and 2280 are designated as secondary high-clearance forest roads. All other Forest Service roads not needed for administrative use or access to other ownerships may receive less maintenance. As roads become overgrown with alder and brush, fewer roads will be open to motorized travel.

Roads that are no longer needed for public access or administrative use and that have a high risk of failing will be closed and/or culverts and fill removed as opportunities arise and funds become available. Table 3-10 shows the current road density by subwatershed, and the anticipated future road density of roads that will remain open according to the ATM Guide.

Table 3-10: Road Densities by Subwatershed

Subwatershed	*Forest Development Road Density**	*Total Road Density*	*ATM Density*
Austin/ McKnight	5.2	5.9	0.5
Bear 1	5.7	5.7	1.5
Fall	5.6	5.6	0.1
Lower Little Nestucca	3.9	4.7	0.2
Louie/Baxter	3.6	4.0	---

Table 3-10 (cont.)

Subwatershed	*Forest Development Road Density**	*Total Road Density*	*ATM Density*
South Fork Little Nestucca	5.7	5.7	0.6
Sourgrass	6.7	7.7	0.8
Stillwell/Hiack	6.9	6.9	0.8
Upper Little Nestucca	3.6	4.1	---
Nestucca Bay	2.0	2.6	---

*Road miles per square mile of total landbase within the subwatershed.

On July 24, 1997, the Oregon Department of Transportation (ODOT) and the Siuslaw National Forest submitted a proposal for improvements to Highway 22. Approximately 4 miles of highway along Sourgrass Creek from Dolph Junction to Sourgrass Summit would be affected. Proposed improvements include travel lane and shoulder widening, replacing two bridges at Dolph Junction with one bridge, and realignment and straightening of the highway. The project was re-submitted for consideration in 1998. If the project were funded, the earliest the work would begin would be 2004.

Chapter 4. Recommendations

The ROD for the Northwest Forest Plan provides standards and guidelines for the various land allocations on federally managed land. For Late-Successional Reserves, standards and guidelines are designed to maintain late-successional forest ecosystems and protect them from loss due to large-scale fire, insects and disease epidemics and major human impacts. The intent is to maintain natural ecosystem processes such as gap dynamics, natural regeneration, pathogenic fungal activity, insect herbivory and low-intensity fire. Silvicultural practices to accelerate the development of overstocked young plantations into stands with late-successional characteristics are encouraged. At the same time, the risk of severe impacts from large scale disturbances should be reduced (ROD, xxx).

The Aquatic Conservation Strategy was developed to restore and maintain the ecological health of watershed and aquatic ecosystems on public lands with the goal of maintaining the "natural" disturbance regime (ROD, xxx).

The recommendations listed below were developed with the concept of restoring and/or mimicking the effects of natural disturbances on National Forest lands within the Little Nestucca Watershed. The landscape have been altered by human activity to the degree that natural disturbances cannot be fully restored to their historic magnitude and frequency (e.g. fire). Therefore, some management is necessary to develop and maintain late-successional characteristics.

The LSR Assessment provides analysis and recommendations for implementation of the ROD within Oregon's Northern Coast Range AMA (See LSRA, Table 21). These recommendations were further refined for the Little Nestucca Watershed..

Issue 1. What is the condition of the National Forest and Bureau of Land Management land and how can it be managed to function as a late-successional ecosystem?

Recommendation 1. *Maintain and accelerate development of mid-to late seral characteristics in PLANTATIONS within the RPA, within critical habitat for the spotted owl (Map 7), and between LSRs.*

<u>Rationale</u>: Over time, fires burned large blocks in the northern Coast Range, leading to the development of large blocks of mature habitat. Logging altered natural processes by creating small, isolated patches at a more frequent rate. As a result, populations of species dependent on large blocks of mature habitat have been declining. The NW Forest Plan gives direction to restore habitat for these species. It is assumed that private land will continue to be managed for timber at a short rotation, which will provide early seral habitat.

Historically, there were larger blocks of intact, mature forest in the Little Nestucca Watershed. In the 1940s, there were 21 patches of interior forest averaging 450 acres in size. The mid 1900s do not represent true reference condition because the landscape had already been altered by building roads, small human set fires and timber removal. Today, there are 37 patches of interior forest averaging 40 acres in size. Future condition will be determined by land ownership, and the greatest potential for recreating larger blocks of intact forest will be on federally managed land.

List of Priorities:

Priority 1: Area within the RPA (Squaw/Austin block.).

Rationale: Mature conifer in the Squaw/Austin portion of the RPA has been fragmented into small patches. The RPA is supposed to function as suitable habitat for owls and is a key part of the recovery plan. Restoring suitable habitat within the RPA is a high priority because it would make up for deficits in suitable habitat amounts for the Kellow/Bowers Creek and Cascade Head owl pairs.

Priority 2: The Hiack/Stillwell block.

Rationale: Part of the Hiack/Stillwell block is in critical habitat for owls (CHU 42) and provides the closest late-successional habitat to the isolated Van Duzer corridor owl pair.

Priority 3: Connecting the block in Upper Bear Creek south to the Hiack/Stillwell block and the RPA.

Rationale: The Upper Bear Creek area is a relatively large block of suitable habitat within LSR and can be connected south to the RPA, creating one large block of interior forest.

Recommendation 2: *Within the non-LSR block of late-seral forest in the Hiack area (T.6S, R.9W, S.5, 6, 7 and 8), silvicultural treatments should be beneficial to the maintenance and development of late-successional habitat; nonsilvicultural activities (road construction and maintenance, fuelwood gathering, removal of special forest products, recreational uses, research, etc.) should be neutral or beneficial to the creation and maintenance of late-successional habitat.*

Rationale: This block contains one of only 37 currently existing interior forest patches in the watershed and is currently on an acceptable trajectory for developing and maintaining late-successional conditions. Most of the block is in designated critical habitat for the northern spotted owl (CHU-42) and is one of two late-seral blocks within two miles of the isolated owl pair in the Van Duzer Corridor. The Hiack block is adjacent to habitat with a high density of occupied marbled murrelet stands and is likely to contain murrelet nest sites (suitable unsurveyed habitat).

Recommendation 3: *Retain all federal lands in the RPA in federal ownership.*

Rationale: Maintaining a contiguous block of federal ownership will result in larger patches of interior forest habitat.

Recommendation 4: *Consider acquiring the private parcel of land in T.6S, R.9W, Section 4, SE 1/4 of SE 1/4.*

Rationale: This parcel would contribute to a contiguous block of federally managed land and eventually result in larger patches of interior forest habitat. It is adjacent to occupied murrelet sites.

Recommendation 5: *Protect and maintain concentrations of coarse woody debris (for example, 10 large down logs or snags within one quarter acre).*

Rationale: There is a limited amount of CWD left after fires and logging. Logging and road building can damage CWD. Potential damage from these actions includes knocking over snags, scraping the moss, fungi and bark off of CWD, and fragmenting, pulverizing and scattering CWD. Removal of shade around concentrations of CWD can alter the CWD's microclimate (temperature and moisture content), which affects the ability of certain species to use the CWD).

Methodology

- Fully suspend logs over concentrations of large down wood.
- Locate logging corridors to avoid concentrations of snags.
- Avoid building roads through concentrations of CWD.
- Provide sufficient shading to maintain the site's microclimate.
- In areas with concentrations of CWD, restrict salvage and firewood cutting to hazard removal.

***Recommendation 6**: Treat Douglas-fir plantations severely infected by Swiss-needle cast*

Rationale: Swiss needle cast drastically reduces diameter growth and over time may eliminate Douglas-fir from microsites favorable to the disease, particularly the spruce zone. The spread of this disease will set back the development of late-successional characteristics. Approximately 61% (all ownerships) is currently infected.

Methods

- Underplant with hemlock, cedar and spruce.
- Thin to promote natural seeding of other coniferous species.
- Select against Douglas-fir during precommercial thinning.
- If planting Douglas-fir, use disease-resistant stock when it becomes available.

***Recommendation 7**: Consider the following areas first for treatment to maintain or accelerate development of late-successional characteristics in dense and/or uniform mature conifer stands according to the LSRA guidelines.*

Areas and Rationale:

Within the **LSR:** east/northeast of Dolph with a much smaller area in the vicinity of Salal Point. Data indicates ages for these stands in the range of 75 to 85 years. Treatment of portions of the Mt. Hebo Plantation, approximately 200 acres in the northeast corner of the watershed (T. 5 S., R. 9 W., Sec. 14 & 15), has the potential to benefit the development of late-successional characteristics.

Within the **AMA:** preliminary photo analysis and field checking indicates that treatments of the area just west of Dolph Junction has the highest potential for enhancing the development of late-successional characteristics.

***Recommendation 8**: Manage alder dominated stands to develop late-successional characteristics, while maintaining about the same amount of alder that existed in the mid 1900s (approximately 2000 acres).*

Rationale: If not maintained by disturbance such as fire, floods and landslides, alder dies out within 150 years. Alder acres should be maintained at mid 1900's levels until more information is available for determining how much alder is needed to maintain its role in the ecology of coastal forests. Depending on the nature of surrounding stands, small patches ($\leq$10 ac.) may be providing valuable diversity. Relatively pure stands of red alder are "simple" having only a salmonberry understory. Establishment of conifer under such stands is very slow and largely dependent on the presence of nurse logs and a seed source. Mixed hardwood conifer stands are typically more complex, showing more developed and diverse understory.

Areas to check: Northeast of Dolph in the Louie and Baxter Creek drainages, patches of pure alder are interspersed among mature conifer stands in a largely uncut portion of the LSR. Other large patches, pure alder and hardwood/conifer mix are located mainly along the Little Nestucca in land designated as "pure" AMA. See Map 10.

Methodology:

- Introduce conifers into pure alder stands by cutting openings large enough to permit acceptable conifer growth, probably ½ to 1 acre at a minimum. Alternative approaches might be a very heavy thinning (down to 30 tpa) or clearcutting.
- Treat mixed hardwood conifer stands by emphasizing retention of the conifer and planting created openings in the alder layer, which would create a similarity to late-successional structure fairly rapidly. Considerations in treating this type of stand include the number of large conifers present as well as the amount of advanced conifer regeneration and vine maple in the understory.
- Within this planning cycle, the recommended methodology for maintaining stands of alder is to leave them alone, rather than establishing new stands.

***Recommendation 9**: Limit thinning entries in hemlock stands to one or two entries.*

Rationale: Because of the role of stumps and wounds in spreading *annosus* root rot, repeated thinning entries will increase the instance of the disease, which will result in blowdown and reset the ecological clock. At this time, the disease is at endemic levels and its effects are not serious.

Recommendation 10: *Avoid mid to large-scale (residual stand falls below 60 TPA) management related blowdown.*

Rationale: Natural blowdown typically occurs at small scales. Management activities can increase the amount and extent of blowdown so that stands are reset to the early seral stage. In addition, if the number of trees falls below 60 TPA, there will be insufficient trees to maintain a steady input of CWD.

Areas with known high susceptibility:

Fall Creek

Austin Creek area

Hiack Creek area

Methods:

- Create snags along edges of mature conifer patches to create windfirmness.
- Avoid management-induced windthrow. Points to consider include:
  - ⇒ Height to diameter ratios of 100 or more indicate susceptibility to wind damage (Petty and Swain 1985).
  - ⇒ Mound-and-pit micro-relief may indicate a long-term blowdown history.
  - ⇒ Shallow rooting, especially in logs and duff, is a major factor in wind throw.
  - ⇒ Wind damage occurs where wind velocity is accelerated by topography: shoulders of mountains, nose of ridge, lee of a saddle or gap, small ridges in the lee of higher ridges and flats downwind from steep slopes (Ruth and Harris 1979).

Recommendation 11: *Take precautions to reduce the risk of fire in order to allow time for development of large blocks of late seral, and to protect what remains of existing late seral habitat. Suppress fires that do get started.*

Rationale: The Northwest Forest Plan recognizes that natural disturbance is an important process within late-successional forest ecosystems, but humans have altered the disturbance regime (ROD, p. B-7). Given the relatively low remaining proportion of late-succesional ecosystems in the landscape at the present time, these older forests should be protected from fire and other stand-resetting disturbances (ROD, p. B-4) Currently, 22% of the vegetation (Table 3-3) in the watershed is in late seral conditions. In the 1940's, 44% of the watershed was in late-seral conditions. (The mid 1900s do not represent true reference condition because the landscape had already been altered by building roads, small human set fires and timber removal.) An intense large-scale fire would set back the development of late-successional habitat. During prolonged dry periods and east winds, this watershed has a higher potential for rapid spread than the rest of the district because the South Fork Yamhill River valley serves as a conduit for dry east winds.

Methodology

- Aggressively use fire suppression and pre-suppression (See LSRA, Appendix C for detailed recommendations)
- Consider temporary closure of roads during periods of extreme fire danger.
- Permanently close roads that are not needed in order to reduce fire danger from human caused sources.
- Maintain sufficient road access for fire crews.
- Reduce fire hazards along ATM roads.

Issue 2. What is the condition of aquatic habitat and riparian areas in this watershed?

