5. HYDROLOGY AND WATER USE

This section of the watershed analysis characterizes the hydrology and water uses within the ODF management areas. Where information is available, this section answers the four OWEB critical questions for hydrology and the seven critical questions for water use.

OWEB Hydrology Questions:

1. *What land uses are present in your watershed?*
2. *What is the flood history in your watershed?*
3. *Is there a probability that land uses in the basin have a significant effect on peak flows?*
4. *Is there a probability that land uses in the basin have a significant effect on low flows?*

OWEB Water Use Questions:

1. *For what beneficial use is water primarily used in your watershed?*
2. *Is water derived from a groundwater or surface-water source?*
3. *What type of storage has been constructed in the basin?*
4. *Are there any withdrawals of water for use in another basin (interbasin transfers)? Is any water being imported for use in the basin?*
5. *Are there any illegal uses of water occurring in the basin?*
6. *Do water uses in the basin have an effect on peak flows?*
7. *Do water uses in the basin have an effect on low flows?*

In the process of answering these questions, specific information is included describing streamflow characteristics, water yield and peak flows, instream water rights and low flows, consumptive water uses, and water withdrawals and storage. The hydrology and water use information for the project area are separated into two sections; the management basins located within the Upper Nehalem watershed and the Clatskanie and Young's Bay contiguous parcels.

5.1 NEHALEM MANAGEMENT BASINS

This section focuses on the hydrology and water use within the Nehalem watershed as a whole, but where applicable and information is available, the hydrologic assessment is described by the 13 ODF management basins. This assessment is based on information provided in the Nehalem River Watershed Assessment and some additional analysis performed using available GIS information.

The Nehalem River is one of the longest rivers in Oregon with a length of 118.5 miles and a drainage area of approximately 855 square miles. The headwaters of the Nehalem basin are on the eastern edge of the Coast Range. The Oregon Coast Range is relatively low, with peaks at 1,500 feet-3,300 feet in elevation. The Nehalem River circles around the northern tip of the mountains then heads in a southwesterly direction until it drains into the Nehalem Bay and then into the Pacific Ocean (Johnson and Maser 2000). The entire basin has the usual coastal type distribution with precipitation heavy in the fall and winter and light in the spring and summer (Young and Colbert 1965). The mean annual precipitation of the Nehalem Basin is approximately 113 inches. Annual precipitation ranges from 80 inches in the lower elevations to more than 150 inches in the higher elevations (ODF 2003). Because of the relatively low elevation, snowfall in the Coast Range is low, averaging 12-24 in annually (Johnson and Maser 2000).

The Oregon Coast range mountains do not collect sufficient snow to supplement spring and summer flows (Johnson and Maser 2000). Eighty percent of the precipitation falls between October and March with snowfall occurring only in the higher elevations (Broad 1996). As a result, peak stream discharges occur between December and February, the rainiest months, and low flows occur during the summer months. Snow that does accumulate is quickly washed away by winter rains. Rain-on-snow events that have the potential to increase peak flows occur infrequently, as in the February 1996 flood discussed in the streamflow section.

5.1.1 Streamflow Characteristics

Descriptions of streamflow for streams within the ODF management basins can not be provided as no tributary flow data is available. Thus, this summary of the hydrological characteristics relies on other data available within the Nehalem watershed. United States Geological Survey and Oregon Water Resources Department have operated several gages throughout the Nehalem watershed. These gages are summarized in Table 5-1. Only the Fishhawk Creek near Jewell gage is located within the project area. This gage was located within the Hamilton management basin and only measured peak flows. The peak flows for this gage are summarized in Table 5-2 along with the corresponding flow at the Nehalem River near Foss gage. The overall hydrology of the Nehalem watershed is best captured by the Nehalem River near Foss gage. This gage is located southwest of the project area on the Nehalem River at river mile 13.5. It has been in continuous operation since 1939 and captures the streamflow from a drainage area of 667 miles, almost 80 percent of the Nehalem watershed. The annual hydrograph for this gage is shown in Figure 5-1. As indicative of rain dominated systems, the hydrograph shows peaks during the rainy months of December through February and low flows during the mid to late summer. Streams located on the ODF management basins likely have a similar shape with variability in

the magnitude of flow. However, to understand the specific hydrology of these smaller streams and ultimately how management of the surrounding forest impacts their hydrology more flow data would be needed.

Table 5-1. Summary of Gages within the Nehalem watershed.

Station Name	Station Number	Period of Record	Drainage Area (mi^2)	Comments
Nehalem River near Foss	14300100	1939-2003	667	
Nehalem River near Vernonia	14299800	2001-2003	70	
Jetty Creek near Brighton	14301250	1975-1995		
Fishhawk Creek near Jewell	14300400	1970-1976	0.71	Peak flows only
Oak Ranch Creek near Vernonia	14300200	1958-1969	11.6	Peak flows only

Table 5-2. Summary of Peak Flow Data for the Fishhawk Creek near Jewell Gage and corresponding Nehalem River near Foss gage data.

Date	Fishhawk Creek Peak Flow (cfs)	Nehalem River Flow (cfs)
1/17/1971	93	23,300
1/21/1972	1,920	38,200
12/21/1972	80	20,200
1/16/1974	131	37,800
3/18/1975	80	8,720
12/4/1975	93	29,000
11/15/1976	5.7	216

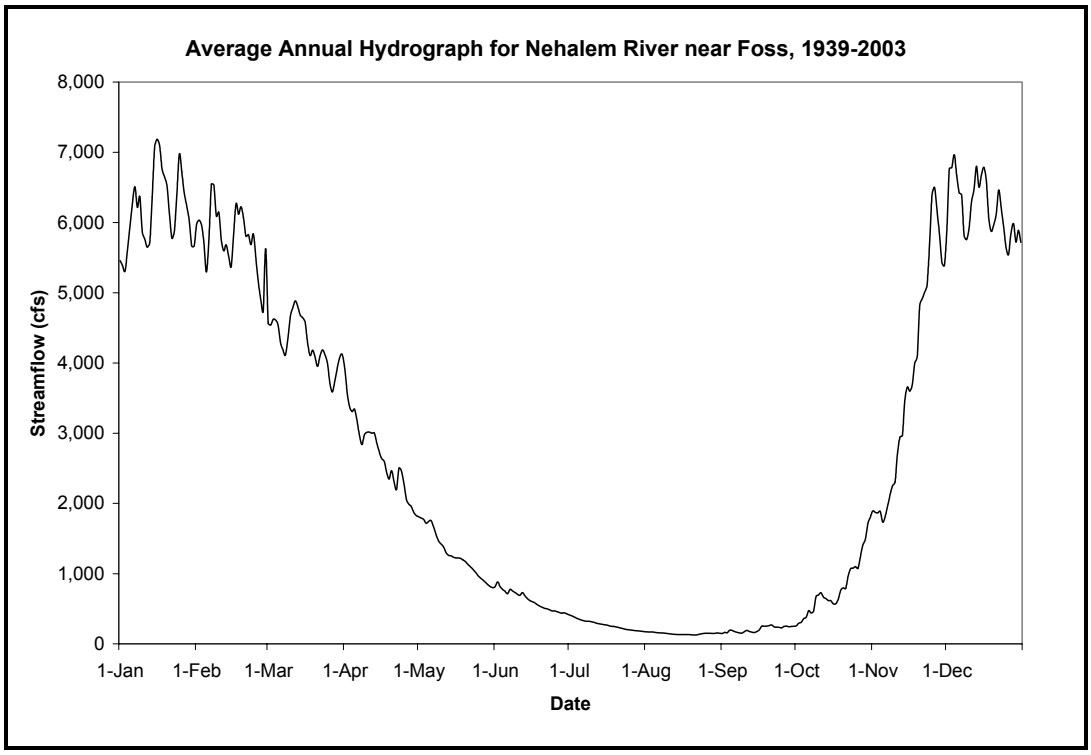


Figure 5-1. Annual Hydrograph for the Nehalem River near Foss, 1939-2003.

A greater than 200-year recurrence interval flood occurred on the Nehalem River in 1996. The Nehalem River near Foss gage read a maximum of 70,300 cfs on February 8, 1996. Other large floods were recorded in 1990, 1972 and 1964. The annual peak flows for the 1938-2003 period of record for Nehalem River near Foss gage are shown in Figure 5-2. Annual low flows for the same period recorded at the Foss gage are shown in Figure 5-3.

Land uses present in the four subwatersheds of the Nehalem watershed are detailed in Table 5-3. Forestry is the predominant land use in the project area. Given the paucity of flow data within the project area, we were unable to assess how specific ODF forestry practices have impacted the hydrology of the Nehalem River. Thus, in lieu of a project specific assessment, a brief and general discussion of how forestry practices can potentially affect stream hydrology is provided below.

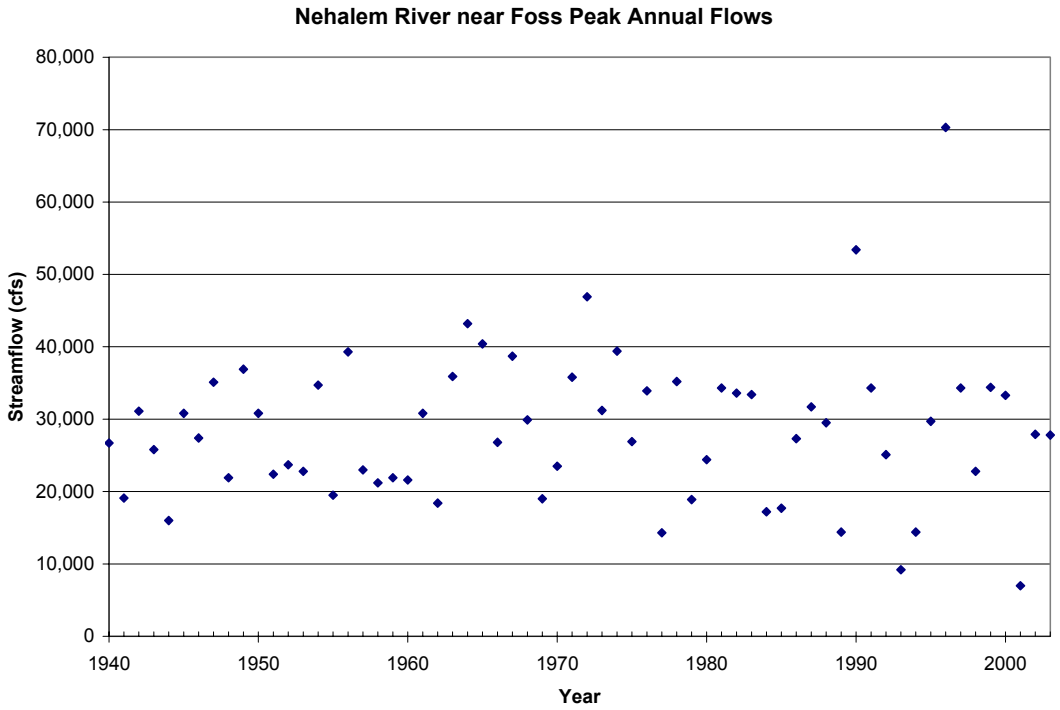


Figure 5-2. Annual Peak Flows for the Nehalem River near Foss Gage #14301000.

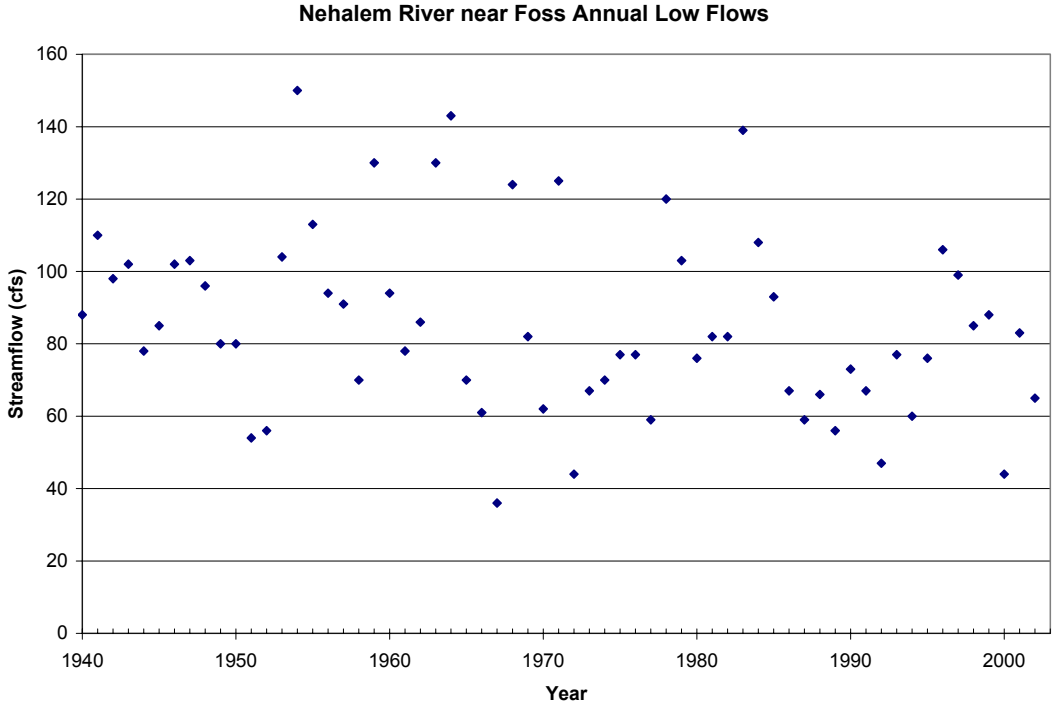


Figure 5-3. Annual Low Flows for the Nehalem River near Foss Gage #14301000.

Table 5-3. Summary of Land Uses for subwatersheds within the Nehalem watershed.

Watershed	Forestry	Ag/Rangeland	Ag/Rangeland/Forestry	Urban	Other[1]
Lower Nehalem River	90.7%	1.6%	4.9%	--	2.8%
Middle Nehalem River	95.8%	0.7%	2.7%	--	0.8%
Upper Nehalem River	95.1%	--	3.0%	0.7%	--
Entire Nehalem River	92.2%	1.7%	3.7%	0.5%	1.9%

[1] "Other" category includes natural resources, parks and recreation, rural industry, and rural residential
Source: PSU, 2000

The streamflow characteristics of a river system can be influenced by land use practices by altering both peak flows and low flows. Forestry practices can influence peak and low flows through several processes resulting from changes in vegetation and construction of new road networks (Johnson and Maser 2000). Loss of vegetative cover can potentially reduce rates of interception and evapotranspiration, and changes in canopy cover can alter streamflows by changing the snow accumulation and melt rate. This change has the most impact on systems that are rain-on-snow dominated and thus is not likely a significant factor in a rain dominated system like the Nehalem River. Forest road networks increase the impervious surface area and can potentially provide a more direct route for runoff into stream channels (Rule 2001). The impact of forest roads on peak and low flows in the Upper Nehalem Project Area is presumed to be insignificant, as the percentage of road per unit forest area and percentage of road drainage with hydrologic connection to streams are both low (see Chapter 8).

