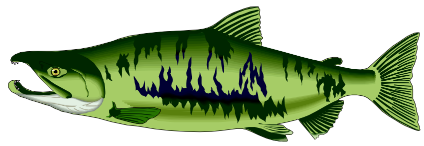
CHETCO RIVER

WATERSHED ASSESSMENT



Prepared for

The Chetco River Watershed Council

Prepared by

Mike Maguire
South Coast Watershed Council

June 2001

South Coast Watershed Council
PO Box 666
Gold Beach, Oregon 97444
(541) 247-2755

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ABSTRACT

The *Chetco River Watershed Assessment* was prepared for the Chetco River Watershed Council whose members are dedicated to sustaining the health of their watershed. This document contains detailed information about the Chetco River watershed and follows guidelines described in the *Governor's Watershed Enhancement Board's 1999 Draft Oregon Watershed Assessment Manual*. Funding was provided by the Oregon Watershed Enhancement Board, Oregon Department of Environmental Quality, United States Bureau of Land Management, Oregon Department of Agriculture, Curry County Soil and Water Conservation District and Oregon State University Extension Service.

ACKNOWLEDGEMENTS

The completion of the *Chetco River Watershed Assessment* was accomplished through the combined effort of private citizens, watershed council members, contracted technical specialists, and local state and federal government agencies. The South Coast Watershed Council would like to thank the following people who generously provided time and energy to improve the quality of this assessment. Additional people helped whose names are not included below. We also acknowledge them.

CONTRIBUTORS

Cindy Meyers	Riparian, Sediment, and Fish
Matt Swanson	Riparian and Wetland
Chris Massingill	Watershed Synthesis and Fish
Joe Wierzba and Harry Hoogesteger	Fish
Hyatt Barnes	Computer Support
Lucy LaBonte, Carol Barnes and Gerry Livingston	History
Mike Mathews	Riparian

REVIEWERS

Harry Hoogesteger	South Coast Watershed Council
Cindy Meyers	South Coast Watershed Council
Matt Swanson	South Coast Watershed Council
Chris Massingill	South Coast Watershed Council
Connie Risley	United States Forest Service
Frank Burris	Oregon State University Extension Service
Dale Stewart	United States Bureau of Land Management
Todd Confer	Oregon Department of Fish and Wildlife
Kathy Wiggins	Oregon Department of Forestry
Bruce Follansbee	Lower Rogue Watershed Council
Russ Stauff	Oregon Department of Fish and Wildlife
Lloyd Van Gordon	Oregon Department of Water Resources

INTRODUCTION & PURPOSE

The *Chetco River Watershed Assessment* contains technical information about past and present conditions in the watershed. This document updates and expands on information presented in the *South Coast Watershed Action Plan (1995)*. This assessment is a resource to promote better understanding of the Chetco River and its drainage area. The assessment was conducted in response to a need for more detailed information on salmonid fish and their habitat as well as water quality within the watershed. Particular emphasis was placed on private lands within the basin. The *Chetco River Watershed Assessment* is based on current information and should be periodically updated, as new information becomes available.

The assessment methodology followed guidance provided by the *Governor's Watershed Enhancement Board's 1999 Draft Oregon Watershed Assessment Manual*. In some instances, diversions were made from this manual based on discussions with technical specialists and/or limitations pertaining to the time and scope of the project. The assessment examined historical conditions, ecoregions, channel habitat types, salmonid fish and their habitat, water quality, sediment sources, riparian conditions, wetland conditions, hydrology and water use. Among the components addressed in the Oregon Watershed Assessment Manual that were not included in this assessment was an assessment of channel modifications.

The purpose of this assessment was to compile, summarize and synthesize existing data and information pertaining to Chetco River's watershed conditions. Near completion of this document an interdisciplinary team, comprised of twelve technical specialists, reviewed the individual components of the assessment. The interdisciplinary team later met to discuss key findings, issues and/or concerns related to each of the assessment components. This information was then synthesized to provide a foundation for the prioritization of projects outlined in the *Chetco River Watershed Action Plan (August, 2001)*. The action plan is a complementary document that addresses site specific and watershed wide recommendations for achieving restoration, enhancement and protection goals.

I WATERSHED CHARACTERIZATION

A INTRODUCTION

The Chetco River, located almost entirely within Curry County, drains approximately 352 square miles or 225,000 acres. The Chetco is the largest coastal watershed (excluding the Rogue River) in Oregon south of the Coquille. The Chetco mainstem is about 56 miles long with its headwaters and the first 28 miles of the mainstem located within the Kalmiopsis Wilderness. Flowing in a westerly direction the Chetco empties into the Pacific Ocean at Chetco Cove located about 6 miles north of the California line between the towns of Brookings and Harbor. Elevations in the watershed range from sea level to approximately 5,098 feet on Pearsoll Peak. Major tributaries include Box Canyon Creek, Tincup Creek, Boulder Creek, Mislatnah Creek, Quail Prairie Creek, Eagle Creek, South Fork, Emily Creek, North Fork and Jack (s) Creek. The upper portion of the basin is characterized by steeply sloped forested areas with narrow valleys and tributary streams that have moderately steep to very steep gradient. The lowest 11 miles of the river is bordered by private land. Rural residential development, forestry, and urban areas are the dominant land uses in this lower portion of the basin. The Chetco estuary, estimated at 1.7 miles in length has been substantially altered from its natural state.

B SUBWATERSHEDS

The Chetco River watershed was divided into 17 “subwatersheds” for the purpose of this assessment. These subwatersheds generally follow hydrologic boundaries. However, some units include a series of small watersheds that do not drain into a common stream or include segments that are parts of a larger watershed. The delineation of subwatersheds provides a convenient way to refer to areas within the larger watershed.

Delineation of subwatershed boundaries was based on several factors, including preexisting boundaries established by federal agencies and major changes in topography, land use and stream size. Subwatersheds were named after the major tributary within the subwatershed so that references to each subwatershed would be consistent throughout all components of the assessment. In cases where no major tributary exists subwatersheds were named according to their relative location within the watershed (e.g. Lower Chetco Mainstem subwatershed).

Table 1 Chetco River Subwatersheds

Subwatershed	Subwatershed Area (square miles)	Subwatershed Area (acres)
Boulder Creek	21.83	13,973
Box Canyon Creek	14.93	9,552
Chetco Coastal Area	7.95	5,093
Eagle Creek	20.55	13,149
Emily Creek	12.48	7,984
Granite & Carter Area	32.89	21,044
Jack Creek	8.80	5,631
Lower Chetco Mainstem (1)	9.24	5,915
Lower Chetco Mainstem (2)	22.63	14,481
Middle Chetco Mainstem	25.44	16,281
Mislatnah Creek	10.98	7,029
North Fork Chetco	40.19	25,713
Quail Prairie Creek	11.48	7,346
South Fork Chetco	31.81	20,282
Tincup Creek	27.74	17,750
Upper Chetco Mainstem (1)	16.60	10,622
Upper Chetco Mainstem (2)	36.39	23,190
Totals	**351.92**	**225,035**

C LAND OWNERSHIP AND USE

<u>Land Ownership</u>

Over eighty percent of the watershed is in public ownership. Approximately seventy eight percent of the watershed is managed by the United States Forest Service (USFS) and includes lands within the Siskiyou National Forest and Kalmiopsis Wilderness. The Bureau of Land Management (BLM) manages approximately five percent of the entire watershed with the majority of their holdings located in the North Fork subwatershed. Private industrial lands account for approximately eleven percent of the total watershed area. South Coast Lumber Co. owns and manages the majority of private industrial lands in the basin. Non-industrial private lands reflect about five percent of the watershed area whereas City, County and State holdings total less than one percent. Approximately one percent of the watershed is unidentified non-federal land ownership.

Table 2 Land Ownership by Subwatershed (acres)

Subwatershed	BLM	Small Private	Private Industrial	USFS	City	State	County	No Data	Total Acres
Boulder Creek				13,973					13,973
Box Canyon Creek				9,553					9,553
Chetco Coastal Area	58	3,163	1,584		3	60			4,868
Eagle Creek	450	4	1,481	11,215					13,150
Emily Creek			25	7,945		16			7,986
Granite & Carter Area				21,047					21,047
Jack Creek		1,576	2,060	1,708			30	257	5,631
Lower Chetco Mainstem (1)	257	2,122	442	2,383		249		461	5,914
Lower Chetco Mainstem (2)				14,481					14,481
Middle Chetco Mainstem	621	1,287	6,837	7,464		51		21	16,281
Mislatnah Creek				7,027					7,027
North Fork Chetco	9,236	3,751	12,464			273			25,724
Quail Prairie Creek			165	6,485				699	7,349
South Fork Chetco				20,358					20,358
Tincup Creek				17,753					17,753
Upper Chetco Mainstem (1)			4	10,044				572	10,620
Upper Chetco Mainstem (2)				23,288					23,288
Total Acres	**10,622**	**11,903**	**25,062**	**174,724**	**3**	**649**	**30**	**2,010**	**225,003**

Land Use

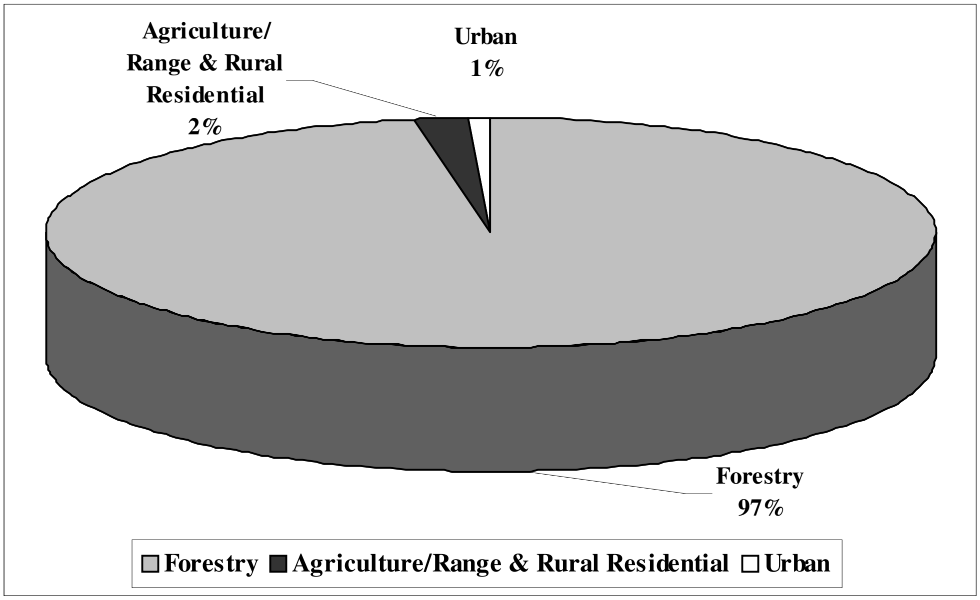
Land use in the watershed is divided into three types including (1) forestry, (2) urban, and (3) agriculture/range or rural residential. **Note:** Distinguishing between agriculture/range and rural residential was beyond the scope of this assessment and therefore the two are lumped into one land use.

(1) Forestry, the most dominant land use in the watershed, accounts for 97% of the watershed area and includes all private industrial and private non-industrial lands in forestry use as well as lands managed by the USFS and BLM. Wilderness allocation accounts for over half (approximately 57%) of the total land area within the Siskiyou National Forest lands in the basin. Although forestry use is common throughout the entire basin it is most prevalent in the middle and upper portions of the watershed.

(2) Urban use accounts for approximately one percent of the watershed and is confined to the Chetco Coastal Area subwatershed. Urban area includes some of Brookings and Harbor townships.

(3) Agriculture/range and rural residential areas, as referred to in this document, are situated upstream of the Chetco Coastal Area subwatershed boundary (near the mouth of the North Fork). Rangelands are primarily managed for livestock grazing whereas agricultural lands, although minimal, are primarily managed for lily production. Major types of livestock include cattle and sheep.

Figure 1 Watershed Land Use Summary



II WATERSHED ISSUES

A BACKGROUND (GWEB 1999)

The issues to be addressed in a watershed assessment typically arise from local efforts to address concerns that often begin at federal and state levels. Listing of fish populations under the federal Endangered Species Act, for example, immediately focuses attention on evaluating habitat quality or hatchery production in the watershed. Likewise, water quality limited stream segments, listed under authority of the federal Clean Water Act, require that watershed management plans or Total Maximum Daily Loads (TMDLs) be developed at the state or local level.

B INTRODUCTION

The identification of watershed issues was intentionally conducted early in the process to help direct the watershed assessment. The purpose of identifying watershed issues was primarily to gain an understanding of the Chetco River Watershed Council's perspective on those practices that may potentially impact salmonid fish habitat and water quality. Watershed council members met during a council meeting held at the Chetco Ranger District Office in Brookings on April 7, 1999.

C RESULTS

The Chetco River watershed issues are summarized in two tables: Table 3, Chetco River Regulatory Issues and Table 4 Chetco River Watershed Council Issues.

Table 3 Chetco River Regulatory Issues

<table>
<tr><td rowspan="9">Aquatic Resource Issues
(Based on federal and state law)</td><td colspan="3">Endangered Species Act</td></tr>
<tr><td>Species</td><td colspan="2">Status</td></tr>
<tr><td>coho salmon</td><td colspan="2">threatened</td></tr>
<tr><td colspan="3">Clean Water Act – 303 (d) List</td></tr>
<tr><td>Tributary / Reach</td><td>Boundary</td><td>Parameter</td></tr>
<tr><td>Chetco River</td><td>Mouth to Box Canyon Creek</td><td>Temperature</td></tr>
<tr><td>North Fork Chetco</td><td>Mouth to Headwaters</td><td>Temperature</td></tr>
<tr><td>Bravo Creek</td><td>Mouth to Headwaters</td><td>Temperature</td></tr>
</table>

Table 4 Chetco River Watershed Council Issues

Issues	Comments
Lack of Large Woody Debris	1) There is less large wood in the main channel now. Landowners recall logjams that forced the river to bend and increase sinuosity.
Undersized Culverts	1) A lot of road construction was done during the last dry period. There are now likely many undersized culverts. 2) Plugged culverts are now a major issue.
Rural Residential Development	1) In 1950, there were less than 10 adjoining property owners near the mouth of the North Fork; now there are 92. 2) Increase in development observed after 1984.
Timber Harvest	1) Bravo Creek (tributary to North Fork) was totally logged out, "blitzed" in the 1950s.
Channel Changes	1) Prior to 1955, the mainstem immediately above the North Fork was against the far SE bank and curved into the hole upstream of the Freeman Gravel operation. The flood of 1955 straightened the river at this location but soon after the river began to migrate across the channel. By 1962 it was taking out cottonwoods that were growing on the NW bank by Keith Smith's pasture. After the 1964 flood the river was back on the SE bank. 2) The delta at the mouth of Jack Creek didn't start to build up until after the 1964 flood. Before that time the thalweg (deepest part) of the river was against the mouth of Jack(s) Creek. 3) During the 1950's and 60's there were larger and deeper pools in the mainstem and the river was more sinuous. There was a deep hole near the mouth of the South Fork that filled in until recent scouring started during the past few years. 4) Significant channel changes observed at the South Fork in 1999. 5) No channel changes were observed downstream of Jack(s) Creek except that Snug Harbor has silted in.
Road Construction	1) After the main road was built above Loeb Park it delivered a lot of sediment to the mainstem.
Water Quality	1) The clarity of the water is higher now than in the 1950's and 60's when there was a lot of logging and road construction.

GWEB 1999. Oregon Watershed Assessment Manual. Governor's Watershed Enhancement Board, July 1999

III HISTORICAL CONDITIONS

A INTRODUCTION

The following is a summary of transcripts from interviews conducted with four residents from the Chetco River watershed in February and March of 1996. Special recognition is given to these residents for contributing to the documentation of historical conditions of the Chetco River watershed. The four residents include Ted Freeman, Sr., Archie McVay, Walt Thompson, and Roger Thompson. Interviews were conducted by Lucie LaBonte and transcripts were prepared by Carol Barnes. Finally, the transcripts were organized by subject and edited by Gerry Livingston.

While the Chetco River watershed has been altered and restoration to a pristine condition is not an option, knowledge of historic conditions and the cumulative effects of land use can help guide restoration actions and improve chances for success (HRWA 1999). Documenting how natural, unmanaged streams interacted with the streamside forest allows us to see how far we have deviated from optimum fish habitat requirements (Sedell and Luchessa 1981).

B SUMMARY

<u>Individuals Interviewed</u>

Ted Freeman (TF): Lived on the south side of the Chetco River for 48 years and on the southwest side of Jack(s) Creek for two years

Archie McVay (AM): Lived his entire life 25 miles up the Chetco River.

Walt Thompson (WT) & Roger Thompson (RT): Lived in Chetco River watershed since 1951-1952.

<u>Recreation</u>

RT/WT/TF: I swam, fished and hunted up and down the watershed. I started drift fishing in the late 50's to early 60's. I had a drift boat before I had a driver's license. Swimming holes were at Freeman's Hole, Second Bridge and Loeb Park. You couldn't go above Loeb State Park. The road ended.

<u>Logging</u>

TF: The big removal was in 1915 when they had the railroad up here. The ranch that my grandparents had was logged-out. The creek, they had a sawmill up there.

RT/WT: We forded the river about seven times at Miller Bar to Wilson Bar; this was our highway to haul lumber out. It was logged about 75 years ago (est. 1919) by the old

Brookings Lumber. They shut the mill down about 1925. They then gave-up fir logging and logged redwood. From 1950 to the 60's was the last time there was timber of any size.

AM: They planted it back. The watershed is in better shape than I've ever seen it.

