Final Report

# Oregon North Coast Salmon Conservation Assessment

*Presented by*

THE WILD SALMON CENTER

## Acknowledgements

Development of this study was guided by a core science team that met three times. This team included Liz Dent (ODF), Jeff Rodgers (ODFW), Gordie Reeves (USFS), and Michael Schindel (TNC). Assistance was also given by Mike Mertens (Ecotrust), Brent Davies (Ecotrust), and Jay Nicholas (ODFW/WSC), David Moskowitz. Other contributors who we are indebted to for their help and insight include: Charley Dewberry, Steve Trask, Christina Friedle, Lindsay Demeter, Chris Robbins, Lee Benda, Dan Miller, Kelly Burnett, Mark Trenholm, Chris Knutsen, Kelly Christiansen, Colleen Kiser, Keith Mills, Rod Krahmer, Julie Firman, Kirstin Gallo, Peter Eldred, Sean Gordon, Lighthawk and pilot Jane Nicolai. This project was made possible through assistance from the Kongsgaard-Goldman Foundation, Lazar Foundation, MJ Murdock Charitable Trust, and the JW & HM Goodman Family Foundation.

Cover Photo: Jeff Mishler, taken from a Lighthawk donated flight.


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# Executive Summary

Wild Salmon Center is an international science-based organization whose mission is to identify, understand, and protect the best wild salmon ecosystems of the North Pacific. Northwest Oregon's coastal salmon runs have been historically strong, and a recent assessment by the North American Salmon Stronghold Partnership identified the Tillamook and Nehalem basins as producers of some of the strongest and most diverse wild runs in Oregon. Wild Salmon Center thus undertook this project to complete a more detailed analysis of areas with the strongest runs and best ecosystem condition, and to examine the degree to which the forested areas with salmon habitat are protected by land management that puts a high emphasis on natural resource conservation.

This project employed a watershed model that integrated numerous indicators of salmon ecosystem condition, such as the water quality, sedimentation, vegetation, and the abundance of large wood in streams. These various indicators were aggregated into an overall score for all coastal catchments (HUC 7 scale). Also analyzed was the intrinsic potential of streams to support salmon and data from counts of juvenile and spawning salmon.

This report is the result of collaboration with several agencies including the Oregon Department of Forestry (ODF), Oregon Department of Fish and Wildlife (ODFW), US Forest Service, Ecotrust, and the Nature Conservancy.

Because of a pending policy decision regarding the management of state forests in Northwest Oregon, special analytical attention was given to areas important for salmon on state-owned forestlands.

Key conclusions of this study are as follows:

1) Only 8% of the forest of the North Coast is managed with a high emphasis on natural resource conservation, mostly on federally-owned late successional reserve areas in the Nestucca watershed. Approximately 40% of the forest area is in moderate conservation areas, including state forests. Over 50% of the forest area is dominated by industrial forestry.

2) Few watersheds (3%) on the north coast received high scores for watershed condition. The main reasons for low scores were the lack of mature conifers and hardwoods in riparian areas, high floodplain road density, the lack of large wood in streams, and excessive fine sediment.

3) Areas in state and federal ownership are generally in better condition than catchments in private ownership. Areas on private agricultural land and industrial forestland in the Tillamook lowlands and upper Nehalem scored particularly low.

4) Areas currently designated as Salmon Anchor Habitat on State forestlands are providing protection for some of the best areas for fish in the region. Several areas are indentified as excellent candidates for the increased protections through Salmon

Anchor Habitat designation. These were identified based upon watershed condition, recent fish survey data, intrinsic potential, and expert opinion.

5) Four emphasis zones are described that deserve the highest conservation focus for salmon at the catchment level: the Miami and Kilchis Rivers, the Little North Fork of the Wilson River, and the Salmonberry River.

Key recommendations of this study are:

1. Protect watersheds that are currently in the best condition.
2. Maintain and enhance the current Salmon Anchor Habitats to provide good watershed condition for salmon across the North Coast.
3. Provide a high conservation/low-risk approach to areas with the strongest, most diverse and/or unique salmon runs in the region. In particular, the Miami, Kilchis, Little North Fork of the Wilson, and the Salmonberry Rivers.

# Oregon North Coast Salmon Conservation

**Wild Salmon Center**

## 1. Introduction

The North Coast of Oregon represents an important landscape for anadramous salmon and trout species. The five rivers of the Tillamook Bay (Miami, Kilchis, Wilson, Trask, and Tillamook) and the Nehalem River produce relatively healthy runs of fish. However, these runs are significantly below their historic and potential productivity.

Wild Salmon Center (WSC) seeks the maintenance and enhancement of aquatic ecosystems that support anadramous salmon and trout in the Oregon North Coast. WSC undertook this assessment to contribute to ongoing policy discussions about watershed management in the region. The purpose of this study is to "take the pulse" of the condition of salmonids and watersheds. The findings are then integrated into conservation recommendations for salmon. Specifically, the questions that guided this study are:

1. Where are key areas for salmon and what is the condition of these areas?
2. How do current protections, particularly Salmon Anchor Habitats, relate to key areas for salmonids?
3. What is a conservation design that is beneficial for salmon?

Because there is a key policy decision before the Oregon Board of Forestry related to salmon protection on state forestlands, this study provides a special emphasis on state forests and the Oregon Department of Forestry's Salmon Anchor Habitat (SAH) strategy. This study looks at watershed condition across the landscape, but pays particular attention to where empirical data supports the location of salmon "hotspots" on state forestlands. This study also assesses the current conservation status across the landscape. Finally, this study integrates the results within core concepts of landscape -scale conservation planning for salmon.

There is a historical framework that is important in structuring these questions. Since the mid-1800s the Oregon North Coast has been subject to extensive anthropogenic and natural disturbances. Floodplains have been cleared, diked, and drained for farms and homes. Forests have been subject to extensive clearing and regeneration for timber. Additionally, catastrophic forest fires in the 1930s and 1940s burned a large area of what is now the Tillamook State Forest. This history is of primary importance as we try to understand "current conditions". The result is a landscape that is dominated by farms, timber plantations and regenerating forest. The whole region is likely outside the range of natural variability as it concerns wetlands, forest structure and aquatic systems.

SAHs are a spatially distributed collection of watersheds with greater than 20% ownership of the Tillamook or Clatsop State Forests. A consortium of Oregon Trout, Ecotrust, and the Wild Salmon Center developed an initial selection of SAHs. A separate selection was developed by Oregon Department of Fish and Wildlife (Talabere and Jones, 2002). The former method was based primarily on snorkel survey counts from 1999. The ODFW method was based on summarizing spawning surveys and stream habitat surveys (Talabere and Jones, 2002). A final selection of SAHs was implemented in 2003 as a mix of uniform and varying management prescriptions that last for ten years (ODF, 2003). SAH riparian strategies are more protective than non-SAH state land. Clearcutting and harvest levels are also capped at levels that vary across the SAH basins.

This study is a mid-course assessment five years after SAH implementation. It is within the scope of adaptive ecosystem management to reassess conservation plans based upon newer data and scientific findings. Significant new data sets (Bio-Surveys, 2008; ODFW surveys) and concepts (Burnett, 2007; Reeves, 2007) have emerged such as intrinsic potential, decision support models, and whole basin surveys. In addition, the Oregon Board of Forestry is considering changes to the Salmon Anchor Habitat strategy. This study and report is to provide dialogue to consider salmon on public lands in the North Coast.

## 2. Background on the North Coast Area

To answer the three key questions, salmon status was considered at the regional scale, along with ownership, and conservation status. The North Coast area, covering 2,224 square miles, is defined in this project as comprising of four major watershed systems: the Tillamook Bay systems and its five rivers (Wilson, Kilchis, Miami, Trask, and Tillamook), the Nehalem River, the Lower Columbia River, and the Nestucca River. See Figure 1 for a depiction of the area. Climatically, this region belongs to the North Pacific Maritime system with abundant rainfall in the winter. The topography is varied with areas of steep terrain mixed with more moderate slopes and lowland floodplains.

### 2.1. Salmon in the Region

The North Coast has some of the most diverse, unique and productive salmon runs in North America. A recent database (2008) produced by the North American Salmon Stronghold Partnership (NASSP) has ranked this region highly with regards to the presence of salmon populations that currently are in good condition (Figure 2). The Tillamook and Nehalem watersheds stand out in particular.

The North Coast includes six different species/run-timings: coho, chum, fall Chinook, spring Chinook, steelhead, and cutthroat trout. The Tillamook Bay chum population is the southernmost significant population of chum in North America (NASSP Expert Opinion Database, 2008). Both the Tillamook Bay and Nehalem watersheds have independent populations of coho (Wainwright, et al, 2008). Independent populations are critical for the long-term persistence of coho salmon on the Oregon Coast.

However, salmon and trout populations in the North Coast, as well as other parts of the Pacific Northwest have declined dramatically in recent years. Widespread, chronic anthropogenic disturbances (Waples, et al, 2008) and lack of protected areas (Pinsky et al, in press) tend to influence salmon populations adversely. Current abundances of fish are far below historic and potential numbers. For example, estimates of coho are around 10% of historic abundance. For coho in the Nehalem system, historical estimates are 236,000 (Meengs and Lackey, 2005) and currently (2000-2004) average around 21,500, or <10% of historic. For coho in the Tillamook drainage, the historic estimate was 234,000 (Meengs and Lackey, 2005) and currently is around 7,000 or 3% of historic abundance (ODFW, 2005).

It has been suggested that marine influences may play a role in the decline. However, on the Oregon Coast, salmon are "relatively more dependant on freshwater habitat" than marine (Salmon Anchor Habitat Work Group, 2004). Modeling has shown that better freshwater habitat conditions lower extinction probabilities for Oregon coastal coho (Nickelson, 1998).

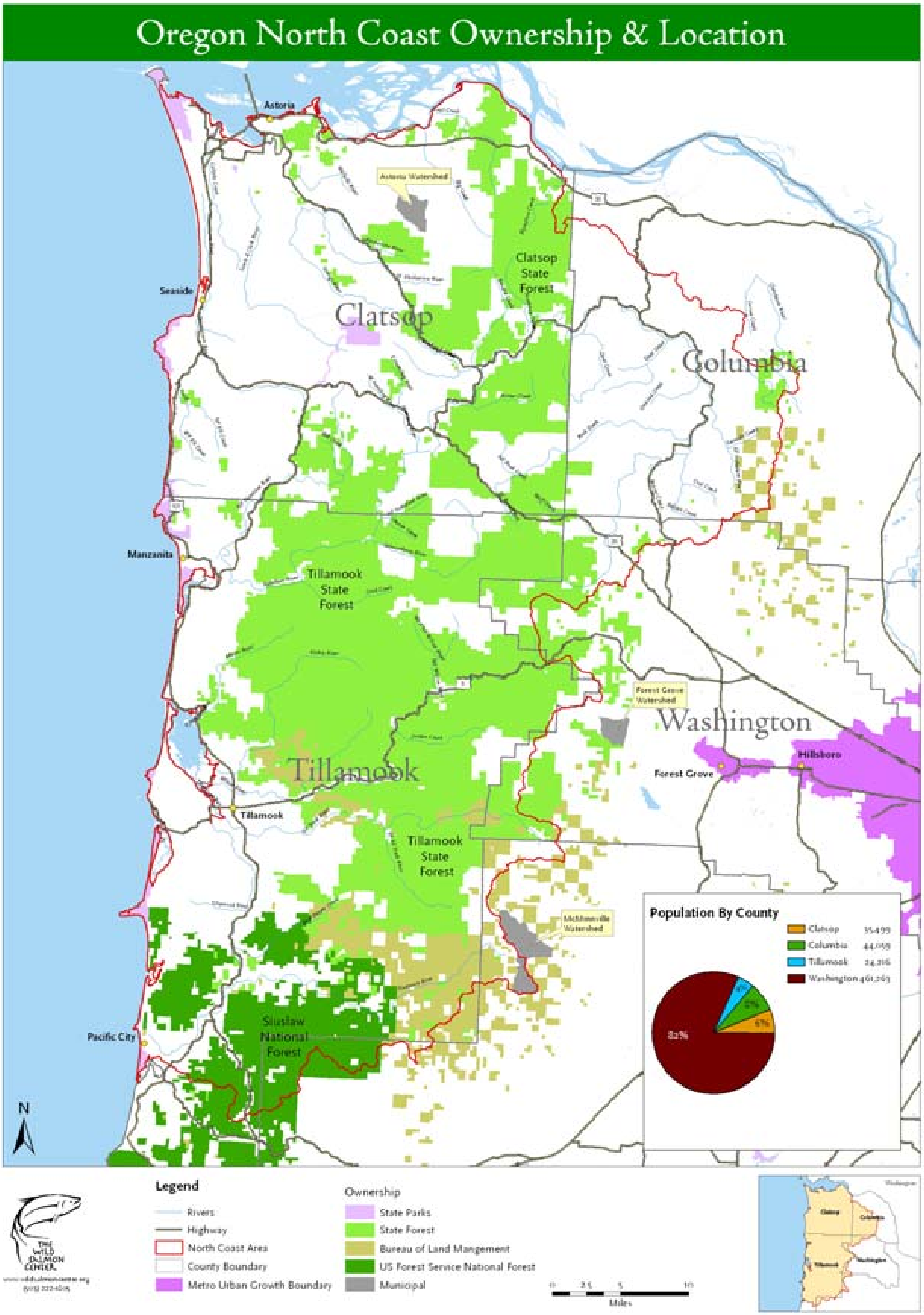


**Figure 1.** Map showing location and land ownership. Graph shows percentage of human population in area by county.

## 2.2. Ownership

Land ownership is dominated by private ownership and state lands (Table 1). Some Federal lands (e.g., BLM and Siuslaw National Forest) are located in the southern portion. The majority (90%) of the land is under private and state forest management.

The primary economic activity in the region is timber harvest. Figure 3 presents a map of how extensive timber extraction over the last 40 years, particularly clearcutting. These patterns will likely remain the same across the landscape given current trends, with potentials for increased clearcutting on ODF lands[1].

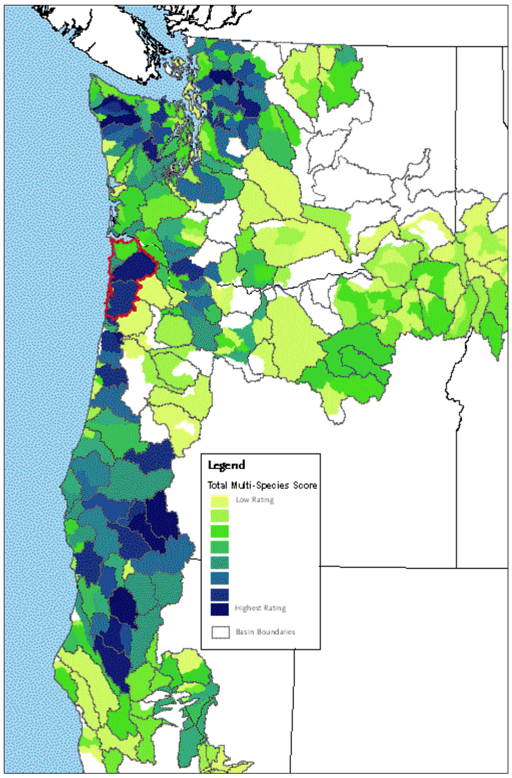


**Figure 2.** Multispecies watershed scores (NASSP, 2008)

## 2.3. Conservation Status of Forests in the Region

"Conservation status" relates to how the land is managed for conservation of biological diversity and ecological processes. This report adopted a classification that reduced conservation status to three basic categories – high, medium and low emphasis. In addition, since one short-term goal of this report is to provide recommendations regarding key locations on state forest land, this section of the study only looked at forested or potentially forested lands, excluding agricultural and urban lands. A more robust analysis of conservation status including all lands awaits further work.

| Land Manager | Square Miles | Percent |
|---|---|---|
| Bureau of Indian Affairs | < 0.1 | 0.0% |
| Bureau of Land Management | 86.8 | 3.9% |
| Local Government | 18.6 | 0.8% |
| National Park Service | 1.4 | 0.1% |
| Oregon Department of Fish and Wildlife | 5.0 | 0.2% |
| Oregon Department of Forestry | 744.8 | 33.5% |
| Oregon Parks and Recreation Department | 21.4 | 1.0% |
| Private | 1,225.4 | 55.1% |
| Undefined | 0.9 | 0.0% |
| United States Department of Agriculture | | |
| US Forest Service | 119.7 | 5.4% |
| United States Fish and Wildlife Service | < 0.1 | 0.0% |
| Totals | 2,224.2 | 100.0% |

**Table 1.** Land ownership in the North Coast.

[1] Currently, ODF is considering a 30-35% timber increase on state lands.

- **High Conservation Emphasis**: Ownerships where medium to long term (50+ years) conservation of forest biodiversity and habitat structure is the primary goal. The landscape can be actively managed for characteristics that enhance ecological processes. The main owners for this category are the BLM, the US Forest Service and the Nature Conservancy. Late successional reserves under the Northwest Forest Plan are also in this category.

- **Medium Conservation Emphasis**: Ownerships where the long-term emphasis is placed on timber production or recreation for the majority of the property, with conservation plans in place for limited portions of the landscape. This category includes all state forestlands and matrix federal lands. While state parks are included in this category due to the intensive recreational development in some parks, these ownerships straddle the line with the high conservation category. As shown on Table 1, however, state parks are only 1% of the North Coast ownership.

- **Low Conservation Emphasis**: In this category are private forestlands where timber production is the primary emphasis. Includes all industrial timber lands.