Specific data was not available to address if these potential hydrological effects are occurring in the Nehalem watershed. Site specific hydrologic data is lacking and is needed in order to understand any relationship between ODF management activities and Nehalem River hydrology.

5.1.2 Water Yield and Peak Flows

As described above, peak flows are potentially influenced by land uses within the watershed. The major land uses in the upper Nehalem River were evaluated to determine the potential impact on peak flows.

The largest land use in the four watersheds covering the management basins was forestry. Without additional hydrologic data is was not possible to assess forest management effect on flows. We were able to assess potential impact that forest roads may have on flows. A summary of the forest road areas within the three sub-watersheds is presented in Table 5-4. The data is presented by management basin in Table 5-5. The linear distance of roads within each

management basin was calculated using the Roads Information Management System (RIMS) data set. According to the GWEB manual (1999), peak flow changes due to roads are small and statistically insignificant in watersheds where roads occupy less than 5 percent of the basin (Nehalem, Washington). A review of available information showed that the subwatersheds of interest and each of the ODF management basins have less than 5 percent of forest area in roads. Overall, the probability of peak flow enhancement from timber harvest in the Upper Nehalem Basin would be low due to the infrequency of rain-on-snow events and the small portion of forestry roads.

Table 5-4. Forest Road Area Summary for subwatersheds of the Nehalem watershed.

Subwatershed	Total Linear Distance of Forest Roads (miles)	Percent of Forested Area in Roads
Lower Nehalem River	344.04	0.98%
Middle Nehalem River	401.34	1.10%
Upper Nehalem River	443.1	0.93%

Source: PSU, 2000

Table 5-5. Forest Road Area Summary by Management Basin.

Management Basin	Total Linear Distance of Forest Roads (miles)	Percent of Forested Area in Roads
Beneke	48.7	1.5
Buster	106.3	1.7
Crawford	27.8	2.0
Fishhawk	32.8	2.0
Hamilton	37.7	1.9
Lousignot	27.5	1.8
Northrup	44.1	1.8
Quartz	55.3	1.9
Sager	69.4	2.1
McGregor	59.6	1.7
Wheeler	102	2.0
Wilark	16.8	2.2

A summary of the rural roads in the three subwatersheds is presented in Table 5-6. Rural road densities between 4 percent and 8 percent have a moderate risk potential of enhancing peak flow (GWEB 1999). The Middle Nehalem River subwatershed had 4.6 percent area in roads and thus, a moderate risk of enhancing peak flows. The Fishhawk, Lousignot, Northrup, and Sager management basins are located within the Middle Nehalem River subwatershed. All other subwatersheds would have a low potential for peak flow enhancement. The small percentage of agriculture/rangeland and urban area in the Nehalem watershed also had a low potential of enhancing peak flow.

Table 5-6. Rural Road Area Summary for subwatersheds of the Nehalem watershed.

Subwatershed	Total Linear Distance of Rural Roads (miles)	Percent Area in Roads	Relative Potential for Peak Flow Enhancement
Lower Nehalem River	50.5	4.6%	Moderate
Middle Nehalem River	18.89	3.42%	Low
Upper Nehalem River	16.07	3.16%	Low

Source: Johnson and Maser 2000

5.1.3 Consumptive Water Uses

Our research identified a total of eight ODF water rights within the management basins. These water rights are used for forest management and fire protection. The most common ODF forest management water uses included processing and compaction of forest roads, dust abatement, slash burning, and mixing with herbicides. Detailed information on ODF water rights within the project area including the permit number, water right type, use, maximum rate/size, specific restrictions, water source and tributary to, and the priority date is summarized in Table 5-7. As per Oregon Revised Statue requirements, some water uses by ODF do not require a permit. These water uses include the withdrawal of water for fire control in training or emergency fire fighting, and some forest management practices such as slash burning and mixing with herbicides. The quantity and timing of withdrawals for these exempt uses was unknown.

In addition to the ODF water rights, there were a total of fifteen private water rights located within the project area (Table 5-8). The data for Tables 5-7 and 5-8 were obtained by searching both the available water right GIS coverage within the identified project area and Oregon Water Resources Department (OWRD) Water Rights Information System for more recently approved water rights. There were a total of two reservoir permits and 21 surface water permits identified within the 11 management basins. We were unable to locate documentation that would allow us

Table 5-7. Summary of ODF Water Rights and Sources located within management basins.

Management Basin	Permit/ Application Number	Type	Use	Maximum Rate/Size	Restrictions	Source	Tributary To	Priority Date
Northrup	S52865	Surface	Forest management, fire protection	0.86 cfs	Jan 1 – May 31	Plympton Creek	Columbia River	12/9/1994
Beneke	S77250 S52852	Surface	Forest management, fire protection	0.86 cfs	Dec 1 – Mar 31, Not to exceed 100,000 gallons per year	Beneke Creek	Nehalem River	12/9/1994
	S52854 S77251	Surface	Forest management, fire protection	0.86 cfs	Dec 1 – Mar 31, Not to exceed 100,000 gallons per year	Bull Heifer Creek	Nehalem River	12/9/1994
Sager	R77249 70974[1]	Reservoir	Forest management, fire protection	2.9 ac-ft		Buster Creek, Plympton Creek, Sager Creek, Beneke Creek, Bull Heifer Creek		1/1/1993
	S52855 S77252	Surface	Forest management, fire protection	0.86 cfs	Nov 1 – Jul 31, Not to exceed 100,000 gallons per year	Sager Creek	Nehalem River	12/9/1994
	S52864 S77253	Surface	Forest management, fire protection	0.86 cfs	Nov 1 – Jul 31, Not to exceed 100,000 gallons per year	Sager Creek	Nehalem River	12/9/1994
Quartz	S52866 S77257	Surface	Forest management, fire protection	0.86 cfs	Nov 1- Jul 31, Not to exceed 100,000 gallons per year	Unnamed Stream	Nehalem River	12/9/1994
	R77248	Reservoir	Fire protection	0.3 ac-ft		Unnamed Stream/Reservoir		1/1/1993

[1] The place of use for this water right covers areas in Sager, Beneke, Fishhawk, Northrup, and Hamilton Management Basins

Table 5-8. Summary of Other (non-ODF) Water Rights and Sources in the ODF Management Basins.

Management Basin	Permit Number	Use	Maximum Rate (cfs) / Size (Acre-feet)	Source	Tributary To
Fishhawk	None				
Northrup	None				
Beneke	None				
Lousignot	S7135	Domestic	0.1	Nelson Creek	Nelson River
Hamilton	S26471	Domestic	0.01	Hamilton Creek	Fishhawk Creek
	S35238	Domestic	0.006	Hamilton Creek	Fishhawk Creek
Crawford	S43607	Domestic	0.005	A Spring	Nehalem River
Sager	S42756	Domestic	0.005	Sager Creek	Nehalem River
	S43757	Domestic expanded including non-commercial garden	0.005	Sager Creek	Nehalem River
Buster	S18269	Domestic including lawn and garden	0.01	Quartz Creek	Nehalem River
	S31735	Livestock	0.005	Unnamed Stream	Nehalem River
	S46988	Domestic, Stock	0.005	Nehalem River	Nehalem Bay
Quartz	S47566	Domestic	0	A Spring	Nehalem River
	S51894	Domestic expanded including non-commercial garden	0.01	A Spring	Nehalem
McGregor	S12432	Domestic	0.01	Unnamed Spring	South Fork Rock Creek
	S5670	Domestic	3	Rock Creek	Nehalem River
Wheeler	S12359	Municipal	0.15	Unnamed Stream	Nehalem River
	S5029	Fire protection	0.03	Unnamed Stream	Nehalem River
Wilark	None				

to determine if any illegal uses of water occurred within the project areas. We also failed to find any evidence of interbasin transfer or importation of water within the Project Area.

Within the entire Nehalem watershed, there were a total of 542 water rights with a potential diversion of 93.25 cfs (Johnson and Maser 2000). The quantities of water rights in each beneficial use category for the entire Nehalem watershed were: fish (33.3%), irrigation (25.8%), municipal (14.1%), geothermal manufacturing (8.8%), domestic (7.5%), fire protection (4.6%), and "other" (includes livestock, agriculture, recreation, wildlife, campground, dairy barn, and power (Johnson and Maser 2000).

5.1.4 Instream Water Rights and Water Availability

At the time of the report, instream water rights existed on eight rivers or streams located within or partially within the 11 ODF management basins. These instream water rights including the permit number, stream, range of flows, use, and priority date are summarized in Table 5-9. These water rights were granted to maintain flows within streams for the support of aquatic life or anadromous and resident fish rearing. These rights were granted to OWRD between 1989 and 1996, but have priority dates between 1973 and 1991. Like all water rights, water is first granted to those with more senior water rights. Many of the other water rights within the Nehalem basin have older priority dates. If all of these water rights are exercised, summer streamflows (low flows) could be significantly reduced.

The OWRD has identified 37 Water Availability Basins (WABs) for the entire Nehalem watershed that represent basins associated with tributaries of the Nehalem River. These WABs are used to identify areas with available or over appropriated water. A review of the 37 WABs in the Nehalem River basin at some point during the year showed that each of them had a potential water deficit. Potential channel dewatering can present problems for spawning and fish passage. Typically, the spawning period that coincides with the lowest flow starts in September and extends through October. Summer rearing habitat for fish also requires flow levels to be maintained.

There is insufficient streamflow data to support an assessment of the impact of forest practices on low flows within the project area. Hydrology data gaps identified include forest-specific streamflow data including low flows in managed and non-managed streams. However, the analysis of rights indicates that water uses in the basin have the potential to significantly impact low flows.

Table 5-9. Summary of Instream Water Rights Located in the ODF Management Basin Project Area.

Management Basin	Permit Number	Stream	Range of Flows (cfs)	Use	Priority Date
Fishhawk	IS71923	Fishhawk Creek	2.7-15	Anadromous and Resident Fish Rearing	10/11/1991
Northrup	IS71925	Northrup Creek	1.9-20	Anadromous and Resident Fish Rearing	10/11/1991
Beneke	None				
Lousignot	IS71923	Fishhawk Creek	2.7-25	Anadromous and Resident Fish Rearing	10/11/1991
Hamilton	None				
Crawford	MF40	Nehalem River	30-160	Supporting Aquatic Life	5/9/1973
Sager	MF39	Nehalem River	50-200	Supporting Aquatic Life	5/9/1973
Buster	IS71927	Buster Creek	3.5-51	Anadromous and Resident Fish Rearing	10/11/1991
	IS71928	Cow Creek	1-15	Anadromous and Resident Fish Rearing	10/11/1991
	MF39	Nehalem River	50-200	Supporting aquatic life	5/9/1973
Quartz	IS71929	Quartz Creek	1.7-30	Anadromous and Resident Fish Rearing	10/11/1991
McGregor	None				
Wheeler	IS71938	Nehalem River	6-40	Anadromous and Resident Fish Rearing	10/11/1991
Unnamed (next to Quartz)	IS71933	Spruce Run Creek	1-20	Anadromous and Resident Fish Rearing	10/11/1991
	MF38	Nehalem River	70-250	Supporting Aquatic Life	5/9/1973
	MF39	Nehalem River	50-200	Supporting Aquatic Life	5/9/1973
Wilark	IS 71921	Oak Ranch Creek	1.5-26	Anadromous and resident fish rearing	10/11/1991

5.1.5 Water Withdrawals and Storage

At the time of this report, the ODF water rights constituted a total of 84.4 million gallons of water withdrawn per year and a total storage capacity of 3.2 acre-feet. The majority of the water withdrawal was encompassed under the Plympton Creek water right that allows a maximum rate of 0.86 cfs withdrawn between January 1st and May 31st. If exercised completely, this water right would correspond to a withdrawal of 83.9 million gallons annually. None of the surface water rights owned by ODF allowed for withdrawals from August to October, the low flow months. However, ODF water uses exempted from water rights may be withdrawn. More detailed description of the types and quantities of ODF exempted water uses would be necessary to quantify the total amount of water withdrawn from ODF management basins.

At the time of this report, there were many other small reservoirs and off-channel ponds located throughout the entire Nehalem watershed. The total storage of water was 1273.6 acre feet. This water was used for recreation (77.5%), fish (15.4%), wildlife (5.2%), irrigation (1.4%), and "other" (fire protection, livestock, domestic/non-commercial). There was also an earth dam on Fishhawk Creek that forms Fishhawk Lake. The dam was privately owned by Fishhawk Lake Recreation Club, Inc. and holds 982 acre feet of water for recreational purposes (Johnson and Maser 2000)

5.2 CONTIGUOUS PARCELS

5.2.1 Clatskanie

A small parcel of the project area is contained within the Clatskanie River watershed, a subwatershed of the Lower Columbia-Clatskanie basin. The Clatskanie parcel is located within the Wilark management basin, is a total of 4,596 acres, with 2,366 acres within the Nehalem watershed and 2,230 acres within the Clatskanie River watershed. The portion within the Clatskanie River watershed covers only 3.7 percent of this watershed by area and is located within the higher elevation headwaters. There is relatively little information specific to the Clatskanie parcel of the project area and as a result, the hydrology and water use assessment was mainly based on information available for the entire Clatskanie River watershed. The majority of the information provided within was based on information provided in the Rule (2001) and some additional analysis performed using available GIS information. General characteristics of the Lower Columbia-Clatskanie watershed and the Clatskanie River subwatershed are summarized in Table 5-10.

Table 5-10. Summary of the Lower Columbia-Clatskanie Subwatershed Characteristics.

Watershed	Area (mi^2)	Mean Elevation (ft)	Minimum Elevation (ft)	Maximum Elevation (ft)	Mean Annual Precipitation (inches)
Lower Columbia-Clatskanie	298.3	654	0	3,008	57.2
Clatskanie River subwatershed	94.9	925	9	2,081	60

5.2.1.1 Streamflow Characteristics

There are several unnamed streams and Oak Ranch Creek within the Clatskanie parcel. No streamflow information existed for any of the streams within the Clatskanie parcel and even very little streamflow information exists for the Oregon portion of the Lower Columbia-Clatskanie watershed. There were no active stream gages and very little historical gage data identified. The historical gage data are summarized in Table 5-11 and the data is provided in Table 5-12. Table 5-13 summarizes the frequency and magnitude of floods for the Clatskanie River. The frequency and magnitude of flood events were calculated in the Lower Columbia-Clatskanie Watershed Assessment and were based on models developed by USGS. The predicted flows from the model were then compared to data from historic stream gage records for verification.

Table 5-11. Summary of streamflow data for the lower Columbia-Clatskanie subwatershed.

Gage Name	Gage Number	Period of Record	Data
Clatskanie River near Clatskanie, OR	14247000	1950-1954	Annual Peak Flows
Fall Creek near Clatskanie, OR	14247020	1972-1983	Annual Peak Flows
Merrill Creek at Deer Island, OR	14222905	1972-1976	Annual Peak Flows

Table 5-12. Summary of historical peak flows on record for the lower Columbia-Clatskanie subwatershed.

