Water Quality Restoration Plan
Olalla Creek/Lookingglass Creek Watershed

Bureau of Land Management
Roseburg District Office

December 2003

Watershed at a Glance	
Watershed	Olalla Creek/Lookingglass Creek: 103,109 acres Federally-Administered Land (BLM): 27,390 acres (27 percent)
Stream Miles*	Total: 1,061 Perennial: 238
Watershed Identifier	1710030212 (Hydrologic Unit Code)
303(d) Listed Parameters	Temperature, Habitat Modification, Flow Modification, and Biological Criteria
Beneficial Uses	Industrial, Mining, Public, and Domestic Water Supply, Irrigation, Livestock Watering, Water Contact Recreation, and Cold Water Biota (Salmonids Spawning and Rearing, Resident Fish and Aquatic Life)
Known Impacts	Agriculture, Timber Harvesting, Roads, Mining, and Water Withdrawals

*Data are from BLM GIS. Perennial streams are estimated to be at least third order streams.

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Statement of Purpose

This water quality restoration plan is being prepared to meet the requirements of Section 303(d) of the 1972 Federal Clean Water Act.

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Water Quality Restoration Plan Element Location

A Table of Contents for location of the Oregon Department of Environmental Quality (ODEQ) elements within the Olalla Creek/Lookingglass Creek Watershed Water Quality Restoration Plan (WQRP) is provided below:

1. Condition Assessment and Problem Description
Chapter 1 Project Overview
Chapter 2 Condition Assessment and Problem Description

2. Goals and Objectives
Chapter 3 Recovery Goals, Objectives, Restoration Plan
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Chapter 1

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Chapter 3

10. Discussion of Costs and Funding
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Chapter 1 - Project Overview

Introduction

The area covered by this plan includes all Federally-administered land (see Table 1) in the Olalla Creek/Lookingglass Creek Watershed managed by the Bureau of Land Management (BLM) following the Standards and Guidelines in the Northwest Forest Plan (NWFP) (USDA and USDI 1994). Private land within the area of this Water Quality Restoration Plan (WQRP) includes urban, agricultural, and forested lands. The private forested land is managed following the Oregon Forest Practices Act (OFPA). A subsequent Water Quality Management Plan (WQMP) will be written by the Oregon Department of Environmental Quality (ODEQ) to cover the private lands in the Olalla Creek/Lookingglass Creek Watershed. The Olalla-Lookingglass Creek WQRP is intended to be adaptive in management implementation and includes the protocols described in the Forest Service and Bureau of Land Management Protocol for Addressing Clean Water Act Section 303(d) Listed Waters (USDA et al. 1999). It allows for future changes in response to new information. Information generated during development of the WQMP may indicate this WQRP for Federally-administered land needs to be revised.

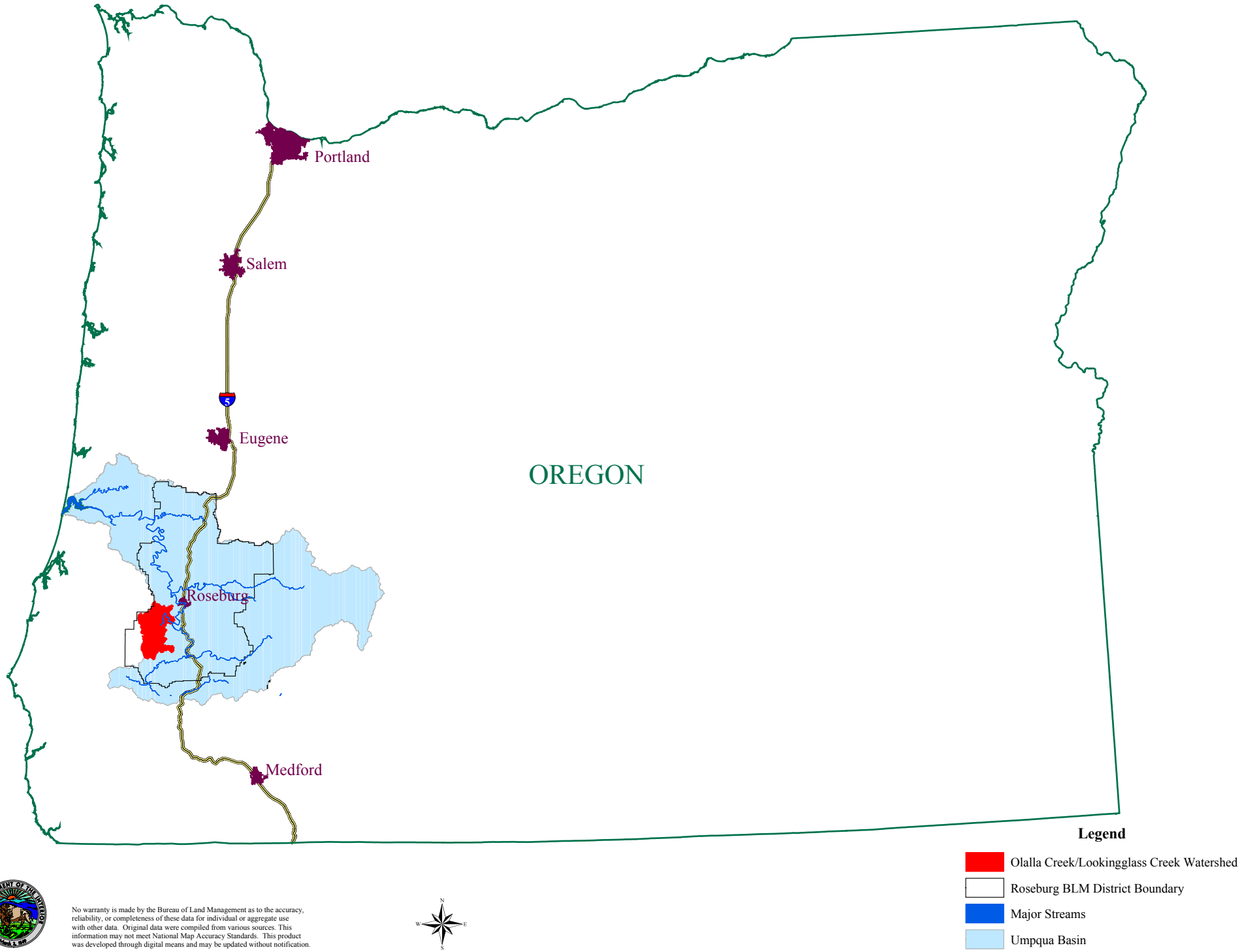
Table 1. Land Ownership in the Olalla Creek/Lookingglass Creek Watershed.

Ownership	Acres
Total	103,109
Federal	27,390
Private	75,719

The Olalla Creek/Lookingglass Creek Watershed is a high value salmonid fish watershed in the Southern Oregon Coastal Basin. Despite habitat and flow modification, spawning coho salmon, fall chinook salmon, and winter steelhead return to Olalla and Lookingglass Creeks every year. Anadromous and resident fish barriers are shown in the Olalla-Lookingglass Watershed Analysis (USDI 1998).

The Olalla Creek/Lookingglass Creek Watershed covers approximately 103,109 acres (161 square miles) in southwestern Oregon and is a major flow contributor to the South Umpqua River (see Figure 1). Some of the land along Olalla and Lookingglass Creeks is flat and used for agricultural purposes. In the agricultural areas some tributaries and the main stems of Olalla and Lookingglass Creeks have been straightened or had their flow patterns altered. Most of the large conifers and hardwoods have been replaced with low growing vegetation, which generally are grasses. Riparian areas may have some deciduous trees (hardwoods) along the stream banks. The higher elevations of the watershed are a combination of Federally-administered and private forested land. Timber harvesting and road construction have probably affected channel complexity, water quality, and hydraulic processes in the watershed.

Figure 1. Olalla Creek/Lookingglass Creek Watershed Vicinity Map



Location

The management area for this WQRP is the Olalla Creek/Lookingglass Creek Watershed, one of thirteen Fifth Field watersheds comprising the South Umpqua Subbasin. The South Umpqua Subbasin drains about 1,800 square miles. The Olalla Creek/Lookingglass Creek Watershed occupies about nine percent of the South Umpqua Subbasin. Olalla Creek flows out of the Coast Mountains into Lookingglass Creek which meets the South Umpqua River near Winston, Oregon. The South Umpqua River meets the North Umpqua River near Roseburg, Oregon where they join to form the Umpqua River. All of the Federally-administered land in the Olalla Creek/Lookingglass Creek Watershed is managed by the Roseburg BLM District. For analytical purposes, the area was divided into ten subwatersheds and 28 drainages (see the Olalla-Lookingglass Watershed Analysis, USDI 1998). The Regional Ecosystem Office has proposed dividing the watershed into six subwatersheds by combining some subwatersheds.

Ownership and Land Use Allocations

Lands administered by the BLM are managed according to the Land Use Allocations established by the Record of Decision and Roseburg District Resource Management Plan (RMP) (USDI 1995) and the Record of Decision (ROD) for Amendments to Forest Service and Bureau of Land Management Planning Documents Within the Range of the Northern Spotted Owl (NWFP) (USDA and USDI 1994). Mapped Land Use allocations for BLM land within the WQRP area include Late-Successional Reserves, Connectivity/Diversity Blocks, and General Forest Management Areas. The analysis area does not contain a Tier 1 Key Watershed (as defined in the NWFP). Riparian Reserves are superimposed upon the Land Use Allocations. Acreage by Land Use Allocation is presented in Table 2 and the Olalla-Lookingglass Watershed Analysis (USDI 1998).

Table 2. Acres and Percentage of Federally Managed Lands by Land Use Allocation.

Land Use Allocation	Acres of Federally Managed Lands	Percent of Federally Managed Lands	Percent of Watershed Analysis Unit
Late-Successional Reserve (LSR)	7,362	27	7
Marble Murrelet Reserve (MMR)	5,348	20	5
Riparian Reserves (Outside of LSR and MMR)	4,504	16	4
Other Reserved Areas (Owl Core Areas and TPCC Withdrawn Areas)	1,649	6	2
Connectivity/Diversity	3,086	11	3
General Forest Management Area (GFMA)	5,437	20	5
Total	27,390	100	27

Late-Successional Reserve (LSR)

This Land Use Allocation is defined on page 7 of the NWFP. Management of the LSR is also described in the South Coast-Northern Klamath Late-Successional Reserve Assessment (USDI and USDA 1998).

Matrix

The Matrix Land Use Allocation includes Federally-administered land outside of designated reserves. The Roseburg BLM District RMP divided Matrix into General Forest Management Areas (GFMA) and Connectivity/Diversity Blocks (CONN).

General Forest Management Areas (GFMA)

General Forest Management Areas would be managed on a regeneration harvest cycle of 80 to 110 years. A biological legacy of six to eight green trees per acre would be retained within harvest units.

Connectivity/Diversity Blocks (CONN)

Connectivity/Diversity Blocks would be managed on a 150 year area control rotation. Twelve to 18 green trees per acre would be retained within harvest units. Twenty-five to 30 percent of each Connectivity/Diversity Block would be maintained in late-successional forests at any point in time.

Current Conditions

The BLM geographic information system (GIS) streams layer for this watershed was updated after the completion of the Olalla-Lookingglass Watershed Analysis (USDI 1998). Therefore, stream length data in this WQRP does not agree with the watershed analysis. The drainage density in the Olalla Creek/Lookingglass Creek Watershed is about 6.6 stream miles per square mile of land. First and second order streams consist of approximately 823 miles, which is about 78 percent of the stream miles in the watershed. These are generally steep headwater channels draining small areas and are often intermittent in late summer. The remaining 238 miles of streams (22 percent) are third order or larger streams, which usually flow all year.

Longitudinal profiles of streams are useful to compare morphology between stream reaches and from one stream to another. Olalla and Lookingglass Creeks have average gradients less than one percent and subsequently are low-energy depositional streams. These and other third order and larger streams contain low gradient reaches, providing quality aquatic habitat. In contrast, tributary streams have narrow canyons, steeper channel gradients, and usually start below steeply sloped headwalls. These high-energy, erosional streams can transport large amounts of water and sediment.

Listing Status

Beneficial water uses within the watershed include industrial, mining, public, and domestic water supply, irrigation, livestock watering, water contact recreation, and cold water biota (salmonid spawning and rearing, resident fish and aquatic life). Table 3 shows the parameters the ODEQ (1998) used to place the streams on the 1998 Water Quality Limited 303(d) list.

Table 3. Water Quality Limited 1998 303(d) Listings in the Olalla Creek/Lookingglass Creek Watershed.

Stream Name and Description	Parameter	Listing Criteria	Miles	Season	Beneficial Uses Affected
Lookingglass Creek Mouth to Headwaters	Flow Modification	--	11.1	--	Resident Fish and Aquatic Life, Salmonid Spawning and Rearing
Olalla Creek Mouth to Thompson Creek	Biological Criteria	--	15.6	--	Resident Fish and Aquatic Life
Olalla Creek Mouth to Thompson Creek	Temperature	> 17.8 ^{o}C (64 ^{o}F)	15.6	Summer	Resident fish and aquatic life, salmonid spawning and rearing
Thompson Creek Mouth to Headwaters	Habitat Modification	--	7.6	--	Resident Fish and Aquatic Life, Salmonid Spawning and Rearing

-- = No Data.

Olalla Creek water temperatures exceeded the ODEQ standard between June and September. The water quality limited status for temperature is located mainly along privately owned land, because there is very little Federally-administered land along Olalla Creek. However, the water temperature of Olalla Creek below Berry Creek has been observed to be cool even during summer months due to the cool water released from Ben Irving Reservoir. It is not known how far downstream Olalla Creek remains cool. Data collected by the BLM (see Tables 4 and 5) show Olalla Creek above Thompson Creek and Thompson Creek from the mouth to the upper site have exceeded the water temperature standard. However, they are not currently on the water quality limited list for temperature. The purpose of this WQRP is to present information if Federally-administered lands are providing the coolest water possible downstream and how the BLM will address problems on that land. The intention is to show the extent to which water is being warmed and identify potential factors contributing to the warming on Federally-administered land.

Table 4. Summary of Water Temperature Data Collected by the BLM in the Olalla Creek/Lookingglass Creek Watershed.

Site Name	Period of Record	Upstream Drainage Area (Acres)	Elevation of Site (Feet)	Range of Annual Maximum 7 Day Average (EC)	Maximum Days Over 17.8 EC (year)	Low Flow at Sites for 2001 (cfs)
Berry Creek	2001	6,680	960	15.7	0	<0.1
Byron Creek	2001	2,660	920	16.4	0	<0.1
Olalla Creek	1994-98, 2000-01	20,140	850	19.4-23.1	75 (1997)	<0.1
Olalla Creek above Thompson Creek	2001	10,060	900	19.9	37 (2001)	<0.1
Thompson Creek at Mouth	1998-2001	8,490	920	18.5-21.4	41 (1998)	<0.1
Thompson Creek (middle site)	2000	6,640	1030	20.5	47 (2001)	----
Thompson Creek (upper site)	2000-2001	6,090	1070	17.5-20.9	47 (2000)	<0.1
Tributary to Tenmile Creek	1998-2001	970	1280	14.6-15.9	0	<0.1
Wildcat Creek	2001	1,060	1510	14.3	0	<0.1
Willingham Creek	2001	1,840	1390	17.7	5 (2001)	<0.1

Table 5. Summary of Water Temperature Data Collected by the BLM in the Olalla Creek/Lookingglass Creek Watershed.

Site Name	Date	Maximum Temperature (°C)	Date	Minimum Temperature (°C)	ΔT	Seven-Day Average Date	Seven-Day Average Maximum Temperature (°C)	Seven-Day Average ΔT	Days Greater Than 17.8 °C
Berry Creek	08/14/01	15.8	06/13/01	9.9	4.1	08/13/01	15.7	0.6	0
Byron Creek	08/12/01	16.9	06/13/01	8.1	4.2	08/12/01	16.4	2.3	0
Olalla Creek	07/22/94	20.6	09/14/94	11.0	4.8	07/22/94	19.7	1.4	19
Olalla Creek	07/27/95	22.6	08/18/95	11.1	5.9	07/26/95	21.4	4.3	49
Olalla Creek	07/29/96	23.8	09/25/96	8.9	6.2	07/27/96	23.1	4.9	47
Olalla Creek	08/06/97	22.1	09/21/97	11.6	6.1	07/21/97	21.1	5.4	75
Olalla Creek	07/28/98	23.2	09/11/98	10.7	5.8	07/26/98	22.0	4.6	64
Olalla Creek	07/31/00	21.6	06/10/00	10.3	5.6	08/01/00	20.9	4.3	62
Olalla Creek	07/12/01	20.0	06/04/01	10.7	5.9	07/11/01	19.4	3.2	47
Olalla Creek above Thompson Creek	08/12/01	20.4	09/22/01	8.8	5.9	08/10/01	19.9	4.8	37
Thompson Creek (mouth)	07/28/98	22.6	09/22/98	10.7	5.4	07/26/98	21.4	3.5	41
Thompson Creek (mouth)	07/13/99	19.2	10/03/99	6.5	4.7	07/12/99	18.5	4.0	18
Thompson Creek (mouth)	06/29/00	20.3	10/23/00	6.2	5.6	06/27/00	19.4	4.4	39
Thompson Creek (mouth)	07/26/01	19.5	09/22/01	9.4	5.6	08/08/01	18.9	3.9	33
Thompson Creek (middle)	08/08/00	21.4	10/24/00	5.3	6.2	08/01/00	20.5	4.8	47
Thompson Creek (upper)	06/29/00	21.3	10/24/00	5.3	9.0	06/27/00	20.9	8.0	47
Thompson Creek (upper)	06/07/01	18.9	06/13/01	8.3	8.7	08/13/01	17.5	2.0	6
Tributary to Tenmile Creek	07/28/98	16.8	06/17/98	9.4	2.0	07/26/98	15.9	1.5	0
Tributary to Tenmile Creek	08/28/99	15.9	09/28/99	8.9	2.0	08/26/99	15.5	1.2	0
Tributary to Tenmile Creek	08/08/00	15.9	06/10/00	8.3	1.9	08/06/00	15.4	1.4	0
Tributary to Tenmile Creek	08/12/01	15.1	06/13/01	7.3	4.0	08/11/01	14.6	1.2	0
Wildcat Creek	08/13/01	14.5	06/13/01	8.2	2.6	08/12/01	14.3	0.8	0
Willingham Creek	06/08/01	18.4	09/06/01	9.3	5.0	07/02/01	17.7	2.7	5

Definitions:
ᵃT = Highest value of daily difference between maximum and minimum temperature for the season.
Seven-Day Maximum = Average value of daily maximum temperatures for the highest seven consecutive days.
Seven-Day Minimum = Average value of daily minimum temperatures for the same seven days.
Seven-Day ᵃT = Average of the daily difference between maximum and minimum temperatures for the same seven days.