Table 2 presents a breakdown of conservation emphasis by square mile and percent. Figure 4 presents the spatial distribution of this classification. Over 90% of the landscape is in low or medium conservation emphasis. The 8% in high conservation emphasis is almost all in Federal Forest Service or BLM late successional reserves. Over 98% of the landscape north of the Nestucca River is in Low or Medium Emphasis.

| Description | Square Miles | Percent |
|---|---|---|
| **High Conservation Emphasis** | 170.6 | 8.08% |
| **Medium Conservation Emphasis** | 847.0 | 40.11% |
| **Low Conservation Emphasis** | 1,094.3 | 51.82% |
| **Total** | 2,111.9 | 100.00% |

**Table 2.** Area and percent of each conservation status of forest lands in the North Coast.

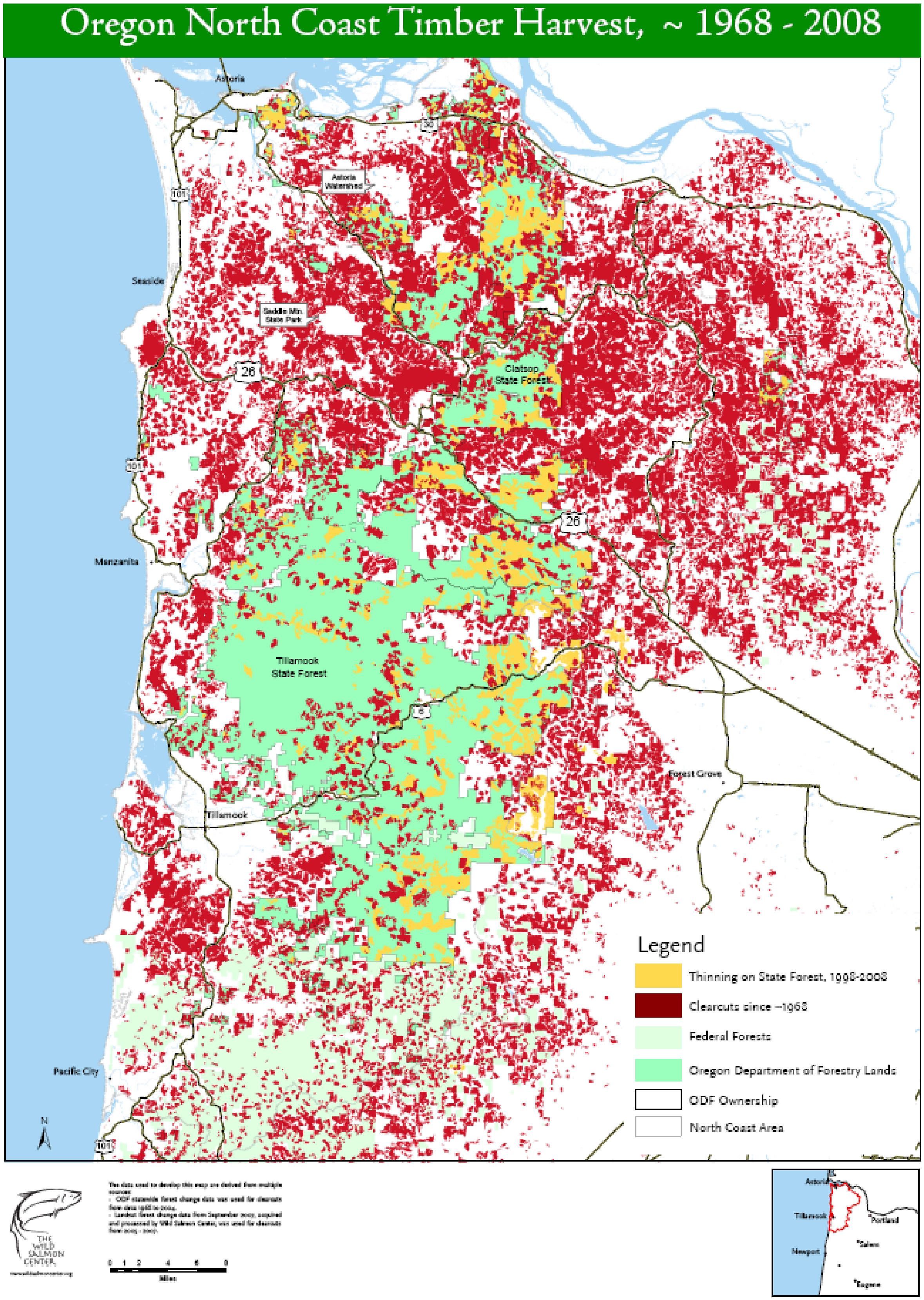


**Figure 3.** Oregon North Coast Timber Harvest 1968-2008

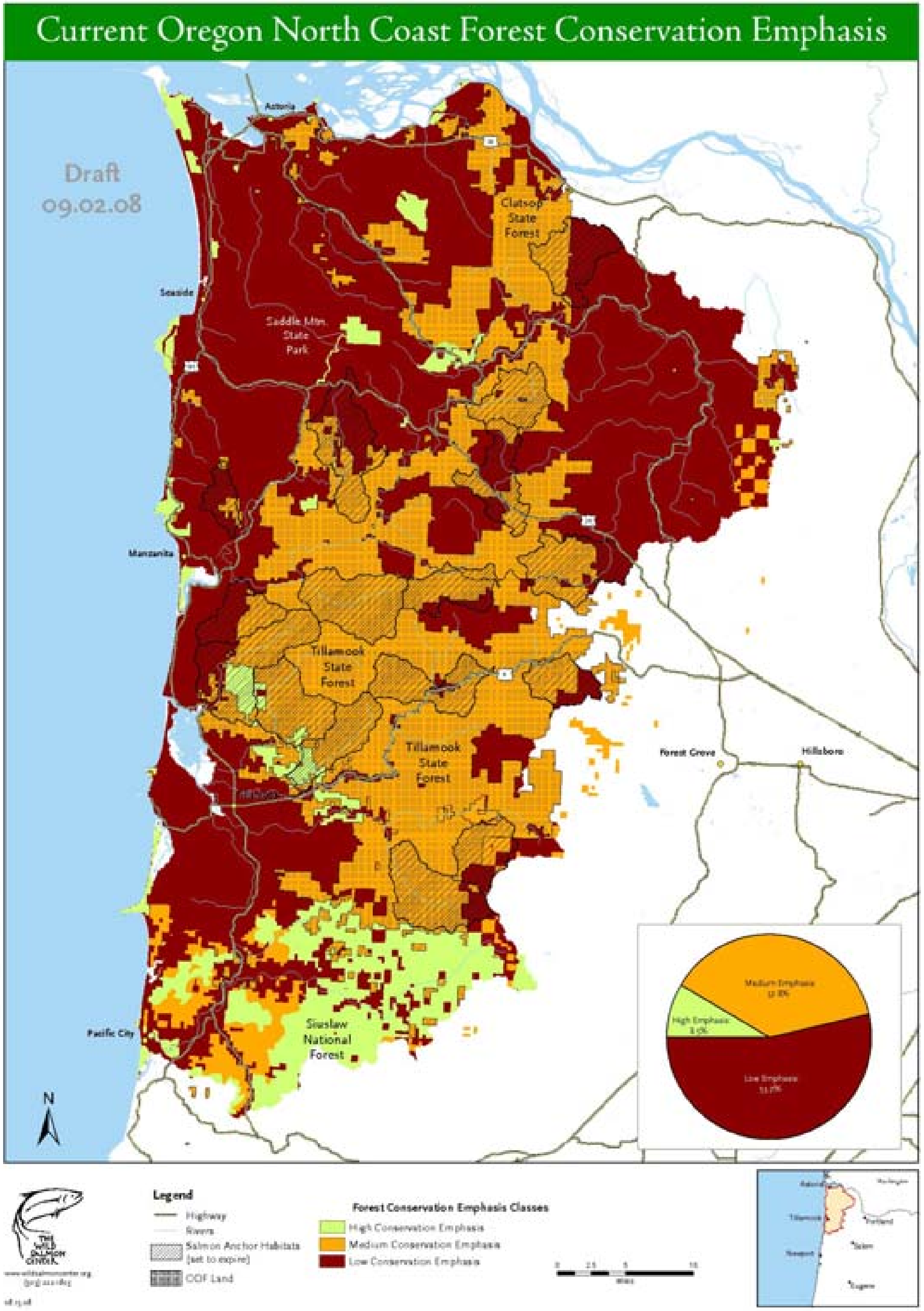


**Figure 4.** Current Oregon North Coast Forest Management.

## 3. Background on Conservation Design for Salmon/Freshwater Systems

A brief discussion of key concepts in salmon ecology and conservation planning can help frame the assessment, results and conservation design that this study presents. This report focuses on the landscape scale.

At the landscape scale, it is useful to view salmon as "meta-populations" (NRC, 1996; Reiman and Dunham, 2000; Salmon Anchor Habitat Working Group, 2004; Schtickzelle and Quinn, 2007). Metapopulations are groups of local populations that are distributed across a heterogeneous landscape and are connected by migration (Independent Multidisciplinary Science Team, 1999; Hanski, 1998). This means that salmon populations tend to spatially arrange themselves into relatively persistent core areas of abundance; "satellite areas" of less suitable habitat; and areas of relatively unused habitat used for migration. Indeed, the conservation strategy of the ODF Salmon Anchor Habitats is to "expand the core populations into the adjacent drainages" (Talabere and Jones, 2002) (Figure 5).

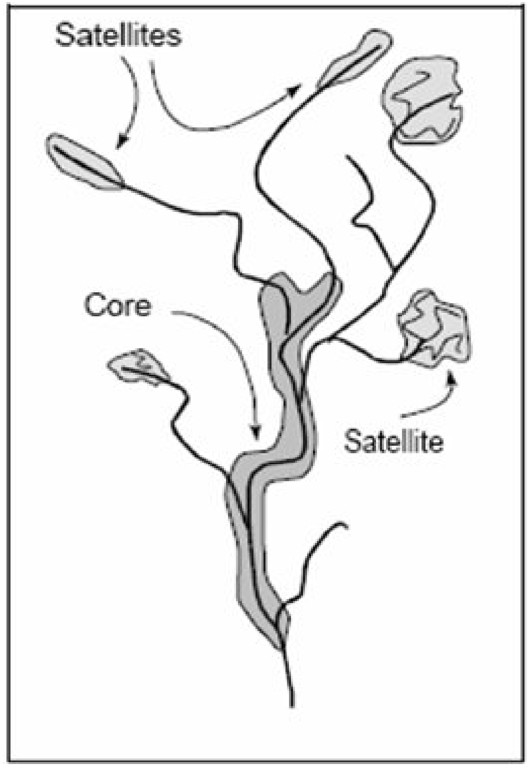


**Figure 5.** Core-satellite model.

Within this spatial context, conservation of salmon in the North Coast must have a temporal component. First, any conservation strategy must include a short-term plan to protect the watershed processes that maintain current core areas or anchor habitats (Reeves et al, 1995). Second, for longer term conservation it is useful to consider the concept of the "intrinsic potential" (IP) of a stream to provide high quality habitat (Burnett et al, 2007). The focus of IP models is to map attributes of the stream that do not change over time, such as valley width, flow, and gradient. Together, these attributes can point to areas in the watershed that are more likely to develop high quality habitat.

In metapopulation theory all available potential habitat may not be used by a population. Instead, habitat might be created and/or destroyed by disturbance processes (Reeves et al, 1995). However, habitat for a particular species is more likely to be created in certain parts of the watershed based upon their intrinsic potential. In the long term, maintaining a distribution of watersheds in "good" condition in areas of high intrinsic potential for multiple species would be a sound conservation strategy.

For example, Figure 6 provides a graphic of how IP, current condition, and conservation strategy are related. A conservation strategy over time and space would bring as many watersheds as necessary into the upper right corner of high IP and good current condition.

The purpose of this study is to use the latest science and data to indentify those areas in good condition and medium-high intrinsic potential.

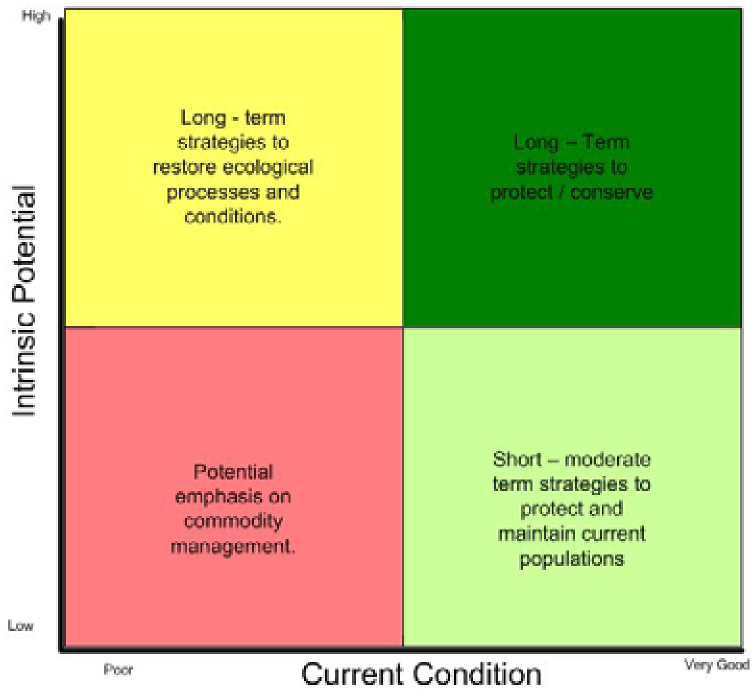


**Figure 6.** Intrinsic potential, condition and conservation emphasis graph.

## 4. Methods

The methods that were developed for this study attempt to provide an open framework for assessing:

1) Watershed condition
2) Spatial and temporal patterns that recent fish surveys express
3) Habitat intrinsic potential

For (1) and (2), a Decision Support Model (DSM) was used for assessing diverse data sets. A knowledge-based system was chosen since it is commonly used for assessing watershed condition in the Pacific Northwest and elsewhere (Reynolds et al, 1999). The software system is the Ecosystem Management Decision Support (EMDS) extension for ArcMap, coupled with the NetWeaver knowledge base development system (Miller and Saunders, 2006). For (3), existing intrinsic potential models were used.

The purpose of using this approach is to provide an objective and transparent framework for capturing expert knowledge of how watersheds function in relation to salmon habitat. These are not mathematical ecological process models. Rather, they model expert knowledge of key ecological processes. These models are meant to be adaptive to reflect new knowledge, data or expert opinion.

It was determined that the appropriate grain of analysis for this project was at the scale of Hydrologic Unit Code 7 (HUC 7), which is referred to as "catchments".

A full treatment of the methods is provided in Appendices A and B. The outputs of the decision support models are termed "scores". Scores reflect the amount of support for a given analysis. Analyses are referred to as "propositions", since the analysis is evaluating a proposition. For example, the proposition was evaluated that a watershed is in good condition, or that a watershed has high intrinsic potential for coho. Scores range from -1 to +1, with -1 indicating "no support" and +1 "full support". A score of 0 indicates low support.

## 5. Results

The following section presents results for watershed condition and integrative analyses of watershed condition, fish population data, and intrinsic potential.

### 5.1. Watershed Condition

Watershed condition scores reflect the amount of support for the proposition: "The catchment is in good condition." The average watershed score across the whole North Coast is 0.037, indicating low support that watersheds are in good condition. A score of >0.5 or higher indicates strong support for the proposition. Only eight watersheds meet these criteria. Relative scores are depicted in Figure 8, providing a picture of relative watershed health. Watershed condition scores, by HUC6 watershed, are presented in Appendix D for all key ecological processes.

Figure 7 shows how watershed condition scores relate to the type and amount of land ownership. Privately owned watersheds on average have lower watershed condition scores than state land. This is due to a number of factors including roads, forest patterns, sedimentation, and lack of woody debris. In agricultural bottomlands, this is due to land use patterns. SAH watersheds tend to be in better condition than state forest lands as a whole.

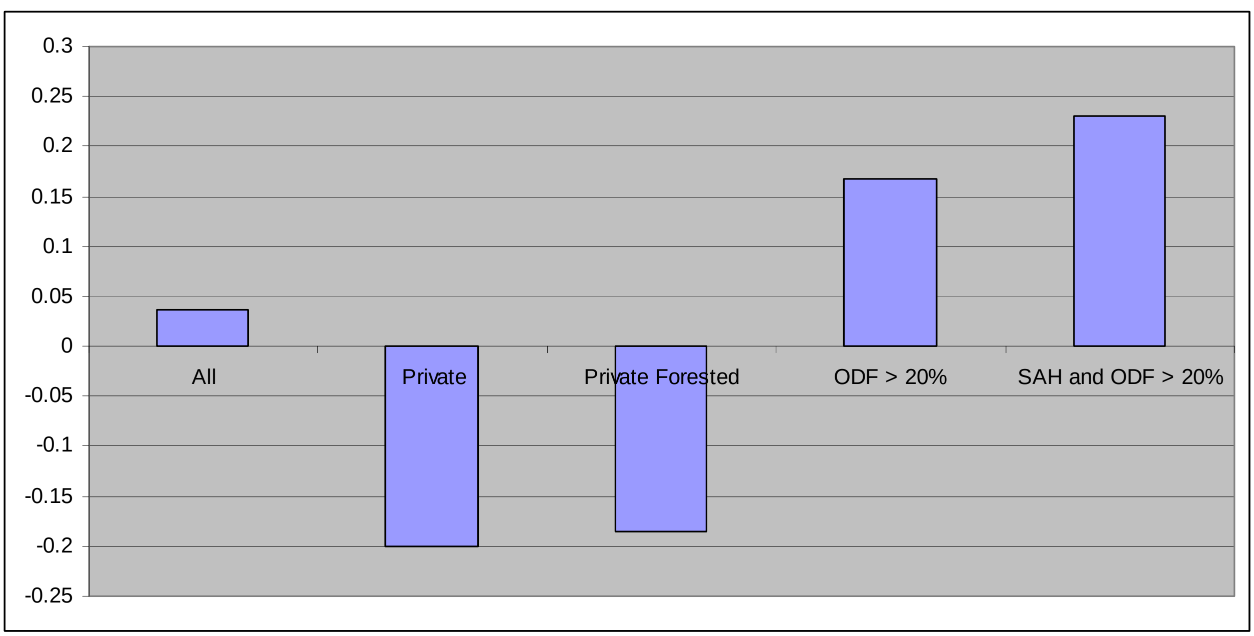


**Figure 7.** Watershed condition scores and land ownership.

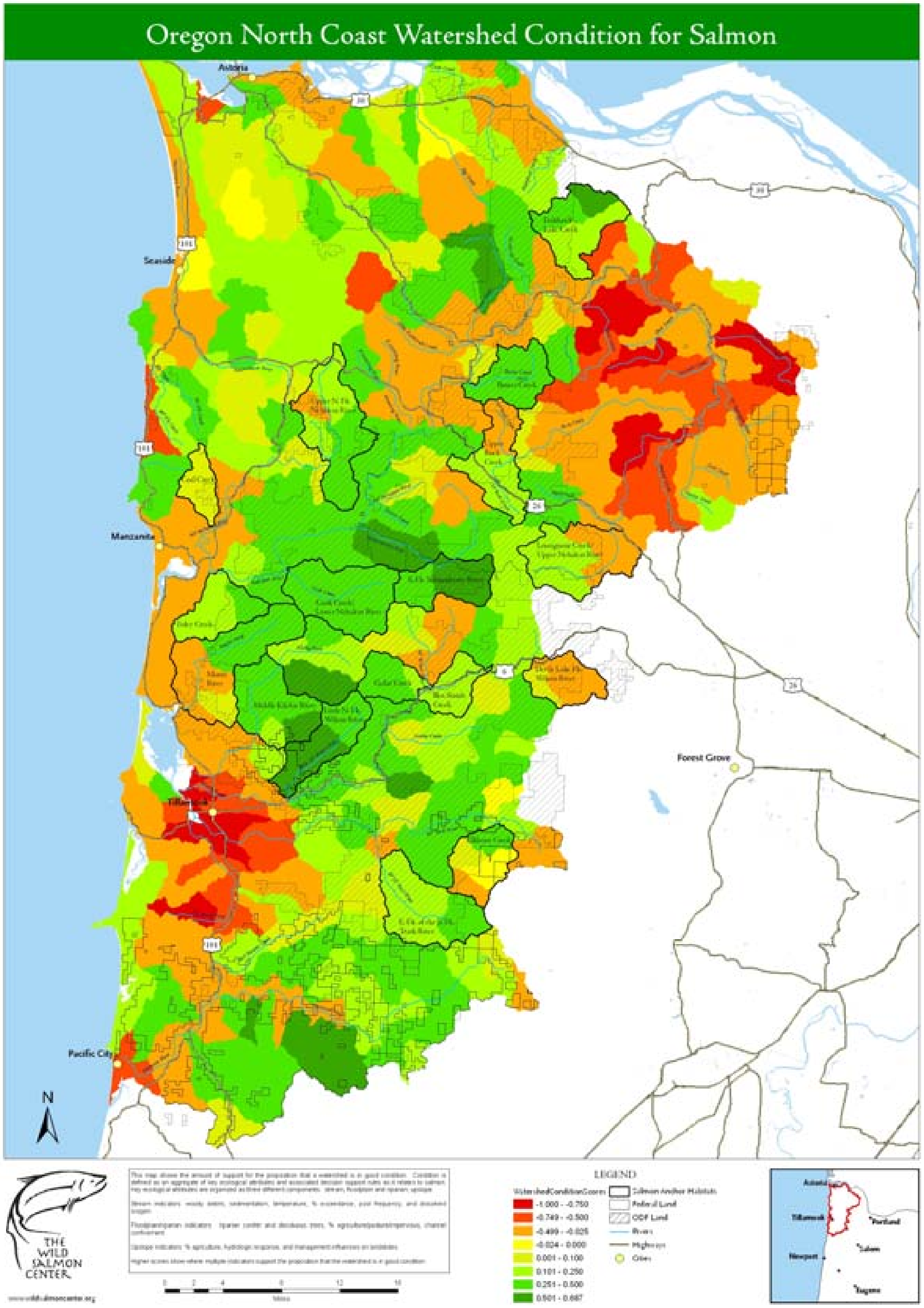


**Figure8.** Watershed condition scores across the North Coast. Darker green colors indicate higher watershed condition scores.