Recommendation 12: *Maintain and re-establish conifers in streamside area to achieve an excess of large (>24" dbh) free growing conifers as compared to natural late seral conditions.*

Rationale: Large woody debris is vital to providing good stream habitat. Blowdown, streambank cutting, and earthflow movements naturally introduce most of the large woody debris into the Little Nestucca. Although 35% of stream adjacent forested stands in the basin have some large trees, this does not come close to the reference condition of 84%. Recruitment material has been removed through salvage and riparian timber harvest. Existing in-channel woody debris has been removed through salvage and stream clean out.. As a result, most streams are lacking in large woody debris.

The excess conifers will allow management to mimic natural processes by toppling trees into the stream without compromising the long term supply for natural processes. In the past, re-establishment of conifer after harvest was often unsuccessful, or is currently in an overstocked condition.

Recommendation 13: *Select sites for stand treatment which are adjacent to or upstream of fish rearing habitat for treatment first.*

Rationale: Because debris torrenting is not a dominant process is this area, woody debris recruitment is most likely to first come from adjacent or upstream areas.

Select sites according to the following priorities:

- Priority 1. Sites on the windward or erosional side of stream channels where trees are likely to be able to grow to sufficient size.

Rationale: The predominant LWD recruitment processes in the basin are blowdown and bank cutting.

- Priority 2: Sites on potentially active earthflow areas that can contribute large wood to the stream in the future. Sites should be chosen so that the area is not eroded by the stream before the trees reach sufficient size.

Rationale: Earthflows are the predominant mass soil movement process in the basin which has the likelihood of introducing LWD into stream channels. Earthflows which are rapidly moving will contribute wood at different rates than slow moving earthflows. Prediction of this movement will allow management to select the sites which are most likely to be able to provide LWD in the future.

- Priority 3: Sites on torrent prone areas.

Rationale: While debris torrents are not common in the Little Nestucca and are lower priority areas to treat, they still have the potential to contribute LWD.

Recommendation 14: *For large woody debris recruitment, consider treatment of stream adjacent areas (200 feet wide) in which less than 45% of the conifer is greater than 21 inches dbh.*

Rationale: The average condition for natural riparian areas at this time is about 45% large conifer. These areas are the most similar to natural conditions and probably are capable of providing sufficient LWD in the long term.

Recommendation 15: *Place large woody debris in areas which have high anadromous fish habitat potential.*

Rationale: Because it will take time for natural disturbance to restock LWD, placing material can mimic these natural disturbance process in the interim. Focus on areas with high habitat potential to expand the refuge areas for anadromous salmonids.

Recommendation 16: *Encourage beaver activity in 6-15' wide low-gradient channels. Consider modifying structures (e.g. road beds and culverts) where beavers pose continuing problems rather than continually removing beaver.*

Rationale: Beavers can provide valuable rearing habitat which mimic the effects of LWD.

Issue 3: How can stable roads be provided to the extend needed to meet public and agency needs?

Recommendation 17: Close and decommission roads that have a high risk of failure.

Rationale: Removing unstable sidecast fill and culverts and fill from stream crossings greatly reduces the risk of road-related landslides. Landslides are a major source of increased sedimentation in streams. Road-related landslides typically have more fine material and less woody debris than landslides originating from slopes with mature timber, and therefore have a greater adverse impact on stream habitat.

Specific Roads:

Road 1201 and associated spur roads: Decommission past the intersection with Road 1287. Road 1201 has a risk score of 4.5, the highest possible. There are two undersized culverts, including one that crosses Stillwell Creek and has a deep fill over it. This road is becoming overgrown.

Road 1287 north of Road 1200 and south of 1287-127: Although this road segment does not have a high risk score, it has numerous stream crossings and one undersized culvert that continually plugs with silt and debris. There is beaver activity in the area, which increases the likelihood that culverts will be plugged in the future. Part of this road is adjacent to the South Fork of Little Nestucca River.

Road 1633-119 and Road 1633-120: These roads are located in the Austin Creek/Squaw Creek area. Road 1633-120 has a risk score of 4.5; road 1633-119 has a risk score of 3.5.

Road 2213: This road has two undersized culverts.

Road 1588: This road has a relatively high risk score because of its mid-slope position and location in a subwatershed with high debris torrent potential and steep slopes. However, it may be a lower priority for treatment because it is partly located on basalt bedrock.

Road 1588-112: This road is a midslope spur road with numerous stream crossings and steep slopes. It was closed at one time, but was re-opened to access private land. The private land has since been logged, and road access to this area will probably not be needed for the long term. Agreements regarding this road will need to be checked before decommissioning can proceed. If this road needs to remain, then the road should be upgraded.

Road 1589 and associated spurs: This road has a risk score of 3.5, and is located in a subwatershed with steep slopes and high debris torrent potential. It accesses private land, but the private land has other means of entry. Agreements regarding this road will need to be checked before decommissionig can proceed.

Methodology:

- Remove fills and culverts from stream crossings.
- Remove unstable sidecast fill.
- Subsoil the road bed as necessary to increase infiltration and reduce runoff. Subsoiling can aid in increasing infiltration and reducing runoff from road surfaces (Luce, 1997).
- Where erosion control is needed, use native seed and/or plants if they are available and will be effective as erosion control. The use of native seed reduces the risk of introducing noxious weeds. If native seed is not available, use non-persistent erosion control seed mixes. Consult with the Forest botanist for specific information.
- See the Siuslaw National Forest Road Obliteration and Upgrade Guide (1995) for more specific direction.

Recommendation 18: *Upgrade ATM roads as funds are available.*

Rationale: Many of the ATM roads were built prior to 1972, when major changes were made in the way roads were constructed. These roads typically have culverts that are considered undersized by today's standards. In addition, these culverts are over 25 years old (the life span expected) and are deteriorating. Prior to 1972, many roads were built using sidecast techniques. As a result, these older roads often have a greater risk of failure and require vigilant maintenance.

- Priority 1: Roads that may affect aquatic resources if they fail.
- Priority 2: Roads that require stabilization of massive slides or have sidecast and/or unstable headwall problems.
- Priority 3: Roads that allow reduction of overall maintenance costs.
- Priority 4: Roads that have limited support (weak) during winter haul.

Specific Roads:

Road 1633: This road has three undersized culverts just south of the Little Nestucca Road, and several stream crossings south of Road 1650 that have potential to plug.

Road 1200: This road has five undersized culverts, and is adjacent to Hiack Creek for part of its route.

Road 1500: There is one undersized culvert in the headwaters of Bear Creek.

Road 2280 and 2281: These roads serve as an unofficial detour route when Highway 22 is blocked along Sourgrass Creek.

Methods:

- Replace undersized and deteriorated culverts

- Reconfigure roadway to allow better drainage, e.g. rolling dips, and diversion devices.
- Add additional ditch relief culverts.

Recommendation 19: *Identify roads that require a minimum amount of maintenance to insure that culverts with deep fills are monitored and failures are prevented. This level of maintenance will also keep the road open to the public, and will require that the waterbars be maintained on a regular basis.*

Rationale: Many roads that would otherwise be allowed to grow closed have stream crossings with deep fills. As long as these fills exist, there is a chance that culverts can plug, and the fill will fail. These culverts still require monitoring to insure that they don't become plugged with debris. A minimum amount of brushing is needed to provide access to check these culverts on a regular basis, and during storm events.

Methodology:

- Identify roads with high-risk culverts that would otherwise be allowed to close.
- Use a minimum amount of brushing to keep the road accessible to vehicles (ATV's at a minimum)
- Keep waterbars maintained, assuming they will be beaten down by traffic over time.

Recommendation 20: *Update and implement the FERM plan to incorporate known undersized culverts which are at risk of failure.*

Rationale: Undersize culverts are prone to plug and fail catastrophically, which can introduce large quantities of fine sediment into stream channels. Identifying potential problems before culverts fail and providing timely road maintenance can prevent culvert failures. The FERM plan is currently being updated to include culverts with a potential to plug and fail. The FERM patrols should be used to monitor and validate which culverts are undersized.

Method

- Periodically update FERM plan using most current information.
- Provide patrols as recommended in the FERM plan.
- Use road maintenance money to prevent culvert failures on system roads. Use other sources of funding on non-system roads.

***Recommendation 21**: Non-ATM roads that are not under special use should be closed.*

Rationale: Roads fragment interior habitat and create 15-20 feet wide corridors that are barriers to some species. Roads are not late seral forest; they create edge effect, and provide a way to introduce noxious weeds and non native plants. In addition, roads with culverts have the risk of plugging and diverting water from stream channels, or causing fills in stream crossings to fail.

Methods:

- If decommissioning is not desirable in the interim of use, consider closing the road by blocking the entrance and allowing it to grow closed (Maintenance Level 1 as defined by ATM Guide).

- If interim use is planned and re-entry can economically be achieved with temporary construction methods, consider decommissioning.

***Recommendation 22**: When issuing special use permits for roads, require maintenance provisions. The permittee's share should be commensurate with use. Maintenance treatments (e.g. waterbarring) should be the same as those required for similar forest road development management objectives.*

Rationale: Money allocated for road maintenance continues to decline. It is possible that if the road were not needed for a special use, the road would be closed. Therefore, charging the permittee with the maintenance on roads kept open for special uses should be seriously considered. This may include their share of dispersed recreation costs if the permittee cannot maintain a permanent barricade.

***Recommendation 23**: Compare the costs of removing culverts, fills and sidecast in road decommissioning decisions to maintenance cost savings and benefits of risk reduction to other resources.*

Rationale: Money for road decommissioning is limited, and there is a need to prioritize roads with a potential for failure so that the greatest resource protection is obtained.

Methodology:

Do a cost/benefit analysis that takes into account the initial cost of decommissioning, the projected maintenance savings, and the potential to reduce risk of landslides and hazards to other resources.

Issue 4: How can road and silvicultural treatments be coordinated for the benefit of fish and wildlife?

***Recommendation 24**: Treat stands accessed by roads with a high risk of failure first.*

Rationale: Due to the geology and topography of the area, debris torrents are uncommon in this watershed. Natural debris torrents typically contain a variety of sediment sizes and woody debris. Although this area has a lower number of debris torrents than other areas in the Coast Range the majority (70%) are related to roads. Approximately 23 road related debris torrents have occurred in the last 35 years. Based on an aerial photo landslide survey encompassing the last 35 years, there were four natural landslides within the watershed. Road related torrents typically lack the woody debris component associated with natural torrents. In order to facilitate timely closure of roads with a high risk of failure (see Roads Database Appendix 3), stands they access should be given a high priority for treatment.

Priority Areas: Treat stands in the Hiack area and the Reserved Pair Area accessed by high risk roads first.

Rationale: High risk roads have been identified in the portion of this report dealing with the current road conditions. Key areas for the development and enhancement of late-successional habitat are identified in the portions dealing with wildlife and silviculture. Specifically, these priorities intersect in two relatively distinct blocks of federally owned land; the Hiack area and the Reserved Pair Area (Austin/Squaw Creek block).

The **Hiack area**, bounded on three sides by non-federal land, is located in T. 5 S., R. 9 W., Sections 31, 32 and 33 and T. 6 S., R. 9 W., Sections 4, 5, 6, 7, 8, and 9. Roads that are a high priority for obliteration include FR 1201 and FR 1287, especially the portion running north-south in the drainage of the South Fork of the Little Nestucca. The portion of FR 1200 located in the western portion of the Hiack area is identified as needing upgrading.

The **Reserved Pair Area (Austin/Squaw Creek block)**, bounded on four sides by non-federal land, is located in T. 5 S., R. 10 W., Sections 25, 26 and 27 and T.6 S., R. 10 W., Sections 25, 26 and 27. Roads that are a high priority for obliteration include two spurs, the 1633-119 and 1633-120. The portion of FR 1633 south of FR 1650 is a high priority for upgrading.

***Recommendation 25**: Forego treatment of stands which do not meet the following criteria:*

- Stocking is dense enough to make thinning economical. If a stand is marginal from an economic standpoint, other stands in the sale will help "carry" it.
- The stand will not develop satisfactorily without thinning during the next 10 to 15 years.
- If the stand is not thinned prior to road closure, the economic and resource impacts of reopening the road would preclude the likelihood of ever thinning the stand.
- There are enough acres worth treating after buffering out windfirm boundaries, riparian areas, special habitats and concentrations of "legacy" components.

Rationale: Although no roads were identified as needing immediate closure, it is undesirable to postpone closure of high risk roads indefinitely. Unless treatment is a certainty in the near future (i.e. 6 months - 1 year), the need for **precommercial thinning** is not sufficient reason to postpone the closure of high risk roads. For commercial thinning, closure of high risk roads should not be deferred more than 5 years after the timber sale is logged. The risk of resource damage increases as long as these roads remain untreated, especially if roads are not readily accessible (grown-in, blocked by down trees, etc.) and unlikely to be checked during storm events.

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Appendix 1: Seral Stage Classification and Mapping Standards

Seral Stage Definitions Used in This Assessment

Seral Stages - The series of relatively transitory plant communities which develop during ecological succession from bare ground following a disturbance such as fire, through climax, when plant succession culminates and the plant community becomes relatively stable:

"Young" conifer stands, as the term is used in this analysis, incorporates various developmental stages from ages 0 through 80 years of age:

⇒ **Pioneer** - This seral stage generally covers the period from **0 to 10 years** following a disturbance, depending on site conditions and stand history. This is the period from disturbance to establishment of a conifer or hardwood stand. Herbs, shrubs, and grasses generally dominate the site. Conifer or hardwood trees are generally less than five inches in diameter at breast height (dbh, measured at four and one half above ground level).