Clatskanie River		Fall Creek		Merrill Creek	
Date	**Flow (cfs)**	**Year**	**Flow (cfs)**	**Year**	**Flow (cfs)**
1/22/1950	795	1972	40	1972	480
2/15/1950	1,110	1973	99	1973	330
2/24/1950	2,000	1974	98	1974	560
3/5/1950	725	1975	73	1975	340
11/17/1950	935	1976	113	1976	450
1/25/1951	750	1978	135		
3/15/1951	970	1979	51		
12/5/1951	1,460	1980	108		
2/1/1952	920	1981	104		
1/20/1953	948	1982	144		
12/6/1953	1,130	1983	114		
12/9/1953	1,840	1984	56		
1/5/1954	1,600				
2/13/1954	1,600				

Source: Lower Columbia-Clatskanie Watershed Assessment, 1997

Table 5-13. Frequency and magnitude of floods in the Clatskanie River.

Frequency	Magnitude (cfs)
100-year	7,349
50-year	6,586
25-year	5,868
10-year	4,830
2-year	2,884

Source: Lower Columbia-Clatskanie Watershed Assessment, 1997

5.2.1.2 Water Yield and Peak Flows

As described in the management basin section, peak flows are potentially influenced by land uses within the watershed. Land use practices within the Lower Columbia-Clatskanie subwatershed are summarized in Table 5-14. These types of land uses were evaluated to determine the potential impact on peak flows.

Overall, the Clatskanie River subwatershed has a low risk of peak-flow enhancement due to associated land uses. At the time of this report, agriculture was limited with in the subwatershed and would, thus, have a low risk of peak enhancement. The largest percentage of land use within the Clatskanie parcel was forestry. Enhancement of peak flows is most problematic for forestry land uses during rain-on-snow events. The Clatskanie River watershed had 45 percent of its timber area in the snow zone (>=1000 ft), and historic crown closure of around 70 percent. This calculates to approximately 33 percent of forested area in the rain-on-snow zone that has less than 30 percent canopy closure (Rule 2001). Based on these statistics and the rain-on-snow rules outlined by OWEB, there was a low potential for peak flow enhancement due to timber land uses. Likewise, forest and rural roads in the Clatskanie River watershed represented less than 4 percent of the forest and rural areas and was therefore a low potential risk for peak flow enhancement. It was assumed that the assessment of the Clatskanie River subwatershed was also directly applicable to the ODF Clatskanie land parcel.

Table 5-14. Summary of land uses within the Clatskanie River subwatershed.

Watershed Area (Acres)	Urban Area (Acres)	Industrial Area (Acres)	Rural Residential Area (Acres)	Percent of Area Occupied by Land Uses (%)
60,724	712.5	67.3	973.6	2.9%

5.2.1.3 Consumptive Water Uses

Consumptive uses on the Clatskanie parcel should not have an impact on peak or low flows since no ODF water rights were identified within this portion of the project area and only one water right was found. This water right (S40755) was for a domestic use of a maximum diversion of 0.005 cfs. The source of the water was from Dribble Creek, a tributary to the Clatskanie River and outside of the Clatskanie parcel. It was difficult to discern from available GIS data, but it was suspected that this water was used outside of the Clatskanie parcel.

There were a total of 53 water rights identified within the entire Clatskanie River subwatershed (Rule 2001); nine were classified as reservoir water rights while the remaining 44 were classified as surface water rights. The reservoir water rights permits were used for recreation, wildlife, fire

protection, livestock, and aesthetics, while the surface water rights permits were used for domestic, power, fish, irrigation, industrial/manufacturing, municipal, livestock, and recreation. All reservoir and surface water rights within the Clatskanie River watershed were derived from surface water sources. A measure of the consumptive use within the Clatskanie River water availability basin, as a percent of the natural streamflow at the 50 percent exceedance level for the Clatskanie River is summarized in Table 5-15.

We were unable to determine if any illegal uses of water occurred within either the Clatskanie parcel or the entire Clatskanie River subwatershed.

Table 5-15. Summary of the Consumptive use in the Clatskanie River Water Availability Basin as a percent of the Natural Streamflow.

Month	Percent
January	0%
February	0%
March	0%
April	0%
May	1%
June	1%
July	3%
August	3%
September	3%
October	4%
November	1%
December	0%

5.2.1.4 Instream Water Rights and Low Flows

Water availability using the 50 percent exceedance level streamflows from OWRD data had been identified for the Clatskanie River watershed and is summarized in Table 5-16. Negative net water availability occurred in the Clatskanie River watershed in the months of July, October, and November. During these months especially, water uses in the basin would be expected to have an effect on low flow.

Table 5-16. Summary of Water Availability within the Clatskanie River.

Month	Water Availability (cfs)
January	180
February	169
March	68.3
April	25.3
May	32.3
June	8.7
July	-0.04
August	0.06
September	0.28
October	-61.1
November	-26.2
December	91.3

5.2.1.5 Water Withdrawals and Storage

If exercised fully, the 0.005 cfs water right within the Clatskanie parcel could reach a withdrawal of 118 million gallons per year. However, this water right was for domestic use and generally a significant portion of the water withdrawn for domestic uses will reenter the system. There was currently no water storage allowed in the Clatskanie parcel. There were however, nine reservoir permit types issued within the Clatskanie River watershed. Three of the reservoir permits were issued for recreation, two for wildlife, one for livestock, two for fire protection, and one for aesthetics.

5.2.2 Young's Bay

Seven hundred forty-two acres of the Hamilton management basin were located within the Young's Bay watershed. The majority of this parcel was located within the South Fork Klaskanine River subwatershed and a small portion in the Upper Young's River subwatershed. Due to the lack of available data for this small portion of land, the hydrology and water use assessment for this area was based on information provided in the Young's Bay Watershed Assessment (E&S Water Chemistry, Inc. and Young's Bay Watershed Council 2000) for the entire watershed.

The general characteristics of the Young's Bay watershed and the two subwatersheds of interest are described in Table 5-17. Similar to the Clatskanie and Nehalem watersheds, the hydrology of the Young's Bay watershed is dominated by rain events. The majority of high flows and storm events occur between October to May, and the low flows occur during the summer.

Table 5-17. Summary of Young's Bay parcel subwatershed characteristics.

Watershed	Area (mi^2)	Mean Elevation (ft)	Minimum Elevation (ft)	Maximum Elevation (ft)	Mean Annual Precipitation (inches)
Young's Bay	186	415	0	3290	98
Upper Young's River subwatershed	37	780	0	3280	122
S Fork Klaskanine River subwatershed	23	880	0	2740	117

Source: E&S Water Chemistry, Inc. and Young's Bay Watershed Council 2000

5.2.2.1 Streamflow Characteristics

There were only a few perennial and intermittent streams located within the Young's Bay parcel and no active gages were located within the entire Young's Bay watershed. Historical gages within the Young's Bay basin are summarized in Table 5-18.

The only gage with a substantial period of record (30 years) was on the Young's River located near Astoria, Oregon. The annual hydrograph for the Young's River near Astoria gage was shown in Figure 5-4. Discharge patterns for the Young's River near Astoria gage was used as representative of hydrograph patterns for the area of interest. However, since the Young's Bay parcel was located much higher in the basin and had a much smaller area, streamflow characteristics on the ODF Young's Bay parcel would be slightly different. Annual peak flow events for the Young's River ranged between 2,000 and 4,000 cfs and are shown in Figure 5-5. The largest flood event on record reached 4,750 cfs, at the Young's River near Astoria and occurred on February 10, 1946.

Table 5-18. Summary of gages within the Young's Bay watershed.

Station Number	Station Name	Period of Record	Drainage Area (mi^2)	Comments
14251500	Young's River near Astoria, OR	1927-1958	40	Mean Daily Flow
14252000	NF Klaskanine River near Olney, OR	1950-1955	14	Annual Peak Flows

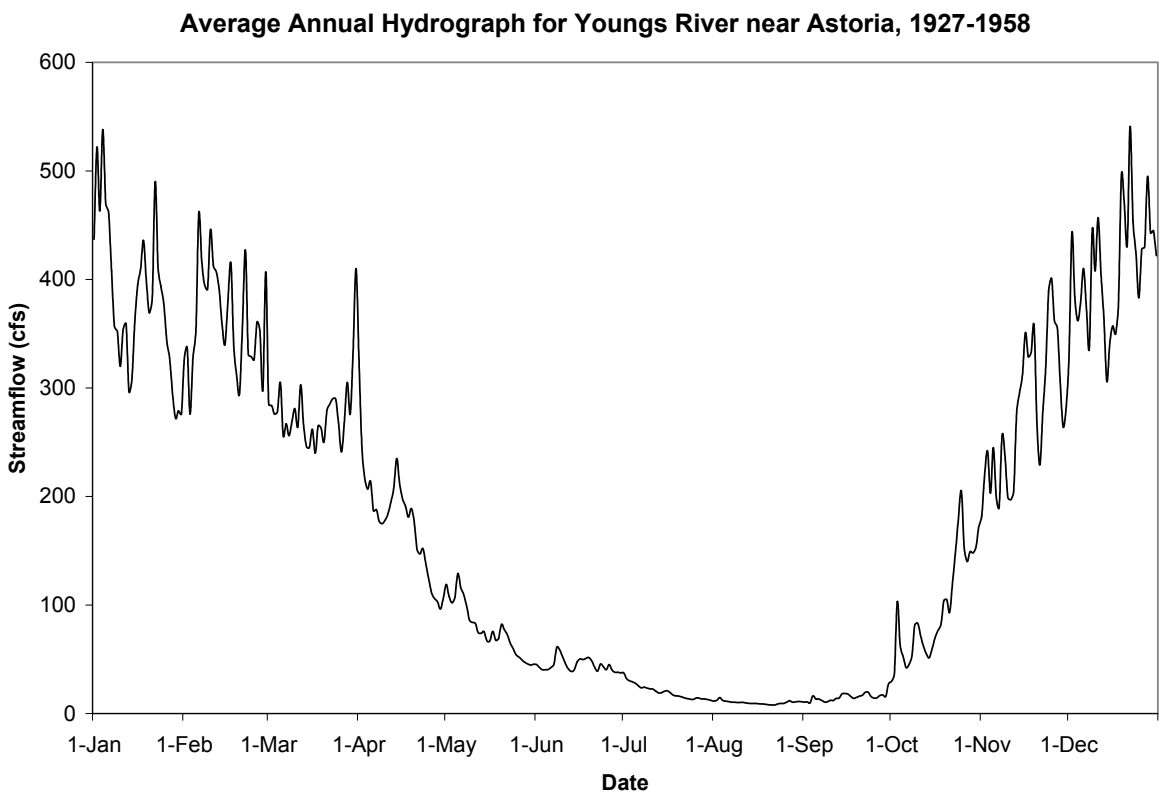


Figure 5-4. Annual Hydrograph for the Young's River near Astoria Gage.

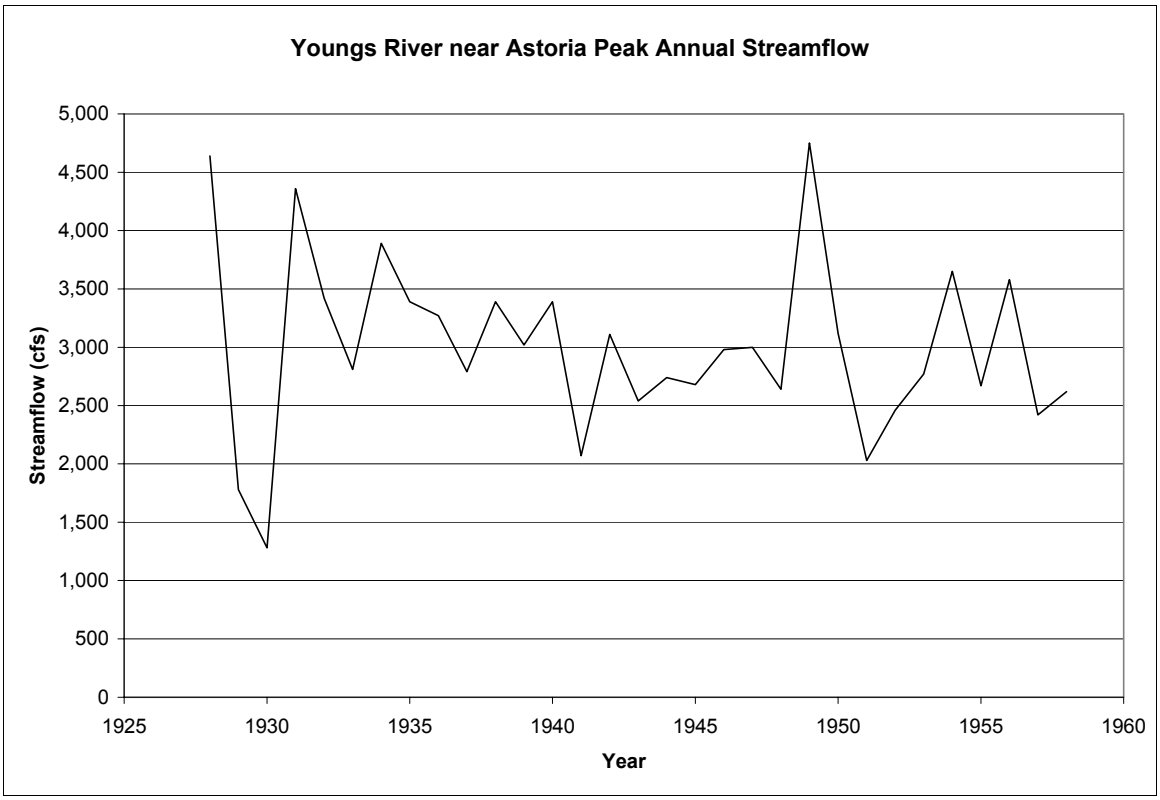


Figure 5-5. Young's River near Astoria Peak Annual Flows between 1927-1958

5.2.2.2 Water Yield and Peak Flows

There are four potential land use practices identified within the Young's Bay watershed that can affect hydrology. These land uses include agriculture and rangeland, urban or rural residential development, forestry, and forest and rural roads. The practice of draining and diking of wetlands has had a large impact on the hydrology of the Young's Bay watershed. However, agricultural land use has been concentrated in the lower elevations of the Young's Bay watershed and has not occurred within the ODF Young's Bay parcel. Urban and rural residential areas in the Young's Bay watershed were concentrated around the city of Astoria and also did not occur within the ODF Young's Bay parcel. Rural road densities would have a moderate risk of peak flow enhancement in the South Fork Klaskanine River subwatershed with 4.1 percent of rural area in roads. There is a low risk of peak flow enhancement in the Upper Young's River subwatershed since only 1.6 percent of the rural area was road area.

The land use of interest within the ODF Young's Bay parcel is forestry. There was a low relative potential impact of timber harvesting on peak flow enhancement within the South Fork Klaskanine and Upper Young's River subwatersheds. The majority of timber related impacts

were related to forest road construction. The percent forested area in roads in the South Fork Klaskanine River and Upper Young's River subwatersheds was 2.7 percent and 2.6 percent, respectively. Only watersheds with forest road areas greater than 4 percent would have a potential for increasing peak flows as a result of timber harvesting. It was assumed that the assessment of the South Fork Klaskanine and Upper Young's River subwatersheds are also directly applicable to the ODF Young's Bay land parcel. However, this assumption could not be verified without more detailed information specific to the parcel.