Seasonal Variation in Temperature and Flow

Both stream temperature and flow vary seasonally and annually. Water temperatures are cool during the winter months but can exceed the state standard during the summer when streamflows are lowest and solar radiation and air temperatures are the highest. Normally stream temperatures increase in July and August when flows are receding but are not at their lowest

flow level. However, maximum temperatures may occur earlier in the summer on streams with little shade (Johnson and Jones 2000). Water temperature data collected by BLM personnel in the Olalla Creek/Lookingglass Creek Watershed were found to be highest during July and August when streamflows were lowest (see Table 5). However, there were exceptions.

Minimum Flows

Streamflow normally decreases until September or October. The two-year recurrence interval, seven-day low flow for Olalla Creek near Tenmile Creek (station 14311200) is 0.1 cfs (0.002 cfs per square mile). The low-flow statistics are uncertain for Lookingglass Creek at Brockway (station 14311500) due to excessive zero events (Wellman et al. 1993). Low flows generally reflect annual precipitation levels with higher summer flows in wetter years and lower summer flows in drier years. Some variation in low flow from year to year is typical of streams in the Olalla Creek/Lookingglass Creek Watershed. Summer flows result from the release of subsurface water. This is primarily dependent upon stream channel conditions, soil type, soil depth, and porosity. Generally, the stream channel, soils, and geology in the watershed do not allow subsurface water retention during the summer.

Timeline for Implementation

The problems leading to water quality limitations and 303(d) listing have accumulated over many decades. Natural recovery and restorative management actions to address these problems will occur over an extended period of time. The first priority is to correct the causes of the problems to avoid additional degradation. This has largely been accomplished through the use of Best Management Practices (BMPs). The second priority is to address the symptoms of the problems. This is accomplished through restorative management actions. Implementation will be continued until the restoration goals, objectives, and management actions described in this WQRP are achieved. The Aquatic Conservation Strategy contained in the NWFP describes restoration timeframes. The ACS seeks to prevent further degradation and restore habitat over broad landscapes as opposed to individual projects or small watersheds. Because it is based on natural disturbance processes, it may take decades, possibly more than a century to achieve objectives.

The South River Resource Area has completed an aquatic restoration assessment. This assessment discusses the restoration needs and ways to address those needs. In addition, the resource area has initiated a programmatic environmental assessment for implementing restoration projects within the next five to ten years.

Responsible Parties

Participants in this plan for Federally-administered lands include the BLM and ODEQ. The BLM is the lead agency in this plan because the BLM manages a large percentage of land in this watershed. Federal land managers agreed that the Federal agency managing the most land within a watershed would be the lead agency for completing a WQRP.

A summary Water Quality Management Plan (including this WQRP) for the Olalla Creek/Lookingglass Creek Watershed will be developed by ODEQ with assistance from the

Oregon Department of Forestry (ODF) and the Oregon Department of Agriculture. The Oregon Water Resources Department (OWRD) may be a participant in the implementation and monitoring components of the Water Quality Management Plan (WQMP). The WQMP will address private forest, agricultural, and non-resource lands.

The ODF is the Designated Management Agency (DMA) for regulation of water quality on non-Federal forest lands. The Oregon Board of Forestry in consultation and with the participation and support of ODEQ has adopted water protection rules in the form of Best Management Practices (BMP) for forest operations. These rules are implemented and enforced by ODF and monitored to assure their effectiveness. The ODF and ODEQ will jointly demonstrate how the Oregon Forest Practices Act (OFPA), forest protection rules (including the rule amendment process), and BMPs adequately protect water quality.

Reasonable Assurance of Implementation

The BLM is responsible for creating and implementing public land management plans for lands under their jurisdiction. The plans are required to comply with the Clean Water Act and state environmental protection programs. These plans fully address water quality and provide the foundation for long term restorative processes that are passive in nature. These plans also protect overall water quality through Best Management Practices (BMPs) that guide land management activities including restoration and rehabilitation.

The BLM works cooperatively with other interested parties in the watershed. This includes watershed councils, other government agencies, and private entities. The problems affecting water quality are widespread. Activities need to be coordinated with other parties to accomplish watershed restoration.

Public Involvement

The NWFP (USDA and USDI 1994) was signed in April 1994, following extensive public review. Watershed analysis is a required component (in certain situations, such as in Key Watersheds) of the Aquatic Conservation Strategy (ACS) under the NWFP. This WQRP is a procedural step that focuses on water quality using elements of the NWFP. It tiers to and appends the Olalla-Lookingglass Watershed Analysis (USDI 1998). The watershed analysis describes the current conditions in the watershed in order to develop the appropriate context upon which this WQRP can base conclusions regarding BLM's ability to meet water quality requirements for Federally-administered lands.

The ODEQ procedure for public input offers a 30-day public comment period prior to submission of a WQMP to the Environmental Protection Agency (EPA). The ODEQ will provide appropriate public notice requesting comments on the information contained in the WQMP and state the document is pending submission to EPA. The public notice would provide an opportunity for public hearings for people to submit written or oral comments if submitted comments indicate significant public interest, written requests from ten or more people are received, or an organization representing at least ten people requests a public hearing.

Chapter 2 - Condition Assessment/Problem Description

Parameter 1. Stream Temperature

Introduction/Listing Validation

For stream temperature, the affected beneficial uses are resident fish and aquatic life and salmonid fish spawning and rearing. Salmonid fish species require specific water temperatures at various stages of their fresh water life (ODEQ 1998b).

The Oregon water quality standard [OAR 340-41 – (basin) (2) (b)] that applies to the Umpqua Basin is:

> Standards applicable to all basins (adopted as of 1/11/96, effective 7/1/96):
> Seven (7) day moving average of daily maximum shall not exceed the following values unless specifically allowed under a Department-approved basin surface water temperature management plan:
>
> 17.8° C (64° F) Rearing (June 1 to September 14)
> 12.8° C (55° F) during times and in waters that support salmon spawning, egg incubation, and fry emergence from the egg and from the gravels (September 15 to May 31).

A stream is listed as water quality limited if there is documentation that the moving seven-day average daily maximum temperature exceeds the appropriate standard. This represents the warmest seven-day period (usually occurring from late July to early September) and is calculated by a moving average of the daily maximum temperatures. The time period of interest for rearing is June 1 through September 14. Olalla Creek is the only stream on the water quality limited list for temperature in the Olalla Creek/Lookingglass Creek Watershed (see Table 3 and Figure 2). The ODEQ GIS coverage incorrectly shows Olalla Creek to start at the junction of Morgan Creek, which is actually Lookingglass Creek, according to the USGS. Furthermore, Olalla Creek begins at the junction of Tenmile Creek with Lookingglass Creek. The BLM collected summertime stream temperature data in the Olalla Creek/Lookingglass Creek Watershed from 1994 to 2001 (see Tables 4 and 5). Locations of the water temperature monitoring sites are shown on Figure 3. Data show Olalla Creek above Thompson Creek and Thompson Creek from the mouth to the upper site have exceeded the water temperature standard (see Tables 4 and 5).

Figure 2. Olalla Creek/Lookingglass Creek Watershed Streams on the 1998 303(d) List of Water Quality Limited Streams for Exceeding the Water Temperature and Biological Criteria Standards

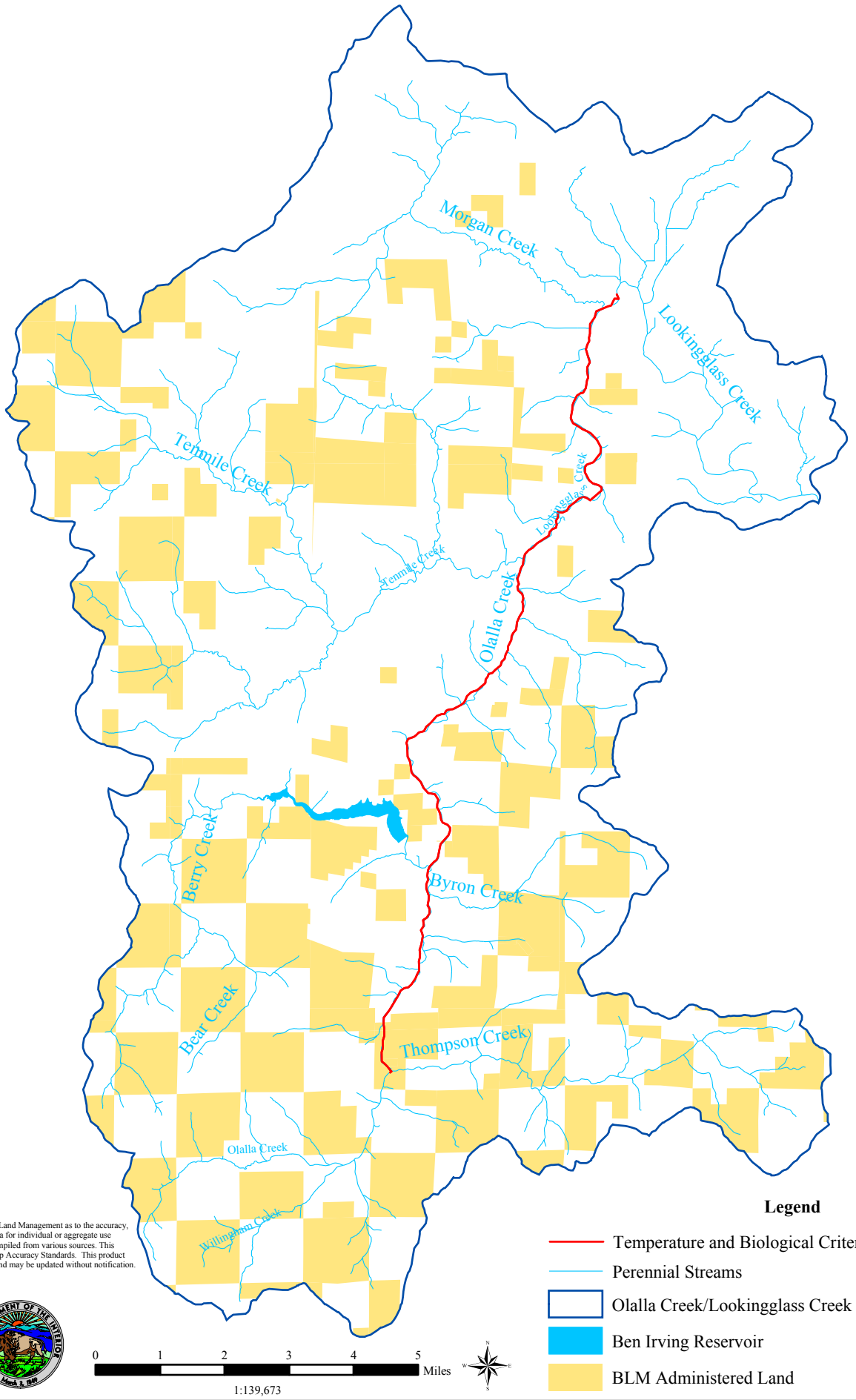


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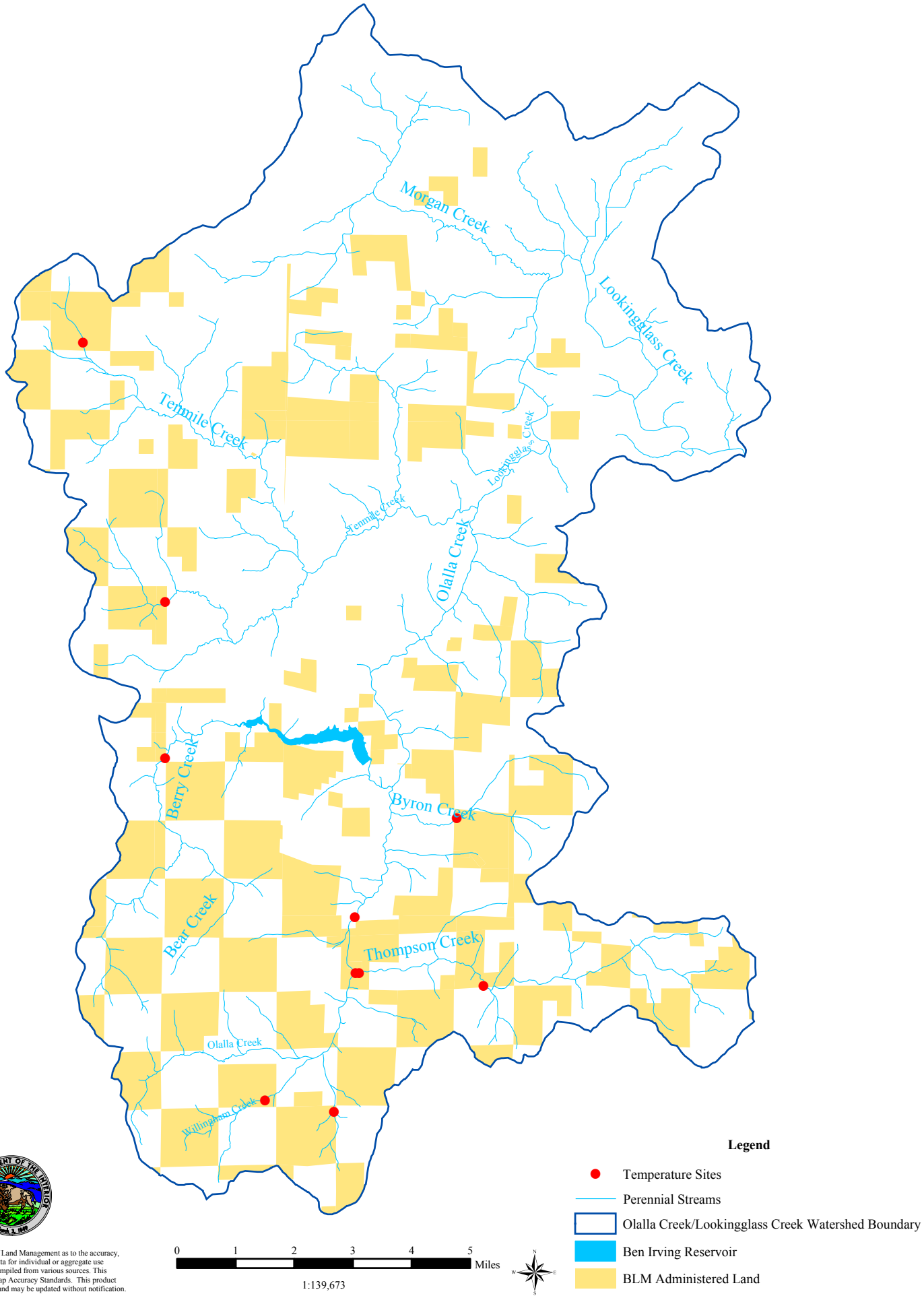
Figure 3. Location of Stream Temperature Sites in the Olalla Creek/Lookingglass Creek Watershed



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Stream temperature is driven by the interaction of many variables, such as stream channel characteristics. Streams with narrow channels tend to have cooler stream temperatures. A stream with a gentle gradient is typically wide, shallow, and has a slow velocity, which contributes to increased stream temperatures. Stream temperature increases or energy exchange may involve solar radiation, longwave radiation, evaporative heat transfer, convective heat transfer, conduction, and advection (Lee 1980 and Beschta and Weatherred 1984). For a stream with a given surface area and stream flow, an increase in the amount of heat entering a stream from solar radiation will produce a proportional increase in stream temperature (Brown 1972). Solar radiation is the most important radiant energy source heating streams during the day (Brown 1983).

Management activities that decrease riparian shade and increase width to depth ratios and stream surface area can increase the amount of solar radiation intercepted by a stream. Water withdrawals during the summer may also enhance the effect solar radiation has on water temperatures (Brown 1972). This WQRP was developed to address stream shade, flow, and stream channel morphology as factors affected by land management activities that may contribute to elevated water temperature in the Olalla Creek/Lookingglass Creek Watershed.

Disturbance of the riparian area and stream channel from landslides and floods can also increase the amount of solar radiation intercepted by a stream. However, these are considered natural processes and are "expected" change agents considered by the ACS (USDA and USDI 1994). The changes in riparian vegetation caused by landslides and floods will likely fluctuate within the range of natural variability for this watershed. Such an analysis is considered to be outside the scope of this assessment. This WQRP focuses on areas where Federal land management activities have influenced natural disturbance and affected water quality.

Temperature Factor 1. Stream Shade

The principal source of heat to water in a stream is solar energy (Brown 1970). When exposed to the sun, large quantities of heat can be transferred to the stream. Exposure to direct solar radiation can increase stream temperatures. Shaded streams often have cooler stream temperatures because of the reduced input of solar energy (Brown 1969, Beschta et al. 1987, and Holaday 1992). Stream shade varies depending on riparian vegetation type and condition. The ability of riparian vegetation to shade the stream depends on the vegetation height and position relative to the stream. Riparian vegetation can effectively reduce the total daily solar heat load. Without riparian vegetation, most incoming solar energy would be available to heat the stream.

Stream channel shade changes as forest stands grow. Timber harvesting and fire can reduce or remove the vegetation shading the stream channel. Other natural processes that may reduce shade in riparian areas include drought, insect damage, disease, and blow down. Shade along some portions of streams in the lower elevations of the Olalla Creek/Lookingglass Creek Watershed has been reduced by agriculture and human settlement.

Historic Riparian Vegetative Shade Conditions

Survey information collected by H. J. Andrews and R. W. Cowlin was used to produce a map of vegetation conditions in 1936. The map gives descriptions of forest types in terms of diameter class and species. The diameter classes were correlated to seral age classes based on "The Yield of Douglas Fir in the Pacific Northwest" by Richard E. McArdle. The diameter class of 0 to 6 inches was correlated to forest stands that are between 0 and 30 years old (Early Seral), 6 to 20 inches with 31 to 80 years old (Mid Seral), and greater than 20 inches were correlated to forest stands greater than 80 years old (Late Seral).

Conditions described from the 1936 map were used to estimate vegetation conditions within 100 feet of third order and larger streams before widespread timber harvesting occurred in the watershed. Third order and larger streams were analyzed because they are assumed to be perennial and potentially fish bearing streams, which could influence stream temperature during the dry summer months. Riparian zones along third order and larger streams consist of two distinct bands of vegetation separated by the stream channel, while lower order streams are so narrow that a functionally continuous canopy usually exists (USDA et al. 1993). In the Oregon Coast Range riparian buffers of 100 feet or more have been reported to provide as much shade as undisturbed late-successional/old-growth forests (USDA et al. 1993). The 1936 data indicates about 35 percent of the riparian vegetation within 100 feet of third order and larger streams were stands greater than 80 years old (see Table 6 and Figure 4). On BLM-administered land about 73 percent of the riparian vegetation within 100 feet of third order and larger streams were stands greater than 80 years old (see Table 7).