⇒ **Very Early-Seral Stage** - This seral stage generally covers the period from **11 to 24 years** following a disturbance, depending on site conditions and stand history. It covers the period from stand establishment to crown closure. At the end of this period, conifers or conifer/hardwood mixes typically dominate the site. Dominant size class of stands is typically **five to ten inches dbh**. Trees have long crowns with live limbs all the way to the ground. These stands serve as good hiding cover for many mammals, reptiles, and amphibians. In managed plantations, tree limbs begin to overlap, shading out the understory shrubs, herbs, and grasses.

⇒ **Early-Seral Stage** - This seral stage generally covers the period from **25 to 49 years** following a disturbance, depending on site conditions and stand history. This is the period in a stand's life from crown closure to self-pruning. Stands maintain full crown closure, however, the live canopy begins to move up. Dominant size class of these stands typically ranges from **five to eighteen inches dbh**. Tree boles have many dead limbs which have been shaded out, making it easier for larger mammals to move along the ground and birds to fly through the understory. In managed plantations, trees often grow so close together that thinning of the stand may be necessary to maintain wind firmness. The understory is often very sparse, with few or no tree seedlings or saplings, shrubs, herbs, and grasses.

⇒ **Mid-Seral Stage** - This seral stage generally covers the period from **50 to 79 years** following a disturbance, depending on site conditions and stand history. This is the period in a stand's life from self-pruning to maturation. Stands still maintain full crown closure, usually resulting in a high, single-canopy layer throughout the stand. Dominant size class of these stands typically ranges from **ten to eighteen inches dbh**. There is little stand diversity (little to no understory yet). In natural and unthinned stands, tree mortality begins to increase. These stands provide some hiding and thermal cover.

"Mature" conifer stands, as the term is used in this analysis, incorporates the following seral stages:

⇒ **Late-Seral Stage** - This condition generally begins at approximately **80 years**, depending on site conditions and stand history. This seral stage includes two stand conditions:

⇒ **Mature** - This condition generally covers the period from **80 to 149 years**, depending on site conditions and stand history. This is the stage in a stand's life when height growth and crown expansion of the dominant trees begins to slow. Trees begin to form large, heavy limbs. Insects, disease, and windthrow begin to kill or damage individual trees, creating openings in the overstory canopy. Shade tolerant seedlings may become established in the understory. Snags and large down logs begin to accumulate. Much of the compositional and structural features of late-successional forests are just beginning to develop - large accumulations of coarse woody debris, trees with large limbs and thick bark, numerous trees with deformities such as broken or forked tops, multiple canopy layers with an abundance of shade tolerant species in the understory, large diameter trees, etc. The dominant size class of these stands typically ranges from **nineteen to 32 inches dbh**.

⇒ **Old Growth** - Stands in this condition are generally **150 years old and older**, depending on site conditions and stand history. At this stage in a stand's life it begins the transition into a more stable plant community with moderate to high canopy closure; a mullet-layered, mullet-species canopy dominated by large overstory trees; a high incidence of large trees with thick bark, some with broken tops and other indications of old and decaying wood (decadence) and deformities; numerous large snags; and heavy accumulations of wood, including large logs on the ground (FEMAT 1993). Size class is extremely variable in these stands, but trees **larger than 32 inches** dbh are common, with a component of trees larger than 48 inches dbh.

⇒ **Late-Successional Habitat** - This term generally refers to stands which have the structural and compositional characteristics believed to be important habitat elements for species dependent on older forest stands, including large trees with deformities or broken tops, large logs on the forest floor and in stream channels, multi-layered canopies, gaps and shade tolerant tree species in the understory. These features may be found in stands in the old growth condition of the late-seral stage; however, the term "late-successional" refers to the structural characteristics of the stand **without regard for age** (LSRA A-2).

Hardwood stands: (Any Seral Stage)

⇒ Hardwood Mix -The term "hardwood mix" following any seral stage implies that the designated stand's overstory canopy is comprised of 50 to 80 percent hardwoods, usually red alder in this assessment area.

⇒ Pure Hardwood - Designates stand's in which 80 percent or more of the overstory canopy is comprised of hardwoods.

Both of these designations were combined o provide hardwood acres in Table 3-3.

Development of Mid 1900s Seral Stage Data

The mid 1900s seral-stage data for this assessment area was developed from a series of county-wide vegetation coverages that were originally digitized by Pacific Meridian Resources (PMR). The original county maps which PMR worked from, were developed in the mid 1900s and published at that time. These maps were assembled from existing maps provided by the individual landowners. Unmapped areas were filled by field observation before World War II and from aerial photographs after World War II (starting in 1946). Data included primary and secondary tree species, mean size class and or dbh, and percent density. These items were used to designate seral stages as shown on the following page (Table A.1). Each county used different size classes, so seral stages were assigned to each county coverage, then the maps were jointed together. In some cases data was vague or missing.

The current seral-stage coverage for this assessment area was developed from aerial photograph interpreted data using 1993 photography:

Scale of Source Data: 1:12000

Source of Original Data:

A set of criteria was used to delineate the area into unique classes of forest or nonforest vegetation types. A unique stand identifier was assigned to each unique polygon.

Unique Data:
Table of unique attributes and values

STAND_TAG	
SERAL_CLAS	
LAY_TYPE	
YR_ORIG	
TOT_CLOS	
L1_CLOS	L3_CLOS
L1_SZCL	L3_SZCL
L1_SPP1	L3_SPP1
L1_SPP2	L3_SPP2
L1_SPP3	L3_SPP3
L1_CLUMP	L3_CLUMP
L1_SNAG	L4_CLOS
L2_CLOS	L5_CLOS
L2_SZCL	REMNANTS
L2_SPP1	REM_DIST
L2_SPP2	
L2_SPP3	
L2_CLUMP	
L2_SNAG	

SERAL CLASS :_There are 17 unique classes identified as follows:
To assign each polygon an unique seral class was a nine step process.
Step one: There can be more than one species in each layer, therefore each layers species has to be classified either as a 'C' or 'H' depending if it is a conifer or hardwood.
Step two: Classify each layer as a 'C', 'H', 'CH', or 'HC' dependent upon the distribution of 'C's and 'H's in each layer.

Table A.1. Cross-walk to mid-1900s seral stages

Seral Stages	Polk County	Tillamook County	Yamhill County	
Grass and forb 47 acres	Assumed for this analysis to be non-forest land			
Untyped 5,927 acres	Primary and secondary species left blank			
Very Early (11 - 24 years) 7,405 acres	Conifer/conifer & conifer/hardwood stands less than 6" dbh	Conifer/conifer & conifer/hardwood stands less than 5" dbh	Conifer/ conifer & conifer/ hardwood stands less than 6" dbh	YOUNG CONIFER
Conifer Mix Pole, Early Pole (25 - 49 years) 1,234 acres	None	Conifer/conifer & conifer/hardwood stands 5" to 11" dbh	Conifer/ conifer & conifer/ hardwood stands which did not have a size class, but had an individual dbh between 5" & 10"	YOUNG CONIFER
Young Conifer Mix, Young Conifer (50 - 79 years) 8,214 acres	None	Conifer/conifer & conifer/hardwood stands 11" to 21" dbh	Conifer/ conifer & conifer/hardwood stands 11" to 21" dbh	YOUNG CONIFER
Mature Conifer, Mature Conifer Mix (80 + years) 15,367 acres	Conifer/conifer & conifer/hardwood stands larger than 16" dbh	Conifer/conifer & conifer/hardwood stands larger than 21" dbh	Conifer/ conifer & conifer/ hardwood stands larger than 20" dbh	MATURE CONIFER
Hardwood (any age) 3,047 ac.	Hardwood/conifer and hardwood/ hardwood stands larger than 6" dbh	Hardwood/conifer and hardwood/ hardwood stands larger than 5" dbh	Hardwood/ conifer and hardwood/ hardwood stands larger than 6" dbh	HARD-WOOD

Step two: Classify each layer as a 'C', 'H', 'CH', or 'HC' dependent upon the distribution of 'C's and 'H's in each layer.
Step three: Assign base percentages for hardwood and conifer within each layer. These base percentages are as follows:

Layer classification	Base percentages
C	90% conifer/ 10% hardwood
H	90% hardwood/10% conifer
CH	65% conifer/35% hardwood
HC	65% hardwood/35% conifer

Step four: Calculate the total conifer percent cover and total hardwood percent cover for each layer.
Step five: Add together the total percent CC conifer that was figured in step four for all layers to arrive at percent conifer cover for the stand as a whole. Do the same for total percent CCHW cover.
Step six: Add an adjustment column to database. This adjustment column will pro-rate up the percentages of canopy cover occupied by the tree component of the stand to equal 100%.
Step seven: Calculate the percentage of total conifer cover and percentage of total hardwood cover for the stand by multiplying the adjustment column by the two columns created in step 5. This indicates if a stand itself is to be classified as a conifer or hardwood stand. This is one of the main item of classification of seral stages.
Step eight: Determine the stand classification by using the two columns created in step seven to examine the proportion of the canopy occupied by either hardwood or conifer and classify the stand as follows:

H = 80% hardwood
C = 80% conifer
HC = between 50% and 80% hardwood
CH = between 50% and 80% conifer

Table A.2. Cross-walk to current seral stages:

SERAL STAGE[1]	Current in Entire Watershed Ac.	
Early	*5,168*	
Young Conifer	*5,583*	*YOUNG*
Young Conifer Mix	*5,856*	*CONIFER*
Conifer Mix Pole	*2,125*	*21,208 ac.*
Conifer Pole	*2,476*	
Mature Conifer Mix	**2,520**	**MATURE**
Mature Conifer	**4,944**	**CONIFER**
Late	**652**	**8,116 ac.**
Mature Hardwood Mix	*2,620*	
Hardwood	*3,080*	*HARDWOOD*
Young Hardwood Mix	*1,839*	*7,994 ac.*
Hardwood Mix Pole	*455*	

Table A.3. Cross-walk to 1914 vegetative descriptions

Vegetative Description	Acres	Interpreted Seral Stage
Non-timber Areas	*2,974 ac.*	*Permanently non-forested*
Burned Areas Re-Stocking	**12,162 ac.**	**YOUNG**
Burned Areas Not Re-Stocking	**6,543 ac.**	**CONIFER/HARDWOOD**
Merchantable Timber	*16,155 ac.*	*MATURE CONIFER*

Appendix 2: Fish Habitat Ratings

Table C3.3-1 Summary of Stream Channel Fish Habitat Parameters in the Little Nestucca WA Area

HUC[1]	Subwatershed Name	% Pool[2]	Miles Surveyed	LWD/ Mile[3]	Pools/ Mile	% Back Water[4]	% Gravel[5]	% Sand[6]	%Pools > 1m deep[7]
1710020354C	Bear	34%	7.5	20	17	12%	45%	3%	14%
1710020354D	Austin/McKnight	33%	7.5	33	21	8%	40%	0%	2%
1710020354E	Louie/Baxter	38%	3.5	15	7	0%	37%	22%	1%
1710020354F	Sourgrass	64%	4.2	25	71	2%	57%	19%	4%
1710020354H	Stillwell/Hiack	66%	7.9	55	20	33%	47%	7%	4%

[1]USGS Hydrologic Unit Code include NFS watershed and subwatershed ID. [2]Percent of surveyed area in pool habitat type. [3]Pieces of LWD >24" dia.x 50' or 2 channel widths long. [4]Percent of surveyed area in beaver ponds, dam pools, or side channels. [5]Percentage of total survey area of riffle habitat units having gravel as a dominant substrate. [6]Percentage of total survey area of riffle habitat units having sand as a dominant substrate. [7]Percent of surveyed area in pool habitat type deeper than 1m.

Table C3.3-2 Stream Channel Habitat Rating (from USDC 1995. OR Coast Province Level-I Fishery Biologists 1996)

HUC	Subwatershed Name	Substrate	Large Woody Debris	% Area in Pools	Pool Quality	Off-Channel Habitat
1710020354C	Bear	A	N	A	A	P
1710020354D	Austin/McKnight	A	A	A	N	A
1710020354E	Louie/Baxter	N	N	A	N	N
1710020354F	Sourgrass	N	N	P	N	N
1710020354H	Stillwell/Hiack	A	A	P	N	P

P - "Properly Functioning" A - "At Risk" N - "Not Properly Functioning"

Criteria used to rate stream habitat (Table C3.2-2) and develop reference conditions: Only stream reaches with less than 4% channel gradient were used to develop habitat ratings.

Large Woody Debris (LWD)
Each piece of woody debris must be at least 24" x 50' or 2 times the channel width.
Properly Functioning - 80+ pieces LWD per mile
At Risk - Less than 80 but more than 30 pieces LWD per mile
Not Properly Functioning - Less than 30 pieces LWD per mile

Substrate
Properly Functioning - More than 50% of riffle unit areas have gravel as dominant substrate and less than 5% of riffle unit areas have sand as dominant substrate.
At Risk - Less than 50% of riffle unit areas have gravel as dominant substrate or more than 5% of riffle unit areas have sand as dominant substrate.
Not Properly Functioning - Less than 20% of riffle unit areas have gravel as dominant substrate or more than 10% of riffle unit areas have sand as dominant substrate.

