Nestucca/Neskowin Watershed Council

Watershed Assessment

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1. Introduction to the Nestucca Watershed Council and the Watershed Assessment

The Nestucca Watershed Council (Council) was formed in 1995. The Council was officially designated by the Tillamook County Commissioners in 1996 and became incorporated in 1997. The name was changed to the Nestucca/Neskowin Council in June 1997, to reflect the expansion of the Council to include the Neskowin area. The Council is comprised of landowners, industry representatives, special district representatives, and interested private citizens. A Board of Directors is responsible for conducting business and organizing activities for the Council. Monthly Board meetings and Council meetings are open to the public.

The Technical Advisory Committee (TAC) was formed in 1995 and works closely with the Council. The TAC is made up of representatives of all public agencies which own, manage, or have jurisdiction/regulatory responsibility in the Nestucca/Neskowin Watershed. The scientists and managers on the TAC were closely involved as advisors in the creation of this watershed assessment.

Many studies have been conducted in the Nestucca River and Little Nestucca River Watersheds. These reports, analyses, and databases were incorporated into this document. This assessment acknowledges these earlier efforts and builds upon them. Listed below are the significant sources used to compile this assessment.

- Little Nestucca Watershed Analysis. USFS 1998.
- Nestucca Watershed Analysis. USFS and BLM 1994.
- Nestucca River Basin Water Quality Study. Tillamook and Yamhill Counties, Oregon. McDonald and Schneider 1992.
- Environmental Assessment. Proposed Nestucca Bay National Wildlife Refuge. USFWS 1990.

2. Scope and Goals of the Nestucca/Neskowin Watershed Assessment

Geographic Scope and Naming Conventions: This assessment dealt with the Nestucca Watershed as defined by all streams and tributaries that flow into the Nestucca Bay; thus, the Nestucca River, the Little Nestucca River and their tributaries are included in this assessment. For the purpose of this document, the "Nestucca Watershed" will be based on this definition. Also included in this assessment is the Neskowin Watershed, as defined by all tributaries that flow into Neskowin Creek and Daley Lake. Much information is available on the "Big" Nestucca Watershed, as defined by the Nestucca River and its tributaries. In this document, the "Big Nestucca Watershed" will refer only to the Nestucca River and its tributaries. For the purpose of this assessment, "the watershed" refers to the entire area of Nestucca and Neskowin Watersheds.

Goal 1: Provide the basis for prioritizing where and how to protect and enhance water quality and fish habitat and assess the condition of native fish and wildlife species and their habitats throughout the watershed. To fulfill this goal, the assessment will accomplish four objectives.

> **Objective 1:** Gather and summarize all existing data and reports concerning the Nestucca and Neskowin Watersheds on the following topics:
> - The water quality of the streams and the Nestucca Bay
> - The condition of fish and wildlife habitat in the streams, riparian areas, uplands, and the Nestucca Bay
> - The status of fish and wildlife populations
> - The local effects of land use activities such as agriculture, timber management, and roads on water quality and fish resources
>
> **Objective 2**: Identify data gaps in the summarized information.
>
> **Objective 3**: Identify factors that limit water quality and fish resources in the watershed. "Limiting factor" is defined for the purposes of this assessment as any environmental factor or land use practice that limits the health or sustainability of a natural resource.
>
> **Objective 4:** Identify goals for future Council activities based on the desired future conditions for natural resources in the watershed. These desired future conditions are derived from ecological concepts of health and sustainability.

Goal 2: Increase public involvement and education and facilitate partnerships between private citizens and public agencies. To achieve this goal, the *process* of creating and discussing this assessment will accomplish two objectives.

> **Objective 1**: Increase public education about water quality, fish habitat, and land management issues through workshops on the assessment's findings and citizen-based monitoring programs.
>
> **Objective 2**: Encourage and facilitate partnerships between private citizens and public agencies through the cooperation of the Nestucca/Neskowin Watershed Council and the Technical Advisory Committee to complete this assessment.

3. Overview of the Watershed

A. Geographic Setting

The Nestucca/Neskowin Watershed is located on the northern coast of Oregon, 50 miles west of Portland (Map 1). It consists of approximately 217,085 acres (340 square miles). Much of the watershed (87.5%) is located in Tillamook County. Yamhill County contains 12%, and Polk and Lincoln Counties contain 0.5%. The watershed is roughly 30 miles wide (west to east), and 20 miles long (north to south). The three main subwatersheds are the Big Nestucca, the Little Nestucca, and Neskowin.

The Nestucca River reaches farther east into the Coast Range Mountains than either the Little Nestucca or Neskowin Creek. The headwaters of the Nestucca are located west of McMinnville, 53 river miles from the Pacific Ocean. The Nestucca River flows in a west-southwest direction to Nestucca Bay, which empties into the Pacific Ocean. The Little Nestucca River flows 18 miles from its headwaters to Nestucca Bay. Neskowin Creek flows 10 miles from its headwaters, directly into the Pacific Ocean.

B. Climate

Coastal northwest Oregon has some of the highest annual rainfall in the state. Annual precipitation varies from an average of 80 inches in the lowlands to 100 inches in the uplands. Precipitation occurs mainly in the form of rainfall, since snowfall is rare except in the higher elevations. Rainfall events can be heavy and severe. Precipitation occurs mainly in the months of October through March.

The watershed has a mild climate with wet winters and cool, dry summers. The average annual high temperature is 60° F, and the average annual low is 43° F. Temperatures tend to be cooler in the river canyons than in the lowlands. Much of the lower watershed is in the coastal fog zone (Figures 1 and 2).

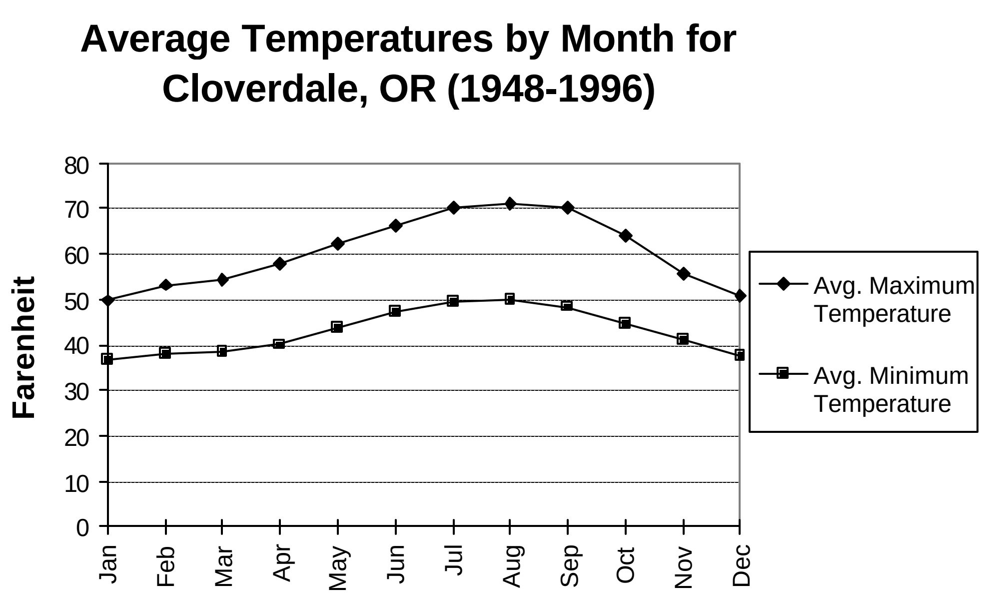

Figure 1 (Source: Western Regional Climate Center)

Average Total Precipitation by Month for Cloverdale, Oregon (1948-1996)

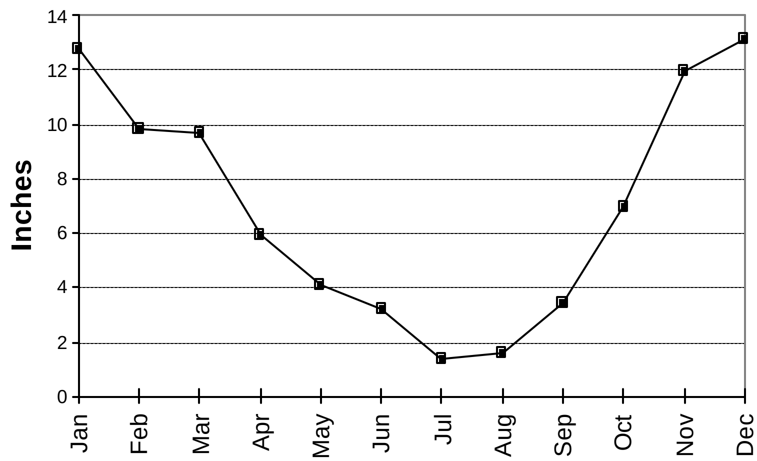

Figure 2 (Source: Western Regional Climate Center)

C. Hydrology

The Nestucca River is 53 miles long and drains an area of 258 square miles. The average gradient on the Nestucca River is 37 feet per mile (0.7% gradient). In the Nestucca/Neskowin watershed, there is only one impoundment: McGuire Reservoir on the upper Nestucca River at river mile 49. The highest point on the river is 2,200 feet above sea level at Walker Flat and Meadow Lake areas. The river drops 1,500 feet to the community of Blaine at river mile 25 (USFS and BLM 1994). This section of the river flows through a narrow valley. At Blaine, the valley widens and the gradient lessens (Map 2 for locations). Broad, flat terraces occur above the current floodplain where the river has experienced downcutting. As the river flows to the bay, the valley continues to widen. The tidal effects reach to river mile 7 at Cloverdale (USFS and BLM 1994), and tidal effects extend 2.5 miles up the Little Nestucca River (USFS 1998).

For the purpose of this watershed assessment, the Big Nestucca Watershed has been divided into 39 subwatersheds, the Little Nestucca into 9 subwatersheds, and Neskowin into 3 subwatersheds. Thus the Nestucca/Neskowin Watershed has a total of 51 subwatersheds. (Map 3)

The Nestucca Bay is a natural, unimproved inlet. The bay and channel are shallow in most areas. The Nestucca Bay spit, forming the west boundary of the bay is a sandy peninsula formed by ocean current. Ocean waves breach the spit at times. Inland from the spit, there are tidelands and diked areas that used to be tidelands.

Streamflow levels have been monitored at gauging stations in the Nestucca Watershed for many years. The locations of the gauging stations changed over time, and some stations were discontinued. The U. S. Geological Survey (USGS) and the Oregon Water Resources Department (OWRD) maintain the gauging stations. Three stations are currently active. One is located on the upper Nestucca River near river mile 49, and another is on Tucca Creek, and the third active gauge is in McGuire Reservoir (Map 2). Two other stations are no longer active. However, data from these sites are available. One station was located on the Nestucca River near Beaver, and the other was on the Nestucca River near McMinnville. There are no gauging stations located in the Neskowin or Little Nestucca Watersheds. Table 1 shows the average annual flow at each of these gauging stations in cubic feet per second (cfs).

Gauge ID Number	Location	Years of Record	Drainage Area (square miles)	Average Annual flow (cfs)	Avg. Annual Yield (acre ft)
14302900	River mile 49.3 on Nestucca River	1960-present	6.18	32.1	23,260
14303000	River mile 37.5 on Nestucca River	1928-1944	12	43.6	31,590
14303600	River mile 13.5 on Nestucca River	1964-1991	180	1068	773,800
14303200	Tucca Creek (Elk Creek Tributary)	1983-1989, 1990-present	3.09	14.6	10,570
14302800	McGuire Reservoir	1970-present	2.85	NA	NA

Table 1. USGS and OWRD Streamflow Gauging Stations in the Nestucca/Neskowin Watershed

The mean annual 30-day low flows (i.e., the average flow of the 30 consecutive days of the year with the lowest streamflow levels) generally occur in the late summer (Table 2). This is also the time of the year with the lowest amount of rainfall, and it coincides with the period of maximum irrigation withdrawals (Figures 3 and 4).

Gauge Location	Period of Record used in this analysis	Mean Annual 30-Day Low Flow (cfs)	Instantaneous Low Flow (cfs) and (date)	Drainage Area (square miles)
River mile 49.3 on Nestucca River	1961-1982	2.83	0.41 (September 1986)	6.18
River mile 37.5 on Nestucca River	1928-1944	2.46	1.0 (October 1929)	12
River mile 13.5 on Nestucca River	1965-1986	85.87	32.0 (September 1967)	180
Tucca Creek (Elk Creek Tributary)	1984-1993	1.18	0.46 (September 1987)	3.09
McGuire Reservoir	1985-1993	0.82	0.0 (October 1989)	2.85

Table 2. Low Flow Record for the Nestucca/Neskowin Watershed

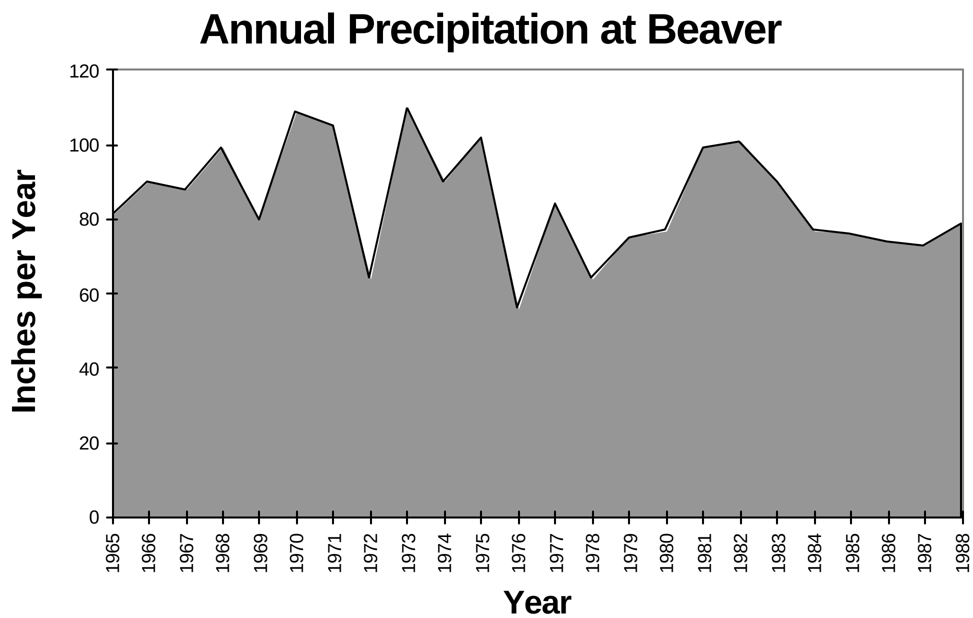

Figure 3 (Source: U.S. Geological Survey)

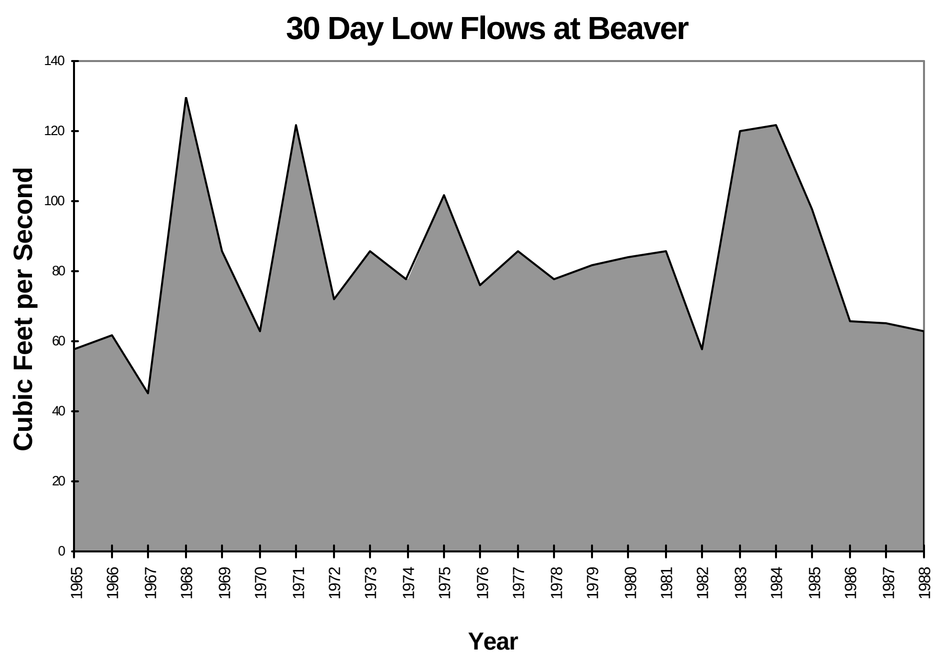

Figure 4 (Source: U.S. Geological Survey)

Minimum streamflows for the Nestucca River were converted to instream water rights to support aquatic life. Oregon Department of Fish and Wildlife (ODFW) applied for these instream water rights with a priority date of May 9, 1973. The Water Resources Department holds these water rights in trust for the state of Oregon. These streamflows are based on the biological requirements of fish. The upper Nestucca River is a designated State Scenic Waterway from McGuire Dam to its confluence with Moon Creek; thus the state's recommended minimum flows for scenic waterways apply to the upper Nestucca River. State scenic waterway flow levels are based on "fishery flows" as determined by ODFW. For Nestucca River at Beaver, the scenic waterway flow level in August is 123 cubic feet per second (cfs), in September the level is 250 cfs, and in October the level is 250 cfs (USFS and BLM 1994). These designated flow levels are much higher than the net minimum flows available at Beaver, taking into account the average natural streamflow level, out-of-channel diversions, and storage at McGuire Dam (USFS and BLM 1994). OWRD may not issue new water permits that would reduce flows below the recommended levels.

Diversions out-of-channel in the watershed can be categorized into two types. One type is the diversion of water within the basin for irrigation and domestic use. The other type is an out-of-basin diversion at McGuire Reservoir for McMinnville's municipal water supply (Tables 3 and 4). Water right information has not been summarized for Little Nestucca Watershed or Neskowin Watershed, but this information is available from Oregon Water Resources Department.

McGuire Reservoir was created by an earth and rock dam, which was constructed in 1969. The reservoir capacity is 1,230 million gallons. The city of McMinnville utilizes the water for domestic and municipal purposes. The water impounded by McGuire Dam is transferred out of basin via a pipeline to Idlewild Creek. Water from Idlewild Creek flows into Link Reservoir near McMinnville for its water supply. Since 1992, McGuire Reservoir has been drained annually. The amount of water released from McGuire Reservoir to Nestucca River varies each year. The average amount released from 1982-1992 was 693 million gallons per year. McMinnville Water and Light has one water diversion permit with a 1958 priority date for the Nestucca River. The permit specifies a total diversion of 16 cfs. Of this diversion, 6.4 cfs comes from Nestucca River, and 9.6 cfs comes from Walker Creek.

As of 1992, McMinnville has submitted an application for increasing McGuire Reservoir capacity and a 34 cfs diversion from Nestucca River and Walker Creek. McGuire Reservoir discharge records for the low flow months (August and September) show an average daily flow of 0.82 cfs released to the Nestucca River from the reservoir. McMinnville Water and Light's water right does not require the release of water into the Nestucca. Releases from the reservoir have been voluntary. Historical records indicate that the average daily low flow in August and September, prior to the construction of the reservoir, was 1.1 cfs. Table 3 summarizes out-of-channel water use by subwatershed in the Big Nestucca Watershed, and Table 4 summarizes the types of water rights.

Subwatershed	Subwatershed Size (Acres)	Subwatershed Size (Square Miles)	Amount of Water Withdrawals for Out-of-Channel Use (cfs)
Lower Nestucca River	10,074	15.7	17.750
Middle Nestucca River	5,680	8.9	5.245
Upper Nestucca River	6,666	10.4	1.178
Horn Creek	3,557	5.6	2.700
Clear Creek	3,408	5.3	1.400
George Creek	1,658	2.6	--
Lower Three Rivers	5,182	8.1	3.105
Cedar Creek	3,681	5.7	0.185
Pollard Creek	2,187	3.4	0.005
Upper Three Rivers	5,189	8.1	--
Alder/Buck Creek	4,493	7.0	4.390
Crazy Creek	3,608	5.6	0.010
Farmer Creek	3,146	4.9	0.698
Lower Beaver Creek	1,784	2.8	1.030
North Beaver Creek	4,947	7.7	1.075
West Creek	1,683	2.6	--
Tiger Creek	1,990	3.1	0.360
East Beaver Creek	9,928	15.5	1.814
Foland Creek	2,165	3.4	1.640
Clarence Creek	2,131	3.3	--
Limestone Creek	1,994	3.1	--
Wolfe Creek	1,852	2.9	0.860
Tony Creek	1,737	2.7	0.140
Boulder Creek	2,806	4.4	1.200
Alder Creek	1,347	2.1	0.010
East Creek	6,824	10.7	0.470
Bays Creek	3,065	4.8	--
Moon Creek	5,621	8.8	0.730
Powder Creek	3,717	5.8	0.460
Niagara Creek	8,032	12.5	0.010
Slick Rock Creek	2,299	3.6	0.010
Elk Creek	6,445	10.1	--
Bible Creek	4,777	7.5	--
Bear Creek	6,253	9.8	--
Bald Mountain Fork	5,174	8.1	--
Testament Creek	5367	8.4	0.380
Fan Creek	8,844	13.8	1.000
Walker Creek	1,925	3.0	9.600
McGuire Reservoir	1,871	2.9	6.400
Total	163,107	254.7	63.85

Table 3. Water Rights: Out-of-Channel Use In Big Nestucca Watershed

Type of Water Right	Number	Amount (cfs)
Domestic	174	8.6
Municipal	13	23.6
Irrigation	118	32.9
Agriculture	7	0.1
Industrial	7	4.4
Livestock	19	0.2
Fish (122cfs for Cedar Creek Hatchery)	14	129.1
Power	3	9.5
Recreation	3	7.4
Miscellaneous	2	less than 0.1
Grand Total	360	215.8
Total Instream Uses	NA	151.95
Total Out-of-Channel Uses	NA	63.85

Table 4. Water Rights Summary: Big Nestucca Watershed

D. Soils, Geology, and Landtypes

This section discusses the soils, geology, and landtypes present in the watershed. Landtype refers to a classification of the landscape based on geology, stream density and gradient, and slope steepness. A list of definitions for technical terms is given below.

Definitions

alluvial deposits: materials, such as gravel and sand, deposited by modern rivers
basalt: rock formed from magma that solidified at the earth's surface
bedrock: solid rock exposed at the earth's surface or overlain by loose materials, such as soil
breccia: rock made up of fragmented, angular components
clay: a soil made of very fine particles, generally less than 1/256 mm in diameter
debris flow or debris torrent: all types of rapidly moving materials, such as gravel, boulders, silt, logs, etc.; a type of landslide
dike: a sheet of rock that cuts across the structure of other rock formations
earthflow: a slow flow of earth, lubricated with water down a hillside
escarpment: a steep face or slope
extrusive: a type of rock that solidified at the earth's surface from volcanic material (magma)
fluvial: of or pertaining to rivers; produced by river action
geology: the study of the earth and rocks
geomorphology: the study of the form of the earth, the configuration of its surface, and the evolution of landforms
hummock: a little hill or knoll
igneous: rock consisting of magma that solidified below the earth's surface
incised: cut down into, as a river cuts down into a plateau
intrusive: a type of rock that (while forming, in its fluid phase), penetrated between other rocks and solidified before reaching the surface

loam: a soil composed of a mixture of clay, silt, sand, and organic matter
relief: the difference in elevation between the high and low points of a land surface
sand: a soil made of particles that are between 2 and 1/16 mm in diameter
sedimentary: a type of rock that formed by the accumulation of layers of sediment
sill: a thin sheet of rock that is intruded between layers of existing rock and is parallel to these layers
silt: a soil made of particles that are between 1/16 and 1/256 mm in diameter
slump: downward slipping of rock or soil, moving as one unit, with a backward rotation
tectonic: of or pertaining to the deformation of the earth's crust
topography: the relief and contour of the land
tuffaceous: rock formed of volcanic ash and pumice
volcanics: extrusive, igneous rock

Soil Associations

Soils are produced by many factors including geology, topography, climate, organisms and time. A soil is often named after the nearest post office or town near the place where the soil was first observed and mapped. A soil association contains a group of soils that occurs in a characteristic pattern. A soil association is named for the most commonly occurring soils within its boundaries, with the most common soil being named first. A general soil association map (Map 4) shows the major soil associations in the Nestucca/Neskowin Watershed (John Shipman, NRCS, personal communication). A description of the major soils that make up each association can be found in Appendix A.

General Geology

The Coast Range bedrock consists of ocean floor basalts overlain by sedimentary rocks that were deposited in a marine environment. Younger volcanic flows, dikes, and sills intruded these older rocks. The Coast Range has experienced tectonic uplift since 10 million years ago, when the Juan de Fuca plate of the Pacific Ocean floor began to subduct beneath the North American plate. This combination of rock types, tectonic forces and climate controls the landforms and river morphology in the Coast Range (USFS and BLM 1994).

Some areas in the Big Nestucca Watershed are susceptible to landslides, and landslide debris is common in the basin. Many large landslides are associated with the contact areas between intrusive rocks and the underlying sedimentary rocks (USFS and BLM 1994).

Sand dunes, beach sands, spit sands, and alluvial deposits make up the youngest geologic materials in the river basin. Both active and stable dunes are located near Neskowin, Pacific City, and Woods. Alluvial deposits, consisting of gravel, sand, and silt, are most extensive along the Nestucca River and its major tributaries. Along Nestucca Bay, the deposits consist mainly of mud, silt, and sand (USFS and BLM 1994).

There are more floodplains and wetlands in the upper part of the Little Nestucca Watershed than are usually seen in Coast Range watersheds. One possible explanation is that the highly erodable siltstone underlying the area allowed more lateral erosion by streams and more floodplain development. Because most of the Little Nestucca Watershed is underlain with easily erodable bedrock, the area may have a naturally high sediment production rate when compared with other parts of the Coast Range (USFS 1998).

Landtype Associations:

A landtype association is a classification that incorporates terrestrial and aquatic classification systems. Landforms, bedrock, and upslope processes affect the aquatic system; and rivers in turn have helped shape the landforms over which they flow. Geology and topography were used to define the boundaries of the landtype associations, and stream density, stream gradient, and slope steepness were used to describe and compare the landtype associations (Ellis-Sugai et al. in prep). The boundaries of landtype associations are shown in Map 5. A complete description of all the landtype associations in the watershed can be found in Appendix B.

The most common landtype association, which covers 71,258 acres, or 32.7% of the watershed, is classified as **interior fluvial lands**. This association has almost equal amounts of sedimentary and volcanic bedrock. Most of the sedimentary bedrock is fine-grained and easily erodable. The volcanic rocks are a mixture of both erodable and durable forms. These soils have high water holding capacity. These soils will be unstable on lower midslopes above incised channels and on upper midslopes that are earthflow escarpment faces.

The second most common landtype association covers 38,847 acres or 17.9% of the watershed, and it is the **igneous-sedimentary contact lands**. The bedrock of this landtype association is primarily fine-grained, sedimentary rocks (80%) with a small amount of erosion-resistant volcanic rocks (14%). These soils have high to very high water holding capacity. Unstable soils occur on lower midslopes above incised channels, on upper midslopes that are earthflow escarpment faces, and on steep headwalls of upper backbone ridge systems.

Volcanic uplands-high relief covers 18,525 acres, or 8.5% of the watershed. This landtype association is underlain by erodable volcanics and a minor amount of fine-grained sedimentary rocks. The common landforms consist of steep, V-shaped canyons and narrow ridges, such as the common landforms found near East Beaver Creek. Relief is high. Debris torrent potential is extremely high. This area has the highest percentage of slopes over 60% in the Coast Range. Road failures have a higher probability of occurring because of instability of bedrock and stream gradient.

Coastal lowlands covers 8,870 acres, or 4.1% of the watershed. The area consists of areas of low relief, such as estuaries, floodplains, dunes, and coastal plains around Nestucca Bay, Cape Kiwanda, and the town of Neskowin. Stream density is 8.24 miles of stream per square mile. This landtype association has the highest percentage of low-gradient streams (40% of all stream miles in this landtype association) of any landtype association in the watershed. Increased human use and activity in this area increases the potential for water pollution. This association historically provided conditions for high quality fish habitat.

Igneous headlands cover 7,431 acres or 3.4% of the watershed. This area consists of headlands along the coast and gently rounded, broad, ridge systems with a few steep, unstable slopes on spur ridges. The primary hillslope erosion process is infrequent landslides, and there is a moderate risk of debris torrents.

E. Human Features in the Watershed

Land Use

Forestry is the major land use in the watershed (Map 6). The entire watershed consists of 217,085 acres. The forest lands administered by the federal government agencies, the United States Forest Service (USFS) and the Bureau of Land Management (BLM), include 131,649 acres, state owned forest lands include 8,920 acres, and industrial, privately owned forest lands include 38,663 acres. Thus, a total of 179,233 acres (approximately 82% of the watershed) are forest lands. A mixture of agriculture, rural residential, and private woodlots make up 35,745 acres or 16% of the watershed (McDonald and Schneider 1992; USFS and BLM 1994). In the Nestucca Watershed, 3,945 acres are managed for dairy production (Bob Pedersen, NRCS, personal communication).

Land Ownership

The pattern of land ownership (Map 7) that developed in the Nestucca/Neskowin Watershed resulted in much of the private lands being located in areas of low relief and low stream gradient. Federal lands are generally located in areas of high relief and high stream gradient.

Much of the land in the watershed is managed by federal agencies. Bureau of Land Management manages 36,331.6 acres (16.7% of the watershed), and U. S. Forest Service manages 95,317.6 acres (43.8%). The U.S Fish and Wildlife Service manages approximately 260 acres (0.1%) as a wildlife refuge. Industrial private forest companies own 38,662.6 acres (17.7%). Oregon Department of Forestry (ODF) manages 8,920.8 acres (4.1%). Private land owners, (agriculture, rural residential and small woodlot) own 35,745.2 acres (16.4%).

Roads

There is an extensive system of private, county, state, and federal roads in the watershed (Map 8 and Figure 5). Road types range from primary highways, such as Highway 101, to unimproved roads suitable only for 4-wheel drive vehicles. The roads in the watershed can be divided into two categories based on surface type. The surface type of roads is related to erosion problems, with gravel and dirt roads being higher potential sources of sedimentation than paved roads. Total road mileage for the watershed is 1318.6 miles, as determined by geographic information system (GIS) analysis. The average density of roads in the watershed is 3.9 miles of road per square mile. Gravel and dirt road surfaces are the dominant surface type in the watershed.

Gravel and dirt surfaces account for 1,174.9 road miles or 89% of the road surface in the watershed. Paved roads account for 143.7 road miles or 11% of the road surface in the watershed.

Major access roads on lands managed by BLM and the state were constructed in the 1960s and 1970s. BLM added many logging roads during the same period to facilitate an intensive commercial thinning program. Most USFS and private timber industry roads were constructed in the 1970s. During both the 1960s and 1970s, roads were built to standards that are less stringent than those that currently exist. Before the development of the Oregon Forest Practices Act, there were many road building practices that are not allowed today. Roads were located next to waterways and primary floodplains, end-hauling of materials was rarely practiced, excavated materials were pushed over the outer edge of the road as sidecast, and culverts were permitted to jut out of slopes into mid-air, which allowed water runoff to drop many feet to the ground and cause erosion problems. When the Oregon Forest Practices Act came into effect in 1971, road construction and maintenance on non-federal forests lands were regulated to minimize impacts of roads on the land. The Forest Practices Act guidelines have become more stringent and less open to interpretation through the years, and federal agencies have developed standards which go beyond the Forest Practices Act guidelines (USFS and BLM 1994).

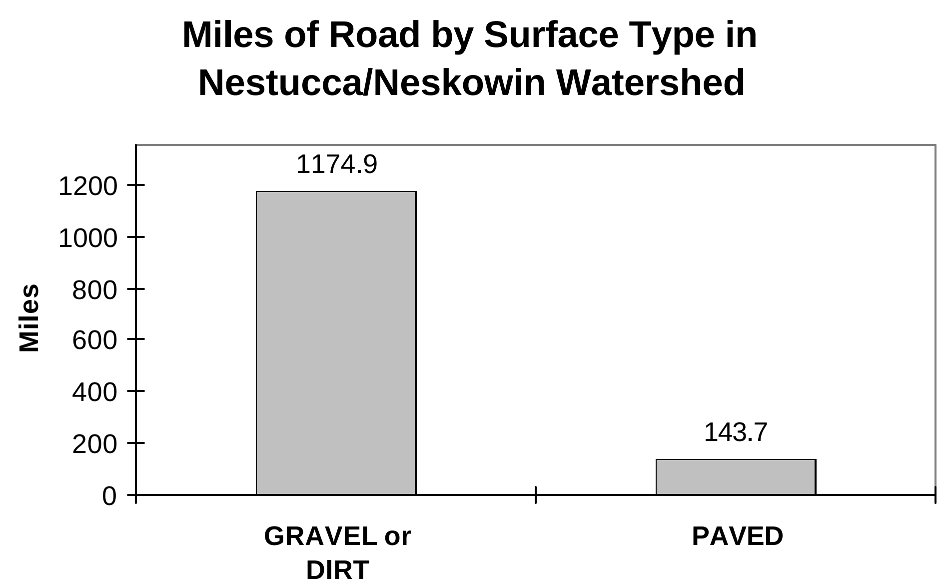

Figure 5

F. Wildlife and Vegetation

Species Status: Legal Definitions and Terminology

Some plant and animal species with special status are known to occur in the watershed. These species include those with Threatened or Endangered status on the Federal or State Endangered Species lists. Other special species are those with Sensitive status or Species of

Concern status. Table 5 and 6 below lists the wildlife and plant species that are on Federal and State Lists.

The United States Endangered Species Act of 1973 defines an Endangered species as any species which is in danger of extinction throughout all or a significant portion of its range as determined by the U.S. Fish and Wildlife Service (USFWS) or the National Marine Fisheries Service (NMFS). A Threatened species is any species which is likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range.

A species which is a Candidate for listing as threatened or endangered (on Federal or State lists) is a species for which there is sufficient information on biological vulnerability to support a proposal to list it as endangered or threatened, but the proposed rule has not yet been issued because the action is precluded by other listing activity.

The State of Oregon's Endangered Species Act authorizes the Oregon Fish and Wildlife Commission to add animal species to the State's Threatened and Endangered Species List. The Oregon Department of Agriculture designates which plant species are Threatened or Endangered. State Endangered and Threatened species are differentiated as follows: an Endangered species is a native wildlife species determined by the Oregon Fish and Wildlife Commission to be in danger of extinction throughout any significant portion of its range within Oregon; a Threatened species is one which is likely to become endangered within the foreseeable future throughout any significant portion of its range within Oregon.

Sensitive status can be designated at the state level by the Oregon Fish and Wildlife Commission to help prevent species from qualifying for listing as threatened or endangered. Sensitive species constitute those naturally-reproducing animals which may become threatened or endangered throughout all or any significant portion of their range in Oregon.

A Species of Concern is a status designated by the United States Fish and Wildlife Service, to help federal agencies, such as USFS and BLM, plan and conserve species on the lands that they manage.

Wildlife

The Nestucca/Neskowin Watershed supports a diversity of wildlife species. The status of many wildlife species in the watershed is closely related to the condition of the vegetation, amount of habitat available, size of habitat units or fragments, and the connectivity between different habitat types that may be needed by each species to survive, reproduce and sustain its population over the long term. There are 16 species of amphibians, 264 species of birds, 64 species of mammals, and 11 species of reptiles that may inhabit the area. Appendix C contains a complete listing of the common names, scientific names, and federal/state status of these wildlife species.

Those species within the watershed that have special status due to federal or state listing are listed in Table 5. Fish species are discussed in the next section of this chapter.

Common Name	Scientific Name	Class	Federal Status	State Status	USFS/ BLM Status
Northern bald eagle	*Haliaeetus leucocephalus*	bird	Threatened	Threatened	------
American Peregrine falcon	*Falco peregrinus anatum*	bird	Endangered	Endangered	------
Northern goshawk	*Accipiter gentilis*	bird	------	------	SoC
Northern spotted owl	*Strix occidentalis caurina*	bird	Threatened	Threatened	------
Aleutian Canada goose	*Branta canadensis leucopareia*	bird	Threatened	Endangered	------
Common loon	*Gavia immer*	bird	------	------	SoC
California brown pelican	*Pelecanus occidentalis californi*	bird	Endangered	Endangered	------
Western snowy plover	*Charadrius alexandrinus nivosus*	bird	Threatened	Threatened	------
Willow Flycatcher (little)	*Empidonax trailii (brewsteri)*	bird	------	------	SoC
Mountain Quail	Oreortyx pictus	bird	------	------	SoC
Long-billed curlew	*Numenius americanus*	bird	------	------	SoC
Harlequin Duck	*Histrionicus histrionicus*	bird	------	------	SoC
Marbled murrelet	*Brachyramphus marmoratus*	bird	Threatened	------	------
Townsend's Big-eared bat	*Plecotus townsendii*	mammal	------	------	SoC
Fringed myotis	*Myotis thysanodes*	mammal	------	------	SoC
Long-legged myotis	*Myotis volans*	mammal	------	------	SoC
Yuma bat	*Myotis yumanensis*	mammal	------	------	SoC
Long-eared bat	*Myotis evotis*	mammal	------	------	SoC
Pacific fisher	*Martes pennanti pacifica*	mammal	------	------	SoC
White-footed vole	*Phenacomys arborimus*	mammal	------	------	SoC
Northern sea lion	*Eumetopias jubatus*	mammal	Threatened	------	------
Red-legged frog	*Rana aurora*	amphibian			SoC
Tailed frog	*Ascaphus truei*	amphibian	------	------	SoC
Southern torrent	*Rhyacotriton variegatus*	amphibian	------	------	SoC
Northwestern pond turtle	*Clemmy's marmota marmota*	reptile	------	------	SoC
Oregon silverspot butterfly	*Speyeria zerene hippolyta*	insect	Threatened	------	------
Vertrees's Ceraclean	*Ceraclea vertreesi*	insect	------	------	SoC
Haddock's Caddisfly	*Rhyacophila haddocki*	insect	------	------	SoC
Newcomb's Littorine Snail	*Algamorda newcombiana*	insect	------	------	SoC

Table 5. Wildlife Species with Federal or State Threatened/Endangered Status likely to be found in the Nestucca/Neskowin Watershed ("SoC" = Species of Concern)

Vegetation

Settlement patterns, floods, fire history, windstorm events, and past land management practices have influenced vegetation types and patterns in the watershed. The majority of the watershed lies in the Western Hemlock and Sitka Spruce Vegetation Zones (USFS and BLM 1994). A **vegetation zone** is determined by local climate, soils, and topography; thus the plants found in a particular vegetation zone are distinctive of an area. Plant communities can be influenced by many factors, such as soils, water availability, and climate. Other factors that can influence the species present in an area are classified as disturbances, such as fire, disease, windstorms, or human activity. The watershed contains several plant species with special status (Table 6).

Scientific Name	Common Name	Occurrence in Watershed	Federal Status	State Status	USFS and BLM status
Pohlia sphagnicola	Pohlia Moss	Known	------	------	SoC
Erythronium elegans	Elegant fawn lily	Known	------	Threatened	SoC
Filipendula occidentalis	Queen-of-the-forest	Known	------	Candidate	SoC
Poa laxiflora	Loose-flowered bluegrass	Known	------	------	SoC
Sidalcea hirtipes	Hairy-stemmed checkermallow	Known	------	Candidate	SoC
Sidalcea nelsoniana	Nelson's checkermallow	Known	Threatened	Threatened	------
Anemone oregana var.	Oregon Bog Anemone	Potential	------	------	SoC
Cardamine pattersonii	Saddle Mt. Bittercress	Potential	------	Candidate	SoC
Cimicifuga elata	Tall Bugbane	Potential	------	Candidate	SoC
Dodecatheon austrofrigidum	Frigid Shooting Star	Potential	------	------	SoC
Fritillaria camschatcensis	Black Lily	Potential	------	------	SoC
Silene douglasii var. oraria	Cascade Head Catchfly	Potential	------	Threatened	SoC

Table 6. Plant Species with Federal or State Threatened/Endangered Status Known to Be or Having Potential to Be in Nestucca/Neskowin Watershed ("SoC" = Species of Concern)

Botanical Resource Areas

The watershed contains areas established for protection of botanical resources. There are four areas designated by BLM as Areas of Critical Environmental Concern (ACEC), one USFS Special Interest Area (SIA), and one USFS Research Natural Area. These areas are described below:

Nestucca River ACEC: Five plant species which are uncommon and of special interest occur in this ACEC. These species are the fringed pinesap (*Pleuricospora fimbriolata*) gnome plant (*Hemitomes congestum*), calypso orchid (*Calypso bulbosa*), phantom orchid (*Eburophyton austiniae*), and weak bluegrass (*Poa marcida*). This area contains the largest known concentration of fringed pinesap. Management actions identified in the ACEC Management Plan require inventories and research to learn more about the botanical resources in this area.