Table 6. 1936 Vegetation Age Classes Within 100 Feet of Third Order or Larger Streams in the Olalla Creek/Lookingglass Creek Watershed.

	Nonforest		Early Seral (0 to 30 Years Old)		Mid Seral (31 to 80 Years Old)		Late Seral (80 + Years Old)		Hardwoods		
Area	Acres	%	Acres	%	Acres	%	Acres	%	Acres	%	Total Acres
Bear Creek	0	0	0	0	0	0	115	100	0	0	115
Ben Irving	141	38	0	0	105	28	129	34	0	0	375
Berry Creek	0	0	0	0	21	15	121	85	0	0	142
Coarse Gold	0	0	0	0	2	5	35	95	0	0	37
Upper Berry	0	0	0	0	0	0	172	100	0	0	172
Berry Creek Subwatershed	141	17	0	0	128	15	572	68	0	0	841
Lookingglass	457	83	0	0	1	0	0	0	90	16	548
Upper Lookingglass	246	54	0	0	167	36	0	0	46	10	459
Winston	263	66	0	0	33	8	0	0	103	26	399
Lookingglass Creek Subwatershed	966	69	0	0	201	14	0	0	239	17	1,406
Porter Creek	64	100	0	0	0	0	0	0	0	0	64
Siebold Canyon	84	37	13	6	128	57	0	0	0	0	225
Tenmile	66	56	0	0	51	44	0	0	0	0	117
Lower Tenmile Subwatershed	214	53	13	3	179	44	0	0	0	0	406
Bushnell Frontal	62	23	0	0	111	41	99	36	0	0	272
Byron Creek	20	12	0	0	96	58	49	30	0	0	165
Middle Olalla Subwatershed	82	19	0	0	207	47	148	34	0	0	437
Olalla Frontal	4	4	0	0	0	0	109	96	0	0	113
Upper Olalla Creek	0	0	0	0	0	0	224	100	0	0	224
Wildcat Creek	0	0	0	0	15	16	78	84	0	0	93
Willingham Creek	0	0	0	0	0	0	129	100	0	0	129
Mt. Shep Subwatershed	4	1	0	0	15	3	540	97	0	0	559

Table 6. 1936 Vegetation Age Classes Within 100 Feet of Third Order or Larger Streams in the Olalla Creek/Lookingglass Creek Watershed.

	Nonforest		Early Seral (0 to 30 Years Old)		Mid Seral (31 to 80 Years Old)		Late Seral (80 + Years Old)		Hardwoods		
Area	Acres	%	Acres	%	Acres	%	Acres	%	Acres	%	Total Acres
Olalla	312	51	25	4	207	34	45	7	20	3	609
Olalla Subwatershed	312	51	25	4	207	34	45	7	20	3	609
Middle Tenmile	76	34	0	0	124	55	25	11	0	0	225
Reston	83	47	0	0	41	23	54	30	0	0	178
Upper Tenmile	10	5	0	0	19	9	192	87	0	0	221
Reston Subwatershed	169	27	0	0	184	29	271	43	0	0	624
Lower Shields	60	75	0	0	17	21	3	4	0	0	80
Shields Creek	0	0	0	0	6	7	75	93	0	0	81
Suicide Creek	0	0	0	0	96	41	138	59	0	0	234
Shields Subwatershed	60	15	0	0	119	30	216	55	0	0	395
Flournoy Creek	117	50	0	0	107	45	12	5	0	0	236
Morgan Creek	107	73	0	0	23	16	0	0	17	12	147
Rock Creek	74	38	21	11	76	39	26	13	0	0	197
Sugar Pine Subwatershed	298	51	21	4	206	36	38	7	17	3	580
Thompson Creek	129	25	0	0	14	3	379	73	0	0	522
Thompson Subwatershed	129	25	0	0	14	3	379	73	0	0	522
Olalla Creek/Lookingglass Creek Watershed	2,375	37	59	1	1,460	23	2,209	35	276	4	6,379

Figure 4. 1936 Vegetation Age Classes Within 100 Feet of Third Order or Larger Streams in the Olalla Creek/Lookingglass Creek Watershed

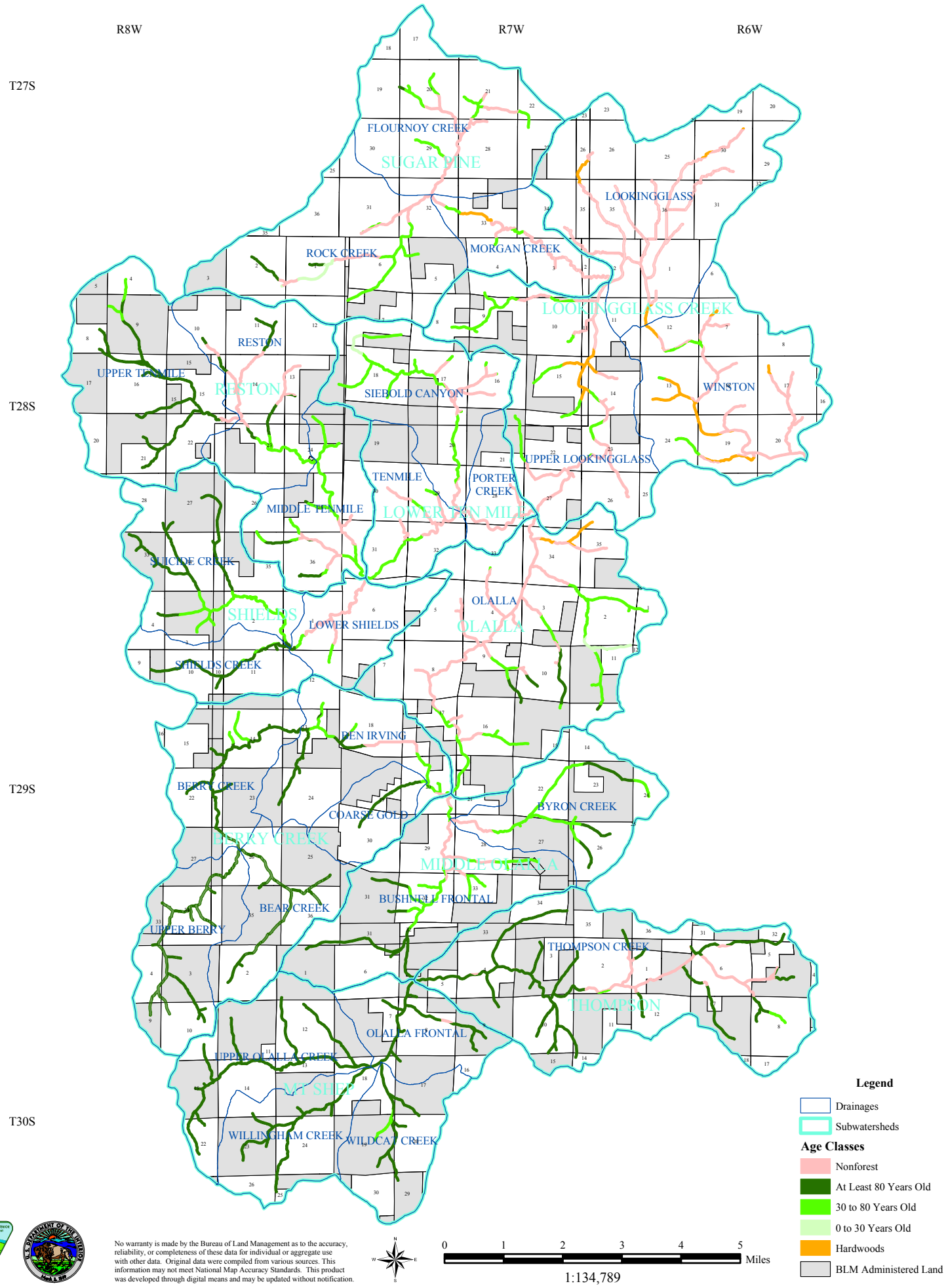

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Table 7. 1936 Vegetation Age Classes on BLM Administered Land Within 100 Feet of Third Order or Larger Streams in the Olalla Creek/Lookingglass Creek Watershed.

	Nonforest		Early Seral (0 to 30 Years Old)		Mid Seral (31 to 80 Years Old)		Late Seral (80 + Years Old)		Hardwoods		
Area	Acres	%	Acres	%	Acres	%	Acres	%	Acres	%	Total Acres
Bear Creek	0	0	0	0	0	0	25	100	0	0	25
Ben Irving	4	10	0	0	9	23	26	67	0	0	39
Berry Creek	0	0	0	0	0	0	18	100	0	0	18
Coarse Gold	0	0	0	0	0	0	0	0	0	0	0
Upper Berry	0	0	0	0	0	0	62	100	0	0	62
Berry Creek Subwatershed	4	3	0	0	9	6	131	91	0	0	144
Lookingglass	0	0	0	0	0	0	0	0	0	0	0
Upper Lookingglass	0	0	0	0	19	100	0	0	0	0	19
Winston	0	0	0	0	0	0	0	0	0	0	0
Lookingglass Creek Subwatershed	0	0	0	0	19	100	0	0	0	0	19
Porter Creek	0	0	0	0	0	0	0	0	0	0	0
Siebold Canyon	0	0	0	0	20	100	0	0	0	0	20
Tenmile	0	0	0	0	0	0	0	0	0	0	0
Lower Tenmile Subwatershed	0	0	0	0	20	100	0	0	0	0	20
Bushnell Frontal	0	0	0	0	11	14	70	86	0	0	81
Byron Creek	0	0	0	0	30	60	20	40	0	0	50
Middle Olalla Subwatershed	0	0	0	0	41	31	90	69	0	0	131
Olalla Frontal	0	0	0	0	0	0	49	100	0	0	49
Upper Olalla Creek	0	0	0	0	0	0	68	100	0	0	68
Wildcat Creek	0	0	0	0	14	26	40	74	0	0	54
Willingham Creek	0	0	0	0	0	0	66	100	0	0	66
Mt. Shep Subwatershed	0	0	0	0	14	6	223	94	0	0	237
Olalla	3	5	8	13	41	67	9	15	0	0	61
Olalla Subwatershed	3	5	8	13	41	67	9	15	0	0	61

Table 7. 1936 Vegetation Age Classes on BLM Administered Land Within 100 Feet of Third Order or Larger Streams in the Olalla Creek/Lookingglass Creek Watershed.

	Nonforest		Early Seral (0 to 30 Years Old)		Mid Seral (31 to 80 Years Old)		Late Seral (80 + Years Old)		Hardwoods		
Area	Acres	%	Acres	%	Acres	%	Acres	%	Acres	%	Total Acres
Middle Tenmile	0	0	0	0	14	93	1	7	0	0	15
Reston	0	0	0	0	0	0	0	0	0	0	0
Upper Tenmile	0	0	0	0	12	21	44	79	0	0	56
Reston Subwatershed	0	0	0	0	26	37	45	63	0	0	71
Lower Shields	0	0	0	0	0	0	0	0	0	0	0
Shields Creek	0	0	0	0	0	0	6	100	0	0	6
Suicide Creek	0	0	0	0	41	41	59	59	0	0	100
Shields Subwatershed	0	0	0	0	41	39	65	61	0	0	106
Flournoy Creek	0	0	0	0	0	0	0	0	0	0	0
Morgan Creek	0	0	0	0	0	0	0	0	0	0	0
Rock Creek	0	0	0	0	7	100	0	0	0	0	7
Sugar Pine Subwatershed	0	0	0	0	7	100	0	0	0	0	7
Thompson Creek	29	18	0	0	0	0	131	82	0	0	160
Thompson Subwatershed	29	18	0	0	0	0	131	82	0	0	160
Olalla Creek/Lookingglass Creek Watershed	36	4	8	1	218	23	694	73	0	0	956

Current Riparian Vegetative Shade Conditions

Riparian vegetation conditions consist mostly of agricultural and conifer species in the Olalla Creek/Lookingglass Creek Watershed (see Table 8 and Figure 5). The mature (at least 80 years old) conifer stands within 100 feet of third order or larger streams are considered to be providing effective shade to the streams. Currently, about 13 percent of third order or larger streams in the Olalla Creek/Lookingglass Creek Watershed have conifer stands at least 80 years old. On BLM-administered land about 46 percent of third order or larger streams in the Olalla Creek/Lookingglass Creek Watershed have conifer stands at least 80 years old (see Table 9).

Table 8. 2002 Vegetation Age Classes Within 100 Feet of Third Order or Larger Streams in the Olalla Creek/Lookingglass Creek Watershed.

	Nonforest		Early Seral (0 to 30 Years Old)		Mid Seral (31 to 80 Years Old)		Late Seral (80 + Years Old)		Hardwoods		
Area	Acres	%	Acres	%	Acres	%	Acres	%	Acres	%	Total Acres
Bear Creek	5	4	54	47	19	17	36	32	0	0	114
Ben Irving	307	81	4	1	37	10	28	7	2	1	378
Berry Creek	22	15	17	12	88	62	14	10	2	1	143
Coarse Gold	10	27	15	41	8	22	4	11	0	0	37
Upper Berry	1	1	90	52	25	14	57	33	0	0	173
Berry Creek Subwatershed	345	41	180	21	177	21	139	16	4	0	845
Lookingglass	517	94	4	1	7	1	0	0	20	4	548
Upper Lookingglass	369	80	0	0	17	4	43	9	30	7	459
Winston	338	84	6	1	10	2	2	0	48	12	404
Lookingglass Creek Subwatershed	1,224	87	10	1	34	2	45	3	98	7	1,411
Porter Creek	37	58	0	0	1	2	11	17	15	23	64
Siebold Canyon	64	28	17	8	39	17	101	45	5	2	226
Tenmile	99	85	6	5	3	3	8	7	1	1	117
Lower Tenmile Subwatershed	200	49	23	6	43	11	120	29	21	5	407
Bushnell Frontal	81	30	14	5	129	47	48	18	0	0	272
Byron Creek	17	10	18	11	90	55	38	23	0	0	163
Middle Olalla Subwatershed	98	23	32	7	219	50	86	20	0	0	435
Olalla Frontal	2	2	43	38	38	33	23	20	8	7	114
Upper Olalla Creek	13	6	67	30	119	53	22	10	3	1	224
Wildcat Creek	0	0	4	4	83	89	6	6	0	0	93
Willingham Creek	1	1	9	7	90	70	8	6	21	16	129
Mt. Shep Subwatershed	16	3	123	22	330	59	59	11	32	6	560
Olalla	386	63	45	7	137	23	21	3	19	3	608
Olalla Subwatershed	386	63	45	7	137	23	21	3	19	3	608

Table 8. 2002 Vegetation Age Classes Within 100 Feet of Third Order or Larger Streams in the Olalla Creek/Lookingglass Creek Watershed.

	Nonforest		Early Seral (0 to 30 Years Old)		Mid Seral (31 to 80 Years Old)		Late Seral (80 + Years Old)		Hardwoods		
Area	Acres	%	Acres	%	Acres	%	Acres	%	Acres	%	Total Acres
Middle Tenmile	120	53	2	1	47	21	36	16	20	9	225
Reston	53	30	31	17	62	35	28	16	4	2	178
Upper Tenmile	29	13	61	27	78	35	54	24	0	0	222
Reston Subwatershed	202	32	94	15	187	30	118	19	24	4	625
Lower Shields	44	56	0	0	12	15	0	0	23	29	79
Shields Creek	26	33	0	0	45	56	6	8	3	4	80
Suicide Creek	26	11	39	17	120	51	27	11	23	10	235
Shields Subwatershed	96	24	39	10	177	45	33	8	49	12	394
Flournoy Creek	150	63	0	0	29	12	4	2	54	23	237
Morgan Creek	109	74	0	0	7	5	7	5	24	16	147
Rock Creek	53	27	6	3	105	53	21	11	12	6	197
Sugar Pine Subwatershed	312	54	6	1	141	24	32	6	90	15	581
Thompson Creek	52	10	141	27	175	34	150	29	4	1	522
Thompson Subwatershed	52	10	141	27	175	34	150	29	4	1	522
Olalla Creek/Lookingglass Creek Watershed	2,931	46	693	11	1,620	25	803	13	341	5	6,388

Figure 5. 2002 Vegetation Age Classes Within 100 Feet of Third Order or Larger Streams in the Olalla Creek/Lookingglass Creek Watershed

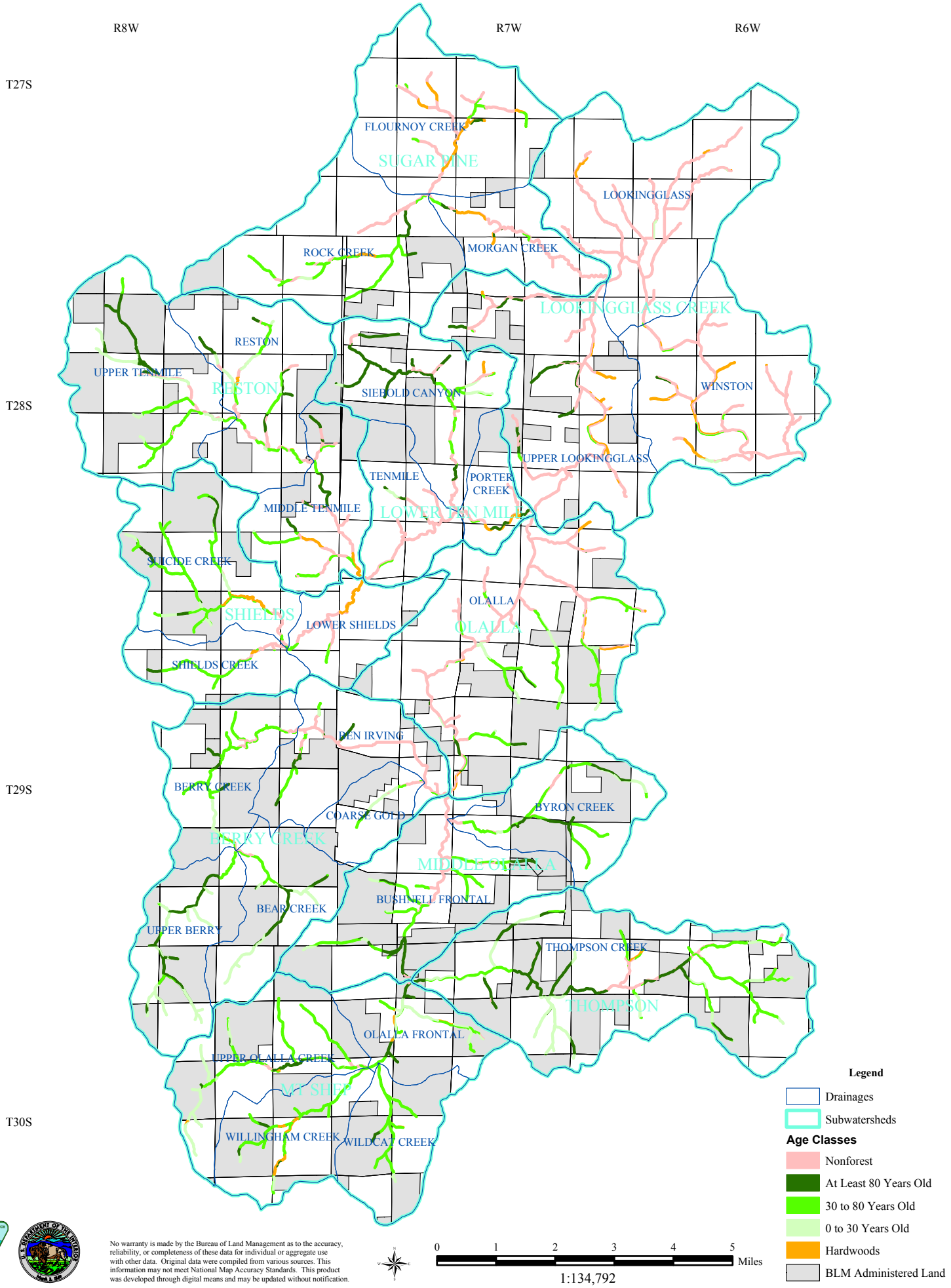

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Table 9. 2002 Vegetation Age Classes on BLM Administered Land Within 100 Feet of Third Order or Larger Streams in the Olalla Creek/Lookingglass Creek Watershed.