Percent area in pools
Properly Functioning - More than 50% of habitat unit area is pool habitat.
At Risk - Less than 50% and more than 30% of habitat unit area is pool habitat.
Not Properly Functioning - Less than 30% of habitat unit area is pool habitat.

Pool Quality

Properly Functioning - More than 20% of habitat unit area is pool habitat greater than 1m deep.

At Risk - Less than 20% and more than 10% of habitat unit area is pool habitat greater than 1m deep.

Not Properly Functioning - Less than 10% of habitat unit area is pool habitat greater than 1m deep.

Appendix 3: Roads Database

A database was created to provide managers with objective data on Forest Service roads within the Little Nestucca watershed. The information is intended to guide management decisions regarding which roads by showing which roads have the highest risk of failure, their current ATM status, which Northwest Forest Plan land allocation they cross, and whether they access other ownerships. Only Forest Service system roads are included in this database because of time constraints in completing the analysis. Data shown in the road database was gathered from maps, GIS data, and local knowledge. Culvert information was derived from field measurements of culvert diameters and a model that estimates runoff in the Coast Range. Before any projects are planned regarding these roads, they will need to be field checked.

There are several abandoned spur roads that are no longer considered system roads. They may or may not have erosion problems, and will need to be field checked.

The information included in this table is listed and defined below.

Subwatershed: The subwatershed in which most of the road is located.

2nd Subwatershed: Other subwatersheds the road might cross. Many roads are located on ridges and may cross more than one subwatershed.

Rd Number: The US Forest Service road number.

Length: Length of the road segment in miles. In the case of the main roads, it is the length of the road within the subwatershed.

Topo position: The slope position of the road. R = ridge top roads, M = mid-slope roads, VB - valley bottom roads.

 # stream Xings: Number of stream crossings the road crosses, as shown on topographic maps and the GIS stream layer.

Past Failures: This information is based on the aerial photo survey of landslides. If the road has had debris torrents, the number of slides located along this road segment is noted. If no debris torrents have occurred, there is a "N" in the column.

Crosses Earthflow: If the road crosses an earthflow, as shown on the 1:24000 geologic map, there is a "Y" in the column. If it is blank, the road does not cross an earthflow.

Debris slide risk: This information is based on a model that uses digital elevation model (DEM) data to identify areas that are susceptible to debris failures. The two factors used in the model are slope angle and slope concavity. "L"= the road crosses a low risk area for debris torrents, "M" = the road crosses a moderate risk area, "H" = the road crosses a high risk area. The road segment may cross more than one risk category.

Photo Yr: The first year in the record of aerial photos in which the road is visible. The road may be older than the photo year.

Construction: The type of construction most likely used to build the road. "S" is sidecast construction, "NS" is not sidecast or endhaul construction. This information is based on the age of the road, which is assumed from the photo year. Roads that were built prior to and including those that appear on the 1972 aerial photos were assumed to be sidecast; roads built later than 1972 were assumed to be not sidecast.

Risk score: The risk score is a combination of topographic position, construction, past failures, risk of debris torrents, and risk of slumping. points were assigned as follows:

Topographic position: Ridge = 0, Midslope - 1, Valley Bottom = 0

Because mid-slope roads generally have more stream crossings, more fill slopes, and more likelihood of disrupting water flow, they are considered to be at higher risk of failure.

Construction: Sidecast = 1, not sidecast = 0

Past failures: Yes = 1, No = 0

Debris torrent risk: High = 2,

 # Undersized culverts: The number of culverts located on the road segment that are too small for flows from a 100 year rainfall event. See Appendix 4 for more information on undersized culverts.

Status: The Access and Travel Management (ATM) maintenance designation of the road.

Primary roads are maintained at a level that will encourage use by low-clearance vehicles, e.g. passenger cars.

Secondary roads in this watershed are maintained at a level that will allow use by high clearance vehicles.

If the category is blank, the road are maintained at a minimum level, and are potential candidates for closure and/or road obliteration.

Land allocation: The land allocation the road crosses, according to the Northwest Forest Plan. AMA = Adaptive Management Area, LSR = Late Successional Reserve

Pvt: Whether the road crosses or access private property. The number of miles of road that cross private land are noted. If the category is blank, the road is located wholly within National Forest lands.

Subwatershed	2nd Subwatershed	Road number	Length (miles)	Topo position	# stream Xings	Past Failures	Crosses earthflow	Debris slide risk	Photo yr	Construction	Risk score	# Undersized culverts	ATM status	Land allocation	Access pvt	Comments
		1200-111	1.05	R	0	N	Y	L	1977	NS	1			AMA/LSR		
Stillwell/Hiack		1200-116	1.95	M	5	N		L, M	1953, 1961,	S	2.5			AMA/LSR	Y?	
Stillwell/Hiack		1200-117	0.84	M	3	N		L, M	1969, 1977	S	2.5			LSR	Y	
Stillwell/Hiack	S.Fk Little Nest	1200-119	1.33	R, M	0	N		L, M	1953, 1961	S	2.5			AMA	N	
Stillwell/Hiack		1200-120	0.69	R, M	1	N		L, M	1977, 1984	NS	1.5			AMA/LSR	N	
Stillwell/Hiack	S.Fk Little Nest	1200-121	0.87	M	2	N		L, M	1969	S	2.5			AMA	N	
Stillwell/Hiack		1200-122	0	M, R	1	N		L	1977	NS	1			AMA		
Stillwell/Hiack		1200-123	0.17	R	0	N		L	1977	NS	0			AMA	N	
S.Fk Little Nest	Stillwell/Hiack	1200-124	0	VB, M	2	N	Y		1953	S	3			AMA		
S.Fk Little Nest		1200-125	1.13	M	2	N		L, M	1977	NS	1.5			AMA	N	
Stillwell/Hiack		1200-140	0.37	R	0	N		L, M	1981	NS	.5			AMA/LSR	N	
S.Fk Little Nest		1200-146	0.23	M	0	N		L	1977	NS	1			AMA		
S.Fk Little Nest		1200-164	0		0	N		L	1989	NS						
Stillwell/Hiack		1201-111	0.44	M	2	N		M, H	1977	NS	2.5			AMA/LSR	N	
Stillwell/Hiack		1201-112	0.3	M	1	N		M, L	1981	NS	1.5			LSR	N	
Stillwell/Hiack		1201-113	0.1	M	0	N		L, M	1981	NS	1.5			LSR		
Stillwell/Hiack		1201-114	0.29	R	0	N		L	NO DATE		0			AMA/LSR		
Stillwell/Hiack		1201-115	0.2	R	0	N		L	1984	NS	0			LSR	N	
L. Little Nest		1280-114	0.09	M	0	N		L	1977	NS	1			LSR		
L. Little Nest		1280-115	0.3	R	0	N	Y	L	1977	NS	1			LSR		
L. Little Nest		1280-116	0.21	R	0	N		L	?		0			LSR	N	
L. Little Nest		1280-117	0.54	R	0	N		L	1969	S	1			AMA	Y?	
Stillwell/Hiack		1287-111	0.39	R	0	N		L	1977	NS	0			LSR		
Stillwell/Hiack	Austin/McKnight	1287-112	1.09	M	0	N		L	1961	S	2			LSR		
Stillwell/Hiack		1287-114	0.4	M	1	N		L	1961	S	2			LSR	N	
Stillwell/Hiack	Austin/McKnight	1287-115	0.4	M	1	N		M, L	1969	S	2.5			LSR	N	
Austin/McKnight		1287-121	1.72	R, M	0	N		L, M	1977	NS	1.5			LSR		
Austin/McKnight		1287-122	0.3	R	0	N		L, M	1977	NS	.5			LSR		
Austin/McKnight	Stillwell/Hiack	1287-123	0.05	R	0	N		L	1989	NS	0			LSR		
S.Fk Little Nest	Austin/McKnight	1287-124	0.65	M	0	N		L, M	1961	S	2.5			LSR	Y?	
S.Fk Little Nest		1287-126	0.08	R	0	N		L	1969	S	1			AMA		
S.Fk Little Nest		1287-127	0.39	M	1	N		L, M	1981	NS	1.5			LSR	?	
Austin/McKnight		1287-129	0.48	R	0	N		L, M	1977	NS	.5			AMA/LSR		
Stillwell/Hiack		1287-130	0.08	M	0	N		L	1989	NS	1			LSR	N	
Stillwell/Hiack	Austin/McKnight	1287-134	0.15	M	0	N		M	?		2			LSR	N	
Austin/McKnight	Stillwell/Hiack	1287-135	0.11	R	0	N		L	1981	NS	0			LSR	N	
S.Fk Little Nest	Austin/McKnight	1287-136	0.12	R	0	N		L	1981	NS	0			LSR	N	
Stillwell/Hiack		1287-137	0.07	M	0	N		L	1989	NS	1			LSR	?	
Austin/McKnight		1500	0	M		2		L, M	1961	S	3.5			AMA		
Bear1		1500-117	0.1	M	0	N		H	1981	NS	3			LSR	N	
Bear1		1500-119	0.88	M	5	N		L, M	1961	S	2.5			LSR	N	
Bear1		1500-120	0.61	M, R	0	N		L	1977	NS	1			LSR	N	
Bear1		1500-121	0.53	R, M	3	N		L	1977	NS	1			LSR	N	
Bear1		1500-122	0.27	M, R	0	N		L	1977	NS	1			LSR	N	
Bear1		1500-123	0	R	0	N		L, M	1981	NS	0.5			LSR		
Bear1		1500-125	0.68	M	2	N		M	?		2			LSR	N	
Bear1		1500-126	0.81	M, R	2	N		L	1961	S	2			LSR	N	
Bear1		1500-127	0.8	R, M	1	1		M, H	1977	NS	3.5			AMA		
Bear1		1500-128	0.28	M	1	1		M, H	1977	NS	3.5			AMA		

Subwatershed	2nd Subwatershed	Road number	Length (miles)	Topo position	# stream Xings	Past Failures	Crosses earthflow	Debris slide risk	Photo yr	Construction	Risk score	# Undersized culverts	ATM status	Land allocation	Access pvt	Comments
Austin/McKnight		1500-132	0.46	R, M	0	N		L	1981	NS	1			AMA		
Austin/McKnight	Bear1	1500-133	0.84	R	0	N		M, H	1984	NS	1.5			AMA		
Bear1	Austin/McKnight	1500-134	0.35	M	0	N		L	1981	NS	1			AMA	N	
Bear1		1500-135	0	M	0	N		L, M	1984	NS	1.5			LSR		
Bear1		1500-136	0.03	R	0	N		L, M	1977	NS	.5			LSR		
Bear1		1500-147	0.06	R	0	N		L	1981	NS	0			AMA		
Fall		1503-111	0.34	M, R	1	N		L	1977	NS	1			LSR		
Fall		1503-112	0.06	M	0	N		M	1977	NS	2			LSR		
Fall		1503-119	0.17	M	0	N		L	1977	NS	1			LSR		
Austin/McKnight		1586-111	0.51	M	0	N		L, M	1977	NS	1.5			AMA		
Austin/McKnight		1586-115	0.35	R	0	N		L	1977, 1984	NS	0			AMA		
Austin/McKnight		1586-116	0.4	R	0	N		L, M	1984	NS	.5			AMA		
Fall		1588	0	R, M		1		L ,M	1961, 1977	S	4					
Fall		1588-111	0.19	M	0	N		L, M	1984	NS	1.5			LSR		
Bear1	Fall	1588-112	2.01	M	9	1,2		M, H	1977, 1984	NS	3.5			AMA	N	Crosses steep, highly dissected slopes
Bear1		1588-113	0.47	M	3	N		L, M	1984	NS	2			LSR	N	
Fall		1588-114	0.13	R	0	N		L	1984	NS	0			LSR		
Fall		1588-115	0.78	M	3	N		L, M	1961, 1977	S	2.5			AMA	N	Gentle slopes
Austin/McKnight		1588-116	0.38	R	0	N		L, M	1977	NS	0.5			AMA/LSR		
Austin/McKnight		1588-117	0.51	R	0	N		L	1977	NS	0			LSR		
Fall	Bear1	1588-118	0.22	R	0	N		L	1977	NS	0			AMA	N	
Fall		1588-119	0.2	M	2	N		L, M	1977	NS	1.5			AMA		
Austin/McKnight	Bear1	1588-120	0.53	M, R	1	N		L, M	?		1.5			AMA/LSR		
Bear1		1588-122	0.32	R	1	N		L, M	1977	NS	0.5			AMA/LSR		
Fall		1589	0	M, R	1	1		L, H	1977	NS	3					
Fall		1589-111	0.6	M	2	N		M	?		1.5			LSR		
Fall		1589-112	0.25	M	1	N		L	1984	NS	1			LSR	N	
Fall		1589-113	0.2	R, M	1	1		L	1977	NS	2			AMA/LSR		
Fall		1589-114	0.28	R	0	N	Y	L	1977	NS	1			AMA		
Fall		1589-115	0.11	M	0	N	Y	L	1977	NS	2			AMA		
Fall		1589-116	0.49	R, M	0	N	Y	L, M	1977	NS	2.5			AMA		
Fall		1589-117	0.31	M	0	N	Y	L	1977	NS	2			AMA		
Fall		1600-111	1.34	M	0	?		L	1977	NS	1					
L.Little Nestucca		1633-114	0.82	VB	1	N		L	1953	S	1			AMA		
L.Little Nestucca		1633-115	1.4	M	1	N		L, M	1977	NS	1.5			AMA/LSR		
L.Little Nestucca	Austin/McKnight	1633-117	0.58	M	1	N		M, H	1977	NS	2.5			AMA	N	
Austin/McKnight		1633-118	0.53	M, R	0	1	Y	L, M	1977	NS	2.5			AMA		
Austin/McKnight		1633-119	0.49	M, R	1	N		L, H	1977, 1953	S	3.5			AMA		
Austin/McKnight		1633-120	0.63	M	3	N	Y	L, H	1961	S	4.5			AMA		
Austin/McKnight		1633-121	0.85	M	1	N	Y	L	1977	NS	2			AMA		
Austin/McKnight		1633-122	0.48	M	0	N		L, M	1977	NS	1.5			AMA		
Austin/McKnight		1633-123	0.1	R	0	N		L	1977	NS	0			AMA		
S.Fk Little Nest		1633-125	0.22	M	0	N		L	1977	NS	1			AMA		
S.Fk Little Nest		1633-128	2.09	M	2	N	Y	L	1977, 1961	NS	2			LSR		
S.Fk Little Nest		1633-129	0.38	M	0	N		L	1977	NS	1			LSR		