Debris

RT/WT: I drifted the river in the 50's and 60's. There was never a lot of wood on the river because the floods kept it washed out.

AM: Not on the river. On the tributaries, yes and (during/from) the 64' flood.

TF: Even before the '64 flood we'd had a lot of completely felled trees come down the river. But, what is coming down now is a lot less than in the past. Debris was removed from the creeks.

Agency Work

AM: There was a project at the falls. During low flows, the salmon couldn't go up-stream. We worked with a fellow from the fish commission; they took a jackhammer and opened up the stream. Now fish can go-up in low water.

RT/WT: I think those decisions affected tributaries like Jack(s) Creek and maybe Wilson creek (but not the main river).

Vegetation

TF: Willows have not grown back along the river, probably due to removal of the topsoil close to the river.

RT/WT: Vegetation grew where there were sand dunes.

Gravel Removal

RT/WT: They took hundreds of thousands of yards of gravel out of the south bank. McKenzie and Tidewater took gravel, but I don't remember anybody taking gravel above Freeman's. There wasn't a great deal of gravel in the 50's and 60's. When they built the high school the gravel came right off the beach, sticks and all.

TF: Actually, there's never been any gravel withdrawn (from the river) where we are because the permit is for the gravel bar.

AM: Removal - Freeman Bar, by second bridge, and Ferry Creek (Tidewater)

Channel Morphology / Streamflow / Floods '55 and '64 / Jetty

AM: '64 was more of a flood than '55. I don't remember the '55 doing that much damage. 1964 washed all the gravel down and filled all the holes where there had been deep holes before. The Chetco hasn't fully recovered yet. It washed out the boat basin.

There are getting to be deep holes again. After the '64 flood we used to be able to drive on the riverbed up to our ranch. Now there are holes there 15 feet deep.

RT/WT: I think the 1955 flood didn't impact this river much. But the '64 flood was terrific...an old house that had been there 70 years and it was the first time there had been water in it.

TF: In our area here it really moved quite a bit of land. All the little meadows and valleys filled up with water. It took out acreage for about 9-10 miles. Channel changed to what it is now.

AM: Drastically changed with the jetties. The river used to come out where the motel is. Now it comes out at the park. The jetties stabilized the channel. The river was deeper than it is now. The jetties pulled the river down so there aren't the holes like there used to be. From below the bridge you had nearly a mile to where the river went out. During summer, the flow would diminish.

TF: The swimming holes that we used to swim in are there no longer.

RT/WT: Morris hole is about the same. Tide Rock hasn't changed. Jack's Creek is about the same. The biggest change was the Freeman Hole, since the '64 flood.
Installation of jetties changed the river forever. They used to have to open it up. Fishing was not in the ocean; it was in the river. The mouth has changed drastically.

RT/WT: The creek (Hanscam?) dumped into the lagoon about 100 feet from the road. This (lagoon) used to be full of beaver.

RT/WT: I have heard it said by the old timers that the lagoon used to fill some when the river was blocked up.

TF: Years back we'd have a big storm and two or three days later the water would rise gradually and go down at a slow rate. It wouldn't raise and lower as fast as it does now.

Stream Temp

RT: I don't think the river was 64 degrees in the summer time for years. The temperature was in the 70's. They tried and tried to promote a fish hatchery here and the answer was no. The water was too warm.

AM: It always gets up in the 70 degrees. *("always been that way?")* Oh yes. There's been very little change in the Kalmiopsis wilderness area. That's why the river is in such good shape.

Climate

RT/WT: I don't think snow has affected any of the floods. It's rain, just plain rain. You can get a flood from rain in all the coastal rivers. We've never had a lot of snow. Maybe 8-12 inches at the most. This winter (1996) we've had a lot of snow on the upper reaches of the Chetco. You can tell by the color of the river. The river is green; that's caused by snowmelt.

RT/WT: The Pilot (kept records). Hew Acres kept the rainfall records for a number of years. They were the official weather people. He took the records from the early 50's until he graduated from high school. It was a national weather station at the time because of the number of airplanes that went over Brookings.

RT/LT: We had snow on the beach in '64, but it was only about four inches deep. We had every kind of weather that year.

Fish

TF: Back in 1925-30 there were…we called them spring salmon. Spring salmon...no longer there.

RT/WT: I think the State of Oregon put some silver salmon in the Smith River back in the 60's but they never took. Also, there was a spring chinook run in the (Chetco) river at one time.

AM: (Chinook) There is a spring run. There's still spring fish. I saw them two years ago. They stay near the bottom where it's cooler. They go up to the deep holes and stay there all summer and then spawn in the fall. Even now, not many, but some (exist). The Fish Commission would try to deny that, but that's a fact. We tried to get them to plant spring salmon, but they said no, this isn't a spring salmon stream. It's too short a stream and not snow fed. They said the water wasn't cold enough. There has been a lot of spring salmon in this river.

When Hugh had his hatchery in Gold Beach, the fishermen went up and brought some down in milk cans and they turned them out here. That was one of the ways they got those early spring salmon. They are pretty easy to catch so there's only a few hundred left up in those holes to spawn.

AM: Chinook - They are pretty much the same. They have their ups and downs. They have probably increased in the last couple of years compared to what it was 5 or 6 years ago. Nothing like it was 30 years ago. Now they go up to Tide Rock to the holes up there to lie. They used to lie in the lower river because it was deep water.

AM: *("remember coho?")* I certainly do, lots of them, all in the lower river. They used to spawn in Benumum Creek and the creek that runs up by Harbor store. They didn't go far up the river. When they had net fishing they used to catch them at Snug Harbor. (Ennis Rock) that was a great place for net-fishing for coho. There were a lot of coho caught with hook and line.

AM: (coho) They would come in, in the fall. They would run right along with the chinook. A lot would come in, in September. It seems like the fish run has gotten later. You used to count on catching the first fish around the last of August. September and October were good months. And now, we're up to November and December. I don't know what caused it, but it seems like a later run.

AM:(steelhead) I don't say it's (population/run) increased. I'd say it has its ups and downs. It's probably the hatch three or four years before. Something happened so they don't have as good a return as they could have. They don't catch steelhead commercially so they can't lay that on the commercial fisherman.

RT/LT: I remember people fishing for cutthroat.

AM: (sea run cutthroat) They used to follow the salmon in. They used to call them salmon trout (and/or) harvest trout. They would come-in, in the fall with the salmon. I don't see them now. There was certainly no problem catching your limit of sea run trout.

<u>Fishing</u>

TF: People that were fishing were getting the fish that they wanted. The people fishing now are going to be short of what they want to catch. So I think fish might be there but there are more people taking them. Spawned-out fish…same size now as they were.

TF: Sport fishing gets the spawners. If they can't hatch their eggs out they sure can't multiply. There used to be about 1 on a spot, now there are about 10.

RT/WT: Never had more fish than when the water was dirty. There were lots of fish. We would think after a hard winter or two, there wouldn't be any salmon in four years, and in four years there would be just as many salmon as there ever were. Logging has some affect on it, but I think the logging has gotten a lot more blame than it should.

The spring run depends on the snowmelt and real cold water. There has been tremendous fishing pressure on the river. That's been a major detriment to fishing.

It seems they used to close the river above Tide Rock on the 15th of November for salmon fishing. I think the Fish and Game Commission is doing a poor job of managing.

AM: (Fish size) Their about the same. It depends on the feed they get out in the ocean. Last year (1995) was a good year for exceptionally big fish. Next year might not be, but I don't see any real pattern.

Fish/History
RT/WT: It's cyclical. The river used to be full of smelt and herring. They were so thick in the river that a whole bunch suffocated. It stank so bad you couldn't stand to be in Harbor. Now they've virtually disappeared. Some years there would be anchovies and herring and some years not.

Fish/Spawning
AM: (Looking at photo) you don't see them like that any more because they are catching them before they get here. I think the spawning areas in the river, as far as I can tell, are as good as they've ever been. Used to be a lot more fish up the river. The old timers said they were survivors. They would go way up the river and spawn. The hatchery fish don't go so far up the river to spawn.

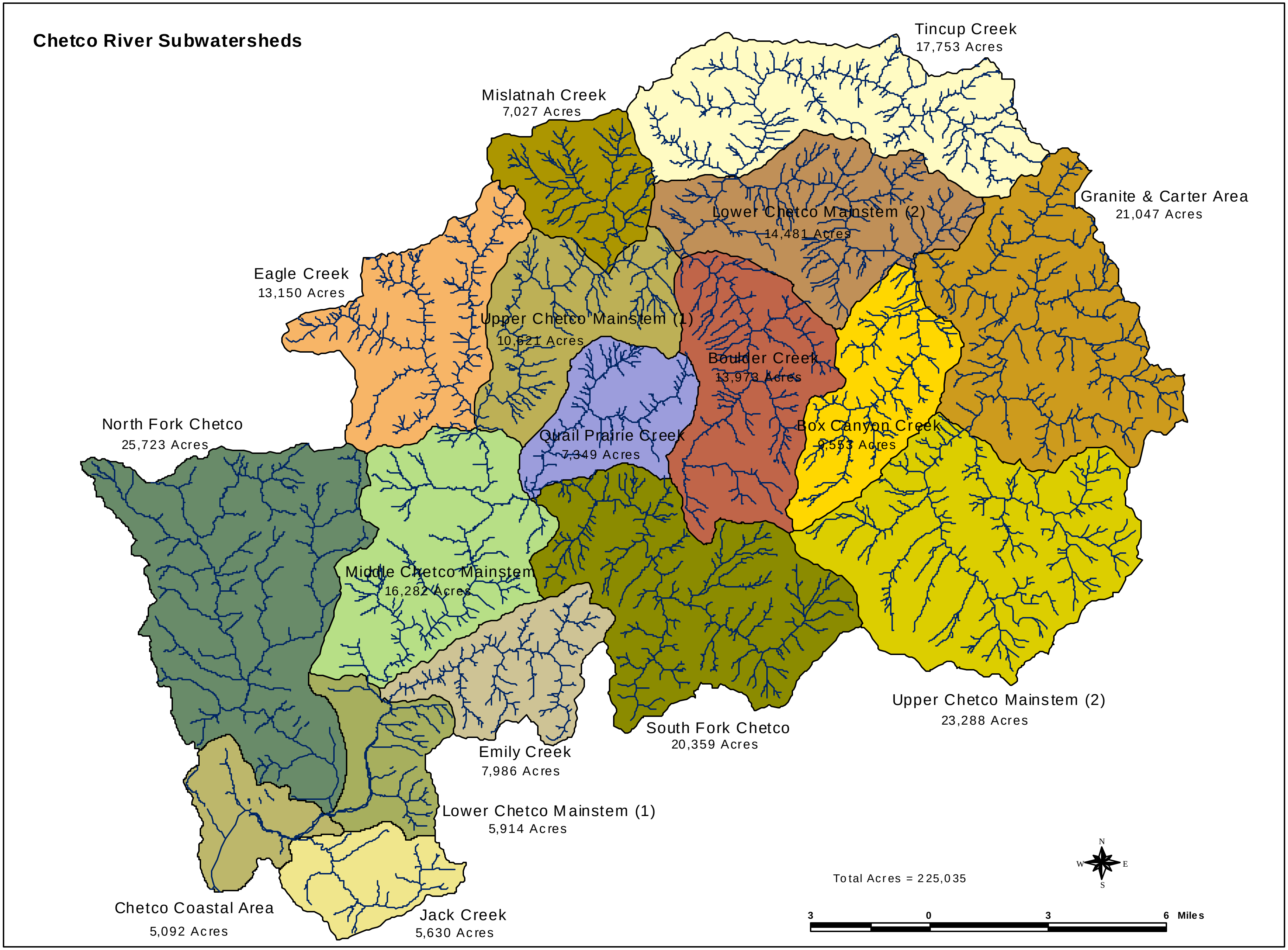
When they hatch up there, they really get acclimated to every thing coming along. They know how to fend for themselves a lot better. It stretches the feeding out. They feed all the way down the river.

AM: If we get heavy rain, like 4 or 5 inches in one night, it washes the eggs down the river.

The worst thing here now for the fish are the predators. Back in the 30's you never saw the cormorants - maybe one or two. They (now) just herd the fish and scoop them up. And of course, there's the sea lion taking its toll.

REFERENCES

HRWA 1999. Hood River Watershed Assessment. December, 1999



Chetco River Subwatersheds
Tincup Creek
17,753 Acres
Mislatnah Creek
7,027 Acres
Granite & Carter Area
21,047 Acres
Lower Chetco Mainstem (2)
14,481 Acres
Eagle Creek
13,150 Acres
Upper Chetco Mainstem (1)
10,621 Acres
Boulder Creek
13,973 Acres
North Fork Chetco
25,723 Acres
Quail Prairie Creek
7,349 Acres
Box Canyon Creek
9,553 Acres
Middle Chetco Mainstem
16,282 Acres
Upper Chetco Mainstem (2)
23,288 Acres
South Fork Chetco
20,359 Acres
Emily Creek
7,986 Acres
Lower Chetco Mainstem (1)
5,914 Acres
Chetco Coastal Area
5,092 Acres
Jack Creek
5,630 Acres
Total Acres = 225,035
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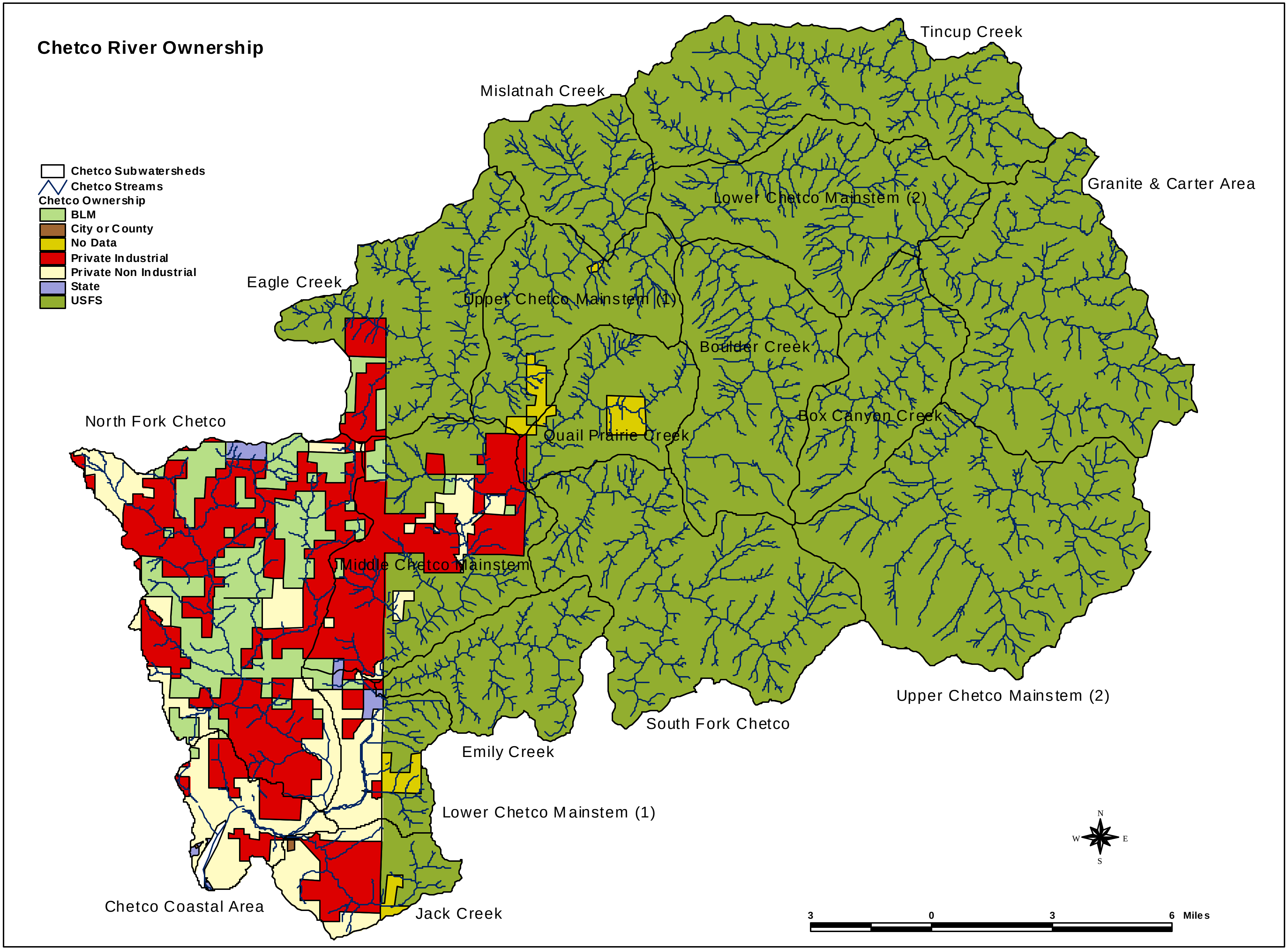

Chetco River Ownership
Chetco Subwatersheds
Chetco Streams
Chetco Ownership
BLM
City or County
No Data
Private Industrial
Private Non Industrial
State
USFS
Tincup Creek
Mislatnah Creek
Granite & Carter Area
Lower Chetco Mainstem (2)
Eagle Creek
Upper Chetco Mainstem (1)
Boulder Creek
Box Canyon Creek
North Fork Chetco
Quail Prairie Creek
Middle Chetco Mainstem
Upper Chetco Mainstem (2)
South Fork Chetco
Emily Creek
Lower Chetco Mainstem (1)
Chetco Coastal Area
Jack Creek
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IV ECOREGIONS

A BACKGROUND (GWEB 1999 and USEPA, 1996; Omernik, 1987)

The State of Oregon is divided into ecoregions that have been identified based on climate, geology, physiography, vegetation, soils, land use, wildlife, and hydrology. Each ecoregion has characteristic disturbance regimes that shape the form and function of watersheds in the region. They are designed to serve as a spatial framework for the research, assessment, management, and monitoring of ecosystems and ecosystem components. Ecoregions are directly applicable to the immediate needs of state agencies, including the development of biological criteria and water quality standards, and the establishment of management goals for nonpoint-source pollution. They are also relevant to integrated ecosystem management, an ultimate goal of most federal and state resource management agencies. The following table illustrates the hierarchy of ecoregions characterized for North America. Level I is the coarsest level, dividing North America into nine ecological regions, whereas at Level II the continent is subdivided into 32 classes. Level III contains 98 subdivisions in the continental United States whereas Level IV is a subdivision of Level III. Level IV Ecoregion descriptions provide the most detail and are therefore, the focus of this assessment.