	Nonforest		Early Seral (0 to 30 Years Old)		Mid Seral (31 to 80 Years Old)		Late Seral (80 + Years Old)		Hardwoods		
Area	Acres	%	Acres	%	Acres	%	Acres	%	Acres	%	Total Acres
Bear Creek	0	0	6	24	0	0	19	76	0	0	25
Ben Irving	21	53	0	0	0	0	19	48	0	0	40
Berry Creek	0	0	4	22	0	0	14	78	0	0	18
Coarse Gold	0	0	0	0	0	0	0	0	0	0	0
Upper Berry	0	0	16	25	8	13	39	62	0	0	63
Berry Creek Subwatershed	21	14	26	18	8	5	91	62	0	0	146
Lookingglass	0	0	0	0	0	0	0	0	0	0	0
Upper Lookingglass	10	53	0	0	9	47	0	0	0	0	19
Winston	0	0	0	0	0	0	0	0	0	0	0
Lookingglass Creek Subwatershed	10	53	0	0	9	47	0	0	0	0	19
Porter Creek	0	0	0	0	0	0	0	0	0	0	0
Siebold Canyon	0	0	3	15	0	0	17	85	0	0	20
Tenmile	0	0	0	0	0	0	0	0	0	0	0
Lower Tenmile Subwatershed	0	0	3	15	0	0	17	85	0	0	20
Bushnell Frontal	4	5	14	17	15	19	48	59	0	0	81
Byron Creek	0	0	6	13	4	8	38	79	0	0	48
Middle Olalla Subwatershed	4	3	20	16	19	15	86	67	0	0	129
Olalla Frontal	2	4	12	24	12	24	23	47	0	0	49
Upper Olalla Creek	0	0	39	57	26	38	3	4	0	0	68
Wildcat Creek	0	0	4	7	44	81	6	11	0	0	54
Willingham Creek	0	0	9	13	51	76	7	10	0	0	67
Mt. Shep Subwatershed	2	1	64	27	133	56	39	16	0	0	238
Olalla	0	0	16	27	37	62	7	12	0	0	60
Olalla Subwatershed	0	0	16	27	37	62	7	12	0	0	60

Table 9. 2002 Vegetation Age Classes on BLM Administered Land Within 100 Feet of Third Order or Larger Streams in the Olalla Creek/Lookingglass Creek Watershed.

	Nonforest		Early Seral (0 to 30 Years Old)		Mid Seral (31 to 80 Years Old)		Late Seral (80 + Years Old)		Hardwoods		
Area	Acres	%	Acres	%	Acres	%	Acres	%	Acres	%	Total Acres
Middle Tenmile	7	47	0	0	0	0	8	53	0	0	15
Reston	0	0	0	0	0	0	0	0	0	0	0
Upper Tenmile	0	0	12	21	9	16	36	63	0	0	57
Reston Subwatershed	7	10	12	17	9	13	44	61	0	0	72
Lower Shields	0	0	0	0	0	0	0	0	0	0	0
Shields Creek	0	0	0	0	0	0	6	100	0	0	6
Suicide Creek	0	0	25	25	49	49	27	27	0	0	101
Shields Subwatershed	0	0	25	23	49	46	33	31	0	0	107
Flournoy Creek	0	0	0	0	0	0	0	0	0	0	0
Morgan Creek	0	0	0	0	0	0	0	0	0	0	0
Rock Creek	0	0	0	0	0	0	7	100	0	0	7
Sugar Pine Subwatershed	0	0	0	0	0	0	7	100	0	0	7
Thompson Creek	3	2	13	8	28	17	117	73	0	0	161
Thompson Subwatershed	3	2	13	8	28	17	117	73	0	0	161
Olalla Creek/Lookingglass Creek Watershed	47	5	179	19	292	30	441	46	0	0	959

In the Olalla Creek/Lookingglass Creek Watershed, the greatest loss of shade on Federally-administered lands resulted from the harvest of trees in the riparian area. Tables 10 and 11 compare 1936 and 2002 vegetation conditions along third order or larger streams. Based on the acres of conifer stands within 100 feet of third order or larger streams and the decrease in the amount of conifer stands greater than 80 years old, the Mt. Shep and Thompson Subwatersheds would be areas to conduct shade restoration activities on Federally-administered lands in the watershed.

Table 10. Comparison of 1936 and 2002 Vegetation Age Classes Within 100 Feet of Third Order or Larger Streams in the Olalla Creek/Lookingglass Creek Watershed.

	1936		2002	
Age Classes	Acres	Percent	Acres	Percent
0 to 30 Years Old	59	1	693	11
30 to 80 Years Old	1,460	23	1,620	25
At Least 80 Years Old	2,209	35	803	13
Hardwoods	276	4	341	5
Nonforested	2,375	37	2,931	46

Table 11. Comparison of 1936 and 2002 Vegetation Age Classes on BLM Administered Land Within 100 Feet of Third Order or Larger Streams in the Olalla Creek/Lookingglass Creek Watershed.

	1936		2002	
Age Classes	Acres	Percent	Acres	Percent
0 to 30 Years Old	8	1	179	19
30 to 80 Years Old	218	23	292	30
At Least 80 Years Old	694	73	441	46
Hardwoods	0	0	0	0
Nonforested	36	4	47	5

Summary and WQRP Targets

The NWFP limits the removal of trees in Riparian Reserves on Federally-administered lands (USDA and USDI 1994). Current management activities would not decrease the amount of shade covering stream channels. About 51 percent of the BLM-administered land within 100 feet of third order or larger streams would be at least 80 years old in 2020. About 80 percent of the BLM-administered land within 100 feet of third order or larger streams would be at least 80 years old in 2054. Thinning in Riparian Reserves may decrease shade in some areas of streams during the first few years after thinning. However, thinnings are designed to promote tree growth and provide more shade from larger trees in the future. Infrequent natural disturbances, such as floods and landslides, may affect shade recovery. About 95 percent of the BLM-administered land within 100 feet of third order or larger streams is considered to be forested land and would have stands at least 80 years old in 2076.

Temperature Factor 2. Flow

The temperature change in a stream produced by a given amount of heat is inversely proportional to the volume of water heated (Brown 1983). A stream with less flow will heat up faster than a stream with more flow, given all other channel and riparian characteristics are the same.

Stream temperatures in the Olalla Creek/Lookingglass Creek Watershed can be affected by groundwater flows. Groundwater input has the tendency to cool streamflow. The groundwater may come from fractured bedrock or deep soils that produce sustained summer flows. Shallow soils have low water storage capacities and contribute less to summer flows. Melting snow may also contribute to summer flows and cool stream temperatures. However, a limited amount of snow falls in this watershed. Groundwater inflow tends to cool summer stream temperatures and augment summertime flows. Reducing or eliminating groundwater inflow allows streams to become warmer. Water withdrawals are addressed in the flow modification parameter. No federal water withdrawals are affecting stream temperatures in the Olalla Creek/Lookingglass Creek Watershed.

Temperature Factor 3. Stream Channel Morphology

While solar radiation and flow play a large role in determining stream temperature, stream channel morphology can also affect stream temperature. Streams that are narrow and have a high percentage of their streambed dominated by cobble and gravel are less prone to thermal loading than wide channels that are dominated by bedrock. Large wood plays an important role in creating stream channel morphology. Obstructions created by large wood help to deposit gravel. Gravel helps decrease thermal loading by increasing subsurface flow and reducing the amount of water exposed to direct solar input. The removal of large wood has affected stream channel morphology. Large wood holds alluvial material in place, preventing stream channels from down cutting and widening and reducing thermal loading and stream heating. A more extensive discussion of stream morphology is included in the habitat modification parameter.

Management Actions

The Standards and Guidelines contained in the NWFP require Riparian Reserves along streams. Riparian Reserve widths are described in the ACS portion of the Standards and Guidelines. They are based on the site potential tree height (160 feet in the Olalla Creek/Lookingglass Creek Watershed) or a minimum slope distance (100 feet on non-fish bearing or 300 feet on fish bearing), whichever is greatest, unless described otherwise in a watershed analysis. Timber harvesting in Riparian Reserves is allowed under certain conditions, such as when catastrophic events result in degraded riparian conditions or when thinning, salvaging, or fuelwood cutting would help attain ACS objectives. In addition, silvicultural practices to control stocking, re-establish and manage stands, and acquire desired vegetation characteristics are to be applied when needed to achieve ACS objectives.

Management activities that influence the amount of shade include allowing riparian vegetation to grow to target shade values and using silvicultural practices to meet ACS objectives. The

watershed analysis states thinning in Riparian Reserves would maintain or enhance the growth of conifers, thinning overstocked stands in Riparian Reserves would reduce fire hazard and loss of ecological function, and planting understocked Riparian Reserves would restore hardwood and conifer species.

Areas to focus on might include:

- Dense stands,
- Dense stands with an elevated risk of catastrophic fires and loss of ecological function,
- Understocked stands that would provide the greatest benefit to streams on the water quality limited list for exceeding the water temperature standard.

Parameter 2. Habitat Modification

Introduction/Listing Validation

The beneficial uses affected by habitat modification include resident fish and aquatic life and salmonid fish spawning and rearing. The Oregon water quality standards that apply are:

> The creation of tastes or odors or 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 [OAR 340-41 – (basin)(2)(i)],

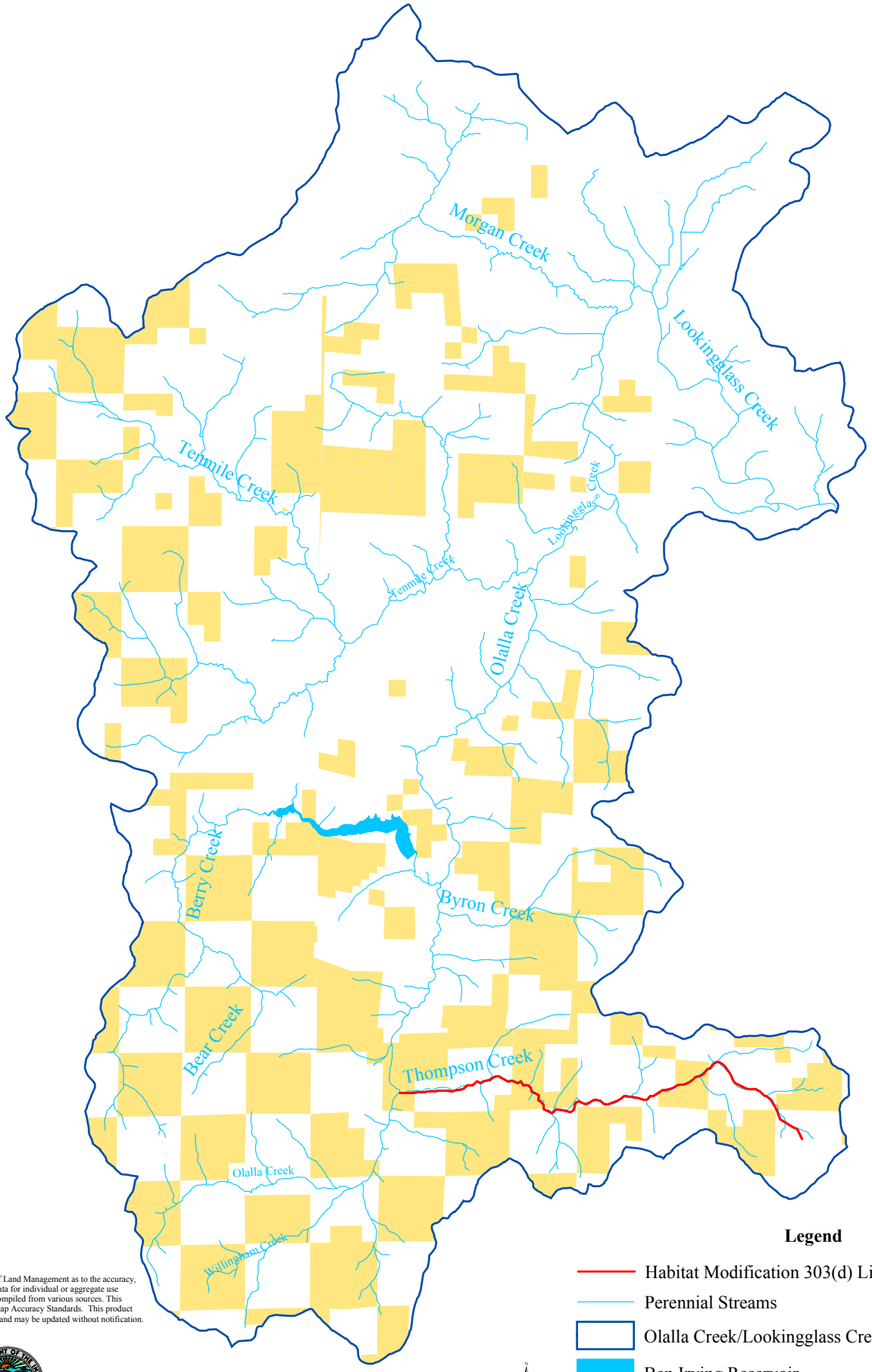
or:

> Waters of the State shall be of sufficient quality to support aquatic species without detrimental changes in the resident biological communities [OAR 340-41-027].

A stream is listed as water quality limited if there is documentation that habitat conditions are a limitation to fish or other aquatic life. The stream listed for habitat modification in the Olalla Creek/Lookingglass Creek Watershed is Thompson Creek which is misspelled Thomson Creek by ODEQ on their WEB site (see Table 3 and Figure 6). This stream was listed because the Oregon Department of Fish and Wildlife (ODFW) surveys indicated habitat conditions were a limitation to fish or other aquatic life.

The ODFW Aquatic Habitat Inventory (AHI) data and macroinvertebrate data collected by the BLM were used to document overall channel conditions and the biological potential of fish-bearing stream reaches in the watershed. The ODFW AHI surveys indicated many of the second through fifth order streams in the watershed do not meet the Large Woody Debris (LWD) Frequency (four or more functional key pieces of wood per 100 meters for 50 percent of the stream length) used by ODEQ to list a stream as water quality limited for habitat modification. Functional key pieces of wood are defined as being greater than ten meters in length and 0.6 meters in diameter. Large woody debris is defined as a functional key piece of woody debris with an adequate length and diameter to be stable within a channel. The seven surveyed reaches on Thompson Creek do not meet the Oregon Coast Salmon Restoration Initiative (CSRI) key LWD criteria used by ODEQ (see Table 12). Four of the seven reaches on Thompson Creek do not meet the CSRI pool frequency criteria used by ODEQ (see Table 12). Therefore, the listing of Thompson Creek appears to be valid for habitat modification based on key LWD frequency and pool frequency.

Figure 6. Olalla Creek/Lookingglass Creek Watershed Streams on the 1998 303(d) List of Water Quality Limited Streams for Exceeding the Habitat Modification Standard



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0 1 2 3 4 5 Miles

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Legend

- Habitat Modification 303(d) Listed Streams
- Perennial Streams
- Olalla Creek/Lookingglass Creek Watershed Boundary
- Ben Irving Reservoir
- BLM Administered Land

Table 12. Summary of ODFW Habitat Data Used by ODEQ to List Thompson Creek for Habitat Modification.

Stream Name	Reach Number	Large Woody Debris Frequency per 100 meters, Key Pieces ≥ 10m x 0.6m (CSRI standard: ≥4/100m)	Summary of Pool Frequency, channel widths between pools (CSRI standard ≤8)
Thompson Creek	1	0.2	4.9
	2	0.3	5.9
	3	0.1	9.4
	4	0.3	5.6
	5	1.0	8.4
	6	0.1	8.2
	7	0.2	321.3

Aquatic Habitat Inventory

The analysis of stream survey data for this WQRP concentrated on five attributes at the stream reach scale and included: 1) percent pool area, 2) riffle width to depth ratio, 3) riparian vegetation and conifer size, 4) pieces of large wood, and 5) key pieces of large wood. All of these attributes, except for riparian vegetation size, have been accepted by Federal and State teams in Oregon as core attributes needed to assess stream conditions. In addition, they are included in the Interagency Aquatic Database and GIS, which is a compilation of stream surveys from various agencies in Oregon. These attributes are inventoried by the Forest Service, BLM, and ODFW following similar protocols. Riparian conifer size is discussed in this WQRP because of important relationships between aquatic and riparian functions.

Data collected in the ODFW AHI can be used to identify the components that may limit the aquatic habitat and fishery resource from reaching their optimal functioning condition. The Habitat Benchmark Rating System is a method developed by the Umpqua Basin Biological Assessment Team (BAT) to rank aquatic habitat conditions. The BAT consists of fisheries biologists from the Southwest Regional Office of the ODFW, Coos Bay BLM District, Roseburg BLM District, Umpqua National Forest, and Pacific Power and Light Company. This group of local fisheries biologists addresses and resolves local questions and problems associated with the fisheries resource in the Umpqua Basin. The matrix designed by the BAT provides a framework to easily and meaningfully categorize habitat condition. This matrix is not intended to reflect quality of the habitat condition of each stream reach but to summarize the overall condition of the surveyed reaches. The matrix consists of four rating categories: Excellent, Good, Fair, and Poor. An explanation of how the ratings relate to the National Marine Fisheries Service (NMFS) Matrix is shown in Table 13. The NMFS Matrix is used during Section 7 consultation with NMFS to determine the effects of a land management action on fisheries and fish habitat.