5.2.2.3 Consumptive Water Uses

Our review of existing consumptive uses within this portion of the project area indicated that these uses would not impact peak or low flows since there are no water rights located within the Young's Bay parcel.

The water rights located within the Upper Young's River and the South Fork Klaskanine River subwatersheds are summarized in Table 5-19. The South Fork Klaskanine River also had 16.7 cfs appropriated for a non-consumptive water use for a fish hatchery. This water right can only be exercised January through May and August and September and generally has reentered the stream quickly.

Table 5-19. Water Use and Storage in the South Fork Klaskanine and Young's River above Klaskanine River Water Availability Basins.

Watershed	Irrigation (cfs)	Municipal (cfs)	Domestic (cfs)	Fish/Wildlife (cfs)	Other (cfs)	Total (cfs)
SF Klaskanine River at Mouth	0.24	--	0.01	16.5	--	16.75
Young's River above Klaskanine River	--	27	2.01	--	2.02	31.03

5.2.2.4 Instream Water Rights and Low Flows

There was one instream water right identified for the South Fork Klaskanine River for anadromous and resident fish rearing, but this water right was not located within the ODF Young's Bay parcel.

OWRD has evaluated the impacts of consumptive uses on water availability that is summarized for the two subwatersheds of interest in Table 5-20. The dewatering potential was based on a 50 percent exceedance streamflow and was the percent of instream flows that are appropriated for consumptive use during the low flow months. This table shows a low dewatering potential for

the South Fork Klaskanine River at the mouth, but a high potential for the Young's River above the Klaskanine River.

Table 5-20. Summary of dewatering potential in the South Fork Klaskanine and Young's River above Klaskanine Water Availability Basins.

	Dewatering Potential					Overall Dewatering Potential	
Water Availability Basin	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Average Percent Withdrawal**	**Potential**
SF Klaskanine River at Mouth	0.7	3.9	5.3	0.5	0.0	2.08	Low
Young's River above Klaskanine River	17.1	35.1	61.9	45.8	17.6	35.50	High

5.2.2.5 Water Withdrawals and Storage

There was only one storage water right identified within the South Fork Klaskanine and Young's River above Klaskanine subbasins. A water right for storage of 36,000 acre-feet was issued for the Young's River above Klaskanine River water availability basin. This storage water right was not located on the ODF Young's Bay parcel.

6. RIPARIAN/WETLANDS

This chapter consists of a remote assessment of riparian vegetation conditions along streams in the Upper Nehalem watershed. It also includes available information concerning the type, extent and location of wetlands and noxious weeds in the watershed. Within this assessment, vegetation information was compared between eleven management basins and two contiguous parcels falling within the Forest Grove and Astoria Districts of ODF. The water quality and fish habitat sections of this report (Chapters 9 and 10) discuss how resources may be influenced as a result of the current or future potential riparian conditions.

6.1 RIPARIAN ASSESSMENT

The purpose of the riparian assessment was to assess the current riparian situations in the watershed and determine how existing conditions compared to typical conditions present along various stream channel types for the ecoregions encompassing the watershed. From a starting point of the existing riparian stand conditions, ODF wished to forecast 50 to 100 years in the future and make an assessment of the potential feasibility of stands to provide reference riparian conditions in the future. An additional purpose was to organize the riparian areas in accordance with appropriate restoration/enhancement opportunities. The specific critical questions for the riparian assessment from the OWEB watershed assessment manual include the following:

1. *What are the current conditions of riparian areas in the watershed?*
2. *How do the current conditions compare to those potentially present or typically present for this ecoregion?*
3. *How can the current riparian areas be grouped within the watershed to increase the understanding of areas needing protection and the appropriate restoration or enhancement opportunities?*

ODF was interested in a little more detail than the standard OWEB approach. They requested the assessment address the following supplemental questions.

1. *What are the current riparian vegetation characteristics on state forest lands within the watershed?*
2. *What riparian areas currently have high, moderate, and low large wood input potential for key conifer pieces (>24-inch conifer)?*
3. *Which riparian areas will provide high large wood input potential for key conifer pieces under 50- and 100-year scenarios?*

6.1.1 Background

A watershed analysis was completed for the Nehalem watershed by Portland State University (PSU) in 2000 (Johnson and Maser 2000). This assessment performed an inventory of riparian conditions based on 1995 aerial photos. The inventory categorized the existing riparian conditions using width, continuity, and age along each reach as factors for determining whether the riparian area represented good, moderate or poor conditions as follows:

Good = mature and continuous

Moderate = mature and discontinuous, or young, narrow and continuous stands

Poor = young, narrow and discontinuous or absent vegetative stands

The existing conditions were subsequently used to determine the future potential for instream large wood as good, moderate or low contribution levels.

The PSU study determined the Upper Nehalem subwatershed (HUC #1710020201) had two reaches with poor riparian conditions; Weed Creek and South Fork Rock Creek. These reaches consisted of grass on both banks. A number of reaches supported narrow riparian buffers including East Fork Nehalem River, and Lower Rock, Beaver, Kist and Lousignont creeks. The balance of the Upper Nehalem typically supported continuous riparian buffers with young trees.

According to the PSU inventory approach there was a concentration of riparian buffer in poor condition in the Middle Nehalem subwatershed (HUC #1710020202) along Fishhawk and North Fork Fishhawk creeks. In addition, there were several small areas along tributaries of the mainstem Nehalem River in poor condition. The subwatershed generally consisted of young riparian trees typical of the entire watershed. Approximately 50 percent of the buffer strips were less than 30 feet wide and there were widespread interruptions and discontinuities in vegetation along the stream banks.

Existing instream levels of key piece-sized large wood in the Upper Nehalem were low (Kavanagh et al. 2005). Estimates of the future potential for recruiting large wood from riparian areas range from moderately high to low. The PSU inventory concluded poor and fair recruitment potential occurred along approximately 30 percent of the streams in both the Upper and Middle Nehalem subwatersheds. The Middle Nehalem basin consisted of a greater frequency of poor recruitment potentials compared to the Upper Nehalem basin (Johnson and Maser 2000).

The PSU approach representing good recruitment conditions included, among other categories, young and continuous, but narrow (>30 ft) riparian stands. As such, it may take many decades to achieve the potential recruitment levels of key piece-size wood from these stands.

The Nehalem River Watershed Assessment did not specifically address the OWEB critical questions, since the work was commissioned prior to completion of the OWEB protocols. As a consequence, this supplemental analysis addresses the aspects of the critical questions not previously covered.

The Upper Nehalem River Watershed Council (UNWC) subsequently developed detailed GIS coverage of existing riparian polygons of various condition codes based on species composition, average stand size (tree diameters) and relative level of density per the OWEB watershed manual guidelines (Watershed Professionals Network 1999) as shown below.

Riparian Species Composition

C = Conifer-dominated Stand (> 70% Conifer)
M= Mixed Stand (30 – 70% Conifer)
H = Hardwood Stand (<30% Conifer; > 70% Hardwood)

Relative Stand Size

Small = < 12” dbh
Medium = 12 – 24” dbh
Large = > 24” dbh

Relative Stand Density

Sparse = More than one-third of the ground is visible from aerial photos
Dense = Less than one third of the ground is visible from aerial photos

The existing photo-based inventory (UNWC, unpublished data) quantified current riparian conditions over 305 miles of ODF streams in the Nehalem watershed using 1995 aerial orthophotos. The results were electronically digitized into a GIS riparian data layer (UNWC, unpublished data).

6.1.2 Methods

6.1.2.1 Aerial Photo Interpretation

For this analysis, the existing UNWC GIS coverage was used as the base riparian layer for the watershed. The current riparian layer was projected onto a base map with 1:12,000 scale

hydrography and the known fish-bearing streams. Aerial photo interpretation was performed on 1:12,000 scale using 2004 orthophotographs along areas extending 150 feet on either side of the centerline of fish-bearing channels not classified previously by UNWC. Locations of stream channels differed slightly between the original UNWC riparian GIS layer and the current 1:12,000 orthophotos, so photo interpreters used the channel location in the current orthophoto set to assess riparian area. A similar aerial photo assessment of the current riparian conditions occurred along streams identified as potentially prone to debris flows in Chapter 7: Sediment Sources. A new riparian data layer incorporating both the original UNWC polygons and the most recent photo assessment was created for this watershed analysis.

6.1.2.2 Field Verification

Riparian ground-truthing to confirm general riparian stand characteristics (i.e., stand composition, tree-size and density) as mapped on the existing riparian coverages or photo-based interpretation of additional stream segments occurred during March 2005. No attempt was made to verify the existing riparian polygon boundaries or conduct a detailed timber cruise, but stand characteristics and subplot data were collected from 19 locations in the watershed along various channel sizes and types. Survey sites for verification were selected based on the percent distribution of vegetative condition types in the watershed. Surveys were chosen for riparian stand codes comprising more than 10 percent of the stream mileage of fish-bearing streams in the basin. Vegetative condition types with high frequencies received correspondingly more field effort.

At each survey site, a lineal distance of approximately 20 times the bankfull channel width or 1,000 feet as measured with a laser range finder was assessed (Smith 1998). As a result of relatively small channel sizes, a typical survey length ranged between 400 and 800 feet. Within each survey reach, channel and riparian condition measurements and observations were recorded a minimum of four times at locations evenly distributed throughout the survey reach. Channel and riparian data were averaged for each reach. The channel measurements included (1) wetted width, (2) bankfull width and (3) valley width. Riparian measurements and observations included: (1) Angle and distance from mid-channel to the height of riparian vegetation providing shade; (2) inner riparian zone (RA1) width and composition (OWEB three-digit riparian condition code, see *Background*); (3) outer riparian zone (RA2) width and composition (OWEB three-digit riparian condition code, see *Background*) out to a distance of 150 feet on either side of the channel.

As a form of further verification, riparian tree species, density, diameters and heights were measured in a standard 30m x 30m (100 ft x 100 ft) sample plot. Plot surveys were based on

Riparian Stand Survey methods (Smith 1998). Plots were delineated using a compass and tape measure. Within the sample plot, the number of trees were enumerated by species and size class (4-8 in., 8-12 in., 12-16 in., 16-20 in., 20-24 in., 24-36 in.) using a standard diameter tape. A minimum of 5 trees of each species was measured to obtain an average tree height using a laser rangefinder when the visibility to tree crown allowed.

6.1.2.3 Assessment Procedures

Existing Stand Conditions

Riparian stands were categorized according to a three-digit alpha code identifying species composition, stand size and density according to the OWEB watershed assessment manual (Watershed Professionals Network 1999). The lineal distance of streams adjacent to various existing riparian polygons and the new photo-based interpretation was determined and summarized by HUC and management unit in the watershed. The existing stand characteristics were described for both an inner (disturbed; RA1) terrace zone and an outer riparian (more uniform, RA2) hillslope zone out to 100 feet from the channel. The existing stand characteristics were compared to the most likely vegetation condition found in these zones along channel habitat types in the eco-regions of the watershed (Table 6-1; adapted from the 1999 OWEB Manual). In developing the assessment protocol, OWEB assumed the vegetation likely to occur in a given riparian zone could be defined by the Channel Habitat type (CHT) and Ecoregion. A determination would be made whether or not the existing stands were consistent with potential riparian community composition based on site characteristics like soil types, moisture, elevation, aspect and natural disturbances. From a large wood recruitment perspective, if a stand was consistent with the historic site potential it would be assumed to offer riparian stand conditions for adequate large wood (key piece size) recruitment potential. The concept of maximum potential riparian stand characteristics was used to define the reference condition for this watershed analysis. However, wood recruitment to stream channels from these stands will occur at some point prior to achieving the reference condition for key piece size wood. Using the same three-digit riparian condition codes, the state of Washington in their guideline for conducting watershed analyses (WFPB 1997) suggest the following large wood recruitment potential:

Low Recruitment Potential

HSS, HSD, MSS, MSD, CSS, CSD, HMS, HLS

Moderate Recruitment Potential

HMD, MMS, CMS, HLD, MLS

High Recruitment Potential

CMD, MMD, MLD, CLD.

Table 6-1. Natural riparian conditions in the Upper Nehalem watershed according to ecoregions and channel types after Watershed Professionals Network 1999.

		Riparian Area 1		Riparian Area 2	
Ecoregion	**Channel Confinement (code)**	**Width (ft)**	**Veg (code)**	**Width (ft)**	**Veg (code)**
1 (d) Volcanics	C	0 - 25	HMD	25 - 100	CLD
	M	0 - 50	HMD	50 - 100	CLD
	U	0 - 75	HMD	75 - 100	CLD
1 (f) Willapa Hills	C	0 - 25	HMD	25 - 100	CLD
	M	0 - 50	HMD	50 - 100	CLD
	U	0 - 75	HMD	75 - 100	MLD

Riparian Area:
RA1 = Inner riparian zone adjacent to streams along shallow terraces; often disturbed
RA2 = Outer riparian zone along hillslopes adjacent to streams; often uniform growth
Confinement Codes:
C = Confined
M = Moderately Confined
U = Unconfined
Riparian Vegetation Condition Codes:
H = Hardwood
C = Conifer
M = Medium Stand Size
L = Large Stand Size
D = Dense Stand

Although short of the OWEB reference condition for the watershed, dense riparian stands of moderate-sized conifer and mixed species (CMD, MMD) should provide a high level of recruitable wood to the streams (WFPB 1997). For the Upper Nehalem Watershed Analysis, both (1) the OWEB reference condition concept for the inner and outer riparian zones according to channel habitat types and Ecoregions and (2) the WFPB potential wood recruitment situations were used to indicate possible trajectories to achieving the large wood recruitment reference conditions.

6.1.2.4 Forecasted Stand Conditions 50 to 100 Years in the Future

The existing riparian vegetation layer was used as the starting point to project conditions into the future under an assumption of no silvicultural riparian management. Each riparian condition code was qualitatively extrapolated to 50 years and 100 years assuming forest succession pathways typical of unmanaged growing conditions (WFPB 1997).

The future codes were assessed for: (1) potential large wood recruitment potential (using stand characteristics including species composition, mean stand diameter, and stand density) and (2) anticipated stream water temperatures using View-to-the-Sky (VTS) blocking angles represented by stand height and opacity (Water Quality Chapter 8). A determination was made whether or not the forecasted future stands were consistent with the potential riparian community composition for each CHT and Ecoregion.