Hierarchical Scheme of Ecoregions

Level I	9 Ecological Regions of North America
Level II	32 Ecological Regions of North America
Level III	98 Ecological Regions of North America
Level IV	>98 Ecological Regions (Subdivision of Level III)

(USEPA, 1996; Omernik, 1987)

B INTRODUCTION

The Chetco River watershed is situated within two Level-III Ecoregions that are subdivided into four Level-IV Ecoregions. The Level-III Ecoregions include the **Coast Range** and **Klamath Mountains**. Brief descriptions of these two broad ecoregions are provided in the following paragraphs. More detailed descriptions of the four Level-IV Ecoregions are provided in the following pages.

<u>Coast Range</u>

The Coast Range contains highly productive, rain drenched coniferous forests that cover low elevation mountains. Sitka spruce forests originally dominated the fog-shrouded coast, while a mosaic of western red cedar, western hemlock, and seral Douglas-fir blanketed inland areas. Today, Douglas-fir plantations are prevalent on the intensively logged and managed landscape. Within the Coast Range exist several Level IV Ecoregions. A portion of the Chetco River watershed is situated within one of these Level IV Ecoregions. It is titled the **Southern Oregon Coastal Mountains**. The Southern Oregon Coastal Mountains include the southern coastal area from Bandon to Brookings, extending inland from 5 to 20 miles.

Klamath Mountains

The Klamath Mountains ecoregion is physically and biologically diverse. Highly dissected, folded mountains, foothills, terraces, and floodplains occur and are underlain by igneous, sedimentary, and some metamorphic rock. The mild, subhumid climate of the Klamath Mountains is characterized by a lengthy summer drought. It supports a vegetal mix of northern California and Pacific Northwest conifers. Within the Klamath Mountains exist several Level IV Ecoregions. A portion of the Chetco River watershed is situated within three of these Level IV Ecoregions. They include the **Coastal Siskiyous**, the **Redwood Zone** and the **Serpentine Siskiyous**. The Coastal Siskiyous reflect the steep southwest mountains located within 60 miles of the coast. The Redwood Zone occurs in a small portion of southern Curry County, near the California border. Finally, the Serpentine Siskiyous are the southwestern Oregon mountains with soils derived from serpentine.

Table 5 Level IV Ecoregions by Subwatershed

Subwatershed	Southern Oregon Coastal Mountains		Coastal Siskiyous		Redwood Zone		Serpentine Siskiyous		Total Acres	Total Square Miles
	(acres)	%	(acres)	%	(acres)	%	(acres)	%		
Boulder Creek		0.0	12,667	90.7		0.0	1,306	9.3	13,973	21.8
Box Canyon Creek		0.0	1,463	15.3		0.0	8,090	84.7	9,553	14.9
Chetco Coastal Area	4,817	94.6	274	5.4		0.0		0.0	5,091	8.0
Eagle Creek		0.0	13,150	100.0		0.0		0.0	13,150	20.5
Emily Creek	2,026	25.4	5,960	74.6		0.0		0.0	7,986	12.5
Granite & Carter Area		0.0	21,047	100.0		0.0		0.0	21,047	32.9
Jack Creek	4,444	78.9		0.0	1,186	21.1		0.0	5,630	8.8
Lower Chetco Mainstem (1)	4,883	82.6	994	16.8	37	0.6		0.0	5,914	9.2
Lower Chetco Mainstem (2)		0.0	14,481	100.0		0.0		0.0	14,481	22.6
Middle Chetco Mainstem	7,077	43.5	9,204	56.5		0.0		0.0	16,281	25.4
Mislatnah Creek		0.0	7,027	100.0		0.0		0.0	7,027	11.0
North Fork Chetco	2,684	10.4	23,039	89.6		0.0		0.0	25,723	40.2
Quail Prairie Creek		0.0	7,349	100.0		0.0		0.0	7,349	11.5
South Fork Chetco		0.0	19,533	95.9		0.0	826	4.1	20,359	31.8
Tincup Creek		0.0	17,753	100.0		0.0		0.0	17,753	27.7
Upper Chetco Mainstem (1)		0.0	10,621	100.0		0.0		0.0	10,621	16.6
Upper Chetco Mainstem (2)		0.0		0.0		0.0	23,288	100.0	23,288	36.4
Totals	25,931	11.5	164,562	73.1	1,223	0.54	33,510	14.9	225,226	351.9

C LEVEL IV ECOREGION DESCRIPTIONS

(1) Southern Oregon Coastal Mountains (11.5% of Chetco River Watershed)

Physiography

The Southern Oregon Coastal Mountains is a mountainous ecoregion with an ocean-modified climate. It is a transitional area between the Siskiyou Mountains and the Coast Range and is underlain by Jurassic sandstone, metamorphosed sediments, granite, and serpentine. Overall, the geology is complex, like that of the Siskiyou Mountains, but its mountains are lower and not as dissected. The distributions of northern and southern vegetation blend together and species diversity is high. Streams are usually high gradient with steep side-slopes. Watersheds in this ecoregion typically have a high stream density due to the high precipitation, moderately steep gradients and fractured geology.

Geology & Soil

Geology is a complex mix of highly-fractured siltstone, shale, sandstone, gray wackie, granite and serpentine. Soils range from very deep to shallow, silt loam to very gravelly loam.

Climate

Precipitation	**Frost Free**	**Mean Temperature**	
Mean Annual (Inches)	Mean Annual (Days)	January Min/Max (°F)	July Min/Max (°F)
70 – 140	170 – 220	36/52	52/76

Wind

Summer	North winds prevail. East wind events associated with extreme high temperatures (>100° F) and high wind speeds (>35 mph) create extreme fire hazard conditions that may result in catastrophic wildfires
Winter	South winds prevail. Extreme high wind events (>100 mph) result in catastrophic wind storms.

(Wiggins 2001)

Runoff

Spring	Partially uniform; rainstorms create periods of higher runoff
Summer	Uniform; runoff gradually declines
Fall	Mostly uniform; runoff gradually increases; higher runoff during late fall rains
Winter	Not uniform; high runoff during rainstorms, especially when snow on ground

Erosion & Peak Flows

Erosion rate is high due to abundant precipitation, high uplift rates, earthquakes, steep slopes, fractured geology, and high landslide occurrence. Landslides are deep-seated earth flows in lower gradient areas or are shallow landslides (often triggering debris slides) in steep headwater channels. Peak flows (50-year recurrence interval, cfs per square mile) are 300 in northern portion to 550 in southern portion of ecoregion.

Stream Channel Characteristics

Characteristic	**Gradient**	**Stream Size**		
		Small	**Medium**	**Large**
Substrate	Low	Gravel	Gravel	Gravel / cobbles
	High	Gravel / cobbles	Gravel / cobbles	Cobbles / bedrock
Beaver Dams	Low	Some year-round	Few year-round	None
	High	Few in summer	None	None

Natural Disturbances

Fires are more frequent in Douglas fir / western hemlock forests than in their neighboring Sitka spruce forests, although the interval between fires is quite variable. Catastrophic fires occur about 50 years (Wiggins 2001). Large wildfires during late summer and fall once burned large areas within the southern Coast Range. Fires sometimes skipped over streamside areas. Native Americans and ranchers both used fire to maintain pastures. Fire suppression has now eliminated most large wildfires.

Extreme wind storms capable of toppling large patches of trees occur about every 35 to 100 years. Smaller earthquakes capable of triggering landslides occur every decade or so and catastrophic earthquakes occur about every 300 years. Extreme flood events are triggered by high intensity rainfall. High intensity rainfall and steep slopes trigger landslides.

Upland & Riparian Vegetation

Conifers	Douglas-fir, western hemlock, white fir/grand fir, Port Orford cedar, incense cedar, Brewer's spruce, and Sitka spruce
Hardwoods	red alder, big leaf maple, myrtle, madrone, tanoak, cascara–buckthorne, Oregon white oak, Oregon ash, and cottonwood
Shrubs	ceonothus spp., elderberry, manzanita, hazelnut, wax myrtle, and vine maple
Understory	huckleberry, ferns, salmonberry, thimbleberry, skunk cabbage, rushes, sedges, grasses, herbaceous (flowers etc.), fireweed, and poison oak
Noxious	gorse, scotch broom, blackberry, tansy, and thistles spp.

(Wiggins 2001)

Current riparian conifer regeneration is uncommon unless streamside areas are intensively disturbed, followed by control of competing hardwoods and brush. Potential riparian vegetation will vary according to channel confinement. Confined and moderately confined channels may include a narrow band of hardwoods (tanoak, myrtle, red alder) and brush nearest the stream with mainly Douglas fir and hardwoods beyond. Unconfined channels may consist of similar riparian communities although the band of vegetation may be considered moderately wide. Coniferous dominated sites along unconfined channels often occur on infrequently disturbed higher terraces.

Land Use

Forestry, recreation, rock quarries, greenery, mushrooms and some mining are the predominant land uses (Wiggins 2001).

Other

Irrigation withdrawals result in the partial dewatering of a number of streams during the summer.

(2) Coastal Siskiyous (73.1% of Chetco River Watershed)

Overview

The Coastal Siskiyous ecoregion has a wetter and milder maritime climate than elsewhere in the Klamath Mountains. Productive forests composed of tanoak, Douglas-fir, and some Port Orford cedar cover the dissected, mountainous landscape. These steep mountains are located within 60 miles of the coast. Elevations in this ecoregion range from 1,000 to 4,800 feet.

Physiography & Topography

Mountains are highly dissected. High gradient perennial and intermittent streams along with a few small alpine glacial lakes are characteristic of this ecoregion. Waterfalls are common. Stream density within watersheds is high; valleys are narrow.

Geology and Soil

Geology is underlain by conglomerates, sandstone, or siltstone. Soils range from deep, very gravelly silt loam to very gravelly loam.

Climate

Precipitation	**Frost Free**	**Mean Temperature**	
Mean Annual (Inches)	Mean Annual (Days)	January Min/Max (°F)	July Min/Max (°F)
70-130	100-190	38/50	50/76

Runoff

Spring	Partially uniform; rainstorms create periods of higher runoff
Summer	Uniform; runoff gradually declines, higher runoff during thunderstorms
Fall	Mostly uniform; runoff gradually increases; higher runoff during late fall rains
Winter	Not uniform; high runoff during rain storms and snow melt

Erosion and Peak Flows

Natural erosion rate is high due to steep terrain, high winter precipitation, high uplift rates, and weak rock. Peak flows (50-year recurrence interval, cfs per square mile) are 400 to 600.

Stream Channel Characteristics

Characteristic	**Gradient**	**Stream Size**		
		Small	**Medium**	**Large**
Substrate	Low	gravel	cobbles / gravel	cobbles
	High	gravel / cobbles	cobbles	cobbles / bedrock
Beaver Dams	Low	some year-round	some year-round	none
	High	few in summer	few in summer	none

Natural Disturbances

Both lightning-caused and human-caused fires were common in this region in the past. Streamside areas sometimes escaped the fires. Past fires varied in severity, depending on specific site conditions. Fire suppression has reduced the frequency of wildfires.

Upland and Riparian Vegetation

Conifers	Douglas-fir, western hemlock, Port Orford cedar, knobcone pine, Jeffrey pine, and western white pine
Hardwoods	red alder, big leaf maple, myrtle, madrone, tanoak, Oregon white oak, golden chinquapin, and canyon live oak
Shrubs	ceonothus spp., elderberry, manzanita, hazelnut, and vine maple
Understory	ferns, salmonberry, thimbleberry, skunk cabbage, rushes, sedges, grasses, herbaceous (flowers etc.), and poison oak
Noxious	scotch broom, gorse, blackberry, tansy, and thistles spp.

(Wiggins, 2001)

Current riparian conifer regeneration is common except where tanoak becomes established. Potential riparian vegetation will vary according to channel confinement. Confined and moderately confined channels may include a narrow band of hardwoods with mainly Douglas-fir, tanoak, Port Orford cedar, and Jeffrey pine beyond. Unconfined channels differ primarily in their width of hardwoods, which may be considered moderately wide rather then narrow.

Land Use

Forestry, ranching, rural residential development, recreation, rock quarries, greenery, mushrooms and some mining are the predominant land uses (Wiggins, 2001). Much of this ecoregion is managed by the Siskiyou National Forest so commercial forestry activities have been greatly curtailed in recent years.

(3) Redwoods Zone (<1% of Chetco River Watershed)

Overview

The Redwoods Zone is the northern most tip of an ecoregion that extends to San Francisco Bay. Remnants of unlogged redwood forest survive east of Brookings. The redwood forest, when it functioned as an intact ecosystem, moderated its own microclimate by entrapment of coastal fog and by shading. This ecoregion is part of the Siskiyou Mountains. Elevations in this ecoregion range from sea level to 2,000 feet.

Physiography & Topography

Dissected mountains with medium gradient, sinuous streams and rivers are characteristic of this ecoregion. Some waterfalls occur. Watersheds in this ecoregion have a high stream density due to high precipitation and fractured geology. Side slopes are moderately steep.

Geology and Soil

Geology is highly dissected greywacke. Soils range from very deep to moderately deep, well-drained, silty clay loam to silt loam.

Climate

Precipitation	**Frost Free**	**Mean Temperature**	
Mean Annual (Inches)	Mean Annual (Days)	January Min/Max (°F)	July Min/Max (°F)
80-95	190-280	38/50	50/74

Runoff

Spring	Partially uniform; rainstorms create periods of higher runoff
Summer	Uniform; runoff gradually declines
Fall	Mostly uniform; runoff gradually increases; higher runoff during late fall rains
Winter	Not uniform; high runoff during rainstorms

Erosion & Peak Flows
Erosion rate is high due to abundant precipitation, high uplift rates, earthquakes, fractured geology, and high landslide occurrence. Landslides are deep-seated earth flows in lower gradient areas or are shallow landslides (often triggering debris slides) in steep headwater channels. Peak flows (50-year recurrence interval, cfs per square mile) are about 550.

Stream Channel Characteristics

Characteristic	Gradient	Stream Size		
		Small	Medium	Large
Substrate	Low	fines	gravel / fines	gravel / cobbles
	High	gravel / fines	gravel / cobbles	cobbles / bedrock
Beaver Dams	Low	some year-round	few year-round	none
	High	few in summer	none	none

Natural Disturbances
Redwood forests experience fires of moderate severity, although redwood trees are fairly resistant to the effects of most fires. Fire return intervals vary, often depending on site moisture. Large wildfires during later summer and fall once burned large areas within the southern Coast Range. Fires sometimes skipped over streamside areas, especially in the Redwood Zone, which is frequently induced by fog. Fire suppression has now eliminated most large wildfires.

Extreme windstorms capable of toppling large patches of trees occur about every 35 to 100 years. Smaller earthquakes capable of triggering landslides occur every decade or so and catastrophic earthquakes occur about every 300 years.

Upland and Riparian Vegetation

Conifers	coastal redwood, Douglas-fir, grand fir/white fir, western hemlock, Port Orford cedar, western red cedar, and Sitka spruce
Hardwoods	red alder, big leaf maple, myrtle, madrone, tanoak, Oregon white oak, golden chinquapin, and canyon live oak
Shrubs	ceonothus spp., elderberry, manzanita, hazelnut, and vine maple
Understory	ferns, salmonberry, thimbleberry, skunk cabbage, rushes, sedges, grasses, herbaceous (flowers etc.), and poison oak
Noxious	scotch broom, gorse, blackberry, tansy, and thistles spp.

(Wiggins, 2001)

Current riparian conifer regeneration is uncommon unless streamside areas are intensively disturbed, followed by control of competing hardwoods and brush. Potential riparian vegetation will vary according to channel confinement. Confined and moderately confined channels are characterized by a narrow band of hardwoods and brush nearest stream with mainly redwood, Douglas-fir, and other hardwoods beyond. Unconfined channels differ primarily in their width of hardwoods, which are considered moderately wide rather then narrow. Areas with mostly conifer often occur on infrequently disturbed higher terraces.

Land Use
Forestry, ranching, rural residential development, recreation, rock quarries, greenery, mushrooms and some mining are the predominant land uses.

(4) Serpentine Siskiyous (14.9% of Chetco River Watershed)

Overview
The mountainous Serpentine Siskiyous ecoregion is highly dissected and is underlain by Jurassic serpentine. Rare understory species and sparse woodlands grow on its unique soils. Mining and associated water quality problems occur. Elevations in this ecoregion range from 1,500 to 4,200 feet.

Physiography & Topography
Mountains are highly dissected. High gradient perennial and intermittent streams are characteristic of this ecoregion. Waterfalls are common. Stream density within watersheds is high; valleys are narrow.

Geology and Soil
Geology is underlain by serpentine rock. Soils are derived from serpentine rock that results in sparse vegetation and a limited number of species. Soils range from stony clay loam to gravelly loam.