Sheridan Peak ACEC: This area was established to protect habitat for weak bluegrass (*Poa marcida*). Loose-flowered bluegrass (*Poa laxiflora*) also occurs in the area. Both plants are native to the Pacific Northwest.

High Peak-Moon Creek ACEC and **Research Natural Area**: This area contains a stand of mature and old-growth western hemlock and Douglas fir which includes some trees that are about 500 years old. This stand is one of the last major concentrations of western hemlock zone old growth in Tillamook county. It also contains plant communities typical of Coast Range forests and populations of weak bluegrass (*Poa marcida*) and fetid adder' tongue (*Scoliopus hallii*).

Walker Flat ACEC: This area contains the largest and healthiest population of the Federally Threatened Nelson's checkermallow (*Sidalcea nelsoniana*) and important marsh habitat.

Mt. Hebo Scenic Biologic SIA: This area contains a variety of special habitats, including rock outcrops, bogs, and meadows. Unique plant species and plant communities also exist in the area, as well as one of five known populations of elegant fawn lily and a population of silverspot butterfly.

Neskowin Crest Research Natural Area: This area contains late-seral stage Sitka spruce/Western hemlock forest. Its boundaries overlap with Cascade Head Experimental Forest and Cascade Head Scenic Research Area.

Noxious and Invasive Weeds

"Noxious weed" is any weed designated by the Oregon State Weed Board of the Oregon Department of Agriculture that is injurious to public health, agriculture, recreation, wildlife or any public or private property. There are two officially listed noxious species for Tillamook County: Canada thistle (*Cirsium arvense*) and tansy ragwort (*Senecio jacobaea*). Other species that are being considered for noxious status are bull thistle (*Cirsium vulgare),* knotweeds (*Polygonum spp.)* and gorse (*Ulex europaeus*). Populations of tansy ragwort have been successfully controlled with biological methods. Up to 90 percent of tansy ragwort populations have been eradicated, though scattered plants still are found in disturbed areas such as roadways (USFS and BLM 1994).

Invasive weeds are plants that are not native to the watershed and have the ability to out-compete native plant species. Invasive weeds found in the watershed include Himalayan blackberry, English ivy, Scotch broom, American holly, and reed canary grass (Carol Bickford, USFS, personal communication).

Seral Stages

For the purpose of this assessment the vegetation in the watershed has been described in terms of seral stages (Map 9). Seral stage data sources were the most complete and comparative data sources available for the entire watershed. **Plant succession** is a change in the species that occupy a certain area over time, and different stages that occur during succession are called **seral**

stages. The following descriptions of seral stages include an average age of the forest stand for each seral stage. These ages are approximate and are in part an artifact of the data available for the watershed. Information on seral stages in the Nestucca/Neskowin Watershed was derived from three different sources. The correlation between the three systems of seral stage classification for the watershed is explained in Appendix D.

Pioneer: This stage generally covers approximately the first 10 years following a disturbance. Herbs, shrubs and grasses dominate the site. Young conifer or hardwood trees may be present with diameters of less than 5 inches.

Very Early: This stage generally covers the period of 11 to 24 years following a disturbance. It covers the time it takes for a stand of trees to become established and to reach crown closure. Trees average 5 to 10 inches diameter at breast height (dbh), and the overstory is 50% or more conifer species. (Diameter at breast height is the diameter at four and half feet from the ground.)

Very Early—Mixed: Same as Very Early, except that the overstory is 50-80% hardwood species.

Early: This stage covers the period from 25 to 49 years following a disturbance. This stand of trees will start at crown closure stage and develop to self-pruning stage. Full crown closure is maintained, and the canopy begins to increase in height. Tree trunks near the ground have lost their branches due to intense shade, making it easier for animal and bird movement in the understory. Understory plants are sparse, with few or no seedlings, saplings, shrubs, herbs or grasses. Trees average 5 to 18 inches dbh, and overstory is 50% or more conifer.

Early—Mixed: Same as Early, except the overstory is 50-80% hardwood.

Mid: This stage covers the period from 50-79 years following a disturbance. Stands reach maturity during this stage, and a single, closed canopy is maintained. There is still little or no understory. Trees average 10 to 18 inches dbh, and the overstory is 50% or more conifer species.

Mid—Mixed: Same as Mid, except the overstory is 50-80% hardwood.

Late: This stage begins approximately 80 years after a disturbance, and is characterized by two stand types: **Mature stands** or **Old-growth stands**. **Mature stands** are 80-149 years old. Trees begin to form heavy, large limbs. Openings are created in the overstory canopy when disease, insects or windthrow kill or damage trees. Snags and large downed logs begin to accumulate. Shade tolerant trees and shrubs establish seedlings. Multiple canopy layers begin to develop. Trees average 19 to 32 inches dbh, and the overstory is 50% or more conifer species. **Old-growth stands** are 150 years or older. Canopy closure is moderate to high. There is a multi-layered, multi-species canopy. Many large trees have thick bark, broken tops and other deformities. Heavy accumulation of coarse woody debris has occurred. Tree diameters are quite variable, but trees with diameters larger than 32 inches are common, and some have diameters of 48 inches or more.

Late—Mixed: Same as Late, except the overstory is 50-80% hardwood.

Pure Hardwood: Any stand in which 80% or more of overstory is hardwood.

Seral Stage	Acres	Percent
Pioneer	46,403	21.0
Very Early	44,378	20.0
Very Early—Mixed	457	<1.0
Early	31,309	14.0
Early—Mixed	14,800	7.0
Mid	15,353	7.0
Mid—Mixed	3,458	1.5
Late	32,946	15.0
Late—Mixed	269	<1.0
Pure Hardwood	25,676	11.0
Other (residential, water)	3,693	2.0
Total Acres	**215,049**	----

Table 7. Acres in Each Seral Stage in Nestucca/Neskowin Watershed

Although the watershed is a Western Hemlock or Sitka Spruce Vegetation Zone, Douglas fir is the predominant tree species in the watershed. The dominant presence of Douglas fir today is due to forestry practices that favored replanting Douglas fir in harvested areas. Much of the watershed is characterized by rapidly growing, even-aged Douglas fir stands as a result of past fires and clearcuts. Red alder and bigleaf maple dominate most river valleys and streams. The oceanfront forests are dominated by lodgepole pine (shorepine). Much of the watershed remains in the early and mid-seral stages due to repeated disturbances such as short rotation harvests, insect pathogens, small scale fires, and debris flows.

Swiss Needle Cast is a disease that is causing forest health concern in the watershed. Swiss needle cast (SNC) infects Douglas fir and has risen to epidemic levels. The disease causes yellowing of needles, decreased needle retention, and decreased growth and vigor of both individual trees and stands of Douglas fir. Currently, the areas most impacted by SNC are young Douglas fir plantations in the fog zone (Kate Skinner, ODF, personal communication).

The disease is endemic (occurs naturally) in the watershed, but has reached epidemic levels due to many factors. One important factor is the increase in the number of acres reforested with Douglas fir over the last three decades. Some Douglas fir has been planted on sites that are more suitable to Western hemlock or Sitka spruce. These Douglas fir trees, already stressed by unsuitable conditions, are more susceptible to the disease. Also, subtle changes in weather patterns or cycles have created conditions favorable to the spread of SNC. These factors, when combined, result in a cumulative effect that favors the spread and intensity of SNC. (Kate Skinner, ODF, personal communication)

Aerial surveys completed in April and May 1997 show SNC present on 75,744 acres, across all landowners in the watershed (Kate Skinner, ODF, personal communication). These surveys, conducted for three years, have shown an increase in the number of acres showing signs of infection each year. The stands were rated as "Light" or "Heavy" infection based on tree color and health as observed from the air. This was followed with ground verification of stand health and individual tree needle retention. (Kanaskie et al. 1997). These surveys were funded by the Swiss Needle Cast Cooperative, made up of state, federal, and private forest landowners. The Swiss

Needle Cast Cooperative is continuing research and monitoring to understand the disease and develop management techniques.

Management implications are difficult to assess because the disease causes a decline in health and vigor; it does not kill a tree outright. It is difficult to decide when commercial harvest of a stand is appropriate or when stands should be rehabilitated by planting more locally suitable species (Katie Cavanaugh, OSU Extension Forester, personal communication, November 1997). Since SNC naturally occurs in the watershed, it is unknown if the stands will "grow out of it" or continue to decline. Thousands of acres in the watershed are young, fast-growing stands of Douglas fir, which are showing early symptoms of SNC. Possible future decisions to manage the effects of SNC are varied, and management could result in changes in species composition and age class distribution in some parts of the watershed. Some available management tools include interplanting, underplanting, rehabilitation of stands, and clearcut harvesting (Kate Skinner, ODF, personal communication).

G. Fish

Species and Status

The Nestucca/Neskowin Watershed is a productive fishery resource for the state of Oregon. Anadromous fish species present in the watershed include chum salmon, chinook salmon, coho salmon, searun cutthroat trout, and steelhead trout. Seasonal migrations of anadromous fish result in year round use of the Big Nestucca Watershed by adult salmon. Resident cutthroat trout are found throughout the watershed. Other freshwater species found in the watershed include brook lamprey, river lamprey, Pacific lamprey, dace and sculpins.

Scientific Name	Common Name	Federal Status	State Status	USFS/BLM Status
Oncorhynchus keta	Chum salmon	-----	-----	Sensitive
Oncorhynchus tshawytscha	Chinook salmon	-----	-----	-----
Oncorhynchus kisutch	Coho salmon	Candidate	Sensitive	Sensitive
Oncorhynchus clarki	Cutthroat trout	-----	-----	Sensitive
Oncorhynchus mykiss	Steelhead trout	Candidate	-----	Sensitive
Cottus spp.	Sculpin species	-----	-----	-----
Lampetra richardsoni	Brook lamprey	-----	-----	-----
Lampetra tridentatus	Pacific lamprey	-----	-----	Species of Concern
Lampetra ayresi	River lamprey	-----	-----	Species of Concern
Rhinichthys sp.	Dace	-----	-----	-----

Table 8. Anadromous and Some Freshwater Fish Species found in the Nestucca/Neskowin Watershed and their Federal and State Threatened/Endangered Status (for definition of status, see section F of this chapter)

The status of most anadromous fish in the Pacific Northwest has been in decline for decades. Spring chinook salmon, chum salmon, and searun cutthroat trout all have depressed populations. Coho salmon are listed as Threatened on the Federal Threatened and Endangered Species List for some areas of Oregon. The coho salmon is currently listed as Potentially Threatened on the federal list for the watershed. The State of Oregon lists coho salmon as a Sensitive species for the entire state. The steelhead trout is listed as Proposed Threatened on the Federal Threatened and Endangered Species List. Fall chinook salmon populations appear healthy and stable. Map 10 shows the distribution of habitat for these species (USFS, GIS data 1997). There is very little data available for searun and native cutthroat trout. Although these fish are important to the area, they are not included in the assessment due the extreme lack of data on their population status and needs.

Species	Miles of Habitat
Chum salmon	30.4
Chinook salmon	117.4
Coho salmon	212.7
Steelhead trout	229.8

Table 9. Estimated Miles of Fish Habitat in the Nestucca/Neskowin Watershed

Life History of Anadromous Fish

Anadromous fish have a complex life cycle. Anadromous fish (fish that travel from the ocean up a river to spawn) have several life stages, beginning with the hatching of fertilized eggs. The young hatchlings are called **alevin**, which are small translucent fish with a yolk sac attached. The sac will be their only source of nourishment for several weeks. After absorbing their yolk sacs, young fish are called **fry,** and they begin to forage for food. In some species fry go directly to the ocean to forage for food; other species remain in the freshwater for one year or more before going to the ocean. When fish reach two inches in length, they are called **parr**, and they feed on insects, worms, mussels, and snails. Once salmon reach about 6 inches in length they are known as **smolts**, and at this stage they begin to undergo physical changes that result in their downstream migration and adaptation to the salt-water environment of the ocean. Smolts that survive the downstream migration will spend some time in the waters of the estuaries as they adjust to salt water and forage for food. Salmon spend one to five years in the ocean, depending on the species. Genetic memory and sense of smell guide the salmon back home to migrate upstream to spawn in the stream where they hatched or nearby. Salmon die within days of spawning.

The following information about the life history traits and patterns of salmonid species is *very generalized*, and there will always be many exceptions to the patterns described below. Life history patterns are extremely diverse. This diversity in life history patterns is an evolutionary survival strategy for each species. As a species encounters environmental stresses and changes over time, the diversity of each species life history patterns enables the species to adapt to new conditions and survive over the long term.

Fall chinook salmon migrate from the ocean to freshwater in September-December, and they spawn in October-January. Spring chinook migrate from the ocean to freshwater in April-June, and they spawn September-October. Fall and spring chinook salmon spawn in the mainstem of Big Nestucca River as well as in larger tributaries. Spring chinook generally spawn in the upper regions of the mainstem rivers. After hatching from eggs, both fall and spring chinook salmon fry spend up to three months in freshwater habitat. During the fry stage, they tend to live in the edges of streams and rivers. As juveniles, chinook salmon depend on deep water in main river channels for early rearing. Then they migrate to the estuary for several months of rearing before smolting in the fall. (TBNEP 1997).

Chum salmon migrate from the ocean to freshwater and spawn in November-December. Chum salmon spawn in the lower mainstems of Little and Big Nestucca Rivers as well as in lower tributaries. After hatching from eggs, chum salmon fry spend a few hours to a few weeks in freshwater habitat. They move quickly to estuarine habitat, where they spend a few days to a couple of months. Chum salmon then migrate to the ocean in the spring. (TBNEP 1997).

Coho salmon migrate from the ocean to freshwater in September-January, and they spawn in October-January. Coho salmon spawn in small tributaries. After hatching from eggs, coho salmon fry spend one year in freshwater habitat, specifically in backwater pools and stream edges. As juveniles, coho salmon depend on deep water pools, off-channel alcoves, ponds, dam pools, and complex cover for rearing and refuge during high winter runoff events. Coho salmon smolt in the spring, approximately one year after hatching, spending up to a few weeks in the estuary before migrating to the ocean. (TBNEP 1997).

Winter steelhead trout migrate from the ocean to freshwater in November-May, and they spawn in January-May. Summer steelhead trout migrate from the ocean to freshwater in May-July, and they spawn in January-April. Both winter and summer steelhead trout spawn in small tributaries with moderate gradients, and late winter spawning fish will sometimes spawn in the mainstem. After hatching from eggs, winter and summer steelhead spend up to two to three years in freshwater habitat. As juveniles, steelhead trout depend on pools, riffles, and runs of tributaries for habitat. Steelhead trout will smolt in the spring, spending up to a few weeks in the estuary before migrating to the ocean. (TBNEP 1997). The run of summer steelhead trout in the watershed is not a natural run. Summer steelhead are descended only from hatchery produced stock. Currently, the summer steelhead trout in the watershed do not reproduce naturally, but they are stocked by the hatchery (Keith Braun, ODFW, personal communication).

H. Economy of the Watershed

The majority of the watershed is a rural environment. The unincorporated communities in the area are Blaine, Beaver, Cloverdale, Hebo, Neskowin, and Pacific City. Most of the watershed lies within Tillamook County. Tillamook County had a population of 23,800 in 1996 (OED 1998). Natural resource based industries continue to be the most important economic activities in the watershed. These activities include agriculture, logging, wood products, commercial fishing, and tourist services. The average covered wage (covered wages are wages earned in a job that is covered by state unemployment insurance program) in Tillamook County in 1996 was $20,000 per year (OED 1998). The average annual per capita income in the county was approximately $17,000 in 1995 (OED 1998).

Agricultural employment in Tillamook County accounted for 510 jobs in 1997 (OED 1998). Non-farm employment provided 7,770 jobs in 1997. Out of these non-farm jobs, 1,370 were manufacturing jobs, and 6,400 were non-manufacturing jobs. Lumber and wood products industry (a manufacturing job category) provided 490 jobs in 1997. Trades and services (a non-manufacturing category) employed 3,800 people in 1997 (OED 1998).

Livestock and dairy production account for 99% of farm income in Tillamook County. Gross agricultural sales in Tillamook County were $60.8 million in 1989 (McDonald and Schneider 1992). Gross agricultural sales in 1995 were $75.8 million, of which 82% was generated by dairy products (TBNEP 1997b). Nearly all lands suitable for the dairy industry in the county (approximately 7%) are being used for this purpose. The Tillamook dairy products industry uses nearly all of the locally available milk and imports more from outside sources (McDonald and Schneider 1992).

The lumber and wood products industry used to be the dominant industry in the area, but mechanization, increased efficiency, and reduction in log supply have reduced employment that relies on forest products (USFS and BLM 1994).

Tourism industry is now becoming more important due to the area's scenic qualities and recreation opportunities. Tourism services employed 867 people in 1989 (McDonald and Schneider 1992). In 1995, tourism industry employed 2,024 people in the county (OED 1998).

Commercial fishing activity in the watershed is centered in Pacific City. Income generated from commercial fishing has been declining in recent years. Gross fish sales in 1988 for the county was $5.9 million. Gross fish sales in 1996 for the county was $2.8 million (OED 1998).

Employment from timber industry, tourism, and commercial fishing is highly seasonal, which leads to underemployment in the off-season. Local fishing and shell fishing are often used to offset seasonal underemployment.

There is a high percentage (20.9%) of retired people in Tillamook County (OED 1998). Retirees are a unique economic entity in the area. Although they do not add to the labor force, they bring in a steady income from outside the local economy in the form of pensions and retirement annuities.

I. Cultural History

Evidence of human occupation of the Oregon Coast dates back at least 8,000 years. Most coastal Native Americans lived very close to the ocean or at the edge of an estuary. The Nestucca band of Tillamook Native Americans lived in the watershed. The Nestucca band was part of the Coast Salish language group. They depended on shellfish, anadromous fish, and berries as food sources. They often set small fires, perhaps one half to one acre in size, to maintain quality hunting and gathering areas. Contact with European people in the early to mid 1800's resulted in pandemic diseases, causing an estimated 70-80% loss in the native population during the years from 1829 to 1845. (BLM and USFS 1997; McDonald and Schneider 1992)

European exploration of coastal Oregon and its river valleys was gradual. The first recorded European to enter the area was Arthur Black in 1828, who sheltered with the Tillamooks. The Donation Land Claims Act of 1850 and the Homestead Act of 1862 provided incentives that encouraged the settlement of the coastal lowlands and river valleys. The rich valleys of the watershed drew the attention of pioneers, but the valleys were hard to access. In the early 1880's a toll road was built from the city of Grand Ronde to Hebo by way of Dolph. Other routes included the Coast Range Trail over Mt. Hebo, and the Cloverdale-Woods road.

Lands adjacent to the Nestucca River were first homesteaded in the mid to late 1800's. Trees were cleared and dairies were started in the lower valleys. The late 1880's and early 1900's were significant years for homesteading. Nine post offices were established in the Nestucca Valley between 1882-1912. As dairy farming became more industrialized, and in order to maintain quality control, local creameries consolidated to form the Tillamook County Creamery in 1969 (McDonald and Schneider 1992).

Demand for lumber began to increase in the late 1800's, and timber companies acquired land in the watershed. Around the turn of the century, much land in the area was burned repeatedly, leaving extensive "brushfields". Most tracts of federal land that had not been homesteaded or acquired by timber companies became the Hebo Ranger District of the Siuslaw National Forest.

J. Agencies, Jurisdictions, Plans, and Rules that Affect the Nestucca/Neskowin Watershed (updated from McDonald and Schneider 1992)

County Level

Tillamook County

The majority of watershed is in Tillamook County (87.5%). There are five main types of zoning for rural lands in Tillamook County: Forest Zone, Farm Zone, Small Farm and Woodlot-20 acre zone, Small Farm and Woodlot-10 acre zone, and Rural Residential. Unincorporated communities in the watershed include Beaver, Cloverdale, Hebo, Neskowin, and Pacific City. Urban lands contain land zoned urban residential, commercial, and industrial (Greg Verret, Tillamook County Community Development Dept., personal communication).

Section 4.080 of the Tillamook County Land Use Ordinance establishes protection for water quality and stream bank stabilization. Riparian setbacks are defined based on stream size. There is a 50 foot setback for lakes larger than 1 acre, estuaries, and the Nestucca, Little Nestucca, and Three Rivers. There is a 25 foot setback for all other streams where the channel is greater than 15 feet in width, and a 15 foot setback for perennial streams where the channel is 15 feet or less in width (Greg Verret, Tillamook County Community Development Dept., personal communication).

Development is prohibited within the riparian area, except for bridges and water-dependent uses. Limited exemptions to reduce the riparian setback may be granted in certain areas where existing lots are not large enough to provide a reasonable building envelope when the riparian setback is applied. Exceptions to the riparian setback can be allowed if the County determines either that natural features allow a smaller riparian area to protect equivalent habitat values or that an area is so degraded that additional development will have minimal negative impact (Greg Verret, Tillamook County Community Development Dept., personal communication). In conjunction with the Tillamook Bay National Estuary Project and watershed councils, Tillamook County will be updating its riparian protection measures during 1998.

In addition to restricting development activities, the ordinance limits removal of riparian vegetation by prohibiting removal of trees or more than 50% of the understory vegetation within the riparian area (with certain exceptions). The County Code Enforcement program has authority to issue citations for violations of the riparian protection ordinance.

A comprehensive plan exists for Tillamook County. It contains inventory information, findings and policies designed to fulfill the requirements of the statewide land use planning goals. The comprehensive plan policies lay out the approach the jurisdiction will take in managing land use to protect natural resources, plan for growth, involve citizens, minimize hazards in land development, allow for recreation opportunities, coordinate public facilities and transportation, encourage economic development, conserve energy, and maintain an agricultural and forest land base. The comprehensive plan policies direct the development of implementing ordinance language. A zoning map is produced which, in tandem with the ordinance, designates the types of uses and the standards for development throughout the jurisdiction.

The ordinance (typically called a zoning ordinance or land use ordinance) governs land use activities on a daily basis. The policies in the comprehensive plan are often referenced in the ordinance, and land use decisions (e.g., conditional uses) are required to be consistent with the policies of the comprehensive plan, but the ordinance contains specific implementation language. The provisions of the ordinance are enforceable through citations, fines, and other sanctions.

Tillamook County also protects water quality through regulation of on-site sanitation (septic systems), and the regulations of the Tillamook County Health Department.

Yamhill County

Twelve percent of the watershed is in Yamhill County. All of the watershed that falls in Yamhill County is zoned Forest District. This district includes large, generally continuous forest lands. The purpose of this district is to conserve and efficiently manage forest resources. A portion of the upper Nestucca Basin is managed by McMinnville Water and Light. This area provides municipal drinking water for the City of McMinnville from McGuire Reservoir. The city is seeking additional water sources in the basin to meet the needs of a growing community.

State Level

Tillamook Soil and Water Conservation District (SWCD)

SWCDs are boards of locally elected officials with responsibility to initiate, develop and implement conservation activities within their boundaries. The Tillamook SWCD boundaries coincide with Tillamook County boundaries. Refer to ORS 568 for duties and powers.

Division of State Lands (DSL)

DSL is a division of the state government that operates under the State Lands Board. It is responsible for managing the beds and banks of Oregon's navigable waterways and administering the State of Oregon fill and removal law. A permit is required for the fill or removal of any gravel within the state waterways and wetlands, irrespective of ownership.

Oregon Department of Agriculture (ODA)

ODA is responsible for agriculture related activities in Oregon. The Division of Natural Resources within ODA assists SWCDs, and oversees the confined animal feeding program, noxious weed program, and other resource concerns. ODA was made responsible by Senate Bill 1010 for developing the Agricultural Water Quality Management Area Plans in 1998 and to begin implementation of the plans in 1999. These plans will require agricultural practices to meet certain natural resource goals.

Oregon Department of Environmental Quality (DEQ)

DEQ implements the Statewide Water Quality Management Plan which establishes standards of water quality for each of Oregon Water Resources Department's eighteen basins in Oregon. DEQ is responsible for managing both point and nonpoint source pollution, and it maintains water quality monitoring stations throughout Oregon.

Oregon Department of Fish and Wildlife (ODFW)

ODFW manages and protects fish and wildlife resources. Its duties include establishing seasons for hunting and fishing, methods of hunting and fishing, and take/bag limits for recreational and commercial activities. ODFW provides technical assistance to the state regulatory agencies.

Oregon Department of Forestry (ODF)

ODF is responsible for the administration of state-owned forest lands. Locally, this includes the Tillamook State Forest, and ODF enforces the Forest Practices Act on all nonfederal lands. ODF has developed a Northwest Region Long Range Plan to guide the management of state forest lands in Northwestern Oregon. This plan's objectives are to promote timber growth and harvesting while maintaining the integrity of the forest ecosystem. The Forest Practices Act sets policy to encourage the growth and harvest of trees consistent with sound management of other forest resources such as wildlife habitat, fish habitat and water quality. The Forest Practices Act applies to state and privately owned lands in Oregon.

Oregon Department of Land Conservation and Development (DLCD)

The DLCD works with counties, cities, and state agencies to develop and maintain the comprehensive land use plans and regulations of Oregon.

Oregon Department of Parks and Recreation (OPR)

OPR manages all state parks and the state scenic waterway program in Oregon. This department manages Cape Kiwanda State Park, Bob Straub State Park, and Neskowin Beach State Wayside in the watershed. OPR has been active in the Nestucca Basin by developing the Nestucca River/Walker Creek State Scenic Waterway Plan.

Oregon Water Resources Department (OWRD)

OWRD manages and allocates the waters of the state. It classifies streamflow according to purposes, issues water rights on all water in the state, and establishes minimum streamflow levels. Policies are established through basin plans. OWRD holds certificated in-stream water rights in trust for the State of Oregon.

Federal Level

Farm Services Agency (FSA) of the United States Department of Agriculture

FSA, formerly the Agricultural Stabilization and Conservation Service, administers price support programs and provides cost-share assistance to individuals and groups to implement conservation practices on agricultural and forest lands. One program funded by FSA in the area deals with water quality and animal waste management systems.

Cooperative Extension Service (CES) of the United States Department of Agriculture

CES provides information and education to groups and individuals on agricultural, coastal, and other topics. The CES is a state and federal partnership to provide connection between sea and land grant universities and rural communities.

U.S. Forest Service (USFS) of United States Department of Agriculture

The Siuslaw National Forest manages 43.7% of the watershed. This land area is managed under the guidelines of the Northwest Forest Plan and the Siuslaw National Forest Land and Resource Management Plan. The Siuslaw National Forest is part of the Northern Coast Range Adaptive Management Area. The management goals of the Northern Coast Range Adaptive Management Area are restoration and maintenance of late-successional forest and the conservation of fisheries habitat and biological diversity.

Natural Resource and Conservation Service (NRCS) of the United States Department of Agriculture

NRCS, formerly the Soil Conservation Service (SCS), provides technical and financial cost-share assistance to individuals and groups for planning and implementing conservation practices. NRCS funded the PL-566 Watershed Protection project in the basin. This project provides assistance to dairies in the development of animal waste management plans. NRCS (SCS at the time) was the primary agency in the Nestucca River Basin Water Quality Study. NRCS is currently conducting a detailed soil mapping of Tillamook County.

Bureau of Land Management (BLM) of the United States Department of the Interior

BLM administers 16.7% of the land in the watershed. This land area is managed under the guidelines of the Northwest Forest Plan, and it is part of the Northern Coast Range Adaptive Management Area. The management goals of the Northern Coast Range Adaptive Management Area are restoration and maintenance of late-successional forest and the conservation of fisheries habitat and biological diversity. BLM lands are managed according to the provisions of the Salem District Record of Decision and Resource Management Plan, as amended by the Northwest Forest Plan.

U.S. Fish and Wildlife Service (USFWS) of the United States Department of the Interior

USFWS is responsible for maintaining viable populations of plants and animals and managing the restoration and protection of endangered and threatened species. It manages the Nestucca Bay National Wildlife Refuge to protect the wintering habitat of the Dusky Canada Goose and the federally threatened Aleutian Canada Goose.

4. Historical, Current, and Desired Conditions of Watershed Resources

A. Water

Historical Influences

Historical events have influenced the present stream channel conditions in the watershed. Water quality, riparian areas, and stream habitat have changed significantly since the mid to late 1800s. Surveyor records indicate that the valley bottomlands were forested since many trees in the lower areas survived the 1850 fire that burned much of the Big Nestucca Watershed (USFS and BLM 1994). Fires in 1845 and 1890 burned much of the Little Nestucca Watershed (USFS 1998). The Nestucca River was navigable by small boat during this time up to Cloverdale, which indicates that woody debris was removed from the river to allow passage.

The effects of historical fires on surface erosion and sedimentation are difficult to describe since historical data on sedimentation and erosion do not exist. However, the effects of fires observed in the present, indicate that fires can increase landsliding and stream temperatures may increase until regrowth of vegetation along streams provide shade to reduce stream temperatures. Tillamook County residents observed increased levels of sediment delivery and siltation of creeks and Tillamook Bay watersheds after the Tillamook Burns of 1933, 1939, 1945, and 1951 (TBNEP 1997a).

Aerial photos in 1939 show that much of the lower valleys were already cleared and farmed. Extensive drainage ditch systems and diking of marshlands between the Nestucca Bay and the U.S. Highway 101 have altered wetlands and tidal areas. The estuary used to be approximately four times bigger than it is today (USFS 1998). Much of the original surface of the bay and its associated wetlands have been diked or drained to create pasture lands (USFS and BLM 1994). Dairy farming became established in the area and early creameries were located near stream channels to use the naturally cool water in the processing and transport of dairy products. Proximity of livestock to stream channels probably resulted in increases in fecal coliform contamination and loss of riparian vegetation (USFS and BLM 1994).

Timber harvesting began when settlers arrived in the mid to late 1800s. The lower watershed was impacted first since trees which had survived the fires were located in the lower wetland and riparian areas. Removal of these trees reduced both stream shading and the source of large woody debris for stream habitat. Significant timber harvest activity in the upper watershed did not occur until 1960, and harvest levels steadily increased until 1990. Construction of roads within riparian areas restricted natural channel movement and reduced stream shading and sources of large woody debris. In addition, large quantities of large woody debris were removed from channels and floodplains in the 1960s and 1970s, when it was believed that woody debris was a barrier to fish passage. Streambank erosion is a natural process in the watershed that has been accelerated along the lower river. Erosion has been accelerated by riparian vegetation removal. The placement of riprap, gabions, and other instream structures has decreased channel movement and aquatic habitat, while protecting property (USFS and BLM 1994).

Flooding has influenced stream channel and aquatic habitat conditions in the watershed. Several major floods have occurred in the area. Recent floods occurred in 1945, 1950, 1955, 1964-65, 1972, 1990, and 1996. Meadow Lake Dam failed in 1962, causing channel scouring, flooding, and washing out of roads for miles below the dam site.

The total precipitation during the storm of 1996 was 20.18 inches in the Cedar Creek watershed, with the highest daily rainfall of 5.91 inches (USFS 1997). The flood of 1996 washed out two sections of Highway 22. Many landslides related to the effects of the flood of 1996 occurred in the Nestucca Watershed. Eleven landslides, greater than or equal to 0.5 acres in size, occurred in the Little Nestucca Watershed, and 72 landslides, greater than or equal to 0.5 acres in size, occurred in the Big Nestucca Watershed (USFS 1997). Of the landslides greater than or equal to 0.5 acres in size in the Little Nestucca Watershed, one was related to harvest practices and 7 were related to roads. Of the landslides greater than or equal to 0.5 acres in size in Big Nestucca Watershed, 27 were related to harvest practices and 26 were related to roads (USFS 1997).

Water Quality Background

The Oregon Water Resources Commission determines which beneficial uses of water are available in a basin. DEQ designates which beneficial uses are to be protected through water quality standards. The beneficial uses for Nestucca/Neskowin Watershed include public and domestic water supply, irrigation, livestock watering, water contact recreation, aesthetic quality, boating, resident fish and aquatic life, salmonid spawning and rearing, anadromous fish passage, fishing, wildlife, hunting, and hydropower. The most sensitive uses are fisheries, aquatic life and human water supplies. Water quality standards are specified for aquatic weeds and algae, bacteria (*Esherichia coli* and fecal coliforms), biological criteria, dissolved oxygen, habitat modification, flow modification, pH, sedimentation, temperature, toxins, and turbidity. 'Chlorophyll a' is also monitored, but it is a non-regulatory standard. Table 10 lists the acceptable levels of each standard and the beneficial use that may be affected by the water quality parameter.

Water Quality Parameter	**Standards**	**Beneficial Uses Affected**
Aquatic Weeds or Algae	Development of fungi or other growths must not be deleterious to stream bottoms, fish, or other aquatic life, or injurious to health, recreation or industry	Water Contact Recreation, Aesthetics, Fishing
Bacteria: *Esherichia coli* and Fecal Coliform	For other than shellfish growing waters, bacteria levels must not exceed: a 30-day log mean of 126 *Esherichia coli* organisms per 100 ml, based on a minimum of 5 samples. And no single sample shall exceed 406 *E. coli* organisms per 100 ml. Fecal coliform levels must not exceed a 30-day log mean of 200 fecal coliform organisms per 100 ml, based on a minimum of 5 samples. No more than 10% of the samples may exceed 400 organisms per 100 ml in the 30 day period.	Water Contact Recreation
Bacteria: Fecal Coliform in Shellfish Growing Waters	Bacteria levels must not exceed a median concentration of 14 organisms per 100 ml, with no more than 10% of the samples exceeding 43 organisms per 100 ml.	Shellfish
Biological Criteria	Waters of the state shall be of sufficient quality to support aquatic species without detrimental changes in resident biological communities.	Resident Fish and Aquatic Life
Dissolved Oxygen (DO)	During times when anadromous fish spawn until fry emergence from the gravel, (aprx. Oct. - May). DO shall not be less than 11 mg/l. UNLESS: intergravel oxygen is greater than 8 mg/l, then DO can be 9 mg/l. Or, DO shall not be less than 90% saturation. For estuarine waters, DO shall not be less than 6.5 mg/l.	Resident Fish and Aquatic Life, Salmonid Fish Spawning and Rearing
Habitat Modification	Creation of tastes, odors, toxic or other conditions that are deleterious to fish or other aquatic life or affect the potability of drinking water or the palatability of fish or shellfish shall not be allowed. Waters of the state shall be of sufficient quality to support aquatic species without detrimental changes in resident biological communities.	Resident Fish and Aquatic Life, Salmonid Fish Spawning and Rearing
Flow Modification	Creation of tastes, odors, toxic or other conditions that are deleterious to fish or other aquatic life or affect the potability of drinking water or the palatability of fish or shellfish shall not be allowed. Waters of the state shall be of sufficient quality to support aquatic species without detrimental changes in resident biological communities.	Resident Fish and Aquatic Life, Salmonid Fish Spawning and Rearing
pH	pH = 6.5 - 7.5	Resident Fish and Aquatic Life, Water Contact Recreation
Sedimentation	The formation of appreciable bottom or sludge deposits or the formation of any organic or inorganic deposits that are deleterious to fish or other aquatic life or injurious to public health, recreation, or industry shall not be allowed.	Resident Fish and Aquatic Life, Salmonid Fish Spawning and Rearing
Temperature	A 7 day average of the daily maximum temperature shall not exceed 64 degrees F (17.8 degrees C); temperatures will not exceed 55 degrees F (12.8 degrees C) during times and in waters that support salmon spawning, egg incubation, and fry emergence from the egg and gravel.	Resident Fish and Aquatic Life, Salmonid Fish Spawning and Rearing
Toxins	Toxic substances shall not be introduced above natural background levels in the waters of the state in amounts, concentrations, or combinations which may be harmful, may chemically change to harmful forms in the environment, or may accumulate in sediments or bioaccumulate in aquatic life or wildlife to levels that adversely affect public health, safety, or welfare, aquatic life, wildlife, or other designated beneficial uses.	Resident Fish and Aquatic Life
Turbidity	No more than 10% cumulative increase in natural stream turbidity shall be allowed, as measured relative to a control point immediately upstream of the turbidity causing activities.	Resident Fish and Aquatic Life, Water Supply, Aesthetics

Table 10. Water Quality Standards and Affected Beneficial Uses (DEQ 1996)

Fecal Coliform

Fecal coliforms are a group of bacteria which are found in human and animal digestive systems. Their presence in the water is an indicator of contamination by human or animal waste. Possible sources of fecal coliform in the watershed include sewage treatment plant outfalls at Cloverdale, Hebo, Neskowin, and Pacific City. Septic systems of domestic households within the watershed are another possible source. Agricultural sources include hobby farms, beef farms, and commercial dairies. Primary wildlife sources are deer and elk populations. Recreation sources from campgrounds and dispersed recreation activities such as fishing activities on river banks and from boats also contribute fecal coliforms. A study by McDonald and Schneider (1992) found that the most probable, significant source of fecal coliform contamination was commercial dairies.

There are 46 dairies in operation in the Nestucca Watershed with approximately 8,504 dairy cows, which produce an amount of waste equivalent to a human population of approximately 80,000. Manure and liquid waste application to pastures can result in fecal coliforms entering surface water through direct runoff during rainfall events.

DEQ monitored water quality in the Big Nestucca Watershed on the Nestucca River at Cloverdale during the years from 1977 to 1984. Samples were taken during the summer months, when flows were lowest and recreation use was greatest. McDonald and Schneider (1992) summarized the data from 1977-1984 and found that water quality standards were met with the exception of fecal coliform. The data published in McDonald and Schneider (1992) show that fecal coliform levels in both the Nestucca River and Nestucca Bay violate Oregon's water quality standards during 1977-1984. Twenty percent of the individual samples exceeded 400 organisms per 100 ml during the summer, and 24% of the samples exceeded this standard annually (the standard for designating a water quality limited stream is 10% of samples). These fecal coliform levels indicate that water contact recreation is negatively impacted in the lower Nestucca River and Nestucca Bay. These fecal coliform levels also negatively impact shellfish production in Nestucca Bay. Highest levels were detected in the fall. The fall is a time of high rainfall levels and high overland water flows, which may move bacteria into the streams from dairy operations or inadequate septic systems. Samples taken by DEQ during 1980 to 1984 found that fecal coliform levels in the Nestucca Bay and Nestucca River, up to river mile 4.3, frequently violated water quality standards in the summer. Based on these findings, the Tillamook SWCD began the Pollution Abatement Program. A total of 33 dairies are participating in the program by implementing management practices and structures to reduce manure and fecal coliform runoff from dairy operations. Of the 33 projects, 15 are fully implemented and 18 are in progress in 1996.

*****NOTE:*** Fecal coliform contamination in the watershed has many possible sources including dairy operations, beef cattle operations, hobby farms, faulty septic systems, sewage plant outfall, human waste during fishing, camping, and other recreation activities, and dispersed wildlife populations. There has been some local debate about the amount of waste produced by the wildlife population (especially, large mammals such as elk and deer) in comparison to the dairy cattle population in the watershed. This assessment acknowledges that there are many sources of fecal coliform bacteria in the watershed, including the human population, but the following comparison addresses only dairy cattle, elk and deer populations. The dairy cow population produces waste equivalent to the amount that a human population of 80,000 would produce. The estimated human population in Nestucca Watershed is approximately 3,000-4,000. Tillamook County in 1996 had a population of 23,800 (OED 1998). Although other mammal species, such as beaver and raccoon, contribute fecal coliform into the watershed, data on these species are not available.