Various ecological attributes within the model can also be examined. The top five limiting factors (or stresses) across the North Coast are:

1. Lack of mature riparian conifers
2. Lack of mature riparian hardwoods
3. Floodplain road density
4. Lack of large wood in streams
5. Fine sediment

Temperature, dissolved oxygen, landslides, hydrologic response, general land cover patterns, and fish blockages were not major limiting factors throughout the North Coast, although any one of these may cause localized problems.

### 5.2. Integrative Analysis

The goal of these analyses is to locate areas with strong fish populations, medium to high intrinsic potential, and good watershed condition. The results of the analyses will be presented by species.

#### 5.2.1. Coho

Figure 12 presents the output of the coho DSM. Blue colors represent support that the watershed has high IP, fish counts and good watershed condition. Darker blues indicate more support. Some key findings include:

- In the Tillamook System, key areas are:
  - The Little North Fork of the Wilson
  - The Upper Miami
  - The Upper Kilchis
  - Devils Lake Fork of the Wilson
  - Elkhorn Creek
  - Ben Smith Creek

- In the Nehalem system, key areas are:
  - Beneke Creek
  - Buster Creek
  - Middle North Fork of the Nehalem River
  - Upper North Fork of the Nehalem River
  - Fishhawk Creek
  - Upper Rock Creek
  - Lousignont Creek
  - Wolf Creek

Within the Tillamook, it is documented that the Little North Fork of the Wilson is consistently the highest producer of coho. The recent work of Bio-Surveys (2008) provides more detail on key areas in the Tillamook system. The results only reiterate their key findings.

### 5.2.2. Steelhead

Steelhead, much like coho, have more data collected in the Tillamook. However, trends can be seen where above average areas are found.

In the Tillamook, key areas are:

- Upper Miami
- Little North Fork of the Wilson
- Ben Smith Creek

In the Nehalem, these are:

- The Salmonberry
- Buster Creek
- Cook Creek
- Foley Creek

ODFW and local biologists pointed out the importance of the Salmonberry. The Salmonberry watershed is one of the five healthiest stocks of wild steelhead in the state of Oregon (Johnson and Maser, 2000).

Figure 13 presents key areas based upon the model.

### 5.2.3. Chinook

Chinook data are relatively sparse in the region. Chinook tend to spawn in the mainstem and larger tributaries. Intrinsic potential and watershed condition were combined with what data does exist.

Key areas for Chinook in the Tillamook system are:

- Middle Kilchis
- Little North Fork of the Wilson
- Large reaches of the mainstem Wilson
- Large reaches of the mainstem Trask

Key areas for Chinook in the Nehalem system are:

- Mainstem Nehalem
- Buster Creek

### 5.2.4. Chum

Spatial data on hotspots for chum are particularly sparse. Expert opinion is more suitable for chum. ODFW, as well as the recent NASSP database have shown that the Miami and Kilchis systems are the most productive chum producers in the North Coast. These watersheds are indicated by the red circle on Figure 12. The IP model indicates several areas that could be good habitat for chum. However, several of the Lower Columbia areas are functionally extinct. The Nehalem population is weak. These areas might be considered for longer term recovery and restoration.

Intrinsic potential and watershed condition were combined with what data does exist. In contrast to the steelhead and coho maps, all watersheds are included in Figure 15. A red circle encloses those areas that have the healthiest chum populations based upon expert opinion.

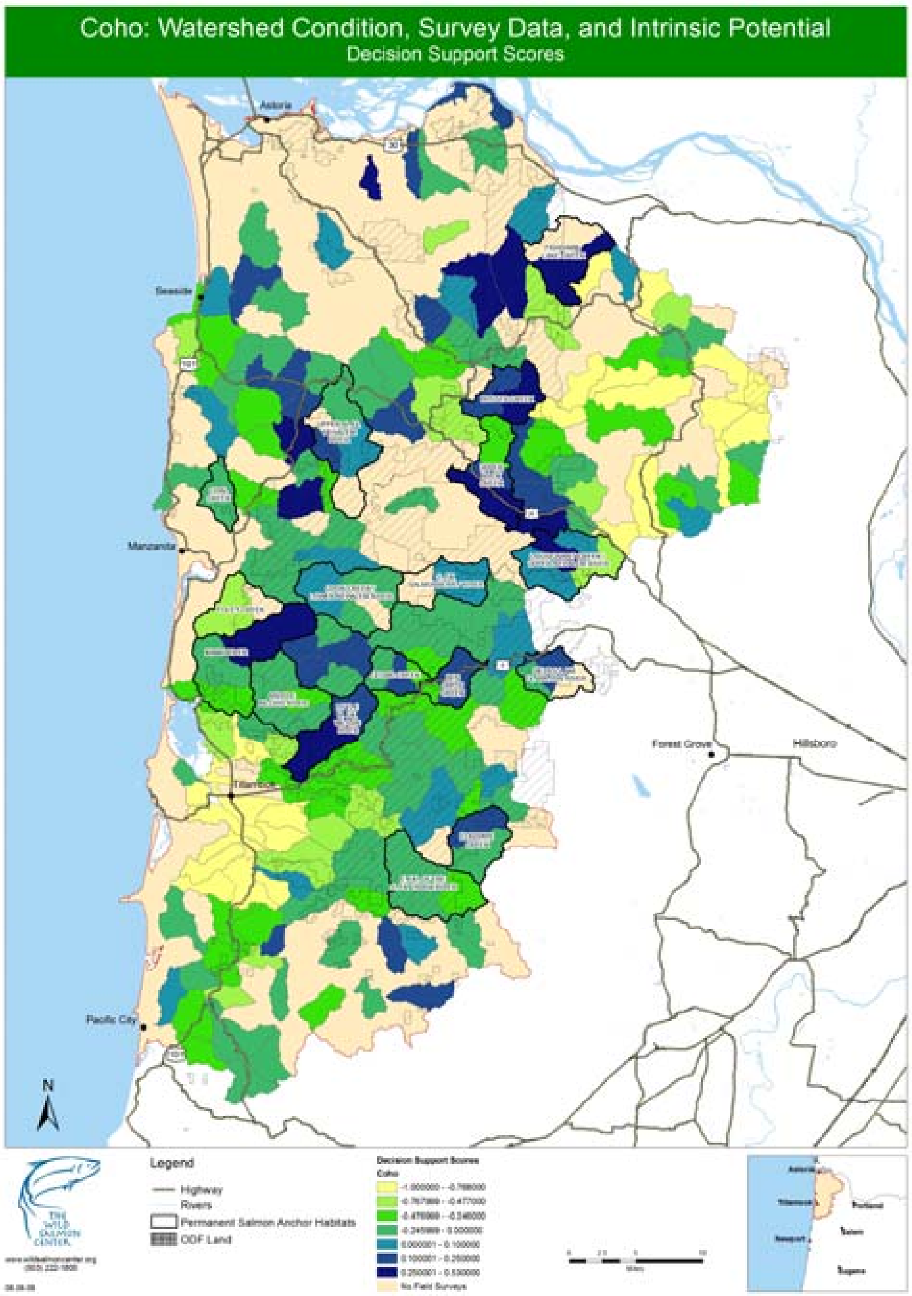


**Figure 9.** Coho decision support scores. Darker blue colors indicate higher support that the watershed has strong coho populations (based on field surveys), good watershed condition, and medium-high intrinsic potential for coho. Areas with no field surveys are colored beige.

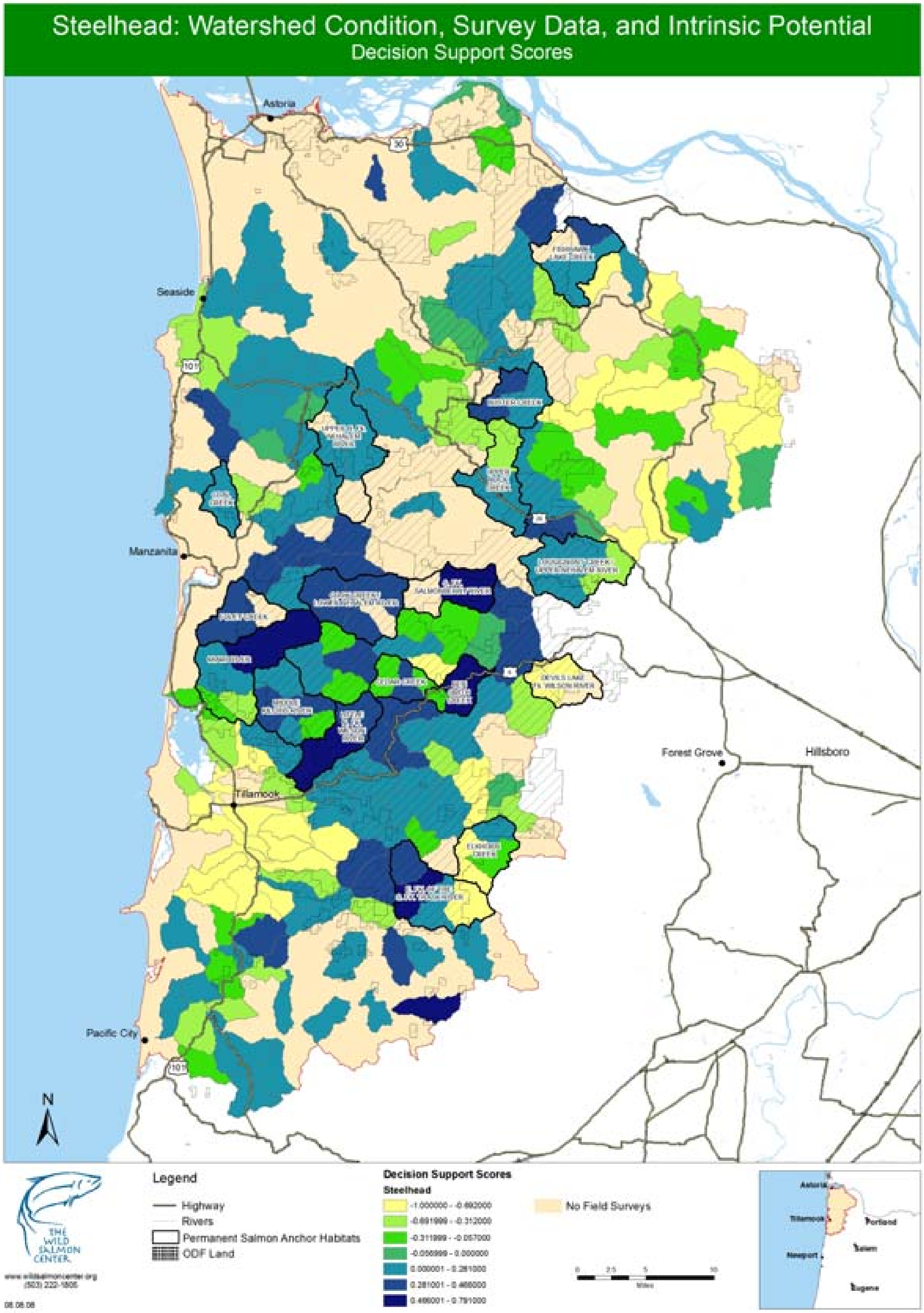


**Figure 10.** Steelhead decision support scores. Darker blue colors indicate higher support that the watershed has strong steelhead populations (based on field surveys), good watershed condition, and medium-high intrinsic potential for steelhead. Areas with no field surveys are colored beige.

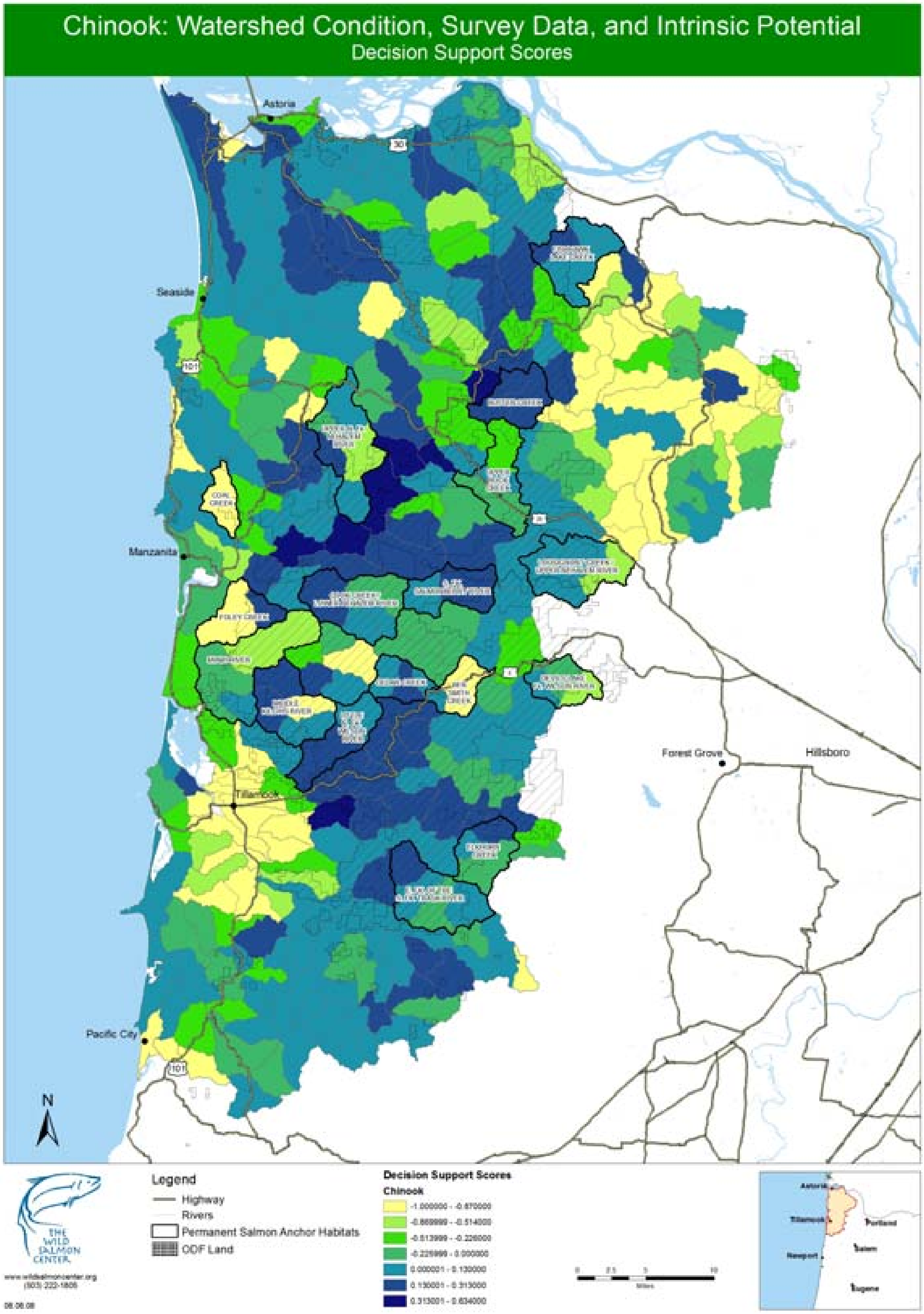


**Figure 11.** Chinook decision support scores. Darker blue colors indicate higher support that the watershed has strong Chinook populations (based on field surveys), good watershed condition, and medium-high intrinsic potential for Chinook. Field surveys were sparse for Chinook, so all areas are considered

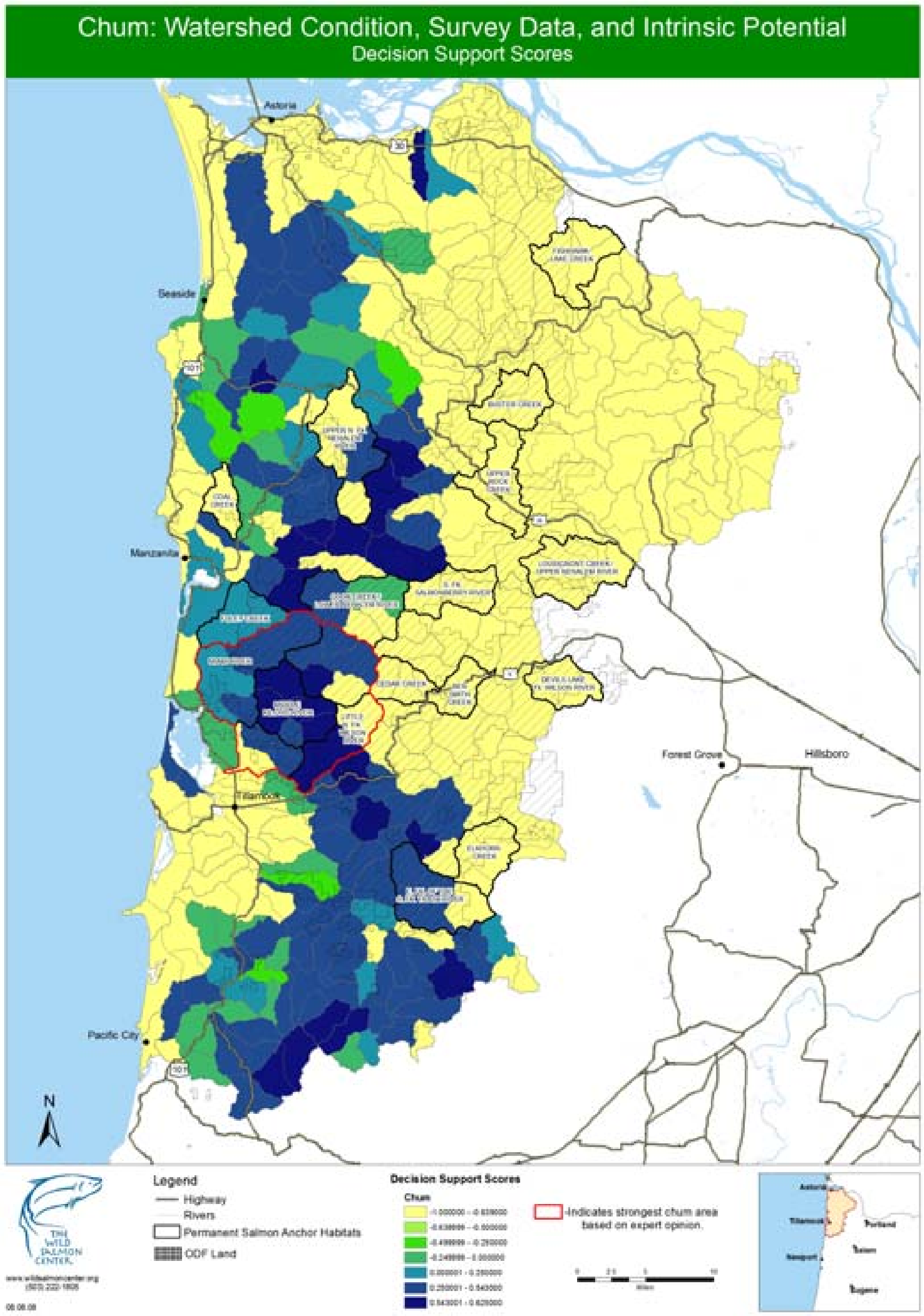


**Figure 12.** Chum decision support scores. Darker blue colors indicate higher support that the watershed has strong chum populations (based on field surveys), good watershed condition, and medium-high intrinsic potential for chum . Field surveys were sparse for chum, so all areas are considered. The red outline represents expert opinion of the strongest chum populations.