Table 13. Comparison of the Aquatic Habitat Ratings (AHR) to the NMFS Matrix Ratings.

ODFW Aquatic Habitat Inventories	NMFS Matrix
Excellent or Good	Properly Functioning
Fair	At Risk
Poor	Not Properly Functioning

The ODFW conducted Aquatic Habitat Inventories on eight streams in the Olalla Creek/Lookingglass Creek Watershed. Most of the 36 stream reaches identified in the inventories were rated as being in fair condition (see Table 14). Eight stream reaches were rated as good, one of the stream reaches was not rated, twenty were rated as fair, and seven were rated as poor. The lack of LWD seemed to be the most common limiting factor in these stream reaches. Limiting factors in other stream reaches included increased sedimentation, hardwood dominated riparian areas, the lack of large conifers available for future recruitment of LWD, low percent pool area, and the lack of shade that contributes to higher stream temperatures. Limiting factors for the fisheries resource include reduced instream habitat structure, increased sedimentation, the absence of a functional riparian area, decreased water quantity or quality, or the improper placement of drainage and erosion control devices associated with roads.

Table 14. Summary of 1995 ODFW Survey Data in the Olalla Creek/Lookingglass Creek Watershed

Stream	Reach	% Pool Area	Residual Pool Depth	Riffle W/D Ratio	% Fines in Riffles	% Gravel in Riffles	Riparian Vegetation (dominant/subdominant)	Riparian Conifer Size	% Shade	LWD pieces per 100m	LWD vol per 100m	Aquatic Habitat Rating (AHR)
Bear Creek (Berry Creek)	1	39.5	0.2	32.9	7	20	hardwood/conifer	small	78	4.8	7.2	Poor
	2	45.3	0.5	20.3	6	53	hardwood/conifer	small	77	9.3	24.0	Fair
	3	64.1	0.4	17.0	4	48	conifer/hardwood	small/medium	70	12.9	17.9	Fair
	4	12.0	0.3	16.7	9	55	conifer/hardwood	small	46	7.1	5.2	Poor
Berry Creek	1	49.1	0.7	18.5	5	31	conifer/hardwood	small	70	1.2	0.8	Fair
	2	--	--	--	--	--	--	--	--	--	--	--
	3	74.6	0.5	34.1	8	52	conifer/hardwood	small	72	16.0	24.3	Fair
	4	62.7	0.5	27.1	12	48	conifer/hardwood	small	75	27.6	68.4	Good
	5	59.6	0.5	9.9	33	60	conifer/hardwood	small/medium	78	15.2	31.5	Good
Byron Creek	1	39.0	0.3	45.2	4	29	hardwood/conifer	small	76	2.1	4.7	Poor
	2	40.9	0.3	31.3	13	31	conifer/hardwood	small/medium	86	16.0	35.1	Fair
	3	9.3	0.3	19.2	36	32	hardwood/conifer	small	76	8.2	20.6	Fair
Coarse Gold Creek	1	50.2	0.4	31.9	7	52	hardwood/conifer	small	51	2.9	2.0	Fair
	2	2.4	0.3	--	--	--	conifer/hardwood	small/medium	77	5.7	16.7	Poor

Table 14. Summary of 1995 ODFW Survey Data in the Olalla Creek/Lookingglass Creek Watershed

Stream	Reach	% Pool Area	Residual Pool Depth	Riffle W/D Ratio	% Fines in Riffles	% Gravel in Riffles	Riparian Vegetation (dominant/subdominant)	Riparian Conifer Size	% Shade	LWD pieces per 100m	LWD vol per 100m	Aquatic Habitat Rating (AHR)
Olalla Creek	1	30.5	0.5	35.6	1	10	hardwood/conifer	small	57	1.4	1.0	Poor
	2	55.4	0.5	27.9	6	20	conifer/hardwood	small	78	4.1	21.7	Fair
	3	50.5	0.5	11.5	1	36	hardwood/conifer	small	55	6.0	14.9	Fair
	4	56.3	0.7	29.5	0	35	hardwood/conifer	medium	86	15.8	62.9	Good
	5	57.3	0.3	21.1	18	28	conifer/hardwood	medium	86	13.1	21.5	Fair
	6	82.2	0.5	12.5	21	55	conifer/hardwood	medium	70	24.7	40.4	Good
	7	62.9	0.3	14.6	19	39	conifer/hardwood	medium	89	32.7	63.1	Good
	8	45.8	0.3	13.2	24	44	conifer/hardwood	medium	77	33.0	64.9	Good
Thompson Creek	1	53.6	0.6	21.7	7	34	conifer/hardwood	medium	72	6.1	7.1	Fair
	2	55.6	0.5	20.6	4	35	conifer/hardwood	medium	74	7.0	12.6	Fair
	3	16.8	0.5	--	--	--	hardwood/conifer	small/medium	78	6.2	8.4	Poor
	4	54.1	0.5	17.8	6	43	conifer/hardwood	medium	76	5.2	9.9	Fair
	5	39.0	0.6	13.3	5	76	conifer/hardwood	small/medium	71	10.5	25.3	Good
	6	36.8	0.4	17.3	6	65	conifer/hardwood	small	62	14.5	17.0	Fair
	7	0.7	0.2	--	--	--	conifer/hardwood	medium	77	6.8	12.3	Poor

Table 14. Summary of 1995 ODFW Survey Data in the Olalla Creek/Lookingglass Creek Watershed

Stream	Reach	% Pool Area	Residual Pool Depth	Riffle W/D Ratio	% Fines in Riffles	% Gravel in Riffles	Riparian Vegetation (dominant/subdominant)	Riparian Conifer Size	% Shade	LWD pieces per 100m	LWD vol per 100m	Aquatic Habitat Rating (AHR)
Wildcat Creek	1	15.7	0.3	21.0	9	36	conifer/hardwood	small	82	38.3	61.2	Fair
	2	13.6	0.3	13.0	5	35	conifer/hardwood	medium	90	32.3	48.0	Good
Willingham Creek	1	48.0	0.3	12.0	7	40	conifer/hardwood	small	82	7.5	9.3	Fair
	2	56.8	0.2	14.6	9	41	conifer/hardwood	medium	71	18.0	17.8	Fair
	3	92.3	0.3	17.0	10	29	conifer/hardwood	small	65	40.0	47.0	Fair
	4	32.2	0.3	13.3	10	20	hardwood/conifer	small	60	19.1	10.5	Fair
	5	11.3	0.2	8.0	15	35	hardwood/conifer	small	88	20.5	25.5	Fair

– = no data available

Individual Attribute Discussion of Aquatic Habitat

Large Wood

Large woody debris is an important part of stream morphology. Large woody debris traps and stores sediment and organic material (which are important to aquatic species) and dissipates stream channel energy. Energy dissipation in a stream with adequate amounts of large wood varies greatly along the channel length and results in a channel form that is diverse. Such channel form diversity is displayed by the frequent occurrence of pools, with scour occurring at stable LWD sites, rather than along the entire reach. Scouring can lead to channel incision, unstable banks, bank erosion, channel widening, and loss of channel complexity and habitat diversity (Montgomery and Buffington 1993). The presence of LWD in a system may also decrease peak streamflow and lengthen the time when the peak flow occurs (decreases the flashiness).

Past management practices, such as stream cleaning, road construction, and salvaging activities in riparian areas, has left many streams lacking LWD. The early seral vegetation along many of the streams does not provide LWD recruitment. The removal of large wood from the stream and potential woody debris from the riparian area had the greatest direct impact on stream channel morphology in the Olalla Creek/Lookingglass Creek Watershed.

Most of the anadromous fish-bearing stream reaches surveyed by ODFW in the watershed are deficient in LWD. The low frequency and volume of instream wood has resulted in fewer pool habitats for fish. The lack of instream large wood has, in most instances, negatively altered stream channel dynamics, such as bedload transport and stream substrate distribution. Other stream channel characteristics affected by the lack of LWD include stream channel sinuosity, streambank stability, and floodplain interaction. Limiting a stream's ability to overflow onto the floodplain during high stream flow events inhibits stream channel hydraulics and channel dynamics. Normally, these conditions cause the channelization of stream flow and channel incision. Bureau of Land Management stream survey crews observed that many streams on BLM-administered land in the Olalla Creek/Lookingglass Creek Watershed are incised and disconnected from their floodplain.

Channel Complexity (Pools)

Research has demonstrated that channel complexity, especially slow water habitat, is a major limiting factor of fresh water habitat for coho salmon (Dolloff 1986). Pool habitat is an essential habitat element for rearing salmonids. Pools are most productive when large wood is present. Large woody debris provides cover both in the summer and winter and velocity refuges during floods. Fish population surveys found the most coho salmon in slow water areas, pools behind beaver dams, and channel spanning pools (State of Oregon 1997).

Complex channels have higher proportions of slow water habitat created by LWD, meanders, and beaver activity (Meehan 1991). Although no direct links between pools and sedimentation

have been found, studies indicate excessive sedimentation may play a role in reducing pool depth and frequency (Lisle and Hilton 1992).

Width to Depth Ratio

Increased channel widths have been attributed to changes in the stream flow regime due to timber harvesting, road construction, and simplification of the stream channel by the removal of LWD from the channel and the riparian area (Dose and Roper 1994). Peak flows can introduce sediment into the channel from upslope and upstream and can simplify the channel by rearranging instream structures. Excess sediment delivery to streams usually changes stream channel characteristics and channel configuration. These changes in the stream channel decrease the depth, number of pool habitats, and space available for rearing fish (Meehan 1991). The changes in channel condition may have contributed to the decline of anadromous salmonid stocks in the Olalla Creek/Lookingglass Creek Watershed.

The ODFW habitat survey data (see Table 14) show that most stream reaches surveyed in the Olalla Creek/Lookingglass Creek Watershed had riffle width to depth ratios ranging from excellent to poor, with an average rating of good. About 35 percent of all reaches were rated as fair or poor. The criteria for the AHR are shown in Table 15. The data indicates channel widening may have occurred in some stream reaches in the Olalla Creek/Lookingglass Creek Watershed.

Table 15. Aquatic Habitat Rating System.

Rating Category	% Pool Area	Pool Frequency (Riffle Widths Between Pools)	Riffle W/D Ratio	% Fines in Riffles	Riparian Vegetation Size (≥ 50 cm DBH/305m)	LWD Pieces per 100m	Key LWD Pieces per 100m ≥ 60 cm Diameter
Excellent	$45	--	#10	#1	--	$30	--
Good	31-44	# 8	11 to 20	2 to 7	--	20-29	$ 4
Fair	16-30	--	21-29	8 to 14	--	11 to 19	--
Poor	#15	--	$30	$15	--	#10	--

-- = No Data.

Riparian Vegetation Size

The historic condition of the riparian zone along the creeks in the lower elevations probably had hardwood trees or lower growing vegetation. In the higher elevations (timbered lands), mature trees probably provided more shade along streams historically than current conditions. In addition, streambanks were more protected by the massive root systems of mature trees.

Management activities in the watershed have been extensive since the early 1900s. Timber harvesting practices often removed standing trees, instream wood, and downed wood lying within floodplains. The ODFW habitat survey data classified riparian vegetation size as small for 50 percent of the stream reaches surveyed.

Biological Assessment

Aquatic invertebrates are the primary food source for young salmonids and are a basic component of the food web in western Oregon montane streams. Many macroinvertebrates are also sensitive to physical and chemical changes in habitat and reflect habitat conditions over their entire life cycles. Consequently, they are useful indicators of cumulative stress to aquatic systems.

Macroinvertebrate community status is one accepted ODEQ 303 (d) listing criteria for determining impairment of aquatic life in areas where habitat conditions may be limiting. Macroinvertebrate data maybe used to place a stream on the water quality limited 303 (d) list for Habitat Modification, Flow Modification, Sedimentation, and Biological Criteria.

The Oregon DEQ Level III Biotic Index (BI) for macroinvertebrates was used to evaluate trends in invertebrate community composition (ODEQ 1999). The index was developed for western Oregon and is a composite of various metrics that measure macroinvertebrate community characteristics known to change as a result of human influence. Examples of macroinvertebrate community characteristics include total taxa richness, mayfly richness, and number of sediment intolerant taxa. The maximum BI score is 50.

Macroinvertebrates were collected in 2001 at six BLM stream temperature monitoring stations located in the watershed (see Table 4). Qualitative habitat assessments were conducted using the Environmental Protection Agency (EPA) *Rapid Bioassessment Protocols For Use in Streams and Wadeable Rivers, 2000* (Barbour et al. 1999). Samples were collected from representative riffle habitats. Because riffles tend to contain the highest diversity of invertebrate species, sampling riffle habitats allows comparisons between streams, as well as analyses of long term trends.

Three out of the six sites had slightly impaired biotic conditions, while the other three sites were moderately impaired (see Figures 7 and 8). Moderate impairment is considered sufficient enough to list a waterbody as water quality limited under State 303(d) criteria.

Biotic index site scores varied more as a function of overall habitat quality, rather than cumulative days exceeding 17.8 degrees Celsius, in 2001 (see Figures 7 and 8). Moderately impaired sites shared the common habitat characteristics of either;

1. Sub-optimal substrate available for colonization (cobbles, gravels, woody debris) with extensive portions of the stream channels in bedrock, or
2. Stream substrates embedded greater than thirty percent.

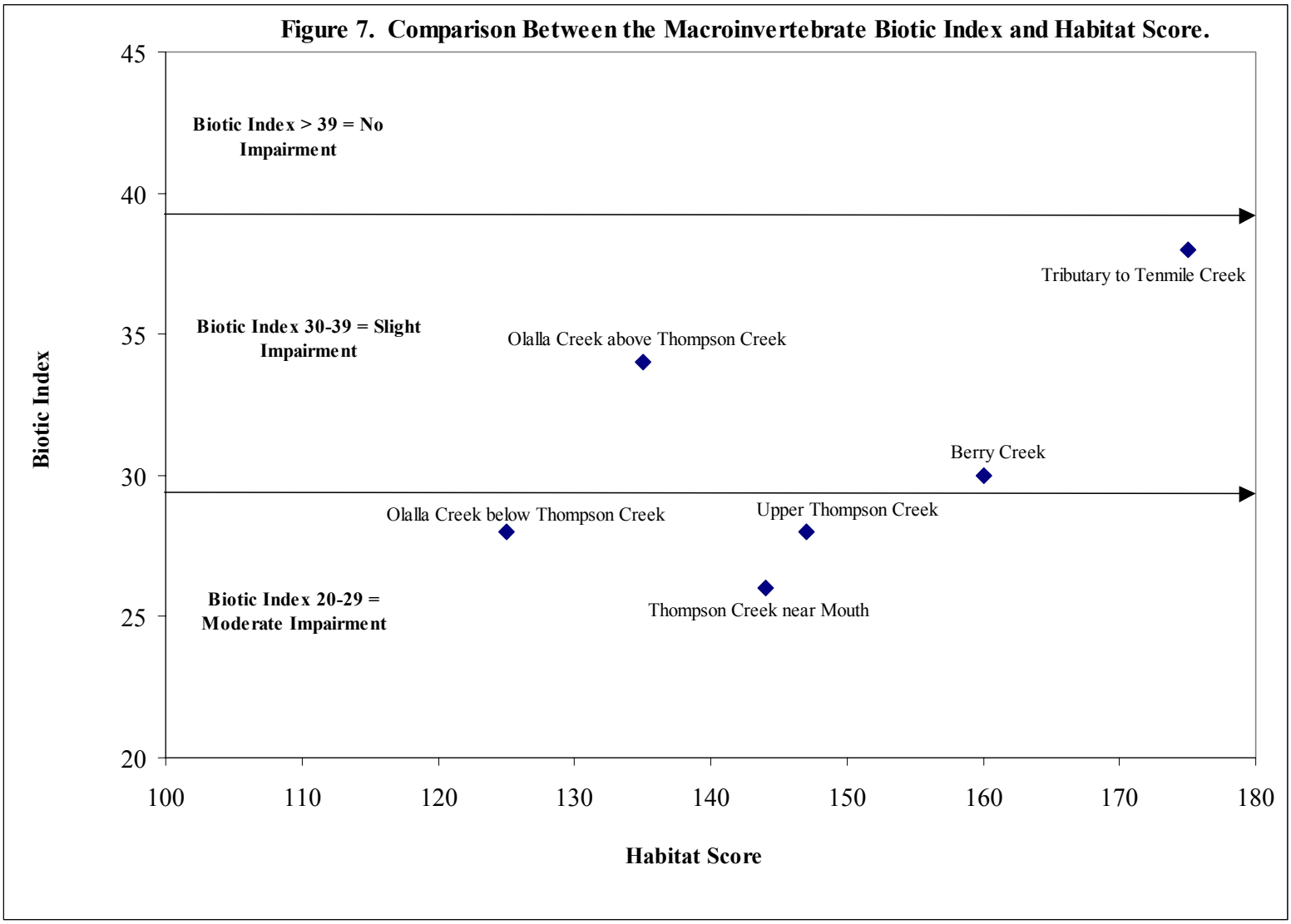
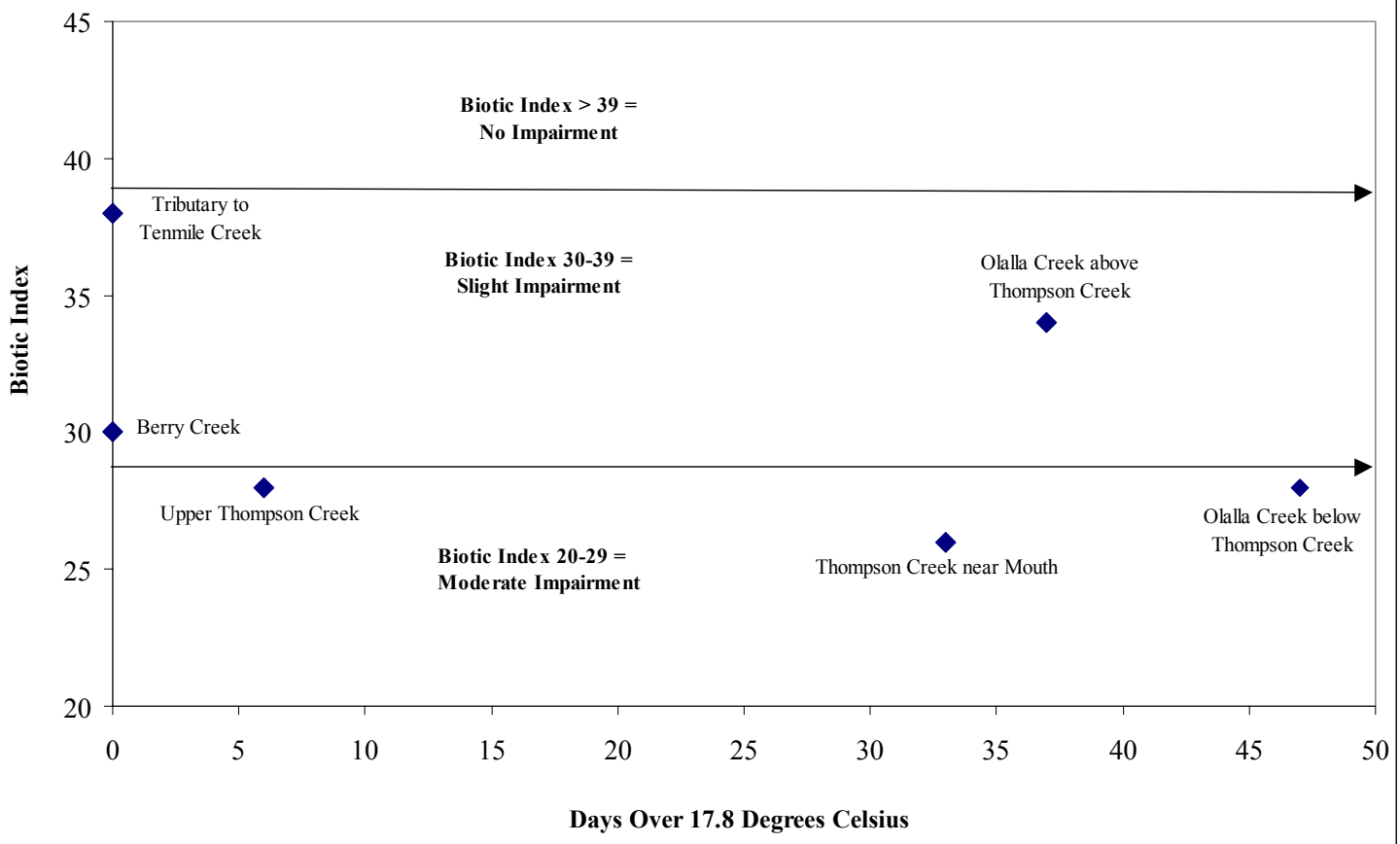