6.1.3 Results

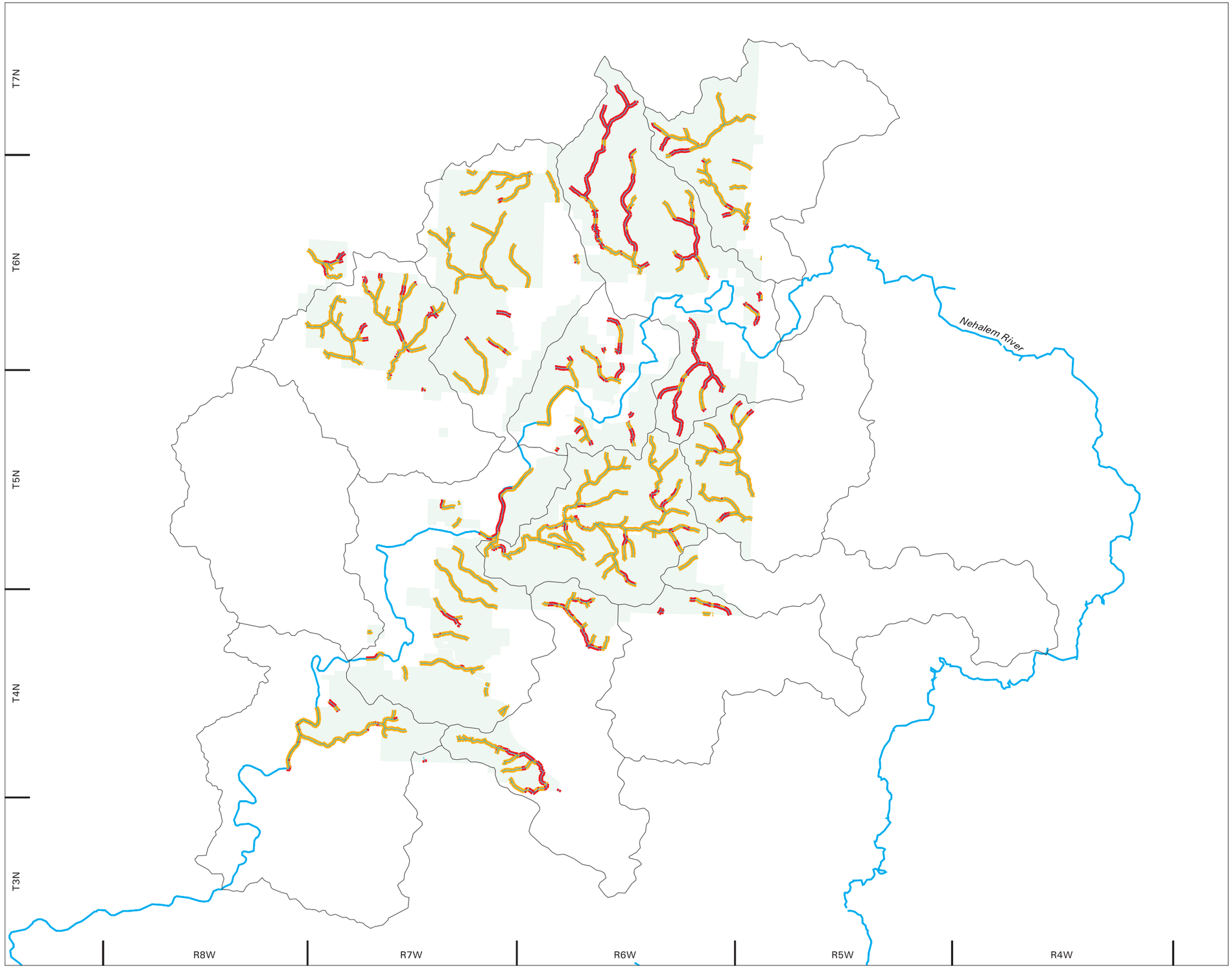
6.1.3.1 Existing Riparian Conditions.

Maps of the adequacy of the existing wood recruitment potential from stream adjacent stands are included as Figure 6-1a,b. The data are summarized by riparian stand characteristics for each of the ODF management basins within the upper Nehalem watershed in Table 6-2. Data are summarized by 6th field HUCs per Management Basin in Appendix B.

6.1.3.2 Field Verification

The results of the field verification occurring March 14-18, 2005 are provided in Appendix C including the overall reach assessment of stand characteristics as well as subplot measurements of individual trees, density in trees per acre (tpa), and measured diameters.

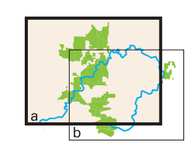
In general, the field verification along samples of small, medium and large channel sizes in the upper watershed indicated good agreement with riparian site conditions and the 1995 aerial photo assessment. The only exceptions were: (1) instances where tree growth in the riparian stand over the intervening 10-year period may have altered a call from a small diameter size class to an average overall medium size class, (2) where harvest since the 1995 photos may have reduced either the overall density or size class of the stand, (3) where a channel may have shifted or (4) stands considered dense as a result of closed canopies noted in the photo assessment may, in fact, have been sparse due to an underlying road. The instances where the field effort did not confirm the photo assessment were few (<10%). The watershed analysts were confident the original photo-based assessment was adequate to characterize the existing riparian conditions relative to their potential to contribute large wood to stream channels.



Legend

- Low Large Wood Recruitment Potential (Current)
- Moderate Large Wood Recruitment Potential (Current)
- Moderate/High Large Wood Recruitment Potential (Current)
- High Large Wood Recruitment Potential (Current)
- Major River
- Project Area
- 6th Field HUC (171002020109)

Map Key



N

1 Inch = 2.7 Miles

0 2

Miles

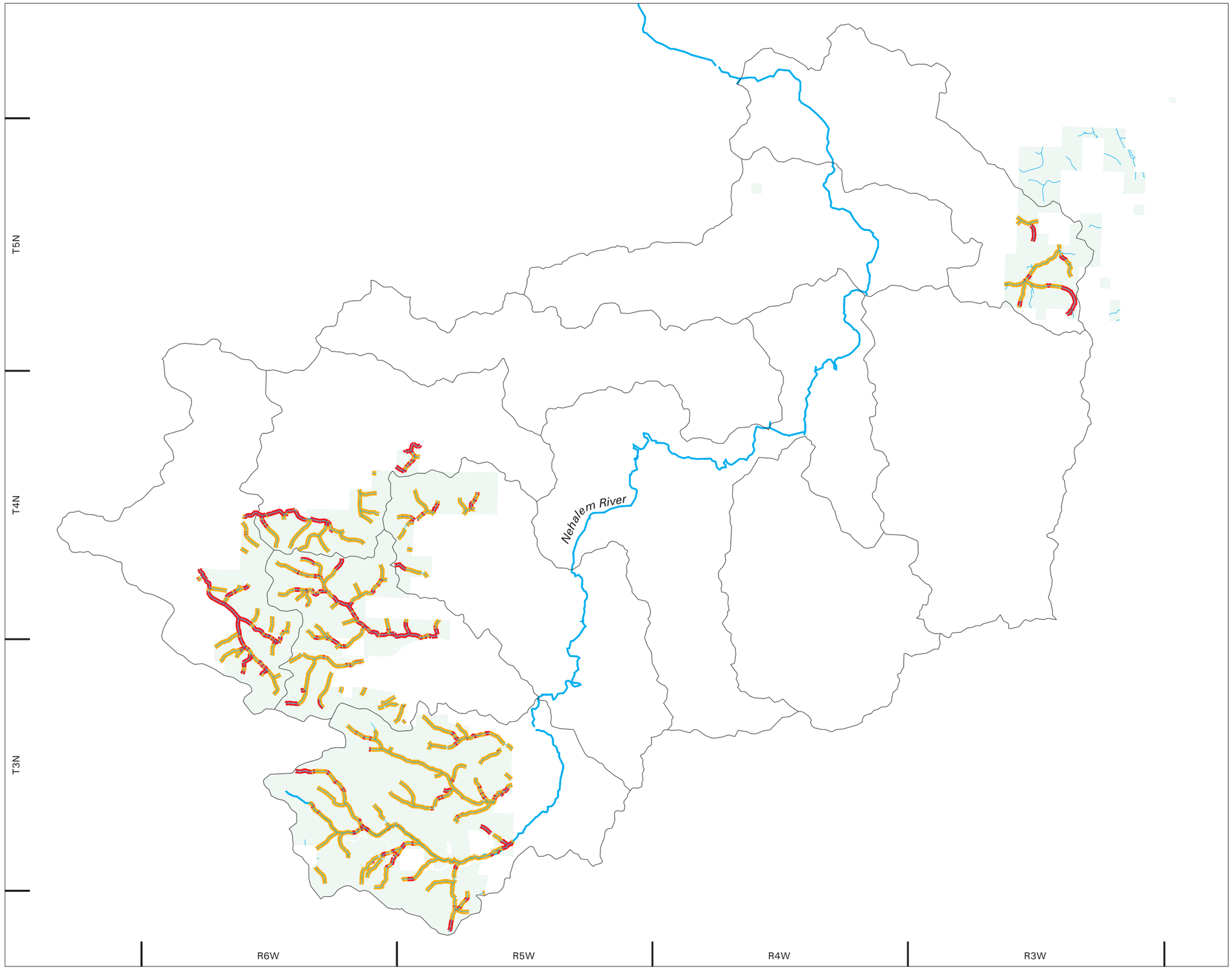
R2 Resource Consultants * map_r2rpt_1205.aml * 08 Dec 05

Oregon Department of Forestry
Upper Nehalem Watershed Analysis

Figure 6-1(a)

Current Large Wood Recruitment Potential

Astoria District



Legend

- Low Large Wood Recruitment Potential (Current)
- Moderate Large Wood Recruitment Potential (Current)
- Moderate/High Large Wood Recruitment Potential (Current)
- High Large Wood Recruitment Potential (Current)
- Major River
- Project Area
- 6th Field HUC (171002020109)

Map Key

N

1 Inch = 2.3 Miles

0 2

Miles

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Oregon Department of Forestry
Upper Nehalem Watershed Analysis

Figure 6-1(b)

Current Large Wood Recruitment Potential

Forest Grove District

Table 6-2. Current riparian conditions and large wood recruitment potential adjacent to fish-bearing streams on ODF lands in various Management Basins.

Code[1/]	Recruitment Potential	Stream Length	ODF Lands	FG District	Astoria District	Forest Grove			Astoria								
						McGregor	Wheeler	Wilark	Beneke	Buster	Crawford	Fishhawk	Hamilton	Lousignot	Northrup	Quartz	Sager
		(ft)	(%)	(%)	(%)												
Water	L	0.3	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	1%	0%	0%	1%
Bareground	L	0.3	0%	0%	0%	0%	0%	0%	1%	0%	1%	0%	0%	0%	0%	0%	0%
Grass	L	1.4	1%	0%	1%	0%	0%	0%	1%	0%	0%	0%	0%	0%	1%	8%	0%
Shrub	L	3.5	1%	1%	1%	0%	2%	1%	1%	1%	0%	0%	0%	1%	1%	9%	0%
Road/RxR	L	0.1	0%	0%	0%	0%	0%	1%	0%	0%	0%	0%	0%	1%	0%	0%	0%
CMD	H	64.9	27%	41%	19%	50%	36%	39%	3%	25%	2%	29%	3%	27%	8%	38%	27%
CMS	M	1.7	1%	2%	0%	3%	1%	2%	0%	0%	0%	2%	0%	0%	0%	0%	0%
CRD	L	9.5	4%	3%	4%	1%	2%	19%	0%	1%	20%	7%	2%	8%	2%	0%	17%
CRS	L	0.0	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
CSD	L	6.4	3%	0%	4%	0%	0%	5%	0%	1%	10%	1%	3%	18%	17%	0%	3%
CSS	L	1.0	0%	1%	0%	1%	1%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
HMD	M	38.7	16%	15%	17%	1%	24%	4%	39%	16%	2%	5%	39%	12%	6%	14%	2%
HMS	L	1.1	0%	0%	1%	0%	0%	0%	0%	2%	0%	0%	0%	0%	0%	0%	0%
HSD	L	24.9	10%	19%	6%	38%	8%	0%	0%	6%	3%	0%	3%	8%	11%	13%	8%
HSS	L	2.5	1%	0%	2%	0%	0%	0%	0%	0%	0%	0%	0%	0%	5%	0%	10%
MMD	H	61.6	26%	12%	34%	4%	15%	24%	48%	40%	50%	45%	47%	11%	9%	17%	23%
MMS	M	5.2	2%	1%	3%	0%	1%	3%	4%	4%	2%	6%	0%	2%	8%	0%	0%
MSD	L	11.9	5%	4%	6%	1%	6%	1%	3%	2%	8%	2%	2%	9%	30%	1%	6%
MSS	L	2.6	1%	1%	1%	0%	1%	0%	0%	1%	0%	2%	2%	4%	1%	1%	2%
			100%	100%	100%	100%	99%	100%	100%	100%	99%	100%	100%	102%	99%	101%	99%
Distance (mi)			238.3	86.9	151.4	31.4	49.3	6.2	18.7	44.4	5.5	10.6	18.4	7.4	13.8	13.9	18.7
Percent (%)			100%	100%	100%	13%	21%	3%	8%	19%	2%	4%	8%	3%	6%	6%	8%

1) Three Digit Riparian Code (Species, Size, Density)

Riparian Species Composition

C = Conifer-dominated Stand (> 70% Conifer)
M = Mixed Stand (30 – 70% Conifer)
H = Hardwood Stand (<30% Conifer; > 70% Hrdwd)

Relative Stand Size

Regeneration = < 4" dbh
Small = 4 – 12" dbh
Medium = 12 – 24" dbh
Large = > 24" dbh

Relative Stand Density

Sparse = More than 1/3rd of the ground is visible from aerial photos
Dense = Less than 1/3rd of the ground is visible from aerial photos

6.1.3.3 Forecasted Stand Conditions 50 to 100 Years in the Future

The results for potential large wood recruitment are shown in a matrix of stand conditions along a trajectory of 50-yr increments in Table 6-3 and Figures 6-2a,b and 6-3a,b. The projection of future riparian stand conditions should be considered a coarse screen tool, given the broad range of conditions potentially occurring under each of the riparian condition codes and variations in site class condition across the landscape. The approach assumes a mean 100-yr site potential tree height equivalent to 150 feet (24-in. dbh) on average for conifer species and 99 feet (24-in. dbh) maximum for hardwood species in the upper Nehalem watershed. Although variability in site characteristics and disturbance regimes exists, these assumptions should prove accurate more times than not as a reference condition.

General Situations

Sparse Stands. In general, sparse stands need to develop either: (1) a closed coniferous canopy or (2) a second cohort underneath to develop into a dense stand capable of supporting a high recruitment potential rating over the 100-year time frame. For shade intolerant species like Douglas-fir, the canopy needs to be sufficiently open (RD <25) and understory conditions sufficient for seedling initiation to support ingrowth of a second cohort.

Except for conifer regeneration and small sparse stands (riparian condition codes: CRS/CSS), it is unlikely an existing sparse riparian stand can generate appropriate conditions for ingrowth of shade intolerant species. Current mature, but sparse stands, will likely grow without future ingrowth of a second cohort within 50 to 100 years. Some mixed stands could become conifer-dominated due to hardwood senescence but they will likely remain in an overall sparse condition.

Mixed Stands. In mixed stands, conifer trees are free to grow when they overtop the hardwood community. The overall stand heights between conifer and mixed stands are likely the same, but conifer density would likely be lower due to the low overall conifer abundance in mixed stands.