Subwatershed	2nd Subwatershed	Road number	Length (miles)	Topo position	# stream Xings	Past Failures	Crosses earthflow	Debris slide risk	Photo yr	Construction	Risk score	# Undersized culverts	ATM status	Land allocation	Access pvt	Comments
S.Fk Little Nest		1633-130	0.34	M	0	N		L	1977	NS	1			LSR		
S.Fk Little Nest		1633-132	0.09	M	0	N	Y	L	1977	NS	2			LSR		
S.Fk Little Nest		1633-134	0.09	M	0	N		M	1984	NS	2			LSR		
L.Little Nestucca		1633-139	0.96	M, VB	0	N		L, H	?		2	1				
Austin/McKnight		1633-141	0.05	M	0	N		M, H	1977	NS	2.5			AMA/LSR		
Austin/McKnight		1633-146	0.14	M	2	N		L	1969	S	2			AMA		
Austin/McKnight		1650-111	1.02	R	0	N		M, H	1984, 1977	NS	1.5			AMA/LSR		
S.Fk Little Nest		1650-112	0.77	M, R	0	N		M, H	1977	NS	2.5			AMA	N	
S.Fk Little Nest		1650-113	0.19	R	0	N		L	1984	NS	0			AMA	N	
Austin/McKnight		1650-116	0.18	R	0	N		M	?		.5			AMA		
Austin/McKnight		1686	0	R, M	3	2		L, M	1981	NS	2.5					
Sourgrass		2234-111	1.86	M	4	2		L, H	1977	NS	3.5			LSR		
Sourgrass		2234-112	0.44	M, R	0	N		L	1977	NS	1			LSR		
Sourgrass		2234-113	0.1	R	0	N		L, M	1977	NS	0.5			LSR		
Sourgrass		2234-114	0.41	R	0	N		M, H	1969	S	2.5			LSR		
Sourgrass		2234-116	0.47	R	0	N		L	1977	NS	0			LSR	N	
Louie/Baxter		2234-118	0.15	R	0	N		L	1981	NS	0			LSR		
Louie/Baxter		2234-120	0.01	M	0	N		L	?		1			LSR		
Louie/Baxter		2234-124	0.23	M	0	N		L	?		1			LSR		
Louie/Baxter		2234-126	0.43	M	1	N		L, M	1977	NS	1.5			LSR		
Sourgrass		2235-111	0.17	R	0	N		L, M	1977	NS	0.5			LSR		
Sourgrass	Louie/Baxter	2235-112	0.15	R	0	N		L	NO DATE		0			LSR	N	
Sourgrass		2235-113	0.33	M	0	N	Y	L	1984	NS	2			LSR	N	Access powerline
Sourgrass		2235-114	0.12	R	0	N			1953	S	1			LSR		
Sourgrass		2280	0	M	0	2		L	1961	S	3			AMA/LSR		
Stillwell/Hiack	Sourgrass	2280-111	0.35	M	0	N		L, M	1961	S	2.5			LSR	N	
Stillwell/Hiack		2280-112	0.37	R	0	N		L	1961	S	1			LSR	N	
Stillwell/Hiack		2281	0	R	0	1		L	1961, 1969	S	2			LSR		
U.Little Nest	Sourgrass	2281-111	3.43	M	2	N		L	?		1			AMA	Y	
U.Little Nest		2281-112	0.09	M	1	N		L	?		1			AMA		
Sourgrass		2281-113	1.14	M	3	N		L, M	?		1.5			AMA		
U.Little Nest	Sourgrass	2281-114	0.18	R	0	N		L	1969	S	1			LSR		
Stillwell/Hiack	U.Little Nest	2281-115	0.49	R, M	0	N		L	1969	S	2			LSR		Access state land
Stillwell/Hiack		2281-116	0.89	M, R	4	N		L, M	1977	NS	1.5			LSR		Access state land
Stillwell/Hiack		2281-117	0.96	R	0	N		L, M	1984	NS	0.5				N	
Sourgrass	Stillwell/Hiack	2281-118	0.19	R	0	N		L, M	1984	NS	0.5			LSR	N	
Sourgrass		2281-119	0.23	R	0	N		L	1969	S	1			LSR		
Sourgrass	Stillwell/Hiack	2281-120	0	R	0	N		L	1981	NS	0			LSR		
Sourgrass		2281-121	0.06	M	0	N		L	1981	NS	1			LSR		
U.Little Nest		2281-123	0.32	R	0	N		L	?		0			LSR		
Stillwell/Hiack		2281-124	0.2	M,R	0	N	Y	L	1977	NS	2			LSR	N	
Stillwell/Hiack		2281-125	0.11	M	0	N		L	1977	NS	1			LSR		
Stillwell/Hiack		2281-126	0.14	R	0	N		L	1977	NS	0			LSR		
Stillwell/Hiack		2281-127	0.1	R	0	N		L	?		0			LSR		
Louie/Baxter		2284-112	0.25	R	0	N		L, H	1984	NS	1.5			LSR		
Louie/Baxter		2284-116	0.12	R	0	N		L	1984	NS	0			LSR		

Subwatershed	2nd Subwatershed	Road number	Length (miles)	Topo position	# stream Xings	Past Failures	Crosses earthflow	Debris slide risk	Photo yr	Construction	Risk score	# Undersized culverts	ATM status	Land allocation	Access pvt	Comments
S.Fk Little Nest		1633	0	M		1,1		L, H	1961	S	4					
L.Little Nestucca		1633-111	1.49	R, M	0	N		L	1969	S	2			AMA		
S.Fk Little Nest		1633-126	0.24	R	0	N		L, M	1961	S	1.5			AMA		
S.Fk Little Nest		1633-133	0.55	M	0	N		L	1961, 1977	S	2			LSR		
Fall		1589-122	0.13	M	0	N		L	1977	NS	1			AMA		
		1500-124	0	M		N		L, M			1.5			LSR		
Austin/McKnight		1200	0.1	VB	1	N		L	1953	S	1		Primary	AMA	0.1 on pvt	
Austin/McKnight		1280	0.95	M	0	N		M	1961	S	3				.44 on pvt	
Austin/McKnight		1287	1.41	R, M	0	N		L, M	1969	S	2.5			LSR		
Austin/McKnight		1500	1.79	M	3	2		L	1961	S	3		Secondar	AMA	.65 on pvt	
Austin/McKnight		1586	2.62	R, M	3	N		L, M	1977	NS	1.5	1		AMA	.73 on pvt	
Austin/McKnight		1588	0.58	M	0	N		L, M	1977	NS	1.5			AMA/LSR		
Austin/McKnight		1633	2.3	M	6	N		L, M	1953	S	2.5		Secondar	AMA		
Austin/McKnight		1650	2.65	M	3	N		L, M	1977	NS	1.5			AMA	1.23 on pvt	
Austin/McKnight		1686	2.45	R, M	3	2		L, M	1981	NS	2.5			AMA	.44 on pvt	
Bear1		1500	5.53	M	19	N	Y	L, H	1961	S	4	1	Secondar	LSR		
Bear1		1588	0.92	M	0	N		L	1961	S	2			AMA/LSR		
Fall		1500	0.21	R	0	N		L	1961	S	1		Secondar	LSR		
Fall		1503	1.29	M	3	N	Y	L, H	1977, 1984	NS	3			LSR		
Fall		1588	2.96	M	1	1		L, M	1961, 1977	S	3.5			AMA/LSR		
Fall		1589	2.3	M, R	3	1		L, H	1977, 1984	NS	3.5			AMA/LSR		
L.Little Nestucca		1031	1.77	M, R	0	N		M, H	1984	NS	2.5			LSR	.09 on pvt	
L.Little Nestucca		1268	0.33	M	2	N		M, H	1969	S	3			AMA		
L.Little Nestucca		1280	1.39	M	4	N		L	1961, 1969,	S	2			AMA/LSR	.42 on pvt	
L.Little Nestucca		1503	0.48	M	0	N		L, M	1981	NS	1.5			AMA		
L.Little Nestucca		1633	2.65	M, R	5	2		L, M	1956, 1969	S	3.5	2	Secondar	AMA/LSR	1.32 on pvt	
L.Little Nestucca		1690	1.97	R,M		N		L	1953, 1961	S	2				1.97 on pvt	
Louie/Baxter		1200	0.06	VB	0	N		L	1953	S	1		Primary		.06 on pvt	
Louie/Baxter		1586	0.2	R		N		L	1977	NS	0			AMA		
Louie/Baxter		1686	0.3	R	0	N		L, M	1981	NS	0.5			AMA		
Louie/Baxter		2213	1.16	M	2	N	Y	L	?		2	2		LSR		
Louie/Baxter		2234	1.26	M, R	1	N		L	1977	NS	1			LSR		
Louie/Baxter		2235	0.93	R	0	N		L, M	1984	NS	0.5			LSR	.27 on pvt	
Louie/Baxter		2284	2.33	R, M	1	N		L, M	1984	NS	1.5	1		LSR	1.14 on pvt	
Sourgrass		2234	1.76	M, R	0	N		L	1953, 1977	S	2			LSR		

Subwatershed	2nd Subwatershed	Road number	Length (miles)	Topo position	# stream Xings	Past Failures	Crosses earthflow	Debris slide risk	Photo yr	Construction	Risk score	# Undersized culverts	ATM status	Land allocation	Access pvt	Comments
Sourgrass		2235	3.01	M	3	N	Y	L	1977, 1984	NS	2	2		LSR	.67 on pvt	
Sourgrass		2280	1.13	M	0	2		L, M	1961	S	3.5		Secondar	AMA/LSR	.15 on pvt	
Sourgrass		2281	1.14	R, M	3	N		L	1969	S	2			LSR		
S.Fk Little Nest		1200	3.23	M	6	N	Y	L, M	1953, 1961	S	3.5	2	Primary	AMA/LSR	1.05 on pvt	
S.Fk Little Nest		1201	0.17	M	0	N		L	1981	NS	1			LSR		
S.Fk Little Nest		1287	2.38	M, VB	8	N		L	1953, 1961	S	2			AMA/LSR		
S.Fk Little Nest		1633	1.7	M	2	N		L	1961	S	2		Secondar	AMA/LSR		
S.Fk Little Nest		1650	1.79	R, M	0	N	Y		1961, 1977	S	2			AMA		
Stillwell/Hiack		1200	3.89	M, VB	7	N		L, M	1953	S	2.5	4	Primary	AMA/LSR	1.26 on pvt	
Stillwell/Hiack		1201	3.39	M, VB	7	N	Y	L, H	1961, 1977	S	4.5	2		LSR		
Stillwell/Hiack		1287	1.01	M	0	N		L			1			LSR		
Stillwell/Hiack		2280	0.3	M	1	N		M	1961	S	2.5		Secondar	AMA/LSR		
Stillwell/Hiack		2281	3.11	M, VB	0	1		L. H			3	1		LSR		
U. Little Nest		2281	0.45	R	0			L	1969	S	1					
Bear1		1500-124	0	M	2											
S.Fk Little Nest	1633-125	1633-124		R	0											
Louie/Bxter	2273		0									2 (on pvt)				