Figure 7. Comparison Between the Macroinvertebrate Biotic Index and Habitat Score.
Biotic Index > 39 = No Impairment
Biotic Index 30-39 = Slight Impairment
Biotic Index 20-29 = Moderate Impairment
Tributary to Tenmile Creek
Olalla Creek above Thompson Creek
Berry Creek
Olalla Creek below Thompson Creek
Upper Thompson Creek
Thompson Creek near Mouth
Biotic Index
Habitat Score
45
40
35
30
25
20
100
110
120
130
140
150
160
170
180

Figure 8. Comparison Between the Maximum Number of Days Over 17.8 Degrees Celsius and Biotic Index.



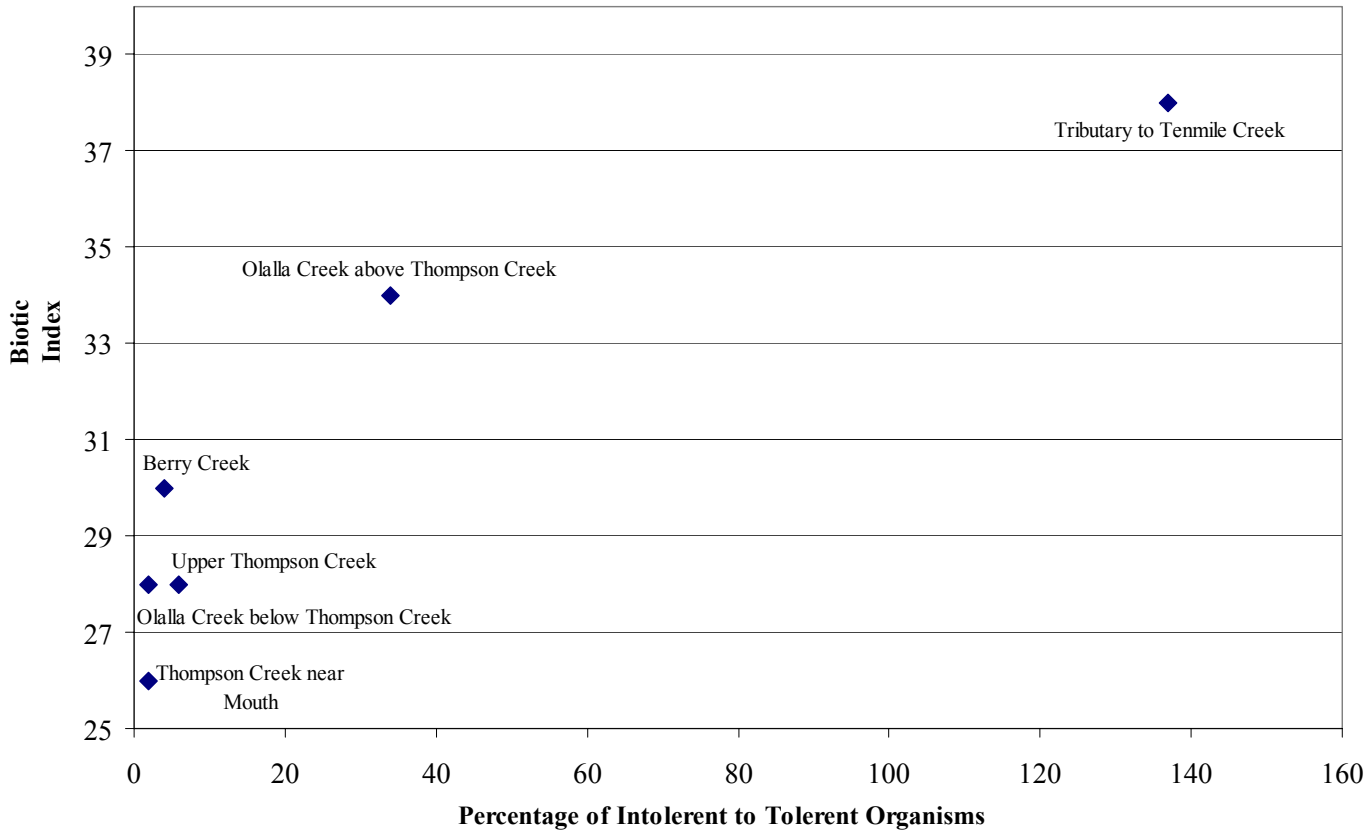
The distribution of macroinvertebrate taxa is determined to a large extent by substrate type (Minshall 1984). Many macroinvertebrates found in undisturbed montane watersheds require relatively clean cobble or gravel substrates with some free space underneath and between rocks. This interstitial "living space" is necessary to escape predators and fast moving streamflows, provide attachment sites, and provide feeding sites for the production or retention of organic material. Watershed conditions resulting in bedrock channels or sedimentation of stream substrates can depress macroinvertebrate diversity and abundance as well as successful salmonid spawning and rearing (Meehan 1991, Chapman and McLeod 1987, and Welch 1980). Figure 9 shows the biotic index scores were related to the percentage the macroinvertebrate community was composed of organisms tolerant of disturbed conditions, such as elevated sediment loads or increased streamflow velocities typical of bedrock stream channels lacking sufficient large woody debris. Macroinvertebrate communities at the three moderately impaired sites were dominated by tolerant beetles, snails, or caddisflies.

The 2001 macroinvertebrate data from 303(d) listed stream segments in the Olalla Creek/Lookingglass Creek Watershed is summarized in Table 16. The data seems to support the DEQ listing of segments on Olalla and Thompson Creeks as water quality limited. However, 2001 was a drought year and may not represent typical climatic conditions. Unusually low stream flows may have eliminated or altered the emergence times of invertebrates, either by physical or temperature controls, and produced an inaccurate representation of the Biotic Index.

Table 16. Summary of the 2001 Macroinvertebrate Data Collected by the BLM in the Olalla Creek/Lookingglass Creek Watershed.

Listed Segment	303(d) Listed Parameter	Biotic Index	Indicated Impairment
Olalla Creek (mouth to Thompson Creek)	Biological Criteria	Olalla Creek below Thompson Creek Site B.I. = 28	Moderate
Thompson Creek (mouth to headwaters)	Habitat Modification	Thompson Creek near Mouth Site B.I.= 26 Upper Thompson Creek Site B.I. = 28	Moderate

Figure 9. Comparison of Biotic Index and Percentage of Intolerant to Tolerant Organisms.



Management Actions

Protective and restorative management actions would be used to achieve water quality and fish habitat goals. Protective actions are the cessation of human activities that cause habitat modification or prevent recovery. They include maintaining LWD in stream channels, thinning in riparian reserves to promote large conifer growth, and allowing riparian vegetation to grow. These protective actions would improve large wood recruitment and bank stabilization.

Restorative actions would restore natural processes and functions to the aquatic ecosystem. Placing large wood in streams would actively restore the aquatic habitat. Reducing the amount of sediment entering streams would focus on the source and placing structures in streams would address the symptoms. Large wood would be placed in streams based on an assessment of local conditions, such as site history, wood availability, habitat quality, and in depositional stream reaches.

Restorative measures to address the temperature listings also will improve aquatic habitat. Table 17 provides a summary of habitat elements, affected processes, and management actions. The table shows a particular management action can affect numerous processes and that it is important actions occur in both the upland and riparian areas.

Table 17. Habitat Elements, Affected Processes, and Potential Management Activities to Restore Aquatic Habitat.

Habitat Element	Affected Process	Management Actions	
		Upland	Riparian
Water Temperature	Riparian canopy closure		Maintain effective stream buffers. Apply silviculture treatments to maintain or enhance tree growth or diversity in riparian areas.
	Sedimentation	Locate and avoid unstable areas. Decommission or improve roads.	Decommission or improve roads.
	Increased peak flows and channel scour.	Maintain canopy closures. Decommission or improve roads.	Maintain effective stream buffers.
	Instream wood		Add large wood to streams.
Sediment	Landslides	Decommission or improve roads. Locate and avoid unstable land.	Maintain effective stream buffers.
	Road surface erosion	Decommission or improve roads.	Decommission or improve roads.
	Stream crossing failures	Decommission or improve roads.	Decommission or improve roads.
	Stream bank erosion	Maintain canopy closures.	Add large wood to streams.
Flow	Bank erosion and channel scour	Maintain canopy closures.	Add wood to streams.
	Stream extension and road ditch lines	Decommission or improve roads.	Decommission or improve roads.
Stream Structure	Stream cleaning		Add large wood to streams.
	Bank erosion and increased peak flows	Maintain canopy closures. Decommission or improve roads.	Apply silviculture treatments to maintain or enhance tree growth or diversity in riparian areas.
	Riparian harvest		Apply silviculture treatments to maintain or enhance tree growth or diversity in riparian areas.

Parameter 3. Flow Modification

Introduction/Listing Validation

The primary beneficial uses affected by flow modification are resident fish and aquatic life and salmonid spawning and rearing. Flow modification refers to a human-caused reduction in instream flows that creates a limitation to fish or other aquatic life. The human contribution is evidence of water rights and diversions above or in the stream segment (ODEQ 1998b). The Oregon water quality standard states waters shall be of sufficient quality to support aquatic species without detrimental changes in the resident biological communities.

Water withdrawn during summer low flows may decrease available habitat for aquatic life, increase summer water temperatures and pH, and decrease dissolved oxygen. Conversely, additional flow should benefit these parameters and improve habitat quality for aquatic life (see Temperature Factor 2). Effective water quality restoration is directly related to the ability to keep water in stream channels and would be unattainable without sufficient flows (USDA et al. 1999).

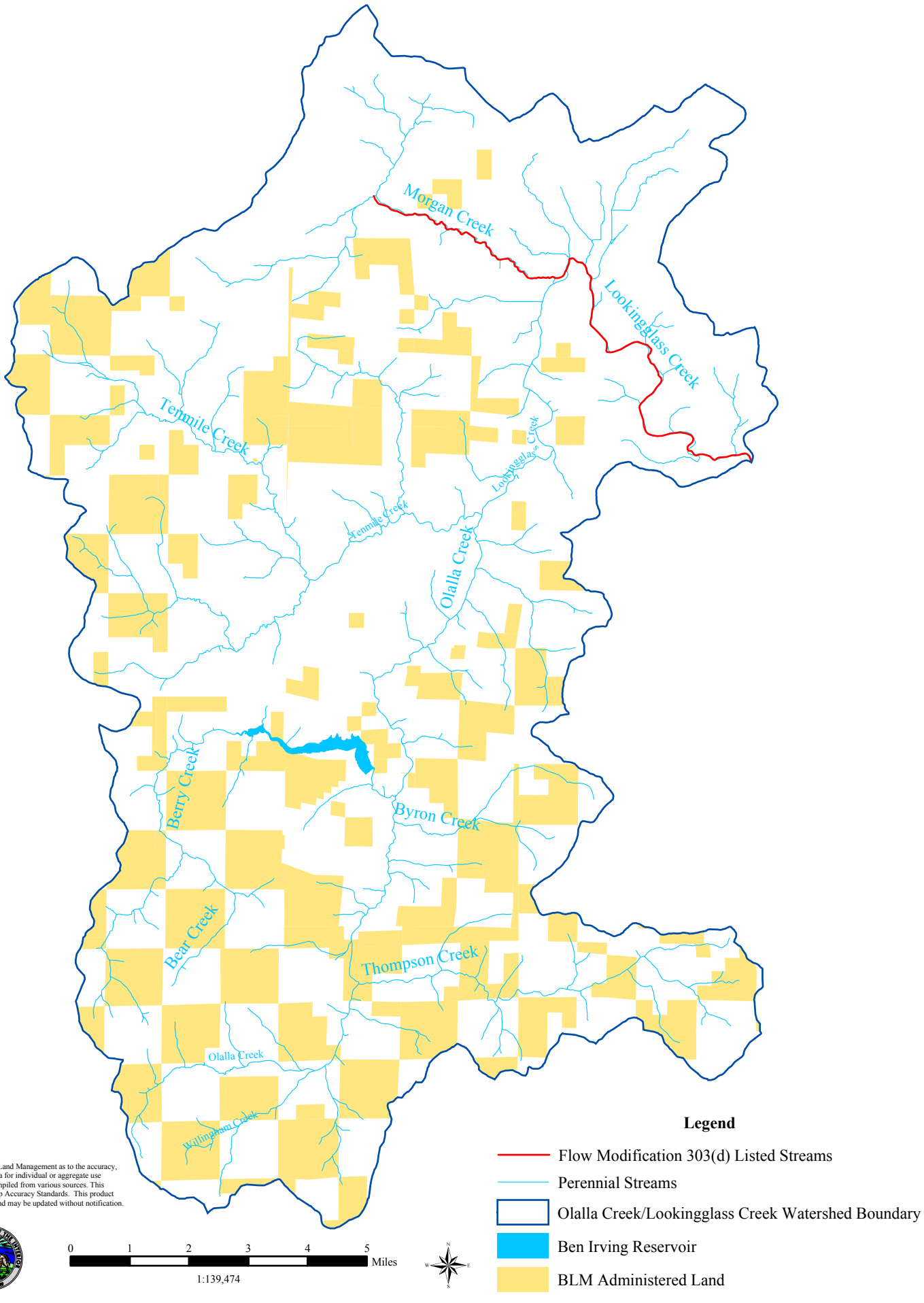
Lookingglass Creek is on the water quality limited list for flow modification from the mouth to the headwaters (see Table 3). The ODEQ GIS data incorrectly shows Morgan Creek to be the headwaters of Lookingglass Creek (see Figure 10). United States Geological Survey (USGS) flow data were used to place this segment on the 303(d) list (ODEQ 1998). These data show that instream water rights are not met during part of the year. The listing appears valid because flow data indicate minimum instream flows designed to protect beneficial uses are not met in some years. It appears that summer flows may be reduced by irrigation withdrawals.

Changes in channel morphology and decreased channel complexity have lowered summer flows by decreasing water storage. In addition, summer flows have also decreased due to water withdrawals.

Changes in riparian vegetation have affected low flows. Removal of forest vegetation has been shown to increase low flows by reducing evapotranspiration (Harr and McCorison 1979). Species conversion from conifers to hardwoods (such as red alder) can decrease summer low flows from pre-harvest conditions, because hardwoods transpire more water during the summer low flow period and act as phreatophytic vegetation. Specific effects of species conversion on low flows has not been determined for this watershed.

Resident Fish, Aquatic Life, and Salmonid Fish Spawning and Rearing are the beneficial uses affected by flow modification. Standards applicable are: The creation of tastes or odors or 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; or, waters of the State shall be of sufficient quality to support aquatic species without detrimental changes in the resident biological communities. A stream is listed as water quality limited if flow conditions are documented to have a significant limitation to fish or other aquatic life. Flow modification is not considered a water quality pollutant.

Figure 10. Olalla Creek/Lookingglass Creek Watershed Streams on the 1998 303(d) List of Water Quality Limited Streams for Exceeding the Flow Modification Standard



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Existing Water Rights

There are 348 appropriated water right permits totaling approximately 46 cubic feet per second (cfs) of streamflow within the watershed. Thirty-nine permits for water diversion or storage total 39,077 acre feet. Water withdrawal is substantial when compared to instream summer low flows in Lookingglass Creek. The water is used for domestic, irrigation, livestock, industrial, municipal, fish, mining, and forest management purposes. The largest use of appropriated water rights in this watershed is for irrigation.

Instream Water Rights and Low Flows

The Oregon Water Resources Department (OWRD) established two instream water rights on the South Umpqua River because summer low flows may be further reduced by human water withdrawals. In order to provide for adequate flows that support beneficial uses, minimum instream flows were designated for reaches of the Umpqua River (Douglas County Watermasters Office, personal communication, 2002). The first instream water right at the mouth of the South Umpqua River established by OWRD has a priority date of March 26, 1974. Table 18 lists minimum instream flows that must be maintained at the mouth of the South Umpqua River. When flows fall below these levels upstream consumptive water users with water rights after March 26, 1974 are restricted, except for domestic water use or irrigation of up to one-half acre gardens. The second water right at the mouth of the South Umpqua River is 60 cfs and was established (year round) on October 24, 1958. When flows fall below this volume, at any time of the year at this point in the river, upstream consumptive water users with water rights after that date are restricted.