Inner Riparian Zones (RA1). Hardwood communities often dominate the riparian species composition on low terraces and areas of frequent flood or debris flow disturbance along stream channels. Red alder are the most prevalent disturbance species in the Upper Nehalem watershed. The OWEB manual suggests a typical species configuration for this zone is dense stands of moderate-sized hardwood species (HMD). The width of the RA1 zone varies in accordance with channel confinement from a narrow 25-feet strip along confined channel types upward to 75 feet along broad, unconfined floodplain type channels regardless of the designated Ecoregion in the watershed (Table 6-1). Growing conditions are not generally conducive to conifer establishment.

Table 6-3. Future Riparian Vegetation Conditions based on Forest Successional Pathways (after WFPB 1997).

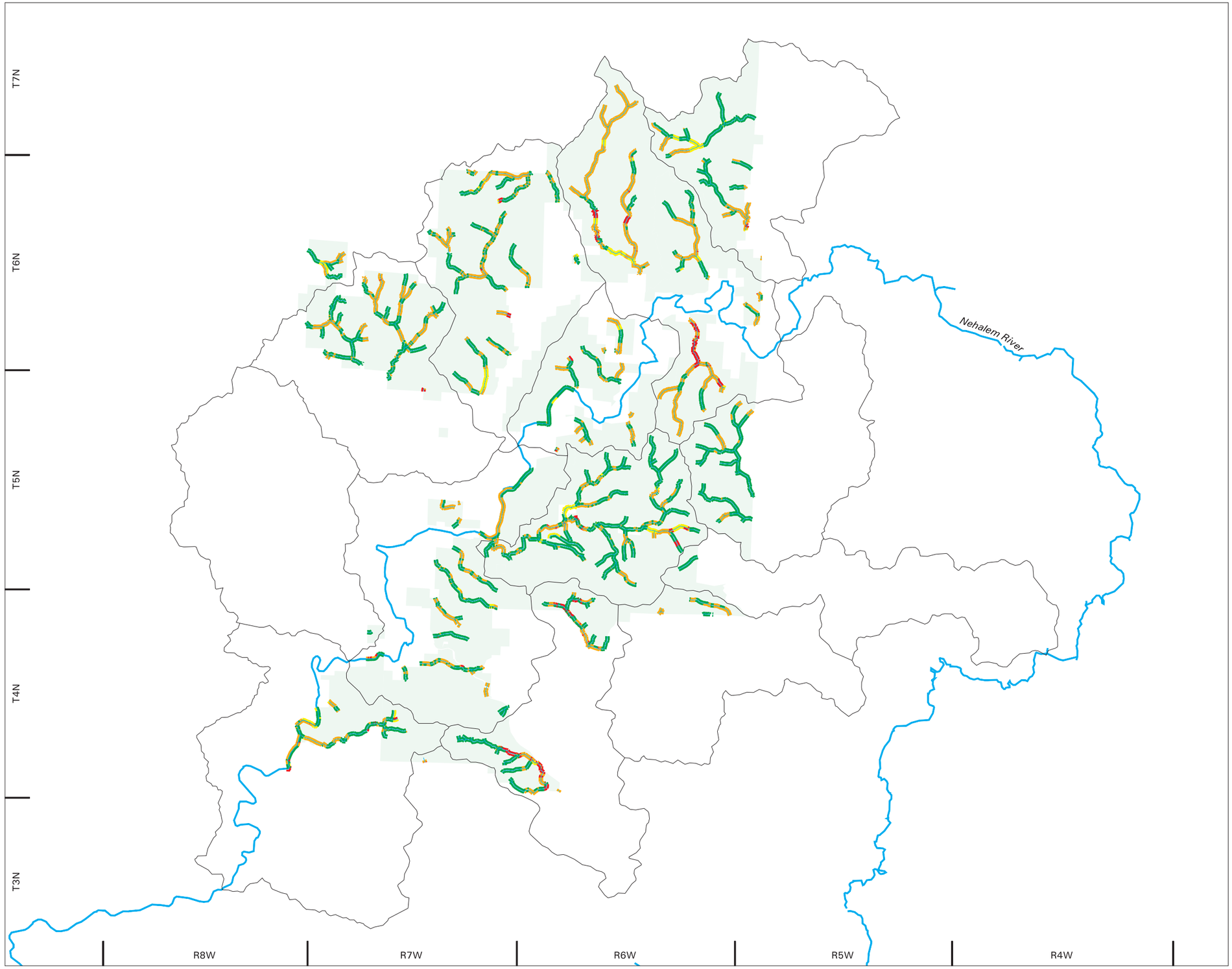
Riparian Characterization					
Code (Current)	**LW Cat.**	**Code 50 - Yr. (unmanaged)**	**LW Cat.**	**Code 100 - Yr. (unmanaged)**	**LW Cat.**
Water	L	Water	L	Water	L
Bare Ground	L	Bare Ground	L	Bare Ground	L
Grass	L	Grass	L	Forbs/STS	L
Shrub	L	Shrub	L	Shrub/STS	L
CRS	L	CMS/CMD	M	CLS/CLD	M/H
CRD	L	CMD	M	CLD	H
HSS	L	HMS	L	HMS/HLS	L
HSD	L	HMD	M	HMS/HLS	L
MSS	L	MMS/MMD	M	MLS/MLD	M/H
MSD	L	MMD	M	MLD/CLD	H
CSS	L	CMS/CMD	M	CLS/CLD	M/H
CSD	L	CMD	M	CLD	H
HMS	L	HLS/HMS	L	HLS/HMS	L
HLS	L	HLS	L	Shrub	L
HMD	M	HLD	M	HLS	L
MMS	M	MLS/MLD	M/H	MLS/CLS/MLD/CLD	M/H
CMS	M	CLS/CLD	M/H	CLS/CLD	M/H
CLS	M	CLS	M	CLD/STS	H
HLD	M	HLS	L	Shrub	L
MLS	M	MLS/CLS	M	CLS/STS	M/H
CMD	M	CLD	H	CLD	H
MMD	M	MLD/CLD	H	CLD	H
MLD	H	MLD/CLD	H	CLD	H
CLD	H	CLD	H	CLD	H

Species Composition
- STS = Shade Tolerant Species
- C = Conifer (>70% Conifer)
- M = Mixed (30 - 70% Conifer)
- H = Hardwood (>70% Hardwood)

Average Stand Size
- R = Regeneration(mean dbh < 4 “)
- S = Small (mean dbh 4 – 12")
- M = Medium (mean dbh 12 - 24")
- L = Large (mean dbh >24")

Stand Density
- S = Sparse (more than one-third of the ground visible on aerial photos)
- D = Dense (less than one-third of the ground visible on aerial photos)

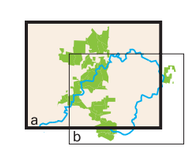
LW Cat. = Large Wood Recruitment Potential Category
[H=high; M=moderate; L=low] for Key Pieces (> 24” dbh)



Legend

- Low Large Wood Recruitment Potential (50-Year)
- Moderate Large Wood Recruitment Potential (50-Year)
- Moderate/High Large Wood Recruitment Potential (50-Year)
- High Large Wood Recruitment Potential (50-Year)
- Major River
- Project Area
- 6th Field HUC (171002020109)

Map Key



N

1 Inch = 2.7 Miles

0 2

Miles

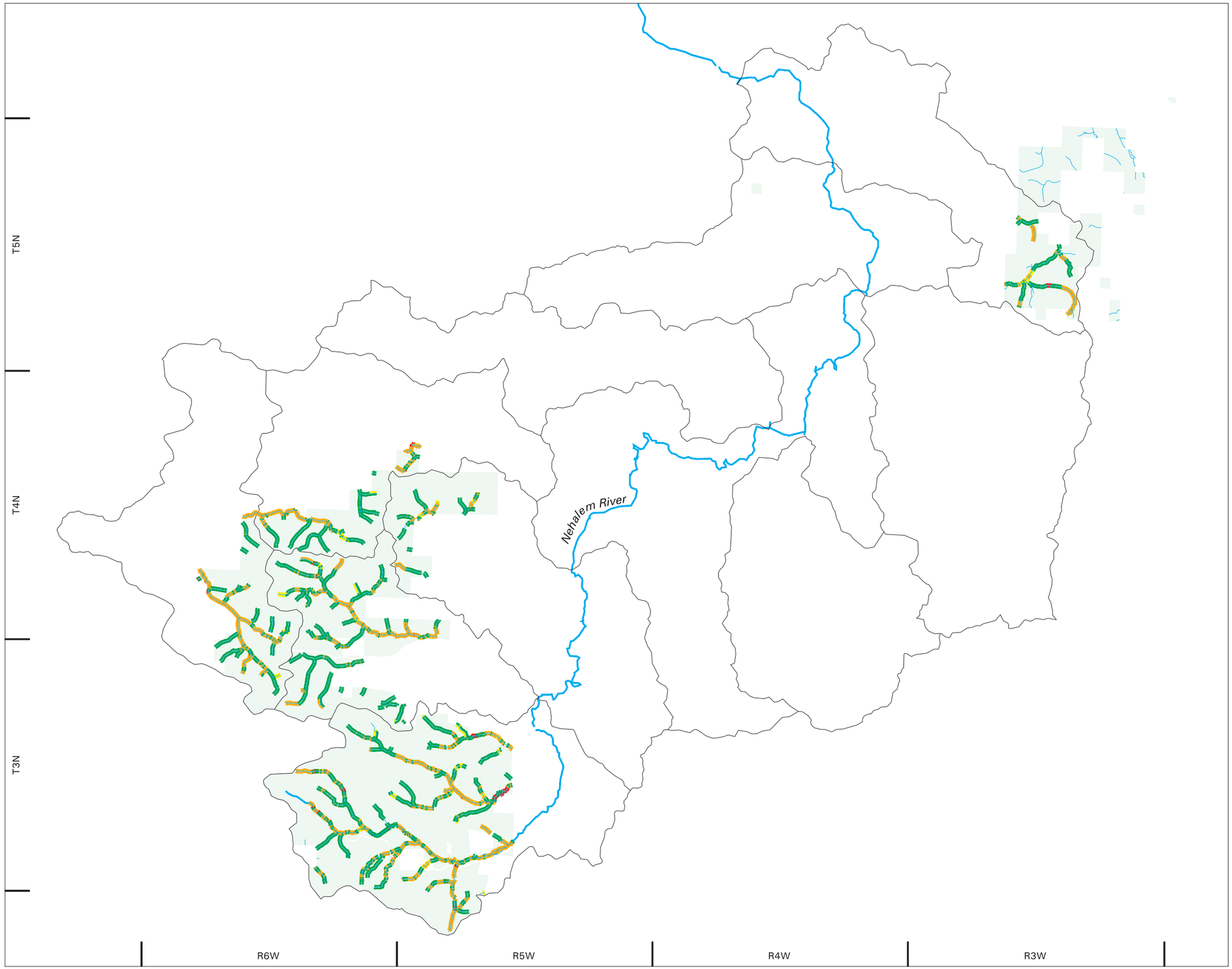
R2 Resource Consultants * map_r2rpt_1205.aml * 08 Dec 05

Oregon Department of Forestry
Upper Nehalem Watershed Analysis

Figure 6-2(a)

50-Year Large Wood Recruitment Potential

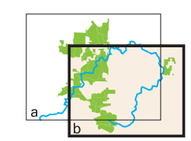
Astoria District



Legend

- Low Large Wood Recruitment Potential (50-Year)
- Moderate Large Wood Recruitment Potential (50-Year)
- Moderate/High Large Wood Recruitment Potential (50-Year)
- High Large Wood Recruitment Potential (50-Year)
- Major River
- Project Area
- 6th Field HUC (171002020109)

Map Key



N

1 Inch = 2.3 Miles

0 2

Miles

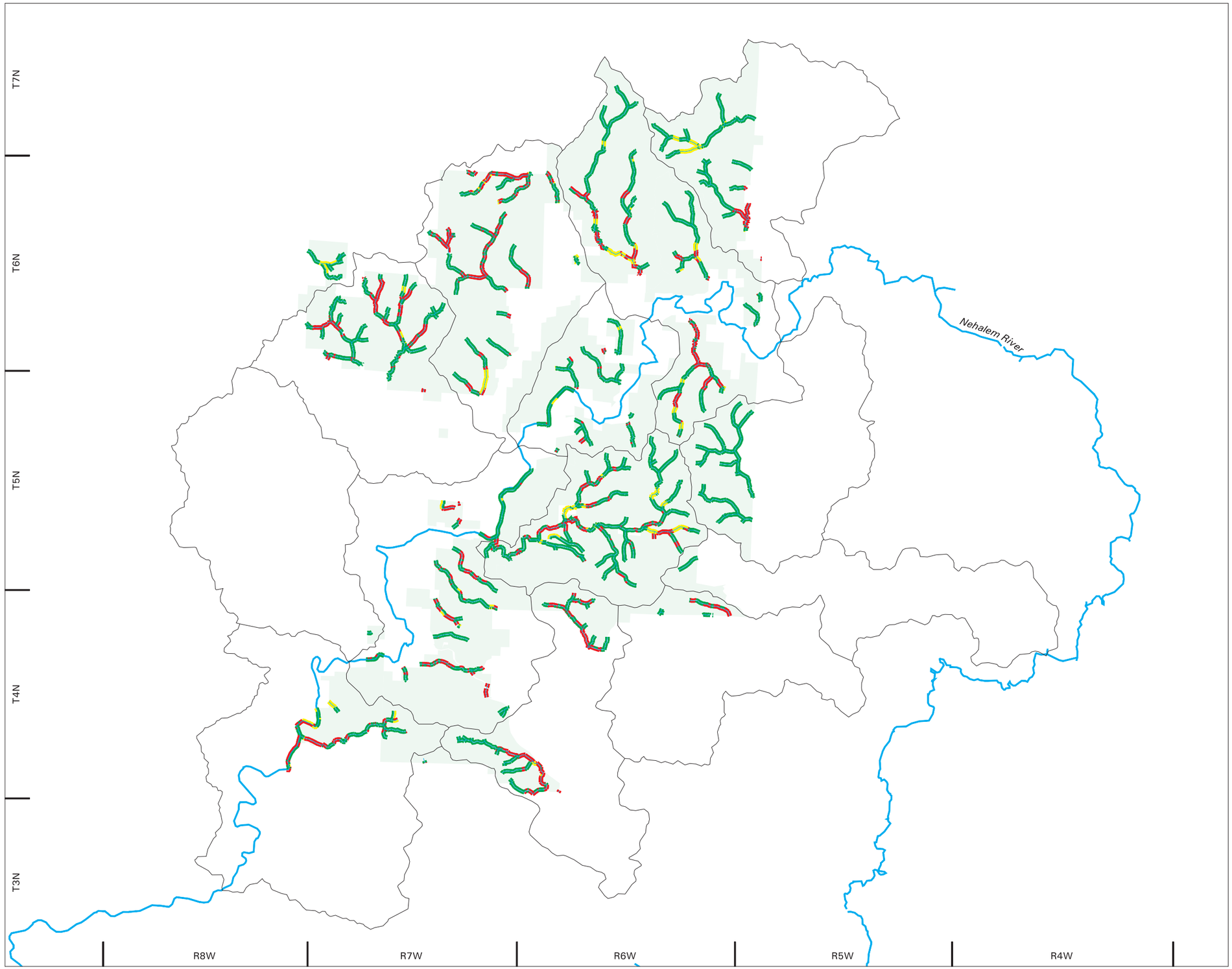
R2 Resource Consultants * map_r2rpt_1205.aml * 08 Dec 05