## 6. Discussion

Using the results from the analysis, the key questions can be addressed.

***Where are key areas for salmon and what is the condition of these areas?***

*Regional Context*

Within the context of the coastal lower 48 states, the Tillamook and Nehalem watersheds are among the most diverse and abundant. However, they are still a fraction of their historical condition. The Tillamook and Nehalem watersheds are in better condition than the lower Columbia watersheds.

*Across the North Coast*

Across the North Coast region, there is generally low support that watersheds are in good condition. Only 3% of the catchments had strong support for good condition.

*Areas within the North Coast*

A few general trends are apparent:

- Areas located in State forests are generally in better condition than catchments outside of the State forests.
- Areas that had consistently low support for watershed condition are the Tillamook lowlands and the Upper Nehalem watershed.
- Areas with high IP for coho tend to be areas that are most and have lower watershed scores.
- A clustered group of watersheds that includes the Miami, Kilchis, and Little North Fork of the Wilson are consistently strong for several species. These also have some of the higher watershed condition scores.
- Areas with timber that are more difficult to access due to steep topography (Upper Kilchis, Salmonberry) tend to have higher watershed condition scores. These are also strong areas for salmonids.

***How do current protections, particularly Salmon Anchor Habitats, relate to key areas for salmonids?***

The SAHs are providing protection to some of the best areas for fish in the region (see Appendix C for scores). This analysis has shown how the integration of watershed condition, salmon populations and intrinsic potential is distributed across the landscape. The SAHs are providing protection of key areas. Appendix 2 presents the details to support this conclusion.

The following recommendations should be added to the portfolio of SAHs:

- North Fork of the Kilchis
    - Consistently high coho densities
    - Consistently high coho spawners
    - Good watershed condition

    - High IP for steelhead
    - Adds to the current Middle Kilchis SAH for full Watershed Protection
- Lower Kilchis
    - High IP for coho, chum, and Chinook
    - High chum counts
    - Adds to the current Middle Kilchis SAH for full Watershed Protection
- Upper and Lower Salmonberry
    - Good watershed condition
    - High IP for steelhead
    - Based on expert opinion, one of the best steelhead areas in the state
- Lost Creek
    - Good watershed condition
    - High IP for steelhead
    - Good for Chinook spawning, steelhead densities
- Little Fishhawk Creek
    - Good support for coho juveniles
    - Medium coho IP
    - Good watershed condition in lower section
- Devils Lake Fork of the Wilson
    - High IP for coho
    - High coho juvenile densities
    - Adds to current section of the Devils Lake Fork SAH

Narrative justifications for maintaining and enhancing the portfolio of SAHs are presented in Table 3.

***What is a conservation design that is beneficial for salmon?***

In order to answer this question, it is useful to consider key principles in conservation biology, landscape ecology and conservation planning. The following will present key concepts for landscape scale conservation planning for salmon. How these concepts relate to the findings of the study will be highlighted.

*Protect areas that are currently in the best condition*

A key finding is that the most recent data support that the SAHs are in important areas for salmonids. SAHs also have better watershed condition scores than ODF land in general. Thus, the SAHs are currently meeting the objective of protecting some of the best areas. There are a set of watersheds proposed as additions to the current SAH portfolio. These are areas that will further enhance the principle of "protecting the best first."

*Place special emphasis on irreplaceable and/or unique areas*

"Irreplaceability" is a term used in conservation biology to mean that if an area is lost, then a significant aspect of biodiversity is lost. Experts are not certain why the Miami and Kilchis rivers represent the strongest chum populations in Oregon. However, if the watershed is lost

**Table 3:** Existing and Proposed SAHs and a synthesis of data/expert opinion support.

| Watershed Name | Synthesis |
| --- | --- |
| North Fork of Kilchis River | Consistently high coho densities (RBA, 2005-07; ODFW 2000 - 07), consistently high coho spawner counts (ODFW, 2000-07), provides cold water to lower watershed, difficult terrain for timber harvest, part of whole watershed strategy for Kilchis, good water |
| Upper Salmonberry River | Unique area for wild steelhead |
| Lower Salmonberry River | Unique area for wild steelhead (no survey data - expert opinion), high IP for steelhead, good watershed condition |
| Miami River | Unique area for multiple species. One of the highest chum producers in Oregon (ODFW); steelhead, cutthroat, coho juveniles (ODFW); cutthroat and coho abundance, consistently high (RBA, 2005-07) |
| Middle Kilchis River | Part of whole Kilchis watershed. High coho abundance and densities (RBA, 2005-07); steelhead abundance (RBA, 2005-07); high IP for steelhead; hotspot for Chum (ODFW) and Chinook (ODFW). |
| Little North Fork Wilson River | Highest producer of coho in the Tillamook watershed (RBA, 2005-07). This is a hotspot of abundance and diversity for multiple species. Several datasets back this up. |
| Kilchis River | Opportunity for whole watershed protection. High IP for chum, coho, Chinook. High Chinook spawner counts (ODFW, 1998, 2001); chum spawner counts (ODFW, multiple years), high coho densities and steelhead abundant (RBA, 2005-07), above average cutthroat (RBA) |
| Upper Salmonberry River | Unique area for wild steelhead (expert opinion) |
| South Fork Salmonberry River | Unique area for wild steelhead (expert opinion), high IP for steelhead, good watershed condition, high steelhead and cutthroat (ODFW) |
| Lower Salmonberry River | Unique area for wild steelhead (no survey data - expert opinion), high IP for steelhead, good watershed condition |
| Lost Creek | Good watershed condition throughout. High IP steelhead. Chinook spawning (ODFW); steelhead and cutthroat juvenile (ODFW) |
| Little Fishhawk Creek | Moderate support for high coho spawners (ODFW); moderate coho IP; good support for coho juveniles (ODFW, 2000-2002, 2005); good watershed condition in lower section. |
| Fishhawk Lake Creek | Good watershed condition; average or above average coho spawning (ODFW, 2003 &2001); moderate IP for coho |
| Upper North Fork Nehalem River | Includes high IP for coho, Chinook spawn (ODFW); steelhead juveniles (ODFW), good watershed condition |
| Lousignont Creek/Upper Nehalem River | High IP steelhead; high IP coho; high juvenile and spawners for coho (ODFW); high juvenile for steelhead (ODFW). Spatially, good coverage for coho in Upper Nehalem. |
| Cook Creek/Lower Nehalem River | Good watershed condition throughout the watershed. 2 HUC7s have above average; moderate support for steelhead juveniles (ODFW); high IP for steelhead. |
| Foley Creek | One of few watersheds with high chum spawner counts (ODFW, 1999, 2001, 2002,2003,2004,2005); average steelhead juvenile densities (ODFW, 2000-2007), good watershed condition |
| Elkhorn Creek | High juvenile coho counts (ODFW, 2003); consistently high juvenile densities and abundance throughout the HUC7s (RBA, 2005-07); good watershed condition |
| East Fork of the South Fork Trask River | IP for steelhead; above average steelhead juvenile counts (2002 and 2004, ODFW); consistently high coho densities and abundance (RBA, 2005-07); above average steelhead abundance and densities ( RBA, 2005-07); above average cutthroat (RBA, 2005-07) |
| Cedar Creek | Consistently strong coho juvenile densities (RBA, 2005-07); moderately strong steelhead juvenile (RBA, 2005-7); highest consistent Chinook spawning in North Coast (ODFW, 2000 - 2007); good watershed condition; above average coho spawning (3 years, ODFW) |
| Ben Smith Creek | Consistently strong coho juvenile densities (RBA, 2005-07; ODFW, 2000-07), consistently strong coho abundance (RBA, 2005-07); consistently strong steelhead abundance (RBA, 2005-07); moderate support for good watershed condition |
| Devils Lake Fork Wilson River | High IP for coho, high coho juvenile (ODFW (1 year), 2000); consistently above average coho abundance and density (RBA, 2005-07); moderate cutthroat (RBA, 2005-07) |
| Lower Devils Lake Fork Wilson River | High IP for coho, high coho juvenile (ODFW (1 year), 2000); consistently above average coho abundance and density (RBA, 2005-07); moderate cutthroat (RBA, 2005-07) |
| Buster Creek | Moderate support for good watershed condition, within matrix of poor condition in the Nehalem , moderate coho spawner (ODFW, 2000 - 07) |
| Upper Rock Creek | High coho spawning and juveniles for all HUC7s (ODFW) |
| Coal Creek | No support from fish data for this area. Relatively fragmented piece of ODF land within a matrix of private land. watershed condition is moderate. |

| |
| --- |
| Proposed Salmon Anchor Habitat |
| Current Salmon Anchor Habitat |

and the estuarine conditions that support these populations, the southernmost chum distribution on the eastern side of the Pacific Rim, and the only significant chum run in Oregon will also be lost.

Based upon expert opinion, the Salmonberry watershed is a unique area for wild steelhead. In addition, the watershed scores for this area are in some of the best conditions. WSC considers this area unique and deserves special conservation emphasis.

The Little North Fork of the Wilson consistently shows as a good area for all species. It is the highest producer of coho, has a significant chum rum, as well as steelhead and Chinook.

*Completely protect ecosystems*
In the context of this study, which is focused on watersheds, there are few opportunities to protect "complete watersheds," or whole systems that drain directly to the estuary. The Miami and Kilchis rivers are the most obvious choices for complete watershed protection. They currently have high scores for watershed condition, fish populations and intrinsic potential. These watersheds, for several criteria, meet the definition of an anchor watershed for salmon.

*Maintain patterns that are within the range of natural condition*
This study has shown evidence that watershed function across the entire region is outside the range of natural variability. It is currently understood that for the coast range, under natural conditions, over 60% of the watersheds were in "good" condition at any one time (Independent Multidisciplinary Science Team, 2002).

This study has shown that only ~2% of the catchments across the landscape exhibit "strong support for good condition". Several of these are within current or proposed SAHs. By maintaining the SAHs, it will ensure development and maintenance of "good" condition of 15% (52/339) of the North Coast catchments.

**Synthesis**
The concepts presented above can be further synthesized into a landscape-scale network of conservation areas. The spatial elements of this conservation design include:

- The highest conservation value areas that have "low-risk" management. These consist of:
  - The entire Miami
  - The entire Kilchis
  - Little North Fork of the Wilson
  - Salmonberry watersheds
- Current distribution of Salmon Anchor Habitats with the additions indicated above.

The scope of this report does not detail management prescriptions or alternatives. Rather, the message is that certain areas require "low-risk" activities. The implications of low-risk activities require continued communication between ODF and the salmon conservation community. At the least, forest practices would follow the current SAH prescriptions.

If low-risk forest management activities are continued in key areas across the landscape, it can be hypothesized that watershed condition will improve within the watersheds and also across the North Coast. In the long-run protecting the best areas now will not only be good for salmon, but will save taxpayer money in restoration activities on state lands.

Figure 19 presents what WSC considers to be a landscape-scale design that would be beneficial to salmon, while also considering economic activity. Areas of high conservation value for salmon are given the "Mixed Use with Conservation Emphasis" classification. "Low-risk" areas are identified and would include increased protection and/or active management to enhance conservation value.

**Potential Future Work**

The scope of this report was to address state forests within the context of the whole North Coast. More work is needed to more fully address key areas outside of state lands. In particular, the Upper Nehalem watershed has high intrinsic potential, but relatively poor condition. Engaging private forestry in this assessment could help frame further conservation planning.

The planning units of this study were relatively small (HUC 7) watersheds. Using modeling tools (e.g., NetMap), even finer levels of detail of the stream network can be analyzed. This would be a useful next step in planning for salmon outside of SAHs.

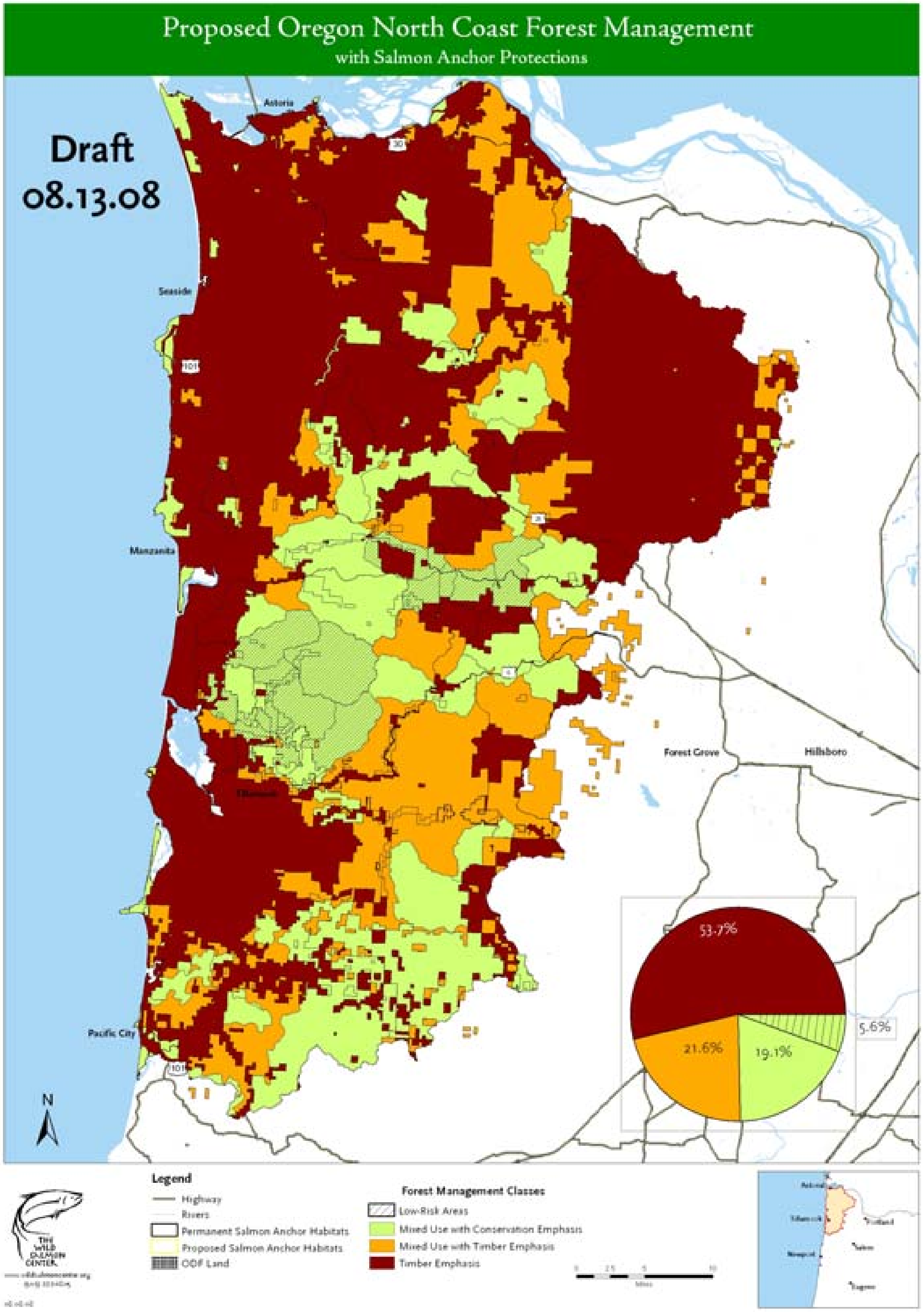


**Figure 13.** Proposed Oregon North Coast Salmon Conservation Management.

## 7. Conclusion

The Oregon North Coast encompasses some of the most diverse and productive populations. However, these populations are far below historic conditions. Watershed condition is one of the key limiting factors.

This report has evaluated watershed condition across the North Coast, finding that watersheds are in better condition on state lands and higher where SAHs are located. SAHs also cover key areas, based upon fish population and intrinsic potential data. This report identified several gaps in the SAH coverage.

In conclusion, key areas on state land need to be protected by low-risk management to maintain watershed condition.

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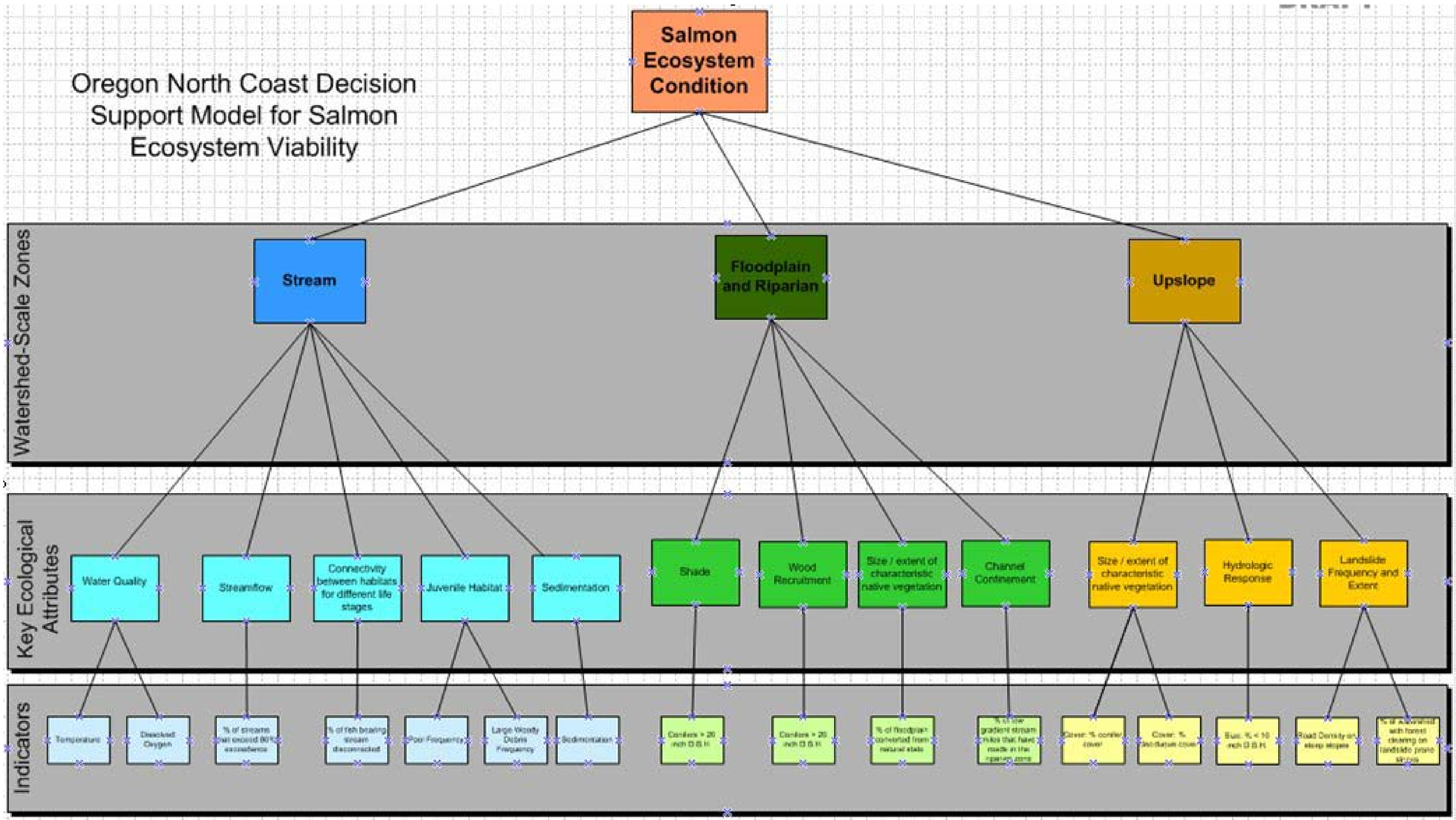


**Figure 14.** Decision support model for salmon ecosystem viability

## Appendix A: Methods detail

**Determining the appropriate components, attributes, and data sources**

The first step was to determine what aspects of the ecosystem were important to capture in the model. Based upon early group discussions, a number of different characteristics were important, including forest condition, riparian, floodplain, and stream condition. Wang et al (2006) identify three spatial scales that influence river conditions: 1) contact with the river channel, which was expanded to include aquatic components, 2) floodplain and riparian areas, and 3) catchment areas beyond the floodplain and riparian zone. The first attribute level in the model is classified into Stream, Floodplain and Riparian, and Upslope to reflect this (Figure A1).