Comparison of Dairy Cattle, Elk, and Deer as Possible Contributors to Fecal Coliform Contamination: The following comparison addresses differences in population size, waste production levels, and habitat utilization patterns of dairy cattle, elk, and deer found in the Nestucca Watershed. As there are no dairy farms in the Neskowin Watershed, it was not included in this comparison.

Population Sizes: The estimated elk population is 2,120 animals in the Nestucca Watershed. The deer population is estimated at 5,265 animals in the Nestucca Watershed. (Dave Nuzum, ODFW, personal communication). There are approximately 8,504 dairy cows in the Nestucca Watershed (Bob Pedersen, NRCS, personal communication).

Waste Production: The average adult elk weighs 552 pounds, and consumes 13-18 pounds of forage per day (Hines and Lemos 1977; Bruce Johnson, ODFW, personal communication). The estimated average amount of solid and liquid waste produced per elk is 33 pounds per day. The average adult deer weighs 130 pounds, and consumes 2.5-5.0 pounds of forage (Dave Nuzum, ODFW, personal communication; Wallmo 1981). The estimated amount of solid and liquid waste produced per deer is 8 pounds per day. The average dairy cow weighs 1200 pounds, taking into account the weight differences of different breeds such as Holstein and Jersey. However, dairy cow numbers are estimated in terms of 1000 pound units to take into account the immature dairy cow population. A 1000 pound unit dairy cow produces 82 pounds of solid and liquid waste per day (Bob Pedersen, NRCS, personal communication).

Species	Elk	Deer	Dairy Cow
Average Weight of Single Animal (pounds)	550	130	1,000
Population Size	2,120	5,265	8,504
Average Amount of Solid and Liquid Waste Produced (per day per animal, in pounds)	33	8	82
Average Amount of Waste Produced for entire Herd in watershed (per day, in pounds)	69,960	42,120	697,328

Table 11. Estimated Waste Production of Elk, Deer, and Dairy Cattle in Nestucca Watershed

The data in Table 11 show that the estimated amount of waste produced by the elk and deer populations combined is 112,080 pounds per day, and the estimated amount of waste produced by the dairy cattle population is 697,328 pounds per day.

Habitat Utilization: The distribution of dairy cattle, elk and deer is an important factor to consider in the discussing the potential for fecal coliforms to enter the waterways of the watershed.

Dairy cattle are restricted to fenced pasture lands or confined animal feeding operations, most of this land is located in broad, flat, floodplain areas, in close proximity to perennial streams. Map 11 shows that the majority of confined animal feeding operations are located within 1000 feet of a perennial stream; and, agricultural lands are geographically adjacent to perennial streams. The dairy cattle population, which produces 620% (6.2 times) more fecal material than the elk and deer populations combined, is confined to 2% (approximately 4,000 acres) of the land area of the watershed. The majority of dairy cattle are confined during the months of November-March. During the rest of the year, dairy cattle are restricted to pasture lands that frequently are floodplain areas, which are subject to seasonally ponded water and high overland runoff rates. Map 11 shows the location of agricultural lands in relation to streams and the forest habitat that the elk and deer populations utilize.

The habitat types used by elk and deer include deep canyons and rocky bluffs, ridgetops and moderate terrain, and broad, flat floodplains. In these habitat types, the diameter of the average home range for elk was 1.4, 2.3, and 3.3 miles, respectively. (Harper et al. 1987, Wallmo 1981). Elk and deer move freely about the entire watershed, and they utilize meadow, riparian, and upland forested slopes and ridges areas as they move about the areas of their home range. A study of Roosevelt Elk habitat use in the southern Coast Range Mountains of Oregon (Pope 1994), found that elk spend significant amounts of time in all forest and meadow habitat types. Elk spend more time in habitat that is within 990 feet (300 meters) of water than would be expected if they spent equal amounts of time in all habitat types. The elk and deer populations are dispersed over the entire watershed, an area of 203,005 acres.

Summary: Given the population size of dairy cattle, volume of fecal material they produce, their location in lowland areas in proximity to streams, dairy cattle would be the most significant source of fecal coliform contamination in the watershed without dairy waste management. Dairy waste management practices are currently in place and being improved. Fifteen dairy operations have completed pollution abatement projects. Eighteen dairy operations have begun to implement pollution abatement projects as of 1996. And another 13 dairy operations have not planned or begun to implement projects due to lack of funding. Since local citizens and land managers have very little opportunity to manage the wildlife populations' contribution to fecal coliform contamination, continued improvement of dairy waste management practices, facilities, and education should remain a priority. Further investigation into other sources of fecal coliform contamination such as septic systems, sewage treatment plants, and hobby farms is needed. Monitoring of fecal coliform levels throughout the watershed will help locate other sources of contamination and determine if the continued implementation and improvement of dairy waste management practices is reducing the fecal coliform levels in the watershed.

National Pollution Discharge Elimination Systems (NPDES)

(All of the following information on NPDES permit holders was supplied by Lauren Elmore, DEQ, 1998, personal communication)

There are five NPDES permit holders in the watershed. They are required to comply with the specifications of their permits. This compliance is monitored by DEQ. **NOTE**: the quantity of gallons treated at each plant listed below is the amount of septic effluent, not undiluted human waste.

Cloverdale Wastewater Treatment Plant: The Cloverdale Sanitary District operates a 20 year old activated sludge doughnut plant. This involves aeration and solids digestion and storage in a concentric ring around the clarifier. This plant discharges filtered and chlorinated effluent to the Nestucca River at river mile 7.0. The treatment plant is designed to handle 40,000 gallons per day and typical flows are 25,000 gallons per day. Review of monthly discharge monitoring reports indicates no compliance problems. An annual inspection of this facility is due. The last DEQ visit was November 1996. DEQ conducted a stream study in the summer of 1995 and found no identified stream problems. DEQ initiated an enforcement action in the fall of 1995 following observance of the pumping of filter backwash material directly to the river. This practice has apparently stopped. This facility will need to address chlorine issues at the next permit renewal in 1999.

Hebo Wastewater Treatment Plant: The Hebo Joint Water and Sewer Authority has a recirculating gravity filter treatment system constructed in 1987 that discharges to Three Rivers at river mile 0.75. The facility was designed to treat 25,000 gallons per day, and flows average about 15,000 gallons per day. The collection system is a STEP system that also treats septic tank effluent. DEQ conducted a stream study at this site in 1988 and found no apparent impact to the stream from the facility's discharge. The plant has had a few problems with disinfection over the last few years. The plant has a chlorine residual limitation that requires them to maintain low chlorine concentrations (<0.2 mg/l). The plant is also required to obtain adequate disinfection. If chlorine levels are too high, they violate the chlorine limit. If the amount of chlorine used is reduced, they may violate their bacteria limit. The facility is aware of the problem, and after enforcement action by DEQ in 1996 it has been implementing corrective measures. According to the plant's discharge monitoring reports, it has not had a violation since April 1997. DEQ will be conducting a compliance inspection in 1998. The NPDES for this facility was renewed in January 1998. The Hebo Joint Water and Sewer Authority recently opened bids to replace the chlorine system with UV disinfection system. The bid to do this was $37,500, which is higher than anticipated. Funding is still needed. A consultant has recommended that the gravel filter media in the filter bed be replaced. This bed has ponding problems, and the underdrain system has been compromised. Replacing the gravel filter media may cost an additional $50,000, but it would increase the likelihood that the plant would not violate its permit for the next 20 years.

Neskowin Wastewater Treatment Plant: The Neskowin Regional Sanitary Authority has a sequencing batch reactor treatment plant that discharges to Neskowin Creek at river mile 1.5. The plant's construction was completed in 1995. It is a summer hold/winter discharge facility. Influent flow to the plant averaged under 40,000 gallons per day in December 1997, while discharges averaged 250,000 gallons per day. The facility was constructed with UV disinfection and has very strict discharge limitations, which are flow based. The facility has consistently met discharge limitations since early 1996. Problems that occurred in 1996 appear to be resolved . Compliance evaluation is based on a review of discharge monitoring reports and the last inspection conducted in November 1996.

Pacific City Wastewater Treatment Plant: The Pacific City Sanitary District operates an activated sludge wastewater treatment facility with a design flow of 360,000 gallons per day. The discharge is to the Nestucca River at river mile 1.5. The average effluent discharge flow is 150,000 gallons per day. According to the discharge monitoring reports and compliance inspections, the plant consistently meets the permit standards. They were issued a permit renewal in January 1988. DEQ conducted a mixing zone study in August 1997, and the last site inspection was conducted at that time. The final mixing zone report has not been completed but preliminary data did not identify any concerns. This plant has a progressive operation system and an ongoing plant upgrade process. UV disinfection will be added within the next two years as part of their long term capital improvement plan.

Cedar Creek Fish Hatchery: The hatchery submits quarterly discharge monitoring reports. According to these reports, the facility is consistently meeting its NPDES permit requirements. A site visit will be conducted by DEQ in 1998.

Water Temperature

Stream temperatures are affected by climate, solar intensity, shade, stream flow levels, channel orientation, elevation, and groundwater influence. Natural events such as wildfires and storms have resulted in flooding and landslides which remove riparian vegetation. These landslides also deliver woody debris to downstream areas. Historical records and photo analysis indicate that before European homesteading began, (mid to late 1800s) the riparian zones were vegetated with conifer and hardwood trees (USFS and BLM 1994). After European homesteading the valley bottoms were subsequently cleared for pasture and crops, reducing riparian vegetation and shade. As vegetation removal continued upstream, the riparian zone upstream to Blaine was mostly without large conifers or hardwoods by 1950 (USFS and BLM 1994). The Meadow Lake Dam failure in 1962, construction of the Blaine Road and Nestucca Access Road, and logging in the upper watershed in the last 30 years have resulted in extensive loss of riparian vegetation. Since 1970, the riparian shade in the lower watershed has increased as hardwood and shrub species have matured. Conifer species in riparian zones are still rare. However, the height of hardwoods is not sufficient to provide adequate shade in the summer months on some mainstem stretches.

Fish die-offs from fungal infections have been noted in the watershed in the summer and fall of 1975 and 1988 (USFS and BLM 1994). Fungal infections are brought on in part by elevated temperatures. Summer low flows in the Nestucca River occur in late July to early October. During this time, waters become warmer due to low flow and high temperature conditions. Summer low flows also concentrate adult fish into the available habitat, thus encouraging the spread of disease. Data collected by the U. S. Geological Survey and DEQ show that water temperature at Beaver on the Big Nestucca River exceeded the water quality standard of a seven-day average maximum temperature of 64° F each year during the period from 1965 to 1984 (USFS and BLM 1994).

Water temperature monitoring in 1994 showed that temperatures do not increase much from the upper Nestucca River to the lower Nestucca River. Nearly all tributaries monitored had lower temperatures than the mainstem Nestucca River. This information indicates that the source of heat for water temperature in the mainstem Nestucca may be in the upper forested part of the watershed. Three tributaries, Bear Creek, Niagara Creek, and East Beaver Creek, had higher temperatures than the mainstem Nestucca (USFS and BLM 1994). These three creeks are outside of the cooling effects of the fog zone of the lower watershed, and they may be contributing to the high temperatures in the mainstem. These three creeks have reduced riparian canopy due to recent timber harvest and road construction (USFS and BLM 1994). Broad meanders in the former Meadow Lake area also may contribute to elevated water temperatures in the Nestucca River. The locations of temperature monitoring sites are shown on Map 12.

Water temperature data was gathered by the Nestucca/Neskowin Watershed Council in the summer of 1997 (Appendix F). The locations of these monitors are indicated on Map 12. These data indicate that the temperatures of Horn Creek, West Creek, and Lower Little Nestucca River do not meet water quality standards for resident fish habitat or aquatic life for the period of record. Horn Creek showed a maximum average 7-day temperature of 66.5° F. West Creek showed a maximum average 7-day temperature of 65° F. Lower Little Nestucca River showed a maximum average 7-day temperature of 64.2° F. Water temperatures were also monitored on East Beaver Creek, Clarence Creek, West Beaver Creek, Fall Creek (in the Little Nestucca Basin), and Boulder Creek. These creeks met water quality standards for temperature. Water temperatures on these creeks ranged from 47° F to 64° F (Appendix F). Water temperature on the Nestucca River (river mile 1.75) has been monitored by the Nestucca Valley Middle School students from 1995-1997. These data do not indicate that water temperature is an issue in at this site (Appendix E).

Water temperature data was gathered by the USFS in the summers of 1996 and 1997 on the upper Little Nestucca River and on the middle Little Nestucca River. Temperatures at both sites were higher than the state standard of 64° F for both years (USFS 1998). Austin, Bear, and Sourgrass Creeks were also monitored in 1996 and 1997. The temperatures on these three creeks met state standard during the summer (USFS 1998).

Dissolved Oxygen

Inadequate dissolved oxygen may be a possible concern in the watershed, based on the observation that high water temperatures during low flow periods are sometimes excessive. Water temperatures in the lower and mid sections of the Nestucca River appear to be high during the late summer months, leading to conditions that can cause low dissolved oxygen concentrations. Generally, warmer water has a lower capacity to hold dissolved oxygen than cooler water. Low dissolved oxygen concentration is also influenced by high consumption of oxygen by bacterial and algal respiration.

The Nestucca Watershed Analysis (USFS and BLM 1994) examined water quality data available for the Big Nestucca. Out of 99 samples taken, only one site, Cloverdale, violated the dissolved oxygen standard of at least 90% saturation (Table 10). Although it is not known how many samples violated the standard, the average of 74 samples taken at Cloverdale was 101%, indicating that dissolved oxygen levels are not an issue in the lower Nestucca River (USFS and BLM 1994).

Sediment

High sediment levels can result in degradation of fish habitat through accumulation of fine sediments in pools and spawning gravels. Sediments clog spaces between gravel, suffocating eggs and pre-emergent fry. Natural and management influenced sources of sediment include debris slides, debris flows, rotational failures, soil creep, streambank erosion, and surface erosion from road surfaces, ditches, and roadsides.

Debris slides are the most common type of active landslide found in the watershed. Debris slides occur on steep slopes covered with thin soils, usually during heavy rainfall. These slides are easily activated by human caused changes in slope, soil water content, or surface runoff .

Debris flows are very rapid downward movements of soil and rock confined to stream channels. They are usually triggered by debris slides. Debris flows often scour first and second order channels to bedrock.

Rotational failures are large, deep-seated masses of soil and rock that move downslope on a curved basal plane. The topography that results from a rotational failure is hummocky and drainage patterns change as some depressions fill up with water to form sag ponds.

Soil creep is a slow, downward movement of soil in response to gravity. An example of large-scale soil creep is found in the lower part of Bear Creek subwatershed.

A geographic information system (GIS) analysis of potential landslide hazard areas in the watershed based on topography was conducted by the USFS in November 1997. This information is available by request from the USFS Ranger Station in Hebo.

Soil creep in Bear Creek subwatershed of the upper Big Nestucca Watershed is a chronic source of sediment into Bear Creek and the Nestucca River. During times of high flow, the water carries soil materials into the stream and undercuts the banks in this area. This has resulted in bank undercutting and slumping. Local BLM personnel believe that Bear Creek is the largest single chronic source of suspended sediment in the Big Nestucca Watershed (USFS and BLM 1994).

Subwatersheds suspected to be the largest overall producers of sediment in the Big Nestucca Watershed are East Beaver Creek, Moon Creek, and Upper Three Rivers Watershed (USFS and BLM 1994). East Beaver Creek and Moon Creek have the majority of identified landslides in the Big Nestucca area. Most of these landslides are associated with timber harvest or road construction activities of the last 20 years (USFS and BLM 1994). Subwatersheds that have similar topography and bedrock types with a potential for high landslide rates and sediment production are Wolfe Creek, Bays Creek, and East Creek. Little information exists on sediment contributions from agricultural areas of the lower watershed.

Streamflow

Reduced streamflows are an issue for aquatic habitat. As flows are reduced, the available wetted habitat for fish and other aquatic life is decreased. Fish are concentrated in limited holding areas, which increases the likelihood of the spread of disease (USFS and BLM 1994). Juvenile rearing habitat is also reduced, affecting the survival rates. Instream water rights are held by OWRD, in trust for the state of Oregon, to keep flow levels adequate for aquatic life. These water rights were granted in 1973, and these rights are junior to those issued prior to that date. During the months of September and October, if all senior level water rights were exercised, there is a 50% chance that the streamflow available would not be sufficient to meet the instream rights (specifically, the 80% exceedance value of 72 cfs) (USFS and BLM 1994).

State scenic waterway flow levels are based on "fishery flows" as determined by ODFW instream water rights. For Nestucca River at Beaver, this flow level in August is 123 cubic feet per second (cfs), in September the level is 250 cfs, and in October the level is 250 cfs (USFS and BLM 1994). These flow levels are much higher than the net minimum flows available at Beaver, taking into account the average natural streamflow level, out-of-channel diversions, and storage at McGuire Dam. OWRD may not issue permits for new water uses that would reduce flows below the recommended levels.

McGuire Reservoir discharge records for the low flow months (August and September) show an average daily flow of 0.82 cfs released to the Nestucca River from the reservoir. McMinnville Water and Light's water right does not require the release of water into the Nestucca. Releases from the reservoir have been voluntary. Historical records indicate that prior to the construction of the reservoir, the average daily low flow in August and September would be 1.1 cfs. The amount of water released from McGuire Reservoir is approximately the same amount of water as would be available during the low flow period if the dam were not there (USFS and BLM 1994).

For additional information on streamflow in watershed, see the hydrology section of chapter 3. Streamflow monitoring sites in the watershed are shown on Map 2.

Water Quality Limited Streams in the Watershed

Those streams in the watershed that do not meet state water quality standards are placed on the DEQ 303(d) List of Water Quality Limited Streams. This list applies only to those streams and water bodies that have been tested for water quality. If a stream is not on the list, it can not be assumed that it meets water quality standards; it may meet the standards or it may not have been tested.

Water Quality Limited Water Body or Stream	**Parameter**
Nestucca Bay	• Fecal coliform for shellfish growing waters—annual
Beaver Creek, East Fork: Mouth to Headwaters	• Habitat modification • Sediment
Nestucca River: Mouth to Powder Creek	• Flow modification • Temperature—summer
Nestucca River: Powder Creek to Headwaters	• Sediment
Niagara Creek: Mouth to Headwaters	• Temperature—summer
Powder Creek: Mouth to Headwaters	• Temperature—summer

Table 12: DEQ 303(d) List of Water Quality Limited Streams in Nestucca/Neskowin Watershed (1994/1996 list)

Data gathered or summarized for this watershed assessment has indicated that other streams may be water quality impaired, but these streams are not on the 303(d) list. These streams are listed in Table 13.

Possible Water Quality Limited Stream (monitor location)	**Parameter**
Horn Creek	• Temperature—summer
West Creek	• Temperature—summer
Nestucca River (at Cloverdale)	• Fecal coliform for water contact recreation—annual
Upper Little Nestucca River (at confluence with Stillwell Creek)	• Temperature—summer
Mid Little Nestucca River (on River between confluences of Bear & South Fork Creeks)	• Temperature—summer
Lower Little Nestucca River (Below confluence with Kellow Creek)	• Temperature—summer

Table 13. Possible Water Quality Limited Streams in Nestucca/Neskowin Watershed

Herbicides

Many herbicides are used in Tillamook County. A survey of county agencies, private forestry operators, Oregon Department of Forestry, and pesticide dealers was conducted in 1986-1987 concerning pesticide use. Although another survey should be conducted to update changes in pesticide use, the 1986-1987 survey provides the best and most complete data for the county. There has been no known testing for the presence/absence of herbicides in the streams of the watershed.

Herbicide: Common or Trade Name	Purpose or Place of Application	Rate of Application (pounds/acre)	Type of Treatment	Acres Treated	Total Pounds Used
2,4-D	Forest Land	2.0-4.0	Foliar	300	600
Glyphosate/Roundup	Forest Land	1.0-3.0	Foliar	320	790
Amitrole/Amizol	weed control	2.0-10.0	Foliar	430	960
Sulfometuron/Oust	weed control	0.14-0.23	Soil	430	60
Triclopyr/Garlon	weed control	0.3-3.2	Foliar	40	60
2,4-D/Crossbow	pasture	0.75-3.0	Foliar	1200	1700
Dicamba/Banvel	pasture	0.25-8.0	Soil	900	450
Triclopyr/Crossbow	pasture	1.5-4.0	Foliar	300	150
Glyphosate/Roundup	right-of-way (power)	0.5-12.0	Foliar	20	40
Imazapyr/Arsenal	right-of-way (power)	0.0-2.0	Foliar	2	4
Triclopyr/Garlon	right-of-way (power)	0.3-3.2	Foliar	50	75
2,4-D /Trimec /Weedone /Banvel 720	right-of-way (roads)	0.0-12.0	Foliar	100	1200
2,4-DP/ Weedone 170	right-of-way (roads)	1.0-12.0	Foliar	100	1200
Amitrole/Amizol	right-of-way (roads)	2.0-10.0	Foliar	250	600
Atrazine/ Aatrex /Atratol	right-of-way (roads)	1.0-10.0	Soil	12	96
Bromacil/Krovar I	right-of-way (roads)	1.2-3.8	Soil	16	32
Chlorsulfuron/Telar	right-of-way (roads)	0.02-0.14	Soil	43	4
Dicamba/Trimec/Banvel 720	right-of-way (roads)	0.25-2.0	Soil	94	47
Dichlobenil/Casoron	right-of-way (roads)	4.0-6.0	Soil	6	34
Diuron/Krovar	right-of-way (roads)	1.2-3.8	Soil	16	32
Fosamine/Krenite	right-of-way (roads)	1.0-12.0	Foliar	81	490
Glyphosate/Roundup	right-of-way (roads)	0.5-12.0	Foliar	15	60
Mecoprop/Trimec	right-of-way (roads)	0.4-0.65	Foliar	6	4
Picloram/ Tordon 10K	right-of-way (roads)	0.25-1.5	Soil	2	12
Simazine/Princep	right-of-way (roads)	3.0-15.0	Soil	180	1400
Sulfometuron/Oust	right-of-way (roads)	0.14-0.23	Soil	59	11
Triclopyr/Garlon	right-of-way (roads)	0.3-3.2	Foliar	32	17

Table 14. Tillamook County Herbicide Use Estimates (McDonald and Schneider 1992)

Desired Future Conditions

The water quality in the watershed should be adequate to meet the standards set by the State of Oregon (Table 10). Thus, the streams should have average temperature below 64° F to promote healthy fish populations. There should be enough streamflow during the summer months to meet the instream water rights for fish habitat. Testing for the presence of pesticides should yield no presence of pesticides in the streams. Sediment contributions should be as close as possible to background levels of a similar natural system (i.e., a system not impacted by human activities), and sedimentation should not impact important fish habitat resource areas in the short term or long term. Fecal coliforms levels should meet the standards for safe recreation and shellfish production. Dissolved oxygen levels should meet the standards for healthy fish populations and other aquatic life.

B. Vegetation and Forests

Historical Influences

Vegetation conditions within the watershed have been affected by historical fires, settlement patterns, timber harvest, floods, and windstorm events. Land has been cleared for farming since the mid to late 1800s. These activities resulted in increased pasturelands as trees and brush were cleared in the lower watershed. Timber harvest has impacted the vegetation in both the lower and upper watershed. The lower watershed was harvested first, as shown by 1939 aerial photographs. Harvest in the upper watershed began around 1960 (USFS and BLM 1994; McDonald and Schneider 1992).

Riparian vegetation has been impacted by road construction, especially in relation to timber harvest. Constructed in 1958-1960, the Nestucca Access Road constricted the stream channel of the Nestucca River and removed much riparian vegetation. Road construction also caused accelerated erosion, landsliding, and slumping in some places. Concern over logjam barriers in the 1960s and 1970s prompted extensive removal of large woody debris from the stream channels. This depleted materials necessary for food, cover, and habitat for aquatic life (USFS and BLM 1994).

Large fires occurred in the Big Nestucca Watershed during the period from the mid 1800s to 1919. The 1910 Hebo Burn consumed 50,000 acres. A later fire in 1934 occurred in Niagara Creek, and the Tillamook Burn of 1939 burned an area from East Beaver Creek to Cedar Creek in the Big Nestucca Watershed. In the northern part of Big Nestucca Watershed, most areas burned only once in the last 100 years. In the southern part, typically vegetated by alder today, areas burned two or three times in the last 100 years (USFS and BLM 1994). Much of the Little Nestucca Watershed burned in the large fires of 1845 and 1890 (USFS 1998). Fires occurred two or three times since the 1850s in many places in the Little Nestucca Watershed. The occurrence of hardwood stands in the Little Nestucca Watershed coincides fairly well with the areas that burned three times since 1850, as repeated fires eliminated much of the conifer seed source (USFS 1998).

Hurricane force winds of 70 miles per hour or more can occur several times in the winter in the watershed. Blowdown from these winds can be significant. Generally, these windstorms result in small, open patches of forest as the overstory trees are blown down. These open patches undergo accelerated growth rates, as understory trees are able to utilize the increased light. An extreme example is the 1962 Columbus Day storm, which blew down 11 billion board feet of timber in Oregon and Washington.

Major floods affect streamside vegetation by favoring those species able to tolerate periodic flooding. Red alder is very common in riparian areas in the watershed because it is able to tolerate flooded conditions and can rapidly colonize disturbed soils and streambanks. In riparian areas of low elevation, Sitka spruce is common, as it also can withstand periodic inundation. Flood events also disperse weed seeds from a source plant to downstream areas. The flood caused by the failure of the Meadow Lake Dam in 1963 impacted the upper Nestucca River riparian area by scouring the streambanks and channel.

Current Conditions

As reported in the vegetation section of Chapter 3, the best data available on the current status of the vegetation in the watershed is seral stages (Map 9). Much of the watershed is in the pioneer seral stage (21%) and the very early seral stage (21%). Thus, 42% of the watershed is vegetated by trees, shrubs, or grass that are 24 years old or less. Thirty percent of the watershed is covered by young forested stands between the ages of 25 and 79 years. Mature conifer forest stands, greater than 80 years old, cover 16% of the watershed. These numbers indicate that 72% of the watershed is dominated by forests that are generally less than 80 years old. Thus, those plant and animal species that inhabit young seral stages (pioneer to mid seral) have adequate habitat, while those species that require habitat with the characteristics of mature or late seral stages have only 16% of the watershed to use as habitat. The remainder of the watershed (12%) is covered by pure hardwood stands of all ages, residential areas, and water.

Desired Future Conditions

The vegetation of the watershed in the future should contain sufficient amounts and distributions of each seral stage to provide habitat for the natural diversity of plant and animal species that occur in the watershed. The portion of the watershed covered by mature, late, and old growth seral stages should be increased, thus supplying the plant and wildlife habitat and ecological functions of these seral stages. Contiguity of forest stands should be increased to provide large patches of continuous habitat and/or forest interior habitat.

Riparian areas throughout the watershed should exhibit a buffer of vegetation consisting of mature conifer trees, hardwoods, and shrubs to provide shade to streams and a source of food and cover material for aquatic and terrestrial species. Riparian systems should be contiguous, especially on creeks that are a priority for water quality and fish habitat. A higher percentage and more diverse mixture of conifer species than currently exists should make up the riparian tree species in both the lower and upper watershed, providing a source of high quality large woody debris and habitat diversity.

Noxious and invasive weeds should not proliferate to levels that are detrimental to the native plant and animal species. Biological control of noxious and invasive species is preferred over chemical control. Young and mature forests should be of sufficient productivity and extent to provide resources for timber harvest without being detrimental to the ecosystem health of the watershed. Harvest activities should be planned only in those areas where harvest activities, site conditions, sustainability, and ecosystem health are compatible. Forest resources should be managed to support the harvest of timber and other forest products in a sustainable manner. Recreational use of the forest should also be available to meet public demand where recreation activities, site conditions, sustainability, and ecosystem health are compatible.

C. Fish

Historical Influences

Many historical events have influenced fish habitat in the watershed, and fires (see Vegetation Section above) have had the most serious impact on fish habitat (USFS and BLM 1994). Fires resulted in the loss of forest cover and exposure of mineral soil, which may have resulted in increased landsliding and sedimentation to streams. Fire-killed trees entered stream channels in the decades following fires, providing large woody debris and stream complexity. Erosion provided gravel and rocks which eventually became spawning gravels (McDonald and Schneider 1992).

Aquatic habitat conditions were also affected by past floods. Major floods occurred in 1945, 1950, 1955, 1964-65, 1972, 1990, and 1996. The Meadow Lake Dam failure in 1962 caused flooding on the entire mainstem of Nestucca River. Floods can scour stream channels down to the bedrock, eliminating spawning gravels. The floods in 1964-65 and 1972 caused damage in East Beaver Creek subwatershed, while not seriously affecting other areas (USFS and BLM 1994). See Section A of Chapter 4 for a description of the effects of the flood of 1996.

Diking of marshlands between the Nestucca Bay and Highway 101 has resulted in a loss in the original area of the estuarine system (McDonald and Schneider 1992). The effects of this loss of estuary habitat on fish populations is not known since there is little data available about fish populations prior to 1926. However, estuary size may be a limiting factor to salmonid populations, since all salmonids spend part of their life cycle in the estuaries as they adjust to salt water conditions before migrating to sea.

Removal of riparian vegetation due to timber harvest, settlement, and agricultural activities has decreased the quality of fish habitat throughout the watershed. Riparian vegetation provides food material, cover, and large woody debris for fish habitat. Active removal of large woody debris from stream channels by the Army Corps of Engineers and the USFS in the 1960s and 1970s significantly depleted cover and decreased channel complexity. Other activities, such as ripraping banks and channelizing creeks, decreased the amount and quality of fish habitat.

Past timber harvest activities, including road building, resulted in reduced riparian vegetation, increased landsliding, and increased sedimentation to creeks. Commercial in-stream gravel removal operations in the lower Nestucca River began in the 1950's. As of October 1997, commercial gravel removal from the lower Nestucca River is no longer allowed. Removal of gravel can be detrimental to spawning habitat. Chum salmon, which utilize the lower Nestucca

River, tend to avoid areas that are repeatedly mined for gravel (Keith Braun, ODFW, personal communication).

Coho salmon once spawned in high numbers in the Big Nestucca Watershed. The average number of spawning coho salmon was 75 fish/mile in the years 1923-1927 (Cleaver 1957 as cited in McDonald and Schneider 1992). Spawning counts for coho salmon in recent years average only 5.7 fish/mile, which is below ODFW management goals. The average estimated yearly coho escapement for 1923-27 was 15,300 fish, after an average annual commercial gillnet harvest of 21,000 fish. The 1991 escapement of coho was 1,160 fish (McDonald and Schneider 1992). In 1995, 3,651 pounds of chinook salmon were landed at Pacific City. The ex-vessel value of commercial caught chinook salmon at Pacific City dropped from $296,701 (1988) to $2,092 (1997) (ODFW 1998).

During the late 1960s and 1970s the steelhead catch averaged an estimated 13,249 fish per year. In the late 1980s to early 1990s, the steelhead harvest dropped to an estimated 2,650 fish per year, 80% of which are estimated to be hatchery fish.

Local History of Salmonid Populations

(The following section is based on citizen observations and anecdotal information, compiled by Connie Gann, Cloverdale, Oregon, personal communication)

- Prior to the Meadow Lake Dam Flood, there were many log jams, beaver dams, and very large, pond-like pools in the Upper Nestucca River, all of which provided spawning and rearing habitat for a variety of fish. When the Meadow Lake Dam failed in 1962, the resulting flood removed such habitat elements, affecting the ability of fish to utilize this area of the watershed.
- Most of the tributaries of the Big Nestucca also used to have beaver dams, log jams, and good spawning areas for salmon and trout.
- Coho salmon, winter steelhead, and fall chinook salmon runs in the upper Nestucca River and most of its tributaries were abundant in the past.
- Sockeye salmon were known to migrate to Moon, Elk, and Tony Creek. Tony Creek frequently had abundant runs.
- There has been a recent sighting of sockeye salmon on Tony Creek at bridge above Beaver.
- Although it is widely believed that chum salmon were found only in the lower watershed, Beaver Creek, East Beaver Creek, West Beaver Creek, and Moon Creek had runs of chum salmon.
- 3 blueback salmon have been spotted in the watershed in the years of 1992-1995.
- Pink salmon have been seen at Cloverdale in recent years.

Current Conditions

The Nestucca River has one of the most productive salmon fisheries in Oregon. Statistics of sport catch in 1989 show that the Nestucca was one of the top five coastal river producers of winter and summer steelhead, and spring and fall chinook (McDonald and Schneider 1992).

The Cedar Creek Hatchery is located near Hebo and is operated by ODFW. The hatchery raises anadromous fish from returning hatchery brood stock to the smolt stage and release in the Nestucca River, Wilson River and Kilchis River basins. The present goal is to produce enough fish to return to the hatchery each year for brood stock and to supply some supplemental fish to the consumptive fishery (Keith Braun, ODFW, personal communication). The total number of anadromous fish released in Nestucca River and Three Rivers in 1996 was 297,000. Specifically, 113,000 spring chinook, 111,000 winter steelhead, and 73,000 summer steelhead were released in Nestucca River and Three Rivers (Keith Braun, ODFW, personal communication). Wild fish are prevented from migrating up Cedar Creek by a barrier weir, to protect hatchery operations from the possibility of disease outbreaks.

Although short term increases in salmon population may result from hatchery practices, hatchery raised salmon can have negative effects on the ultimate survival of wild salmon. Much of the negative impact of hatchery fish stems from the behaviors encouraged by the artificial environment in which they are raised, and which are passed on from one generation to the next. Hatchery salmon are raised in a controlled environment that exposes them to little predation, little need to seek cover, and plenty of food for little effort. These circumstances cause hatchery salmon to learn behaviors that, once they return to the wild, are detrimental to their survival and reduce their chances to contribute to the reproduction of their species. They become aggressive feeders that are not afraid of movement from above the water surface, making them easy targets for predation. Since they are raised in a carefully controlled environment, with little need to swim about looking for food or cover, they are weaker than wild salmon. Conditions in hatcheries can increase risk of disease. Hatchery fish used as brood stock each year are a limited number of individuals; thus the gene pool can become smaller with each successive year. Gene pool diversity is important for the long term survival of any species. Such diversity ensures that a variety of behaviors and abilities exists to enable a species to adapt to pressure from the environment.

Wild salmon are reared in an unpredictable environment that subjects them to predation and competition for cover and food. Wild salmon that survive these conditions learn to be cautious feeders, avoid predators, and survive on their own. Genetic diversity in wild populations is greater because reproducing individuals are not limited to a small subset of the entire population, as in hatchery programs.

The specific status of each salmonid species in the Nestucca Watershed was discussed in Chapter 3. In general, Oregon coastal coho stocks are threatened by overharvest, habitat damage and interactions with hatchery fish (Nehlsen et al. 1991 as cited in McDonald and Schneider 1992). Ocean conditions also play a large role in the health of salmonid populations, but ocean conditions are beyond our ability to manage. Nearly all salmonid fish species present in the watershed have depressed populations. The only stock that appears to be in healthy condition is the fall chinook salmon (USFS et al 1994).

Population Influences							
Species	**Ocean Habitat**	**Marine Harvest**	**Freshwater Harvest**	**Marine Predators**	**Hatchery Influences**	**Estuary Habitat**	**Freshwater Habitat**
Coho salmon	High	Low	Low	Low	Low	Medium	High
Chum salmon	High	unknown	Low	Low	N/A	High	High
Chinook salmon (fall)	Medium	High	Medium-High	Low	Low	High	Medium
Chinook salmon (spring)	Medium	High	Medium-High	Low	Low-Medium	High	Medium
Steelhead trout (winter)	High	Low	Medium-High	Low	Medium	Low-Medium	High
Steelhead trout (summer)	High	Low	High	Low	High	Low-Medium	N/A
Cutthroat trout (searun)	Medium	N/A	Low	Low	Medium	High	High
Cutthroat trout (resident)	N/A	N/A	Low-Medium	N/A	Low	N/A	High

Table 15. Factors that Affect Population Levels on Salmonid Fishes (adapted from: Keith Braun, ODFW as cited in USFS and BLM 1994) “N/A” = Not Applicable

Pesticides and Salmon

Pesticides are known to affect fish both directly and indirectly. Toxic effects of pesticides on fish can be acute (short-term) or chronic (long-term). Direct exposure to some toxins can kill fish. Sub-lethal exposure to pesticides can affect fish directly resulting in reduced reproduction and survival capabilities. Acute toxicity for fish is the concentration of pesticide (measured as milligrams of pesticide per liter of water) at which half of the experimental fish population dies over a designated length of time. This is also called lethal concentration for 50 percent of fish or LC_{50}. The range of LC_{50} varies from one species to another, and there is significant variability within a species. Juvenile fish are often more susceptible to pesticides than adults (Grier et al. 1994).

It is important to study both the active and inactive ingredients in pesticides. Most research tests only the active ingredient in isolation from the other ingredients that are usually included in the formulation (Grier et al. 1994).. However, any ingredient may affect an organism in one manner in isolation and in another manner when combined with other inactive ingredients, such as surfactants, emulsifiers, preservatives and propellants. For example, the active ingredient in Roundup and Rodeo is not the ingredient most toxic to fish that is present in that complete pesticide (Wan et al. 1989, Servizi et al. 1987, Mitchell et al. 1987, as cited in Grier et al. 1994). An adjuvant (an ingredient used to aid the operation of a main ingredient) used in conjunction with an herbicide containing 2,4-D was responsible for a fish kill in Douglas County Oregon (PARC 1991-92, as cited in Grier et al. 1994)

Sub-lethal effects of pesticide use also must be considered as important to the survival of fish species. Sub-lethal exposures of a variety of pesticides can have deleterious effects on salmon. The herbicide triclopyr caused behavioral changes such as reduced predator avoidance and downstream drift. Triclopyr was used in Tillamook County as of 1987 (McDonald and Schneider

1992) , and it may still be in use at present. It has been noted that at recommended levels of application, triclopyr could cause behavioral changes that lead to mortality in juvenile coho salmon (Johansen and Green 1991, as cited in Grier et al 1994). Increased respiration and hypersensitivity to stimuli were noted in juvenile coho salmon exposed to triclopyr at a concentration only 20% of the LC_{50} (Janz 1991 as cited in Grier et al. 1994).

A study of sub-lethal doses of six chemicals (carbaryl, chlordane, 2,4-D, DEF, methyl parathion, and pentachlorophenol) on rainbow trout found that exposure to these chemicals reduced the trout's survival from predation, and behavioral modifications were evident 96 hours after exposure, even when toxin concentrations were below EPA-established water quality standards (Little et al.1990, as cited in Grier et al. 1994).

Pesticide residues could be widespread throughout the watershed, based on the types and amount of pesticides being applied throughout the county (Table 14). However, no known testing for pesticide contamination has been done in the watershed. Various land management techniques in both the upper and lower watershed utilize pesticides including forest management, agricultural land management, residential garden and lawn applications, and road and right-of way maintenance (Table 14).

Aquatic Habitat

Aquatic habitat has been surveyed in some parts of the watershed by ODFW, USFS, BLM, and private timber industry. Those reaches that have been surveyed in recent years are indicated on Map 13. Reaches surveyed for spawning numbers are shown on Map14. The importance of the Nestucca Bay in providing fish habitat is briefly discussed in the Wildlife section below (Section D).

Summer low flows in the Nestucca River occur in late July to early October. During this time waters become warmer due to low flow and high temperature conditions. Warm water temperatures can cause increases in algae and fungus production. Increased oxygen consumption by algae can result in decreased dissolved oxygen levels in streams, reducing the oxygen available for fish species. Adult and juvenile fish die-offs in the watershed have been linked to fungal infections of *Dermocystidium salmonis* (USFS and BLM 1994).

Research suggests that a common limiting factor for some depressed salmonid populations is over-wintering habitat (USFS 1998). Unconstrained or moderately constrained stream channels with gradients less than 4% have the potential to provide good winter habitat (USFS 1998). These channel types have the potential to provide over-wintering habitat elements such as backwater/low velocity areas, deep pools, and large woody debris. These areas are also called productive flats. Productive flats are areas where the channel widens, large wood accumulates, pools are scoured, and water velocities are low due to low gradients. These areas provide crucial habitat for juvenile fish during times of flood and high runoff. Productive flats have low velocity riffles and side channels that provide habitat for cutthroat, steelhead and coho fry. Pools, especially deep pools associated with beaver ponds and large woody debris, are inhabited by coho, chinook, steelhead fry and juveniles, and older cutthroat trout.