Oregon Department of Forestry
Upper Nehalem Watershed Analysis

Figure 6-2(b)

50-Year Large Wood Recruitment Potential

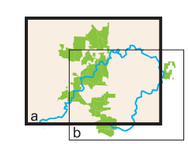
Forest Grove District



Legend

- Low Large Wood Recruitment Potential (100-Year)
- Moderate Large Wood Recruitment Potential (100-Year)
- Moderate/High Large Wood Recruitment Potential (100-Year)
- High Large Wood Recruitment Potential (100-Year)
- Major River
- Project Area
- 6th Field HUC (171002020109)

Map Key



N

1 Inch = 2.7 Miles

0 2

Miles

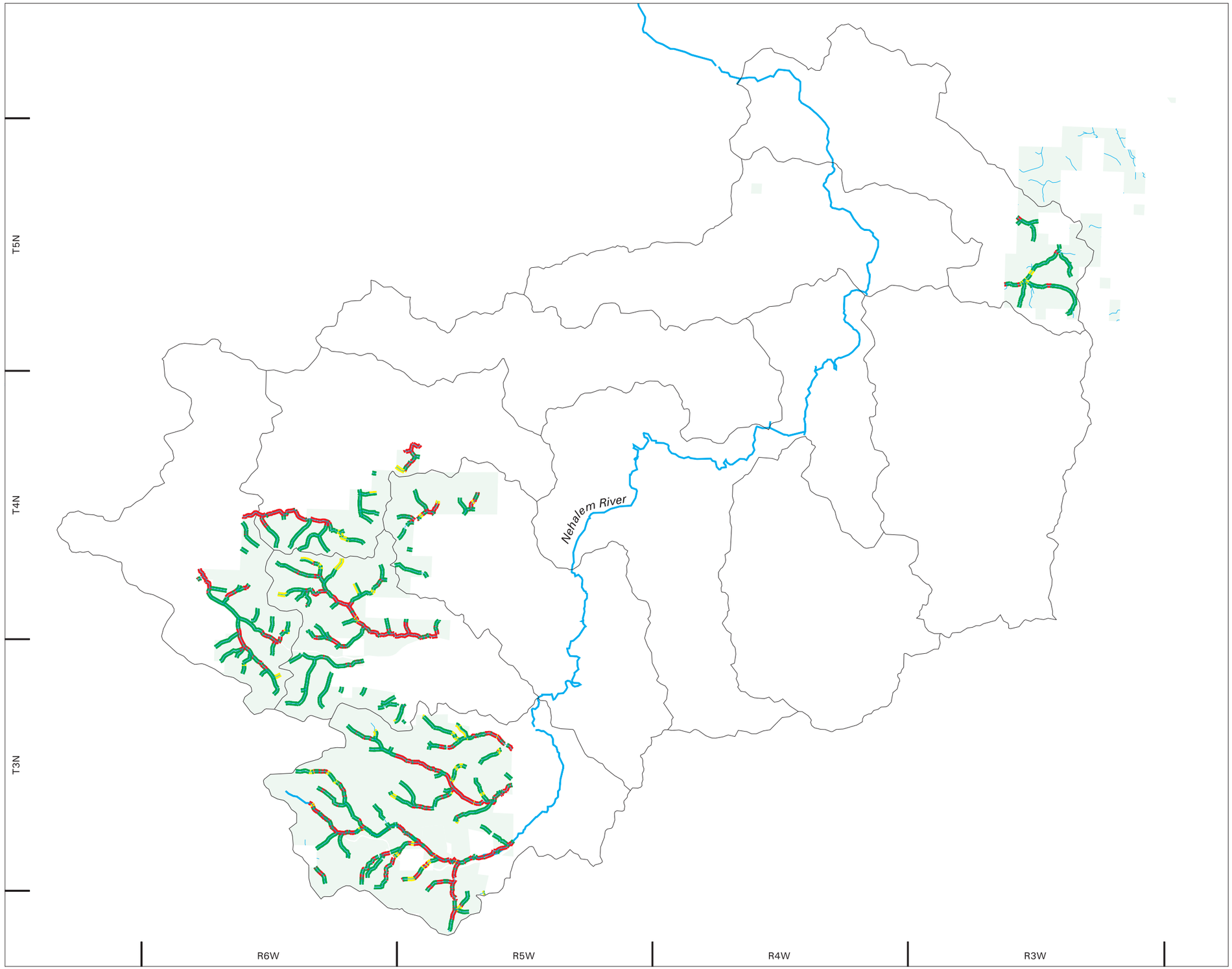
R2 Resource Consultants * map_r2rpt_1205.aml * 08 Dec 05

Oregon Department of Forestry
Upper Nehalem Watershed Analysis

Figure 6-3(a)

100-Year Large Wood Recruitment Potential

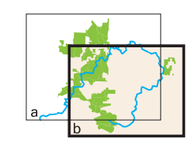
Astoria District



Legend

- Low Large Wood Recruitment Potential (100-Year)
- Moderate Large Wood Recruitment Potential (100-Year)
- Moderate/High Large Wood Recruitment Potential (100-Year)
- High Large Wood Recruitment Potential (100-Year)
- Major River
- Project Area
- 6th Field HUC (171002020109)

Map Key



N

1 Inch = 2.3 Miles

0 2

Miles

R2 Resource Consultants * map_r2rpt_1205.aml * 08 Dec 05

Oregon Department of Forestry
Upper Nehalem Watershed Analysis

Figure 6-3(b)

100-Year Large Wood Recruitment Potential

Forest Grove District

and these zones are not predicted to support conifer in the future. Repeated disturbances in this zone may keep the hardwood species in an early successional state. Without such disturbances, the hardwood species could mature and given their relatively short longevity could succeed to shrub-dominated vegetation communities in these zones. The natural disturbance regimes however are typically more frequent than the 100-year life cycle of some hardwood tree species

Outer Riparian Zones (RA2). Conifer or mixed species compositions typically dominate the riparian hillslope areas alongside streams where the soils are better drained than the low lying terraces. The OWEB manual suggests the typical species configuration for this zone are dense stands of large-sized conifer and mixed hardwood:conifer species (MLD, CLD). For the purposes of this assessment, the RA2 zone lies adjacent and upslope of the RA1 zone out to a distance of 100 feet on either side of the streams. The width of the RA2 zone subsequently varies in accordance with channel confinement and the width of the RA1 zone. The widest outer riparian areas are found along the confined channel types (Table 6-1).

Specific Situations

Specific assumptions and forecasts for each of the vegetation categories are summarized in this section.

Initial riparian stand conditions providing existing low large wood recruitment potential.

Water: For this analysis it is assumed a water body will not change in 100 years and the potential wood recruitment from this class would remain low throughout the entire period.

Bare Ground: This assessment assumed bare ground meant hard rock or other soil types incapable of growing a forest stand. As such, potential wood recruitment would remain low throughout the entire 100-year time period.

Grass: Grass as ground cover was assumed to preclude tree establishment; except for shade tolerant species (STS) that might initially develop in 100 years. These tree species would not be of sufficient size to contribute large wood in the 100-year time frame.

Shrubs: Shrubs were assumed to preclude tree establishment; except for STS that might initially develop in 100 years. Shrubs and developing STS tree species would not be of sufficient size to contribute large wood in the 100-year time frame.

Conifer Regeneration Sparse (CRS): This assessment assumed sparse conifer regeneration would add crown closure and could develop appropriate stand sizes and densities to offer a moderate and high large wood recruitment potential in 50 to 100 years, respectively. Depending

upon the initial density, it is also possible stand conditions would remain sparse leaving the recruitment potential of large wood in the moderate category within 100-year time frame.

Conifer Regeneration Dense (CRD): It was assumed dense conifer regeneration would add crown closure, thin by stand suppression and develop appropriate stand densities in 100 years to offer high large wood recruitment potential.

Hardwood Small Sparse (HSS): Young hardwood stands (<12 in dbh) as a starting point were assumed to grow in excess of 12 in dbh in 50 years with an occasional large hardwood remaining in the stand at 100 years. However, the stand would not likely regenerate a second cohort so the density should remain sparse. Hardwood canopy and shrub understory was anticipated to preclude conifer regeneration. The large wood recruitment potential under this successional pathway will remain low throughout the 100-year time frame.

Hardwood Small Dense (HSD): This assessment assumed dense, young hardwood stands (<12 in dbh) would grow in excess of 12 in dbh in 50 years with an occasional large hardwood remaining in the stand at 100 years due to a short life span. The stand would not likely regenerate a second cohort, so the density at 100 years will become sparse. Hardwood canopy and shrub understory was anticipated to preclude conifer regeneration. Red alder would probably not mature to a large (> 24" dbh) category, but black cottonwood and broad leaf maple have the potential to exceed 24 inches in 100 years. The large wood recruitment potential under this successional pathway increases slightly to a moderate category in 50 years but deteriorates to low at 100 years due to hardwood senescence.

Mixed Small Sparse (MSS): Mixed sparse stands would likely grow from small to medium to large trees in 50 to 100 years, respectively. However, they would not likely develop a second cohort. Stands with sufficient numbers of conifers may become "dense" and could offer a moderate and high potential for large wood recruitment in 50 or 100 years, respectively. Depending upon the initial density, it is also possible stand conditions would remain sparse leaving the recruitment potential of large wood in the moderate category within 100-year time frame.

Mixed Small Dense (MSD): Mixed, dense stands were anticipated to grow from small to medium to large trees in 50 to 100 years, respectively. The hardwood component would begin to decrease in 100 years such that conifer might begin to dominate the stand composition. Ingrowth of a second cohort would likely include only STS. The stand conditions should offer a moderate level of large wood recruitment potential within 50 years and a high potential within the 100-year term.

Conifer Small Sparse (CSS): Depending upon the initial density, young, sparse conifer stands have the capacity to provide canopy closure and to mature into either dense or sparse stands for a moderate level of large wood recruitment potential in 50 and 100 years. It is also possible the dense stand conditions could offer a high degree of large wood recruitment potential in 100 years.

Conifer Small Dense (CSD): This assessment assumed young, dense conifer stands (4 - 12 dbh) would likely grow to greater then 12 in. dbh in 50 years and greater than 24 in. dbh in 100 years in unmanaged conditions, without a significant loss of overstory density. These conditions should offer a high level or wood recruitment potential for key pieces within 100 years.

Hardwood Medium Sparse (HMS): It was assumed medium-sized hardwood stands (12 - 24 in. dbh), as a starting point, would approach 24 in. dbh in 50 years with an occasional large hardwood remaining in the stand at 100 years. However, the stand would not likely regenerate a second cohort, so the density should remain sparse. Hardwood canopy and shrub understory was anticipated to preclude conifer regeneration. Red alder would probably not mature to the large (> 24 in. dbh) category, but black cottonwood and broad leaf maple have the potential to exceed 24 inches in diameter. As a result of sparse stand conditions, the recruitment potential would remain low for the duration of the 100-year time period.

Hardwood Large Sparse (HLS): Large-sized hardwood stands (>24 in. dbh), as a starting point, were anticipated to deteriorate with an occasional large hardwood remaining in the stand in 50 years and only shrubs at 100 years (WFPB 1997). The stand was not projected to regenerate a second cohort so the density remains sparse to none. Hardwood canopy and shrub understory was anticipated to preclude conifer regeneration. As a result of sparse stand conditions, the recruitment potential would remain low for the duration of the 100-year time period and beyond without either a stand disturbance event or silvicultural manipulation.

Initial riparian stand conditions providing existing moderate large wood recruitment potential.

Hardwood Medium Dense (HMD): Medium-sized hardwood stands (>12 in. dbh), as a starting point, likely would approach 24 in dbh in 50 years with an occasional large hardwood remaining in the stand at 100 years. The stand would likely remain dense for the first 50 years retaining its moderate large wood recruitment potential. However, due to hardwood senescence, tree densities should thin considerably in the subsequent 50-year period. Unmanaged, these hardwood stands are not anticipated to regenerate a second cohort so the density would remain sparse. Hardwood canopy and shrub understory was anticipated to preclude conifer regeneration. As a result of sparse stand conditions, the recruitment would deteriorate to a low

potential at the 100-year time period and beyond without ongoing stand disturbances or silvicultural manipulation.

Mixed Medium Sparse (MMS): This assessment assumed medium-sized, sparse, mixed composition stands would grow medium to large trees in 50 years. It was anticipated the hardwood component would begin to decrease in 100 years such that conifer might dominate the stand composition. Ingrowth of STS as a second cohort would not likely contribute to the large wood potential until 150 to 200 years in the future. Stands at the upper limit of "sparse" may achieve "dense" conditions by 50 or 100 years offering this starting stand condition a number of different successional pathways. It is likely future stands would retain the moderate large wood recruitment potential and it is possible some combinations could provide a high level of recruitment as early as 50 years in the future.

Conifer Medium Sparse (CMS): Medium-sized, sparse, conifer stands would likely grow large trees in 50 years. Stands near the upper limit of the "sparse" category may reach "dense" stands by 50 or 100 years offering a high level of wood recruitment potential. Since, ingrowth of STS as a second cohort would not contribute to large wood potential until 150 years in the future, sparse stands near the lower limit of the category would retain a moderate wood recruitment potential during the 100-year term of this assessment.

Hardwood Large Dense (HLD): Large-sized hardwood stands (>24 in. dbh), as a starting point, would deteriorate with an occasional large hardwood remaining in the stand in 50 years and only shrubs at 100 years (WFPB 1997). The stand was not projected to regenerate a second cohort, so tree density should decrease over time. Hardwood canopy and shrub understory was anticipated to preclude conifer regeneration. The initial moderate large wood recruitment potential was anticipate to deteriorate to a low category by year 50 and remain low for the balance of the assessment period.

Mixed Large Sparse (MLS): Mixed, sparse stands greater than 24 inches dbh would remain large in size over the next 50 to 100 years. The hardwood component would likely deteriorate, giving way to a conifer dominated stand in 100 years, but conifers would not be able to reach "dense" level unless a second cohort of shade tolerant conifer species grows to sufficient size to contribute large wood in 100 years. The wood recruitment potential rating would likely remain moderate for the next 100 years. If an understory of STS develops, the recruitment rating could increase to a high potential in 100 years.

Mixed Medium Dense (MMD): Medium-sized, dense, mixed stands were assumed to grow large trees in 50 years. The hardwood should begin to decrease in 50 to 100 years, such that conifer dominate the stand composition. Ingrowth, with only STS as a second cohort, would not

contribute to large wood potential until 150 to 200 years in the future. The large wood recruitment potential should remain high throughout the 100-year assessment period.

Conifer Medium Dense (CMD): This assessment assumes medium-sized, dense, conifer stands would grow from medium to large trees in 50 years and the stand would continue to offer large, dense conditions at 100 years. Ingrowth of STS as a second cohort would not likely contribute to the large wood recruitment potential until 150 years in the future. These conditions should maintain the high recruitment potential rating for the duration of the assessment period.