Appendix 4: Information on Culvert Sizing

Culvertshed	Road Number	Approx M.P.	Pipe Dia (in.)	Basin Acres	Mean Elev. (E)	Q100 (cfps)	Existing Pipe Capacity	Actual Reqr'd Dia(in.) HW/D=1 (100 Yr)	Reqr'd Pipe Dia (in) For HW/D = 0.8	Reqr'd Pipe Dia (in) For HW/D = 0.5
Legal										
T5-R10-S22	1633	0.5	24	80	600	26	NG	30	32	47
T5-R10-S22	1633	0.6	36	80	600	26	OK	30	32	47
T5-R10-S22	1633	0.7	24	80	600	26	NG	30	32	47
T5-R10-S27	1633115	0.1	120	800	600	257	OK	76	81	118
T5-R10-S27	W.off1633	0.5	36	160	600	51	NG	40	43	62
T5-R10-S27	1633	1.2	48	80	600	26	OK	30	32	47
T5-R10-S27	1633	1.4	0	400	600	129	NG	57	61	89
T5-R10-S34	1280	1.0	32	80	600	26	OK	30	32	47
T5-R10-S34	1280	1.1	36	80	600	26	OK	30	32	47
T5-R10-S34	1280	1.5	36	80	600	26	OK	30	32	47
T5-R10-S27	1280121	0.4	24	40	600	13	OK	23	24	36
T5-R10-S27	1633	4.5	48	160	600	51	OK	40	43	62
T5-R10-S11	1589	2.5	60	400	600	129	OK	57	61	89
T5-R9-S7	1500	0.5	24	80	600	26	NG	30	32	47
T5-R10-S14	1588	4.1	48	160	600	51	OK	40	43	62
T5-R9-S18	1500121	0.5	36	80	600	26	OK	30	32	47
T5-R9-S18	1500	1.7	36	80	600	26	OK	30	32	47
T5-R9-S19	1500	1.2	36	80	600	26	OK	30	32	47
T5-R9-S19	1586	0.7	36	240	600	77	NG	47	50	73
T5-R9-S14	2213	0.1	30	160	600	51	NG	40	43	62
T5-R9-S15	2213	0.5	24	80	600	26	NG	30	32	47
T5-R9-S23	2234126	0.5	60	240	600	77	OK	47	50	73
T5-R9-S27	2235	-1.0	36	240	600	77	NG	47	50	73
T5-R9-S27	2235	-2.0	48	320	600	103	NG	52	56	82

Culvert information (continued)

Culvertshed	Road Number	Approx M.P.	Pipe Dia (in.)	Basin Acres	Mean Elev. (E)	Q100 (cfps)	Existing Pipe Capacity	Actual Reqr'd Dia(in.) HW/D=1 (100 Yr)	Reqr'd Pipe Dia (in) For HW/D = 0.8	Reqr'd Pipe Dia (in) For HW/D = 0.5
T5-R9-S21	2284	1.0	30	80	600	26	NG	30	32	47
T5-R9-S28	2273	0.5	18	80	600	26	NG	30	32	47
T5-R9-S28	2273	0.7	42	240	600	77	NG	47	50	73
T5-R9-S35	2235		48	160	600	51	OK	40	43	62
T5-R9-S33	12	0.5	24	120	600	39	NG	35	38	55
T5-R9-S33	12	1.0	24	160	600	51	NG	40	43	62
T5-R9-S33	12	0.1	120	1280	600	412	OK	91	98	142
T5-R9-S33	1201	0.3	48	1280	600	412	NG	91	98	142
T5-R9-S32	1201	1.0	48	480	600	154	NG	62	66	96
T6-R9-S4	2281	0.1	0	240	600	77	NG	47	50	73
T6-R9-S5	1200116	3.0	60	800	600	257	NG	76	81	118
T6-R9-S8	1200	3.2	24	240	600	77	NG	47	50	73
T6-R9-S8	1200122	0.1	48	240	600	77	OK	47	50	73
T6-R9-S6	1287	0.5	36	160	600	51	NG	40	43	62
T6-R9-S7	12	5.1	24	160	600	51	NG	40	43	62
T6-R9-S7	12	5.5	48	480	600	154	NG	62	66	96

Appendix 5: Riparian Vegetation Analysis

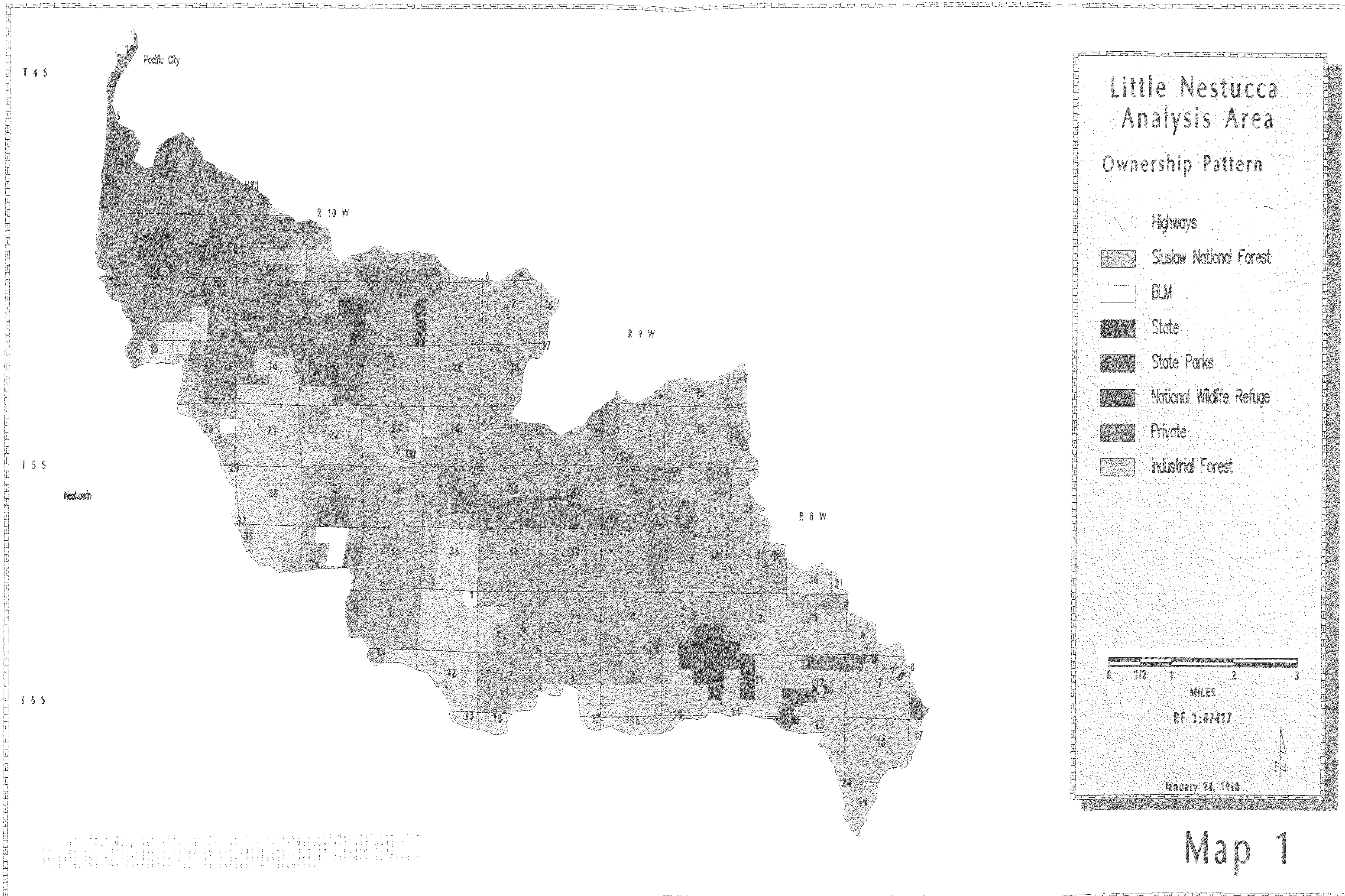
Riparian vegetation was analyzed using the vegetation information described in Appendix 1. This information does not consistently delineate riparian areas and so the results of this analysis show trends and relative conditions but do not offer absolute comparisons between stands or watersheds.

Stand polygons adjacent to third order and larger streams were selected from the overall vegetation coverage. These polygons were then clipped using the BUFFER command at a distance 60 meters from the adjacent stream. Acreage figures for each resultant polygon were calculated by dividing the GIS calculated area in m2 by 4047.

Codes were assigned to each vegetation layer for each polygon based upon the species present within each layer. Hardwoods (ACMA and ALRU) were coded H and conifers (PISI, TSHE, PSME, TREE) were coded C. Each polygon layer was then classified as conifer or hardwood dominated based on the preponderance of H or C codes (e.g., HHC is hardwood, HCC is conifer, C is conifer).

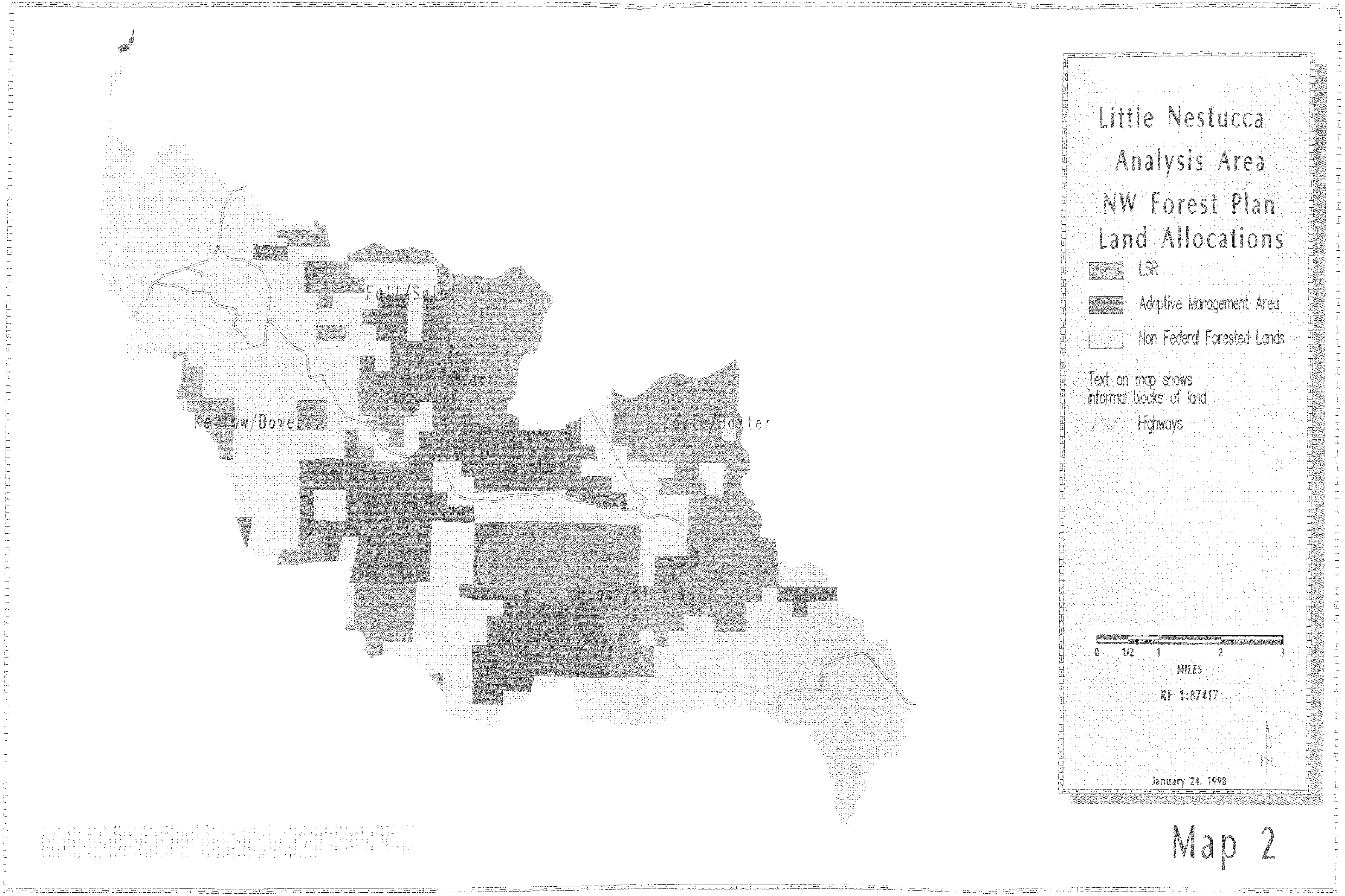
For each polygon the percent cover of hardwood and conifer dominated area was calculated for each layer whose size class was greater than 7. The acreage of each polygon which was dominated by large conifer or hardwood was calculated by multiplying the percent cover of each times the total acreage of each polygon.