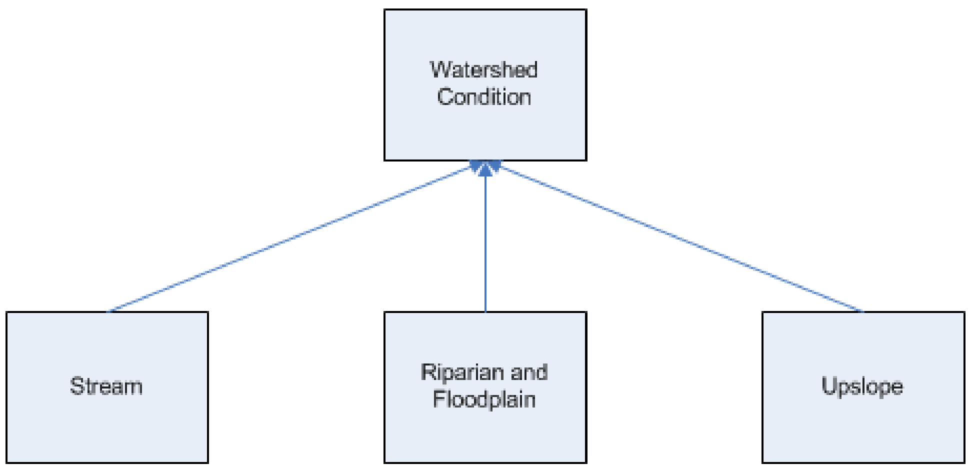


**Figure A1.** Watershed condition variables.

The next step was to determine the key ecological attributes that are critical to salmon. For the stream component it was determined that sedimentation, water quality, in-stream habitat, water quantity, and connectivity between habitats for different life stages were critical. For floodplain and riparian attributes, shade, wood recruitment, land use conversion, and channel confinement were identified. For the upslope component, hydrologic response, management influence on landslides, and land use conversion were identified as key ecological attributes.

For each of the key ecological attributes, a quantitative indicator of the condition of the attribute was identified. The criteria for identifying an indicator was its ability to provide meaningful information and the availability of data. Table A1 lists all key ecological attributes, their indicators and measures and data source. For a full explanation of assumptions and limitations for each of the attributes and their respective indicators, please refer to Appendix A.

**Table A1. Key Ecological Attributes**

| Group | Key Ecological Attribute | Indicator | Indicator Measure | Data Source(s) |
|---|---|---|---|---|
| **Stream** | | | | |
| | | Water Quality (.3) | | |
| | **Water quality** | Dissolved Oxygen | 7DAYMOVING Mean of Daily Max (if more than one point, take the highest) | 1998 - 2005 DEQ water quality Stream Dissolved Oxygen |
| | **Water quality** | Temperature | 7DAYMOVING Mean of Daily Max (if more than one point, take the highest) | 1998 - 2005 DEQ water quality Stream Temperature |
| | **Connectivity between habitats for different life stages** | Fish Passage | % of potential Fish Bearing streams cut off from full or partial barrier | 2004 barriers data from ODFW |
| | **Habitat** | CWD Frequency (.2) | Average number pieces of wood (0.3 x 3 m minimum) per 100 m | ODFW Aquatic Inventory (1990 - ) |
| | **Habitat** | Pool Frequency (.2) | Number of bankfull widths per pool | ODFW Aquatic Inventory (1990 - ) |
| | **Sedimentation** | Fine Sediments | Substrate pool-tail fines (percent) | ODFW Aquatic Inventory (1990 - ) |
| | **Water quantity** | Consumptive use Exceedance | Percent of streams that exceed 80% of low flow condition | ODEQ Coastal Coho Water Quantity |
| **Floodplain** | | | | |
| | | Riparian (.4) | | |
| | **Shade and Wood Recruitment** | Conifer Cover | % of 164 ft riparian buffer with >= 20" d.b.h. conifers | streams: ODF fish bearing / vegetation: Forest Service GNN (2001) |
| | **Shade and Wood Recruitment** | Hardwood cover | % of 164 ft riparian buffer with deciduous or mixed forest | streams: ODF fish bearing / vegetation: NOAA C-CAP (2001) |
| | **Size / extent of characteristic native vegetation** | Human Use (.2) | % of floodplain that is occupied by agriculture, pasture, or urban | floodplain: DEM derived from 10 m/ land use: NOAA C-CAP (2001) |
| | **Channel Confinement** | Road Density (.4) | miles of road/ miles of stream in the riparian buffer. | Roads: BLM / Streams: buffered ODF fish bearing streams. |
| **Upslope** | | | | |
| | **Hydrologic Response** | Forest Age (.6) | % of potentially forested area that is < 10" dbh | Forest Service GNN, 2000/ WSC forest clear cuts from 2004 - 2007 |
| | **Landslides** | Departure from normal landslide potential due to timber clearing and roads. | Departure from normal landslide potential due to timber clearing and roads. | Landslide model from NetMap, BLM roads, and ODF forest data |
| | **Size / extent of characteristic native vegetation** | Land Use (.2) | Land use that is urban, agriculture, or pasture in the HUC 7. | Land use: 2001 NOAA C-CAP |
| | **Condition of Forest** | Swiss Needle Cast | % of the watershed that | ODF Forest Inventory |

The data were then compiled by catchment.

## Developing evaluation curves for each Attribute

The next step was to develop evaluation criteria for each of the key ecological attributes. The evaluation criteria provide quantitative measures of functioning vs. degraded condition. An attribute that meets the criteria of "functioning" condition receives a score of +1. An attribute that meets the criteria of "degraded" receives a score of -1. Between "degraded" and "functioning" are a series of states. A linear "fuzzy" score is given for areas in between.

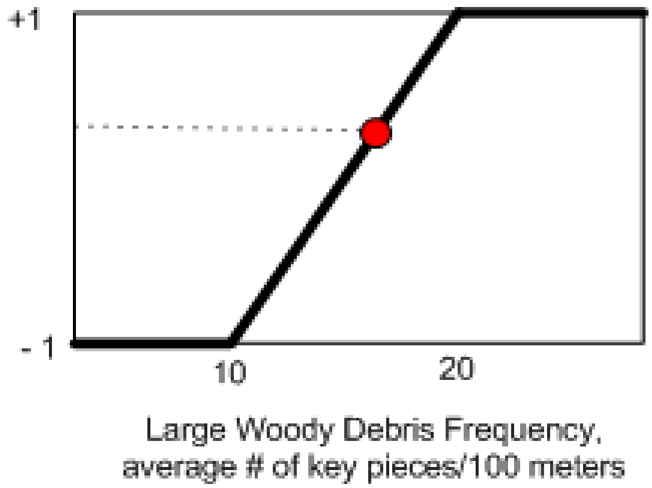


**Figure A2.** Decision rules for large woody debris frequency.

In Figure A2, decision rules for large woody debris frequency were developed. A value of 20 key pieces of wood per 100 meters was determined as "good condition" based upon US Forest Service decision rules (Aquatic-Riparian Effectiveness Monitoring Program, AREMP). Less than 10 key pieces of wood was determined as "poor". These decision rules were agreed upon by the group and incorporated into the model. If a data value for this attribute for a given catchment had a value between 10 and 20, it would be give a fuzzy value in between. As depicted in Figure A1 with the dot, the value would be 0.25, indicating a moderate level of support.

This same process was completed for all of the key ecological attributes in the model.

**Fish Data Assessment**

The proposition for the fish assessment was that catchment X has consistently above average counts for fish. A higher score is given to a catchment that has multiple years of above average scores.

The following data sets were used:

- ODFW juvenile surveys from 1998-2007for coho and steelhead.
- ODFW spawning surveys from 1998-2007 for coho, chum, Chinook.
- Tillamook watershed rapid bio-assessment (RBA) juvenile surveys from 2005-2007 for coho and steelhead only.

Together, these data sets provide a multi-temporal perspective on salmon use over the whole North Coast. There are limitations in using each data set. The major limitations are as follows:

- Not all species are equally represented, with coho being best represented. The RBA surveys are geared primarily towards coho.
- The RBA survey, while covering a large area, covers only the Tillamook watershed.
- The ODFW surveys cover a broader extent, but the samples are randomly placed throughout the landscape.

- Fish survey data does not cover the entire landscape. However, it does cover 61% of the 339 HUC7 catchments. The main data gaps are in the Youngs River drainage of the Lower Columbia system.

The decision support framework provides an appropriate method to integrate and analyze these disparate data sets. A decision support model was created that functions much like the watershed condition model. An example is provided for coho. For a given year, species and data set (e.g., 2001 ODFW spawning surveys) the North Coast-wide average is calculated. Using the ODFW spawning surveys, in 2001 the North Coast wide average for coho spawners was 43 spawners at each survey site. Catchments with data were then analyzed using the decision support system, where a catchment with a value greater than or equal to 43 would get a +1, catchments with samples but *no occurrence of* coho would get -1. A catchment with no data would get a 0.

The model is set up only to find those parts of the landscape that have above average fish counts. If there are more years of support for this, then the catchment will have a higher score than a catchment with only one year of support.

**Intrinsic Potential**

Intrinsic potential data were developed for all salmon/steelhead species in the North Coast. Models for coho, steelhead, and Chinook were already developed by the US Forest Service (Burnett et al, 2007). A new model was developed for chum based upon expert opinion, literature review and review of the chum distribution data for the Tillamook basin.

The essential concept behind intrinsic potential is to model habitat preferences based on features of the landscape that are not subject to significant change. For these species, the parameters are flow, valley width and gradient. Preferences are quantified using decision support models much like those described above. For a full review of IP, please refer to Burnett et al, 2007.

**Expert Opinion**

The primary purpose of this study was to investigate existing empirical data. As with most biological assessments at this scale, there are data gaps. ODFW and local fish biologists played a role in identifying key areas that the data do not address. For example, there are significant gaps in the distribution of chum. An attempt was not made to quantify expert opinion. Rather, the information was incorporated into the results and discussion section.

**Integration of Watershed Condition, Fish Condition, and Intrinsic Potential**

The following section discusses how watershed condition, fish condition and intrinsic potential were integrated. Again, these revolved around the use of a decision support model.

The models are designed to address the proposition: catchment X has functioning watersheds, above average fish counts, and medium to high intrinsic potential. To refer back to Figure 6, this finds the upper left area of the chart, good current condition, with high intrinsic potential.

The general structure of the integrated models are as follows, using coho as an example (*note that models for Chinook and chum lacked sufficient fish survey throughout the landscape. Only watershed condition and intrinsic potential were used for these species*):

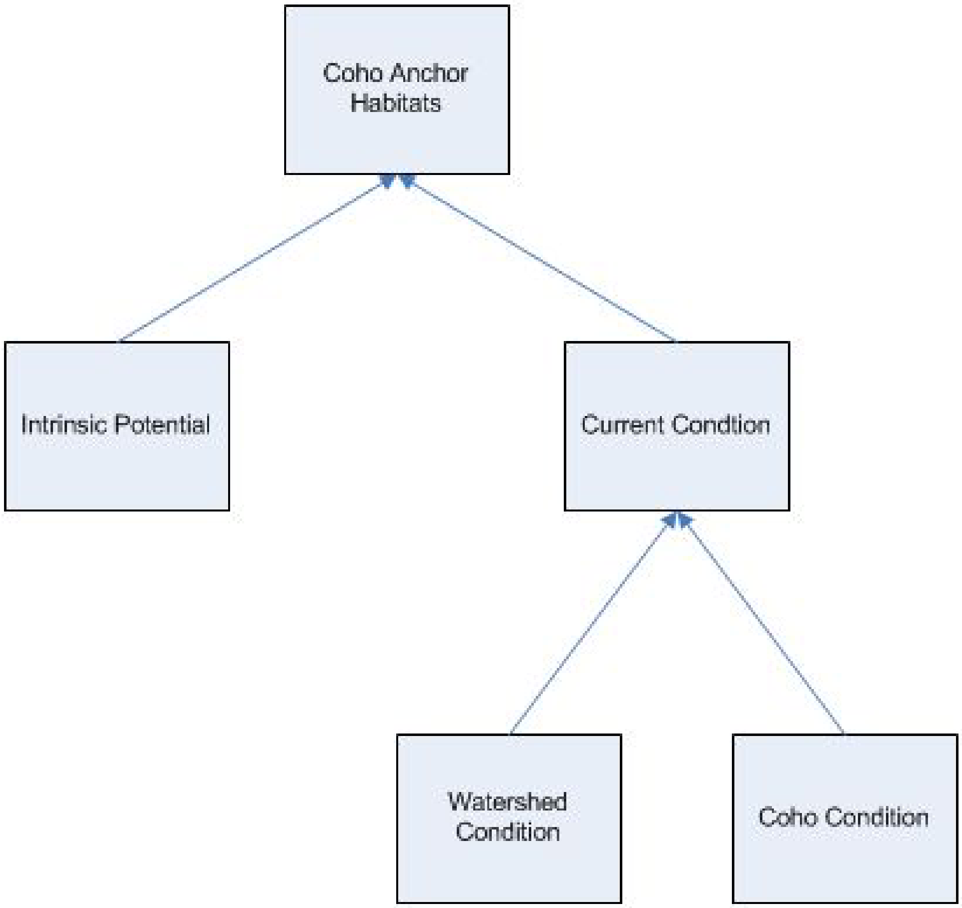


**Figure A3.** Integration model

For all models, the following thresholds were used for Full Support (+1) and No Support (-1):

Watershed Condition:

- A watershed condition score of 0.5 receives a score of +1.
- A watershed condition score of -0.5 receives a score of -1.

Intrinsic Potential:

- An IP score of 0.5 receives a score of +1.
- An IP score of 0 receives a -1.

Fish Species Condition:

- A Fish score of 0.5 receives a score of +1
- A Fish score of -0.5 receives a score of -1.

## Appendix B: Documentation of Model

### 1. Stream Condition

#### a. Water Quality/Condition:

i. Temperature.

*Purpose (EMDS Explanation)*: Temperature is a limiting factor for salmon health.

*Measure (EMDS Comment)*: Temperature, measured by Oregon DEQ

*Data Description (Domain Source)*:

> 1998 – 2005 DEQ water quality Stream Temperature 7 DAY MOVING Mean of Daily Max (if more than one point, take the highest).

*Assumptions and Caveats (EMDS Assumptions):*

*Source:* (reference: Gallo et al 2005, PNW-GTR-647)

ii. Dissolved Oxygen

*Purpose (EMDS Explanation)*: Dissolved oxygen is critical for biological functioning.

*Measure (EMDS Comment)*: Dissolved Oxygen, measured by Oregon DEQ

*Data Description (Domain Source)*:

> 1998 – 2005 DEQ water quality Stream Dissolved Oxygen 7 DAYMOVING Mean of Daily Max (if more than one point, take the highest).

*Assumptions and Caveats (EMDS Assumptions):*

*Source:* (reference: Gallo et al 2005, PNW-GTR-647)

#### b. Connectivity

*Purpose (EMDS Explanation)*: This variable describes the percent of the potential fish bearing network (as derived from the CLAMS dataset) that has been either permanently cutoff to all species and life stages and parts of the network that have been partially cut off. This variable is critical to understanding the amount of potential habitat that is available.

*Measure (EMDS Comment)*: Percent of the 1:100k stream layer that has been cut off.

*Data Description (Domain Source)*: From Oregon Fish Passage Barriers, a joint project of ODOT and ODFW. Data is from Sept. 2004.

*Assumptions and Caveats (EMDS Assumptions) )*: It is assumed that these have not been repaired since 2004. We will need to check on these. The Tillamook Estuary Project (TEP) has developed culvert prioritizations for the Nestucca/Neskowin areas (Hoffman, 2006).

*Source:* Oregon North Coast Working Group

### c. Streamflow

*Purpose (EMDS Explanation)*: Identifies areas where August stream flows are below exceedance levels.

*Measure (EMDS Comment)*: % Exceedance

*Data Description (Domain Source)*: Oregon DEQ

*Assumptions and Caveats (EMDS Assumptions):*

*Source:* Oregon North Coast Working Group

### d. Large Woody Debris Frequency

*Purpose (EMDS Explanation)*: A critical indicator of habitat complexity for salmon.

*Measure (EMDS Comment)*: Key pieces of large woody debris/100m of primary stream length. The size of the piece of wood is > 0.60 m in diameter and > 12 m long.

*Data Description (Domain Source)*: ODFW Habitat surveys. (1990s to 2004)

*Assumptions and Caveats (EMDS Assumptions):* Data is not continuous through all fish bearing streams in the region. Conditions in the data may not reflect current conditions since survey dates are spread out from 2001 to 2006 (see http://oregonstate.edu/dept/ODFW/freshwater/inventory/nworgis.html) for survey dates across the region.

*Source:* (reference: Gallo et al 2005, PNW-GTR-647)

### e. Pool Frequency

*Purpose (EMDS Explanation)*: An indicator of habitat frequency for salmon.

*Measure (EMDS Comment)*: Pool Frequency from ODFW Aquatic Habitat surveys.

*Data Description (Domain Source)*:

ODFW Habitat surveys. (1990s to 2004)

*Assumptions and Caveats (EMDS Assumptions):* data provide a regional picture of the spatial distribution of habitat types.

*Source:* (reference: Gallo et al 2005, PNW-GTR-647)

### f. Sedimentation

*Purpose (EMDS Explanation)*: Sedimentation has adverse effects on gravels.

*Measure (EMDS Comment)*: Embeddedness from ODFW surveys

*Data Description (Domain Source)*: ODFW Habitat surveys

*Assumptions and Caveats (EMDS Assumptions):* ODFW survey data is not complete throughout the whole North Coast region.