Climate

Precipitation	**Frost Free**	**Mean Temperature**	
Mean Annual (Inches)	Mean Annual (Days)	January Min/Max (°F)	July Min/Max (°F)
45-140	70-140	32/44	49/82

Runoff

Spring	Partially uniform; rainstorms create periods of higher runoff
Summer	Uniform; runoff gradually declines; higher runoff during thunderstorms
Fall	Mostly uniform; runoff gradually increases; higher runoff during late fall rains
Winter	Not uniform; high runoff during rainstorms and snow melt

Erosion & Peak Flows
Natural erosion rate is high due to steep terrain and high winter precipitation. Peak flows (50-year recurrence interval, cfs per square mile) are 100 to 600.

Stream Channel Characteristics

Characteristic	Gradient	Stream Size		
		Small	Medium	Large
Substrate	Low	gravel	cobbles / gravel	cobbles
	High	gravel / cobbles	cobbles	cobble / bedrock
Beaver Dams	Low	few year-round	few year-round	none
	High	none	none	none

Natural Disturbances

Both lightning-caused and human-caused fires were common in this region in the past. Streamside areas sometimes escaped the fires. Past fires varied in severity, depending on specific site conditions. Fire suppression has eliminated many wildfires.

Upland and Riparian Vegetation

Conifers	Douglas-fir, white fir, red fir, Port Orford cedar, western red cedar, incense cedar, knobcone pine, western white pine, sugar pine, ponderosa pine, Jeffrey pine, and Brewer's spruce
Hardwoods	red alder, big leaf maple, myrtle, madrone, tanoak, Oregon white oak, golden chinquapin, and canyon live oak
Shrubs	ceonothus spp., elderberry, manzanita, hazelnut, and vine maple
Understory	ferns, salmonberry, thimbleberry, skunk cabbage, rushes, sedges, grasses, herbaceous (flowers etc.), beargrass, and poison oak
Noxious	scotch broom, gorse, blackberry, tansy, and thistles spp.

(Wiggins, 2001)

Sparse woodlands with unique understory vegetation characterize upland vegetation. Potential natural vegetation includes species listed below and unique understory plants due to soils derived from underlying serpentine rock.

Current riparian conifer regeneration is common except where tanoak becomes established. Potential riparian vegetation will vary according to channel confinement. Confined and moderately confined channels are characterized by a narrow band of sparse brush with mainly Jeffrey pine, tanoak, and Douglas-fir beyond. Unconfined channels differ primarily in their width of riparian vegetation, which is considered moderately wide rather then narrow.

Land Use

Land use includes recreation, forestry, and mining.

Other

This ecoregion is a regional water source.

REFERENCES

GWEB 1999. Oregon Watershed Assessment Manual. Governor's Watershed Enhancement Board, July 1999

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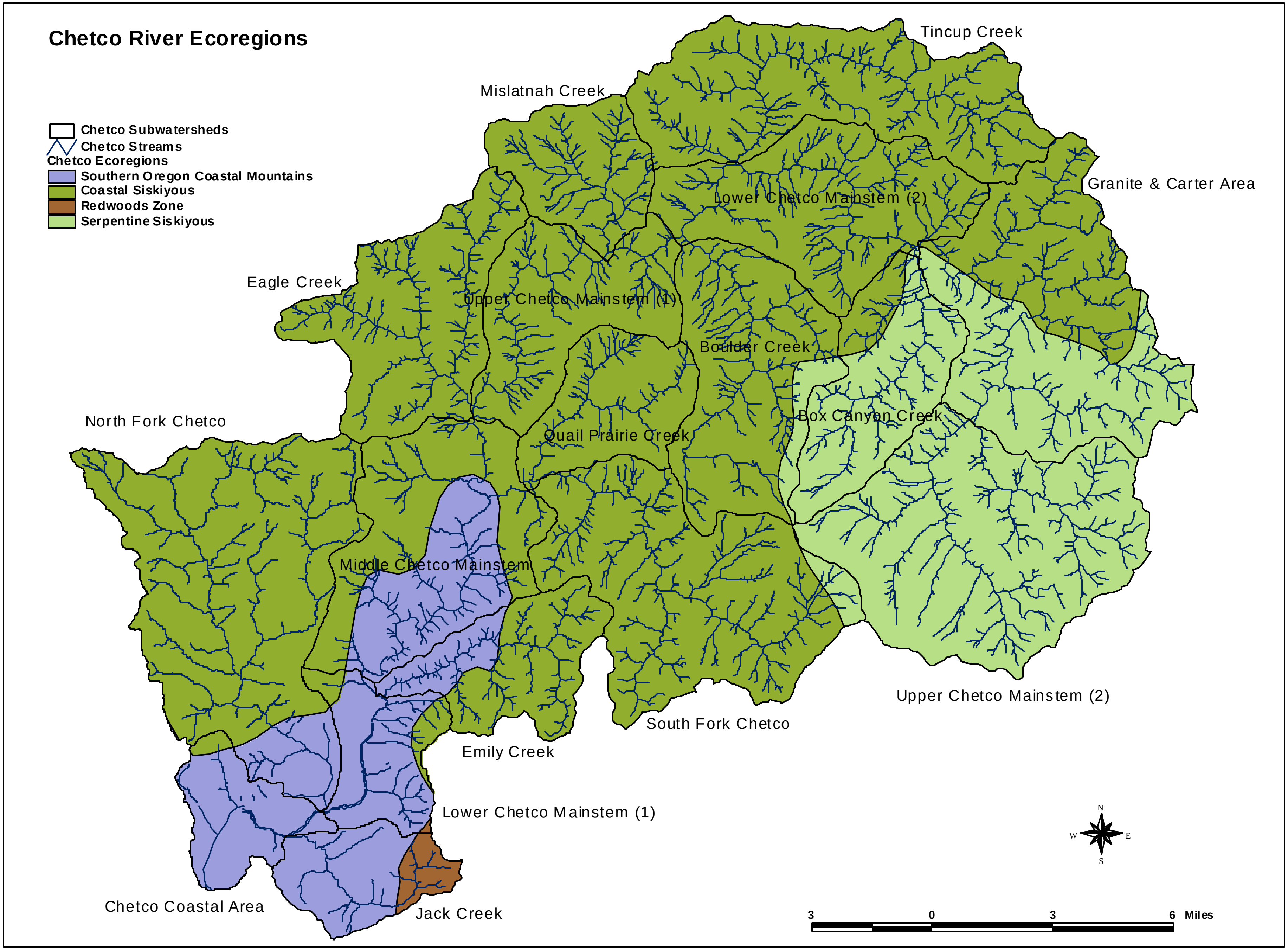


Chetco River Ecoregions
Chetco Subwatersheds
Chetco Streams
Chetco Ecoregions
Southern Oregon Coastal Mountains
Coastal Siskiyous
Redwoods Zone
Serpentine Siskiyous
Tincup Creek
Mislatnah Creek
Granite & Carter Area
Lower Chetco Mainstem (2)
Eagle Creek
Upper Chetco Mainstem (1)
Boulder Creek
North Fork Chetco
Box Canyon Creek
Quail Prairie Creek
Middle Chetco Mainstem
Upper Chetco Mainstem (2)
South Fork Chetco
Emily Creek
Lower Chetco Mainstem (1)
Chetco Coastal Area
Jack Creek
N
W
E
S
3
0
3
6
Miles

V CHANNEL HABITAT TYPES

A BACKGROUND (GWEB 1999)

Stream classification systems can be organized on different scales within a watershed: from as large as the entire channel network down to individual pools or microhabitats within those pools. The Oregon Watershed Assessment Manual (OWAM) provides a classification system centered in the middle of this hierarchy and incorporates landscape features such as valley type and stream reach features such as gradient. The variables selected to describe each channel type remain relatively constant within time scales of concern to land management. The scale of channel features is small enough to predict patterns in physical characteristics, yet large enough to be identified from topographic maps and limited field-work.

The following classification system, titled Channel Habitat Types (CHT), is based on several existing stream classification systems including Rosgen and Montgomery & Buffington (Rosgen 1993; Montgomery and Buffington 1993). The CHTs will enable users to make inferences about how land use impacts can alter physical channel form and process and, therefore, fish habitat.

Bankfull Width, Confinement & Modern Floodplain

Bankfull width is the width of the channel at the point at which over-bank flooding begins (unless the stream is incised), and often occurs as flows reach the 1.5 year recurrence interval level. *Confinement* is defined as the ratio of the bankfull width to the width of the modern floodplain. *Modern floodplain* is the flood-prone area (Rosgen 1996); it may or may not correspond to the 100-year floodplain.

Confinement Class	Floodplain Width
Unconfined	>4x Bankfull Width
Moderately Confined	>2x Bankfull Width but <4xBankfull Width
Confined	<2x Bankfull Width

Management Considerations

It is important to remember that CHTs cannot be managed as isolated segments. Stream reaches in one part of a watershed can be affected by activities taking place in a different part of the watershed, either up-stream, down-stream, or on adjacent land areas.

B INTRODUCTION

Chetco River and its tributaries represent a diversity of Channel Habitat Types. Table 6 Channel Habitat Type Attributes is a comparison of the 15 different channel types that potentially occur in a watershed. Each of these stream channels provides unique functions and significant values to both anadromous and resident fish. Eleven of these CHTs (see list below) were identified throughout approximately 140 miles of streams within the lower Chetco River basin. For the purpose of this assessment, the lower Chetco River includes five subwatersheds: Chetco Coastal Area, Jack Creek, Lower Chetco Mainstem, Middle Chetco Mainstem, and the North Fork Chetco. A description of each Channel Habitat Type assessed in the lower Chetco River is presented in Section E of this component.

Table 6 Channel Habitat Type Attributes (GWEB 1999)

CHT Code	Type	Gradient	Valley Shape	Channel Pattern	Channel Confinement	OR Stream Size	Position in Drainage
ES	Small Estuarine Channel	0 to 1%	broad	sinuous single or multiple	unconfined	small-med	bottom, mouth of stream
EL	Large Estuarine Channel	0 to 1%	broad	sinuous single or multiple	unconfined	large	bottom, mouth of stream
FP1	Low Gradient Large Floodplain Channel	0 to 1%	broad floodplain	sinuous single or multiple	unconfined	large	bottom, low in drainage
FP2	Low Gradient Floodplain Channel	0 to 2%	broad, flat or gentle landforms	sinuous single or multiple	unconfined	med-large	middle to lower end of drainage
FP3	Low Gradient Small Floodplain Channel	0 to 2%	broad	single or multiple	moderate to unconfined	small-med	variable
AF	Alluvial Fan Channel	1 to 12%	where hillslope opens to broad valley	single or multiple spread like a fan	variable	small-med	lower end of small tributaries
LM	Low Gradient Moderately Confined Channel	0 to 2%	broad, generally much wider than channel	single w/ occasional multiple channels	variable	variable, usually med-large	variable, often mainstem & low end of main tribs.
LC	Low Gradient Confined Channel	0 to 2%	low-mod gradient hillslope w/ limited floodplain	single channel, variable sinuosity	conifined by hillslope/terrace	variable, usually med-large	variable, generally mid to lower in large basin
MM	Moderate Gradient Moderately Confined	2 to 4%	narrow valley w/ flood-plain or narrow terrace	single, low to moderate sinuosity	variable	variable, usually med-large	middle to lower portion of drainage
MC	Moderate Gradient Confined Channel	2 to 4%	gentle to narrow V-shaped valley, little to no floodplain	single, relatively straight or conforms to hillslope	confined	variable	middle to lower portion of drainage
MH	Moderate Gradient Headwater Channel	1 to 6%	open, gentle V-shaped valley	low sinuosity to straight	confined	small	upper, headwater
MV	Moderately Steep Narrow Valley Channel	4-8%	narrow, V-shaped valley	single channel, relatively straight	confined	small-medium	middle to upper
BC	Bedrock Canyon Channel	>4%	canyons, gorges, very steep side slopes	single channel, straight	tightly confined by bedrock	variable	variable
SV	Steep Narrow Valley Channel	8 to 16%	steep, narrow V-shaped valley	single, straight	tightly confined	small, small to medium	middle upper to upper
VH	Very Steep Headwater	>16%	steep, narrow V-shaped valley	single, straight	tightly confined	small, small to medium	middle upper to upper

Shaded CHT Codes = Found in Chetco River

1. Alluvial Fan Channel (AF)
2. Small Estuarine Channel (ES)
3. Low Gradient Medium Floodplain Channel (FP2)
4. Low Gradient Small Floodplain Channel (FP3)
5. Low Gradient Confined Channel (LC)
6. Steep Narrow Valley Channel (SV)
7. Moderately Steep Narrow Valley Channel (MV)
8. Moderate Gradient Confined Channel (MC)
9. Very Steep Headwater Channel (VH)
10. Low Gradient Moderately Confined Channel (LM)
11. Moderate Gradient Moderately Confined Channel (MM)

C METHODOLOGY

1. US Geologic Survey (USGS) maps at the 7.5-minute or 1:24,000 scale were compiled and utilized as base maps for the lower Chetco River watershed. Perennial streams and landscape features such as valley type were analyzed for consideration of stream classification.
2. Stream reaches were delineated on mylar overlays based on channel gradient and channel confinement. Stream reaches were then evaluated based on valley shape, channel pattern, stream size, position in drainage and dominant substrate.
3. Preliminary CHTs were assigned to each reach using a CHT Guide to Identification (Table 6) as well as CHT Descriptions provided in the GWEB Oregon Watershed Assessment Manual.
4. CHT classifications were verified with field data from the Chetco River Riparian Shade Assessment.
5. CHT lengths were measured in ArcView GIS.
6. A labeling system was developed for purposes of subwatershed characterization.

D CHANNEL SENSITIVITY / RESPONSIVENESS

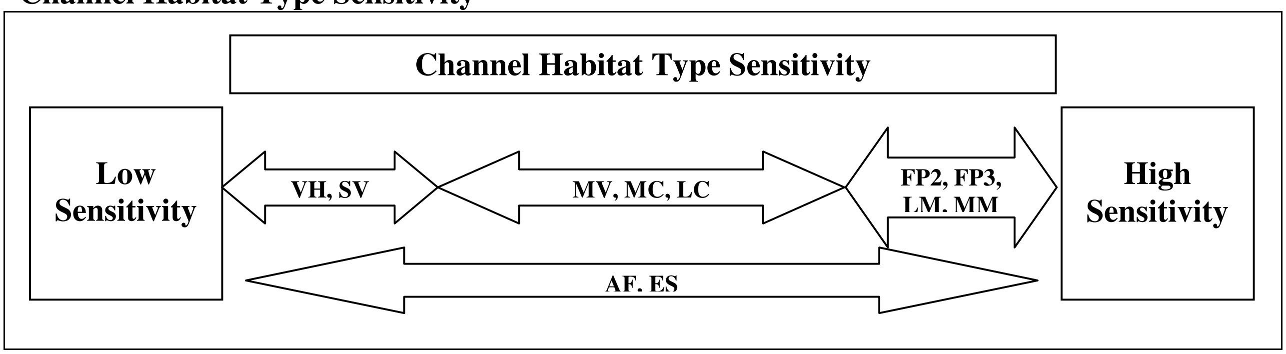
In general, responsive portions of the channel network are those that lack the terrain controls which define confined channels. Unconfined or moderately confined channels display visible changes in channel characteristics when flow, sediment supply, or the supply of roughness elements such as large woody debris are altered. These areas are commonly referred to as response reaches, and usually possess an active floodplain. At the other end of the responsive spectrum would be those channels whose characteristics and form are not easily altered, such as Bedrock canyon.

Differences in gradient, confinement, and bed morphology suggest that different channel types are more or less responsive to adjustment in channel pattern, location, width, depth sediment storage, and bed roughness (Montgomery and Buffington 1993). These changes in channel characteristics will in turn trigger alterations of aquatic habitat conditions. The more responsive or sensitive areas are more likely to exhibit physical changes from land management activities, as well as restoration efforts.

Channel Sensitivity/Response Descriptions

Rating	LWD	Fine Sediment	Coarse Sediment	Peak Flows
High	Critical element in maintenance of channel form, pool formation, gravel trapping/sorting, bank protection	Fines are readily stored with increases in available sediment resulting in widespread pool filling and loss of overall complexity of bed form	Bedload deposition dominant active channel process; general decrease in substrate size, channel widening, conversion to planebed morphology if sediment is added	Nearly all bed material is mobilized; significant widening or deepening of channel
Moderate	One of a number of roughness elements present; contributes to pool formation and gravel sorting	Increases in sediment would result in minor pool filling and bed fining	Slight change in overall morphology; localized widening and shallowing	Detectable changes in channel form; minor widening, scour expected
Low	Not a primary roughness element; often found only along channel margins	Temporary storage only; most is transported through with little impact	Temporary storage only; most is transported through with little impact	Minimal change in physical channel characteristics, some scour and fill

Channel Habitat Type Sensitivity



E DESCRIPTION OF CHANNEL HABITAT TYPES (GWEB 1999)

(1) Alluvial Fan Channels (AF) (<1% of Assessed Channels)

Alluvial fans are generally tributary streams that are located on foot-slope landforms in a transitional area between valley floodplains and steep mountain slopes. Alluvial fan deposits are formed by the rapid change in transport capacity as the high-energy mountain-slope stream segments spill onto the valley bottom. Channel pattern is highly variable, often dependent on substrate size and age of the landform. Channels may change course frequently, resulting in a multibranched stream network. Channels can also be deeply incised within highly erodible alluvial material. Smaller alluvial fan features may be difficult to distinguish from FP3 channels.

Channel Sensitivity / Responsiveness

The response of alluvial fans to changes in input factors is highly variable. Response is dependent on gradient, substrate size and channel form. Single-threaded channels confined by high banks are likely to be less responsive than an actively migrating multiple-channel fan. The moderate gradient and alluvial substrate of many fans results in channels with a moderate to high overall sensitivity.