The potential productive flats in the watershed are indicated on Map 15. This information was based on broad scale aerial photograph analysis. These sites need to be field checked before planning occurs. Unconfined channels with a gradient less than 2% have the most potential productivity for salmonids, and moderately confined channels with gradient less than 2% are next in terms of potential productivity. Unconfined channels with a gradient of 2-4% and moderately confined channels with gradient of 2-4% are also potentially productive areas, but not as ideal as the lower gradient areas. Channels that are confined and have gradients over 4% are not considered potentially productive habitat (USFS and BLM 1994). Low gradient reaches are relatively abundant in the watershed. Neskowin Watershed has not yet been analyzed for productive flats.

It should be noted that conditions in the mainstem of Nestucca River may not provide quality productive flats like the tributary streams (USFS and BLM 1994). Although the channel of the mainstem below Blaine, Oregon, would appear to provide potentially good habitat, it is a confined channel, due to the relationship between stream channel and valley width. In these reaches, the mainstem is entrenched between broad valley terraces which are used for fields and pastures. During times of high flow, the river is unable to rise out of its banks, and fish in the main channel are washed downstream, as they are unable to find quiet water or withstand the water velocity (USFS and BLM 1994).

Another habitat element to consider for fish habitat is the amount of large woody debris in a stream. Large woody debris dissipates stream energy, retains gravel, and diversifies stream habitat. Large woody debris provides structure needed to form resting pools and cover. To be stable in high energy streamflows during winter storms, large woody debris should be at least 24 inches in diameter and greater than 50 feet in length (USFS et al 1994). A stretch of river is considered “properly functioning” in terms of providing adequate amounts of large woody debris if there are more than 80 pieces per mile. A stretch of river is “impaired” in its functioning as fish habitat if there are only 30 to 80 pieces of large woody debris. And, a stretch of river is “not properly functioning” if there are less than 30 pieces. (NMFS Habitat Conservation BR 1996) The amount of large woody debris, that is 50 feet long and 24 inches in diameter, is shown in Map 16 for those reaches that have been inventoried in the watershed.

A primary factor in high quality fish habitat is the size and frequency of pools in a stream. Deep pools provide protection from predators, cool water refuge in summer months, and slow water habitat in times of high flows. The number of pools (pool frequency) found in a stream influences fish habitat diversity and quality. A stretch of river is considered “properly functioning” in terms of providing adequate numbers of pools for fish habitat if there are less than 8 channel widths between pools. A stretch of river is “impaired” in its functioning as fish habitat if there are 8 to 20 channel widths between pools. And, a stretch of river is “not properly functioning” if there are more than 20 channel widths between pools (NMFS Habitat Conservation BR 1996). Pool frequency classes for those creeks that have been inventoried in the watershed are shown on Map 17.

Stream Prioritization Process

All streams were classified into three priority levels based on potential to provide high quality, productive habitat for anadromous species and natural characteristics likely to promote successful restoration projects. Prioritization of streams was based on aerial photo, topographic map, and geographic information system data. All conclusions must be field checked before planning project site locations. An advantage of this prioritization is that it is based on information that is available for the entire watershed. This prioritization does not rely on habitat survey data, which is not complete for all the creeks in the watershed. Riparian vegetation condition is very important to any watershed restoration plan. However, riparian vegetation data is not available for much of the watershed. The Council plans to do a riparian condition survey using aerial photos and field checking in the future. Landowners interested in restoration and protection projects on streams that are not classified as high priority should be aware that projects can still be organized.

This prioritization used productive flat, fish species distribution, and Core Area status to classify streams likely to provide high quality, productive habitat and to be suitable for restoration. Such data were available for the all of the streams in the watershed, allowing a watershed-wide approach to prioritization. If one reach of a stream met high priority classification standards, the entire creek was listed as high priority. Field work will further refine prioritization to the reach level.

Streams were classified into three priority classes:

1--High Priority: Streams with characteristics that provide the best potential to provide high quality, productive habitat and successful restoration projects,
2-- Medium Priority: Streams with characteristics that provide good potential to provide high quality, productive habitat and successful restoration projects,
3-- Low Priority: Streams with characteristics that provide low potential to provide high quality, productive habitat and successful restoration projects.

All streams began the prioritization process with high priority status and were dropped into lower classes (or not) based on their characteristics. All data on which this prioritization was based, as well as other available data, are presented in Table 16.

- ⇒ If productive flat class = 1 or 2 (see definition in Table 16), classify as high priority. This class has channel confinement and gradients with the best potential to provide high quality, productive habitat for anadromous species.
- ⇒ If productive flat class = 3 or 4 (see definition in Table 16), classify as medium priority. This class has channel confinement and gradients with the potential to provide high quality, productive habitat for anadromous species.
- ⇒ If productive flat class = 0 (see definition in Table 16), classify as low priority. This class does not have channel confinement or gradients with potential to provide high quality, productive habitat for anadromous species.
- ⇒ If no fish species are naturally occurring in the stream, classify as low priority.
- ⇒ If stream is a Core Area, add a "+" to priority class to indicate additional habitat value of core salmonid spawning and rearing habitat and higher than local average salmonid abundance (ODFW 1998b, OCSRI 1997)

Key for Table 16:

Large woody debris and pool frequency: 1 = properly functioning, 2 = impaired functioning, and 3 = not properly functioning. (Applies to surveyed reaches only)

Pool frequency: 1 = properly functioning, 2 = impaired functioning, and 3 = not properly functioning. (Applies to surveyed reaches only)

Fish present: salmonid species that may be present due to each species natural range of distribution

Habitat miles: miles of habitat for anadromous species on the stream

Productive flats: 1 = unconfined with < 2% gradient, 2 = moderately confined with < 2% gradient, 3 = unconfined with 2-4% gradient, 4 = moderately confined with 2-4% gradient, 0 = no productive flat on stream. Followed by miles found in each category.

Riparian ownership: P = privately owned, T = timber industry, F = US Forest Service, B = Bureau of Land Management, S = Oregon (State) Department of Forestry and O = Other.

Habitat Survey: Y = a habitat survey has been done on the creek within the last ten years, N = no habitat survey has been done on the creek within the last ten years.

Spawning Survey: Y = a spawning survey has been done on the creek within the last ten years, N = no spawning survey has been done on the creek within last ten years.

Core Area: a stream reach that currently supports relatively high densities of spawning and/or rearing salmon (ODFW 1998b, OCSRI 1997). If stream is a core area, a number indicates which species, as follows: 1 = coho salmon core area, 2 = fall chinook salmon core area, 3 = spring chinook salmon, 4 = winter steelhead, 5 = summer steelhead, 6 = chum salmon. (Applies to certain reaches only) (ODFW 1998b)

Restoration Project Present: Y = yes, project(s) present in stream, N = no project present.

Channel Width: in meters, (North Coast Stream Project Guide to Restoration Site Selection, Phase II, ODFW June 1997)

Access: H = high accessibility for restoration equipment, M = moderate accessibility, L = low accessibility, N = No access, and U = unknown accessibility (North Coast Stream Project Guide to Restoration Site Selection, Phase II, ODFW June 1997)

Upland and Other Issues: Fecal = stream impaired for fecal coliform contamination, Sediment = stream impaired for sediment levels, Temp = stream impaired for high water temperatures in summer, Habitat = stream impaired for habitat modification, Flow = stream impaired for flow modification, DT-MR = Debris torrent potential-moderate risk (Igneous Headlands), DT-HR = Debris torrent potential-high risk (Volcanic Uplands-High Relief)

Priority Class: High = stream with characteristics that provide the best potential to provide high quality, productive habitat and successful restoration projects;

Medium = stream with characteristics that provide good potential to provide high quality, productive habitat and successful restoration projects; Low = stream with characteristics that provide low potential to provide high quality, productive habitat and successful restoration projects. Prioritization process described above.

NA = Data Not Available

NYA = Not Yet Assessed, data available

***** = Stream which has a priority class designated by the Technical Advisory Committee, justification follows:

> **Cedar Creek in Three Rivers Basin**: Priority class is Low--no anadromous fish migrate past mouth due to electric weir at Cedar Creek Hatchery (Keith Braun and Rick Klumpf, ODFW, personal communication).
>
> **Squaw Creek**: Priority class is Low-- has a natural barrier that presents questionable passage at 0.3 miles from mouth (Keith Braun and Rick Klumpf, ODFW, personal communication).
>
> **Bald Mountain Fork**: Priority Class is Medium--relatively high numbers of coho and steelhead are recorded in population records (Matt Walker, BLM, personal communication).

Stream	Large Woody Debris	Pool Fre-quency	Fish Present	Habitat Miles	Productive Flats/ miles	Riparian Owners-hip	Spawn Survey	Habitat Survey	Core Area	Rest. Project Present	Channel Width (meters)	Access	Upland & Other Issues	Priority Class
Lower Nestucca River (from Bay to confluence w/ Farmer Cr.)	NA	NA	Chinook Chum Coho Steelhead	11.7	1/ 9.0 3/ 2.5	P	N	N	----	Y	12-20	H	Flow, Temp, Fecal	High
Middle Nestucca River (from confluence w/ Farmer Cr., to confluence with Alder Cr.)	NA	NA	Chinook Chum Coho Steelhead	10.7	1/ 9.7 3/ 1.0	P	N	N	----	Y	12-20	H	Flow, Temp	High
Upper Nestucca River (from confluence with Alder Cr. to headwaters)	NA	NA	Chinook Coho Steelhead	24.9	1/ 16.0 2/ 0.5 3/ 1.0 4/ 1.0	P, T, F, B, S, O	N	N	3,4	Y	4-12	H	Flow, Temp, Sediment	High +
Smith Creek	NA	NA	Chum Coho Steelhead	2.3	0	P, T, F	N	N	----	Y	4-12	H		Low
Horn Creek	1-2	2-3	Chum Coho Steelhead	4.0	1/ 1.3 3/ 2.3 4/ 0.5	P, T, F	Y	Y	6	Y	4-12	L	Temp	High +
Clear Creek	NA	NA	Chinook Chum Coho Steelhead	3.4	1/ 1.0 3/ 0.75 4/ 0.4	P, T, F	Y	N	1,2,6	N	4-12	H, N	Tidegates	High +
George Creek	2-3	2	Chum Coho Steelhead	1.1	3/ 0.3	P, F	N	Y	----	Y	4-12	M		Medium
Lower Three Rivers (from mouth to confluence w/ Pollard Cr.)	NA	NA	Chinook Chum Coho Steelhead	7.3	1/ 7.3	P, T, F	N	N	----	Y	12-20	H		High

Table 16. Habitat Condition Summary by Stream for Anadromous Fish in Nestucca/Neskowin Watershed (continued)

Stream	Large Woody Debris	Pool Fre-quency	Fish Present	Habitat Miles	Productive Flats/ miles	Riparian Owners-hip	Spawn Survey	Habitat Survey	Core Area	Rest. Project Present	Channel Width (meters)	Access	Upland & Other Issues	Priority Class
Middle Three Rivers (from confluence w/ Pollard Cr. to confluence w/ Crazy Cr.)	NA	NA	Chinook Coho Steelhead	2.9	1/ 2.9	P, T, F	N	N	----	Y	4-12, 12-20	M		High
Upper Three Rivers (from confluence w/ Crazy Cr. to headwaters)	NA	NA	Chinook Coho Steelhead	2.9	3/ 0.5	T, F	N	N	----	N	4-12	L		Medium
*** Cedar Creek (Three Rivers)**	NA	NA	NONE	0	3/ 0.5	P, F	N	N	----	N	4-12	M		Low
Pollard Creek	NA	NA	Coho Steelhead	1.3	3/ 0.4	F	N	Y	----	N	4-12	U, N		Medium
Lawrence Creek	NA	NA	Coho Steelhead	1.3	3/ 0.2	P, F	Y	Y	----	N	4-12	U, N		Medium
Alder (Three Rivers)	1-3	1-2	Chinook Coho Steelhead	3.8	1/ 2.8 3/ 1.0	P, F	N	N	----	N	4-12	H		High
Buck Creek	NA	NA	Coho Steelhead	1.0	3/ 0.4	P, F	Y	Y	----	N	4-12	H		Medium
Crazy Creek	NA	NA	Coho Steelhead	2.2	3/ 0.4	T, F	N	N	----	N	4-12	L, N		Medium
Farmer Creek	1-3	1-2	Chinook Chum Coho Steelhead	4.0	3/ 2.3	P, T, F	Y	Y	----	Y	4-12	H		Medium
Lower Beaver Creek	NA	NA	Chinook Coho Steelhead	4.2	1/ 4.2	P, T	Y	N	----	N	12-20	H		High
North Beaver Creek	NA	NA	Chinook Coho Steelhead	1.7	1/ 2.3 3/ 0.5	P, T	N	N	----	N	4-12	H		High
West Beaver Creek	NA	NA	Chinook Coho Steelhead	5.1	1/ 1.2 3/ 2.0	P, T, F	N	N	----	N	4-12	H		High

Table 16. Habitat Condition Summary by Stream for Anadromous Fish in Nestucca/Neskowin Watershed (continued)

Stream	Large Woody Debris	Pool Fre-quency	Fish Present	Habitat Miles	Productive Flats/ miles	Riparian Owners-hip	Spawn Survey	Habitat Survey	Core Area	Rest. Project Present	Channel Width (meters)	Access	Upland & Other Issues	Priority Class
West Creek	NA	NA	Coho Steelhead Chinook	2.8	1/ 1.0 3/ 0.7	P, T, F	Y	N	----	N	4-12	H	Temp	High
Tiger Creek	1	3	Chinook Coho Steelhead	3.4	1/ 4.2 3/ 1.0	P, T	Y	N	----	Y	4-12	H, U		High
East Beaver Creek	3	1-2	Chinook Coho Steelhead	10.9	1/ 2.7 3/ 6.0 4/ 1.0	P, T, F	Y	Y	----	Y	4-12, 12-20	H, M	DT-HR, Habitat, Sediment	High
Bear Creek (East Beaver Basin)	NA	NA	Chinook Coho Steelhead	2.9	3/ 2.0	P, T, F	Y	N	----	N	4-12	M, N		Medium
Foland Creek	2	1	Coho Steelhead	3.9	3/ 2.0	P, T, F, S	Y	Y	----	Y	4-12	H, U, N		Medium
Clarence Creek	3	2	Coho Steelhead Chinook	1.2	3/ 1.3	T, F, B	Y	Y	4	N	4-12	H, M		Medium +
Limestone Creek	1	1-2	Coho Steelhead	1.9	3/ 0.2	P, F	N	Y	----	N	4-12	U, N		Medium
Wolfe Creek	NA	NA	Coho Steelhead	3.2	1/ 0.7 3/ 0.5 4/ 0.5	P, T, F	Y	N	----	Y	4-12	H, N	DT-HR	High
Tony Creek	2-3	1-3	Coho Steelhead	2.5	3/ 0.5	P, T, F	N	Y	----	Y	4-12	N		Medium
Boulder Creek	3	2	Coho Steelhead	3.7	3/ 2.0	P, T, F	Y	Y	----	Y	4-12	H		Medium
Alder Creek (Big Nestucca)	NA	NA	Coho Steelhead	0.2	0	P, T, F	Y	Y	----	N	4-12	L		Low
East Creek	NA	NA	Chinook Coho Steelhead	6.2	1/ 0.7 2/ 0.5 3/ 1.3 4/ 0.5	P, T, F, B, S	Y	Y	1	Y	4-12, 12-20	M, L, N	DT-HR	High +
Bays Creek	1-3	1-2	Chinook Coho Steelhead	4.1	1/ 1.5 3/ 0.3 4/ 0.3	T, F, S	Y	Y	----	Y	4-12	H, N	DT-HR	High
Moon Creek	NA	NA	Chinook Coho Steelhead	5.2	1/ 1.5 3/ 2.0	P, T, F, B, S	Y	Y	2	N	4-12, 12-20	M, N	DT-HR	High +

Table 16. Habitat Condition Summary by Stream for Anadromous Fish in Nestucca/Neskowin Watershed (continued)

Stream	Large Woody Debris	Pool Fre-quency	Fish Present	Habitat Miles	Productive Flats/ miles	Riparian Owners-hip	Spawn Survey	Habitat Survey	Core Area	Rest. Project Present	Channel Width (meters)	Access	Upland & Other Issues	Priority Class
Powder Creek	1-3	2	Chinook Coho Steelhead	2.6	3/ 2.0	F, P	Y	Y	4	Y	4-12	H, U	Temp	Medium +
Left Fork Powder	NA	NA	Steelhead	1.8	0	F	N	Y	4	N	4-12	U		Low +
Dahl Fork of Powder	NA	NA	Steelhead	1.3	0	F	Y	Y	4	N	4-12	U		Low +
Niagara Creek	3	1-2	Chinook Coho Steelhead	4.7	3/ 3.5 4/ 0.8	P, T, F	Y	Y	2,4	Y	4-12, 12-20	H, L, N	Temp	Medium +
Pheasant Creek	3	NA	Coho Steelhead	1.8	3/ 1.0	F	N	Y	4	N	4-12	N		Medium +
Buelah Creek	3	2	Coho Steelhead	0.6	3/ 0.5	F	Y	Y	4	N	4-12	U		Medium +
Slick Rock Creek	NA	NA	Coho Steelhead Chinook	0.8	3/ 0.3 4/ 0.3	P, T, F	N	Y	4	N	4-12	U		Medium +
Elk Creek	NA	NA	Chinook Coho Steelhead	3.3	3/ 0.5 4/1.5	B, S	Y	Y	1,4	Y	4-12, 12-20	H, M		Medium +
Stockpile Creek	NA	NA	Coho Steelhead	1.0	0	B	N	Y	----	N	4-12	L		Low
Bible Creek	NA	NA	Coho Steelhead	0.8	1/ 1.5	P, T, F, B, S	N	Y	4	N	4-12	L		High +
Bear Creek (Big Nestucca)	NA	NA	Chinook Coho Steelhead	3.2	2/ 0.5 3/ 0.2 4/ 2.0	T, B, S	Y	Y	4	Y	4-12	M, L		High +
*** Bald Mountain Fork**	NA	NA	Coho Steelhead	1.1	0	B	N	Y	----	N	4-12	L, M		Medium
Testament Creek	NA	NA	Coho Steelhead	4.0	4/ 0.7	P, T, F, B	Y	Y	4	N	4-12	U		Medium +
Fan Creek	NA	NA	Coho Steelhead	0.8	0	B	Y	Y	----	N	4-12	U		Low
Walker Creek	NA	NA	Coho Steelhead	1.5	1/ 1.0 2/ 0.5 3/ 0.2	B, O	N	N	----	N	4-12	U		High

Table 16. Habitat Condition Summary by Stream for Anadromous Fish in Nestucca/Neskowin Watershed (continued)

Stream	Large Woody Debris	Pool Fre-quency	Fish Present	Habitat Miles	Productive Flats/ miles	Riparian Owners-hip	Spawn Survey	Habitat Survey	Core Area	Rest. Project Present	Channel Width (meters)	Access	Upland & Other Issues	Priority Class
McGuire Reservoir	NA	NA	NONE	0	0	P, T, O	N	N	----	N	4-12	U		Low
Lower Little Nestucca (from Bay to confluence w/ Austin Cr.)	NA	NA	Chinook Chum Coho Steelhead	3.9	1/ 3.0 2/ 1.5	P, T, F	N	N	----	N	12-20	H	Temp	High
Middle Little Nestucca (from confluence w/ Austin Cr. to confluence w/ Hiack Cr.)	NA	NA	Chinook Chum Coho Steelhead	9.2	1/ 4.0 2/ 3.6 3/ 0.4	P, T, F	Y	Y	----	Y	4-12, 12-20	H	Temp	High
Upper Little Nestucca (from confluence w/ Hiack Cr. to headwaters)	NA	NA	NONE	0	1/ 7.0 2/ 1.7 3/ 0.5 4/ 2.0	P, T, S, O	N	N	----	N	4-12	U	Temp	Low
Fall Creek (Little Nestucca)	NA	NA	Chinook Chum Coho Steelhead	1.1	3/ 0.4	P, T, F, S	N	N	1,6	N	4-12	M		Medium +
McKnight Creek	NA	NA	Steelhead	0.3	0	F	N	Y	----	N	4-12	U		Low
Austin Creek	2-3	2	Chinook Coho Steelhead	1.4	3/ 0.3 4/ 1.0	F	Y	Y	1	N	4-12	N		Medium +
South Fork Little Nestucca	1	1-2	Chinook Coho Steelhead	5.3	1/ 2.3 2/ 0.3 3 /0.3 4/ 2.7	T, F	Y	N	----	Y	4-12, 12-20	M, N		High
Stillwell Creek	1-2	1	Chinook Coho Steelhead	1.0	2/ 0.2 4/ 0.3	P, T, F	Y	Y	----	N	4-12	H, N		High
Hiack Creek	2	1-2	Chinook Coho Steelhead	0.3	3/ 0.5 4/ 0.5	P, T, F	Y	Y	----	N	4-12	H		Medium

Table 16. Habitat Condition Summary by Stream for Anadromous Fish in Nestucca/Neskowin Watershed (continued)

Stream	Large Woody Debris	Pool Fre-quency	Fish Present	Habitat Miles	Productive Flats/ miles	Riparian Owners-hip	Spawn Survey	Habitat Survey	Core Area	Rest. Project Present	Channel Width (meters)	Access	Upland & Other Issues	Priority Class
Conklin Creek	NA	NA	Chinook Coho Steelhead	1.0	0	F	N	N	----	N	4-12	U		Low
Louie Creek	NA	NA	Chinook Coho Steelhead	2.1	4/ 0.2	P, F, T	N	N	----	N	4-12	H, N, U		Medium
Baxter Creek	NA	NA	Chinook Coho Steelhead	1.3	2/ 0.8	P, F	Y	Y	----	N	4-12	H, N	Culverts	High
Sourgrass Creek	NA	NA	Chinook Coho Steelhead	2.6	2/ 2.5 4/ 0.8	P, T, F	Y	Y	----	N	4-12	M, L		High
Bear Creek (Little Nestucca)	NA	NA	Chinook Chum Coho Steelhead	1.7	3/ 3.0 4/ 0.7	T, F	Y	Y	1	Y	4-12	M		Medium +
Bower Creek	NA	NA	Chinook Chum Coho Steelhead	1.0	1/ 1.0 3/ 0.5 4/ 0.5	P, F	N	N	----	N	4-12	H		High
Kellow Creek	1	2-3	Coho Steelhead	1.9	1/ 0.3 3/ 0.3 4/ 0.3	T	N	Y	1	Y	4-12	M, N		High +
*** Squaw Creek**	1	1-3	Chinook Coho Steelhead	0.3	1/ 0.3 3/ 0.3	T, F	Y	Y	1	N	4-12	H, U		High +
Lower Neskowin Creek (from mouth to confluence w/ Jim Cr.)	NA	NA	Coho Steelhead	5.6	1/5.6	P	Y	NYA	6	NYA	4-12, 12-20	H	DT-MR	High +
Upper Neskowin Creek (from confluence w/ Jim Cr. to headwaters)	NA	NA	Coho Steelhead	3.0	1/1.0 4/1.5	P, T, F	NYA	NYA	----	NYA	4-12, 12-20	H		High

Table 16. Habitat Condition Summary by Stream for Anadromous Fish in Nestucca/Neskowin Watershed (continued)

Stream	Large Woody Debris	Pool Fre-quency	Fish Present	Habitat Miles	Productive Flats/ miles	Riparian Owners-hip	Spawn Survey	Habitat Survey	Core Area	Rest. Project Present	Channel Width (meters)	Access	Upland & Other Issues	Priority Class
Fall Creek	NA	NA	Coho Steelhead	1.5	3/0.2 4/0.3	F	NYA	Y	----	NYA	4-12	M, L	DT-MR	Medium
Jim Creek	1-3	1-2	Coho Steelhead	1.1	3/0.2 4/0.7	P, F	NYA	Y	----	NYA	4-12	U		Medium
Lewis Creek	3	1	Coho Steelhead	NYA	1/0.3	P, T, F	NYA	NYA	----	NYA	4-12	H, N		High
Sloan Creek	2-3	2-3	Coho Steelhead	0.6	3/0.5	F	NYA	NYA	----	NYA	4-12	H		Medium
Prospect Creek	3	1	Coho Steelhead	1.0	3/0.2 4/0.4	P, T, F	NYA	NYA	----	NYA	4-12	H	DT-MR	Medium
Hawk Creek	1-3	3	Coho Steelhead	1.7	1/0.5 2/0.7 4/0.5	P, T	NYA	NYA	----	NYA	4-12	H, N	DT-MR	High
Butte Creek	NA	NA	Coho Steelhead	1.5	1/0.3 2/0.8	P, T	NYA	NYA	----	NYA	4-12	M	DT-MR	High

Table 16. Habitat Condition Summary by Stream for Anadromous Fish in Nestucca/Neskowin Watershed (continued)

Watershed Restoration Projects

Many water quality and fish habitat improvement projects have been completed in the watershed on federal and private lands. Conifers and willows have been planted in riparian zones to provide shade for cooler water temperatures, stabilize streambanks, and provide cover for fish. Logs and boulders have been placed in streams to enhance stream habitat complexity, pool depth, and pool frequency. Some fencing has been installed to protect streambanks and riparian vegetation. Off-stream watering and stream crossings for livestock have also been a part of the restoration efforts. The locations of existing riparian and instream restoration monitoring projects are indicated on Map 12.

Desired Future Conditions

Watershed conditions are sufficient to support all life cycles of anadromous and resident fish; also, there are adequate numbers of all life cycles of anadromous and resident fish distributed throughout their natural range in the watershed to ensure long term survival. Peak spawning counts of salmon species should reach the designated ODFW goals. Fish habitat maintains a balance between high quality pools, riffles, glides, and side channels. Large woody debris, boulders, and streambank vegetation provide abundant cover. Spawning gravels contain low percentages of fine sediments. Channels are free of all artificial obstructions to salmon as they migrate upstream and downstream. Large woody debris in forest reaches meets or exceeds 80 pieces of wood per mile. Summer water temperatures are low enough to meet state standards for fish habitat (Table 10).

D. Wildlife

Historical Influences

Wildlife populations in the watershed have been affected by many of the same events that impacted the vegetation: fires, human settlement, and timber harvest. There is not much data available on historical wildlife population levels and health. Past timber harvest has resulted in decreased habitat for marbled murrelet and spotted owls. It is known that local elk populations were drastically reduced in the late 1800s due to intensive hunting. The population has since recovered due to ODFW's elk reintroduction program. Elk is an important game species in the area (USFS and BLM 1994).

Current Conditions

One of the major negative influences on the diversity of native wildlife species in the watershed is the current lack of balance in the seral stages. Much of the watershed (42%) is covered by pasture lands or forest stands that consist of trees that are 24 years old or less. This is beneficial to those species that utilize pioneer and early seral stages; however, this condition is detrimental to those species that depend on mature or old growth forest stands of 80 years or older, also called late-successional habitat.

Also at risk are those species that require minimum amounts of continuous habitat (habitat patches) before they can successfully inhabit and reproduce in an area and those species that require forest interior habitat (habitat that is buffered from edges such as clearcuts and roads). Due to the intense timber harvest of the past, much of the watershed consists of highly fragmented stands of varying ages and a high density of roads. These conditions benefit those species that live in edge habitat, but not those that need forest interior habitat or large, contiguous forest patches. The average road density in the watershed is 3.9 miles of road per square mile. Road density varies from one place to another in the watershed; in some areas, the road density is as high as 5.7 miles/square mile. Roads can decrease the quality of habitat for some wildlife species by fragmenting habitat and by introducing disturbances such as traffic noise and increased presence of hunters and other recreationists.

An analysis of which species are at risk in the present landscape is beyond the scope of this study. The federal and state status of species is discussed in chapter 3. However, the Nestucca Watershed Assessment (USFS and BLM 1994) and the Little Nestucca Watershed Analysis (USFS 1998) discuss this topic. Federal lands are currently being managed under the Northwest Forest Plan as part of the Northern Coast Range Adaptive Management Area. The goals of the Northern Coast Range Adaptive Management Area are restoration and maintenance of late-successional forest and the conservation of fisheries habitat and biological diversity. Most of the federally managed lands in the watershed (60.5%) are therefore now being managed for restoration and maintenance of late-successional forest.

Nestucca Bay

Based on aerial photos and local residents' memories, the estuary used to be approximately four times bigger than it is today (USFS 1998). Diking and tidegates have changed estuary/salt marsh into fresh or brackish water wetlands with shrubs , rushes, and sedges; or pastures for livestock; or partially flooded pastures such as the Nestucca Bay National Wildlife Refuge (USFS 1998). The refuge was set up to protect the Aleutian Canada goose, a federally threatened species. The bay and the surrounding area has supported at least one pair of bald eagles in the past (USFS 1998).

The beach, bay, tidal flats, estuary, and wetlands support many species, such as brown pelicans, cormorants, wintering waterfowl and shorebirds, great blue herons, great egrets, black-shoulder kites, bald eagles, peregrine falcons, river otters, harbor seals, and sea lions (USFS 1998). The bay is important habitat for fish because the mixing of fresh and salt waters within the bay permits anadromous fish to adjust to the change in salinity and temperature as they pass to and from the ocean environment (USFWS 1990). The water quality and food production in the bay is important to the health of fish populations. Critical phases of salmon and steelhead life histories occur within the bay (Wick 1970).

Desired Future Conditions

The native wildlife species of the watershed have sufficient amounts of all habitat types to provide resources needed for healthy, viable populations. Forest habitats provide increased amounts of late-successional conditions. Contiguity of habitat is increased to support those species that require large patches of continuous habitat and/or forest interior. Road densities are decreased from the current level to reduce impacts on wildlife and their habitat. Riparian areas throughout the watershed have increased amounts of conifer species, maintain adequate amounts of hardwood species, woody debris, and snags to enhance the habitat for wildlife species.

5. Limiting Factors, Possible Causes, and Data Gaps

A. Agricultural Pollution Abatement Project

In the Nestucca Watershed, one of the limiting factors to water quality is the fecal coliform bacteria present in the waste produced by the dairy industry. An agricultural pollution abatement project is being administered by USDA Farm Services Agency. Another potential project to help manage dairy waste is the Methane Energy and Agricultural Development (MEAD) Project.

The purpose of the Agricultural Pollution Abatement Project is to provide cost-share dollars to livestock operators over a ten year period to install waste management systems. These systems will help prevent manure and fecal coliform runoff from animal confinement operations. Out of the 46 dairies in the watershed, 33 are currently participating in the program by implementing management practices and structures to reduce manure and fecal coliform runoff. Of the 33 projects, 15 are fully implemented and 18 are in progress as of December 1996. The other 13 dairies are not participating due to lack of funding (Bob Pedersen, NRCS, personal communication).

The acres available in the watershed for manure application are adequate for the estimated number of livestock, in terms of nitrogen and potassium application. However, the manure must be applied at times when the climatic and soil conditions are favorable to preventing runoff. The level of phosphorous application may be exceeding utilization rates, and water, soil and manure testing should be conducted to determine if phosphorus from manure application is a potential water quality problem in the watershed. (personal communication, Bob Pedersen, NRCS). Tables 18 and 19 illustrate how the acres required to utilize nitrogen, potassium, and phosphorus varies with different manure storage systems, grass species used, and tons of dry matter removed from the pastures.

Big Nestucca Watershed : Acres Available for Nutrient Application = 3084 1000 pound dairy cow units: 6686	Pasture/Hayland Acres Required to Utilize Nutrients Contained in the Manure Application		
Waste Management Method	**Nitrogen**	**Phosphorous**	**Potassium**
• Liquid Waste Storage: **Scrape/above ground** with sprinkler application • Solid Waste Storage: **Dry with roof** with broadcast application • Pasture Management is **high** or 8 tons of dry matter per year • Nutrients applied to **fescue, alta pasture** on moderately well-drained soil	2018.4	2542.2	1732.8
• Liquid Waste Storage: **Scrape/above ground** with sprinkler application • Solid Waste Storage: **Dry with roof** with broadcast application • Pasture Management is **medium** or 6 tons of dry matter per year • Nutrients applied to **rye grass pasture** on moderately well-drained soil	1956.5	4252.6	3059.0
• Liquid Waste Storage: **Scrape/above ground** with sprinkler application • Solid Waste Storage: **Dry with roof** with broadcast application • Pasture Management is **medium** or 6 tons of dry matter per year • Nutrients applied to **fescue, alta pasture** on moderately well-drained soil	2691.2	3389.6	2310.4
• Liquid Waste Storage: **Below ground pit** with sprinkler application • Solid Waste Storage: **Dry with roof** with broadcast application • Pasture Management is **medium** or 6 tons of dry matter per year • Nutrients applied to **fescue, alta pasture** on moderately well-drained soil	2848.4	3484.6	2375.1

Table 17. Dairy Waste Utilization in Big Nestucca Watershed

Little Nestucca Watershed : Acres Available for Nutrient Application = 861 1000 pound dairy cow units: 1818	Pasture/Hayland Acres Required to Utilize Nutrients Contained in the Manure Application		
Waste Management Method	**Nitrogen**	**Phosphorous**	**Potassium**
• Liquid Waste Storage: **Scrape/above ground** with sprinkler application • Solid Waste Storage: **Dry with roof** with broadcast application • Pasture Management is **high** or 8 tons of dry matter per year • Nutrients applied to **rye grass pasture** on poorly drained soil	298.5	876.7	630.6
• Liquid Waste Storage: **Scrape/above ground** with sprinkler application • Solid Waste Storage: **Dry with roof** with broadcast application • Pasture Management is **medium** or 6 tons of dry matter per year • Nutrients applied to **fescue, alta pasture** on poorly drained soil	547.5	931.7	635.1
• Liquid Waste Storage: **Below ground pit** with sprinkler application • Solid Waste Storage: **Dry with roof** with broadcast application • Pasture Management is **medium** or 6 tons of dry matter per year • Nutrients applied to **rye grass pasture** on poorly drained soil	412.0	1188.8	855.1
• Liquid Waste Storage: **Below ground pit** with sprinkler application • Solid Waste Storage: **Dry with roof** with broadcast application • Pasture Management is **medium** or 6 tons of dry matter per year • Nutrients applied to **fescue, alta pasture** on moderately well-drained soil	566.8	947.6	645.9

Table 18. Dairy Waste Utilization in Little Nestucca Watershed

B. Methane Energy and Agricultural Development (MEAD) Project

The Methane Energy and Agricultural Development (MEAD) Project will offer animal waste management flexibility to local dairy farmers by providing an alternative to land application of raw animal waste. An anaerobic digestion facility will be used to treat dairy waste, which will then be separated into solids and liquids. The solids will be blended with local log yard waste and composted to produce a soil product for sale on the retail market. The liquids will be available for land application on local pasture lands, replacing the nutrients formerly provided by land application of raw manure. The digested liquid is 95% free of fecal coliform and other pathogens, and unlike raw manure, contains no weed seeds. The project will be able to process 25% of all liquid manure produced in Tillamook County (Vicki Goodman, MEAD, personal communication).

Farmers will have the option of receiving only the volume of liquid nutrient required to apply nutrient at agronomic rate (the rate at which plants use the nutrients). They will pay a service fee of $0.01 per gallon of manure treated. This includes pick up of raw manure from their farm and return of the desired amount of liquid back to their farm. In the Nestucca Watershed, 9 of the 46 dairies (20%) are signed up for the project. This represents 1,155 cows (14% of the cows in the Nestucca Watershed) and 15,627 tons of manure (Vicki Goodman, MEAD, personal communication).

The preliminary design and financing of the processing facility has been completed by Eco Tec of Northwest America. The facility is scheduled to begin construction in 1998 and be fully operational in 1999.

C. Limiting Factors for Water Quality

Limiting Factors for Water Quality	Possible Causes	Possible Solutions
Fecal Coliform	Livestock Waste	Storage and application: best mgt. practices
	Residential and Commercial Septic Systems	Identify problem sites and fix problems
	Elk and Deer Population	Not currently manageable
Sedimentation	Forest Practices: timber harvest	Increase riparian buffer widths
	Forest Practices: road construction and maintenance	Survey and replace blocked culverts
	Erosion of streambanks from livestock activity	Fence livestock out of riparian areas
	Natural Landslide Activity	-----
	Home Site Development	Restrict development along streams
	Road Construction (non-forest)	Use best management practices
Water Temperature (High)	Lack of Riparian Shade	• Plant conifer trees • Protect from damage by livestock and humans
	Natural Environmental Variability	-----
	Low Streamflow Levels	Water conservation practices
Dissolved Oxygen (Levels too low)	High Water Temperature	• Plant conifer trees • Create deep pools
	Low Streamflow Levels	• More efficient use of existing water rights • Limit new withdrawals
Nutrients in Water	Municipal Sewage Treatment Plants	Monitor for problems and update technology
	Livestock Waste	Use best management practices
	Residential and Commercial Septic Systems	Identify problem sites and fix problems
	Fertilizer Applications: Agricultural, Golf Course, and Residential	Public education and best management practices
Pesticide and Other Chemical Contamination	Pesticide Applications by Forest, Agriculture, Residential, Golf Course, and Road Right-of-Way activities.	Public and owner education, promote safe alternatives
	Automotive oil runoff from roads and parking lots	Riparian buffers

Table 19. Limiting Factors for Water Quality, Possible Causes, and Solutions

D. Limiting Factors for Salmonids

Limiting Factors for Salmonids	Possible Causes	Possible Solutions
Aquatic Habitat Modification	Forest Practices	• Decrease harvesting in riparian areas • Full suspension logging techniques
	Home Site Development and Commercial Development	Restrict new construction in floodplains and riparian zones
	Stream Cleaning (60-70s)	Practice already eliminated
	Ripraping	• Riparian planting • Use bio-technology in place of riprap to stabilize stream banks
	Decreased presence of riparian conifer trees	• Riparian planting • Protect riparian areas from livestock and human impacts
	Road Construction	Construct new roads away from stream channel
	Channelization of streams	Conservation easement on tidally influenced land to reverse channelization effects
	Fish Passage Barriers—culverts. tidegates	Survey for barriers, obtain permission and funding to remove/remedy barriers
	Noxious/exotic/invasive plants	Introduce biological control methods
Ocean Conditions	Natural Causes	Beyond human control
Fishing—Commercial and Recreational	Commercial and Recreational Demands and Practices	Regulate fishing to sustainable levels
Decreased Estuary Habitat	Agricultural Land Use and Land Clearing	Conservation Easements with willing landowners
	Diking, Tidegates and Draining	Acquire easements to allow flooding
Pesticide Contamination	Forest, Agriculture, Residential, and Road Right-of-Way activities	Riparian buffers, promote safe alternatives
Sedimentation of Spawning Beds	Forestry Timber Harvest	Limit riparian harvest, Increase buffer width
	Home Site Development	Restrict new construction in floodplains and riparian zones
	Road Construction	Construct new roads away from stream channel; Use best management practices
	Streambank erosion	Riparian plantings, protect banks from livestock and human activities
Water Temperature (High)	Lack of Riparian Shade	• Riparian planting • Protect riparian areas from livestock and human impacts
	Natural Environmental Variability	Beyond human control
	Low Streamflow Levels	• More efficient use of existing water rights • Limit new withdrawals

Table 20. Limiting Factors for Salmonids, Possible Causes, and Solutions

Limiting Factors for Salmonids	Possible Causes	Possible Solutions
Low Summer Streamflow	Domestic and Municipal Water Use	• More efficient use of existing water rights • Limit new withdrawals
	Irrigation Water Use	• More efficient use of existing water rights; Limit new withdrawals
	Natural Environmental Variability	Beyond human control
Natural Predation	Marine Mammals and Birds	Protect fish stocks from predation by hazing/harassing predators when feasible and legal

Table 20. Limiting Factors for Salmonids, Possible Causes, and Solutions (continued)

E. Data Gaps

- Measure of road proximity to streams. Identify streams most impacted by this proximity.
- Road system contribution to sedimentation of streams
- Habitat condition of wetlands (fish and wildlife)
- Habitat condition of riparian areas (fish and wildlife)
- Habitat condition of Nestucca Bay (fish and wildlife)
- Water right allocations for Little Nestucca Watershed and Neskowin Watershed
- Culvert and tidegate survey –location and condition
- McMinnville permit application for increase in amount of water diverted to McGuire Dam
- Herbicide survey for agriculture, forest, residential, and road/right-of-way practices
- Field check prioritized streams
- Floodplain boundaries –50 year and 100 year
- Complete mapping of locations of spawning surveys
- Agricultural landuse: contribution to sedimentation of streams
- Agricultural practices' contribution to nutrient levels
- Groundwater monitoring for nutrient levels
- Septic system record surveys: septic system ages and probability of failure

6. Executive Summary

Streamflow: Streamflow levels of Nestucca River in summer do not meet fishery flow levels as determined by ODFW. Nestucca River from the mouth to Powder Creek is listed as water quality impaired for flow modification by DEQ on the 1994/1996 303(d) list. Summer streamflow levels after accounting for natural streamflow levels, out-of-channel diversions, and storage at McGuire Reservoir do not meet fishery flow levels. This reduces the quantity and quality of freshwater habitat for resident fish and aquatic life and salmonid fish species.