*Source:* (reference: Gallo et al 2005, PNW-GTR-647)

## 2. Floodplain/Riparian

### g. Riparian Conifer

*Purpose (EMDS Explanation)*: Riparian condition is critical for temperature, wood delivery to streams, nutrients, and buffering against excess runoff/sedimentation. Riparian conifer size is indicative of the potential for providing these areas to fish bearing streams. *Measure (EMDS Comment)*: % of riparian zone, 164 ft., which is greater than 20 inch DBH. We used the same measure as the NWFP. This measure is meant to capture the both the cover and the size of the trees.

The buffer of 164 feet is based upon research in the Pacific Northwest. It corresponds to the average tree height of a mature conifer forest. In other words, the rule of thumb of one tree height riparian distance.

*Data Description (Domain Source)*: Forest size data was collected from the Interagency Vegetation Mapping Project (IVMP) data at 30m based upon 1996 Landsat imagery. The data has been continually developed and verified. Since the data was based upon 1996, we updated the data to 2007, accounting for major forest clearings.

The streams layer used for this analysis was the High Resolution NHD data. This data set was used in favor of the ODF streams layer or the NetTrace model due to: 1) it provides a more consistent distribution than ODF, and 2) it is based off of actual streams rather than modeled. The modeled streams from NetTrace could potentially case error.

*Assumptions and Caveats (EMDS Assumptions):* Tree size (DBH) data from landsat data on the "per-pixel" level can have scale dependant errors in classification. However, as an analysis shifts towards averages over an area, as this study does, the data tends to become more representative of the landscape. We expect there to be errors with the IVMP data.

*Source:* (reference: Gallo et al 2005, PNW-GTR-647)

### h. Riparian Deciduous

*Purpose (EMDS Explanation)*: Riparian condition is critical for temperature, wood delivery to streams, nutrients, and buffering against excess runoff/sedimentation. Riparian deciduous size is indicative shade, nutrient, and woody debris source. Hardwood trees do not generally remain in the stream for as long large conifers.

*Measure (EMDS Comment)*:

*Data Description (Domain Source)*:

> 1998 – 2005 DEQ water quality Stream Temperature 7 DAYMOVING Mean of Daily Max (if more than one point, take the highest).

*Assumptions and Caveats (EMDS Assumptions):*

*Source:* (reference: Gallo et al 2005, PNW-GTR-647)

### i. Floodplain Development

*Purpose*: Land use and land cover are key indicators of the "human footprint". In a floodplain setting, these are indicators of the amount of development and modification of the stream channel.

*Measure*: The percent of the floodplain in the HUC 7 catchment that has been converted. Specifically, this is an aggregation of: impervious surfaces, open space developed, cultivated, and pasture.

*Data Description*: A floodplain model was developed across the whole region using a DEM and a raster processing program. This program was developed at Utah State University and has been systematically tested by University of Montana Flathead Lake Biological Station for using in delineating floodplains for salmon applications.

Land use/land cover data was derived from the NOAA Coastal Change Analysis Program (C-CAP) project based upon imagery from 2001. While the data is 8 years old, the amount of urban or agriculture to change in the floodplain in this region is not expected to be drastic. C-CAP data is quantified to be around 80% accurate for the land cover classes used.

*Assumptions* and *Caveats*: The floodplain and land cover data are good regional depictions of the landscape. When aggregated to the HUC 7 level, several of the potential errors will become minimal. However, it is important to note that

*Source:* (reference: Gallo et al 2005, PNW-GTR-647)

### j. Floodplain Roads

*Purpose (EMDS Explanation)*: The purpose of this is to provide an indicator of the influence of the road network on the stream channel.

*Measure (EMDS Comment)*: Miles per road/miles per stream within a 164 ft buffer on slopes less than or equal to 3%.

*Data Description (Domain Source)*:

The data source for the roads is the BLM data set. The fish bearing stream network from CLAMS was used to derive the buffer.

*Assumptions and Caveats (EMDS Assumptions):* The fish bearing stream layer of ODF was used. It is assumed that this is an accurate representation of fish bearing streams. The scale of the data may provide limitations at the local scale.

*Source:* (reference: Gallo et al 2005, PNW-GTR-647)

## 3. Upslope

### k. Land Use

*Purpose:* Land use in the watershed is indicative of the amount of human development.

*Measure*: Percent of the watershed that is classified urban, agriculture or pasture.

*Data Description*: 2000 NOAA C-CAP data

*Assumptions*: The data provide a regional picture of the spatial distribution of land use. NOAA C-CAP data is the most accurate general land use at the regional scale.

*Caveats*: Data is around 80% accurate. Small scale developments will generally be not classified. Development underneath a canopy of trees (>50%) will generally not be classified.

*Source:* (reference: Gallo et al 2005, PNW-GTR-647)

### l. Road Density

*Purpose (EMDS Explanation)*: Roads have multiple influences on stream condition.

*Measure (EMDS Comment)*: miles of road / sq miles of watershed

*Data Description (Domain Source)*:

Roads are from BLM roads database.

*Assumptions and Caveats (EMDS Assumptions):*

*Source:* Reference is from AREMP 2008 decision support model for the Cascades (AREMP white paper).

## m. Landslides and Management Influence

*Purpose (EMDS Explanation)*: Landslides can be beneficial natural occurring phenomenon by delivering wood and coarse sediments to the channel. When landslides occur outside the range of natural variability, it can be detrimental. This measure is meant to capture the potential of landslides to occur beyond what is considered "normal"

*Measure (EMDS Comment)*: The measure is the percent that landslide probability is increased by roads and forest age.

*Data Description (Domain Source)*:

Roads data is from the BLM roads data set. They were buffered by 20 meters. Roads were given a value of xx. Forest stands less than 15 years old were derived from a combination of ODF clearcuts data and augmented by an analysis of Landsat data by WSC. These forest stands were given a value of 3.0.

Landslide potential data was derived from the Coastal Landscape Analysis and Modeling Study (CLAMS).

*Assumptions and Caveats (EMDS Assumptions):*

*Source:* The decision rule was derived from AREMP, personal communication with Peter Eldred, US Forest Service, and Dan Miller, Earth Systems Institute.

## n. Hydrologic Response

*Purpose (EMDS Explanation)*: Forest canopies buffer against excess peak flows. Excess peak flows can alter hydrologic condition and stream habitat. This parameter is an indicator for the potential of the watershed to have peak flows that are outside the range of natural variability.

*Measure (EMDS Comment)*: The measure is the percent that landslide probability is increased by roads and forest age. Pixels were given the following values based upon their land cover or forest age.

Fully Forested (> 30 years ) = 1
< 30 years = 0
Agriculture = -0.5
Pasture = -0.6
Urban = -1

HUC 7s were then averaged based upon their pixel values.

*Data Description (Domain Source)*:

ODF Forest Change Detection layer, WSC changes to 2007.

*Source:* The decision rule was developed by ODF staff.

Appendix C: Decision Support Scores for Salmon Anchor Habitats.

| | | Fish Data | | | | Intrinsic Potential | | | | Species Watershed Condition | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Salmon Anchor Habitat/ Catchment Number** | **Watershed Condition** | **Coho** | **Chinook** | **Chum** | **Steelhead** | **Coho** | **Chinook** | **Chum** | **Steelhead** | **Coho** | **Chinook** | **Chum** | **Steelhead** |
| **FISHHAWK LAKE CR.** | | | | | | | | | | | | | |
| 17100202020602 | 0.527 | 0.237 | 0 | NO DATA | 0 | 0.398832 | 0.080563 | 0 | 0.36513 | 0.53 | 0.088 | -1 | 0.316 |
| 17100202020601 | 0.395 | 0 | 0 | NO DATA | 0 | 0.408861 | 0.074595 | 0 | 0.42635 | 0 | 0.154 | -1 | 0 |
| 17100202020603 | 0.211 | 0.064 | 0 | NO DATA | 0 | 0.375595 | 0.183704 | 0 | 0.385297 | 0.264 | 0.115 | -1 | 0.133 |
| **BUSTER CR.** | | | | | | | | | | | | | |
| 17100202030502 | 0.477 | 0 | 0 | NO DATA | 0 | 0.415702 | 0.114335 | 0 | 0.373777 | 0.32 | 0.168 | -1 | 0.319 |
| 17100202030501 | 0.387 | 0.076 | 0 | NO DATA | 0 | 0.358777 | 0.074516 | 0 | 0.314394 | 0.323 | 0.153 | -1 | 0.213 |
| **UPPER N. FK. NEHALEM R.** | | | | | | | | | | | | | |
| 17100202050101 | -0.943 | 0 | 0 | NO DATA | 0 | 0.267314 | 0.105363 | 0 | 0.372027 | -0.001 | 0.051 | -1 | 0.111 |
| 17100202050102 | -0.196 | 0 | 0 | NO DATA | 0 | 0.487576 | 0.108259 | 0 | 0.353677 | 0 | -0.173 | -1 | 0 |
| 17100202050104 | 0.115 | 0.057 | 0.15 | NO DATA | 0 | 0.419749 | 0.090793 | 0 | 0.395951 | 0.275 | 0.192 | -1 | 0.206 |
| 17100202050103 | -0.379 | 0.075 | 0 | NO DATA | 0.091 | 0.265585 | 0.205145 | 0.475535 | 0.368185 | 0.076 | -0.793 | 0.476 | 0.281 |
| 17100202050105 | 0.244 | 0 | 0 | NO DATA | 0 | 0.236428 | 0.035455 | 0 | 0.382843 | 0 | 0.076 | -1 | 0 |
| **UPPER ROCK CR.** | | | | | | | | | | | | | |
| 17100202010503 | -0.273 | 0.118 | 0 | NO DATA | 0 | 0.30346 | 0.083727 | 0 | 0.432638 | -0.37 | -0.338 | -1 | -0.324 |
| 17100202010502 | 0.218 | 0.061 | 0 | NO DATA | 0 | 0.285755 | 0.162171 | 0 | 0.318521 | 0.15 | 0.093 | -1 | 0.156 |
| 17100202010501 | 0.165 | 0.212 | 0 | NO DATA | 0 | 0.292165 | 0.062837 | 0 | 0.368843 | 0.201 | -0.021 | -1 | 0.186 |
| **COAL CR.** | | | | | | | | | | | | | |
| 17100202050306 | 0.037 | 0 | 0 | NO DATA | 0 | 0.318865 | 0.081667 | 0 | 0.341498 | -0.068 | -1 | -1 | 0.114 |

| | | Fish Data | | | | Intrinsic Potential | | | | Species Watershed Condition | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Salmon Anchor Habitat/ Catchment Number** | **Watershed Condition** | **Coho** | **Chinook** | **Chum** | **Steelhead** | **Coho** | **Chinook** | **Chum** | **Steelhead** | **Coho** | **Chinook** | **Chum** | **Steelhead** |
| **LOUISIGNONT CR. / UPPER NEHALEM R.** | | | | | | | | | | | | | |
| 17100202010101 | 0.155 | 0.067 | 0 | NO DATA | 0.091 | 0.230347 | 0.027422 | 0 | 0.371877 | -0.03 | 0.057 | -1 | 0.243 |
| 17100202010103 | 0.219 | 0.137 | 0 | NO DATA | 0 | 0.310063 | 0.037766 | 0 | 0.407146 | 0.236 | 0.079 | -1 | 0.255 |
| 17100202010104 | -0.053 | 0.043 | 0 | NO DATA | 0 | 0.463554 | 0.095518 | 0 | 0.382933 | 0.144 | 0.023 | -1 | 0.06 |
| 17100202010102 | -0.365 | 0.11 | 0 | NO DATA | 0 | 0.506861 | 0.149999 | 0 | 0.425911 | -0.527 | -0.545 | -1 | -0.577 |
| **COOK CR. / LOWER NEHALEM R.** | | | | | | | | | | | | | |
| 17100202060204 | 0.385 | 0 | 0 | NO DATA | 0 | 0.230473 | 0.130036 | 0.481685 | 0.44116 | -0.029 | 0.226 | 0.543 | 0.363 |
| 17100202060201 | 0.264 | 0 | 0 | NO DATA | 0.046 | 0.209883 | 0.062803 | 0.240167 | 0.412934 | -0.129 | -0.212 | -0.022 | 0.321 |
| 17100202060203 | -1 | 0 | 0 | NO DATA | 0.136 | 0.19123 | 0.013184 | 0 | 0.426829 | -0.18 | 0.036 | -1 | 0.393 |
| 17100202060202 | 0.373 | 0 | 0 | NO DATA | 0 | 0.202924 | 0.013463 | 0 | 0.415136 | 0 | 0.042 | -1 | 0 |
| **FOLEY CR.** | | | | | | | | | | | | | |
| 17100202060402 | 0.26 | 0 | 0 | NO DATA | 0 | 0.228501 | 0.109567 | 0.2642 | 0.356149 | 0 | 0.18 | 0.066 | 0 |
| 17100202060401 | -0.766 | 0 | 0 | NO DATA | 0.229 | 0.318217 | 0.088281 | 0.352935 | 0.352559 | -0.544 | -1 | 0.231 | 0.304 |
| **MIAMI R.** | | | | | | | | | | | | | |
| 17100203070101 | 0.25 | 0.419 | 0 | NO DATA | 0.636 | 0.266346 | 0.062274 | 0.592219 | 0.460444 | 0.194 | -0.646 | 0.521 | 0.756 |
| 17100203070102 | -1 | 0.333 | 0 | NO DATA | 0.572 | 0.275974 | 0.081308 | 0.716992 | 0.354529 | -0.145 | -0.205 | 0.198 | 0.108 |
| 17100203070103 | -1 | 0.021 | 0 | NO DATA | 0.046 | 0.267939 | 0.033663 | 0.434016 | 0.361081 | -0.327 | 0.04 | 0.312 | -0.413 |
| 17100203070104 | -1 | 0 | 0 | NO DATA | 0.096 | 0.391555 | 0.09482 | 0.6165 | 0.4076 | -0.354 | -0.154 | 0.068 | -0.16 |

| Salmon Anchor Habitat/ Catchment Number | Watershed Condition | Fish Data | | | | Intrinsic Potential | | | | Species Watershed Condition | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Coho | Chinook | Chum | Steelhead | Coho | Chinook | Chum | Steelhead | Coho | Chinook | Chum | Steelhead |
| **MIDDLE KILCHIS R.** | | | | | | | | | | | | | |
| 17100203060201 | 0.436 | 0.333 | 0 | NO DATA | 0.282 | 0.204546 | 0.159684 | 0.735377 | 0.35526 | -0.086 | 0.269 | 0.599 | 0.215 |
| 17100203060202 | 0.385 | 0.192 | 0 | NO DATA | 0 | 0.211397 | 0.164395 | 0.786345 | 0.330637 | -0.131 | 0.262 | 0.581 | 0.36 |
| 17100203060203 | 0.344 | 0.026 | 0 | NO DATA | 0.311 | 0.222647 | 0.024877 | 0.559343 | 0.469833 | -0.322 | -1 | 0.566 | 0.413 |
| 17100203060205 | 0.133 | 0 | 0 | NO DATA | 0.227 | 0.222147 | 0.081176 | 0.7053 | 0.346819 | -0.19 | 0.025 | 0.477 | 0.219 |
| 17100203060204 | 0.35 | 0.141 | 0 | NO DATA | 0 | 0.189801 | 0.010263 | 0.6966 | 0.366508 | -0.176 | 0.04 | 0.625 | -0.059 |
| **ELKHORN CR.** | | | | | | | | | | | | | |
| 17100203040104 | 0.244 | 0.333 | 0 | NO DATA | 0.042 | 0.229102 | 0.222245 | 0 | 0.421376 | 0.061 | 0.298 | -1 | 0.14 |
| 17100203040103 | -0.425 | 0.365 | 0 | NO DATA | 0 | 0.26514 | 0.03564 | 0 | 0.341041 | 0.091 | 0.039 | -1 | -0.95 |
| 17100203040102 | -0.014 | 0.333 | 0 | NO DATA | 0.264 | 0.218074 | 0.089352 | 0 | 0.283022 | -0.069 | -0.177 | -1 | -0.057 |
| 17100203040101 | -0.075 | 0.107 | 0 | NO DATA | 0 | 0.279656 | 0.026527 | 0 | 0.323099 | -0.064 | -0.048 | -1 | -0.746 |
| **E. FK. OF THE S. FK. TRASK R.** | | | | | | | | | | | | | |
| 17100203040604 | 0.171 | 0 | 0 | NO DATA | 0.063 | 0.208192 | 0.154132 | 0.670532 | 0.444511 | -0.199 | 0.189 | 0.487 | 0.31 |
| 17100203040603 | 0.151 | 0.098 | 0 | NO DATA | 0.281 | 0.224342 | 0.05305 | 0.470819 | 0.434375 | -0.05 | 0.092 | 0.428 | 0.503 |
| 17100203040602 | 0.085 | 0.333 | 0 | NO DATA | 0.428 | 0.20526 | 0.03529 | 0.492876 | 0.349554 | -0.12 | -0.036 | 0.478 | 0.255 |
| 17100203040601 | 0.249 | 0 | 0 | NO DATA | 0 | 0.191789 | 0.007332 | 0 | 0.294958 | -0.258 | 0.026 | -1 | -0.86 |
| **CEDAR CR.** | | | | | | | | | | | | | |
| 17100203050403 | 0.422 | 0.126 | 0 | NO DATA | 0 | 0.168262 | 0.012769 | 0 | 0.340158 | -0.255 | 0.045 | -1 | -0.186 |
| 17100203050404 | -0.037 | 0.518 | 1 | NO DATA | 0.482 | 0.20145 | 0.083618 | 0 | 0.394368 | -0.048 | 0.223 | -1 | 0.446 |
| 17100203050402 | 0.189 | 0 | 0 | NO DATA | 0.13 | 0.240522 | 0.15635 | 0 | 0.315298 | -0.38 | 0.014 | -1 | -0.164 |

| | | Fish Data | | | | Intrinsic Potential | | | | Species Watershed Condition | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Salmon Anchor Habitat/ Catchment Number** | **Watershed Condition** | **Coho** | **Chinook** | **Chum** | **Steelhead** | **Coho** | **Chinook** | **Chum** | **Steelhead** | **Coho** | **Chinook** | **Chum** | **Steelhead** |
| **BEN SMITH CR.** | | | | | | | | | | | | | |
| 17100203050402 | 0.189 | 0 | 0 | NO DATA | 0.13 | 0.240522 | 0.15635 | 0 | 0.315298 | -0.38 | 0.014 | -1 | -0.164 |
| 17100203050401 | 0.236 | 0.667 | 0 | NO DATA | 1 | 0.23301 | 0.12737 | 0 | 0.362128 | 0.064 | -1 | -1 | 0.514 |
| **LITTLE N. FK. WILSON R.** | | | | | | | | | | | | | |
| 17100203050901 | 0.051 | 0.286 | 0 | NO DATA | 0.323 | 0.223972 | 0.030334 | 0 | 0.466523 | 0.046 | 0.073 | -1 | 0.466 |
| 17100203050902 | 0.639 | 0.387 | 0 | NO DATA | 0.5 | 0.229416 | 0.082365 | 0.716345 | 0.41811 | 0.133 | 0.173 | 0.625 | 0.791 |
| **DEVILS LAKE FK. WILSON R.** | | | | | | | | | | | | | |
| 17100203050103 | 0.084 | 0 | 0 | NO DATA | 0 | 0.337798 | 0.035485 | 0 | 0.370983 | -0.14 | 0.057 | -1 | -0.826 |
| 17100203050102 | -0.074 | 0.4 | 0 | NO DATA | 0 | 0.475019 | 0.085966 | 0 | 0.437841 | 0.224 | -0.075 | -1 | -0.794 |
| 17100203050101 | -0.376 | 0 | 0 | NO DATA | 0 | 0.441087 | 0.092348 | 0 | 0.346923 | 0 | -0.582 | -1 | 0 |
| **S. FK. SALMONBERRY R.** | | | | | | | | | | | | | |
| 17100202040202 | 0.348 | 0 | 0 | NO DATA | 0 | 0.199686 | 0.019467 | 0 | 0.417585 | 0 | 0.053 | -1 | 0 |
| 17100202040201 | 0.569 | 0 | 0 | NO DATA | 0.273 | 0.239266 | 0.072593 | 0 | 0.514264 | 0.002 | 0.155 | -1 | 0.676 |