Input Factors	Sensitivity/Responsiveness Rating
Large Woody Debris	Variable
Fine Sediment	Moderate to High
Coarse Sediment	High
Peak Flows	Moderate to High

Fish Use

Anadromous - Important rearing and migration corridor; potential spawning in lower gradients
Resident - Important spawning and rearing

Riparian Enhancement Opportunities

As many alluvial fans are actively moving at a rate greater than most channels, they are generally not well-suited to successful enhancement activities. Although they are considered responsive channels, long-term success of enhancement activities is questionable. High sediment loads often limit the success of efforts to improve habitat complexity such as wood placement for pool development.

(2) Small Estuarine Channels (ES) (<1% of Assessed Channels)

These channels are found at the mouths of drainages along outer coastal beaches or bays. They are intertidal streams that occur exclusively within estuary landforms, usually draining a small, high-relief or moderate-sized watershed. They are associated with saltwater marshes, meadows, mudflats, and deltas.

These streams are predominantly sediment depositional channels associated with low-relief coastal landforms. Stream energy is low due to nearly flat gradients, with substrate material consisting mainly of small gravels, sand, and silt. Channel morphology is strongly influenced by tidal stage. Fine-grained streambanks are highly sensitive to erosion. Beach erosion processes often have a dominant influence on deposition and erosion in the outer coastal estuarine streams.

The original boundary of an estuary may be difficult to determine due to modifications associated with marinas, highways, or reclamation. Many coastal estuaries have been delineated through county, state, or municipal planning processes and may include the predevelopment boundaries.

Channel Sensitivity / Responsiveness

These channels are low-energy areas where sediment deposition is a dominant process. While channel sensitivity in estuaries can vary, the unconfined nature of these areas tends to attenuate changes over space and time. Abandonment and reoccupation of relic channels commonly occurs, but it may be a slow process.

Input Factors	Sensitivity/Responsiveness Rating
Large Woody Debris	Moderate
Fine Sediment	Moderate to High
Coarse Sediment	Low to Moderate
Peak Flows	Low

Fish Use

Anadromous – Important rearing and migration corridor for chinook, coho, steelhead and sea-run cutthroat trout

Resident - Unknown

Riparian Enhancement Opportunities

Many enhancement efforts in estuaries are related to long-term preservation of the area. As these channels harbor unique biological communities, limiting development is a common strategy. Structural enhancement activities often involve dike breaching or removal to reconnect wetlands or sloughs.

(3) Low Gradient Medium Floodplain Channel (FP2) (2% of Assessed Channels)

FP2 channels are mainstem streams in broad valley bottoms with well-established floodplains. Alluvial fans, dissected foot slopes, and hill slope and lowland landforms may directly abut FP2 floodplains. These channels are often sinuous, with extensive gravel bars, multiple channels, and terraces. FP2 channels are generally associated with extensive and complex riparian areas that may include such features as sloughs, side-channels, wetlands, beaver pond complexes, and small groundwater-fed tributary channels.

Sediment deposition is prevalent, with fine sediment storage evident in pools and point bars, and on floodplains. Bank erosion and bank-building processes are continuous, resulting in dynamic and diverse channel morphology. Stream banks are composed of fine alluvium and are susceptible to accelerated bank erosion with the removal or disturbance of stream-bank vegetation and root mats. Channel gradient is low, and high stream flows are not commonly contained within the active channel banks, resulting in relatively low stream power.

Channel Sensitivity / Responsiveness

Floodplain channels can be among the most responsive in the basin. The limited influence of confining terrain features and fine substrate allows the stream to move both laterally and vertically. Although often considered low-energy systems, these channels can mobilize large amounts of sediment during high flows. This often results in channel migration and new channel formation.

Input Factors	Sensitivity/Responsiveness Rating
Large Woody Debris	High
Fine Sediment	Moderate
Coarse Sediment	High
Peak Flows	Low to Moderate

Fish Use
Anadromous – Important spawning, rearing, and migration corridor
Resident – Important spawning, rearing, and overwintering

Riparian Enhancement Opportunities
Due to the unstable nature of these channels, the success of many enhancement efforts is questionable. Opportunities for enhancement do occur, however, especially in channels where lateral movement is slow. Lateral channel migration is common, and efforts to restrict this natural pattern will often result in undesirable alteration of channel conditions downstream. Side channels may be candidates for efforts that improve shade and bank stability.

(4) Low Gradient Small Floodplain Channel (FP3) (<1% of Assessed Channels)

FP3 streams are located in valley bottoms and flat lowlands. They frequently lie adjacent to the toe of foot slopes or hill slopes within the valley bottom of larger channels, where they are typically fed by high-gradient streams. They may be directly downstream of small alluvial fan and contain wetlands. FP3 channels may dissect the larger floodplain. These channels are often the most likely CHT to support beavers, if they are in the basin. Beavers can dramatically alter channel characteristics such as width, depth, form, and most aquatic habitat features.

These channels can be associated with a large floodplain complex and may be influenced by flooding of adjacent mainstem streams. Sediment routed from upstream high-and-moderate gradient channels is temporarily stored in these channels and on the adjacent floodplain.

Channel Sensitivity / Responsiveness
Floodplain channels can be among the most responsive in the basin. The limited influence of confining terrain features and fine substrate allows the stream to move both laterally and vertically. Although often considered low-energy systems, these channels can mobilize large amounts of sediment during high flows. This often results in channel migration and new channel formation.

Input Factors	Sensitivity/Responsiveness Rating
Large Woody Debris	High
Fine Sediment	Moderate to High
Coarse Sediment	High
Peak Flows	Low

Fish Use
Anadromous – Important spawning, rearing, and migration corridor
Resident – Important spawning, rearing, and overwintering

Riparian Enhancement Opportunities

Floodplain channels are, by their nature, prone to lateral migration, channel shifting, and braiding. While they are often the site of projects aimed at channel containment (diking, filling, etc.), it should be remembered that the floodplain channels can exist in a dynamic equilibrium between stream energy and sediment supply. As such, the active nature of the channel should be respected, with restoration efforts carefully planned. The limited power of these streams offers a better chance for success of channel enhancement activities than the larger floodplain channels. While the lateral movement of the channel will limit the success of many efforts, localized activities to provide bank stability or habitat development can be successful.

(5) Low Gradient Confined Channels (LC) (15% of Assessed Channels)

LC channels are incised or contained within adjacent, gentle landforms or incised in uplifted coastal landforms. Lateral channel migration is controlled by frequent high terraces or hill slopes along stream banks. They may be bound on one bank by hill slopes and lowlands on the other. They may also have a narrow floodplain in places, particularly on the inside of meander bends. Streambank terraces are often present, but they are generally above the current floodplain. Channels confined by hill slope or bedrock are often stable and display less bank erosion and scour compared to incised channels that are often unstable and confined by alluvial terraces.

High flow events are well-contained by the upper banks. High flows in these well-contained channels tend to move all but the most stable wood accumulations downstream or push debris to the channel margins. Stream banks can be susceptible to landslides in areas where steep hill slopes of weathered bedrock parent materials meet the channel.

Caution: Caution should be used in interpreting channels that have downcut into alluvial material set in a wide flat valley. If streambanks are high enough to allow a floodplain width less than two times the bankfull width, then the stream meets the definition of confined. However, some streams meeting this definition may have recently down-cut, effectively reducing floodplain width as the channel deepens. It is beyond the scope of this assessment to address technical issues such as the rate of channel incision. However, for the purpose of interpreting Channel Sensitivity / Responsiveness, it should be noted that these channels may have transitioned from LM to LC channels.

Channel Sensitivity / Responsiveness

The presence of confining terraces or hill slopes and control elements such as bedrock limit the type and magnitude of channel response to changes in input factors. Adjustment of channel features is usually localized and of a modest magnitude.

Input Factors	Sensitivity/Responsiveness Rating
Large Woody Debris	Low to Moderate
Fine Sediment	Low
Coarse Sediment	Moderate
Peak Flows	Low to Moderate

Fish Use

Anadromous - Important spawning, rearing and migration corridor for chinook, coho, steelhead and sea-run cutthroat trout

Resident - Important spawning, rearing and overwintering for cutthroat trout

Riparian Enhancement Opportunities

These channels are not highly responsive, and in channel enhancements may not yield intended results. In basins where water-temperature problems exist, the confined nature of these channels lends itself to establishment of riparian vegetation. In nonforested land, these channels may be deeply incised and prone to bank erosion from livestock. As such, these channels may benefit from livestock access control measures.

(6) Low Gradient Moderately Confined Channel (LM) (5% of Assessed Channels)

These channels consist of low-gradient reaches that display variable confinement by low terraces or hill slopes. A narrow floodplain approximately two to four times the width of the active channel is common, although it may not run continuously along the channel. Often low terraces accessible by flood flows occupy one or both sides of the channel. The channels tend to be of medium to large size, with substrate varying from bedrock to gravel and sand. They tend to be slightly to moderately sinuous, and will occasionally possess islands and side channels.

Channel Sensitivity / Responsiveness

The unique combination of an active floodplain and hill slope or terrace controls acts to produce channels that can be among the most responsive in the basin. Multiple roughness elements are common, with bedrock, large boulders, or wood generating a variety of aquatic habitat within the stream network.

Input Factors	Sensitivity / Responsiveness Rating
Large Woody Debris	Moderate to High
Fine Sediment	Moderate to High
Coarse Sediment	Moderate to High
Peak Flows	Moderate

Fish Use

Anadromous - Potential spawning and rearing for chinook, coho, steelhead and sea-run cutthroat trout

Resident - Potential spawning, rearing and overwintering for cutthroat trout

Riparian Enhancement Opportunities

Like intact floodplain channels, these channels can be among the most responsive of channel types. Unlike floodplain channels, however, the presence of confining landform features often improves the accuracy of predicting channel response to activities that may affect channel form. Additionally, these controls help limit the destruction of enhancement efforts common to floodplain channels. Because of this, LM channels are often good candidates for enhancement efforts.

In forested basins, habitat diversity can often be enhanced by the addition of wood or boulders. Pool frequency and depth may increase, and side-channel development may result from these efforts. Channels of this type in non forested basins are often responsive to bank stabilization efforts such as riparian planting and fencing. Beavers are often present in the smaller streams of this channel type. Fish habitat in some channels may benefit from beaver introduction through side-channel and scour pool development. Introduction of beavers, however, may have significant implications for overall channel form and function, and should be thoroughly evaluated by land managers, as well as biologists, as a possible enhancement activity.

(7) Moderate Gradient Confined Channel (MC) (7% of Lower Chetco River's Channels)

MC streams flow through narrow valleys with little river terrace development, or are deeply incised into valley floors. Hill slopes and mountain slopes composing the valley walls may lie directly adjacent to the channel. Bedrock steps, short falls, cascades, and boulder runs may be present; these are usually sediment transport systems. Moderate gradients, well contained flows, and large-particle substrate indicate high stream energy. Landslides along channel side slopes may be a major sediment contributor in unstable basins.

Channel Sensitivity / Responsiveness

The presence of confining terraces or hill slopes and control elements such as bedrock substrates limits the type and magnitude of channel response to changes management. Adjustment of channel features is usually localized and of a modest magnitude.

Input Factors	Sensitivity / Responsiveness Rating
Large Woody Debris	Low
Fine Sediment	Low
Coarse Sediment	Moderate
Peak Flows	Moderate

Fish Use

Anadromous - Potential steelhead and coho spawning and rearing; may have pockets of suitable chinook habitat depending on site-specific factors

Resident - Potential spawning, rearing and overwintering for cutthroat trout

Riparian Enhancement Opportunities

These channels are not highly responsive, and in-channel enhancements may not yield intended results. Although channels are subject to relatively high energy, they are often stable. In basins where water-temperature problems exist, the stable banks generally found in these channels lend themselves to establishment of riparian vegetation. In nonforested land, these channels may be deeply incised and prone to bank erosion from livestock. As such, these channels may benefit from livestock access control measures.

(8) Moderate Gradient Moderate Confined Channel (MM) (2% of Assessed Channels)

This group includes channels with variable controls on channel confinement. Altering valley terraces and/or adjacent mountain-slope, foot-slope, and hill-slope landforms limit channel migration and floodplain development. Similar to the LM channels, a narrow floodplain is usually present, and may alternate from bank to bank. Bedrock steps with cascades may be present.

Channel Sensitivity / Responsiveness

The unique combination of a narrow floodplain and hill-slope or terrace controls acts to produce channels that are often the most responsive in the basin. The combination of higher gradients and the presence of a floodplain set the stage for a dynamic channel system. Multiple roughness elements such as bedrock, large boulders, or wood may be common, resulting in a variety of aquatic habitats within the stream network.

Input Factors	Sensitivity / Responsiveness Rating
Large Woody Debris	High
Fine Sediment	Moderate
Coarse Sediment	Moderate to High
Peak Flows	Moderate

Fish Use

Anadromous - Potential steelhead and coho spawning and rearing; may have pockets of suitable chinook habitat depending on site-specific factors
Resident - Potential spawning, rearing and overwintering for cutthroat trout

Riparian Enhancement Opportunities

Like floodplain channels, these channels are among the most responsive of channel types. Unlike floodplain channels, however, the presence of confining landform features improves the accuracy of predicting channel response to activities that may affect channel form. Additionally, these controls help limit the destruction of enhancement efforts, a common problem in floodplain channels. Outcome of enhancement efforts are a bit more uncertain than in LM channels. MM channels, however, are often good candidates for enhancement efforts.

In forested basins, habitat diversity can often be enhanced by the addition of roughness elements such as wood or boulders. Pool frequency and depth may increase as well as side-channel development as the result of these efforts. Channels of this type in nonforested basins are often responsive to bank stabilization efforts such as riparian planting and fencing.

Beavers are often present in the smaller streams of this channel type, and fish habitat in some channels may benefit from beaver introduction through side-channel and scour pool development. Introduction of beavers, however, may have significant implications for overall channel form and function, and should be thoroughly evaluated by land managers as well as biologists as a possible enhancement activity.

(9) Moderately Steep Narrow Valley Channel (MV) (14% of Assessed Channels)

MV channels are moderately steep and confined by adjacent moderate to steep hill slopes. High flows are generally contained within the channel banks. A narrow floodplain, one channel width or narrower, may develop locally.

MV channels efficiently transport both coarse bedload and fine sediment. Bedrock steps, boulder cascades and chutes are common features. The large amount of bedrock and boulders create stable streambanks; however, steep side slopes may be unstable. Large woody debris is commonly found in jams that trap sediment in locally low-gradient steps.

Channel Sensitivity / Responsiveness

The gradient and presence of confining terraces or hill slopes and control elements such as bedrock substrates limit the type and magnitude of channel response to changes in input factors. Adjustment of channel features is localized and of a minor magnitude.

Input Factors	Sensitivity / Responsiveness Rating
Large Woody Debris	Moderate
Fine Sediment	Low
Coarse Sediment	Moderate
Peak Flows	Moderate

Fish Use

Anadromous - Potential steelhead, coho and sea-run cutthroat spawning and rearing
Resident - Potential spawning, rearing and overwintering for cutthroat trout

Riparian Enhancement Opportunities

These channels are not highly responsive, and in channel enhancements may not yield intended results. Although channels are subject to relatively high energy, they are often stable. In basins where water-temperature problems exist, the stable banks generally found in these channels lend themselves to establishment of riparian vegetation. In nonforested land, these channels may be deeply incised and prone to bank erosion from livestock. As such, these channels may benefit from livestock access control measures.

(10 & 11) Steep Narrow Valley Channel (SV) & Very Steep Headwater (VH)

(SV = 24% & VH = 28% of Assessed Channels)

These two channel types are very similar and are thus presented together. However VH channels are steeper. SV channels are situated in a constricted valley bottom bounded by steep mountain or hill slopes. Vertical steps of boulder and wood with scour pools, cascades, and falls are common. VH channels are found in the headwaters of most drainages or side slopes to larger streams, and commonly extend to ridge-tops and summits. These steep channels may be shallowly or deeply incised into the steep mountain or hill slope. Channel gradient may be variable due to falls and cascades.

Channel Responsiveness
The gradient and presence of confining terraces or hill slopes and control elements such as bedrock substrates limit the type and magnitude of channel response to changes in input factors. Adjustment of channel features is localized and of a minor magnitude. These channels are also considered source channels supplying sediment and wood to downstream reaches, sometimes via landslides.

Input Factors	Sensitivity / Responsiveness Rating
Large Woody Debris	Moderate
Fine Sediment	Low
Coarse Sediment	Low to Moderate
Peak Flows	Low

Fish Use
Anadromous (SV) - Lower gradient areas provide limited rearing (if accessible)
Resident (SV) - Limited resident spawning and rearing / **Resident** (VH) - Very limited rearing

Riparian Enhancement Opportunities
These channels are not highly responsive, and in-channel enhancements may not yield intended results. Although channels are subject to relatively high energy, they are often stable. In basins where water temperature problems exist, the stable banks generally found in these channels lend themselves to establishment of riparian vegetation. This may also serve as a recruitment effort for large woody debris in the basin.