Sedimentation: Natural and management-influenced sediment sources exist in the watershed. The areas that produce large amounts of sediment are East Beaver Creek, Bear Creek (upper Nestucca), Moon Creek, Nestucca River (from Powder Creek to the Headwaters) and Upper Three Rivers Subwatersheds. Sedimentation affects the quality of habitat for incubating and pre-emergent salmon. Sediment clogs the spaces between gravel, suffocating the eggs and pre-emergent fry. High-relief volcanic uplands and igneous headland are areas of high risk for debris torrents and are another source of sedimentation.

Fecal Coliform: Data indicate fecal coliform contamination is an issue for Nestucca Bay and Nestucca River at Cloverdale. Fecal coliform sources in the watershed include septic systems, wastewater treatment plants, dairy farms, hobby farms, and wildlife populations. Waste management practices are in place or are in the process of being implemented to prevent livestock waste from reaching streams. Monitoring of fecal coliform levels throughout the watershed is needed to help locate other sources of fecal coliform contamination and determine if the continued implementation and improvement of livestock waste management practices is reducing the fecal coliform levels in the bay.

Water Temperature: Niagara Creek, Powder Creek, Horn Creek, West Creek, Upper Little Nestucca River, Mid Little Nestucca River, and Lower Little Nestucca River have summer water temperatures that are too high to meet state standards for resident fish and aquatic life and salmonid rearing habitat.

Vegetation and Wildlife: 42% of the watershed is vegetated by trees (including shrubs and grass) that are less than 24 years old. 72% of the watershed is less than 80 years old. There is a lack of mature and old growth forest stands in the watershed. Thus, there is a lack of habitat for plant and animal species that rely on mature and old growth forest. Ecological functions specific to mature and old growth forests are also lacking. Minimum habitat patch size needs to be increased, and connectivity of critical habitat for threatened species needs to be increased. Vegetation in riparian areas in general is not continuous, and coniferous trees need to be increased to provide shade for lower water temperatures. Coniferous trees are necessary to provide high quality, long-term large woody debris and to enhance stream complexity for aquatic species. Noxious and invasive weeds are present and are decreasing native habitat quality in the watershed.

Fish: Anadromous species in the watershed have depressed populations, except for fall chinook. Ocean conditions, freshwater habitat quality, riparian habitat quality, estuary habitat quality, commercial and recreational fisheries, and predation by wildlife all impact these fish populations. Ocean conditions are beyond human control. The quality of freshwater, riparian, and estuary habitats needs to be improved in terms of stream complexity, pool frequency, large woody debris, shade, water temperature, sediment, and streambank erosion. Continued management of the impacts of commercial and recreational fisheries on fish species is also important. Predation by wildlife on "at risk" fish species needs to be managed to reduce impacts on sensitive populations.

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Appendix A: Soil Associations (John Shipman. 1997. Tillamook Soil and Water Conservation District, personal communication.)

Murtip-Caterl-Laderly: (45,772.2 acres, or 21% of the watershed)

Murtip: The Murtip soil is 40 to more than 60 inches deep to bedrock. It formed in material weathered from volcanic rocks on mountains. Elevation is 1,800 feet to 3,200 feet. The mean annual precipitation is 110 inches, and the mean annual air temperature is 44° F . The soil is loamy, well drained, with moderate permeability. Slopes are 5 to 90 percent. The Murtip soil is used for timber production, recreation, and wildlife. Native vegetation includes Douglas fir, western hemlock, noble fir, red alder, western swordfern, salal, red and tall blue huckleberry.

Caterl: The Caterl soil is 40 to more than 60 inches deep to bedrock. It formed in material weathered from volcanic rocks on mountains. Elevation is 1,800 feet to 3,200 feet. The mean annual precipitation is 110 inches, and the mean annual air temperature is 44° F . The soil is loamy, high in rock fragments, well drained, with moderate permeability. Slopes are 5 to 90 percent. The Caterl soil is used for timber production, recreation, and wildlife. Native vegetation includes Douglas fir, western hemlock, noble fir, red alder, western swordfern, salal, red and tall blue huckleberry, and cascade Oregon grape.

Laderly: The Laderly soil is 20 to 40 inches deep to bedrock. It formed in material weathered from volcanic rocks on mountains. Elevation is 1,800 feet to 3,200 feet. The mean annual precipitation is 110 inches, and the mean annual air temperature is 44° F . The soil is loamy, high in rock fragments, well drained, with moderate permeability. Slopes are 5 to 90 percent. The Laderly soil is used for timber production, recreation, and wildlife. Native vegetation includes Douglas fir, western hemlock, noble fir, salal, and cascade Oregon grape.

Hemcross-Klistan-Ginsberg: (59,779.8 acres, or 27.5% of the watershed)

Hemcross: The Hemcross soil is 40 to more than 60 inches deep to bedrock. It formed in material weathered from volcanic rocks on mountains. Elevation is 200 feet to 2,000 feet. The mean annual precipitation is 100 inches, and the mean annual air temperature is 49° F . The soil is loamy, well drained, with moderate permeability. Slopes are 5 to 90 percent. The Hemcross soil is used for timber production, recreation, and wildlife. Native vegetation includes Douglas fir, western hemlock, red alder, vine maple, western swordfern, and salal.

Klistan: The Klistan soil is 40 to more than 60 inches deep to bedrock. It formed in material weathered from volcanic rocks on mountains. Elevation is 200 feet to 2,000 feet. The mean annual precipitation is 100 inches, and the mean annual air temperature is 49° F . The soil is loamy, high in rock fragments, well drained, with moderate permeability. Slopes are 5 to 90 percent. The Klistan soil is used for timber production, recreation, and wildlife. Native vegetation includes Douglas fir, western hemlock, red alder, vine maple, western swordfern, salal, and cascade Oregon grape.

Ginsberg: The Ginsberg soil is 40 to more than 60 inches deep to bedrock. It formed in material weathered from tuffaceous sedimentary rocks on mountains. Elevation is 200 feet to 2,000 feet. The mean annual precipitation is 100 inches, and the mean annual air temperature is 49° F . The soil is loamy over clayey, well drained, with moderately slow permeability. Slopes are 5 to 60 percent. The Ginsberg soil is used for timber production, recreation, and wildlife. Native vegetation includes Douglas fir, western hemlock, red alder, vine maple, western swordfern, salal, and wild rose.

Appendix A: Soil Associations (John Shipman. 1997. Tillamook Soil and Water Conservation District, personal communication.)

Klootchie-Necanicum: (7,073.6 acres, or 3.3% of the watershed)

Klootchie: The Klootchie soil is 40 to more than 60 inches deep to bedrock. It formed in material weathered from volcanic rocks on mountains. Elevation is 50 feet to 1,800 feet. The mean annual precipitation is 95 inches, and the mean annual air temperature is 49° F . The soil is loamy and well drained. Slopes are 5 to 90 percent. The Klootchie soil is used for timber production, recreation, and wildlife. Native vegetation includes Douglas fir, western hemlock, sitka spruce, red alder, salmonberry, western swordfern, red huckleberry, and salal.

Necanicum: The Necanicum soil is 40 to more than 60 inches deep to bedrock. It formed in material weathered from volcanic rocks on mountains. Elevation is 50 feet to 1,800 feet. The mean annual precipitation is 95 inches, and the mean annual air temperature is 49° F . The soil is loamy, high in rock fragments, and well drained. Slopes are 5 to 90 percent. The Necanicum soil is used for timber production, recreation, and wildlife. Native vegetation includes Douglas fir, western hemlock, sitka spruce, red alder, salmonberry, western swordfern, red huckleberry, and salal.

Nehalem-Knappa-Waldport: (19,590.6 acres, or 9% of the watershed)

Nehalem: The Nehalem soil is more than 60 inches deep to bedrock. It formed in material weathered from alluvium on floodplains. Elevation is 15 feet to 200 feet. The mean annual precipitation is 90 inches, and the mean annual air temperature is 50° F . The soil is loamy, well drained, with moderate permeability. Slopes are 0 to 3 percent. The Nehalem soil is used for hay, pasture, and wildlife. Native vegetation includes sitka spruce, western hemlock, red alder, salmonberry, red elderberry and grasses.

Knappa: The Knappa soil is more than 60 inches deep to bedrock. It formed in material weathered from alluvium on floodplains. Elevation is 20 feet to 250 feet. The mean annual precipitation is 90 inches, and the mean annual air temperature is 50° F . The soil is loamy, well drained, with moderate permeability. Slopes are 0 to 7 percent. The Knappa soil is used for homesites, hay, pasture, and wildlife. Native vegetation includes sitka spruce, western hemlock, red alder, salmonberry, red elderberry and grasses.

Waldport: The Waldport soil is more than 60 inches deep to bedrock. It formed from eolian sands on dunes. Elevation is 10 feet to 50 feet. The mean annual precipitation is 85 inches, and the mean annual air temperature is 50° F . The soil is sandy, excessively well drained, with moderate permeability. Slopes are 0 to 30 percent. The Waldport soil is used for homesites, recreation, and wildlife. Native vegetation includes beachgrass, shorepine, and sitka spruce.

Peavine-Blachly-Honeygrove: (2,655.0 acres, or 1.2% of the watershed)

Peavine: The Peavine soil is 40 to 60 inches deep to bedrock. It formed from siltstone and shale on hills and mountains. Elevation is 200 feet to 2,800 feet. The mean annual precipitation is 75 inches, and the mean annual air temperature is 50° F . The soil is silty clay loam, well drained, with moderately slow permeability. Slopes are 2 to 75 percent. The Peavine soil is used for timber production, pasture, and wildlife habitat. Native vegetation includes Douglas fir, Oregon white oak, poison oak, snowberry, swordfern, brackenfern, hazel brush.

Blachly: The Blachly soil is more than 60 inches to bedrock. It formed from basalt and sandstone on ridges and steep slopes. Elevation is 200 feet to 3,000 feet. The mean annual precipitation is 100 inches, and the mean annual air temperature is 49° F . The soil is silty clay loam, well drained, with moderately slow permeability. Slopes are 0 to 75 percent. The Blachly soil is used for timber production and wildlife habitat. Native vegetation includes Douglas fir, red alder, western hemlock, western red cedar, vine maple, salal, western swordfern, oceanspray, western dewberry, and brackenfern.

Honeygrove: The Honeygrove soil is 40 inches or greater to bedrock. It formed from alluvium on uplands. Elevation is 200 feet to 2,500 feet. The mean annual precipitation is 75 inches, and the mean annual air temperature is 51° F . The soil is clayey, well drained, with moderately slow permeability. Slopes are 0 to 75 percent. The Honeygrove soil is used for timber production, pasture, and wildlife habitat. Native vegetation includes Douglas fir, western hemlock, vine maple, salal, swordfern, Cascade Oregon-grape, oceanspray, and wild rose.

Templeton-Ecola: (2,337.0 acres, or 1% of the watershed)

Templeton: The Templeton soil is 40 to more than 60 inches deep to bedrock. It formed from sedimentary rocks on hills and mountains. Elevation is 50 feet to 1,800 feet. The mean annual precipitation is 100 inches, and the mean annual air temperature is 49° F . The soil is loamy, well drained, with moderate permeability. Slopes are 5 to 90 percent. The Templeton soil is used for timber production, recreation, and wildlife. Native vegetation includes Douglas fir, sitka spruce, red alder, salmonberry, western swordfern, red huckleberry, and salal.

Ecola: The Ecola soil is 20 to 40 inches deep to bedrock. It formed from sedimentary rocks on hills and mountains. Elevation is 50 feet to 100 feet. The mean annual precipitation is 95 inches, and the mean annual air temperature is 49° F . The soil is loamy, well drained, with moderate permeability. Slopes are 5 to 90 percent. The Templeton soil is used for timber production, recreation, and wildlife. Native vegetation includes western hemlock, sitka spruce, Douglas fir, red alder, salmonberry, western swordfern, red huckleberry, and salal.

Templeton-Klootchie-Mingpoint: (80,134.1 acres, or 37% of the watershed)

Templeton: The Templeton soil is 40 to more than 60 inches deep to bedrock. It formed from sedimentary rocks on hills and mountains. Elevation is 50 feet to 1,800 feet. The mean annual precipitation is 100 inches, and the mean annual air temperature is 49° F . The soil is loamy, well drained, with moderate permeability. Slopes are 5 to 90 percent. The Templeton soil is used for timber production, recreation, and wildlife. Native vegetation includes Douglas fir, sitka spruce, red alder, salmonberry, western swordfern, red huckleberry, and salal.

Klootchie: The Klootchie soil is 40 to more than 60 inches deep to bedrock. It formed in material weathered from volcanic rocks on mountains. Elevation is 50 feet to 1,800 feet. The mean annual precipitation is 95 inches, and the mean annual air temperature is 49° F . The soil is loamy and well drained. Slopes are 5 to 90 percent. The Klootchie soil is used for timber production, recreation, and wildlife. Native vegetation includes Douglas fir, western hemlock, sitka spruce, red alder, salmonberry, western swordfern, red huckleberry, and salal.

Mingpoint: The Mingpoint soil is 40 to more than 60 inches deep to bedrock. It formed in material weathered from tuffaceous sedimentary rocks on hills and mountains. Elevation is 50 feet to 1,800 feet. The mean annual precipitation is 95 inches, and the mean annual air temperature is 49° F . The soil is loamy over clayey, well drained, with moderately slow permeability. Slopes are 5 to 60 percent. The Mingpoint soil is used for timber production, recreation, and wildlife. Native vegetation includes Douglas fir, western hemlock, sitka spruce, red alder, salmonberry, western swordfern, red huckleberry, and salal.

Appendix B. Landtype Associations in Nestucca/Neskowin Watershed (from Ellis-Sugai et al. in prep.)

Interior Fluvial Lands: (71,258.6 acres, or 32.7% of the watershed) This landtype association has a mixture of volcanic and fine-grained sedimentary rocks in almost equal amounts. Most of the sedimentary bedrock is fine-grained and easily erodable. The volcanic rocks are a mixture of both erodable and durable forms. The common landforms are hummocky earthflow terrain with medium relief. Stream density is 6.36 miles of stream per square mile. Soils are moderately deep to very deep and range from gravelly clay loams to gravelly clay. These soils have high water holding capacity. These soils will be unstable on lower midslopes above incised channels and on upper midslopes that are earthflow escarpment faces. The primary hillslope erosion processes are slumps and small earthflows. This landtype association has more low gradient streams than the otherwise similar Igneous/Sedimentary Uplands landtype association.

Igneous/Sedimentary Uplands: (28,863.1 acres, or 13.3% of the watershed) This landtype association has fine-grained sedimentary rocks. Soft sedimentary rocks are the most common, covering 49% of this landtype association. The common landforms are hummocky terrain. Stream density is 7.29 miles of stream per square mile. Soils are moderately deep to very deep and range from gravelly clay loams to gravelly clay. These soils have high water holding capacity. These soils will be unstable on lower midslopes above incised channels and on upper midslopes that are earthflow escarpment faces. The primary hillslope erosion processes are slumps and small earthflows.

Igneous Headlands: (7,431 acres, or 3.4% of the watershed) This landtype association has erosion-resistant volcanic headlands surrounded by more erodable marine sedimentary rocks. The common landforms consist of headlands along the coast and gently rounded, broad, ridge systems with a few steep, unstable slopes on spur ridges. Stream density is 6.35 miles of stream per square mile. Soils are moderately deep to very deep and range from gravelly clay loams to clay loams. These soils have moderate to high water holding capacity. The primary hillslope erosion process is infrequent landslides. Moderate risk of debris torrents.

Igneous Marine Hills: (22,472.8 acres, or 10.3% of the watershed) This landtype association has volcanic rocks and fine-grained sedimentary rocks. The common landforms consist of subdued topography with low, rounded hills. Stream density is 9.34 miles of stream per square mile. Soils are moderately deep to very deep and range from gravelly clay loams to gravelly clay. These soils have high to very high water holding capacity. The primary hillslope erosion processes are slumps and small earthflows, though unstable soils are not common in this landtype association. This landtype association has the highest stream density in the watershed and a high percentage of low-gradient streams.

Volcanic Uplands-High Relief: (18,525.2 acres, or 8.5% of the watershed) This landtype association is underlain by erodable volcanics and a minor amount of fine-grained sedimentary rocks. The common landforms consist of steep, V-shaped canyons and narrow ridges, such as those found in East Beaver Creek. Relief is high. Stream density is 4.60 miles of stream per square mile. Soils are moderately deep to very deep and range from gravelly loams to clay. These soils have moderately high to very high water holding capacity. The primary hillslope erosion processes are landslides. The steepest slopes and most unstable soils are on upper portions of spur ridges. There are few streams with low gradients in this landtype association compared to other areas in the watershed. Debris torrent potential is extremely high. This area has the highest percentage of slopes over 60% in the Coast Range. Road failures are more likely to occur because of instability of bedrock, steep slopes, and high stream gradient.

Appendix B. Landtype Associations in Nestucca/Neskowin Watershed (from Ellis-Sugai et al. in prep.)

Igneous Uplands: (14,248.7 acres, or 6.6% of the watershed) This landtype association has a mixture of erosion-resistant volcanic rocks and fine-grained sedimentary rocks. Although the volcanic rocks only cover 23% of the area, they control the topography and underlie the ridges. The common landforms consist of steep, dissected slopes, underlain by intrusive volcanic rocks, and gentle slopes, underlain by easily erodable sedimentary bedrock. Stream density is 6.57 miles of stream per square mile. Soils are moderately deep to deep and range from gravelly loams to gravelly clay loams. These soils have moderately high to high water holding capacity. Although unstable soils and earthflow terrain are not common, unstable soils may occur on lower midslopes above incised channels and on upper convex sideslopes. These soils will be unstable on lower midslopes above incised channels and on upper convex sideslopes. The primary hillslope erosion processes are slumps and small earthflows.

Igneous-Sedimentary Contact Lands: (38,847.1 acres or 17.9% of the watershed) The bedrock of this landtype association is primarily fine-grained sedimentary rocks (80%) with a small amount of erosion-resistant volcanic rocks (14%). The common landforms consist of hummocky topography with low relief, gentle slopes and rounded ridges. Stream density is 4.32 miles of stream per square mile. Soils are deep to very deep and range from gravelly clay loams to gravelly clay. These soils have high to very high water holding capacity. Unstable soils occur on lower midslopes above incised channels, on upper midslopes that are earthflow escarpment faces, and on steep headwalls of upper backbone ridge systems. The primary hillslope erosion processes at low elevations are slumps and small earthflows, and debris slides occur infrequently at high elevations.

Interior Valley: (7,773.6 acres, or 3.6% of the watershed) This landtype has bedrock consisting almost exclusively of fine-grained alluvial and lake deposits in a broad valley with low relief. Soils are moderately deep to very deep and range from clay loams to gravelly clay loams to sandy loams. These soils have moderately high water holding capacity. Unstable soils are not common. They may occur on lower midslopes above incised channels. The primary hillslope erosion process is fluvial erosion in channels.

Coastal Lowlands: (8,870.3 acres, or 4.1% of the watershed) The bedrock of this landtype association is dominated by fine-grained sedimentary rocks. The common landforms consist of areas of low relief, such as estuaries, floodplains, dunes, and coastal plains around Nestucca Bay and Cape Kiwanda. Stream density is 8.24 miles of stream per square mile. Soils are moderately deep to very deep and range from clay loams to gravelly clay loams to sandy loams. These soils (except for the dunes) have high water holding capacity. Unstable soils are not common. They may occur on lower midslopes above incised channels. The primary hillslope erosion process is fluvial erosion in channels. This landtype association has the highest percentage of low-gradient streams (40% of all stream miles in this landtype association) of any landtype association in the watershed.

Appendix C. Wildlife Species that May Occur within Nestucca/Neskowin Watershed (derived from Southern Coast Range LSRA and Nestucca Watershed Analysis species lists.)

CLASS: Amphibian, Bird, Mammal, Fish, Invertebrate -

Within each class are alphabetical sorting codes which are groupings by family, primary habitat, and\or genus:

<u>family</u> - "AMPHIBIAN-F" is a frog, "AMPHIBIAN-S" is a salamander; "BIRD-BL" refers to the blackbird family; "BIRD-FIN" is a finch; "BIRD-GAL" is a gallinaceous bird; "BIRD-WTR-SH " is a shorebird; MAMMAL-RO" is a rodent; "MAMMAL-RO-SQ" is a squirrel; etc.

<u>primary habitat</u> - "wtr" for water; "wtro" for ocean

<u>genus</u> - "AMPHIBIAN-SA" is a salamander in the genus *Ambystoma*; "BIRD-DOC" is a dove in the genus *Columba;* "BIRD-wtroAL" is associated with water/ocean and is an alcid; "BIRD-wtroCO" is associated with water/ocean and is a cormorant). In some cases, letters were selected merely as grouping tools in an alphabetical-sorting system. This sorting system was used to make it easier to locate specific species or genera by scientific or common name.

STATUS: Federal & USFS listing/State Listing/Oregon Natural Heritage Program Status/BLM Listing

SC = Federal Species of Concern S&M = Survey and Manage Species, identified in NW Forest Plan

T=Threatened, E=Endangered, and S = Sensitive PT = Proposed for Federal Listing as Threatened

C=Critical, V=Vulnerable, P=Peripheral or Naturally Rare, and U=Undetermined

1 = Threatened with extinction or presumed to be extinct throughout entire range

2 = Threatened with extirpation or presumed to be extirpated from Oregon

3 = More information needed before status can be determined; may be Threatened or Endangered in Oregon or throughout their range

4 = Taxa which are of concern, but are not currently Threatened or Endangered

BT = Bureau Tracking BA = Bureau Assessment BS = Bureau Sensitive

EXOTIC = Non-native, introduced species. EXTIRP? = may no longer be in area

ABUND = Abundance Category: C=Common; R=Rare; O=Occasional; U=Uncommon

CLASS	SCIENTIFIC NAME	COMMON NAME	STATUS	ABUND
AMPHIBIAN-F	Rana aurora	Red-legged Frog	SC/U/3/-	C
AMPHIBIAN-F	Rana catesbeiana	Bullfrog	EXOTIC	C
AMPHIBIAN-F	Pseudacris regilla	Pacific Treefrog		C
AMPHIBIAN-F	Ascaphus truei	Tailed Frog	SC/V/3/BS	C
AMPHIBIAN-FT	Bufo boreas	Western Toad	-/V/3/-	C
AMPHIBIAN-S	Aneides ferreus	Clouded Salamander	-/U/3/BS	C
AMPHIBIAN-S	Ensatina eschscholtzii	Ensatina		C
AMPHIBIAN-SA	Ambystoma gracile	Northwestern Salamander		C
AMPHIBIAN-SA	Ambystoma macrodactylum	Long-toed Salamander		C
AMPHIBIAN-SD	Dicamptodon copei	Cope's Giant Salamander		C
AMPHIBIAN-SD	Dicamptodon tenebrosus	Pacific Giant Salamander		C
AMPHIBIAN-SP	Plethodon dunni	Dunn's Salamander		C
AMPHIBIAN-SP	Plethodon vehiculum	Western Redback		C
AMPHIBIAN-SR	Rhyacotriton kezeri	Columbia Torrent	-/V/3/BS	C
AMPHIBIAN-SR	Rhyacotriton variegatus	Southern Torrent Salamander	SC	C
AMPHIBIAN-SU	Taricha granulosa	Rough-skinned Newt		C
BIRD-BL	Dolichonyx oryzivorus	Bobolink	-/V/4/-	O
BIRD-BL	Corvus corax	Common Raven		C
BIRD-BL	Xanthocephalus xanthocephalus	Yellow-headed Blackbird		O
BIRD-BL	Eremophila alpestris	Horned Lark		U
BIRD-BL	Sturnella neglecta	Western Meadowlark		U
BIRD-BL	Molothrus ater	Brown-headed Cowbird		C

CLASS	SCIENTIFIC NAME	COMMON NAME	STATUS	ABUND
BIRD-BL	Euphagus cyanocephalus	Brewer's Blackbird		C
BIRD-BL	Agelaius phoeniceus	Red-winged Blackbird		C
BIRD-BL	Corvus brachyryhnchos	American Crow		C
BIRD-BL	Sturnus vulgaris	European Starling	EXOTIC	C
BIRD-BL	Icteus galbula	Northern Oriole		U
BIRD-BL-J	Cyanocitta stelleri	Steller's Jay		C
BIRD-BL-J	Perisoreus canadensis	Gray Jay		U
BIRD-CAP	Chordeiles minor	Common Nighthawk		U
BIRD-DO	Zenaida macroura	Mourning Dove		U
BIRD-DOC	Columba fasciata	Band-tailed Pigeon		C
BIRD-DOC	Columba livia	Rock Dove	EXOTIC	U
BIRD-F	Tyrannus verticalis	Western Kingbird		U
BIRD-FCC	Contopus sordidulus	Western Wood-pewee		C
BIRD-FCC	Contopus borealis	Olive-sided Flycatcher		C
BIRD-FCE	Empidonax difficilis	Pacific-slope Flycatcher		C
BIRD-FCE	Empidonax traillii (brewsteri)	Willow Flycatcher (Little)	SC	C
BIRD-FCE	Empidonax hammondii	Hammond's Flycatcher		U
BIRD-FIN	Carduelis pinus	Pine Siskin		C
BIRD-FIN	Carduelis tristis	American Goldfinch		C
BIRD-FIN	Carduelis psaltria	Lesser Goldfinch		C
BIRD-FINP	Carpodacus mexicanus	House Finch		C
BIRD-FINP	Carpodacus purpureus	Purple Finch		C
BIRD-GAL	Meleagris gallopavo	Wild Turkey		U
BIRD-GAL	Bonasa umbellus	Ruffed Grouse		C
BIRD-GAL	Phasianus colchicus	Ring-necked Pheasant (WV)	EXOTIC	U
BIRD-GALG	Dendragapus obscurus	Blue Grouse		U
BIRD-GALQ	Oreortyx pictus	Mountain Quail	-/-/4/SC	U
BIRD-GALQ	Callipepla californica	California Quail		C
BIRD-GRO	Loxia curvirostra	Red Crossbill		C
BIRD-GRO	Coccothraustes vespertina	Evening Grosbeak		C
BIRD-GRO	Pheucticus melanocephalus	Black-headed Grosbeak		C
BIRD-HA-EA	Aquila chrysaetos	Golden Eagle		U
BIRD-HA-EA	Haliaeetus leucocephalus	Northern Bald Eagle	T/T/1/T	U
BIRD-HA-EA-O	Pandion haliaetus	Osprey		U
BIRD-HA-FAL	Falco sparverius	American Kestrel		U
BIRD-HA-FAL	Falco peregrinus anatum	American Peregrine Falcon	E/E/1/E	U
BIRD-HA-FAL	Falco columbarius	Merlin	-/-/-/BA	U
BIRD-HAW	Elanus caeruleus	Black-shouldered Kite	-/-/3/BT	U
BIRD-HAWH	Circus cyaneus	Northern Harrier		U
BIRD-HAWKA	Accipiter striatus	Sharp-shinned Hawk		U
BIRD-HAWKA	Accipiter cooperii	Cooper's Hawk		U
BIRD-HAWKA	Accipiter gentilis	Northern Goshawk	SC/C/3/S	R
BIRD-HAWKB	Buteo lagopus	Rough-legged Hawk (WV)		U
BIRD-HAWKB	Buteo jamaicensis	Red-tailed Hawk		C
BIRD-HTV	Cathartes aura	Turkey Vulture		C
BIRD-HU	Stllula calliope	Calliope Hummingbird		R
BIRD-HU	Calypte anna	Anna's Hummingbird		U
BIRD-HUS	Selasphorus rufus	Rufous Hummingbird		C
BIRD-HUS	Selasphorus sasin	Allen's Hummingbird	-/-/4/-	C
BIRD-NU	Certhia americana	Brown Creeper		C
BIRD-NU	Sitta canadensis	Red-breasted Nuthatch		C
BIRD-NU	Sitta carolinensis	White-breasted Nuthatch		C

CLASS	SCIENTIFIC NAME	COMMON NAME	STATUS	ABUND
BIRD-OWL	Bubo virginianus	Great Horned Owl		C
BIRD-OWL	Otis kennicottii	Western Screech-owl		U
BIRD-OWL	Glaucidium gnoma	Northern Pygmy Owl	-/U/3/BT	U
BIRD-OWL	Tyto alba	Barn Owl		U
BIRD-OWL	Aegolius acadicus	Northern Saw-whet Owl	-/-/-/BT	U
BIRD-OWLA	Asio otus	Long-eared Owl		U
BIRD-OWLA	Asio flammeus	Short-eared Owl		U
BIRD-OWLS	Strix occidentalis caurina	Northern Spotted Owl	T/T/1/T	U
BIRD-OWLS	Strix varia	Barred Owl		O
BIRD-PIP	Anthus spinoletta (rubescens)	American Pipit		C
BIRD-SK	Lanius ludovicianus	Loggerhead Shrike		U
BIRD-SK	Lanius excubitor	Northern Shrike		U
BIRD-SL	Calcarius lapponicus	Lapland Longspur		U
BIRD-SP	Passer domesticus	House Sparrow	EXOTIC	C
BIRD-SP	Passerella iliaca	Fox Sparrow		C
BIRD-SP	Spizella passerina	Chipping Sparrow		U
BIRD-SP	Pooecetes gramineus	Vesper Sparrow	-/U/3/-	U
BIRD-SP	Chondestes grammacus	Lark Sparrow		U
BIRD-SP	Passerculus sandwichensis	Savannah Sparrow		C
BIRD-SPME	Melospiza georgiana	Swamp Sparrow		U
BIRD-SPME	Melospiza lincolnii	Lincoln's Sparrow		U
BIRD-SPME	Melospiza melodia	Song Sparrow		C
BIRD-SPT	Pipilo erythrophtalmus	Rufous-sided Towhee		C
BIRD-SPZ	Zonotrichia atricapilla	Golden-crowned Sparrow		C
BIRD-SPZ	Zonotrichia albicollis	White-throated Sparrow		U
BIRD-SPZ	Zonotrichia leucophrys	White-crowned Sparrow		C
BIRD-SW	Chaetura vauxi	Vaux's Swift		C
BIRD-SW	Cypeseloides niger	Black Swift	-/P/3/BA	R
BIRD-SWG	Progne subis	Purple Martin	-/C/3/BS	U
BIRD-SWH	Hirundo rustica	Barn Swallow		C
BIRD-SWH	Hirundo pyrrhonota	Cliff Swallow		C
BIRD-SWR	Riparia riparia	Bank Swallow	-/U/3/_	U
BIRD-SWS	Stelgidopteryx serripennis	No. Rough-winged Swallow		U
BIRD-SWT	Tachycineta bicolor	Tree Swallow		C
BIRD-SWT	Tachycineta thalassina	Violet-green Swallow		C
BIRD-TAN	Passerina amoena	Lazuli Bunting		U
BIRD-TAN	Piranga ludoviciana	Western Tanager		C
BIRD-TAO	Sialia currucoides	Mountain Bluebird	-/-/-/BT	O
BIRD-TAP	Sialia mexicana	Western Bluebird	-/V/4/BS	U
BIRD-TH	Turdus migratorius	American Robin		C
BIRD-TH	Ixoreus naevius	Varied Thrush		C
BIRD-THC	Catharus ustulatus	Swainson's Thrush		C
BIRD-THC	Catharus guttatus	Hermit Thrush		U
BIRD-THMK	Mimus polyglottos	Northern Mockingbird		U
BIRD-TI	Psaltriparus minimus	Bushtit		C
BIRD-TI	Chamaea fasciata	Wrentit		C
BIRD-TIJ	Junco hyemalis	Dark-eyed Junco		C
BIRD-TIKLT	Regulus satrapa	Golden-crowned Kinglet		C
BIRD-TIKLT	Regulus calendula	Ruby-crowned Kinglet		C
BIRD-TIP	Parus rufescens	Chestnut-backed Chickadee		U
BIRD-TIP	Parus gambeli	Mountain Chickadee		O
BIRD-TIP	Parus atricapillus	Black-capped Chickadee		C

CLASS	SCIENTIFIC NAME	COMMON NAME	STATUS	ABUND
BIRD-V	Vireo huttoni	Hutton's Vireo		C
BIRD-V	Vireo solitarius	Solitary Vireo		U
BIRD-V	Vireo gilvus	Warbling Vireo		C
BIRD-V	Vireo olivaceus	Red-eyed Vireo		U
BIRD-VS	Myadestes townsendi	Townsend's Solitaire		U
BIRD-W	Icteria virens	Yellow-breasted Chat		C
BIRD-WA	Wilsonia pusilla	Wilson's Warbler		C
BIRD-WA	Geothlypis trichas	Common Yellowthroat		C
BIRD-WA	Oporornis tolmiei	MacGillivray's Warbler		C
BIRD-WAD	Dendroica nigrescens	Black-throated Gray Warbler		C
BIRD-WAD	Dendroica townsendi	Townsend's Warbler		U
BIRD-WAD	Dendroica coronata	Yellow-rumped Warbler		C
BIRD-WAD	Dendroica occidentalis	Hermit Warbler		U
BIRD-WAD	Dendroica palmarum	Palm Warbler		U
BIRD-WAD	Dendroica petechia	Yellow Warbler		C
BIRD-WAV	Vermivora ruficapilla	Nashville Warbler		U
BIRD-WAV	Vermivora celata	Orange-crowned Warbler		C
BIRD-WAX	Bombycilla garrulus	Bohemian Waxwing		U
BIRD-WAX	Bombycilla cedrorum	Cedar Waxwing		C
BIRD-WDPK	Sphyrapicus ruber	Red-breasted Sapsucker		U
BIRD-WDPK	Colaptes auratus	Northern Flicker		C
BIRD-WDPK	Dryocopus pileatus	Pileated Woodpecker	-/V/4/BS	U
BIRD-WDPKP	Picoides villosus	Hairy Woodpecker		U
BIRD-WDPKP	Picoides pubescens	Downy Woodpecker		U
BIRD-WDPKW	Melanerpes formicivorus	Acorn Woodpecker (WV)		U
BIRD-WR	Thryomanes bewickii	Bewick's Wren		C
BIRD-WR	Cistothorus palustris	Marsh Wren		C
BIRD-WR	Salpinctes obsoletus	Rock Wren		U
BIRD-WRT	Troglodytes aedon	House Wren		U
BIRD-WRT	Troglodytes troglodytes	Winter Wren		C
BIRD-wtr	Cinclus mexicanus	American Dipper		C
BIRD-wtr	Ceryle alcyon	Belted Kingfisher		C
BIRD-wtr-DUCK	Aix sponsa	Wood Duck		U
BIRD-wtr-DUCK	Histrionicus histrionicus	Harlequin Duck	-/P/2/SC	U
BIRD-wtr-DUCK	Oxyura jamaicensis	Ruddy Duck		C
BIRD-wtr-DUCK	Clangula hyemalis	Oldsquaw		U
BIRD-wtr-DUCKA	Anas strepera	Gadwall		U
BIRD-wtr-DUCKA	Anas clypeata	Northern Shoveler		U
BIRD-wtr-DUCKA	Anas platyrhynchos	Mallard		C
BIRD-wtr-DUCKA	Anas acuta	Northern Pintail		C
BIRD-wtr-DUCKAT	Anas discors	Blue-winged Teal		U
BIRD-wtr-DUCKAT	Anas crecca	Green-winged Teal		C
BIRD-wtr-DUCKAT	Anas cyanoptera	Cinnamon Teal		U
BIRD-wtr-DUCKAW	Anas americana	American Widgeon		C
BIRD-wtr-DUCKAW	Anas penelope	Eurasian Widgeon		U
BIRD-wtr-DUCKAY	Aythya valisineria	Canvasback		C
BIRD-wtr-DUCKAY	Aythya americana	Redhead		U
BIRD-wtr-DUCKAY	Aythya affinis	Lesser Scaup	-/-/4/-	C
BIRD-wtr-DUCKAY	Aythya collaris	Ring-necked Duck	-/-/4/BT	U
BIRD-wtr-DUCKAY	Aythya marila	Greater Scaup		C
BIRD-wtr-DUCKB	Bucephala albeola	Bufflehead	-/P/2/BA	C
BIRD-wtr-DUCKB	Bucephala clangula	Common Goldeneye		C

CLASS	SCIENTIFIC NAME	COMMON NAME	STATUS	ABUND
BIRD-wtr-DUCKB	Bucephala islandica	Barrow's Goldeneye	-/P/4/BA	C
BIRD-wtr-DUCKM	Lophodytes cucullatus	Hooded Merganser		U
BIRD-wtr-DUCKME	Mergus serrator	Red-breasted Merganser		C
BIRD-wtr-DUCKME	Mergus merganser	Common Merganser		C
BIRD-wtr-GA	Anser albifrons	Great White-fronted Goose		U
BIRD-wtr-GB	Branta canadensis	Canada Goose		C
BIRD-wtr-GB	Branta canadensis leucopareia	Aleutian Canada Goose	T/E/1/T	R
BIRD-wtr-GB	Branta canadensis occidentalis	Dusky Canada Goose	-/-/4/BS	U
BIRD-wtr-GBB	Branta bernicla	Brant		C
BIRD-wtr-GC	Chen rossii	Ross' Goose		C
BIRD-wtr-GC	Chen caerulescens	Snow Goose		C
BIRD-wtr-GL	Gavia immer	Common Loon	SC/-/2/BA	C
BIRD-wtr-GL	Gavia adamsil	Yellow-billed Loon		R
BIRD-wtr-GL	Gavia pacifica	Arctic (Pacific) Loon		C
BIRD-wtr-GL	Gavia stellata	Red-throated Loon		C
BIRD-wtr-GRA	Aechmophorus occidentalis	Western Grebe		C
BIRD-wtr-GRA	Aechmophorus clarkii	Clark's Grebe		U
BIRD-wtr-GRPC	Podiceps nigricollis	Eared Grebe		U
BIRD-wtr-GRPC	Podiceps grisegena	Red-necked Grebe	-/C/2/BS	U
BIRD-wtr-GRPC	Podiceps auritus	Horned Grebe	-/P/4/BA	C
BIRD-wtr-GRPL	Podilymbus podiceps	Pied-billed Grebe		C
BIRD-wtr-GS	Cygnus buccinator	Trumpeter Swan		U
BIRD-wtr-GS	Cygnus columbianus	Tundra Swan		C
BIRD-wtr-GU	Oceanodroma leucorhoa	Leach's Storm Petrel		U
BIRD-wtr-GULL	Rissa tridactyla	Black-legged Kittiwake		C
BIRD-wtr-GULLK	Xema sabini	Sabine's Gull		U
BIRD-wtr-GULLL	Larus philadelphia	Bonaparte's Gull		C
BIRD-wtr-GULLL	Larus occidentalis	Western Gull		C
BIRD-wtr-GULLL	Larus heermanni	Heermann's Gull		C
BIRD-wtr-GULLL	Larus glaucescens	Glaucous-winged Gull		C
BIRD-wtr-GULLL	Larus thayeri	Thayer's Gull		U
BIRD-wtr-GULLL	Larus californicus	California Gull		C
BIRD-wtr-GULLL	Larus canus	Mew Gull		C
BIRD-wtr-GULLL	Larus delawarensis	Ring-billed Gull		C
BIRD-wtr-GULLL	Larus argentatus	Herring Gull		U
BIRD-wtr-GULLT	Sterna caspia	Caspian Tern	-/-/4/BT	C
BIRD-wtr-GULLT	Sterna paradisaea	Arctic Tern		U
BIRD-wtr-GULLT	Sterna hirundo	Common Tern		U
BIRD-wtr-HE	Egretta thula	Snowy Egret	-/V/2/-	C
BIRD-wtr-HE	Bubulcus ibis	Cattle Egret		U
BIRD-wtr-HE	Casmerodius albus	Great Egret	-/U/4/-	U
BIRD-wtr-HE	Nycticorax nycticorax	Black-crowned Night-heron		U
BIRD-wtr-HE	Botaurus lentiginosus	American Bittern		U
BIRD-wtr-HE	Butorides striatus	Green-backed Heron		U
BIRD-wtr-HE	Ardea herodias	Great Blue Heron		C
BIRD-wtr-PEL	Pelecanus occidentalis californi	California Brown Pelican	E/E/2/E	C
BIRD-wtr-RA	Coturnicops noveboracensis	Yellow Rail		U
BIRD-wtr-RA	Fulica americana	American Coot		C
BIRD-wtr-RA	Porzana carolina	Sora		U
BIRD-wtr-RA	Rallus limicola	Virginia Rail		U
BIRD-wtr-S	Gallinago gallinago	Common Snipe		C
BIRD-wtr-SH	Actitis macularia	Spotted Sandpiper		U