Table 18. Monthly Minimum Instream Flows in Cubic Feet per Second (cfs) at the Mouth of the South Umpqua River for the Priority Date of March 26, 1974.

December Through April	May	June	July	August	September	October 1 Through October 15	October 16 Through October 31	November
350	275	225	150	90	90	90	300	400

Flows below those listed for instream rights, and subsequent restriction of water use, occurs frequently during the summer in the watershed (Douglas County Watermasters Office, personal communication, 2002). Water in the South Umpqua Subbasin is over-appropriated and according to state law no new water rights are being allocated except where public interest in those uses is high and uses are conditioned to protect instream values (OAR 690-410-070).

Streamflow Restoration Plan

The OWRD in cooperation with ODFW has developed a Streamflow Restoration Plan for the Umpqua Basin. Smaller basins inside the Umpqua Basin were prioritized using a combination of biological needs for additional flow and existing opportunities for restoring instream flows. The plan recommends a complete inventory of water rights, improving efficiency, a coordinated

enforcement plan, education, additional monitoring, and other measures to increase summer flows.

BLM Water Rights and Water Use

Most streams in the higher elevations of this watershed are not impacted by irrigation withdrawals. However, water is withdrawn from streams in the higher elevations for road maintenance and fire protection. The state requires reporting yearly water use for these activities. Individual project permits are required in some instances. The BLM did not use any water in the watershed in 2001. The BLM has sixteen water rights in the watershed. The water rights are used for forest management activities including fire suppression and road maintenance.

Management Actions

The BLM will work in cooperation with the OWRD and the local Watermaster to maintain flows supporting beneficial uses in the watershed. The BLM will provide support to the Streamflow Restoration Plan. This would involve continued reporting of water use, examining more efficient use of water by BLM, and reporting illegal water diversions on BLM-administered lands to OWRD. The OWRD has full authority over water rights in the state including those on BLM-administered lands.

The BLM would continue measuring summer low flows, in conjunction with temperature monitoring, on streams draining BLM-administered lands in the watershed. Long term monitoring can help identify trends in summer low flows and may discover unauthorized diversions.

Parameter 4. Biological Criteria

Introduction/Listing Validation

The beneficial uses affected by biological criteria are resident fish and aquatic life. The Oregon water quality standard that applies is:

> Waters of the state shall be of sufficient quality to support aquatic species without detrimental changes in the resident biological communities [OAR 340-41-027].

A stream is listed as water quality limited if aquatic communities (primarily macroinvertebrates) are 60 percent or less of the expected reference community for both multimetric and multivariate model scores. Streams with multimetric or multivariate model scores between 61 and 75 percent of expected reference communities are considered to be streams of concern. Streams with greater than 75 percent of expected reference communities using either multimetric or multivariate model scores are considered to be unimpaired.

A stream may also be listed as water quality limited when a Biotic Condition Index, Index of Biotic Integrity, or similar metric rating determines conditions are poor, or a significant departure from reference conditions exists. The rating should use a suggested EPA biomonitoring protocol or other technique acceptable to ODEQ.

Olalla Creek from the mouth to Thompson Creek is on the water quality limited list for biological criteria (see Figure 2). The ODEQ GIS coverage incorrectly shows Olalla Creek starting at the junction with Morgan Creek. According to USGS maps, Olalla Creek begins at the junction of Tenmile Creek with Lookingglass Creek. Data collected by the BLM supports listing Olalla Creek as water quality limited (See Figures 7, 8, and 9, and Table 16).

Management Actions

Management actions to address water quality limited listings in the watershed are being implemented. Restoration activities to address temperature and habitat modification water quality limited listings would also improve biological criteria conditions. Table 17 provides a summary of habitat elements, affected processes, and management actions. The table shows a particular management action can affect numerous processes and that it is important actions occur in both upland and riparian areas.

Chapter 3 - Recovery Goals, Objectives, and Restoration Plan

Recovery goals and plans associated with this WQRP are designed to maintain components of the ecosystem currently functioning and improve sites showing the greatest potential for recovery in the shortest amount of time. This WQRP maximizes recovery while minimizing expensive and ineffective restoration treatments.

The objective of this plan is to prescribe activities to meet water quality standards, where they are not being met. When the water quality standards are met, beneficial uses for the Umpqua Basin under Oregon Administrative Rules (OAR) 340-41-362 would be protected.

The recovery of habitat conditions in the Olalla Creek/Lookingglass Creek Watershed are dependent, in part, on implementation of the Roseburg BLM District Resource Management Plan. However, because 73 percent of the watershed is privately owned, habitat recovery would require involvement by private owners in cooperative restoration plans. Recovery projects on Federally-administered lands would follow the Standards and Guidelines in the NWFP to meet the ACS. This includes designating Riparian Reserves and implementing silvicultural activities to reach vegetative potential most rapidly. Instream large wood placement may be beneficial where favorable channel and riparian conditions exist. One project being considered is large wood placement in Olalla Creek downstream from Thompson Creek. Another project, accomplished in 2002, placed large woody debris in Thompson Creek.

Restoration Plan to Achieve Objectives

The following Standards and Guidelines in the NWFP, some of which are summarized in Table 19, would be used to attain the goals in the Olalla Creek/Lookingglass Creek Watershed:

Stream Temperature - Shade
Aquatic Conservation Strategy - B-9 to B-11, C-30
Riparian Vegetation - B-31
Riparian Reserves - B-12 to B-17 and ROD 9
Watershed Restoration - B-30 to B-34

Stream Temperature - Channel Form
Aquatic Conservation Strategy - B-9 to B-11, C-30
Riparian Vegetation - B-31
Riparian Reserves - B-12 to B-17 and ROD 9
Watershed Restoration - B-30 to B-34
Roads - B-31, C-32, 33
Instream Habitat Structures - B-31

Habitat Modification
Aquatic Conservation Strategy - B-9 to B-11, C-30
Riparian Vegetation - B-31
Riparian Reserves - B-12 to B-17 and ROD 9
Watershed Restoration - B-30 to B-34
Roads - B-19, B-31 to B-33
Instream Habitat Structures - B-31

Flow Modification
Aquatic Conservation Strategy - B-9 to B-11, C-30
Roads - B-31,C-32, 33

Biological Criteria
Aquatic Conservation Strategy - B-9 to B-11, C-30, 34

Maintenance of Effort Over Time

In the 1994 Record of Decision, the Secretary of Agriculture and the Secretary of the Interior jointly amended current planning documents with the Land Use Allocations and Standards and Guidelines of the NWFP. The Roseburg District RMP incorporated the final Land Use Allocations and Standards and Guidelines. The RMP can be revised if resource or management conditions change.

Assessing the Potential for Recovery of Water Quality

Recovery of riparian areas, stream channels, and aquatic habitat requires a base condition with adequate vegetation, channel form, and LWD to dissipate stream energy associated with high stream flows. The potential for recovery on BLM-administered lands would be assessed using watershed analysis and information stored on GIS as a first step in determining the feasibility of restoration and recovery.

Restoration in the Olalla Creek/Lookingglass Creek Watershed would be both active and passive (see Table 19). Growth of vegetation on floodplains is important to recovery. The overall goal is to improve pool frequency, large wood, riffle width to depth ratio, and riparian vegetation conditions from the present poor and fair ratings to fair and good ratings using the ODFW benchmarks. These attributes are used to measure if and when the stream is nearing its biological potential for supporting aquatic and riparian species, including anadromous and resident fish. These attributes and benchmarks should be validated with subsequent inventory and monitoring work in the watershed. The attributes and benchmarks would be refined to suit the range of conditions expected in the stream channels as more is learned about the watershed.

Table 19. Active and Passive Restoration in the Olalla Creek/Lookingglass Creek Watershed.

Element	Goals	Passive Restoration	Active Restoration
Temperature - Shade Component	Achieve maximum shading possible per segment. Margin of Safety: Recognize wildfire and flood effects to riparian vegetation.	Let riparian vegetation grow to reach potential.	Prescriptions to increase or maintain growth rates and insure long term health.
Temperature - Channel Form Component	Reestablish historic channel form, focusing on reducing width/depth ratios. Reduce sediment inputs to the stream channel. Increase wood-to-sediment ratio during mass failures.	Allow natural channel evolution to continue (time required varies with channel type). Allow historic mass wasting sites to re-vegetate. Maintain Riparian Reserves for slope stability. Maintain Riparian Reserves for potential large wood and slope stability.	Place large wood to manipulate channel form, proposed project in Olalla Creek and completed project in Thompson Creek. Minimize failures through stability review and land reallocation, if necessary. Ensure unstable sites retain large wood to increase wood-to-sediment ratio. Reconstruct roads to reduce erosion, channel network extension, diversion potential, and accommodate a 100 year flood event (see Appendices 1, 2, and 3). Decommission, obliterate, or improve roads that are sediment sources (see Appendices 2 and 3). Riparian prescriptions to increase or maintain growth rates and vegetation diversity.

Table 19. Active and Passive Restoration in the Olalla Creek/Lookingglass Creek Watershed.

Element	Goals	Passive Restoration	Active Restoration
Habitat Modification	Increase size and number of large wood pieces in the channel. Reestablish historic channel form, focusing on reducing width/depth ratios and increasing the volume and frequency of pools. Restore channel and floodplain connections. Reduce sediment input to stream channels.	Allow large wood to remain in channel and maintain Riparian Reserves for potential large wood. Allow natural channel evolution to continue. Maintain Riparian Reserves for slope stability.	Riparian prescriptions to increase or maintain vegetation growth rates and diversity. Place large wood in channels to manipulate channel form, proposed project in Olalla Creek and completed project in Thompson Creek. Reconstruct roads to reduce erosion, channel network extension, diversion potential, and accommodate a 100 year flood event (see Appendices 1, 2, and 3). Decommission, obliterate, or improve roads that are sediment sources (see Appendices 2 and 3).
Flow Modification Withdrawals	Maintain optimum flows for fish. Maintain minimum flows for fish passage.		Improve efficiency of water use by BLM. Enforce existing regulations - report illegal water diversions from BLM administered lands. Measure summer low flows on streams that drain BLM administered lands to establish trends.
Biological Criteria	Reduce adverse impacts.	Maintain Riparian Reserves to provide stream shade and nutrients.	Riparian prescriptions to increase or maintain vegetation growth rates and diversity. Prevent fertilizer from entering streams. Prevent herbicides from entering streams. Implement hazardous materials BMPs on Federally-administered land.

Restoration Prioritization and Funding

Restoration funds received by the Roseburg BLM District are dependent on the amount of money appropriated each year. Restoration funds for activities on BLM-administered land are mostly available through the NWFP Jobs-In-The-Woods program. The District prioritizes projects based on if they are located in a Key Watershed and the resource benefits the project provides. The State Office evaluates the submitted projects and prioritizes the projects at the State level using similar criteria.

The Olalla Creek/Lookingglass Creek Watershed is not a key watershed. The Roseburg BLM District will seek funds for implementing and monitoring components of this WQRP. However, due to the limitations of the Federal budget process, the funds cannot be guaranteed. As part of the Clean Water Action Plan, the State of Oregon began an interagency effort that identifies high priority watersheds in need of restoration and protection as part of the Unified Watershed Assessment. It is possible that funding associated with the Clean Water Action Plan could be pursued to carry out protection and restoration actions in the Olalla Creek/Lookingglass Creek Watershed. Efforts will be made to apply for grants under the Clean Water Action Plan and Oregon Watershed Enhancement Board (OWEB).

Another potential funding source, which began in fiscal year 2001, is Douglas County funds received through section 103 of the "Secure Rural Schools and Community Self-Determination Act of 2000" (P.L. 106-393). Title II of the Act allows counties to spend a portion of these funds for restoration projects on Federal and non-Federal lands.

Recovery to Full Physical and Biological Potential

Current stream and riparian habitat conditions in the Olalla Creek/Lookingglass Creek Watershed are discussed in previous sections. Even if changes in land management practices and comprehensive restoration are initiated, it is possible that all degraded aquatic systems will not completely recover within the next 100 years (USDA et al. 1993, p. V-77). It is estimated recovery of the habitat conditions to full biological potential in this watershed will take more than 100 years. The estimate accounts for some variability in recovery based on current aquatic and riparian conditions and natural foreseeable events (floods or fires).

Many interrelationships exist between riparian and floodplain vegetation, summer stream temperatures, sediment storage and routing, and the complexity of habitats in the Olalla Creek/Lookingglass Creek Watershed. Large mature conifers or hardwoods would continue to be rare on private lands, particularly agricultural lands, within the watershed unless major changes in land uses or land use regulations occur. The agricultural lands include streams with low gradients that have a high biological potential for anadromous fish. Improving or maintaining the number of large trees on upstream public lands would not directly benefit the habitat on private lands but would have indirect impacts, such as decreased sediment delivery and cooler stream temperatures.

Generally, in transport or steeper reaches of the watershed, the aquatic and riparian habitat are in fair to good condition. Downstream, in lower gradient stream reaches, aquatic and riparian habitat is in poor to fair condition. The low gradient reaches generally are not located on Federally-administered lands.

Stream shade recovery will occur quicker than habitat recovery. Habitat recovery and sediment storage and routing in the channel would recover to an optimum range of conditions with the maturation of riparian trees. A mature riparian forest would provide shade, increase bank and channel stability, decrease channel width, and increase pool depths. Lower summer water temperatures and higher quality habitat conditions for salmonids would be created by maintaining maturate riparian forests and addressing road-related problems. The reduced amount of timber harvesting directed in the NWFP would also contribute to improving water quality.

Margin of Safety

The Clean Water Act requires a margin of safety (MOS). A margin of safety is to account for uncertainty in available data or in the actual effect activities would have on load reductions and water quality.

Assumptions

Natural Fire Disturbance

The Olalla Creek/Lookingglass Creek Watershed has a variable fire history. The lower elevations burned more frequently than the higher elevations of the watershed. Recovery of riparian vegetation in areas disturbed by fire and flood may be interrupted by future events. This is a conservative assumption that does not account for fire suppression as a management tool. Fire suppression has reduced the number of acres burned by wildfire in riparian areas and throughout the watershed.

Channel Form Recovery

Stream habitat surveys, conducted by ODFW, measured channel widths in the Olalla Creek/Lookingglass Creek Watershed. Increased channel widths are probably contributing to elevated stream temperatures. Channel recovery was not considered when projecting shade recovery values. Narrower channels would allow stream temperatures to decrease. Restoration activities would also lead to channel recovery by decreasing the amount of sediment entering streams. Improved pool frequency conditions would help restore the groundwater and floodplain connection and increase the groundwater and stream interaction with an expected increase in cool water refugia. Increased amounts of LWD would reduce flow velocity and bed and bank shear stress. Increased channel stability and bank building processes would help restore channel width to depth conditions. The improved temperatures and channel widths were not included in the shade recovery values.

Riparian Restoration

Riparian restoration would increase storage capacity for subsurface and groundwater inflow. Two benefits not included in the shade recovery values are groundwater inflow cooling stream temperatures directly by the mass transfer of energy and groundwater inflow increasing streamflow and maintaining stream temperatures.

Timber Harvesting on Private Land

Seventy-three percent of the watershed is privately owned. Some of the private lands are managed for timber production. The assessment of private lands in this watershed is beyond the scope of this WQRP. The WQMP prepared by ODEQ would determine the shade recovery expected, as well as, the site potential for recovery on private lands. While Standards and Guidelines on Federally-administered land establish wider stream shade buffers than the Oregon Forest Practices Act, the Oregon Forest Practices Act guidelines do offer some stream shade protection.

A statewide demonstration of the Oregon Forest Practice Act's ability to protect water quality is expected to address the specific parameters affected by forest management practices (temperature, sediment and turbidity, aquatic habitat modification, and biological criteria). The schedule and other requirements for addressing these parameters are included in the ODEQ/ODF Memorandum of Understanding (MOU) of May 16, 1998.

Riparian Reserves

The Standards and Guidelines for Riparian Reserve widths on fish bearing streams are used to protect fish habitat and other riparian dependent species and resources. The additional protection for the other species and resources provides an additional margin of safety for fish and stream protection.

Chapter 4 - Monitoring Plan

The NWFP provides the framework[1] to accommodate a nesting of geographic scales (region, province, subbasin, watershed, and site) in a manner that allows localized information to be compiled and summarized in a broader context. Monitoring at all scales should:

- Detect changes in ecological systems from both individual and cumulative management actions and natural events
- Provide a basis for natural resource policy decisions
- Provide standardized data
- Compile information systematically
- Link overall information management strategies for consistent implementation
- Ensure prompt analysis and application of data in the adaptive management process
- Distribute results in a timely manner

The NWFP monitoring provides a framework for three types of monitoring (implementation, effectiveness, and validation) to meet objectives and evaluate the efficacy of management practices. The Roseburg BLM Resource Management Plan (RMP) contains a monitoring plan that addresses implementation, effectiveness, and validation monitoring. It includes statements of expected future conditions and outputs along with key questions and specific monitoring requirements (USDI 1995, page 84 and Appendix I, page 189).

Implementation monitoring is meant to ensure that management actions are following the prescribed management direction. The Roseburg District Annual Program Summary and Monitoring Report tracks how management actions are being implemented according to standard and guidelines. It also outlines the progress of watershed restoration work. Roseburg BLM produces this document yearly and it shows the success and progress of implementing water quality related objectives.

Effectiveness monitoring answers the question of whether or not prescribed management actions meet the desired objectives. For aquatic and riparian objectives (including water quality) this will provide the necessary information to evaluate natural conditions, ranges, and distributions of water quality parameters and watershed processes, and the dominant processes determining their distribution and trends. Inventory and monitoring will help identify sources and causal factors for water quality and watershed condition. The goal is to improve prescribed management actions and achieve the goals of the standards and guidelines. If results of monitoring indicate existing management practices are not achieving water quality objectives, plan amendments may be written to provide for new actions. The amendment process includes programmatic compliance with NEPA and other environmental laws.

Validation monitoring, the testing of basic assumptions, will be accomplished through formal research. The Roseburg District could be involved in some of this research but most likely would defer to larger scale efforts.

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[1] Final Supplemental Environmental Impact Statement, Appendix I

The NWFP calls for an interagency monitoring network using a common design framework and common indicators. The Aquatic/Riparian Effectiveness Monitoring Plan (AREMP), which was approved March 12, 2001 and published in 2003 (Reeves et al. 2003) is a broad based tool spanning the NWFP area for meeting this need. The Aquatic/Riparian Effectiveness Monitoring Plan will provide information in a decade or more at the province scale. In the adaptive management process, adjustments would take place as the result of feedback from action-based planning, monitoring, researching, and evaluation.