F RESULTS

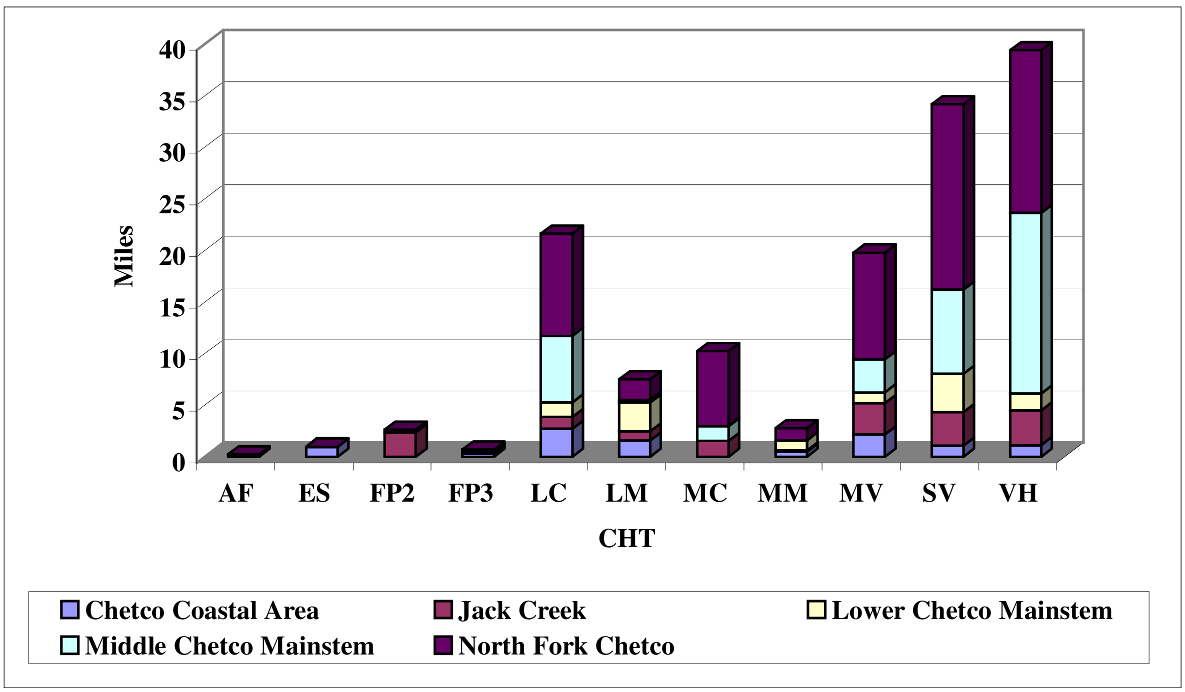
Table 7 Channel Habitat Types by Subwatershed (miles)

	Channel Habitat Types											Grand
Subwatershed	**AF**	**ES**	**FP2**	**FP3**	**LC**	**LM**	**MC**	**MM**	**MV**	**SV**	**VH**	**Total**
Chetco Coastal Area	0.00	0.98	0.00	0.31	2.70	1.58	0.00	0.51	2.15	1.08	1.14	10.44
Jack Creek	0.00	0.00	2.38	0.24	1.16	0.86	1.52	0.10	3.05	3.25	3.36	15.92
Lower Chetco Mainstem	0.00	0.00	0.00	0.09	1.42	2.81	0.00	1.00	1.06	3.72	1.62	11.72
Middle Chetco Mainstem	0.23	0.00	0.00	0.00	6.46	0.24	1.43	0.00	3.16	8.15	17.54	37.19
North Fork Chetco	0.00	0.00	0.23	0.08	9.89	2.04	7.30	1.17	10.38	17.97	15.77	64.82
Grand Total	0.23	0.98	2.61	0.71	21.62	7.53	10.25	2.77	19.79	34.18	39.43	140.09

Table 8 Lower Chetco River Channel Habitat Type Summary

CHT	Channel Description	Percent of Miles	Response to Disturbance	Riparian Treatment Opportunities
ES	Small estuarine	<1	Moderate	Limit human structures
FP2	Low gradient medium floodplain	2	High	Respect lateral movement
FP3	Low gradient small floodplain	<1	High	Respect lateral movement
AF	Alluvial fan	<1	Variable	Few opportunities
LM	Low gradient moderately confined	5	High	Good candidates
LC	Low gradient confined	15	Low Mod	Manage livestock access
MM	Moderate gradient moderately confined	2	High	Good candidates
MC	Moderate gradient confined	7	Mod	Manage livestock access
MV	Moderately steep narrow valley	14	Mod	Manage livestock access
SV	Steep narrow valley	24	Low	Few opportunities
VH	Very steep headwater	28	Low	Few opportunities

Figure 2 Miles of Channel Habitat Types



G KEY FINDINGS

- Of the 140 stream miles evaluated in this assessment, 52 percent are classified as steep (SV) to very steep (VH) narrow valleys. These are typically the small headwater streams in all of the Lower Chetco River subwatersheds. The channels are stable, not highly responsive to either disturbance or restoration, but their stable banks support riparian vegetation, making them good candidates for riparian planting or thinning.

- Moderate gradient confined and headwater streams (MC and MV) comprise 21 percent of the channels, and low gradient confined channels (LC) are 15 percent, for a total of 36 percent. These are typically located in small to medium size streams. Nearly 18 miles of MC and MV channels are found in the North Fork subwatershed with smaller amounts distributed through the other four subwatersheds. The largest amounts of LC are in the North Fork and Middle Chetco Mainstem. Channels are fairly stable, moderately responsive to disturbance, and not highly responsive to restoration activities except for riparian planting or thinning. In nonforested areas, channels may be deeply incised and prone to erosion by livestock, so they may benefit from livestock access control measures.

- Moderate gradient, moderately confined channels (MM) characterize 2 percent and low gradient streams that are moderately confined (LM) characterize 5 percent of the channels. These are fairly evenly distributed through the subwatersheds, except that very little LM and no MM are in the Middle Chetco Mainstem. These 7 percent of the channel miles are among the most responsive to both disturbance and restoration activities. Habitat diversity can be enhanced by adding structure such as boulders and large wood; banks can be stabilized by planting and fencing.

- Less than one percent of channel was classified as alluvial fan (AF), in the Middle Chetco Mainstem area. These channels tend to be very responsive to disturbance, but single thread channels with high banks are less responsive. Movement in the alluvial fan itself usually makes channel restoration efforts unsuccessful.

- Low gradient streams with small (FP3) flood plain channels comprise less than one percent of the stream network, located on the valley floor, primarily in the Chetco Coastal and Jack Creek subwatersheds with a small amount in North Fork Chetco. They are among the most responsive to disturbance, and channels often migrate. Attempts to control channel migration may not be effective and may cause problems elsewhere. In localized areas where lateral movement is slow, restoration or enhancement activities may be successful.

- Low gradient streams with medium (FP2) flood plain channels comprise 2 percent of the stream network, located on the valley floor, primarily in Jack Creek, with a small amount in North Fork Chetco. They are among the most responsive to disturbance, and channels often migrate. Attempts to control channel migration may not be effective and may cause problems elsewhere.

- Less than one percent of the channel length inventoried was classified as small estuarine channel (ES), in the Chetco Coastal area. This channel type is unconfined and responds to variations in sediment and weather patterns from both upstream and ocean. Restoration and enhancement activities often focus on long-term preservation of habitat for unique biological communities through techniques such as limiting future development and reconnecting wetlands isolated by manmade dikes.

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VI FISH & FISH HABITAT

A BACKGROUND

Salmonid Life Cycles (OSU 1998)

Salmonid is the group name for salmon, trout, and char. These fish share a common life history pattern. Many are anadromous, i.e., they spawn in fresh water, migrate to sea as juveniles, grow to maturity, and return to their freshwater stream to reproduce.

Adult salmonids spawn by burying their eggs in nests called redds. Spawning site selection depends on the species, gravel size, and flow pattern of the stream. A common spawning location is the "tail-out" of a pool – the area where a pool becomes shallow before entering a downstream riffle. The eggs remain in the gravel for 45 – 70 days depending on water temperatures. Hatching alevins (fry with yolk sacs for nutrients) remain in the gravel until the yolk sac is absorbed. They then work their way through the gravel and emerge into the stream channel as feeding fry. This is a critical stage for all salmonid species. During this part of their life, fry need adequate food and sediment-free water that contains a lot of oxygen.

Natural mortality of juveniles is high during the first month. Many fry are eaten by birds, amphibians, reptiles, and other fish. Depending on the species, juvenile anadromous salmonids grow 1-3 years before migrating to sea as smolts. Smolts need to adapt from freshwater to saltwater by spending transition time in the estuary. After maturing in the ocean, they return to the stream to spawn.

Life cycles vary greatly from river to river and among species (e.g., winter vs. summer steelhead, spring vs. fall chinook, sea run vs. resident cutthroat trout). Where several salmonid species coexist in a river system, each species has its own schedule for rearing, spawning, and migration, although it is not uncommon for juveniles and adults to occupy the same stream areas throughout the year. Adult anadromous salmonids find their way back from the ocean to the streams where they were born. This life cycle feature is called homing and is one of the least understood yet most wonderful aspects of salmon ecology.

Chinook salmon

Chinook (king) salmon are the largest and longest lived of the Pacific salmon. They average 20-25 pounds as adults, although individuals as large as 100 pounds have been reported. There are two basic life-history patterns of chinook in Oregon – fall and spring. Fall chinook return from the ocean in late-August through December. They spawn in main river channels and low-gradient tributaries. Since chinook are large, they can dig redds deep in the gravel, thus protecting the eggs from channel scouring during winter storms. If an unusually heavy storm does scour the eggs and a year is lost, successive generations can replace the stock because adult chinook spawn from 3-6 years of age. All chinook can spawn once but they then die.

Juvenile fall chinook emerge from the gravel in February or March. They stay in the stream only about 90 days. Peak downstream migration in south coast streams (excluding the Rogue River) is typically early to mid July. They generally spend the next 3-4 months in the estuary and then migrate to the ocean with fall rains. Spring chinook adults return to rivers in the spring and spend the summer in deep pools. They spawn in early fall. The life histories of these juveniles are more variable than those of all chinook.

<u>Coho salmon</u>
Coho (silver) salmon historically were the most abundant salmon on the Oregon Coast. Adults average 6-12 pounds and have a strict 3-year life cycle. Because coho spawn mostly at age 3 with no year class overlap, their survival is susceptible to catastrophic events. If a year is lost, a population is likely to remain depressed for a long time. Coho can recolonize tributaries from highly populated source areas. However, this species can be eliminated from a basin quickly if these source areas deteriorate.

Coho spawn from November to March with two dominant life-history patterns. “Early” coho enter streams on the first major storm of the year, usually in mid-November. If they are successful at spawning, their fry have the advantage of getting the first shot at the food resources. These fry also become the largest individuals, providing additional survival advantage.

Coho are not as large as chinook, they spawn in smaller gravel, and their redds are not as deep as those of chinook. Thus, their redds are likely to be scoured out during winter storms. Therefore, a second stock of “late” coho has evolved to delay spawning until most major winter storms have passed, often as late as March or April. These two groups provide important genetic variation to the species and help coho withstand natural climate variations.

Coho juveniles generally emerge from the gravel from February through April. They prefer to live in pools with slow flow or in beaver ponds. Juveniles remain in the stream for a full year and then migrate to the ocean in April or May. Some coho return as 2-year-old jacks (males), but most return as 3-year-old adults.

<u>Steelhead</u>
Steelhead are seagoing rainbow trout. Adults average 8-12 pounds, and some adults live as long as 7 years. Winter steelhead return from the ocean from November through April, allowing them to move into headwaters of stream during winter flows. Some spawning occurs in May Like salmon, they deposit their eggs in gravel. However, not all steelhead die after spawning. About 30 percent survive to spawn again in the stream of their birth.

Juveniles emerge as late as early July. During the first year they live in riffles and along the edges of stream channels. Therefore, low water conditions can severely affect steelhead. They spend 1-3 years in a stream before migrating to the ocean. This long freshwater residence time also makes them more vulnerable to habitat degradation.

Summer steelhead adults enter river systems from April through August. Unlike winter fish, but like spring chinook, these steelhead need deep, cool pools to reside in until spawning in January or February. The juvenile life history of summer steelhead is similar to that of winter steelhead.

Cutthroat trout

Cutthroat trout have variable life history patterns. Some migrate to the ocean while others remain in the same area of a stream all of their lives. Anadromous and fluvial forms use estuarine, mainstem, and lower portions of the system for adult holding and juvenile rearing, and use small headwater streams for spawning. The resident form of cutthroat are also typically found in headwater areas, but can be found in low gradient backwater areas lower in the system. Cutthroat spawn in the spring or fall, usually in very small tributaries, and the juveniles emerge by June or July. Sea-run cutthroat rarely exceed a length of 20 inches or a weight of 4 pounds. (ODFW, 1995)

Salmonid Spawning Habitat

Successful spawning and development from eggs to fry stages require the following:

- No barriers to upstream migration for adults
- Spawning areas (usually in a riffle or at the tail-out of a pool) with stable gravel, free of fine sediment
- A combination of pools and riffles that provides both spawning areas and places to hide nearby
- A constant flow of clean, well oxygenated water through the spawning gravel

Salmonid Rearing Habitat

Fry are vulnerable to predators and must endure high stream flows and food shortages. They need pools for rearing, temperature regulation, and cover. Good juvenile-rearing habitat exhibits the following characteristics:

- Low to moderate stream gradient (slope) and velocity
- A good mix of pool and riffle habitats
- Clean, oxygenated water and cool stream temperatures
- A variety of bottom types to provide habitat for juvenile fish and food organisms
- Overhanging vegetation, large woody material, and stream cutbanks, which provide protection for juvenile fish and leaf litter for aquatic insect food
- Sufficient nutrients to promote algal growth and decomposition of organic material

As young fish grow, they seek increased summer flow, moving from the edge of a stream to midstream to take advantage of insect drift. In winter, all species seek areas of lower water velocity where they can conserve energy while food and growing conditions are limited.

Salmonid Habitat Use

Although their basic requirements are the same, salmonid species differ in the types of habitat they use. For example, juvenile coho prefer pool areas of moderate velocity in the summer, especially those with slack water current near undercut stream banks, root wads, or logs. In winter, they seek slow, deep pools or side channels, utilizing cover under rocks, logs and debris.

Conversely, juvenile steelhead spend their first summer in relatively shallow, cobble-bottomed areas at the tail-out of a pool or shallow riffle. During winter, they hide under large boulders in riffle areas.

In summer, older steelhead juveniles prefer the lead water of pools and riffles where there are large boulders and woody cover. The turbulence created by boulders also serves as cover. During winter, these steelhead juveniles are found in pools, near streamside cover, and under debris, logs or boulders.

Cutthroat trout habitat requirements are similar to those of steelhead with the exception that they spend the summer in pools. Chinook juveniles tend to rear in large tributaries, and their habitat requirements are different than those of coho. For example, estuarine residence and growth are key elements in a chinook life-history pattern. Coho salmon require backwaters, beaver ponds, or side-channel rearing habitats to survive high winter flows and low summer flows.

Salmonid Limiting Factors

The quantity and quality of spawning and rearing habitat limit the success of spawning and production of smolts. These limiting factors establish the carrying capacity of a stream. Carrying capacity is the number of animals a habitat can support throughout the year without harm to either the organisms or the habitat. Depending upon the limits of available habitat, ocean factors, escapement, etc., salmonid populations fluctuate annually as a result of varying environmental factors (e.g. extreme high and low stream flows, high stream temperatures in the summer, or ice). A stream does not necessarily reach its carrying capacity each year because of these factors.

Salmonid Fish Passage

Stream channel crossings by roads have been the cause of serious losses of fish habitat due to improperly designed culverts. Assessment of migration barriers is important, because anadromous salmonids migrate upstream and downstream during their lifecycles. In addition, many resident salmonids and other fish move extensively upstream and downstream to seek food, shelter, better water quality, and spawning areas. Where these barriers occur, fish can no longer reach suitable habitats. Because of reduced accessible habitat, fish populations may be limited.

Culvert road crossings can create barriers to fish migration in the following ways:

- The culvert is too high for the fish to jump into.
- The water velocity in the culvert is too fast for the fish to swim against.
- The water in the culvert is not deep enough for the fish to swim, or has a disorienting turbulent flow pattern, making it difficult for fish to find their way through.
- There is no pool below the culvert for the fish to use for jumping and resting, so they cannot access the culvert, or there are no resting pools above the culvert, so the fish are washed back downstream.

A combination of these conditions may also impede fish passage. It is not always clear when a culvert blocks fish passage. Some culverts may be velocity barriers during high flows but pass fish successfully during low flows. Other culverts may not be deep enough during summer low flows to pass fish, but fish can pass successfully during higher flows. Large, adult anadromous fish may be able to pass through culverts that are total barriers to smaller juvenile or resident fish. For these reasons it is important to understand what fish species occur in the watershed and when they will be migrating.

Culverts can be round, square, elliptical, or other shapes. Culverts can be made of various materials, including concrete, but metal pipe is the most common material. Because of the variability in culvert type and design, it is often difficult to definitively determine if a culvert blocks fish passage.

Other fish passage concerns can include impoundments, dams, unscreened and screened irrigation pipes and water withdrawals that result in dewatered reaches and/or low flows that restrict migration. Natural barriers, in contrast, are characteristic of a stream's channel morphology and where present, play a vital role in the co evolution of various fish species.

B INTRODUCTION

Chinook, coho, steelhead and cutthroat are all native to the Chetco River watershed. The historic abundance and distribution of these salmonids, within the watershed, is poorly understood (ODFW 1995). Historical numbers of coho are thought to have been relatively small in most south coast basins including Chetco River River. Coho populations in Chetco River were probably smaller than chinook populations due to the relatively steep topography that leads to a steep, confined and high-energy system (ODFW 2001). Abundance of coho has probably been reduced due to modification of low gradient streams (ODFW 2001).