CLASS	SCIENTIFIC NAME	COMMON NAME	STATUS	ABUND
BIRD-wtr-SH	Aphriza virgata	Surfbird		C
BIRD-wtr-SH	Heteroscelus incanus	Wandering Tattler		U
BIRD-wtr-SH	Catoptrophorus semipalmatus	Willet		U
BIRD-wtr-SH	Haematopus bachmani	American Black		U
BIRD-wtr-SH	Himantopus mexicanus	Black-necked Stilt		O
BIRD-wtr-SHA	Arenaria interpres	Ruddy Turnstone		C
BIRD-wtr-SHA	Arenaria melanocephala	Black Turnstone		C
BIRD-wtr-SHCA	Calidris ptilocnemis	Rock Sandpiper		U
BIRD-wtr-SHCA	Calidris canutus	Red Knot		U
BIRD-wtr-SHCA	Calidris acuminata	Sharp-tailed Sandpiper		U
BIRD-wtr-SHCA	Calidris pusilla	Semipalmated Sandpiper		U
BIRD-wtr-SHCA	Calidris bairdii	Baird's Sandpiper		U
BIRD-wtr-SHCA	Calidris alpina	Dunlin		C
BIRD-wtr-SHCA	Calidris minutilla	Least Sandpiper		C
BIRD-wtr-SHCA	Calidris mauri	Western Sandpiper		C
BIRD-wtr-SHCA	Calidris melanotos	Pectoral Sandpiper		U
BIRD-wtr-SHCA	Calidris alba	Sanderling		C
BIRD-wtr-SHCH	Charadrius alexandrinus nivosus	Western snowy plover	T/T/2/T	U
BIRD-wtr-SHCH	Charadrius semipalmatus	Semipalmated Plover		C
BIRD-wtr-SHCH	Charadrius vociferus	Killdeer		C
BIRD-wtr-SHLI	Limnodromus griseus	Short-billed Dowitcher		C
BIRD-wtr-SHLI	Limnodromus scolopaceus	Long-billed Dowitcher		C
BIRD-wtr-SHLIN	Limosa fedoa	Marbled Godwit		C
BIRD-wtr-SHNU	Numenius americanus	Long-billed Curlew	SC/-/4/BS	U
BIRD-wtr-SHNU	Numenius phaeopus	Whimbrel		C
BIRD-wtr-SHPH	Phalaropus lobatus	Red-necked Phalarope		C
BIRD-wtr-SHPH	Phalaropus fulicaria	Red Phalarope		C
BIRD-wtr-SHPL	Pluvialis dominica	Lesser Golden-plover		U
BIRD-wtr-SHPL	Pluvialis squatarola	Black-bellied Plover		C
BIRD-wtr-SHTR	Tringa flavipes	Lesser Yellowlegs		C
BIRD-wtr-SHTR	Tringa melanoleuca	Greater Yellowlegs	-/-/2/BA	C
BIRD-wtr-SHTR	Tringa solitaria	Solitary Sandpiper	-/-/3/BT	R
BIRD-wtroAL	Brachyramphus marmoratus	Marbled Murrelet	T/C/2/T	U
BIRD-wtroAL	Synthliboramphus antiquus	Ancient Murrelet		U
BIRD-wtroAL	Ptychoramphus aleuticus	Cassin's Auklet		C
BIRD-wtroAL	Cepphus columba	Pigeon Guillemot		C
BIRD-wtroAL	Uria aalge	Common Murre		C
BIRD-wtroAL	Fratercula cirrhata	Tufted Puffin		C
BIRD-wtroAL	Cerorhinca monocerata	Rhinoceros Auklet		C
BIRD-wtroCO	Phalacrocorax pelagicus	Pelagic Cormorant		C
BIRD-wtroCO	Phalacrocorax auritus	Double-crested Cormorant		C
BIRD-wtroCO	Phalacrocorax penicillatus	Brandt's Cormorant		C
BIRD-wtroDUCKSS	Melanitta fusca	White-winged Scoter		C
BIRD-wtroDUCKSS	Melanitta nigra	Black Scoter		U
BIRD-wtroDUCKSS	Melanitta perspicillata	Surf Scoter		C
MAMMAL	Aplodontia rufa	Mountain Beaver		C
MAMMAL	Didelphis virginianus	Opossum	EXOTIC	C
MAMMAL-BAT	Eptesicus fuscus	Big Brown Bat		C
MAMMAL-BAT	Plecotus townsendii townsendii	Townsend's Big-eared Bat	SC/C/2/S	R
MAMMAL-BATLA	Lasionycteris noctivagans	Silver-haired Bat		C
MAMMAL-BATLA	Lasiurus cinereus	Hoary Bat		U
MAMMAL-BATMY	Myotis thysanodes	Fringed Myotis	SC/V/1/BS	R

CLASS	SCIENTIFIC NAME	COMMON NAME	STATUS	ABUND
MAMMAL-BATMY	Myotis volans	Long-legged Bat	SC	C
MAMMAL-BATMY	Myotis californicus	California Myotis		C
MAMMAL-BATMY	Myotis yumanensis	Yuma Bat	SC	U
MAMMAL-BATMY	Myotis evotis	Long-eared Bat	SC	C
MAMMAL-BATMY	Myotis lucifugus	Little Brown Myotis		C
MAMMAL-CARN	Ursus americanus	Black Bear		C
MAMMAL-CARNC	Vulpes vulpes	Red Fox		U
MAMMAL-CARNC	Urocyon cinereoargenteus	Gray Fox		U
MAMMAL-CARNC	Canis latrans	Coyote		C
MAMMAL-CARNF	Felis concolor	Mountain Lion		U
MAMMAL-CARNF	Felis rufus	Bobcat		C
MAMMAL-CARNM	Procyon lotor	Raccoon		C
MAMMAL-	Martes americana	Pine (American) Marten	-/C/3/BS	R
MAMMAL-	Martes pennanti pacifica	Pacific Fisher	SC/C/2/S	R
MAMMAL-CARNME	Mephitis mephitis	Striped Skunk		C
MAMMAL-CARNME	Spilogale gracilis	Western Spotted Skunk		C
MAMMAL-	Mustela vison	Mink		C
MAMMAL-	Mustela erminea	Short-tailed Weasel (Ermine)		C
MAMMAL-	Mustela frenata	Long-tailed Weasel		C
MAMMAL-	Lutra canadensis	River Otter		C
MAMMAL-CERV	Odocoileus hemionus	Black-tailed Deer		C
MAMMAL-CERV	Cervus elaphus	Elk		C
MAMMAL-H	Lepus americanus	Snowshoe Hare		U
MAMMAL-H	Sylvilagus bachmani	Brush Rabbit		C
MAMMAL-I	Sorex bendirei	Marsh Shrew		C
MAMMAL-I	Sorex trowbridgei	Trowbridge's Shrew		C
MAMMAL-I	Sorex vagrans	Vagrant Shrew		C
MAMMAL-I	Sorex yaquinae	Yaquina Shrew		U
MAMMAL-I	Sorex obscurus	Dusky Shrew		U
MAMMAL-IN	Neurotrichus gibbsi	Shrew-Mole		C
MAMMAL-ISC	Scapanus townsendi	Townsend Mole		C
MAMMAL-ISC	Scapanus orarius	Coast Mole		C
MAMMAL-RO	Thomomys mazama	Mazama Pocket Gopher		C
MAMMAL-RO	Myocastor coypus	Nutria	EXOTIC	C
MAMMAL-RO	Ondatra zibethicus	Muskrat		U
MAMMAL-RO	Erethizon dorsatum	Porcupine		C
MAMMAL-RO	Castor canadensis	Beaver		C
MAMMAL-RO-M	Zapus trinotatus	Pacific Jumping Mouse		C
MAMMAL-RO-M	Mus musculus	House Mouse	EXOTIC	C
MAMMAL-RO-M	Peromyscus maniculatus	Deer Mouse		C
MAMMAL-RO-M	Clethrionomys californicus	Western Red-backed Vole		C
MAMMAL-RO-MI	Microtis longicaudus abditus	Long-tailed Vole		C
MAMMAL-RO-MI	Microtis oregoni	Creeping Vole		C
MAMMAL-RO-MI	Microtus townsendii	Townsend's Vole		C
MAMMAL-RO-SQ	Spermophilus beecheyi	California Ground Squirrel		C
MAMMAL-RO-NE	Neotoma cinerea	Bushy-tailed Woodrat		C
MAMMAL-RO-NE	Neotoma fuscipes	Dusky-footed Woodrat		C
MAMMAL-RO-PH	Phenacomys longicaudus	Red Tree Vole	S&M	U
MAMMAL-RO-PH	Phenacomys (Arborimus) albipes	White-footed Vole	SC/U/3/S	R
MAMMAL-RO-RA	Rattus rattus	Black Rat	EXOTIC	C
MAMMAL-RO-RA	Rattus norvegicus	Norway Rat	EXOTIC	C
MAMMAL-RO-SQ	Tamias townsendii	Townsend's Chipmunk		C

CLASS	SCIENTIFIC NAME	COMMON NAME	STATUS	ABUND
MAMMAL-RO-SQ	Spermophilus beecheyi	California Ground Squirrel		C
MAMMAL-RO-SQT	Glaucomys sabrinus	Northern Flying Squirrel		C
MAMMAL-RO-SQT	Tamiasciurus douglasii	Douglas' Squirrel		C
MAMMAL-RO-SQT	Sciurus griseus	Western Gray Squirrel (WV)		U
MAMMAL-SEA	Zalophus californianus	California Sea Lion		U
MAMMAL-SEA	Phoca vitulina	Harbor Seal		C
MAMMAL-SEA	Eumetopias jubatus	Northern Sea Lion	T/V/3/T	U
MAMMAL-SEA	Mirounga angustirostris	Northern Elephant Seal		O
REPTILE-LIZ	Elgaria coerulea	Northern Alligator Lizard		C
REPTILE-LIZ	Eumeces skiltonianus	Western Skink		C
REPTILE-LIZ	Sceloporus occidentalis	Western Fence Lizard		C
REPTILE-S	Charina bottae	Rubber Boa		U
REPTILE-S	Coluber constrictor	Racer		U
REPTILE-S	Diadophis punctatus	Ringneck Snake		U
REPTILE-S	Pituophis melanoleucus	Gopher snake		U
REPTILE-STH	Thamnophis elegans	Western Terrestrial Garter		U
REPTILE-STH	Thamnophis sirtalis	Common Garter Snake		C
REPTILE-STH	Thamnophis ordinoides	Northwestern Garter Snake		C
REPTILE-TUR	Clemmys marmota marmota	Norwestern Pond Turtle	SC/C/2/S	R
Selected FISH	***************************	************************	**********	*******
SF-FS	Oncorhynchus mykiss	Steelhead	PT/-/-/PT	C
SF-FS	Oncorhynchus keta	Chum Salmon		C
SF-FS	Oncorhynchus nerka	Sockeye Salmon		U
SF-FS	Oncorhynchus tshawytscha	Chinook Salmon		C
SF-FS	Oncorhynchus kisutch	Coho Salmon	PT/-/-/PT	C
SF-FSA	Oncorhynchus clarki clarki	Coastal Cutthroat Trout		C
SF-FSL	Lampetra tridentata	Pacific lamprey	SC	R
SF-FSL	Lampetra ayresi	River lamprey	SC	
SF-FST	Acipenser transmontanus	White Sturgeon		C
SF-FST	Acipenser medirostris	Green Sturgeon	SC	C
Selected Inverts.	***************************	************************	**********	*******
SI-INSECT	Speyeria zerene hippolyta	Oregon Silverspot Butterfly	T/-/1/T	
SI-INSECTC	Ceraclea vertreesi	Vertrees's Ceraclean	SC	
SI-INSECTC	Rhyacophila haddocki	Haddock's Caddisfly	SC/-/3/-	
SI-INSECTC	Ochrotrichia alsea	Alsea Micro Caddisfly	-/-/3/-	
SI-SN	Algamorda newcombiana	Newcomb's Littorine Snail	SC	

Appendix D: Seral Stage Correlation between Big Nestucca Watershed, Little Nestucca Watershed and Neskowin Watershed.

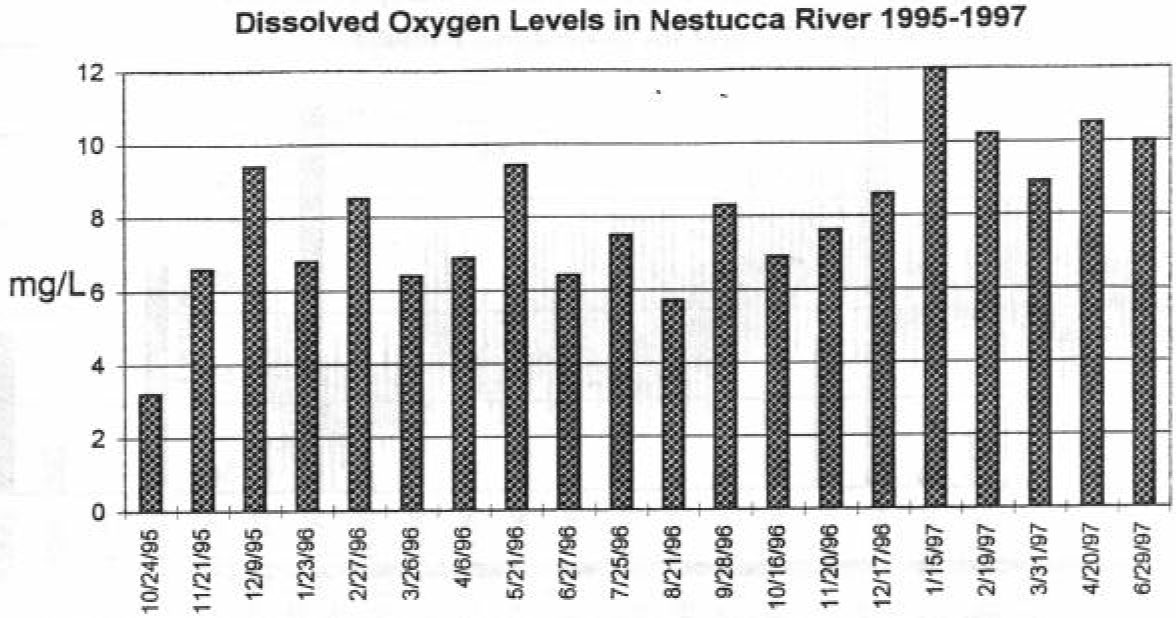
The Nestucca/Neskowin Watershed Analysis classified seral stages using the seral stage classification system of the Late-Successional Reserve Assessment for Oregon's North Coast Range Adaptive Management Area (US Forest Service and Bureau of Land Management 1997). While data exists using this system for Neskowin, the Big Nestucca Watershed and Little Nestucca Watershed, there were data gaps in the Big Nestucca Watershed and Little Nestucca Watershed. Other, more complete, seral stage classifications for the Big Nestucca Watershed and Little Nestucca Watershed were available from Watershed Analyses produced by the US Forest Service and Bureau of Land Management. These classes were converted to the Late-Successional Reserve Assessment's seral stage classification. (DBH = diameter of tree at breast height or 4 and ½ feet above ground level.)

Late-Successional Reserve Assessment Seral Stages (Neskowin Watershed)	**Big Nestucca Watershed Analysis Seral Stages (USFS and BLM 1994)**	**Little Nestucca Watershed Analysis Seral Stages (USFS in prep)**
Pioneer: 0-10 years old, conifer or hardwood trees less than 5 inches dbh	Agricultural lands Herb/Forb: 0 to 5 years old Shrub: 6-14 years old	Grass/forb Very Early Seral: 0 to 10 years old, conifer or hardwood trees.
Very Early Seral: 11 to 24 years old, 5 to 10 inches dbh, overstory is 50% or more conifer species.	Sapling/Pole: 15 to 34 years old, 5-9.9 inches dbh, overstory is 80% or more conifer species.	Early Seral: 11 to 24 years old, less than 8 inches dbh, overstory is 80% or more conifer species. Conifer Mixed Pole: 11 to 24 years old, less than 8 inches dbh, overstory is 50-80% conifer species.
Very Early Seral—Mixed: 11 to 24 years old, 5 to 10 inches dbh, overstory is 50-80% hardwood species.	None	Hardwood Mixed Pole: 11 to 24 years old, less than 8 inches dbh, overstory is 50-80% hardwood species.
Early Seral: 25 to 49 years old, 5 to 18 inches dbh, overstory is 50% or more conifer species.	Conifer/Hardwood (Early to Mid Seral): All ages, overstory is 51-80% conifer species.	Young Conifer: 25 years or older, 8 to 21 inches dbh, overstory is 80% or more conifer species. Young Conifer Mixed: 25 years or older, 8 to 21 inches dbh, overstory is 50-80% conifer species.
Early Seral—Mixed: 25 to 49 years old, 5 to 18 inches dbh, overstory is 50-80% hardwood species.	Hardwood/Conifer (Early to Mid Seral): All ages, overstory is 51-80% hardwood species.	Young Hardwood Mixed: 25 years or older, 8 to 21 inches dbh, overstory is 50-80% hardwood species.
Mid Seral: 50 to 79 years old, 10 to 18 inches dbh, overstory is 50% or more conifer species.	Small Conifer: 35 to 74 years old, 10-17.9 inches dbh, overstory is 80% or more conifer species.	Mature Conifer: 21 to 32 inches dbh, overstory is 80% or more conifer species. Mature Conifer Mixed: 21 to 32 inches dbh, overstory is 50-80% conifer species.
Mid Seral—Mixed: 50 to 79 years old, 10 to 18 inches dbh, overstory is 50-80% hardwood species.	None	Mature Hardwood Mixed: 21 to 32 inches dbh, overstory is 50-80% hardwood species.

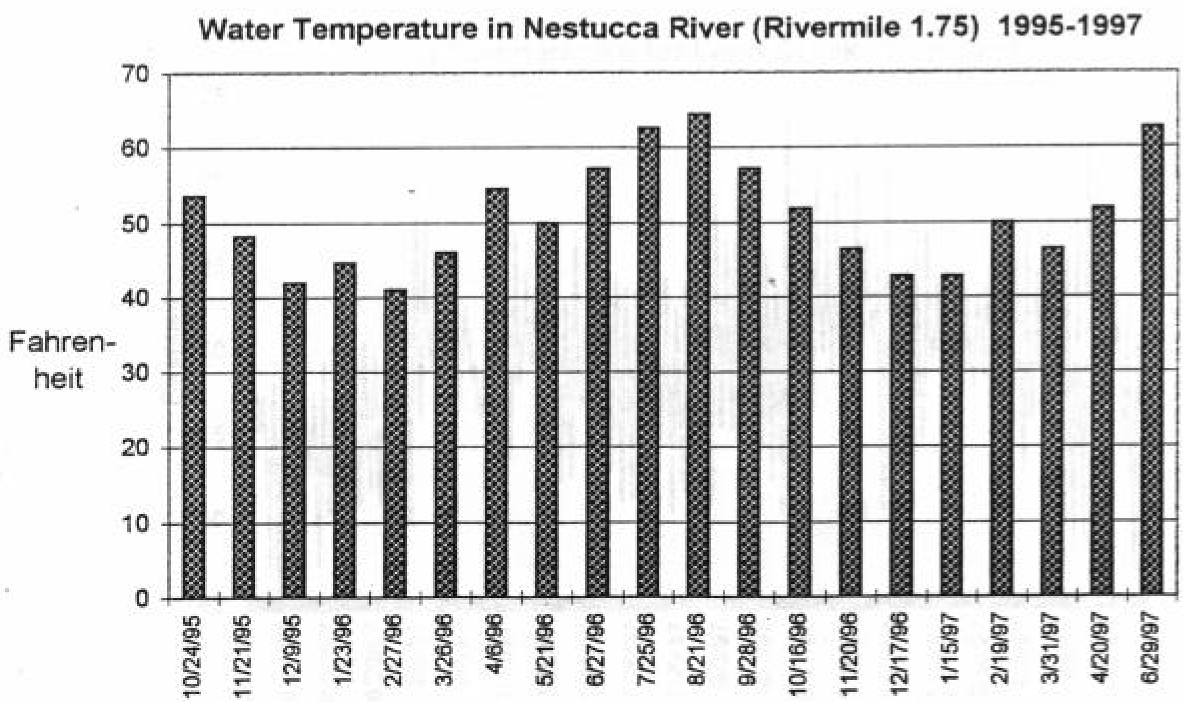
Appendix D. Seral Stage Correlation between Big Nestucca Watershed, Little Nestucca Watershed, and Neskowin Watershed

Late-Successional Reserve Assessment Seral Stages (Neskowin Watershed)	**Big Nestucca Watershed Analysis Seral Stages (USFS and BLM 1994)**	**Little Nestucca Watershed Analysis Seral Stages (USFS in prep)**
Late Seral—Mixed: 80 years or older, 19 or more inches dbh, overstory is 50-80% hardwood species	None	None
Pure Hardwood: All ages, overstory is 80% or more hardwood species.	Alder Dominated: All ages, overstory is less than 20% conifer species.	Hardwood: all ages, overstory is 80% or more hardwood species.
Residential, Rock, or Sand	None	Rock and Sand
Water	Water	Water

Appendix E. Water Quality Data for Nestucca River at Rivermile 1.75. (Courtesy of Nestucca Middle School.)

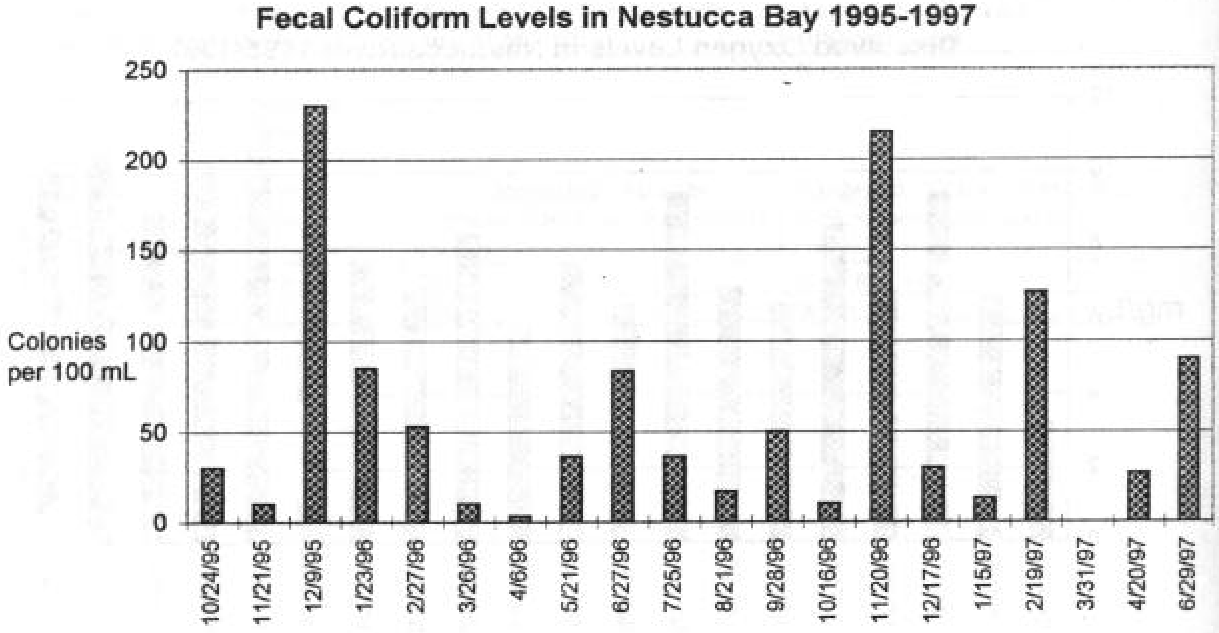


Data Gathered by Nestucca Middle School through the COASTnet Estuary Water Quality Monitoring Program, Hatfield Marine Science Center, O.S.U. No water quality conclusions should be drawn from this data, as the sampling schedule of one day per month is not sufficient.



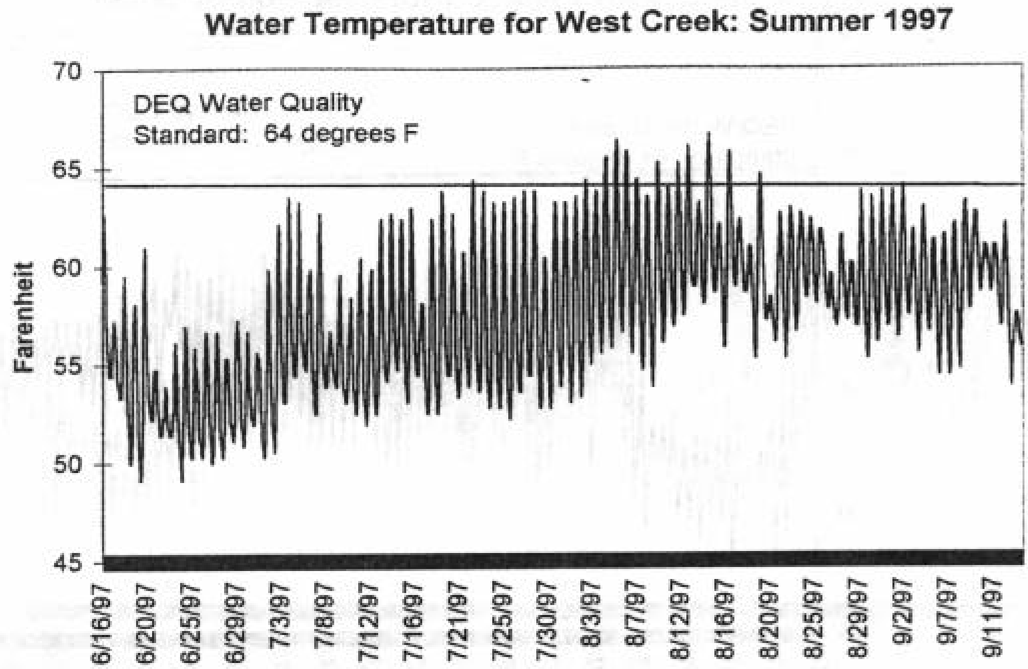
Data Gathered by Nestucca Middle School through the COASTnet Estuary Water Quality Monitoring Program, Hatfield Marine Science Center, O.S.U. This data does not represent a seven-day average. No water quality conclusions should be drawn from this data, as the sampling schedule of one day per month is not sufficient.

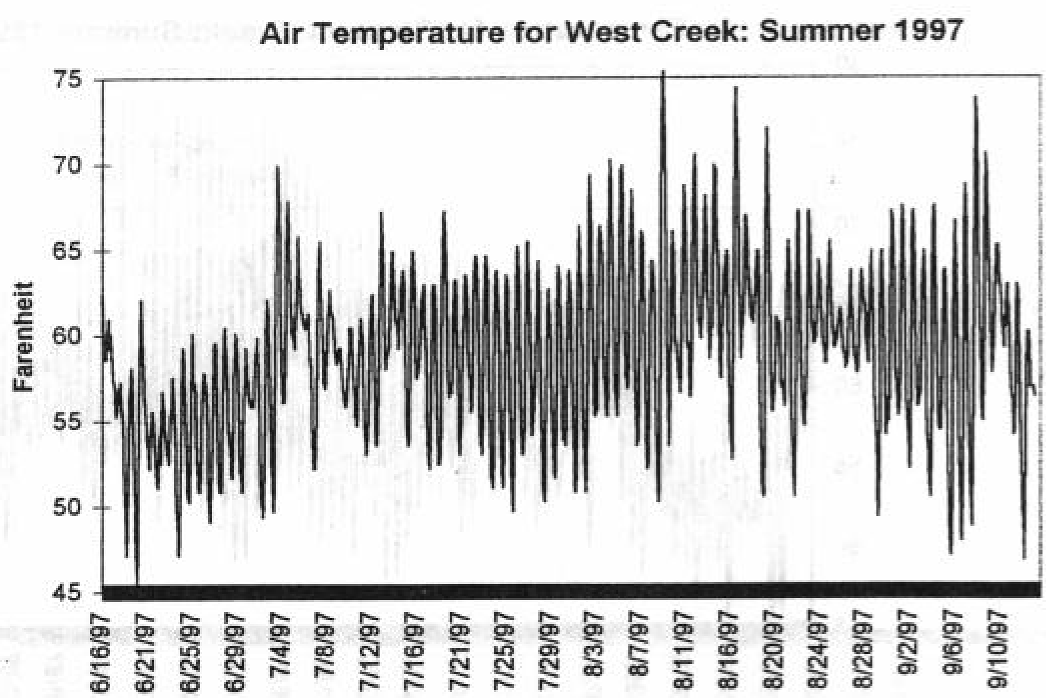
Appendix E. Water Quality Data for Nestucca River at Rivermile 1.75. (Courtesy of Nestucca Middle School.)



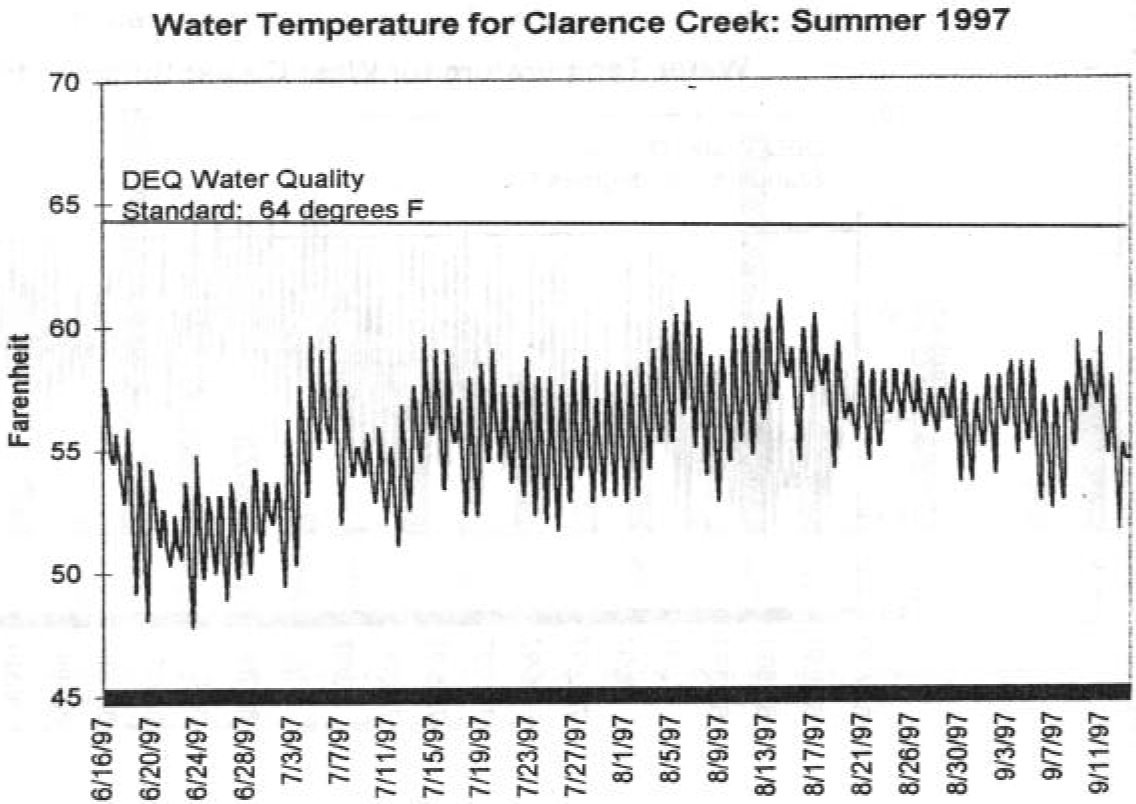
Data Gathered by Nestucca Middle School through the COASTnet Estuary Water Quality Monitoring Program, Hatfield Marine Science Center, O.S.U. No water quality conclusions should be drawn from this data, as the sampling schedule of one day per month is not sufficient.

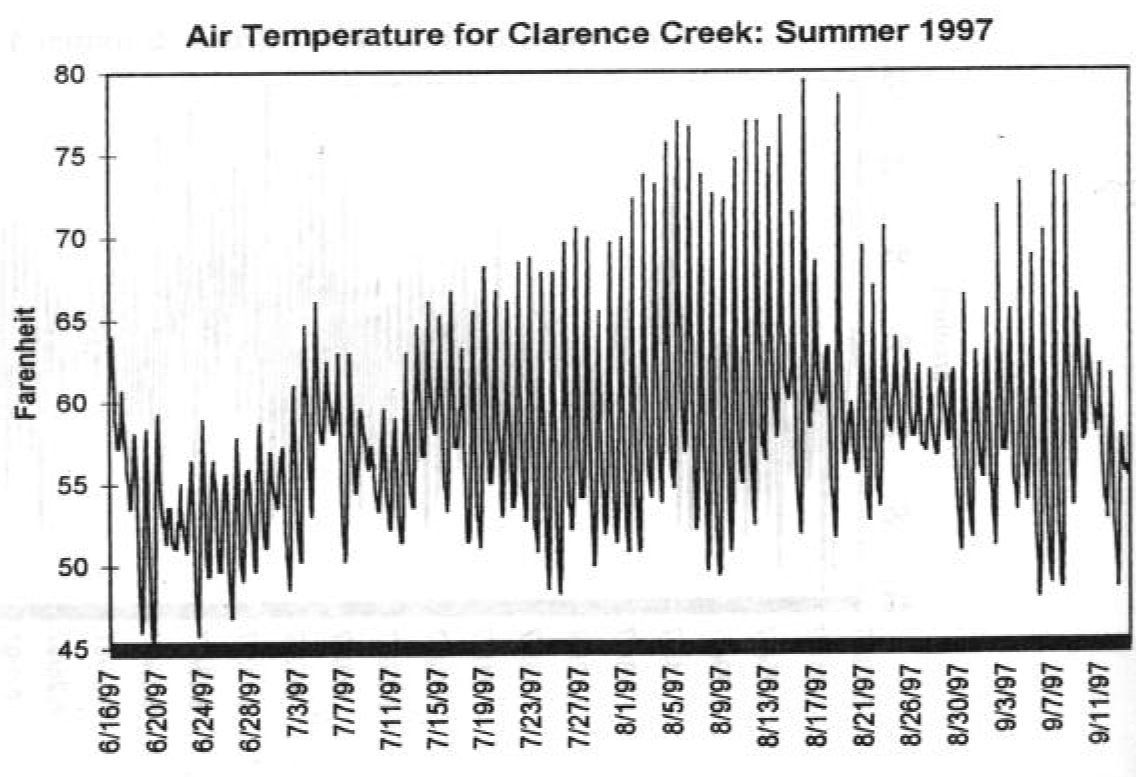
Appendix F. Water Temperature Data Collected by Nestuccca/Neskowin Watershed Council (Summer 1997)



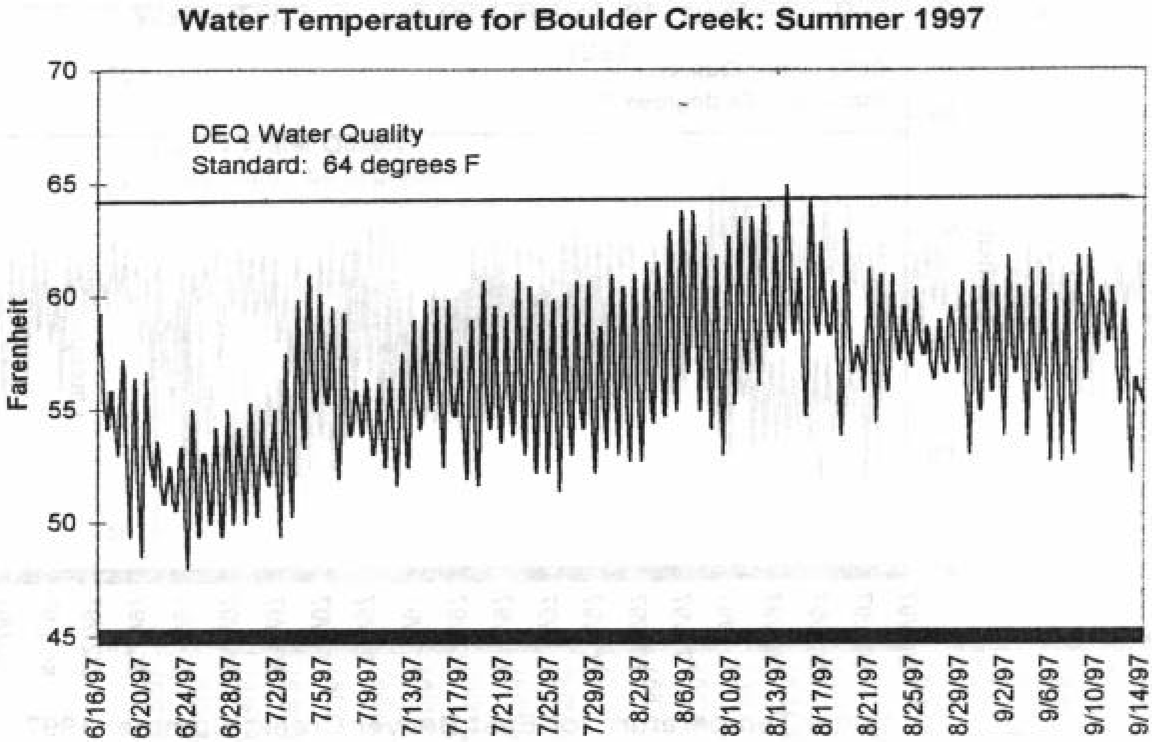


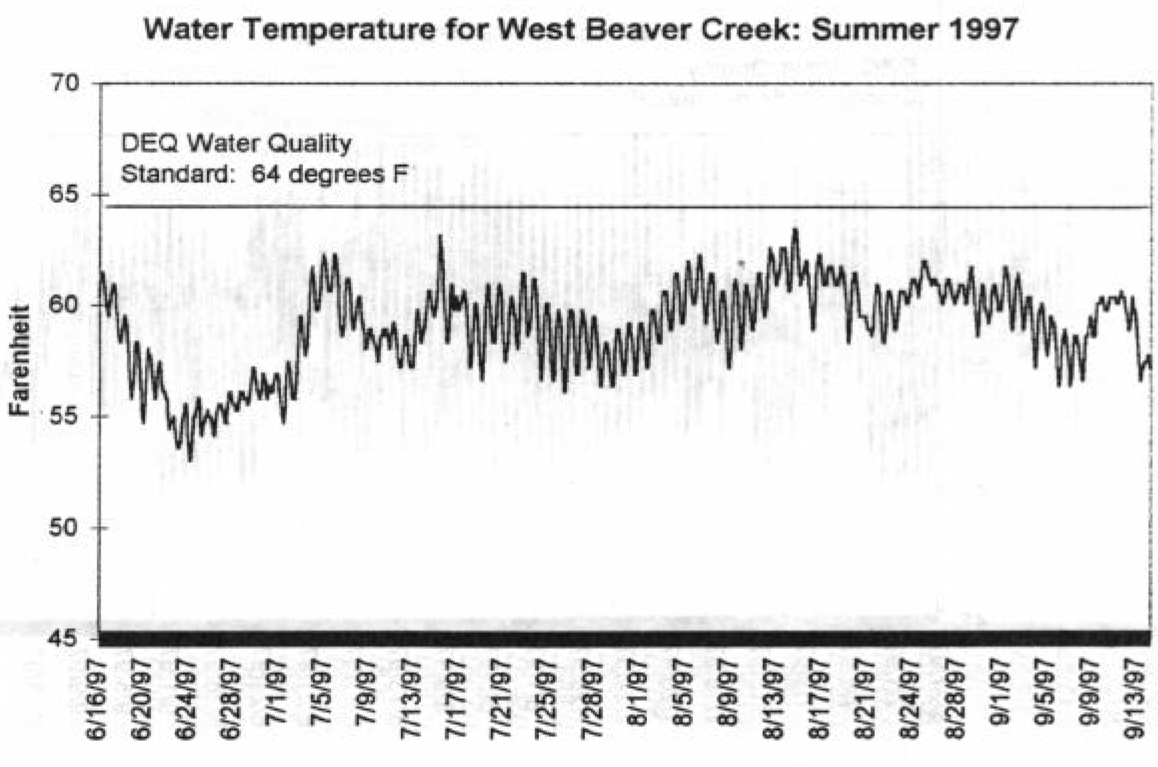
Appendix F. Water Temperature Data Collected by Nestuccca/Neskowin Watershed Council (Summer 1997)