Initial riparian stand conditions providing existing high large wood recruitment potential:

Mixed Large Dense (MLD): Large-sized, dense, mixed stands were anticipated to retain their size in 100 years. The hardwood component would likely decrease in 50-100 years such that conifer dominate the stand composition. Ingrowth, with only STS as a second cohort, would not contribute to large wood potential until 150 to 200 years in the future. The large wood recruitment potential should remain high throughout the 100-year assessment period.

Conifer Large Dense (CLD): This assessment assumed large-sized, dense, conifer stands would retain their composition, size and density over the next 100 years. Ingrowth of STS, if any, as a second cohort may begin to contribute to the large wood recruitment potential in 100 years. The potential wood recruitment rating should remain high for the duration of the assessment period.

6.1.4 Discussion

6.1.4.1 Summary of Existing Riparian Conditions by Management Unit

Astoria District

Fishhawk Management Basin. The existing riparian situation in Fishhawk basin with respect to large wood recruitment was determined to be favorable. Nearly 73 percent of the streams in the management basin currently provide a high level of potential wood recruitment with an additional 14 percent in the moderate recruitment category. Approximately, 5 percent of the RA1 zone (0.6 stream miles) was currently in the reference condition, while none of the RA2 zone falls within its maximum potential. All of the current 13 percent of the stream length in low recruitment categories showed the potential to achieve moderate and high recruitment levels in 50 years. According to the vegetation succession model, the influence of natural hardwood stand thinning due to senescence in 100 years on the large wood recruitment potential is minor in this management basin. It was anticipated that 5 percent of the fish-bearing stream network (0.6 miles) would lie within the low recruitment category in 100 years.

Northrup Management Basin. Riparian conditions in the Northrup basin are currently in a relatively poor state with respect to potential wood recruitment. Only 6 percent of the RA1 zone (0.9 stream miles) complied with the reference condition and only 17 percent of the fish-bearing stream length offered high wood recruitment potential. Nearly 68 percent of the fish-bearing stream length falls within the low recruitment category. Approximately 90 percent of the low situations are predicted to achieve moderate and high recruitment levels in 50 years. According to the vegetation succession model, the influence of natural hardwood stand thinning due to senescence in 100 years on the large wood recruitment potential is substantial in this management basin. It is anticipated 24 percent of the fish-bearing stream network (3.3 miles) would lie within the low recruitment category in 100 years. Nevertheless, the predicted level of sparse stands remains consistent with the distribution of young age class stands under historic reference conditions (Benda and Dunne 1997).

Beneke Management Basin. Riparian conditions on ODF lands adjacent to fish-bearing streams in the Beneke basin offered 51, 43, and 6 percent of the stream mileage in high, moderate and low wood recruitment categories, respectively. Approximately 39 percent of the RA1 zone (7.8 stream miles) complied with the reference HMD condition, while none of the RA2 zone was mature enough to meet the OWEB reference condition. Half of the low recruitment situations should develop moderate and high recruitment levels in 50 years. According to the vegetation succession model, the influence of natural hardwood stand thinning due to senescence in 100 years on the large wood recruitment potential is considerable in this management basin. It is anticipated 42 percent of the fish-bearing stream network (7.8 miles) would lie within the low recruitment category in 100 years. The level of sparse stands is inconsistent with the distribution of young age class stands under historic reference conditions (Benda and Dunne 1997) and stand manipulation to achieve desired riparian conditions should be considered.

Lousignot Management Basin. Riparian conditions on ODF lands adjacent to fish-bearing streams in the Lousignot basin offered 38, 14, and 51 percent of the stream mileage in high, moderate and low wood recruitment categories, respectively. Approximately 13 percent of the RA1 zone (0.9 stream miles) complied with the reference HMD condition, while none of the RA2 zone was mature enough to meet the OWEB reference condition. Approximately 98 percent of the low recruitment situations should develop moderate and high recruitment levels in 50 years, respectively. According to the vegetation succession model, the influence of natural hardwood stand thinning due to senescence in 100 years on the large wood recruitment potential is substantial in this management basin. It is anticipated 24 percent of the fish-bearing stream network (1.7 miles) would lie within the low recruitment category in 100 years. Nevertheless, the predicted level of sparse stands remains consistent with the distribution of young age class stands under historic reference conditions (Benda and Dunne 1997).

Hamilton Management Basin. Riparian conditions on ODF lands adjacent to fish-bearing streams in the Hamilton basin offered 50, 39, and 11 percent of the stream mileage in high, moderate and low wood recruitment categories, respectively. Approximately 39 percent of the RA1 zone (7.2 stream miles) complied with the reference HMD condition, while none of the RA2 zone was mature enough to meet the OWEB reference condition. All of the low recruitment situations should develop moderate and high recruitment levels in 50 years. According to the vegetation succession model, the influence of natural hardwood stand thinning due to senescence in 100 years on the large wood recruitment potential is considerable in this management basin. It is anticipated 42 percent of the fish-bearing stream network (7.8 miles) would lie within the low recruitment category in 100 years. The level of sparse stands is inconsistent with the distribution of young age class stands under historic reference conditions (Benda and Dunne 1997) and stand manipulation to achieve desired riparian conditions should be considered.

Crawford Management Basin. Riparian conditions on ODF lands adjacent to fish-bearing streams in the Crawford basin offered 52, 4, and 43 percent of the stream mileage in high, moderate and low wood recruitment categories, respectively. Approximately 2 percent of the RA1 zone (0.1 stream miles) complied with the reference HMD condition, while none of the RA2 zone was mature enough to meet the OWEB reference condition. Ninety eight percent of the low recruitment situations should develop moderate and high recruitment levels in 50 years. According to the vegetation succession model, the influence of natural hardwood stand thinning due to senescence in 100 years on the large wood recruitment potential is minor in this management basin. It was anticipated that 6 percent of the fish-bearing stream network (0.3 miles) would lie within the low recruitment category in 100 years.

Sager Management Basin. Riparian conditions on ODF lands adjacent to fish-bearing streams in the Sager basin offered 50, 2, and 47 percent of the stream mileage in high, moderate and low wood recruitment categories, respectively. Approximately 2 percent of the RA1 zone (0.4 stream miles) complied with the reference HMD condition, while none of the RA2 zone was mature enough to meet the OWEB reference condition. More than three-fourths of the low recruitment situations should develop moderate and high recruitment levels in 50 years. According to the vegetation succession model, the influence of natural hardwood stand thinning due to senescence in 100 years on the large wood recruitment potential is substantial in this management basin. It is anticipated 21 percent of the fish-bearing stream network (3.9 miles) would lie within the low recruitment category in 100 years. Nevertheless, the predicted level of sparse stands remains consistent with the distribution of young age class stands under historic reference conditions (Benda and Dunne 1997).

Buster Management Basin. Riparian conditions on ODF lands adjacent to fish-bearing streams in the Buster basin offered 65, 19, and 16 percent of the stream mileage in high, moderate and low wood recruitment categories, respectively. Approximately 16 percent of the RA1 zone (7.0 stream miles) complied with the reference HMD condition, while none of the RA2 zone was mature enough to meet the OWEB reference condition. Seventy five percent of the current low recruitment situations should develop moderate and high recruitment levels in 50 years. According to the vegetation succession model, the influence of natural hardwood stand thinning due to senescence in 100 years on the large wood recruitment potential is substantial in this management basin. It is anticipated 25 percent of the fish-bearing stream network (11.2 miles) would lie within the low recruitment category in 100 years. Nevertheless, the predicted level of sparse stands remains consistent with the distribution of young age class stands under historic reference conditions (Benda and Dunne 1997).

Quartz Management Basin. Riparian conditions on ODF lands adjacent to fish-bearing streams in the Quartz basin offer 55, 14, and 32 percent of the stream mileage in high, moderate and low wood recruitment categories, respectively. Approximately 14 percent of the RA1 zone (2.0 stream miles) complied with the reference HMD condition, while none of the RA2 zone was mature enough to meet the OWEB reference condition. Approximately half of the current 32 percent of stream miles in the low recruitment category are predicted to develop moderate and high recruitment levels in 50 years. According to the vegetation succession model, the influence of natural hardwood stand thinning due to senescence in 100 years on the large wood recruitment potential is considerable in this management basin. It is anticipated 44 percent of the fish-bearing stream network (6.1 miles) would lie within the low recruitment category in 100 years. The level of sparse stands is inconsistent with the distribution of young age class stands under historic reference conditions (Benda and Dunne 1997) and stand manipulation to achieve desired riparian conditions should be considered.

Contiguous Parcels

Young's Bay. Portions of the Hamilton Management Basin extend into the headwater region of the Young's Bay watershed. Approximately 3 miles of small and medium-sized streams were included in this riparian assessment. More than half of the riparian situations consisted of stand condition code CMD. These existing stands are anticipated to provide a moderate potential for current inputs of large wood to channels. Given the overall small size of the streams, some wood from this stand class may be functioning as key pieces. Within 50 years, these stands are predicted to offer conifer trees in excess of 24 in. dbh. The balance of the riparian situations in the Young's Bay contiguous parcels offered a mosaic of conifer-dominated or mixed species compositions in relatively young, small size classes. These situations offered current low wood

recruitment potential, but have the potential in 100 years to provide key-piece size wood to the streams.

Forest Grove District

McGregor Management Basin. Riparian conditions on ODF lands adjacent to fish-bearing streams in the McGregor basin offered 54, 4, and 42 percent of the stream mileage in high, moderate and low wood recruitment categories, respectively. Approximately 1 percent of the RA1 zone (0.3 stream miles) complied with the reference HMD condition, while none of the RA2 zone was mature enough to meet the OWEB reference condition. All of the low recruitment situations should develop moderate and high recruitment levels in 50 years. According to the vegetation succession model, the influence of natural hardwood stand thinning due to senescence in 100 years on the large wood recruitment potential is considerable in this management basin. It is anticipated 40 percent of the fish-bearing stream network (12.5 miles) would lie within the low recruitment category in 100 years. The level of sparse stands is inconsistent with the distribution of young age class stands under historic reference conditions (Benda and Dunne 1997) and stand manipulation to achieve desired riparian conditions should be considered.

Wheeler Management Basin. Riparian conditions on ODF lands adjacent to fish-bearing streams in the Wheeler basin offered 51, 27, and 21 percent of the stream mileage in high, moderate and low wood recruitment categories, respectively. Approximately 24 percent of the RA1 zone (12.0 stream miles) complied with the reference HMD condition, while none of the RA2 zone was mature enough to meet the OWEB reference condition. Ninety percent of the low recruitment situations should develop moderate and high recruitment levels in 50 and 100 years. According to the vegetation succession model, the influence of natural hardwood stand thinning due to senescence in 100 years on the large wood recruitment potential is considerable in this management basin. It is anticipated 35 percent of the fish-bearing stream network (17.2 miles) would lie within the low recruitment category in 100 years. The level of sparse stands is inconsistent with the distribution of young age class stands under historic reference conditions (Benda and Dunne 1997) and stand manipulation to achieve desired riparian conditions should be considered.

Wilark Management Basin. Riparian conditions on ODF lands adjacent to fish-bearing streams in the Wilark Management Basin offered 63, 9, and 28 percent of the stream mileage in high, moderate and low current wood recruitment situations, respectively. Approximately 4 percent of the RA1 zone (0.2 stream miles)] complied with the reference HMD condition, while none of the RA2 zone was mature enough to meet the OWEB reference condition. More than 90 percent of

the low recruitment conditions were anticipated to develop moderate and high recruitment levels within 50 years. According to the vegetation succession model, the influence of natural hardwood stand thinning due to senescence in 100 years on the large wood recruitment potential is minor in this management basin. It was anticipated that 6 percent of the fish-bearing stream network (0.4 miles) would lie within the low recruitment category in 100 years.

Contiguous Parcels

Clatskanie. Portions of the Wilark Management Basin extend into headwater regions of the Clatskanie watershed. Approximately 14 miles of typed streams occurred on ODF lands in this area. Less than a mile of channel represented large streams, while approximately 3 miles consisted of medium-sized streams. As such, almost three-fourths of the typed waters on ODF lands in the Clatskanie were small streams. The riparian conditions along these channels were unknown and consist as a data gap in this watershed analysis.

6.2 WETLANDS ASSESSMENT

The purpose of the wetlands assessment was to assess the current locations and general characteristics of wetlands in the watershed and determine if opportunities exist to restore degraded wetland conditions. The specific critical questions for the wetlands assessment from the OWEB watershed assessment manual include:

6.2.1 Critical Questions

1. *Where are the wetlands in this watershed?*
2. *What are the general characteristics of wetlands within the watershed?*
3. *What opportunities exist to restore wetlands in the watershed?*

Existing literature and digital databases including: (1) the PSU watershed analysis, (2) subsequent Upper Nehalem River Watershed Council's update of the OWEB analysis, (3) National Wetlands Inventory maps and database as well as (4) ODF databases were reviewed. No information was located concerning the distribution of wetlands in the upper Nehalem River basin. Thus, the condition of forest wetlands is identified as a data gap in this watershed analysis.

6.3 NOXIOUS WEEDS ASSESSMENT

The purpose of the noxious weed assessment is to assess the current locations, type and extent of noxious weed communities based on ODF digital data. The OWEB watershed assessment manual does not include assessment guidelines for noxious weeds.

Very limited information is available for the noxious weed assessment in the upper Nehalem watershed. The distribution of Japanese knotweed *(Polygonum cuspidatum)* was obtained from the upper Nehalem Watershed Council (unpublished data). During the 2005 field verification of riparian habitat, R2 survey crews surveyed vegetation at 19 locations as described above in riparian methods. No noxious weeds, including communities of Japanese knotweed, were observed at any of the surveyed locations. A tally of noxious weed sites per HUC and ODF Management Basin is included in Table 6-4. While it is likely that the distribution of noxious weeds within the Upper Nehalem Project Area is more extensive than is outlined in Table 6-4, more survey effort will be required to determine the distribution of noxious weeds. The condition of noxious weeds is identified as a data gap in this watershed analysis.

A tally of noxious weed sites per HUC and ODF Management Basin is included in Table 6-4. Although 18 survey sites, from a total of more than 158 sites surveyed for Japanese knotweed in the upper watershed, occur within ODF Management Basin, only four of these sites (4) have positive identifications. Three occurrences of knotweed are found in the Quartz Management Basin on ODF lands in the Astoria District and one occurrence is located in the Wheeler Management Basin in Forest Grove. The observation of Japanese knotweed in the Wheeler basin is not located on ODF lands.

Table 6-4. Confirmed presence of Japanese knotweed *(Polygonum cuspidatum)* in various management basins in the Upper Nehalem Watershed. Data obtained from Upper Nehalem Watershed Council (comments from Weed Project 1-041305.xls database).

	Astoria		Forest Grove		
	Quartz		Wheeler		
	HUC 171002020208		HUC 171002020101		
Case	Size	Extent	Size	Extent	Comments
143	Large	30			Large spread patch next to campsite
144	Large	200			Everywhere, canes in water
145	Small	5			Small clump next to culvert opp. Nehalem
158			Large	30	4 clumps beaver presence