Information describing historic distribution of chinook within these basins is scant. It is likely however, that contemporary distributions of chinook and steelhead are not considerably reduced from the period when white settlers in the area began altering pristine habitats (ODFW 1995). While considerable information exists regarding the contemporary distribution of spawning and rearing of chinook, coho and steelhead, little is known about contemporary cutthroat distributions. Typically, however, cutthroat are thought to utilize all portions of the basin.

Life History Patterns of Anadromous Salmonids

Table 9 lists the life history characteristics of anadromous salmonids in the south coast watersheds including ChetcoRiver. These characteristics were identified by cross referencing three sources of information: GWEB Oregon Watershed Assessment Manual; Watershed Stewardship, A Learning Guide, Oregon State University Extension Service; and Oregon South Coastal River Basin Fish Management Plan, June, 1995 (ODFW Working Draft). ODFW Fish Biologist, Todd Confer from the Gold Beach district office, then verified the information.

Table 9 Life History Patterns of Anadromous Salmonids in South Coast Watersheds

Species	Adult Return	Spawning Location	Spawning Period	* Eggs in Gravel	Young in Stream	Freshwater Habitat	Young Migrate Downstream	Time in Estuary	Outmigration Period	Time in Ocean	Adult Weight (average)
COHO	Oct-Jan	coastal streams, shallow tributaries	late fall-early winter	Oct-May	1+yrs	tributaries, mainstem, slack water	Mar-June (2nd yr)	few days - several weeks	fall-winter	2 yrs	5-20 lb (8)
CHINOOK		mainstem large & small rivers				mainstem large & small rivers		days-months		2-5 yrs	
spring	Jan-Jul			Jul-Jan	1+yrs		Mar-Jul (2nd yr)				10-20 lb (15)
fall	Aug-Mar		Nov-Jan	Sep-Mar	3 months		Apr-July	3-4 months	Aug-Oct		10-40 lb
STEELHEAD		tributaries, streams & rivers	Feb-Apr			tributaries		less than a month		1-4 years	
winter	Nov-Jun		Dec-May	Jan-Jul	1-3 yrs		Mar-Jun (2nd-5th yr)		1-3 yrs after hatch		5-28 lb (8)
summer (Col. R.)	Jun-Oct			Feb-Jun	1-3 yrs		Mar-Jun (3rd-5th yr)				5-30 lb (8)
Coastal Sea Run CUTTHROAT	Jul-Dec	small tributaries of coastal streams	Feb-May?	Dec-Jul	1-3 yrs (2 avg.)	tributaries	Mar-Jun (2nd-4th yr)	less than a month **	1-3 yrs after hatch	0.5-1 yrs	0.5-4 lb (1)

* The eggs of most salmonids take 3-5 months to hatch at the preferred water temperature of 50-55 F; steelhead eggs can hatch in 2 months.

** Fluvial and immature sea run cutthroat may reside in estuary through the summer

Threatened and Endangered Species
Table 10 lists the threatened and endangered species according to the National Marine Fisheries Service (NMFS) and ODFW. The Northwest Region of NMFS is responsible for marine and anadromous fishes under the Endangered Species Act (ESA). In May of 1997, coho were listed as Threatened in the Chetco River basin. More recently, in April 2001, the status of steelhead was changed from Candidate to Not Warranted.

Table 10 Chetco River Threatened and Endangered Species

Species	**ESA Status** (1)	**ODFW Status** (2)	**Population Trends** (3)
Chinook	Not Warranted	Not Warranted / Not Reviewed	Not Available
Coho	Threatened	Not Listed	Not Available
Cutthroat	Not Warranted	Not Warranted / Not Reviewed	Not Available
Steelhead	Not Warranted	Not Warranted / Not Reviewed	Not Available

(1) NMFS – NW Region website //www.nwr.noaa.gov/1salmon/salmesa/specprof.htm
(2) Tim Whitesel, ODFW ESA Coordinator
(3) ODFW – Oregon South Coastal River Basin Fish Management Plan, June, 1995 (Working Draft)

Fish Distribution
Fish distribution maps were obtained in digital format from the ODFW. Due to the resolution of the scale (1:100,000) distribution of all three species was not available for small streams. All maps reflect distribution only; they do not provide any indication of the relative abundance of each species. Furthermore, all maps are in draft form. The following paragraph was adapted from the fish distribution metadata files (ODFW web site) that correspond to the maps. The following paragraph was adapted from the fish distribution metadata files (ODFW web site) that correspond to the maps.

Fish distribution maps illustrate areas of suitable habitat (spawning, rearing and migration) currently believed to be utilized by wild, natural, and/or hatchery fish populations. The term "currently" is defined as within the past five reproductive cycles. This information is based on survey data, supporting documentation and best professional judgment of ODFW staff biologists and in some cases, that of staff from other natural resource agencies within Oregon. Areas displayed may not be utilized by a species of fish on an annual basis due to natural variations in run size, water conditions, and other environmental factors. Due to the dynamic nature of this information, it may be updated at any time. This distribution information makes no statement as to the validity of absence in any particular area; no attempt has been made to verify where fish are not present. Historic genetic origin and current production origin have yet to be defined and are not found as attributes of the distribution data at this time.

Distribution of salmonids occurs throughout significant areas of the Chetco River watershed. However, certain subwatersheds or stream reaches are more prone to provide spawning and summer/winter rearing habitat. Table 11 provides a summary of information that pertains to these important locations.

Table 11 Important Locations for Spawning and Summer/Winter Rearing

Species/Purpose	Location
Steelhead spawning & rearing	Road mile 20.4 to headwaters and portions of most tributaries
Chinook spawning & rearing	Mainstem and tributaries up to Mislatnah Creek

Chetco River Watershed Analysis, Iteration 1.0, USDA Forest Service, 4/24/96 and (ODFW 2001)

Spawning Surveys – Peak Counts

Peak counts from spawning surveys provide one measure of fish populations and long term trends in streams and rivers. Spawning surveys on selected rivers range from ½ mile to 2 miles of stream. A trained biologist walks the stream during the peak spawning season (December to January), counting live and dead salmon. Surveys are conducted every 7-10 days. Adverse conditions such as turbidity indefinitely affect the observer's ability to see fish. The numbers listed in Table 12 reflect the peak counts for each spawning season, from 1995 to 2000. Numbers include both live and dead adult fish; jacks are not included.

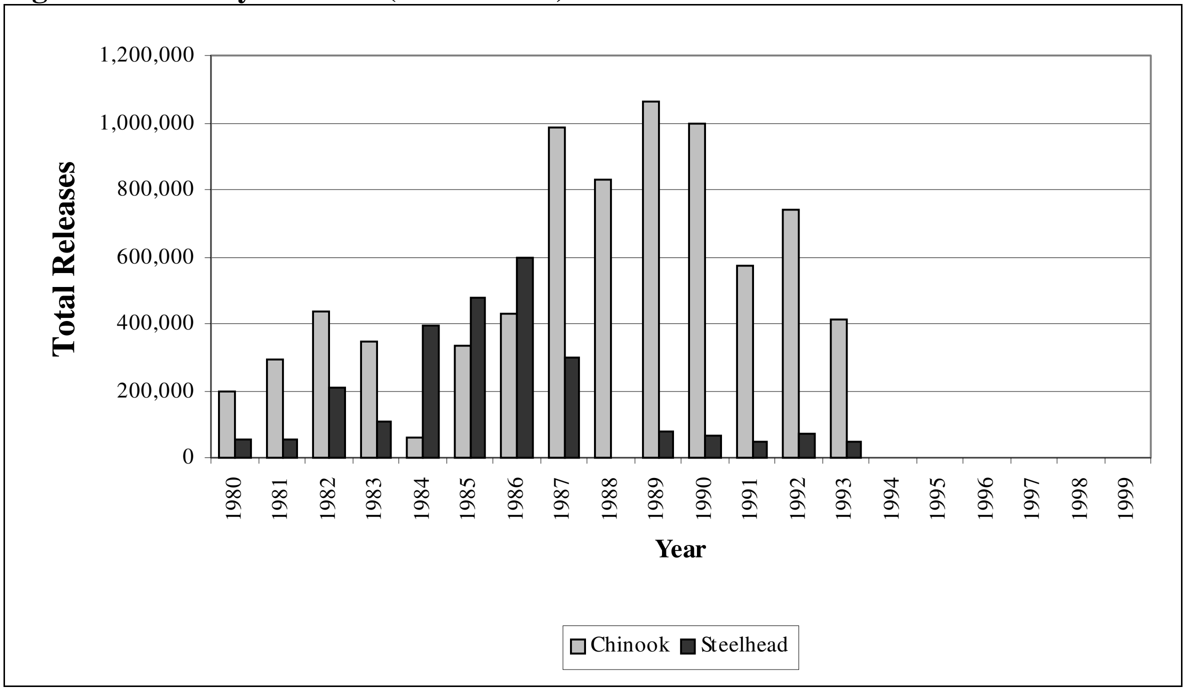
Table 12 Chinook Peak Counts from 1995-2000 (ODFW #20031, 20053 & 20037)

Survey	1995	1996	1997	1998	1999	2000	Historic High
Jack Creek	112	150	95	67	36	41	189 (1989)
Big Emily Creek	111	79	60	52	12	60	344 (1972)
North Fork Chetco	129	59	69	61	15	82	213 (1994)

Stocking Summary

Figure 3 illustrates the total releases of hatchery fish for each species and each year on record with the local ODFW district office in Gold Beach. Stocking (hatchery release) data was compiled from two sources: ODFW's draft basin plan and the local Salmon and Trout Enhancement Program. Although not included in Figure 3 current annual hatchery releases in the Chetco River consist of an estimated 50,000 winter steelhead smolts and 150,000 fall chinook smolts (Stauff 2001). The stocking summary is provided to help identify potential interactions between native and stocked species and to assist in determining if hatchery fish have an influence on current population trends. **Note:** Although not present here, stocking data, dating back to 1947, was also available from a third source known as Streamnet.

Figure 3 Hatchery Releases (1980 – 1999)



<u>Migration Barriers</u>

In 1995, a group of displaced fishermen were hired by the South Coast Watershed Council to conduct surveys of culverts in an effort to address fish passage concerns. The compilation of data from these surveys became known as the "Hire the Fishermen Survey". Culverts from this survey, within the Chetco River watershed, were evaluated to determine adult and juvenile fish passage based on guidance (Robinson 1997) from the Oregon Department of Forestry and Oregon Department of Fish and Wildlife.

Initially, culverts were classified as "Adult Barrier," "Juvenile Barrier," or "Passable" categories. However, according to more recent standards (Robison, et. al., Spring 1999, Oregon Road/Stream Crossing Restoration Guide) outlet drops exceeding one foot in height are expected to restrict adults of some species. As a result, another category was created to represent "Adult Restricted". Additionally, some culvert slope measurements were estimated at 1% with a clinometer. Due to the resolution of these measurements, a degree of uncertainty exists in determining whether these slopes actually met the 0.5% slope criteria. As a result, when slope was the only criteria in doubt, these sites were classified as "Uncertain if Juvenile Barrier". Similarly, in consideration of adult passage, some culverts were estimated at 4% slope. Thus, when slope was the only criteria in doubt, these sites were classified as "Uncertain if Adult Barrier". Finally, the Outlet Drop was determined by estimating pool depth at bankfull flow. The assumption was made that bankfull flow is a better estimate of adult migration conditions than the measured summer flow pool depths.

Culvert conditions were evaluated for juvenile and adult salmonid fish passage. The listed criteria applies only to bare culverts. Few culverts surveyed were embedded or baffled. In both cases these criteria are not minimum values; they describe the conditions in which passage of most fish is blocked. Other conditions may still prevent some fish from passing through a specific culvert.

Juvenile Fish Passage Criteria

Slope	<0.5%
Outlet Drop	<6 inches, with residual pool 1.5 times deeper than the jump
Inlet Condition	Diameter > ½ bankfull channel width; no inlet drop
Length	<100 feet long

Adult Fish Passage Criteria

Slope	<4%
Outlet Drop	<4 feet, with residual pool 1.5 times deeper than the jump or 2 feet deep
Length	<200 feet long

Culverts, bridges and fords were assessed by the "Hire the Fishermen Survey". Some culverts and bridges have been more recently assessed and are included as well. Stream crossings were labeled by a "Site ID" and an estimated length of potential fish habitat. Potential fish habitat upstream of each culvert was measured, for all Hire The Fishermen culverts, to an estimated channel gradient of 16%. Stream channels greater than 16% gradient are considered "Very Steep Headwaters" as described in the Channel Habitat Component of this watershed assessment. Salmonid fish habitat in these very steep headwater channels provides only very limited rearing.

<u>Stream Surveys</u>

The ODFW has developed a standard stream habitat survey methodology (Moore et al. 1997) that they and other agencies and some industrial landowners have used to collect extensive amounts of fish habitat data. An assessment of existing stream habitat survey data was conducted in the Chetco River basin to help determine how habitat conditions vary throughout the watershed and/or to identify specific portions of the watershed where problems may exist. Existing stream survey summary data was compiled in GIS format from the Southwest Oregon Province GIS Data CD (shapefile titled "Stream Survey Data"). Sampled conditions were compared to "benchmark" conditions established by the ODFW. Conditions were rated as Undesirable (U), Desirable (D), or in-between range (B). The overall condition rating was assigned using the following criteria:

- **Desirable (D):** All parameters rated desirable or in-between
- **Between (B):** Parameter ratings were mixed
- **Undesirable (U):** Most of the parameters rated undesirable
- **ND:** No data

ODFW HABITAT BENCHMARKS
(GWEB 1999)

The ODFW habitat benchmark values are designed to provide an initial context for evaluating measures of habitat quality. While the natural regime of a stream depends on climate, geology, vegetation, and disturbance history, it is useful to know whether a value of a habitat feature in a reach of stream is high or low. For example, knowing whether a reach has a lot of large woody debris (LWD) or fine sediments is useful for understanding the condition of aquatic habitat and its influence on the life history of fishes. The determination of whether the "value" of a habitat feature is "good" or "bad" depends on the natural regime of the stream and the fish species of interest. The habitat benchmark values for desirable and undesirable conditions are derived from a variety of sources. Values for specific parameters were derived for appropriate stream gradient, and regional and geologic groupings of reach data (see Moore et al. 1997). This assessment is designed to look at combinations of features rather than to single out individual values. This approach should help identify patterns within these features that can then be interpreted in a broader watershed context.

The benchmark values of habitat features are listed as desirable or undesirable, but emphasis should be applied to view the values on a sliding scale, and that watershed context be considered. For example, eight pieces of LWD per 100 meters may be very low for a stream in the Cascade Mountains, but extremely high for a stream in the high desert of southeast Oregon. The stream must be viewed within its natural environment. Similarly, a reach in the Cascade Mountains may have eight pieces of LWD per 100 meters, but neighboring reaches may have 25 pieces of LWD per 100 meters. Variability within a watershed may reflect normal disturbance and hydrologic cycles in addition to management history. The assessment of habitat conditions should look to other components of the watershed assessment to find if there are historic or current activities influencing these measures. This provides the basis for linking the findings from the broader assessments of upslope and upstream activities and impacts to actual in-channel conditions.

Tables 13, 14, and 15 (See Appendix) include summaries of available stream survey data, individual benchmark ratings and overall habitat ratings based on various habitat attributes. Specifically, the tables include a Riparian Habitat Condition Summary (Table 13), Pool Habitat Condition Summary (Table 14), and Riffle and Woody Debris Habitat Condition Summary (Table 15). **Note:** stream survey data from the USDA Forest Service was also available although not in a usable format. Therefore it was not evaluated in this assessment.

Caution: Stream survey data is like a single photograph of a dynamic system. Stream channel conditions may change drastically between years, especially if there has been a high flow (flood) event. Also, some surveyed reaches have been inconsistently sampled, and the summary data do not necessarily reflect actual conditions.

C KEY FINDINGS

Threatened and Endangered Species

- Coho have been listed as Threatened, according to the Endangered Species Act, since May 1997. No other salmonids are currently listed.

Fish Distribution

- Winter steelhead are well distributed throughout the basin and extend into all subwatersheds.
- Chinook are found throughout the lower and middle portions of the watershed extending up the mainstem Chetco to just below Boulder Creek. Subwatersheds where chinook are found include: Chetco Coastal Area, Jack(s) Creek, North Fork, Emily Creek, Middle Chetco Mainstem, South Fork, Quail Prairie Creek, Eagle Creek, Upper Chetco Mainstem (1) and Mislatnah Creek.
- Coho are found throughout the lower and middle portions of the watershed and extend, on occasion, up the Chetco mainstem to the Granite & Carter Area subwatershed.

Stocking Summary

- Over time, there has been a general reduction in chinook releases as well as a modification of hatchery programs in order to reduce risk to naturally produced fish. Large-scale releases of hatchery fish and transfers between basins have discontinued. Stocks of fish from other watersheds that were released in south coast basins were not particularly well adapted and do not appear to have survived well. Limited genetic analysis indicates that non-indigenous stocks have not persisted in south coast basins since releases were discontinued. (ODFW 2001)
- Current annual hatchery releases in the Chetco River consist of an estimated 150,000 fall chinook smolts.
- Current annual hatchery releases in the Chetco River consist of an estimated 50,000 winter steelhead smolts.
- Historic releases of cutthroat and rainbow trout were discontinued due to poor cost/benefit ratio (low harvest) and concerns about naturally produced fish.