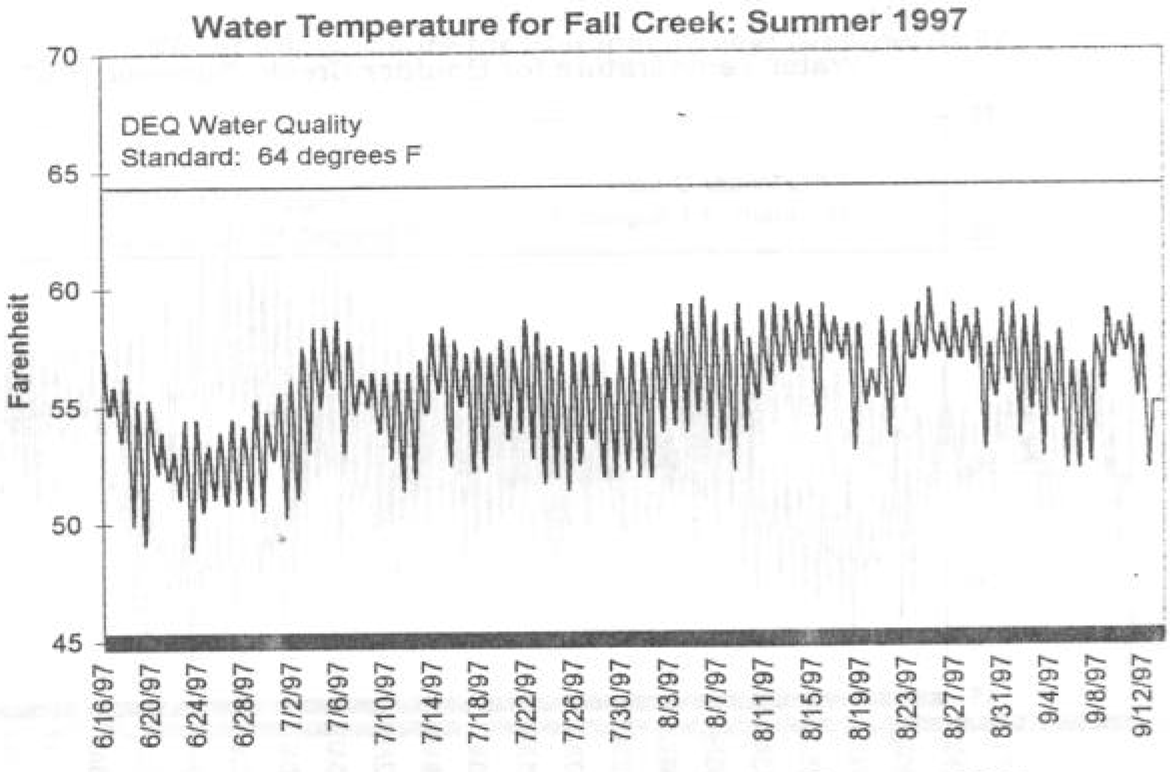


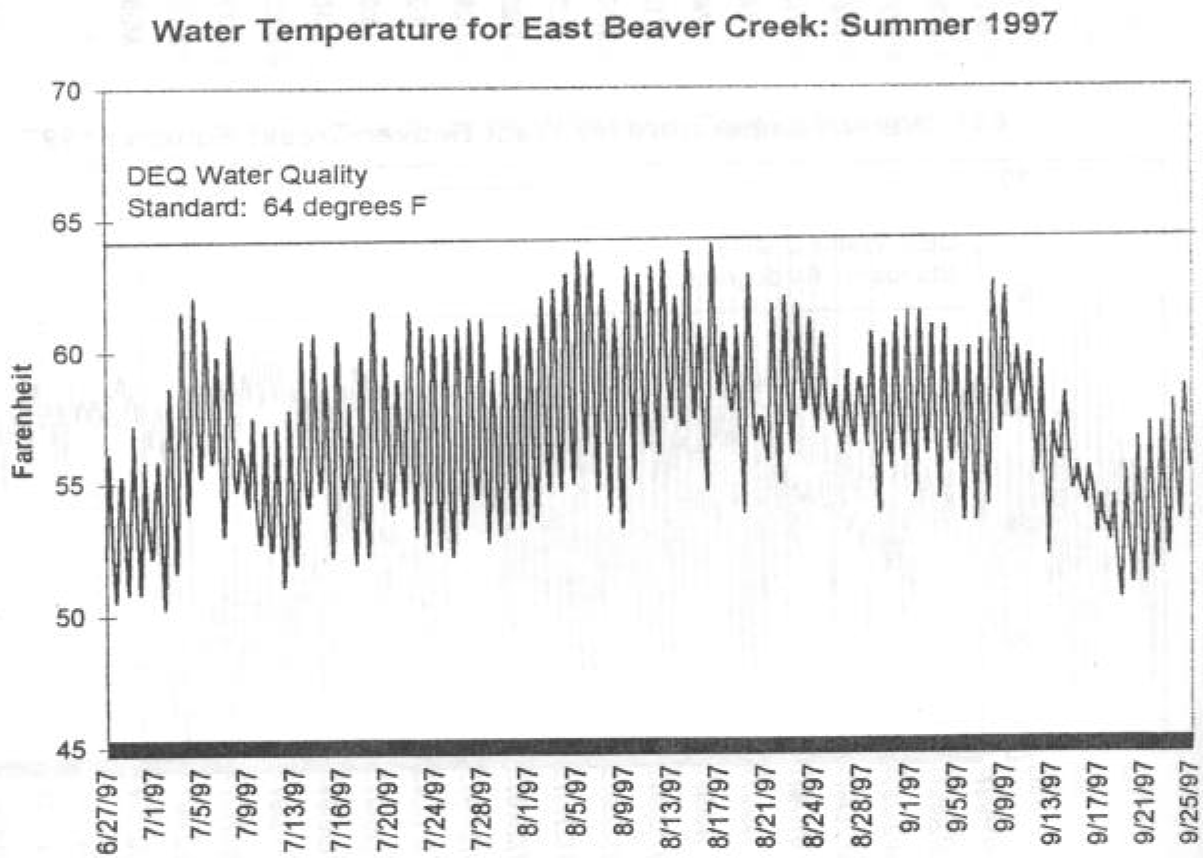
Appendix F. Water Temperature Data Collected by Nestuccca/Neskowin Watershed Council (Summer 1997)



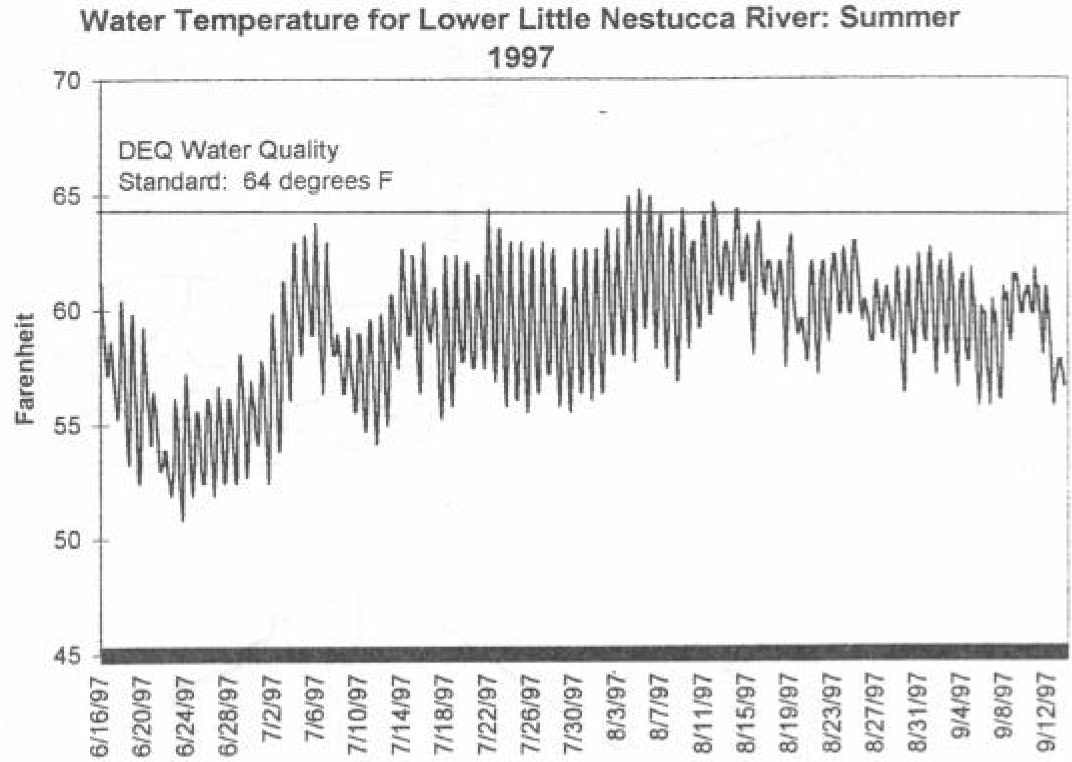


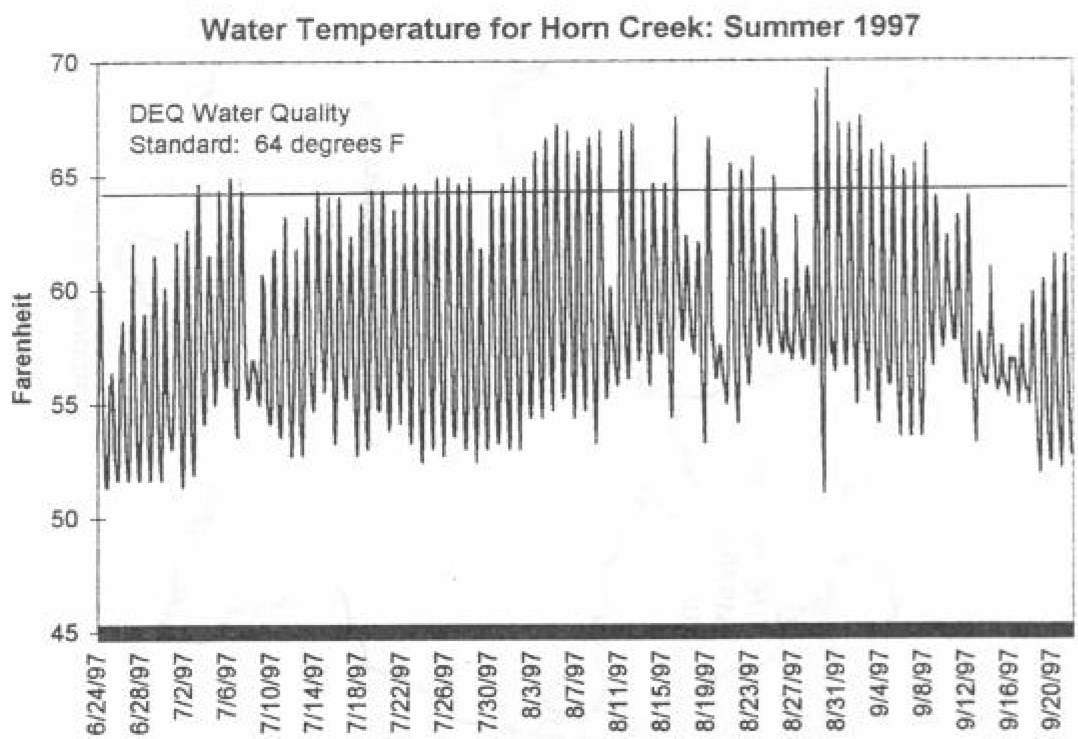
Appendix F. Water Temperature Data Collected by Nestuccca/Neskowin Watershed Council (Summer 1997)



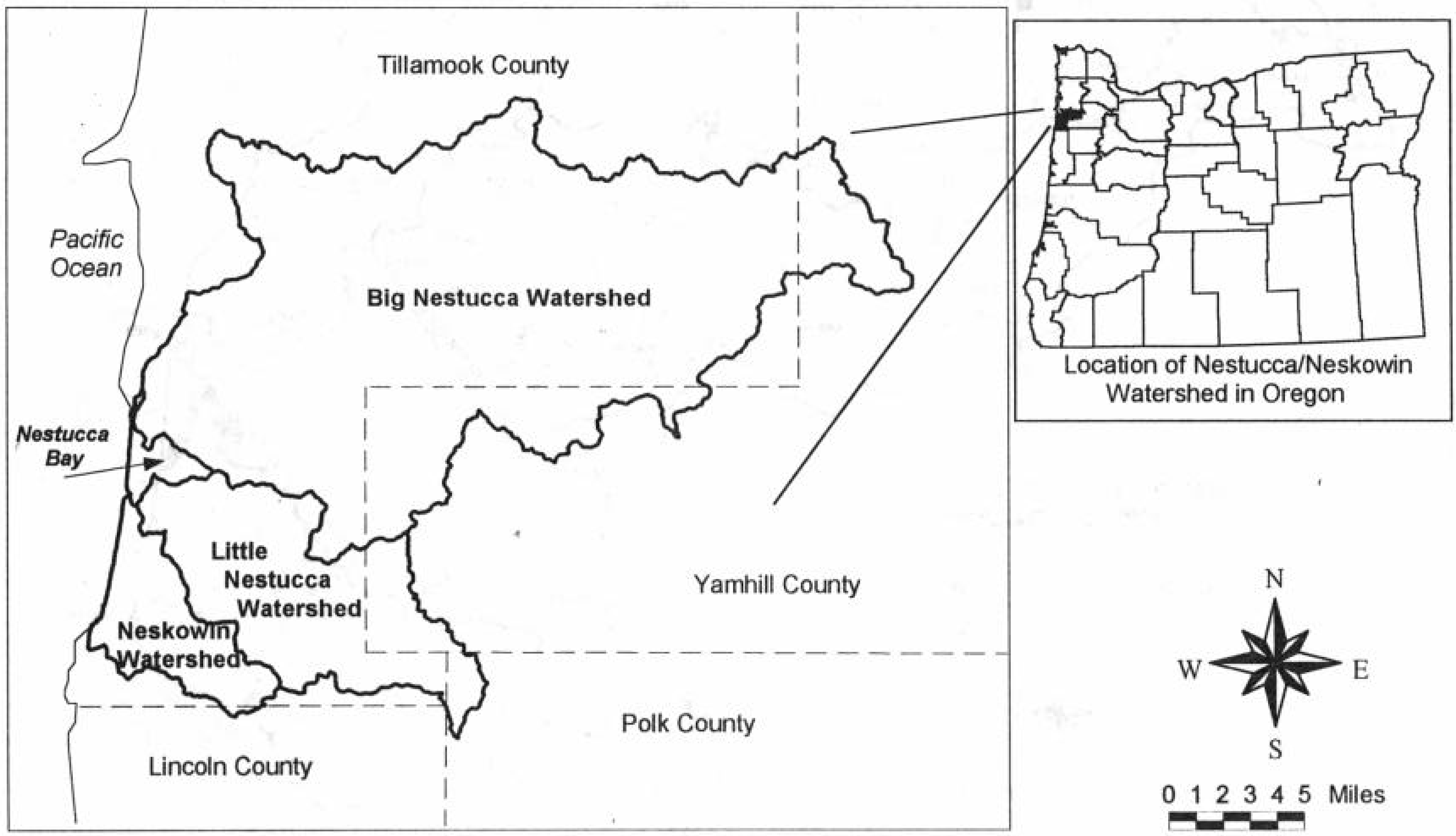


Appendix F. Water Temperature Data Collected by Nestuccca/Neskowin Watershed Council (Summer 1997)





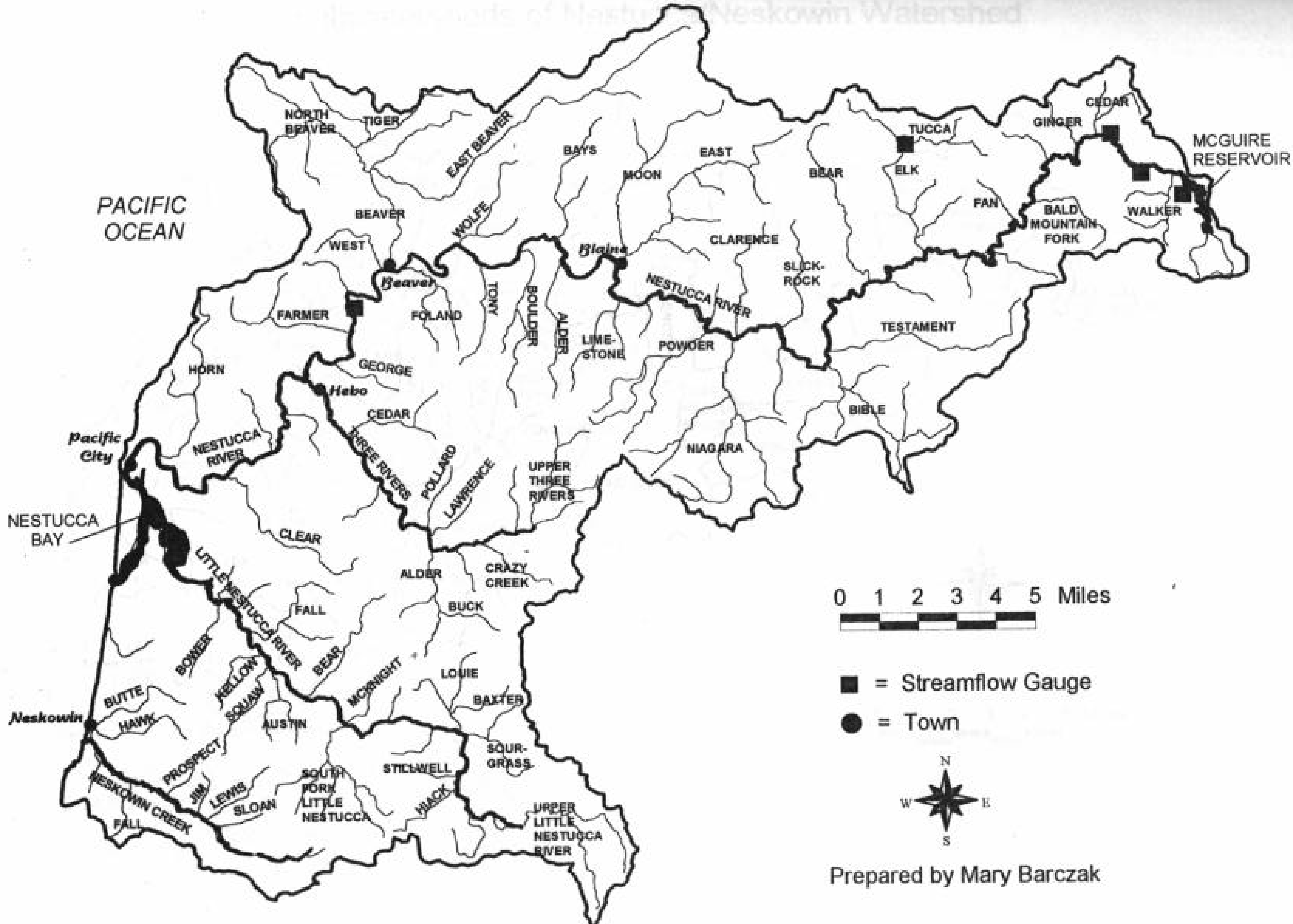
Geographic Location of Nestucca/Neskowin Watershed



Map 1

Prepared by Mary Barczak

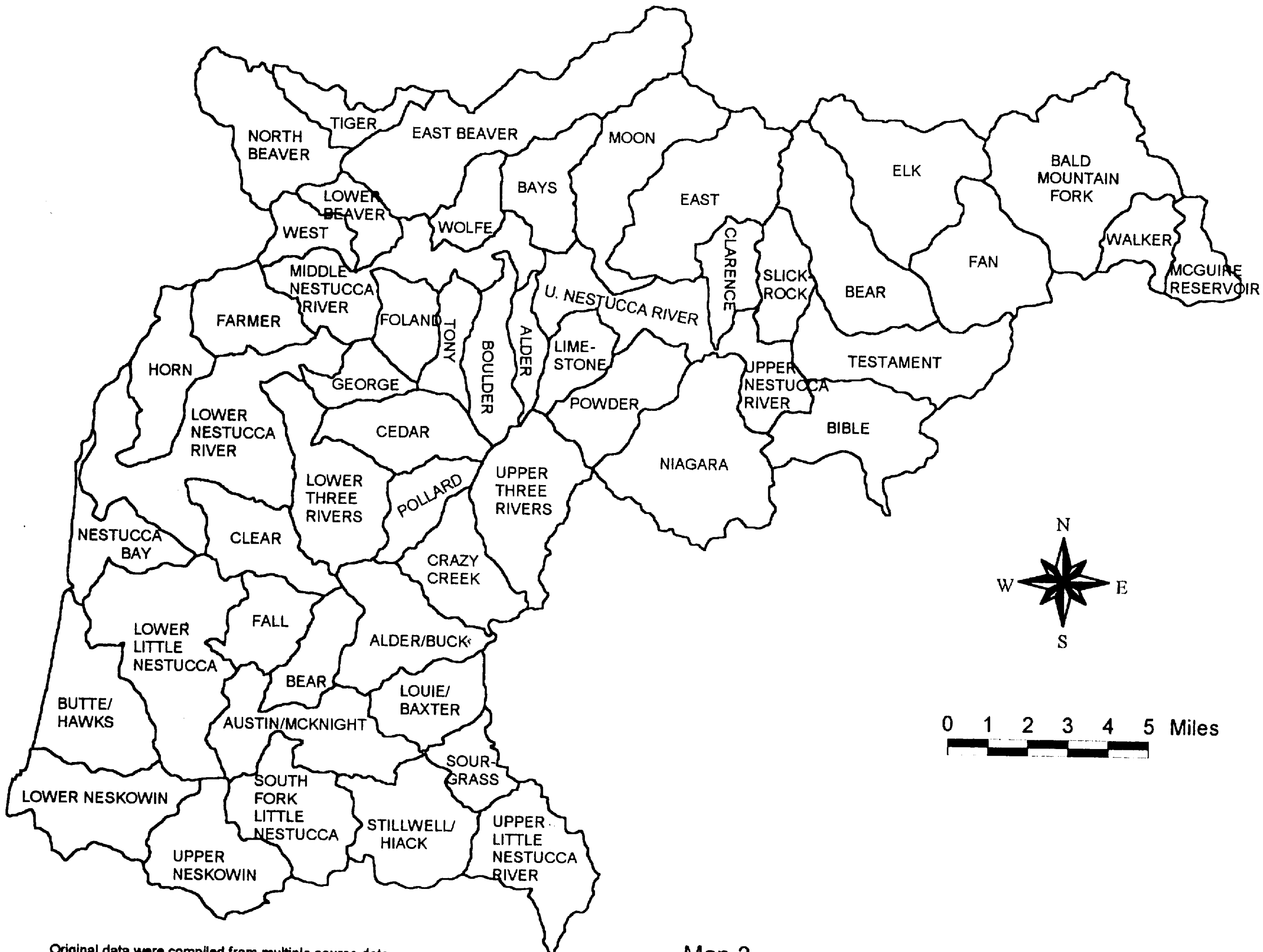
Streams of Nestucca/Neskowin Watershed



Map 2

Original data were compiled from multiple source data and may not meet U.S. National Mapping Standards of the Office of Management and Budget. For specific data source dates and additional information, contact the Nestucca/Neskowin Watershed Council.

Subwatersheds of Nestucca/Neskowin Watershed

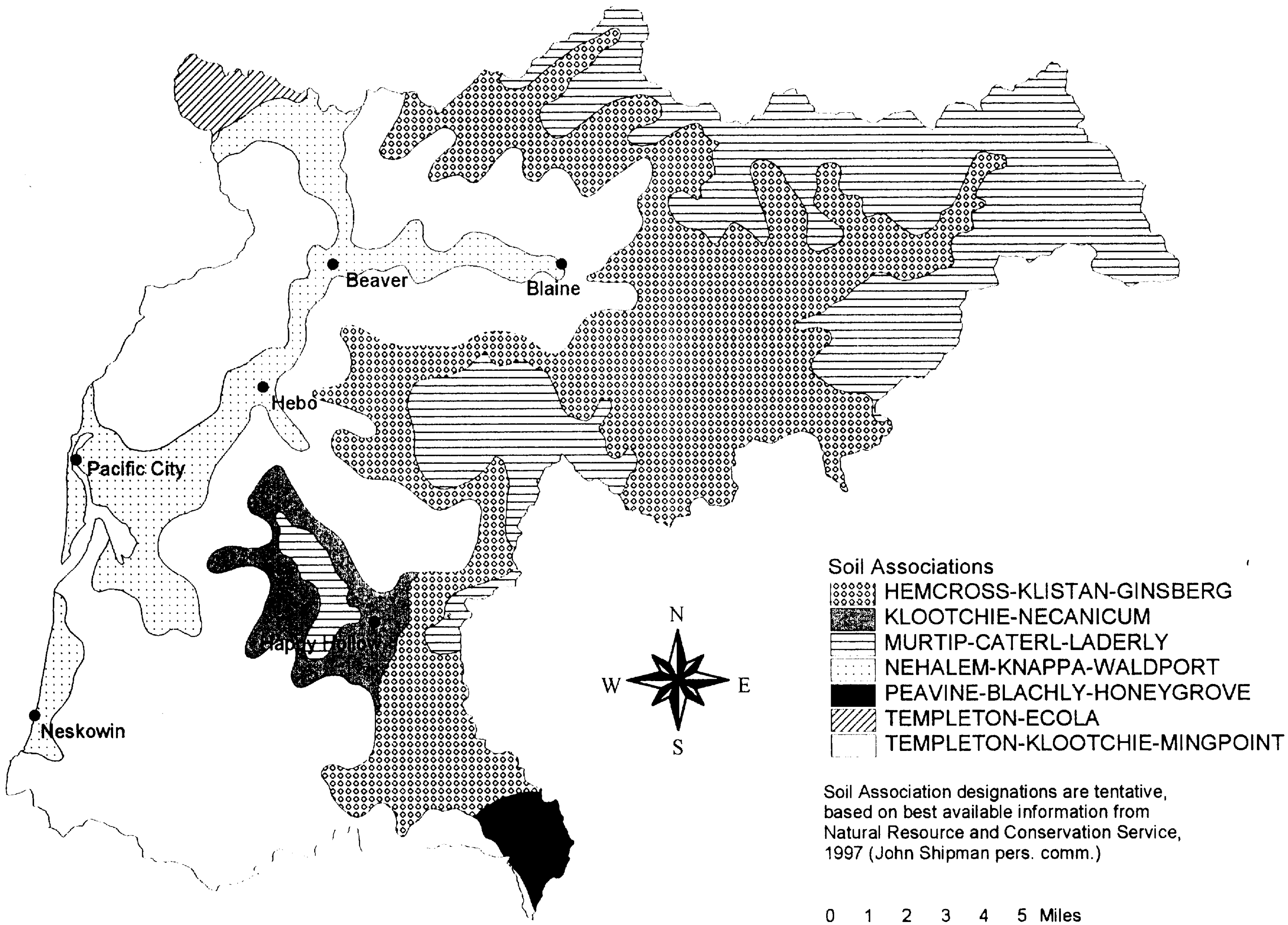


Original data were compiled from multiple source data and may not meet U.S. National Mapping Standards of the Office of Management and Budget. For specific data source dates and additional information, contact the Nestucca/Neskowin Watershed Council.

Map 3

Prepared by Mary Barczak

Soil Associations: Nestucca/Neskowin Watershed



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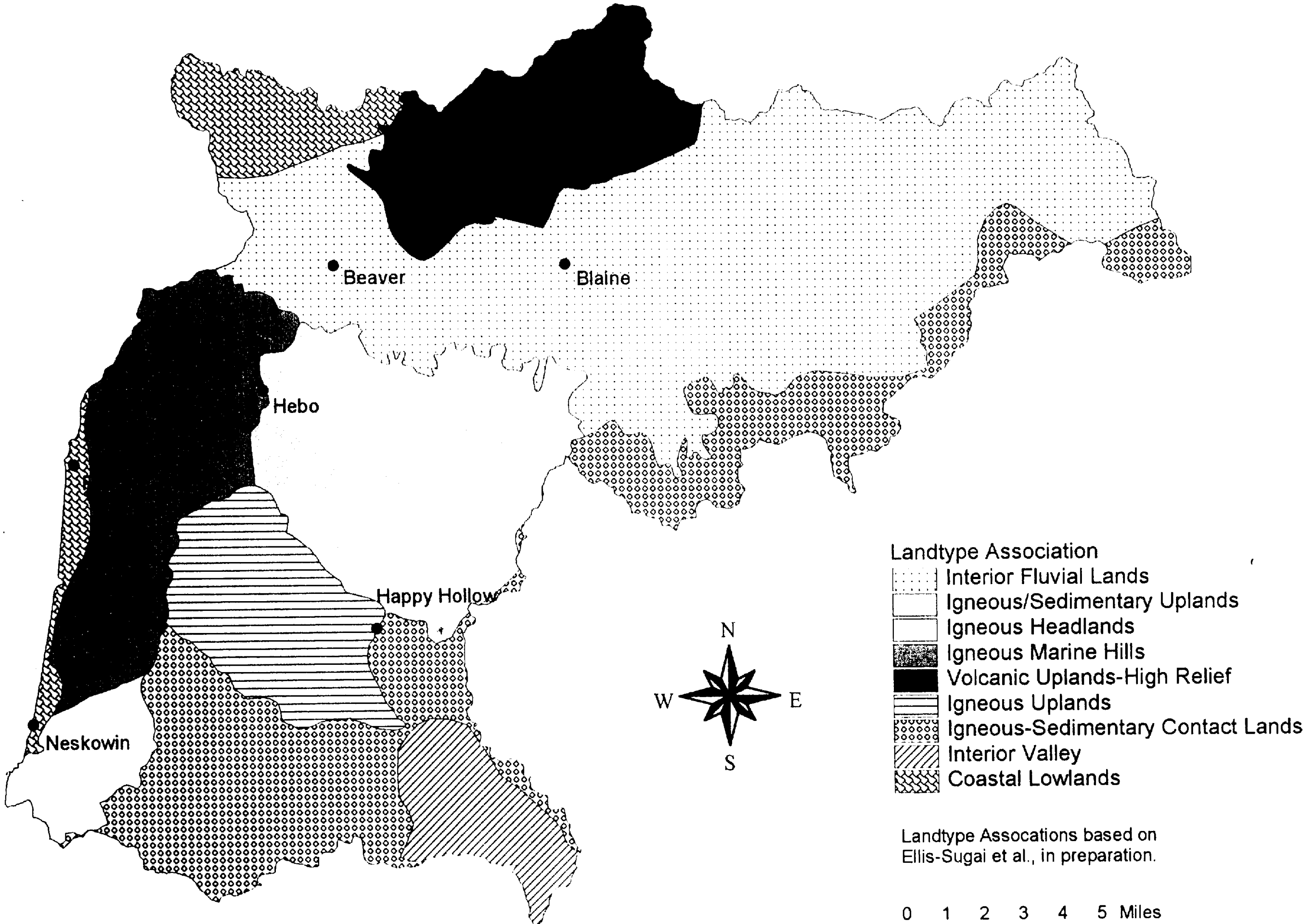
Map 4

Prepared by Mary Barczak

Landtype Associations: Nestucca/Neskowin Watershed



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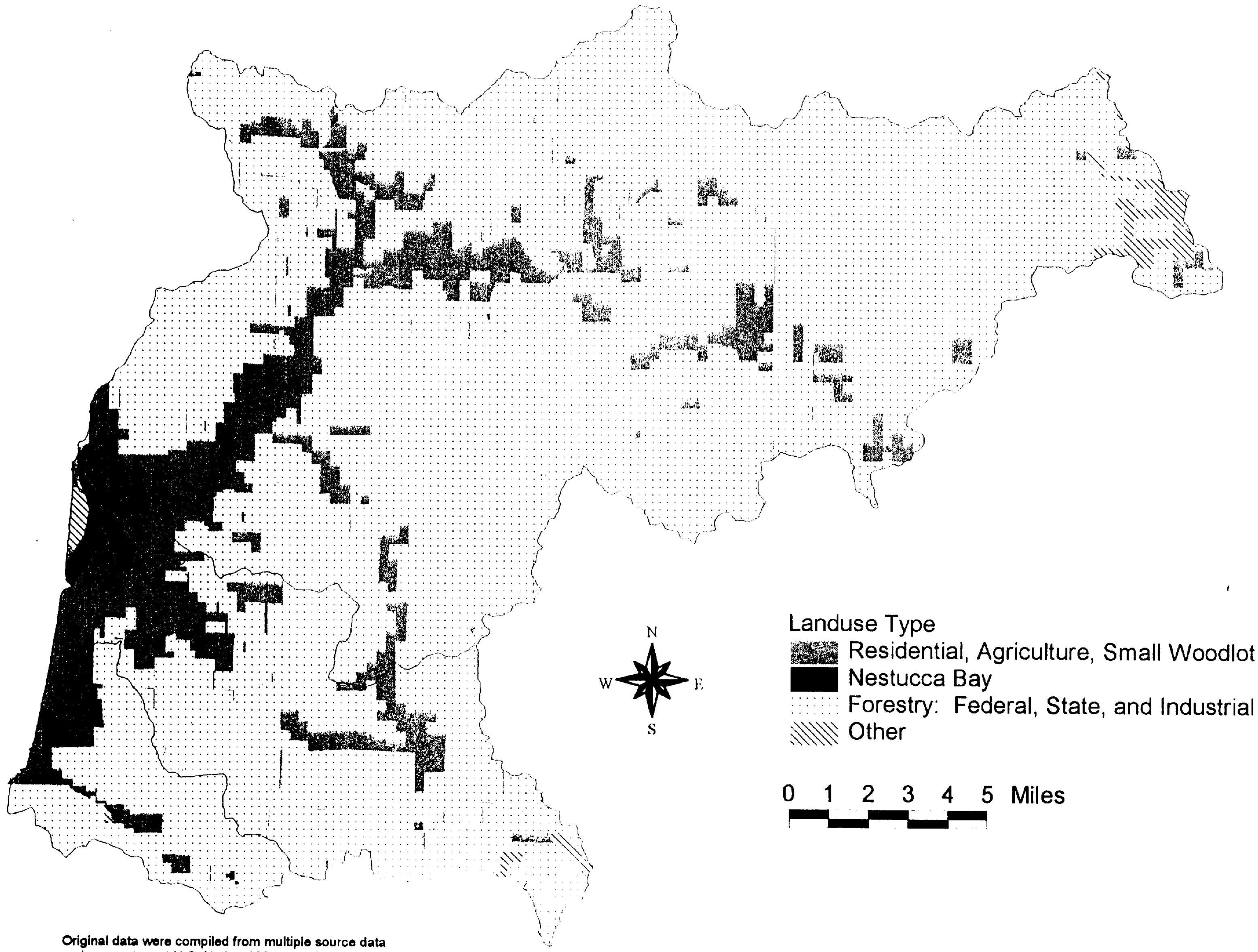
Map 5

Prepared by Mary Barczak

Landuse: Nestucca/Neskowin Watershed



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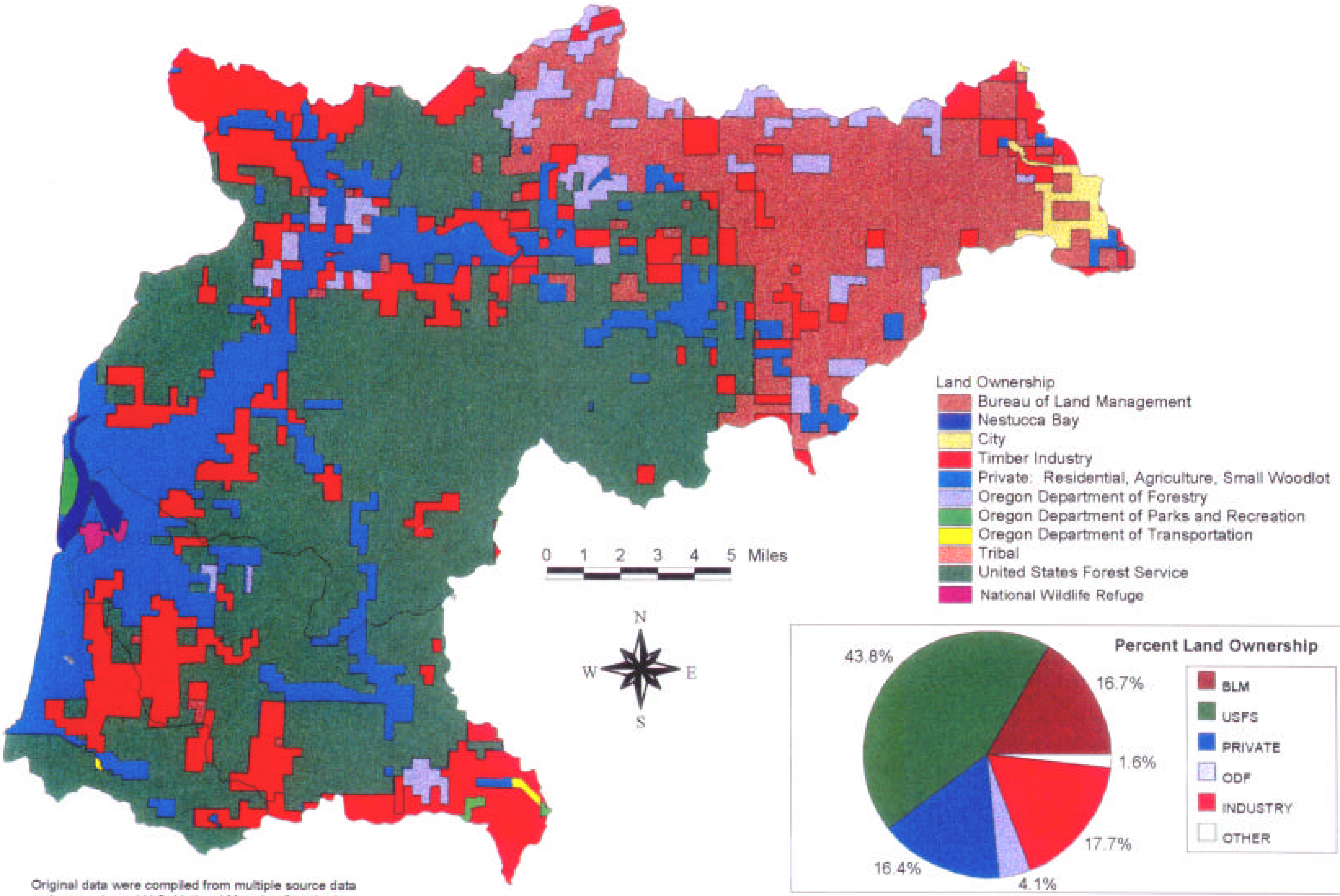
Map 6