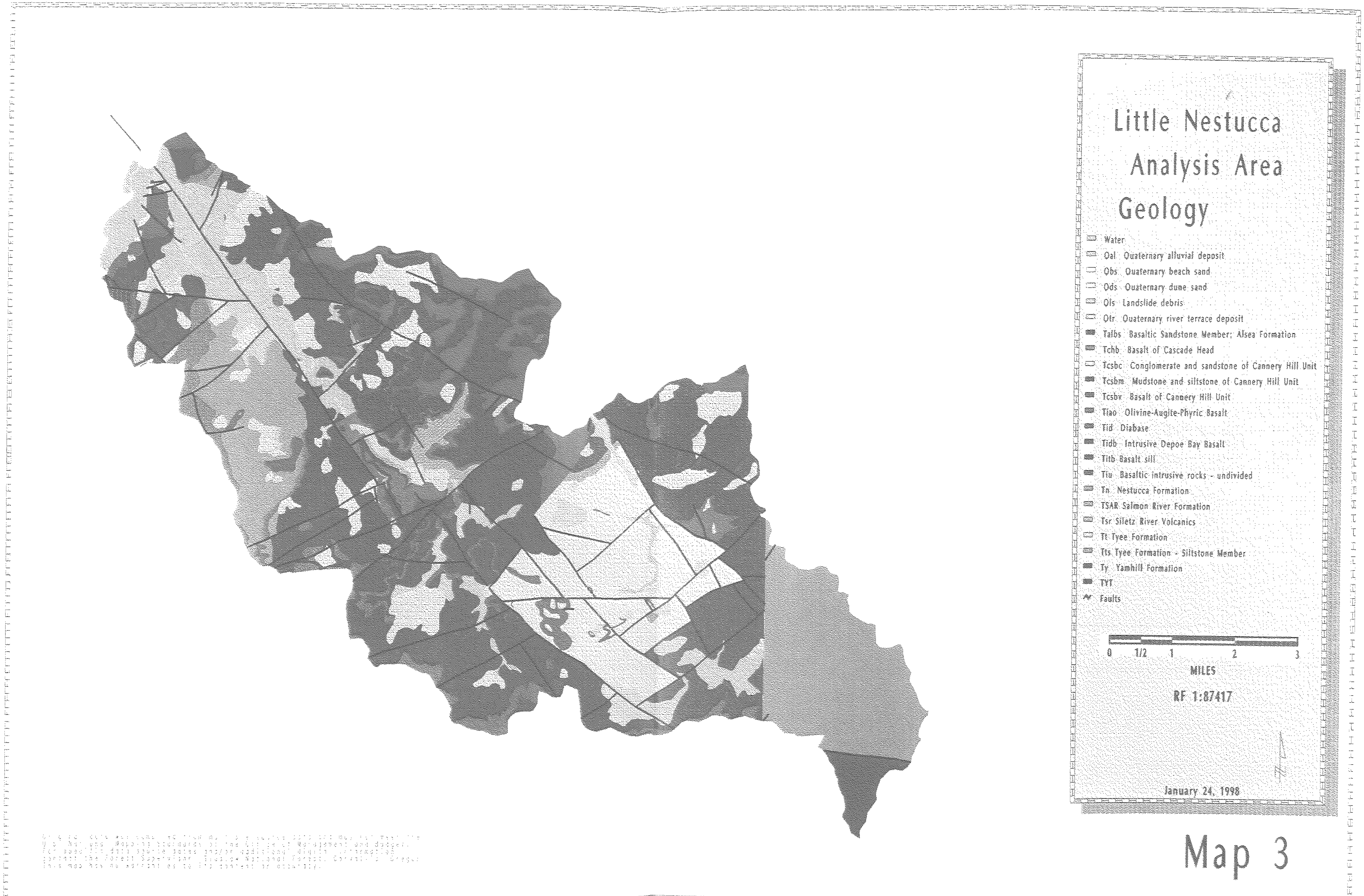
Riparian vegetation condition was then assessed by comparing the acreage of large conifers between each watershed and between managed and natural stands. The results of this analysis are in the text of the document.



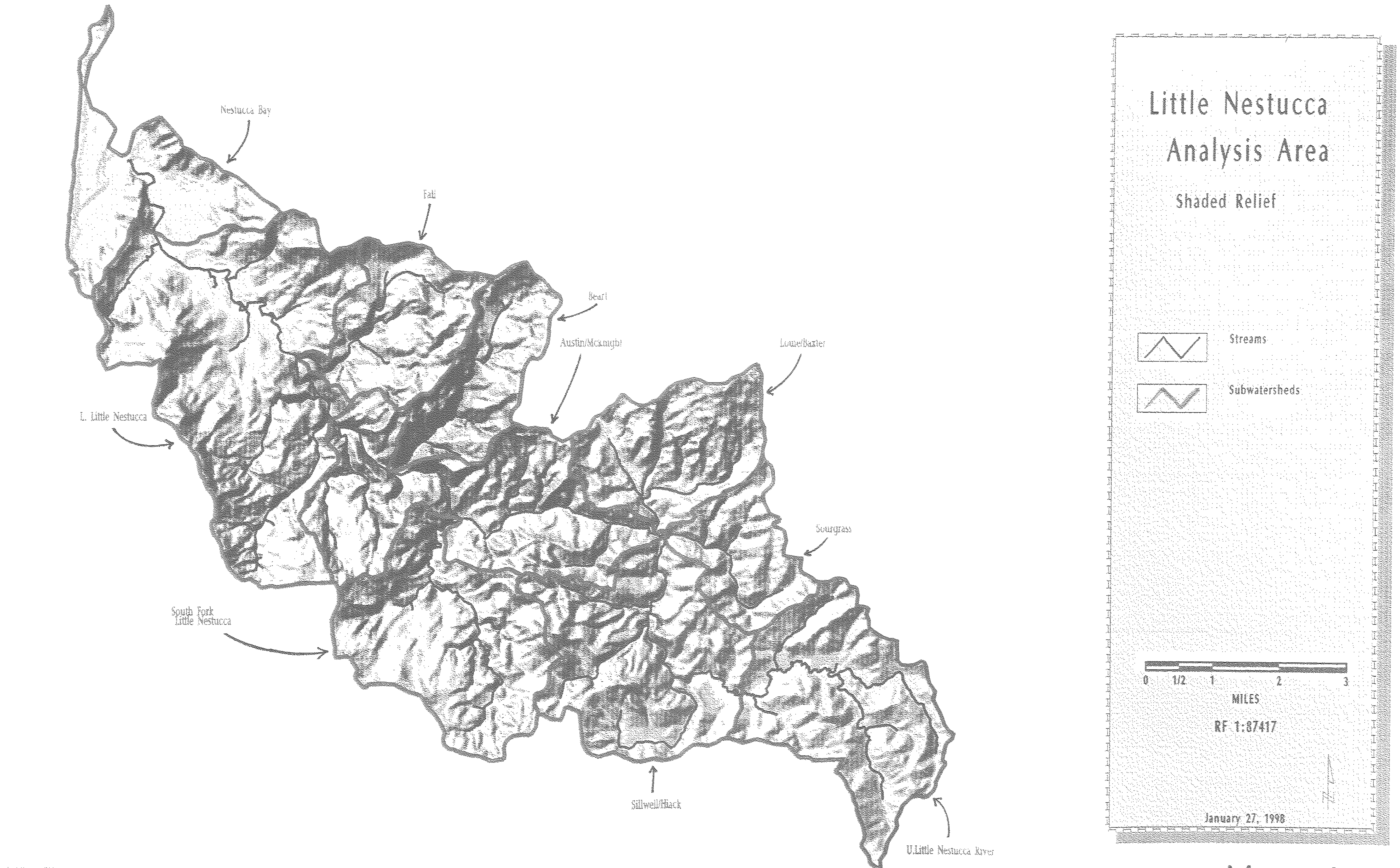
Little Nestucca Analysis Area
Ownership Pattern
Highways
Siuslaw National Forest
BLM
State
State Parks
National Wildlife Refuge
Private
Industrial Forest
0 1/2 1 2 3
MILES
RF 1:87417
January 24, 1998
Pacific City
Neskowin
T 4 S
T 5 S
T 6 S
R 10 W
R 9 W
R 8 W

Map 1


Little Nestucca
Analysis Area
NW Forest Plan
Land Allocations
LSR
Adaptive Management Area
Non Federal Forested Lands
Text on map shows
informal blocks of land
Highways
0 1/2 1 2 3
MILES
RF 1:87417
N
January 24, 1998
Fall/Salal
Bear
Kellow/Bowers
Louie/Baxter
Austin/Squaw
Hiack/Stillwell
Map 2



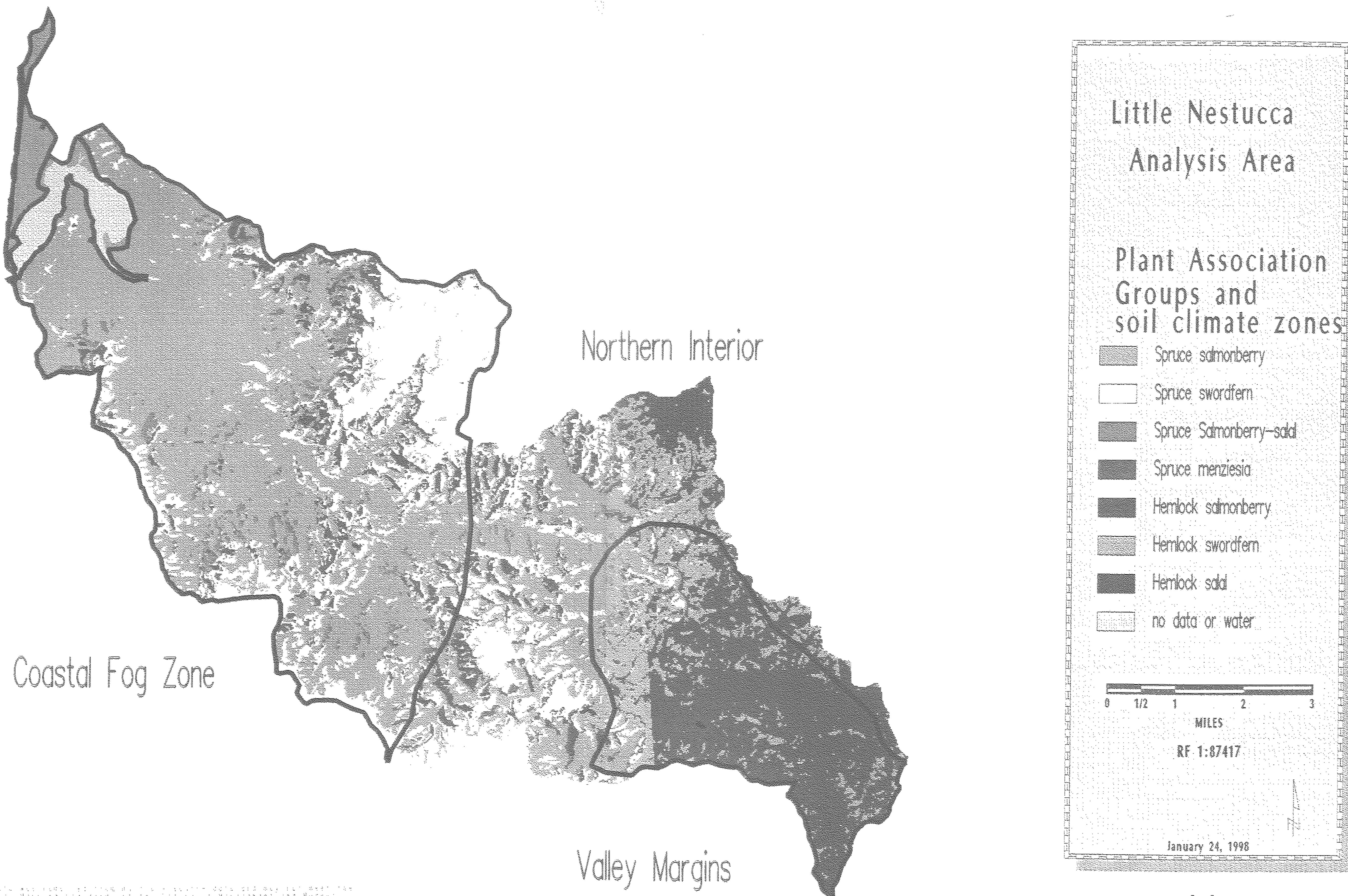
Little Nestucca
Analysis Area
Geology
Water
Qal Quaternary alluvial deposit
Qbs Quaternary beach sand
Qds Quaternary dune sand
Qls Landslide debris
Qtr Quaternary river terrace deposit
Talbs Basaltic Sandstone Member; Alsea Formation
Tchb Basalt of Cascade Head
Tcsbc Conglomerate and sandstone of Cannery Hill Unit
Tcsbm Mudstone and siltstone of Cannery Hill Unit
Tcsbv Basalt of Cannery Hill Unit
Tiao Olivine-Augite-Phyric Basalt
Tid Diabase
Tidb Intrusive Depoe Bay Basalt
Titb Basalt sill
Tiu Basaltic intrusive rocks - undivided
Tn Nestucca Formation
TSAR Salmon River Formation
Tsr Siletz River Volcanics
Tt Tyee Formation
Tts Tyee Formation - Siltstone Member
Ty Yamhill Formation
TYT
Faults
0 1/2 1 2 3
MILES
RF 1:87417
January 24, 1998
Map 3


Little Nestucca
Analysis Area
Shaded Relief
Nestucca Bay
Fall
Bear
Austin/Mcknight
Lone/Baxter
L. Little Nestucca
Sourgrass
South Fork
Little Nestucca
Sillwell/Hiack
U.Little Nestucca River
Streams
Subwatersheds
0 1/2 1 2 3
MILES
RF 1:87417
January 27, 1998