Key questions from the effectiveness and validation monitoring section of the Roseburg RMP provide a framework to address water quality and aquatic issues (USDI 1995, Appendix I, pages 191, 196, and 198). These questions are valid for the life of the RMP however they would need to be revisited if a new planning document were adopted. The following are a sample of monitoring questions that could be answered through AREMP or by other means initiated by the Roseburg District:

- Is the health of Riparian Reserves improving?
- Are the management actions that are designed to rehabilitate Riparian Reserves effective?
- Are State water quality criteria being met? When State water quality criteria are met, are the beneficial uses of riparian areas protected?
- Are prescribed Best Management Practices maintaining or restoring water quality consistent with basin specific State water quality criteria for protection of specified beneficial uses?
- Is the ecological health of the aquatic ecosystems recovering or sufficiently maintained to support stable and well-distributed populations of fish species and stocks?
- Is fish habitat in terms of quantity and quality of rearing pools, coarse woody debris, water temperature, and width to depth ratio being maintained or improved as predicted?
- Are desired habitat conditions for listed, sensitive, and at-risk fish stocks maintained where adequate, and restored where inadequate?

The Roseburg District is developing a water quality/aquatics monitoring strategy. This strategy will provide the framework for how to answer monitoring questions, what tools to use for answering these questions, as well as for coordinating with other agencies within the Umpqua Basin to monitor aquatic and riparian issues. The AREMP may be incorporated into this strategy for answering some of the above questions and providing feedback for changes in management. Completion of this strategy is expected sometime in 2004.

Over the last several years the Roseburg District has cooperated with ODEQ, ODFW, and the Umpqua Basin Watershed Council in monitoring efforts. The following is a summary of the types of monitoring completed over the last several years:

- Stream Temperature – Approximately 150 Sites
- Macroinvertebrate Sampling - Approximately 20 Sites
- Riparian and Stream Condition Classification – 50 to 100 Stream Miles

The Roseburg District will continue to cooperate with these types of efforts and with other agencies as needed. The Roseburg District monitoring strategy will guide future monitoring efforts.

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Appendix 1. Culverts in the Olalla Creek/Lookingglass Creek Watershed to Consider Replacing.

Culvert Number and Location	Miles of Fish Habitat Upstream	Quality of Fish Habitat	Comments
3054 (28S-8W-9, NW ¼)	0.2	Moderate	Adult fish barrier; Low gradient above culvert
3055 (28S-8W-9, NW ¼)	0.5	Moderate	Adult fish barrier; approximately a 3% gradient above culvert
1001 (28S-8W-15, SW ¼)	4.0	Good	Adult fish barrier; Major culvert to be administered by the District Engineer
3051 (28S-7W-27, SE ¼)	0.4	Fair/ Unknown	Adult fish barrier; Moderate gradient above culvert; 20% gradient below culvert; No ODFW habitat data
3046 (29S-7W-20, SE ¼)	1.0	Moderate	Barrier to juvenile fish and adult cutthroat trout; Coho using stream; Active mining claim; Limited shade
3042 (30S-8W-18, NW ¼)	0.8	Moderate/ Fair	Barrier to juvenile fish and adult cutthroat trout; Small tributary
3039 (30S-8W-24, NW ¼)	1.3	Good	Barrier to juvenile fish and adult cutthroat trout; 7% gradient stream above; a substantial tributary
Total	7.9		

Appendix 2. Roads in the Olalla Creek/Lookingglass Creek Watershed to Consider Decommissioning.

Road Number	Miles	Surface	Condition	Maintenance Level	Field Checked	Road Closure Options	Comments
Berry Creek Subwatershed							
30-8-3.04A	0.13	Natural	Unknown	1		D, FD, O	
Mt. Shep Subwatershed							
30-7-8.03A	0.78	Natural	Fair	2	IDT tried	D, FD, O	Tried to check it road leading to it not driveable, consider decommissioning other roads in this area
30-7-18.05A	0.44	Natural				D, FD, O	GIS says was decommissioned in 1998, crosses private land
30-7-18.06A	0.13	Natural				D, FD, O	GIS says was decommissioned in 1998, begins on private land
30-7-20.01B	0.22	Natural	Fair	2	Yes (IDT)	D, FD, O	road leading to it not drive able, already passively decommissioned
30-8-11.02A	0.27	Natural	Good	2		D, FD, O	Accesses private land, looks like recently improved (rocked) on photo
30-8-24.02E	0.34	Natural	Fair	1 or 2		D, FD, O	Begins on private
Reston Subwatershed							
28-8-15.00B	0.30	Natural	Unknown	1	Yes (IDT)	T, D, FD, O	Accesses private land, gate at beginning of road system consider adding lock
28-8-15.00D	0.26	Natural	Unknown	1	Yes (IDT)	D, FD, O	Passively decommissioned
Total	2.87						

Appendix 3. Roads in the Olalla Creek/Lookingglass Creek Watershed to Consider Improving.

Road Number	Miles	Surface	Condition	Maintenance Level	Field Checked	Road Closure Options	Comments About Improving and Priorities
Berry Creek Subwatershed							
29-7-7.01A	0.17	Rock	Fair	2			High-S (PCT)
29-7-19.00A	0.20	Rock	Fair	2			Medium-S (CT), ridgetop
29-7-20.02A	0.40	Rock	Fair	2	Yes (IDT)	T-current gate	Medium-F, High-S
29-7-20.02B	1.20	Rock	Fair	2	Yes (IDT)	T-current gate	Medium-F, High-S
29-8-1.00C	3.70	Rock	Fair	4			Medium-F, High-S
29-8-1.00D	2.65	Rock	Fair	3			Low-F, High-S
29-8-2.02B1	0.87	Rock	Fair	2			Low-F, High-S
29-8-11.00A	0.39	Rock	Fair	2			L-F, H-S (PCT), accesses private land
29-8-11.01A	0.24	Rock	Fair	1			Low-F, Medium-S (PCT)
29-8-13.00F	0.30	Natural	Poor	2			Medium-F, Low-S
29-8-13.00H	0.40	Natural	Poor	2		T-current gate	Low-F and S
29-8-13.00J	0.10	Natural	Poor	2		T-current gate	Low-F and S
29-8-13.01A	3.09	Rock	Fair	2			Medium-F, High-S
29-8-13.03A	0.12	Rock	Fair	1			Low-F, Medium-S (PCT)
29-8-14.01C	0.29	Natural	Poor	2			M-F, L-S (PCT), crosses private land
29-8-23.01A	0.84	Rock	Fair	2			Low-F, Medium-S (PCT)
29-8-23.05A	0.20	Rock	Fair	1			Low-F and S (PCT)
29-8-23.06A	0.20	Rock	Fair	1			Low-F, Medium-S (PCT)

Appendix 3. Roads in the Olalla Creek/Lookingglass Creek Watershed to Consider Improving.

Road Number	Miles	Surface	Condition	Maintenance Level	Field Checked	Road Closure Options	Comments About Improving and Priorities
29-8-27.00C	1.00	Rock	Good	2			Low-F, Medium-S
29-8-27.00D	0.70	Rock	Good to Fair	2			Low-F, Medium-S
29-8-27.01B	0.10	Rock	Self Decommissioned	2	Yes (MF)	D	Low-F, High-S (PCT), ridgetop, good location for fire control
29-8-27.02A	0.28	Rock	Good	2			Low-F, Medium-S, slide above stream
29-8-27.03A	0.36	Rock	Good	2			Low-F, Medium-S (PCT), fuel break between stand types
29-8-27.04A	0.14	Rock	Fair	1 or 2			L-F, M-S (PCT), accesses private land
29-8-27.05A	0.11	Rock	Fair	1			Low-F and S, T-needs road
29-8-27.06A	0.11						Low-F, High-S (PCT)
29-8-35.00A	0.22	Rock	Fair	1			Low-F and S (CT)
29-8-35.01A	0.23	Natural	Fair	1			Medium-F, Low-S (PCT)
29-8-35.02A	0.15	Natural	Fair	1			Medium-F and S (PCT)
29-8-35.03A	0.29	Rock	Fair	1			Low-F, Medium-S (PCT)
29-8-35.05A	0.54	Rock	Good to Fair	2			Low-F, High-S (PCT)
30-8-3.00A	0.75	Rock	Fair	2			Low-F, Medium-S
30-8-3.01A	0.10	Rock	Fair	2			Low-F, Medium-S
30-8-9.02C	0.92	Rock	Fair	2			Medium-F, High-S
30-8-9.03A	0.26	Natural	Unknown	1			Low-F, Medium-S

Appendix 3. Roads in the Olalla Creek/Lookingglass Creek Watershed to Consider Improving.

Road Number	Miles	Surface	Condition	Maintenance Level	Field Checked	Road Closure Options	Comments About Improving and Priorities
Lookingglass Creek Subwatershed							
28-7-9.00A	2.69	Rock	Good	2			Medium-F, High-S
28-7-9.00C	0.04	Rock	Good	2			Low-F, Medium-S (PCT)
28-7-9.01A	0.25	Rock	Good	2			Low-F, Medium-S (PCT)
28-7-27.00B	0.29	Natural	Unknown	2			Medium-F, Low-S
Mt. Shep Subwatershed							
29-7-31.02A	0.59	Rock	Fair	2			Low-F, Medium-S
30-7-5.00G	0.14	Rock	Fair	3			Low-F and S
30-7-5.00I	0.04	Rock	Fair	3			Low-F and S
30-7-5.01A	0.65	Rock	Fair	2			Low-F, High-S
30-7-6.02A	1.25	Rock	Fair	3			Low-F, Medium-S
30-7-7.01A	1.18	Rock	Good	2			Low-F, Medium-S
30-7-8.01B	0.21	Natural	Fair	2	Yes (MF)	D	original TMO said maintain
30-7-8.02A	0.79	Natural	Fair	2			High-F, Low-S
30-7-8.04A	0.56	Natural	Fair	2			Low-F and S, T-needs road
30-7-9.00A	0.70	Natural	Poor	2			High-F, Fish bearing stream
30-7-18.01B1	0.90	Rock	Poor	3			Medium-F, High-T
30-7-18.01B2	0.70	Rock	Poor	3			Low-F, High-T
30-7-18.04B	0.13	Natural	Fair	2			Medium-F, Low-S

Appendix 3. Roads in the Olalla Creek/Lookingglass Creek Watershed to Consider Improving.

Road Number	Miles	Surface	Condition	Maintenance Level	Field Checked	Road Closure Options	Comments About Improving and Priorities
30-7-19.00A	0.05	Natural	Fair	2			Low-F and S
30-7-19.00C	0.60	Natural	Fair	2			High-F, Low-S
30-7-19.01A	1.76	Rock	Rough	3	Yes (MF)		Medium-F, High-S
30-7-20.00B	1.16	Natural	Very Rough	2	Yes (MF)		High-F
30-7-20.00C	0.21	Natural	Very Rough	2	Yes (MF)		High-F
30-8-1.02A	0.33	Rock	Fair	2			Low-F, Medium-S (PCT)
30-8-1.03A	0.22	Rock	Fair	2			Low-F, Medium-S (PCT)
30-8-1.04A	0.31	Rock	Fair	2			Low-F, Medium-S (CT)
30-8-11.00A	0.43	Rock	Good	2	Yes (MF)		recently improved
30-8-11.00B	0.82	Rock	Good	2	Yes (MF)		recently improved
30-8-11.00C	0.09	Rock	Good	2	Yes (MF)		recently improved
30-8-11.01A1	0.91	Rock	Fair	3			Medium-F and S
30-8-11.01A2	1.39	Rock	Fair	3			Medium-F and S
30-8-11.03A	0.32	Rock	Good	2			Low-F and S
30-8-11.04A	0.30	Natural				D	Medium-F, Low-S (CT), GIS says road was decommissioned in 1998
30-8-12.00B	0.59	Natural	Good	2			Low-F and S
30-8-13.00B	0.59	Natural	Erosion	2	Yes (MF)	T, D	High-F, Medium-S, T-needs road
30-8-14.00B	0.74	Rock	Good	2			Low-F, Medium-S

Appendix 3. Roads in the Olalla Creek/Lookingglass Creek Watershed to Consider Improving.

Road Number	Miles	Surface	Condition	Maintenance Level	Field Checked	Road Closure Options	Comments About Improving and Priorities
30-8-14.00C	0.50	Rock	Good	2			Medium-F and S
30-8-14.01A	0.33	Rock	Fair	2			Low-F, High-S
30-8-14.04A	0.40	Rock	Good	2			Low-F, Medium-S
30-8-15.01A	0.40	Rock	Fair	2			Medium-F and S
30-8-23.00A	0.60	Natural	Good	2	Yes (MF)		High-F, Medium-S
30-8-23.01A	0.16	Natural	Good	2			Low-F, Medium-S
30-8-23.01B	0.15	Natural	Good	2			Low-F, Medium-S
30-8-24.00B	1.50	Rock	Good	2			High-F and S
30-8-26.00A	1.04	Rock	Good	2			High-F, Medium-S
Olalla Subwatershed							
29-7-3.00E	1.74	Rock	Fair	3			Medium-F, High-S
29-7-7.00A	0.33	Rock	Fair	2			L-F, M-S (PCT), ridgetop, good for fire access, houses 1,000 feet below road
29-7-11.01A	0.62	Rock	Fair	3			High-F and S
29-7-11.01B	0.50	Rock	Fair	3			Low-F, High-S
29-7-11.02A	0.70	Rock	Fair	3			Low-F, High-S
29-7-11.04A	0.30	Rock	Good	2			Low-F, Medium-S (PCT)
29-7-15.00B	0.40	Rock	Fair	2			Low-F, High-S
29-7-17.00A	0.16	Natural	Fair	2			Low-F and S

Appendix 3. Roads in the Olalla Creek/Lookingglass Creek Watershed to Consider Improving.

Road Number	Miles	Surface	Condition	Maintenance Level	Field Checked	Road Closure Options	Comments About Improving and Priorities
Reston Subwatershed							
28-8-9.00A2	0.15	Natural	Unknown	1			Low-F, High-S (PCT)
28-8-9.02A	0.40	Rock	Fair	1			Low-F, Medium-S (PCT)
28-8-12.02B	0.05	Natural	Poor	2			Low-F, Medium-S
28-8-13.00A	2.93	Rock	Fair	3			Low-F, High-S
28-8-13.01A	0.96	Rock	Big Ruts, Slides	2	Yes (MF)	D	High-F, Medium-S
28-8-13.02A	0.23	Rock	Fair	1			Low-F and S accesses rock pit
28-8-13.03A	0.28	Rock	Good	2			Low-F, High-S (PCT)
28-8-15.02A	0.26	Rock	Fair	2			Low-F, Medium-S (PCT)
28-8-16.00A	4.30	Bituminous	Fair	5	Yes (IDT)		M-F, H-S, main road, looked fine
28-8-16.03B	0.57	Rock	Fair	2			Low-F, Medium-S (PCT)
28-8-21.02A	0.10	Rock	Good	2			Low-F, Medium-S (CT)
28-8-21.03A	0.07	Rock	Good	2			Low-F, Medium-S (CT)
28-8-23.02A1	0.20	Rock	Fair	3			Low-F, High-S
28-8-23.02A2	0.70	Rock	Fair	2			Medium-F, High-S
28-8-26.00B	0.08	Rock	Fair	2			Low-F, Medium-S (PCT), one mile from Tenmile, good for fire access
28-8-26.00C	0.60	Rock	Fair	2			Low-F, Medium-S (PCT), one mile from Tenmile, good for fire access

Appendix 3. Roads in the Olalla Creek/Lookingglass Creek Watershed to Consider Improving.

Road Number	Miles	Surface	Condition	Maintenance Level	Field Checked	Road Closure Options	Comments About Improving and Priorities
28-8-27.01A	0.49	Natural	Overgrown	2	Yes (MF)	T	Medium-F, Low-S
28-8-27.01B	0.11	Natural	Overgrown	2	Yes (MF)	T	Low-F and S
28-8-27.02A	0.63	Rock	Good	2			L-F, H-S (PCT), ridgetop, fire access
28-8-27.03A	0.16	Rock	Good	2			Low-F, Medium-S (CT)
28-8-27.05A	0.25	Rock	Fair	3			Low-F, Medium-S
28-8-27.06A	0.25	Rock	Good	2			Low-F, Medium-S (PCT)
28-8-27.07A	0.19	Rock	Good	2			Low-F, High-S (PCT)
28-8-27.08A	0.45	Rock	Good	2			L-F, H-S (PCT), ridgetop, fire access
28-8-34.00C	1.00	Natural	Ruts, Erosion	2	Yes (MF)	T	High-F, Medium-S
28-8-34.01B	0.50	Natural	Unknown	2	Yes (MF)	T	Low-F, Medium-S (CT)
28-8-34.02A	1.19	Rock	Fair	2			Low-F, Medium-S (PCT)
29-8-2.00D	0.60	Rock	Good to Fair	3			Medium-F, High-S
29-8-2.00F2	0.51	Natural	Fair	1			Medium-F and S
29-8-2.01F	0.08	Natural	Unknown	2			Medium-F, Low-S
29-8-3.01A	1.01	Rock	Good to Fair	2			Medium-F, High-S (CT)
Thompson Subwatershed							
29-6-31.03A	0.39	Rock	Fair	2			Low-F, Medium-S
29-6-31.03B	0.15	Rock	Fair	2			Low-F and S
29-7-35.03C	0.11	Rock	Fair	2			Low-F, Medium-S (CT)

Appendix 3. Roads in the Olalla Creek/Lookingglass Creek Watershed to Consider Improving.

Road Number	Miles	Surface	Condition	Maintenance Level	Field Checked	Road Closure Options	Comments About Improving and Priorities
30-6-4.02B	1.85	Natural	Good	1			High-F and S
30-6-5.00A	0.33	Rock	Good	2			Low-F, Medium-S
30-6-5.00E	0.14	Natural	Fair to Poor	1			Low-F, Medium-S
30-6-7.02A	0.20	Natural	Good	1			Low-F and S
30-6-7.06A	0.13	Rock	Good	2			Low-F, High-S (PCT)
30-7-2.02B	0.30	Natural	Unknown	2			Low-F and S
Total	76.28						

Maintenance Level - 1 = Minimum, 2 = Administrative, 3 = Seasonal or year-round, 4 = Annual, 5 = Highest
Field Checked - MF = Matt Fairchild, IDT = Interdisciplinary Team
Road Closure Options (to consider) - T = Temporary/Seasonal/Limited Access (Gate or Barrier), D = Decommission, FD = Full Decommission, O = Obliterate
Improve - H = High Importance, M = Medium Importance, L = Low Importance
- F = Fisheries (priority based on surface type and closeness to stream), S = Silviculture (priority based on potential use for activities, such as PCT = Precommercial Thinning, CT = Commercial Thinning), T = Timber, E = Engineering