Prepared by Mary Barczak

Land Ownership in the Nestucca/Neskowin Watershed



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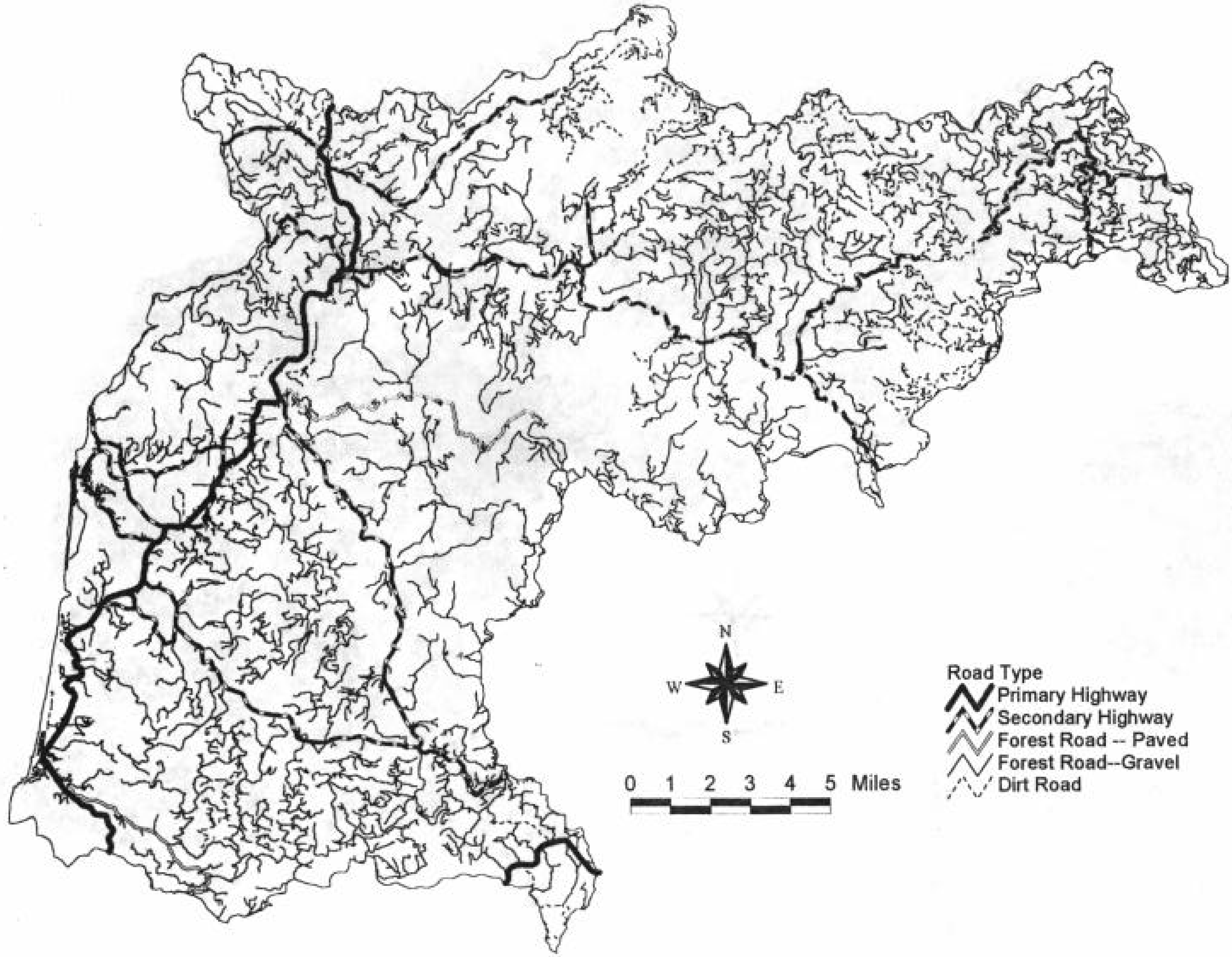
Map 7

Prepared by Mary Barczak

Road Types in Nestucca/Neskowin Watershed

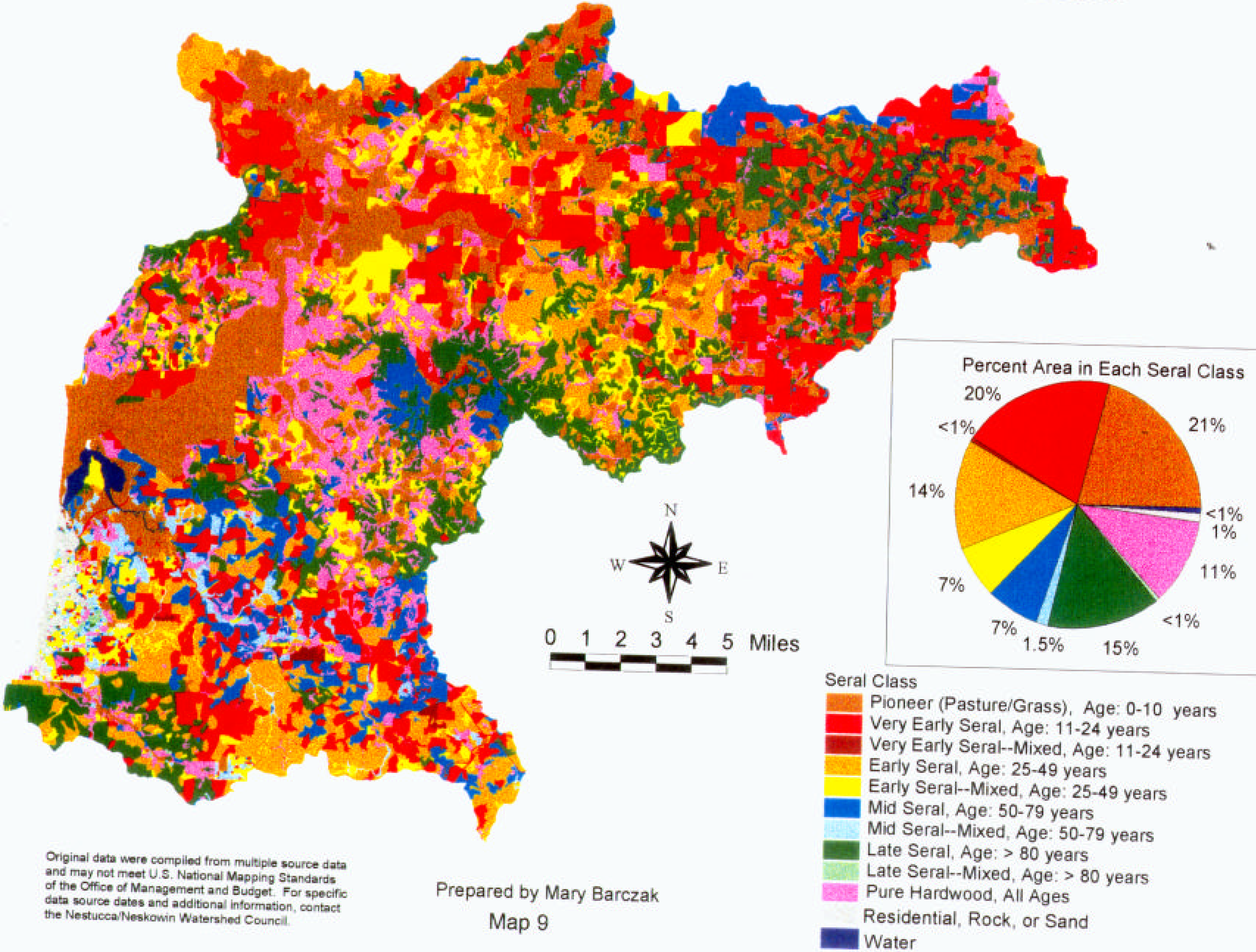


Original data were compiled from multiple source data and may not meet U.S. National Mapping Standards of the Office of Management and Budget. For specific data source dates and additional information, contact the Nestucca/Neskowin Watershed Council.

Map 8

Prepared by Mary Barczak

Vegetation (Seral Class) of Nestucca/Neskowin Watershed

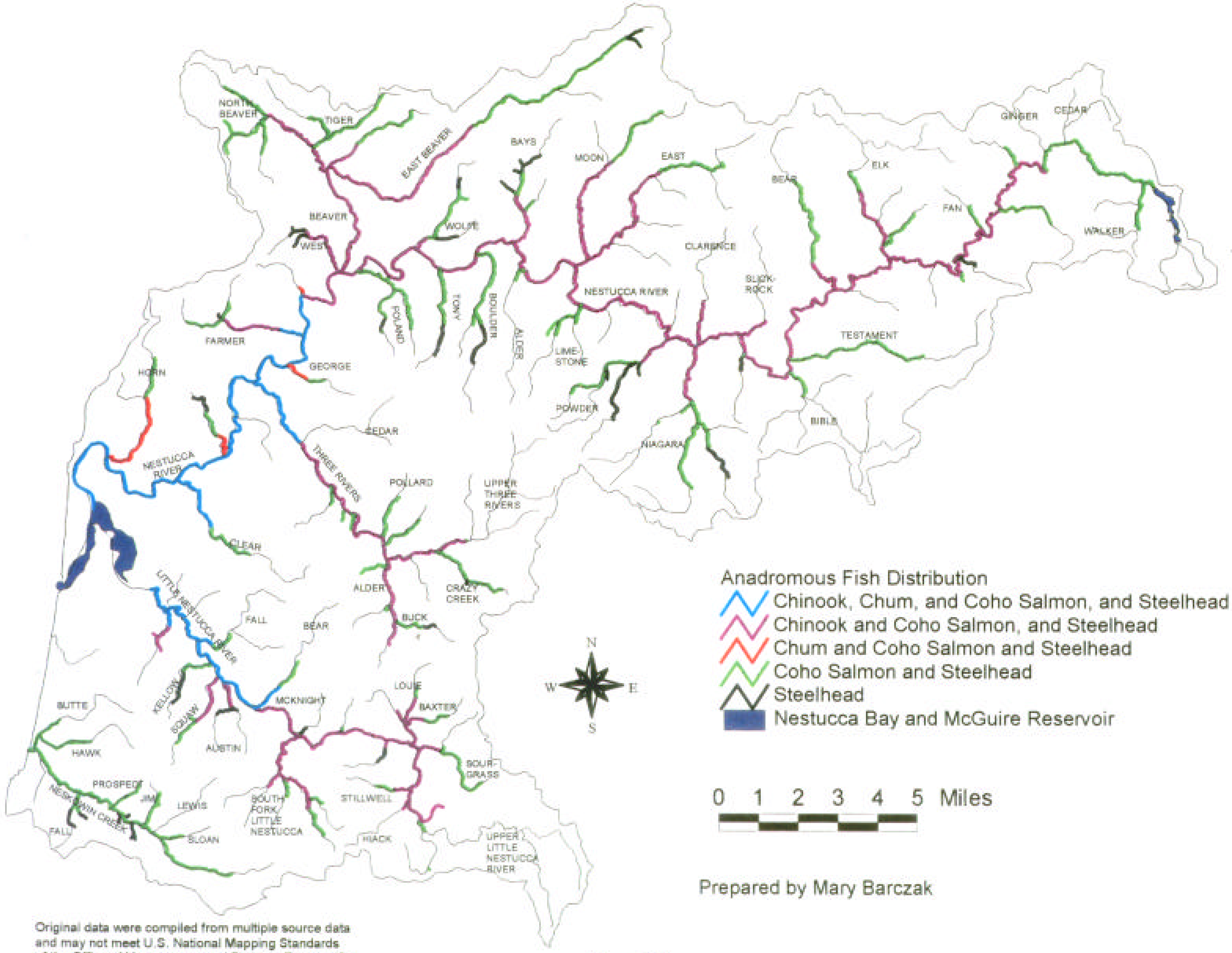


Original data were compiled from multiple source data and may not meet U.S. National Mapping Standards of the Office of Management and Budget. For specific data source dates and additional information, contact the Nestucca/Neskowin Watershed Council.

Prepared by Mary Barczak

Map 9

Anadromous Fish Distribution: Nestucca/Neskowin Watershed

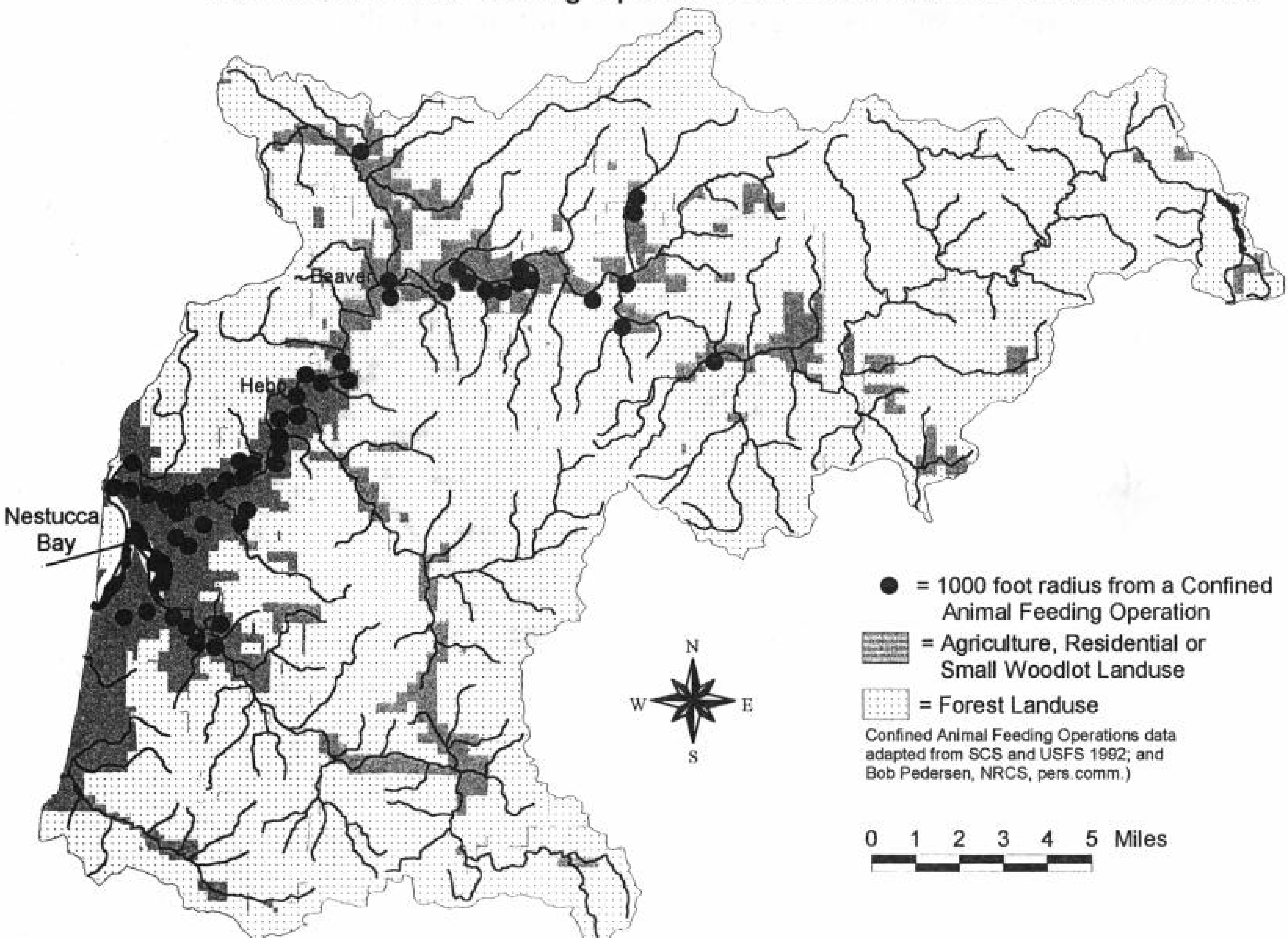


Prepared by Mary Barczak

Original data were compiled from multiple source data and may not meet U.S. National Mapping Standards of the Office of Management and Budget. For specific data source dates and additional information, contact the Nestucca/Neskowin Watershed Council.

Map 10

Confined Animal Feeding Operations in Nestucca/Neskowin Watershed

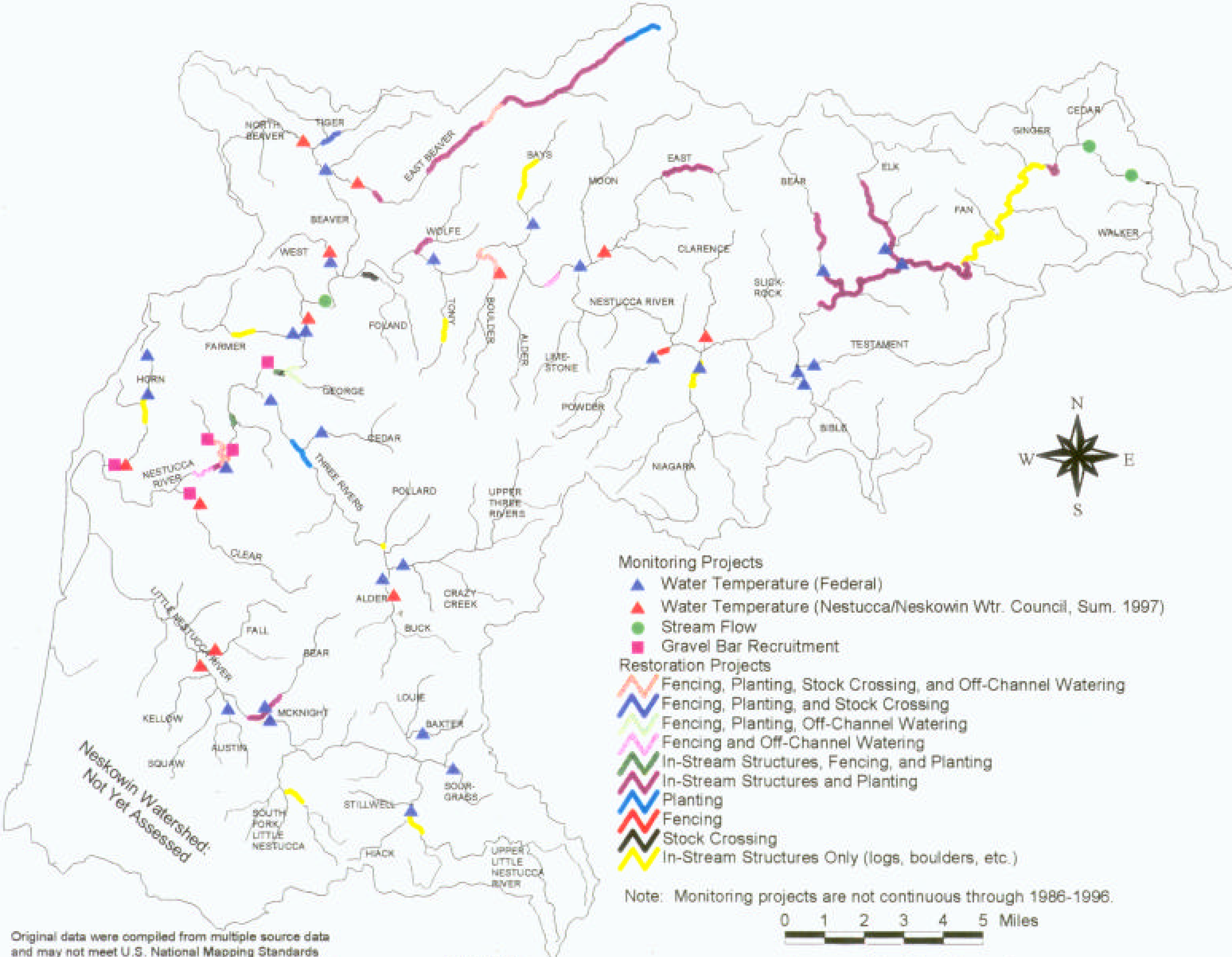


Original data were compiled from multiple source data and may not meet U.S. National Mapping Standards of the Office of Management and Budget. For specific data source dates and additional information, contact the Nestucca/Neskowin Watershed Council.

Map 11

Prepared by Mary Barczak

Watershed Monitoring and Restoration Projects in the Nestucca/Neskowin Watershed (1986-1996)

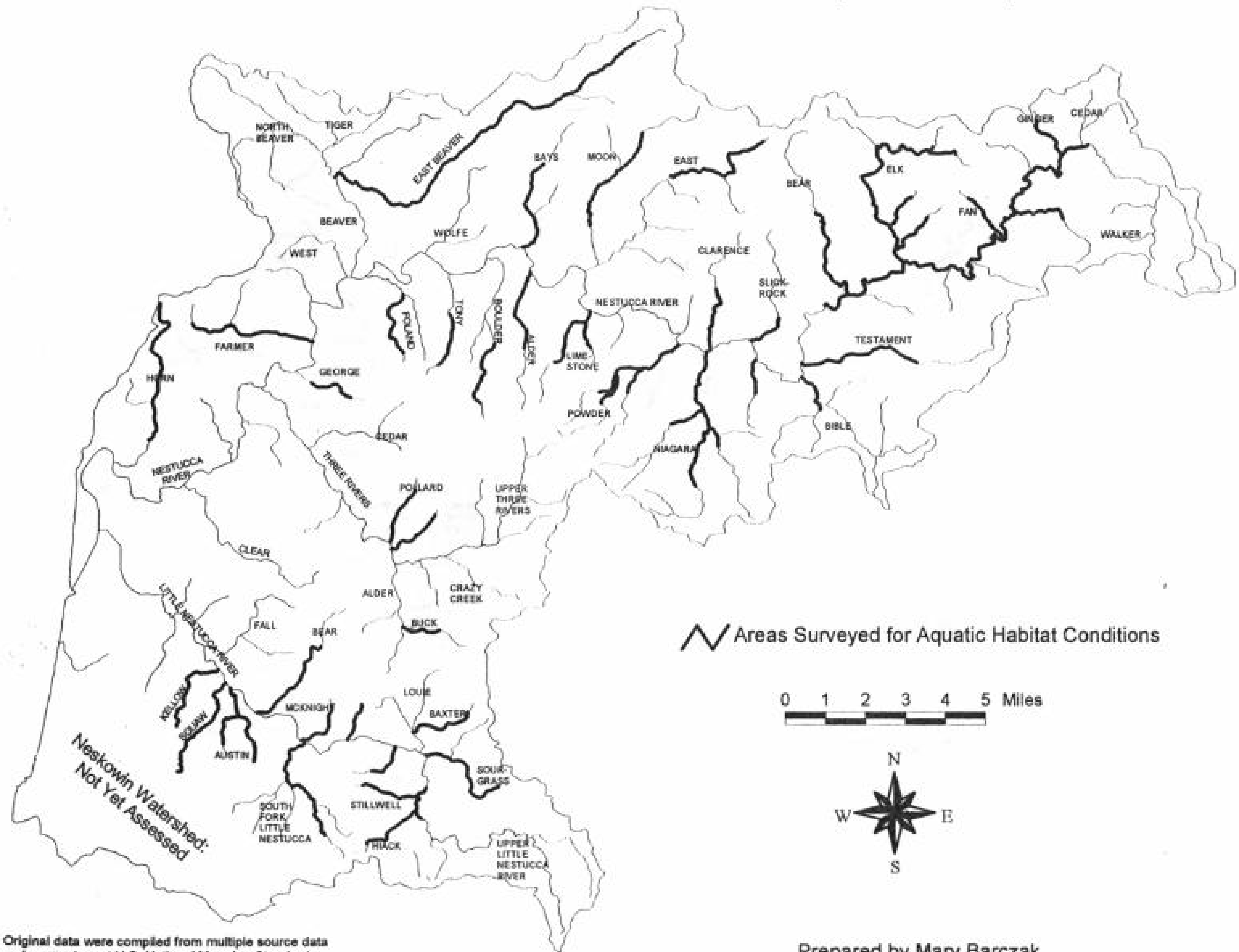


Original data were compiled from multiple source data and may not meet U.S. National Mapping Standards of the Office of Management and Budget. For specific data source dates and additional information, contact the Nestucca/Neskowin Watershed Council.

Map 12

Prepared by Mary Barczak

Aquatic Habitat Inventories in the Nestucca/Neskowin Watershed (1984-1996)

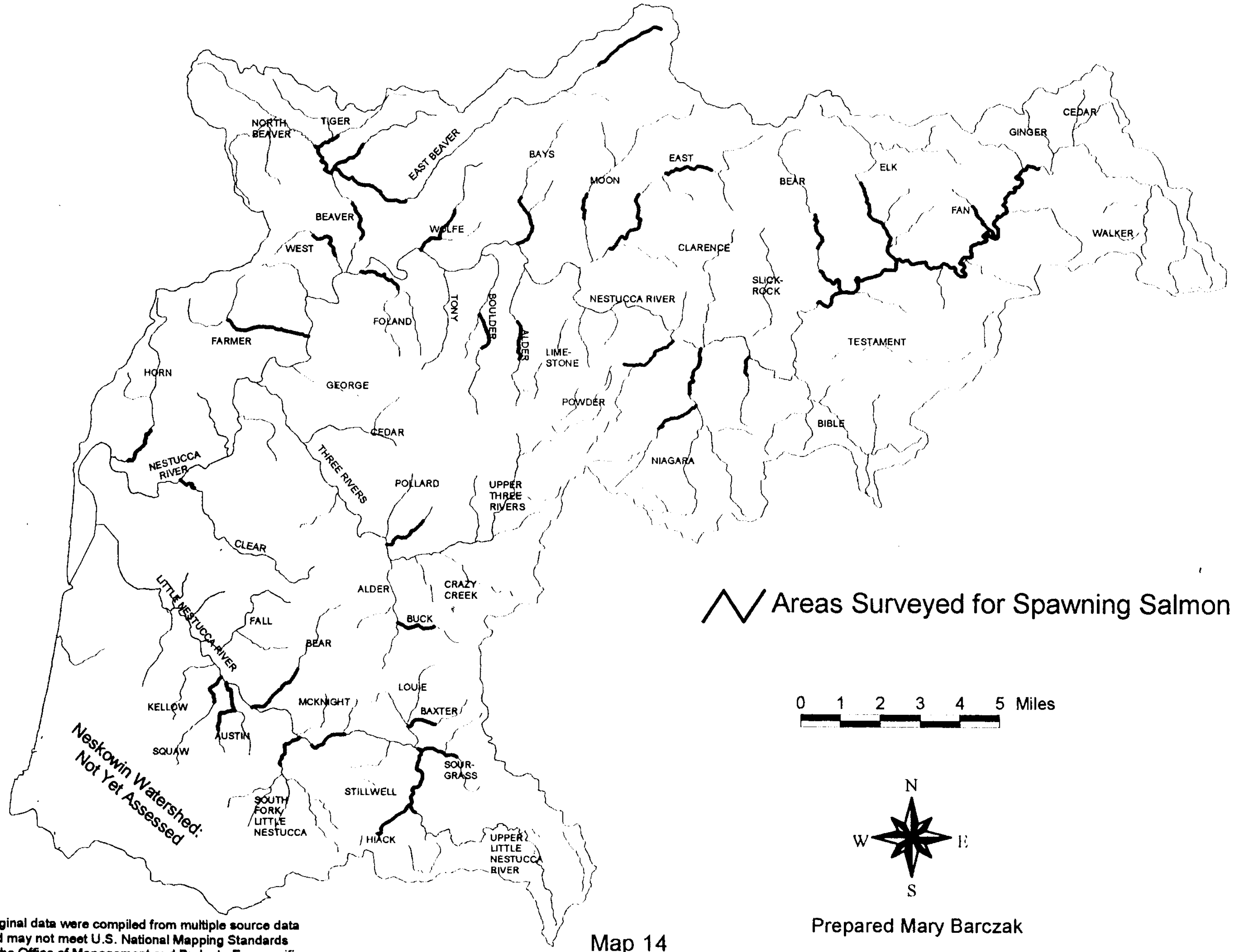


Original data were compiled from multiple source data and may not meet U.S. National Mapping Standards of the Office of Management and Budget. For specific data source dates and additional information, contact the Nestucca/Neskowin Watershed Council.

Map 13

Prepared by Mary Barczak

Salmon Spawning Surveys in the Nestucca/Neskowin Watershed (1986-1996)



Prepared Mary Barczak

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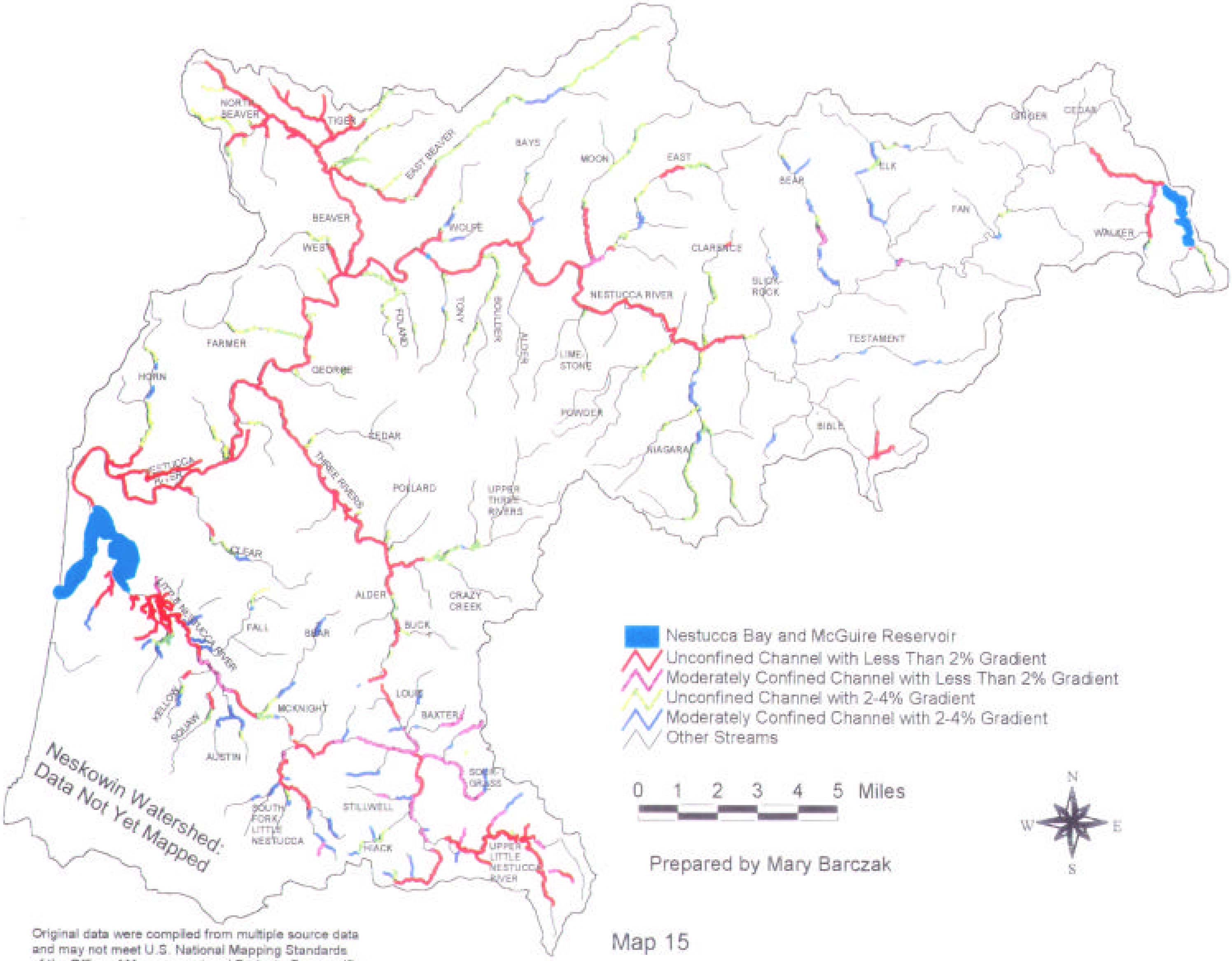
Map 14

Productive Flats for Anadromous Fish: Nestucca/Neskowin Watershed



Map 15

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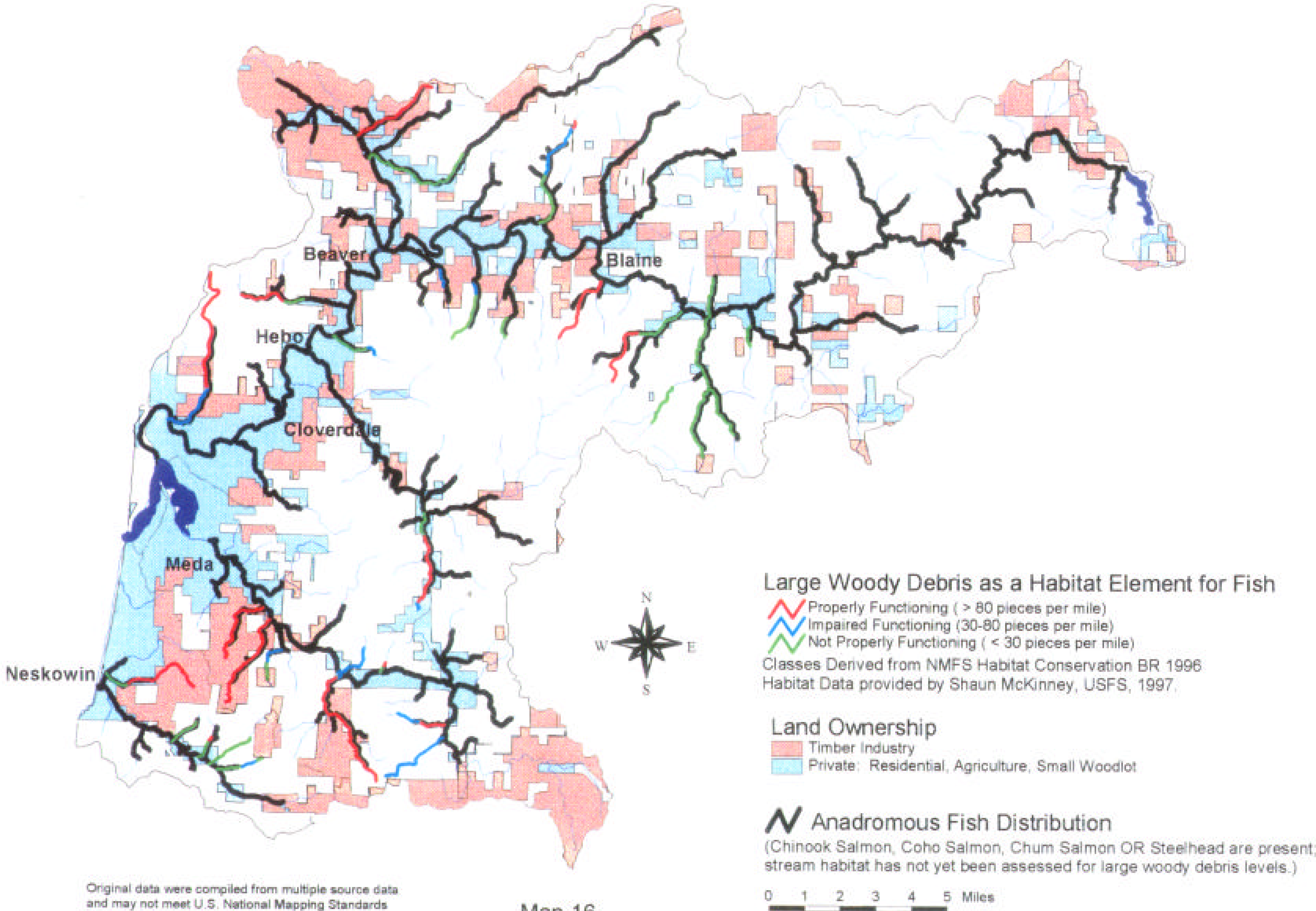
Large Woody Debris per Mile: Nestucca/Neskowin Watershed

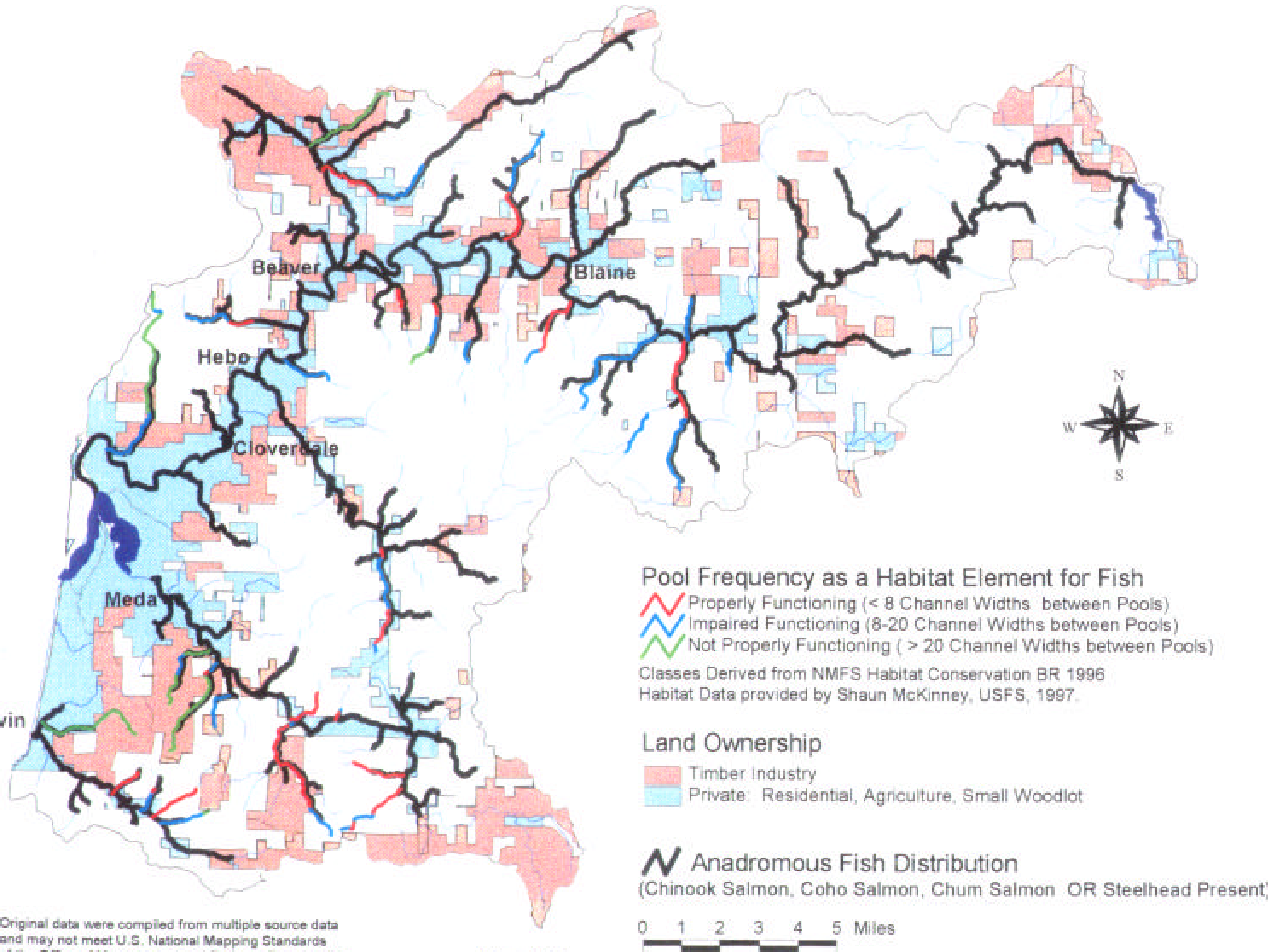


Prepared by Mary Barczak

Original data were compiled from multiple source data and may not meet U.S. National Mapping Standards of the Office of Management and Budget. For specific data source dates and additional information, contact the Nestucca/Neskowin Watershed Council.

Map 16

Pool Frequency: Nestucca/Neskowin Watershed



Original data were compiled from multiple source data and may not meet U.S. National Mapping Standards of the Office of Management and Budget. For specific data source dates and additional information, contact the Nestucca/Neskowin Watershed Council.

Map 17

Prepared by Mary Barczak