Appendix D: Watershed Condition Decision Support Scores by HUC6

| Stream Name | Catchment Condition | Connectivity | CWD Frequency | Dissolved Oxygen | Fines | Floodplains | Floodplains Road Density | Habitat | Human Use | Hydrologic Response | Land Use / Land Cover | Landslides / Land Use | Pool Frequency | Riparian | Riparian Conifer | Riparian Deciduous | Road Density | Stream | Stream Flow | Temperature | Upslope | Water Quality | Watershed Condition | Watershed Name |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Tillamook Bay | -0.19 | 0.67 | -0.22 | 0.00 | 0.15 | -0.28 | -0.24 | -0.16 | 0.23 | 0.75 | 0.95 | 0.31 | -0.10 | -0.68 | -0.60 | -0.75 | -0.21 | 0.28 | 1.00 | 0.00 | 0.32 | 0.00 | -0.19 | -1.00 |
| Upper Wilson River-Cedar Creek | 0.34 | 0.94 | 0.61 | 0.33 | 0.35 | 0.18 | 0.24 | 0.77 | 1.00 | 0.87 | 1.00 | 1.00 | 0.92 | -0.44 | -1.00 | 0.12 | 0.02 | 0.63 | 1.00 | 0.33 | 0.65 | 0.33 | 0.34 | -1.00 |
| Kilchis River | 0.20 | 0.95 | -0.67 | 0.38 | 0.37 | -0.19 | 0.19 | -0.04 | 0.75 | 0.91 | 1.00 | 0.96 | 0.59 | 0.02 | -0.96 | 1.00 | 0.22 | 0.39 | 0.75 | 0.25 | 0.72 | 0.31 | 0.20 | -1.00 |
| Upper Necanicum River | 0.14 | 0.18 | -1.00 | 0.00 | -0.36 | 0.36 | 0.17 | 0.00 | 0.85 | 0.69 | 1.00 | 0.44 | 1.00 | -0.70 | -1.00 | -0.40 | -0.66 | 0.16 | 1.00 | 0.00 | 0.21 | 0.00 | 0.14 | -1.00 |
| Deer Creek | -0.51 | 0.60 | 0.03 | 0.20 | -0.26 | -0.59 | -0.57 | -0.09 | -0.12 | 0.28 | 1.00 | 0.35 | -0.20 | -1.00 | -1.00 | -1.00 | 0.85 | 0.24 | 1.00 | 0.20 | 0.52 | 0.20 | -0.51 | -1.00 |
| Middle Necanicum River | 0.21 | 1.00 | -0.92 | 0.00 | 0.06 | 0.52 | 0.23 | 0.04 | 0.91 | 0.61 | 1.00 | 0.60 | 1.00 | -0.74 | -1.00 | -0.47 | 0.10 | 0.21 | 0.50 | 0.00 | 0.47 | 0.00 | 0.21 | -1.00 |
| Bear Creek | 0.15 | -0.16 | -0.57 | 0.00 | 0.00 | 0.15 | 0.19 | -0.33 | 0.84 | 0.74 | 0.83 | 0.67 | -0.10 | -0.41 | -0.86 | 0.03 | 0.75 | 0.14 | 1.00 | 0.00 | 0.72 | 0.00 | 0.15 | -1.00 |
| Hunt Creek | -0.39 | 0.19 | 0.00 | 0.00 | 0.00 | -0.77 | -0.48 | 0.00 | 0.32 | 0.62 | 1.00 | 0.55 | 0.00 | -1.00 | -1.00 | -1.00 | 0.94 | 0.25 | 1.00 | 0.00 | 0.72 | 0.00 | -0.39 | -1.00 |
| Lower Nestucca River | -0.23 | 0.40 | -0.35 | 0.20 | 0.13 | -0.29 | -0.28 | -0.12 | -0.28 | 0.68 | 1.00 | 0.43 | 0.11 | -0.26 | -0.49 | -0.03 | 0.17 | 0.29 | 1.00 | 0.00 | 0.46 | 0.10 | -0.23 | -1.00 |
| Lower Wilson River | -0.02 | 0.31 | -0.40 | 0.00 | 0.06 | -0.19 | -0.02 | -0.04 | 0.01 | 0.72 | 1.00 | 0.81 | 0.31 | 0.13 | -0.46 | 0.71 | 0.37 | 0.26 | 1.00 | 0.00 | 0.66 | 0.00 | -0.02 | -1.00 |
| Netarts Bay | -0.07 | -0.04 | 0.00 | 0.33 | 0.00 | 0.01 | 0.00 | 0.00 | 1.00 | 0.79 | 1.00 | 0.41 | 0.00 | -1.00 | -1.00 | -1.00 | -0.30 | 0.11 | 0.33 | 0.00 | 0.34 | 0.17 | -0.07 | -1.00 |
| Fertile Valley Creek | 0.22 | -0.87 | 0.00 | 0.00 | 0.00 | 0.35 | 0.18 | 0.00 | 0.82 | 0.70 | 1.00 | 0.60 | 0.00 | -0.64 | -1.00 | -0.29 | 1.00 | 0.17 | 1.00 | 0.00 | 0.78 | 0.00 | 0.22 | -1.00 |
| Upper Little Nestucca River | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Upper South Yamhill River | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Middle Little Nestucca River | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Agency Creek | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Lower Little Nestucca River | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Coast Creek | 0.14 | -1.00 | 0.00 | 0.00 | 0.00 | 0.02 | 0.08 | 0.00 | 0.81 | 0.59 | 1.00 | 0.57 | 0.00 | -0.57 | -1.00 | -0.15 | 0.92 | 0.16 | 1.00 | 0.00 | 0.71 | 0.00 | 0.14 | -1.00 |
| Three Rivers | 0.32 | -1.00 | 0.00 | 0.20 | 0.00 | 0.18 | 0.42 | 0.00 | 1.00 | 0.90 | 1.00 | 1.00 | 0.00 | 0.08 | -0.83 | 1.00 | 0.82 | 0.21 | 1.00 | 0.20 | 0.91 | 0.20 | 0.32 | -1.00 |

| Stream Name | Catchment Condition | Connectivity | CWD Frequency | Dissolved Oxygen | Fines | Floodplains | Floodplains Road Density | Habitat | Human Use | Hydrologic Response | Land Use / Land Cover | Landslides / Land Use | Pool Frequency | Riparian | Riparian Conifer | Riparian Deciduous | Road Density | Stream | Stream Flow | Temperature | Upslope | Water Quality | Watershed Condition | Watershed Name |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Baker Creek | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Upper Willamina Creek | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Nestucca River- Niagara Creek | 0.38 | 1.00 | -0.13 | 0.33 | -0.24 | 0.40 | 0.52 | 0.18 | 1.00 | 0.87 | 1.00 | 0.84 | 0.50 | 0.15 | -0.08 | 0.39 | 0.24 | 0.33 | 1.00 | -0.02 | 0.67 | 0.16 | 0.38 | -1.00 |
| Panther Creek | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Lower Nestucca River- Farmer Creek | 0.08 | 0.68 | 0.00 | 0.00 | 0.00 | -0.01 | 0.09 | 0.00 | 0.32 | 0.75 | 1.00 | 0.81 | 0.00 | -0.05 | -0.78 | 0.69 | 0.20 | 0.28 | 1.00 | 0.00 | 0.61 | 0.00 | 0.08 | -1.00 |
| Upper Nestucca River-Testament Creek | 0.29 | 0.50 | 0.92 | 0.50 | -0.50 | 0.33 | 0.31 | 0.73 | 1.00 | 0.82 | 1.00 | 0.80 | 0.55 | -0.42 | -0.84 | 0.01 | -0.45 | 0.43 | 1.00 | 0.39 | 0.43 | 0.44 | 0.29 | -1.00 |
| Middle Nestucca River-Powder Creek | 0.34 | 0.60 | 0.00 | 0.00 | 0.00 | 0.20 | 0.46 | 0.00 | 0.95 | 0.91 | 1.00 | 0.95 | 0.00 | 0.22 | -0.50 | 0.93 | 0.55 | 0.27 | 1.00 | 0.00 | 0.82 | 0.00 | 0.34 | -1.00 |
| Upper Nestucca River-Elk Creek | 0.32 | 1.00 | 0.98 | 0.33 | 0.56 | 0.06 | 0.27 | 0.92 | 1.00 | 0.85 | 1.00 | 0.69 | 0.86 | -0.24 | -0.63 | 0.14 | -0.89 | 0.72 | 1.00 | 0.29 | 0.27 | 0.31 | 0.32 | -1.00 |
| Upper Nestucca River | 0.02 | 1.00 | 0.36 | 0.40 | -0.62 | -0.17 | -0.04 | 0.33 | 0.83 | 0.69 | 1.00 | 0.58 | 0.29 | -0.78 | -0.86 | -0.70 | -0.32 | 0.30 | 1.00 | 0.15 | 0.36 | 0.28 | 0.02 | -1.00 |
| Haskins Creek | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Moon Creek | 0.26 | 1.00 | 0.55 | 0.00 | 0.79 | 0.18 | 0.23 | 0.77 | 1.00 | 0.79 | 1.00 | 0.67 | 1.00 | -0.48 | -1.00 | 0.03 | -0.62 | 0.67 | 1.00 | 0.00 | 0.33 | 0.00 | 0.26 | -1.00 |
| Sand Creek | 0.19 | 0.78 | 0.00 | 0.25 | 0.00 | 0.00 | 0.15 | 0.00 | 0.99 | 0.86 | 1.00 | 0.70 | 0.00 | -0.54 | -0.87 | -0.21 | 0.23 | 0.34 | 1.00 | 0.24 | 0.62 | 0.25 | 0.19 | -1.00 |
| Beaver Creek | -0.02 | 0.50 | 0.07 | 0.25 | -0.25 | -0.82 | -0.08 | -0.09 | 0.98 | 0.76 | 1.00 | 0.67 | -0.25 | -0.40 | -1.00 | 0.20 | -0.50 | 0.22 | 1.00 | 0.06 | 0.35 | 0.16 | -0.02 | -1.00 |
| Upper North Yamhill River | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Upper Tillamook River | -0.40 | 0.33 | 0.25 | 0.17 | -0.63 | -0.33 | -0.38 | 0.30 | -0.33 | 0.51 | 1.00 | 0.38 | 0.35 | -0.47 | -1.00 | 0.06 | -0.78 | 0.06 | 0.33 | 0.11 | 0.10 | 0.14 | -0.40 | -1.00 |
| East Fork South Fork Trask River | 0.21 | 1.00 | -0.39 | 0.00 | 0.37 | 0.23 | 0.20 | -0.69 | 1.00 | 0.81 | 1.00 | 0.95 | -1.00 | -0.64 | -1.00 | -0.27 | 0.03 | 0.23 | 1.00 | 0.00 | 0.62 | 0.00 | 0.21 | -1.00 |
| Turner Creek | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| South Fork Trask River | 0.10 | 0.95 | -0.40 | 0.00 | 0.21 | -0.37 | 0.04 | -0.04 | 1.00 | 0.81 | 1.00 | 1.00 | 0.33 | -0.50 | -1.00 | -0.01 | 0.24 | 0.34 | 1.00 | 0.00 | 0.70 | 0.00 | 0.10 | -1.00 |
| Middle Tualatin River | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |

| Stream Name | Catchment Condition | Connectivity | CWD Frequency | Dissolved Oxygen | Fines | Floodplains | Floodplains Road Density | Habitat | Human Use | Hydrologic Response | Land Use / Land Cover | Landslides / Land Use | Pool Frequency | Riparian | Riparian Conifer | Riparian Deciduous | Road Density | Stream | Stream Flow | Temperature | Upslope | Water Quality | Watershed Condition | Watershed Name |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Upper Trask River | 0.24 | 0.92 | -0.88 | 0.00 | 0.35 | 0.01 | 0.34 | -0.21 | 1.00 | 0.65 | 1.00 | 0.77 | 0.46 | 0.00 | -1.00 | 1.00 | -0.04 | 0.33 | 1.00 | 0.00 | 0.49 | 0.00 | 0.24 | -1.00 |
| Lower Trask River | -0.64 | 0.76 | -0.75 | 0.25 | -0.60 | -0.78 | -0.69 | -0.54 | -1.00 | 0.03 | -0.44 | 0.19 | -0.33 | -0.29 | 0.00 | -0.58 | 0.00 | 0.05 | 1.00 | 0.00 | 0.04 | 0.13 | -0.64 | -1.00 |
| Lower Tillamook River | -0.58 | 1.00 | -0.22 | 0.04 | -0.25 | -0.74 | -0.64 | -0.11 | -0.47 | 0.55 | 0.99 | 0.51 | 0.00 | -0.71 | -0.60 | -0.81 | -0.08 | 0.22 | 1.00 | 0.00 | 0.37 | 0.02 | -0.58 | -1.00 |
| North Fork of Trask River | 0.31 | 1.00 | -0.18 | 0.33 | 0.48 | 0.26 | 0.22 | 0.36 | 1.00 | 0.87 | 1.00 | 1.00 | 0.90 | -0.60 | -0.98 | -0.22 | 0.40 | 0.57 | 1.00 | 0.26 | 0.77 | 0.30 | 0.31 | -1.00 |
| Upper Tualatin River | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Middle Fork of North Fork of Trask River | 0.05 | 0.47 | -0.40 | 0.20 | 0.39 | 0.59 | 0.20 | 0.14 | 0.82 | 0.82 | 1.00 | 0.66 | 0.68 | -0.79 | -1.00 | -0.59 | 0.00 | 0.10 | -0.40 | 0.10 | 0.53 | 0.15 | 0.05 | -1.00 |
| Scoggins Creek-Sain Creek | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Lower Gales Creek | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Jordan Creek | 0.20 | 0.38 | -0.50 | 0.25 | 0.81 | -0.11 | 0.11 | -0.10 | 1.00 | 0.93 | 1.00 | 0.94 | 0.29 | -0.57 | -1.00 | -0.15 | 0.23 | 0.48 | 1.00 | 0.25 | 0.72 | 0.25 | 0.20 | -1.00 |
| Middle Wilson River | 0.36 | 0.26 | 0.75 | 0.25 | 0.72 | 0.21 | 0.26 | 0.75 | 0.94 | 0.82 | 1.00 | 1.00 | 0.75 | -0.38 | -1.00 | 0.25 | 0.56 | 0.62 | 1.00 | 0.00 | 0.81 | 0.13 | 0.36 | -1.00 |
| Little North Fork Wilson River | 0.53 | -0.36 | 0.22 | 0.50 | 0.79 | 0.83 | 0.56 | 0.11 | 1.00 | 0.82 | 1.00 | 0.98 | 0.00 | -0.17 | -1.00 | 0.67 | 0.28 | 0.50 | 1.00 | 0.27 | 0.71 | 0.38 | 0.53 | -1.00 |
| South Fork Wilson River | 0.18 | 1.00 | 0.69 | 0.00 | 0.42 | 0.17 | 0.10 | 0.20 | 1.00 | 0.97 | 1.00 | 0.80 | -0.28 | -0.88 | -1.00 | -0.75 | 0.18 | 0.45 | 1.00 | 0.00 | 0.67 | 0.00 | 0.18 | -1.00 |
| Middle Gales Creek | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Lower Miami River | -0.08 | 0.57 | -0.70 | 0.00 | -0.06 | -0.48 | -0.14 | -0.36 | 0.59 | 0.81 | 1.00 | 0.52 | -0.02 | -0.53 | -1.00 | -0.07 | -1.00 | 0.17 | 1.00 | 0.00 | 0.17 | 0.00 | -0.08 | -1.00 |
| Spring Creek | -0.26 | 1.00 | 0.00 | 0.00 | 0.00 | -0.36 | -0.35 | 0.00 | 0.33 | 0.73 | 1.00 | 0.46 | 0.00 | -1.00 | -1.00 | -1.00 | -0.77 | 0.30 | 1.00 | 0.00 | 0.19 | 0.00 | -0.26 | -1.00 |
| North Fork of Kilchis River | 0.38 | 1.00 | 0.10 | 0.50 | 0.53 | -0.09 | 0.29 | 0.32 | 1.00 | 0.99 | 1.00 | 1.00 | 0.53 | -0.04 | -1.00 | 0.92 | 0.59 | 0.61 | 1.00 | 0.47 | 0.87 | 0.49 | 0.38 | -1.00 |
| Lower Devils Lake Fork Wilson River | -0.01 | 1.00 | 0.00 | 0.00 | 0.33 | -0.28 | -0.11 | 0.22 | 0.90 | 0.72 | 1.00 | 0.69 | 0.44 | -0.96 | -1.00 | -0.91 | 0.29 | 0.43 | 1.00 | 0.00 | 0.59 | 0.00 | -0.01 | -1.00 |
| Upper Miami River | 0.25 | 1.00 | 0.06 | 1.00 | -1.00 | -0.51 | 0.16 | 0.53 | 1.00 | 0.97 | 1.00 | 1.00 | 1.00 | 0.00 | -1.00 | 1.00 | 0.57 | 0.43 | 1.00 | 1.00 | 0.86 | 1.00 | 0.25 | -1.00 |
| North Fork Wilson River | 0.04 | 1.00 | 0.61 | 0.00 | 0.13 | -0.45 | -0.07 | 0.52 | 1.00 | 0.91 | 1.00 | 0.92 | 0.43 | -0.74 | -1.00 | -0.49 | -0.36 | 0.45 | 1.00 | 0.00 | 0.52 | 0.00 | 0.04 | -1.00 |