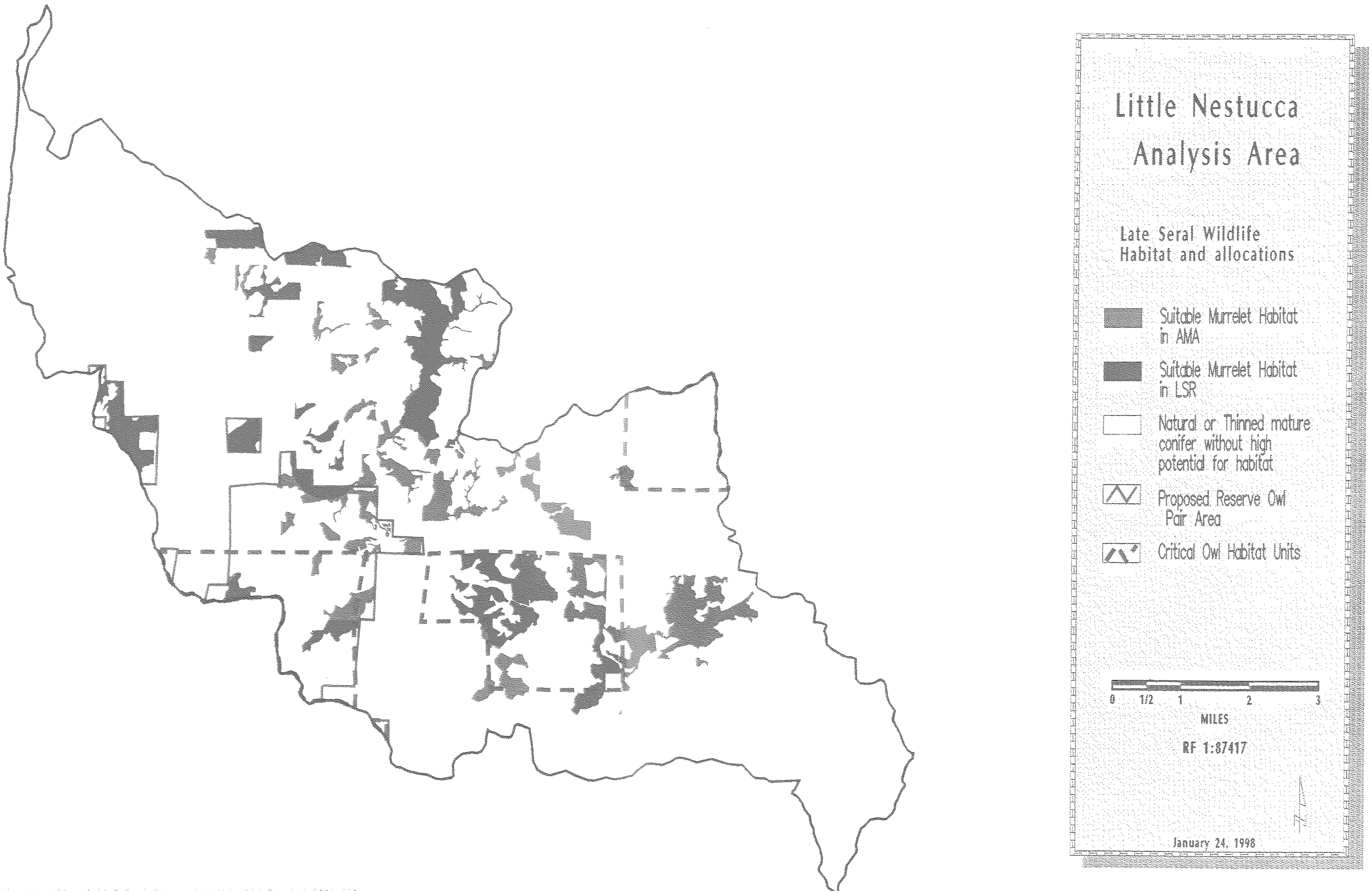
Map 4

Little Nestucca Analysis Area
Stream Confinement and Gradient
Gradient < 1 %
Gradient 1 to 2 %
Gradient 2 to 4 %
Gradient 4 to 8 %
Gradient 8 to 20 %
Gradient > 20 %
Confinement indicated by line thickness
Confined
Moderately Confined
Unconfined
Untyped
0 1/2 1 2 3
MILES
RF 1:87417
January 27, 1998

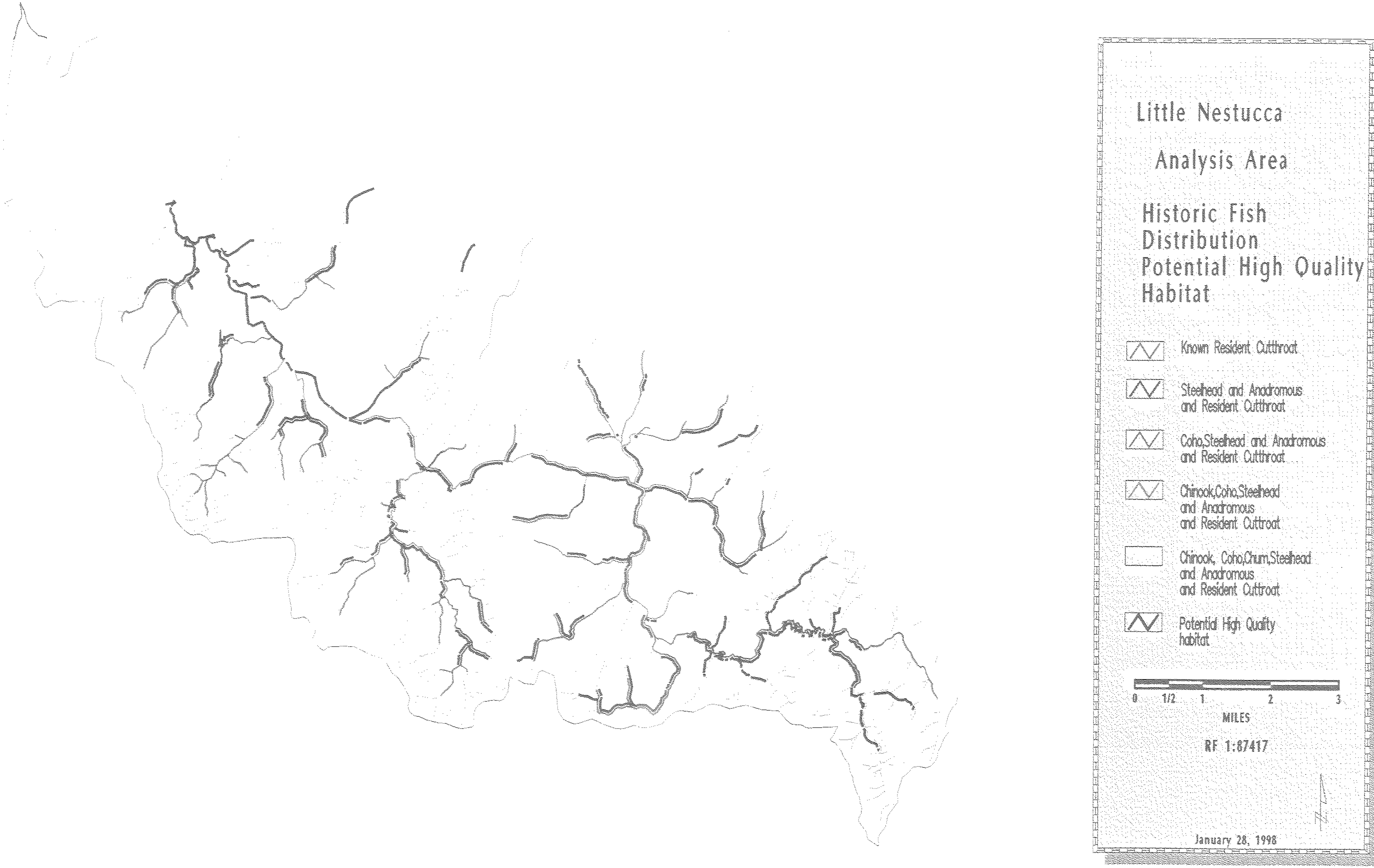
Map 5


Little Nestucca
Analysis Area
Plant Association
Groups and
soil climate zones
Spruce salmonberry
Spruce swordfern
Spruce Salmonberry-salal
Spruce menziesia
Hemlock salmonberry
Hemlock swordfern
Hemlock salal
no data or water
0 1/2 1 2 3
MILES
RF 1:87417
January 24, 1998
Northern Interior
Coastal Fog Zone
Valley Margins

Map 6


Little Nestucca
Analysis Area
Late Seral Wildlife
Habitat and allocations
Suitable Murrelet Habitat in AMA
Suitable Murrelet Habitat in LSR
Natural or Thinned mature conifer without high potential for habitat
Proposed Reserve Owl Pair Area
Critical Owl Habitat Units
0 1/2 1 2 3
MILES
RF 1:87417
January 24, 1998

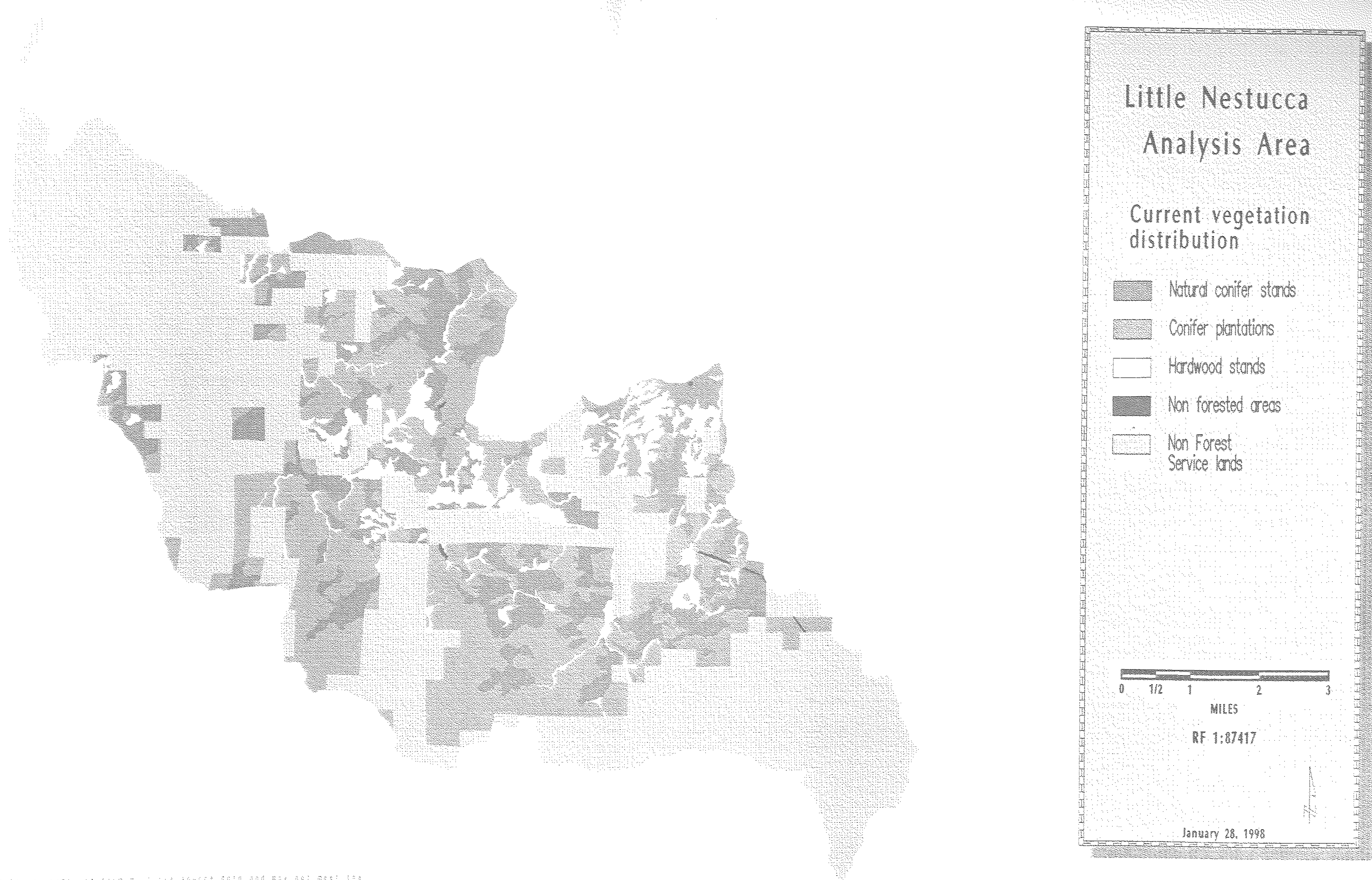
Map 7


Little Nestucca
Analysis Area
Historic Fish Distribution Potential High Quality Habitat
Known Resident Cutthroat
Steelhead and Anadromous and Resident Cutthroat
Coho,Steelhead and Anadromous and Resident Cutthroat
Chinook,Coho,Steelhead and Anadromous and Resident Cuttroat
Chinook, Coho,Chum,Steelhead and Anadromous and Resident Cuttroat
Potential High Quality habitat
0 1/2 1 2 3
MILES
RF 1:87417
January 28, 1998

Map 8


Little Nestucca
Analysis Area
Roads shown with
risk of failure
Low Risk
Moderate Risk
High Risk
Non Forest Service Lands
Undersized Culverts
0 1/2 1 2 3
MILES
RF 1:87417
January 28, 1998

Map 9


Little Nestucca
Analysis Area
Current vegetation distribution
Natural conifer stands
Conifer plantations
Hardwood stands
Non forested areas
Non Forest Service lands
0 1/2 1 2 3
MILES
RF 1:87417
January 28, 1998

Map 10