| Stream Name | Catchment Condition | Connectivity | CWD Frequency | Dissolved Oxygen | Fines | Floodplains | Floodplains Road Density | Habitat | Human Use | Hydrologic Response | Land Use / Land Cover | Landslides / Land Use | Pool Frequency | Riparian | Riparian Conifer | Riparian Deciduous | Road Density | Stream | Stream Flow | Temperature | Upslope | Water Quality | Watershed Condition | Watershed Name |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Upper Gales Creek | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Foley Creek | 0.23 | 1.00 | -0.96 | 0.00 | 0.39 | -0.14 | 0.18 | 0.02 | 1.00 | 0.87 | 1.00 | 0.88 | 1.00 | -0.33 | -1.00 | 0.35 | -0.48 | 0.40 | 1.00 | 0.00 | 0.46 | 0.00 | 0.23 | -1.00 |
| Cook Creek | 0.32 | 1.00 | 0.00 | 0.00 | 0.00 | 0.47 | 0.39 | 0.00 | 1.00 | 0.93 | 1.00 | 0.84 | 0.00 | -0.32 | -1.00 | 0.37 | -0.33 | 0.30 | 1.00 | 0.00 | 0.51 | 0.00 | 0.32 | -1.00 |
| Upper West Fork Dairy Creek | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Upper Salmonberry River | 0.32 | 1.00 | -0.09 | 0.00 | 0.33 | 0.73 | 0.33 | 0.19 | 1.00 | 0.77 | 1.00 | 0.71 | 0.48 | -0.74 | -1.00 | -0.47 | 0.08 | 0.43 | 1.00 | 0.00 | 0.55 | 0.00 | 0.32 | -1.00 |
| Lousignont Creek | -0.03 | 0.92 | 0.39 | 0.40 | -0.67 | -0.22 | -0.10 | 0.47 | 0.79 | 0.71 | 1.00 | 0.73 | 0.55 | -0.88 | -0.82 | -0.94 | 0.83 | 0.33 | 1.00 | 0.26 | 0.77 | 0.33 | -0.03 | -1.00 |
| Anderson Creek | 0.30 | 0.13 | -0.50 | 0.00 | 0.50 | -0.06 | 0.27 | 0.00 | 0.89 | 0.77 | 1.00 | 0.90 | 0.50 | -0.02 | -1.00 | 0.96 | 0.09 | 0.36 | 1.00 | 0.00 | 0.61 | 0.00 | 0.30 | -1.00 |
| Lower Salmonberry River | 0.46 | 1.00 | -0.50 | 0.00 | 0.27 | 0.82 | 0.52 | 0.00 | 1.00 | 0.83 | 1.00 | 1.00 | 0.50 | -0.27 | -1.00 | 0.46 | 0.39 | 0.36 | 1.00 | 0.00 | 0.75 | 0.00 | 0.46 | -1.00 |
| Upper East Fork Dairy Creek | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Nehalem Bay | -0.30 | 0.47 | 0.50 | 0.00 | 0.50 | -0.23 | -0.41 | 0.21 | -0.41 | 0.60 | 1.00 | 0.57 | -0.08 | -0.57 | -0.50 | -0.64 | -0.01 | 0.43 | 1.00 | 0.00 | 0.43 | 0.00 | -0.30 | -1.00 |
| Lost Creek | 0.45 | 1.00 | -0.25 | 0.00 | 0.03 | 0.69 | 0.56 | 0.00 | 1.00 | 0.94 | 1.00 | 1.00 | 0.25 | 0.00 | -1.00 | 1.00 | 0.74 | 0.31 | 1.00 | 0.00 | 0.90 | 0.00 | 0.45 | -1.00 |
| Wolf Creek | 0.32 | 1.00 | 1.00 | 0.00 | -0.22 | 0.78 | 0.27 | 0.50 | 1.00 | 0.72 | 1.00 | 0.87 | 0.00 | -0.99 | -0.97 | -1.00 | 0.60 | 0.37 | 1.00 | 0.00 | 0.75 | 0.00 | 0.32 | -1.00 |
| North Fork Salmonberry River | 0.15 | 1.00 | 0.40 | 0.00 | 0.88 | 0.64 | 0.04 | 0.60 | 0.22 | 0.49 | 1.00 | 0.60 | 0.80 | -0.73 | -1.00 | -0.46 | -0.12 | 0.65 | 1.00 | 0.00 | 0.36 | 0.00 | 0.15 | -1.00 |
| Clear Creek | -0.43 | 1.00 | 0.33 | 0.00 | -0.75 | -0.66 | -0.50 | 0.29 | 0.16 | 0.46 | 1.00 | 0.47 | 0.25 | -1.00 | -0.99 | -1.00 | 0.21 | 0.20 | 1.00 | 0.00 | 0.42 | 0.00 | -0.43 | -1.00 |
| Pebble Creek | -0.05 | 0.78 | 0.50 | 0.50 | -0.27 | -0.24 | -0.14 | 0.25 | 0.79 | 0.30 | 1.00 | 0.48 | 0.00 | -0.96 | -1.00 | -0.93 | 0.92 | 0.35 | 1.00 | 0.11 | 0.60 | 0.31 | -0.05 | -1.00 |
| North Scappoose Creek | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Cronin Creek | 0.22 | 1.00 | 0.00 | 0.00 | 0.11 | 0.19 | 0.18 | 0.29 | 0.55 | 0.57 | 1.00 | 0.67 | 0.57 | -0.19 | -1.00 | 0.62 | 0.39 | 0.39 | 1.00 | 0.00 | 0.57 | 0.00 | 0.22 | -1.00 |
| Lower North Fork Nehalem River | 0.02 | 0.81 | 0.00 | 0.29 | 0.17 | 0.35 | -0.03 | 0.12 | 0.20 | 0.65 | 1.00 | 0.37 | 0.25 | -0.63 | -1.00 | -0.26 | -0.16 | 0.42 | 1.00 | 0.29 | 0.33 | 0.29 | 0.02 | -1.00 |
| Middle Rock Creek | -0.20 | 1.00 | -0.11 | 0.00 | 1.00 | -0.43 | -0.32 | 0.44 | 0.33 | 0.33 | 1.00 | 0.24 | 0.99 | -0.85 | -1.00 | -0.70 | 0.09 | 0.64 | 1.00 | 0.00 | 0.27 | 0.00 | -0.20 | -1.00 |

| Stream Name | Catchment Condition | Connectivity | CWD Frequency | Dissolved Oxygen | Fines | Floodplains | Floodplains Road Density | Habitat | Human Use | Hydrologic Response | Land Use / Land Cover | Landslides / Land Use | Pool Frequency | Riparian | Riparian Conifer | Riparian Deciduous | Road Density | Stream | Stream Flow | Temperature | Upslope | Water Quality | Watershed Condition | Watershed Name |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Upper Rock Creek | 0.04 | 0.54 | 0.60 | 0.00 | 0.03 | 0.35 | -0.05 | 0.62 | 0.33 | 0.44 | 1.00 | 0.40 | 0.64 | -0.83 | -1.00 | -0.67 | 0.76 | 0.42 | 1.00 | 0.00 | 0.56 | 0.00 | 0.04 | -1.00 |
| Middle North Fork Nehalem River | 0.16 | 1.00 | 0.42 | 0.20 | 0.00 | 0.25 | 0.10 | 0.43 | 0.37 | 0.62 | 1.00 | 0.52 | 0.45 | -0.30 | -1.00 | 0.40 | 0.24 | 0.43 | 1.00 | 0.00 | 0.49 | 0.10 | 0.16 | -1.00 |
| East Fork Nehalem River | -0.36 | 0.57 | -0.11 | 0.00 | -0.56 | 0.11 | -0.38 | -0.37 | -0.40 | 0.40 | 1.00 | 0.43 | -0.62 | -0.85 | -1.00 | -0.71 | -0.03 | 0.06 | 1.00 | 0.00 | 0.31 | 0.00 | -0.36 | -1.00 |
| Coon Creek | -0.55 | 1.00 | 0.18 | 0.00 | -0.75 | -0.23 | -0.62 | 0.37 | -0.62 | 0.21 | 1.00 | 0.60 | 0.57 | -1.00 | -1.00 | -1.00 | 0.92 | 0.21 | 1.00 | 0.00 | 0.60 | 0.00 | -0.55 | -1.00 |
| Lower Rock Creek | -0.41 | 1.00 | 0.10 | 0.00 | 0.80 | -0.01 | -0.51 | 0.55 | -0.51 | 0.31 | 1.00 | 0.25 | 1.00 | -1.00 | -1.00 | -1.00 | 0.48 | 0.62 | 1.00 | 0.00 | 0.39 | 0.00 | -0.41 | -1.00 |
| Arch Cape Creek | -0.06 | 0.83 | 0.00 | 0.00 | 0.00 | 0.13 | -0.09 | 0.00 | 0.36 | 0.69 | 0.85 | 0.58 | 0.00 | -0.76 | -0.71 | -0.80 | -0.25 | 0.29 | 1.00 | 0.00 | 0.37 | 0.00 | -0.06 | -1.00 |
| Cow Creek | 0.16 | 0.57 | 0.24 | 0.00 | 0.05 | 0.58 | 0.12 | 0.27 | 0.11 | 0.55 | 1.00 | 0.65 | 0.29 | -0.35 | -1.00 | 0.29 | 0.70 | 0.35 | 1.00 | 0.00 | 0.65 | 0.00 | 0.16 | -1.00 |
| Crooked Creek | -0.29 | 0.86 | -0.54 | 0.00 | -0.10 | -0.73 | -0.37 | -0.24 | 0.55 | 0.25 | 1.00 | 0.29 | 0.05 | -0.93 | -1.00 | -0.86 | 1.00 | 0.21 | 1.00 | 0.00 | 0.54 | 0.00 | -0.29 | -1.00 |
| Buster Creek | 0.43 | 1.00 | 1.00 | 0.00 | -0.42 | 0.45 | 0.42 | 0.73 | 1.00 | 0.88 | 1.00 | 1.00 | 0.46 | -0.18 | -0.86 | 0.50 | 0.73 | 0.37 | 1.00 | 0.00 | 0.88 | 0.00 | 0.43 | -1.00 |
| Upper North Fork Nehalem River | 0.13 | 0.90 | 0.73 | 0.00 | 0.17 | -0.17 | 0.05 | 0.64 | 1.00 | 0.75 | 1.00 | 0.55 | 0.55 | -0.67 | -1.00 | -0.34 | -0.32 | 0.48 | 1.00 | 0.00 | 0.37 | 0.00 | 0.13 | -1.00 |
| Ecola Creek | 0.21 | 0.50 | 0.67 | 0.00 | 0.59 | 0.40 | 0.14 | 0.61 | 0.79 | 0.51 | 1.00 | 0.50 | 0.56 | -0.79 | -1.00 | -0.57 | -0.34 | 0.53 | 0.93 | 0.00 | 0.27 | 0.00 | 0.21 | -1.00 |
| Headwaters Clatskanie River | -0.24 | 0.08 | 0.00 | 0.00 | 0.00 | -1.00 | -0.33 | 0.00 | 1.00 | 0.60 | 1.00 | 0.61 | 0.00 | -1.00 | -1.00 | -1.00 | 0.98 | 0.24 | 1.00 | 0.00 | 0.75 | 0.00 | -0.24 | -1.00 |
| Humbug Creek | 0.11 | 1.00 | -0.95 | 0.00 | 1.00 | 0.61 | 0.02 | 0.02 | 0.39 | 0.51 | 1.00 | 0.38 | 1.00 | -0.95 | -1.00 | -0.90 | -0.03 | 0.54 | 1.00 | 0.00 | 0.33 | 0.00 | 0.11 | -1.00 |
| Deep Creek | -0.50 | 1.00 | -0.25 | 0.00 | -0.70 | -0.21 | -0.52 | 0.17 | -0.50 | 0.39 | 1.00 | 0.51 | 0.58 | -0.85 | -0.84 | -0.85 | 0.11 | 0.18 | 1.00 | 0.00 | 0.38 | 0.00 | -0.50 | -1.00 |
| Squaw Creek | -0.18 | 1.00 | 0.31 | 0.00 | -1.00 | 0.38 | -0.25 | 0.13 | -0.80 | 0.54 | 1.00 | 0.70 | -0.05 | -0.34 | -1.00 | 0.32 | -0.11 | 0.10 | 1.00 | 0.00 | 0.42 | 0.00 | -0.18 | -1.00 |
| Little Fishhawk Creek | 0.06 | 1.00 | 0.11 | 0.25 | 0.15 | 0.17 | -0.02 | 0.33 | 0.29 | 0.41 | 1.00 | 0.57 | 0.55 | -0.53 | -1.00 | -0.06 | 0.47 | 0.45 | 1.00 | 0.09 | 0.52 | 0.17 | 0.06 | -1.00 |
| Carcus Creek | 0.02 | 1.00 | 0.00 | 0.00 | 0.00 | 1.00 | -0.07 | 0.00 | -0.22 | 0.20 | 1.00 | 0.95 | 0.00 | -1.00 | -1.00 | -1.00 | 1.00 | 0.30 | 1.00 | 0.00 | 0.74 | 0.00 | 0.02 | -1.00 |
| Upper Lewis And Clark River | 0.20 | 0.50 | -0.75 | 0.00 | 0.24 | 0.49 | 0.17 | 0.00 | 0.95 | 0.57 | 1.00 | 0.67 | 0.75 | -0.94 | -1.00 | -0.87 | 0.14 | 0.32 | 1.00 | 0.00 | 0.49 | 0.00 | 0.20 | -1.00 |
| Upper Clatskanie River | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |

| Stream Name | Catchment Condition | Connectivity | CWD Frequency | Dissolved Oxygen | Fines | Floodplains | Floodplains Road Density | Habitat | Human Use | Hydrologic Response | Land Use / Land Cover | Landslides / Land Use | Pool Frequency | Riparian | Riparian Conifer | Riparian Deciduous | Road Density | Stream | Stream Flow | Temperature | Upslope | Water Quality | Watershed Condition | Watershed Name |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Calvin Creek | -0.66 | 1.00 | -0.67 | 0.00 | -0.67 | -0.13 | -0.71 | 0.00 | -1.00 | 0.30 | 1.00 | 0.57 | 0.67 | -1.00 | -1.00 | -1.00 | 0.72 | 0.15 | 1.00 | 0.00 | 0.56 | 0.00 | -0.66 | -1.00 |
| Beneke Creek | 0.23 | 0.93 | 1.00 | 0.00 | -0.25 | 0.61 | 0.22 | 0.64 | 0.25 | 0.63 | 1.00 | 0.93 | 0.29 | -0.21 | -1.00 | 0.59 | 0.83 | 0.39 | 1.00 | 0.00 | 0.81 | 0.00 | 0.23 | -1.00 |
| Lundgren Creek | -0.34 | 0.62 | 0.00 | -0.11 | 0.00 | 0.14 | -0.40 | 0.00 | -0.35 | 0.39 | 1.00 | 0.77 | 0.00 | -0.97 | -1.00 | -0.95 | 0.57 | 0.26 | 1.00 | 0.00 | 0.60 | -0.06 | -0.34 | -1.00 |
| Middle Clatskanie River | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Northrup Creek | 0.02 | 1.00 | 0.53 | 0.00 | -0.76 | 0.11 | -0.03 | 0.28 | 0.11 | 0.62 | 1.00 | 0.81 | 0.04 | -0.31 | -0.96 | 0.34 | 0.20 | 0.19 | 1.00 | 0.00 | 0.57 | 0.00 | 0.02 | -1.00 |
| Fishhawk Creek | 0.38 | 1.00 | 1.00 | 0.33 | -0.93 | 0.45 | 0.48 | 0.87 | 0.94 | 0.59 | 1.00 | 0.87 | 0.74 | 0.05 | -0.30 | 0.40 | 0.84 | 0.33 | 1.00 | 0.00 | 0.78 | 0.17 | 0.38 | -1.00 |
| South Fork Klaskanine River | 0.19 | 0.84 | 0.49 | 0.00 | 0.87 | 0.45 | 0.12 | 0.75 | 0.71 | 0.64 | 1.00 | 0.13 | 1.00 | -0.79 | -1.00 | -0.59 | -0.48 | 0.67 | 1.00 | 0.00 | 0.15 | 0.00 | 0.19 | -1.00 |
| Upper Youngs River | -0.09 | 1.00 | -0.33 | 0.00 | -0.11 | 0.13 | -0.15 | -0.01 | 0.33 | 0.51 | 1.00 | 0.46 | 0.32 | -0.90 | -1.00 | -0.81 | 0.22 | 0.27 | 1.00 | 0.00 | 0.43 | 0.00 | -0.09 | -1.00 |
| Lower Clatskanie River | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| North Fork Klaskanine River | 0.04 | -0.15 | 0.17 | 0.00 | -0.14 | 0.15 | 0.01 | 0.13 | 0.42 | 0.66 | 1.00 | 0.48 | 0.09 | -0.55 | -1.00 | -0.09 | 0.71 | 0.22 | 1.00 | 0.00 | 0.64 | 0.00 | 0.04 | -1.00 |
| Plympton Creek | 0.21 | -1.00 | 0.00 | 0.00 | 0.00 | 0.46 | 0.15 | 0.00 | 1.00 | 0.88 | 1.00 | 1.00 | 0.00 | -1.00 | -1.00 | -1.00 | 1.00 | 0.16 | 1.00 | 0.00 | 0.96 | 0.00 | 0.21 | -1.00 |
| Lower Lewis And Clark River | 0.05 | 1.00 | -1.00 | 0.00 | -0.25 | 0.37 | -0.02 | -0.39 | 0.37 | 0.47 | 1.00 | 0.59 | 0.22 | -0.79 | -1.00 | -0.58 | 1.00 | 0.15 | 1.00 | 0.00 | 0.71 | 0.00 | 0.05 | -1.00 |
| Wallooskee River | 0.01 | 1.00 | 0.00 | 0.00 | 0.00 | -0.56 | -0.09 | 0.00 | 1.00 | 0.85 | 1.00 | 0.62 | 0.00 | -0.72 | -1.00 | -0.44 | 0.84 | 0.30 | 1.00 | 0.00 | 0.78 | 0.00 | 0.01 | -1.00 |
| Big Creek | -0.16 | 1.00 | 0.76 | 0.00 | -0.22 | 0.36 | -0.26 | 0.74 | -0.25 | 0.48 | 1.00 | 0.61 | 0.73 | -0.88 | -1.00 | -0.75 | 0.28 | 0.42 | 1.00 | 0.00 | 0.49 | 0.00 | -0.16 | -1.00 |
| Lower Youngs River | 0.14 | 0.47 | 0.00 | 0.00 | 0.00 | 0.09 | 0.06 | 0.00 | 1.00 | 0.82 | 1.00 | 0.76 | 0.00 | -0.90 | -1.00 | -0.79 | 1.00 | 0.27 | 1.00 | 0.00 | 0.87 | 0.00 | 0.14 | -1.00 |
| Gnat Creek | 0.13 | 0.56 | 0.37 | 0.00 | -0.70 | 0.29 | 0.11 | 0.19 | 0.83 | 0.69 | 1.00 | 0.82 | 0.00 | -0.79 | -0.86 | -0.72 | 0.85 | 0.15 | 1.00 | 0.00 | 0.80 | 0.00 | 0.13 | -1.00 |
| Skipanon River | -0.07 | -0.33 | 0.00 | 0.00 | 0.00 | -0.13 | -0.10 | 0.00 | 0.33 | 0.71 | 0.84 | 0.96 | 0.00 | -0.50 | 0.00 | -1.00 | 0.00 | 0.21 | 1.00 | 0.00 | 0.57 | 0.00 | -0.07 | -1.00 |
| Lower Necanicum River | -0.09 | 0.38 | -0.40 | 0.20 | -0.40 | -0.15 | -0.16 | 0.00 | 0.43 | 0.60 | 1.00 | 0.72 | 0.39 | -0.75 | -0.60 | -0.90 | 0.35 | 0.19 | 1.00 | 0.04 | 0.59 | 0.12 | -0.09 | -1.00 |
| Columbia River-Cathlamet Channel | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Columbia River-Baker Bay | 0.26 | 0.34 | 0.00 | 0.00 | 0.00 | 0.26 | 0.25 | 0.00 | 1.00 | 0.72 | 1.00 | 0.15 | 0.00 | -0.50 | 0.00 | -1.00 | 0.00 | 0.26 | 1.00 | 0.00 | 0.33 | 0.00 | 0.26 | -1.00 |