Migration Barriers

- Among the culverts that were evaluated in this assessment five were assessed as adult barriers; four were assessed as adult restricted and one was assessed as a juvenile barrier. Consultation with ODFW fish biologists and site visits are recommended to verify fish passage barriers and estimated habitat above each barrier.
- Estimated habitat above each adult barrier is considered minimal whereas three "adult restricted" barriers may each block more than a ½ mile of habitat.
- Other human-caused migration barriers potentially exist. These include culverts that warrant additional surveys to determine if they meet criteria for both adult and juvenile passage. *(See Migration Barrier Map for uncertain barriers.)*

Riparian Habitat Condition Summary

- High shade for all reaches
- Low bank erosion for all reaches

- Few large riparian conifers in any surveyed reach
- No riparian conifer data available for Bravo #3

<u>Pool Habitat Condition Summary</u>

- Complex pools are lacking in the surveyed reaches - related to low amounts of large wood.
- Shallow residual pool depths for most reaches, except Bravo, reach #3, and Lower North Fork Chetco. Cross check with sediment module.
- Pool area and frequency are all in the desirable and in-between categories for surveyed reaches. High pool area percentage, combined with low gradient and low wood values indicate simplified habitat - less beneficial to fish

<u>Riffle and Woody Debris Habitat Condition Summary</u>

- Width to depth ratio generally in-between or undesirable. Only Ransom #1 in the desirable range
- Low amounts of fine sediments in riffle gravels, beneficial for spawning habitat.
- Area of gravel predominantly moderate to low, with only 2 of 16 reaches in desirable range
- Overall riffle conditions moderate, with two reaches having desirable rating.
- Key pieces generally lacking, except Ransom #1 & #2, Bravo #3, and Bosley #1
- Overall large wood ratings undesirable (11 of 16 reaches), to moderate (5 of 11 reaches

REFERENCES

GWEB 1999. Oregon Watershed Assessment Manual. Governor's Watershed Enhancement Board, July 1999

ODFW 1995. Oregon South Coastal River Basin Fish Management Plan, Working Draft, June 1995).

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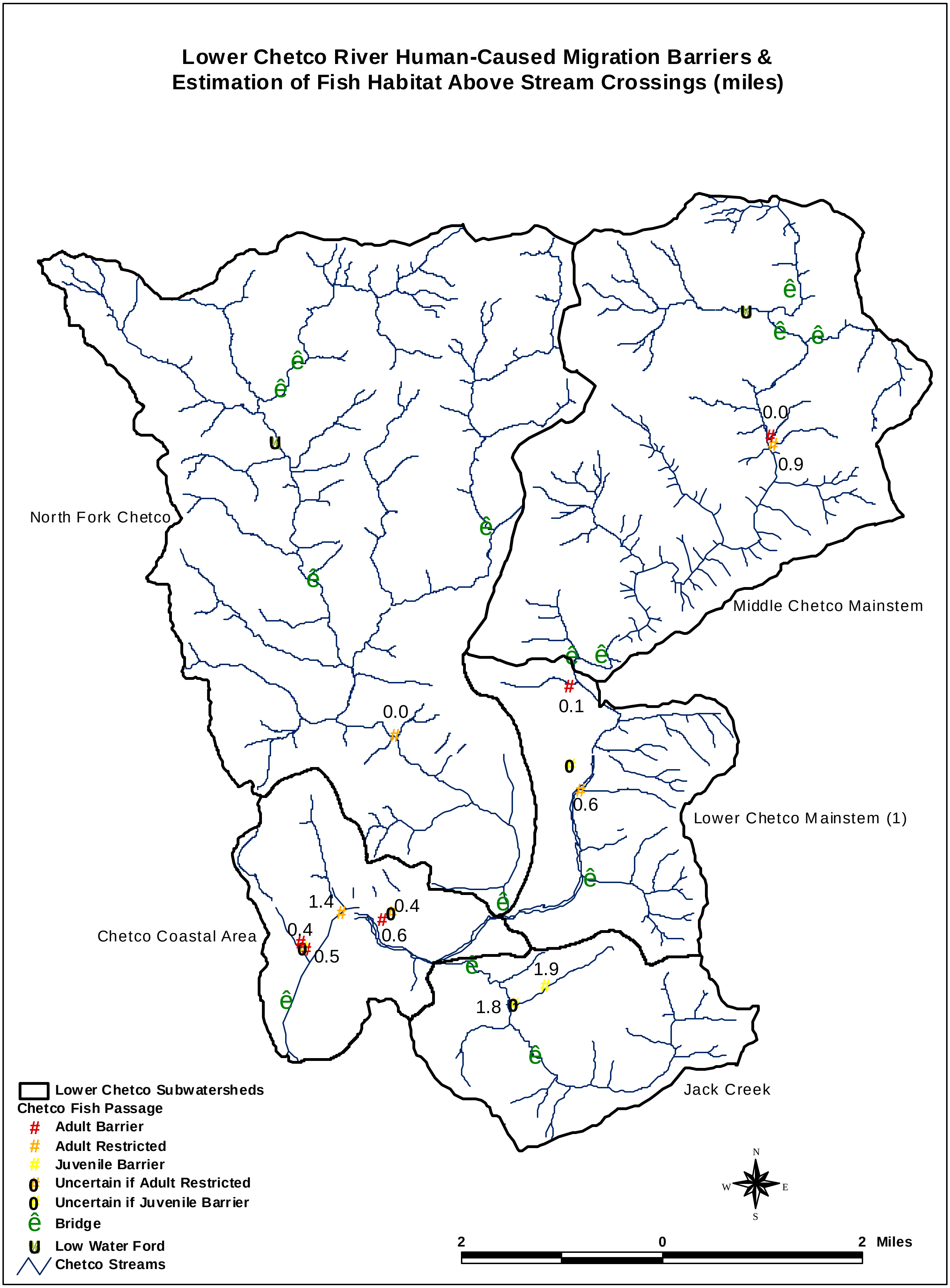
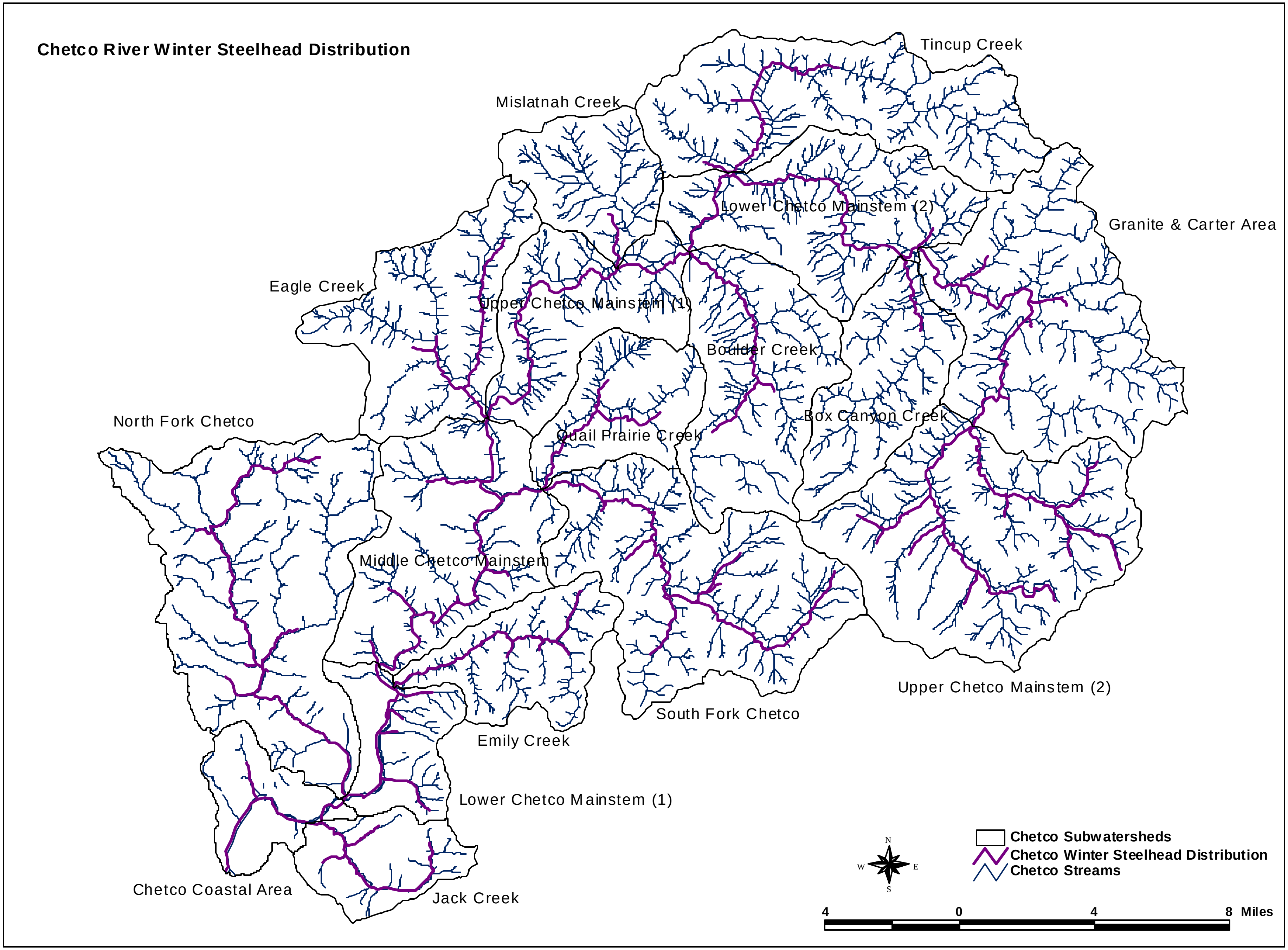
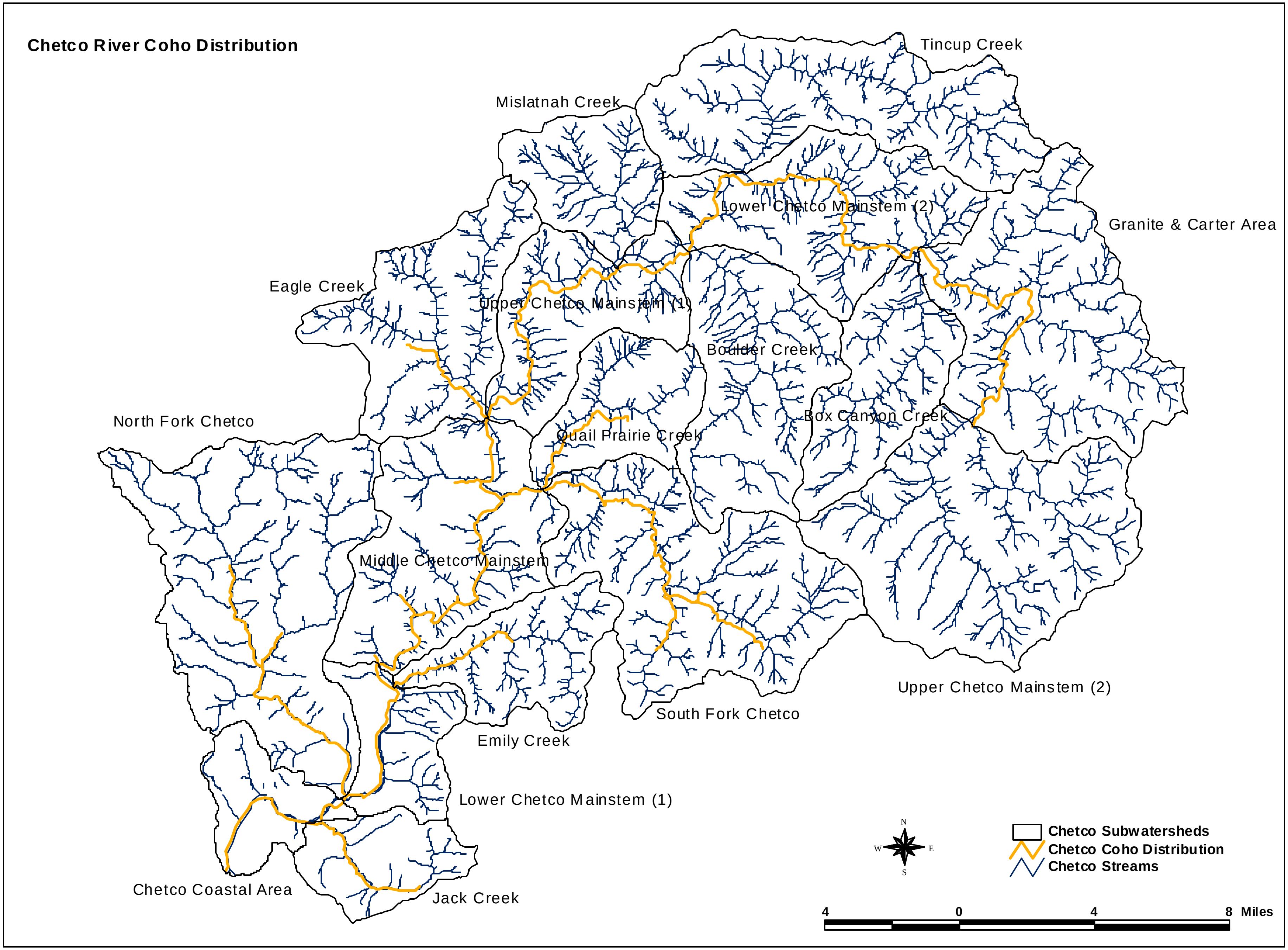
Stauff 2001. Personal communication with Russ Stauff, District Fish Biologist, Oregon Department of Fish and Wildlife – Gold Beach, Oregon.

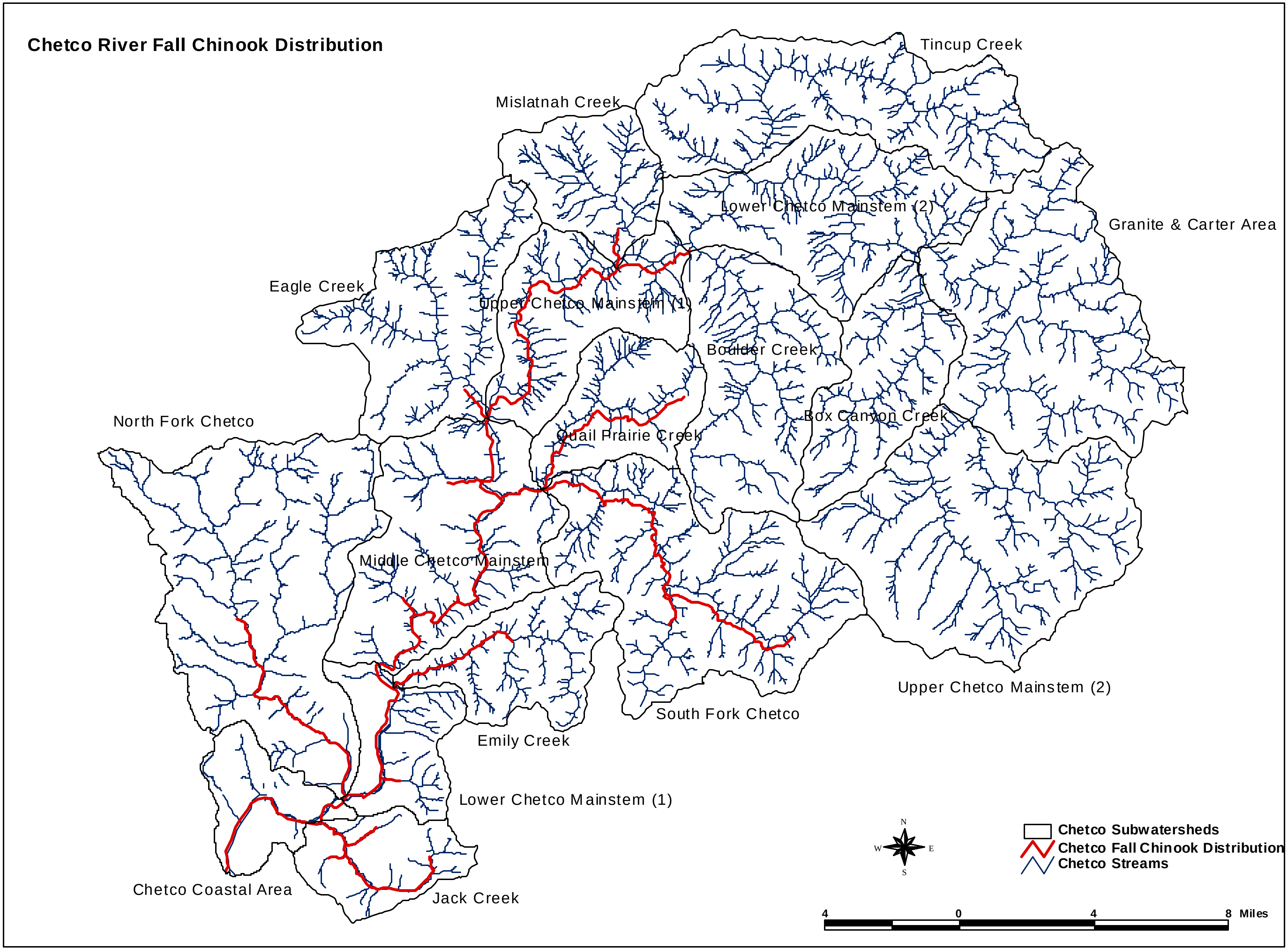


Lower Chetco River Human-Caused Migration Barriers &
Estimation of Fish Habitat Above Stream Crossings (miles)
North Fork Chetco
Middle Chetco Mainstem
Lower Chetco Mainstem (1)
Chetco Coastal Area
Jack Creek
0.0
0.9
0.0
0.1
0.6
1.4
0.4
0.4
0.6
0.5
1.9
1.8
Lower Chetco Subwatersheds
Chetco Fish Passage
Adult Barrier
Adult Restricted
Juvenile Barrier
Uncertain if Adult Restricted
Uncertain if Juvenile Barrier
Bridge
Low Water Ford
Chetco Streams
N
S
E
W
2
0
2 Miles



Chetco River Winter Steelhead Distribution
Tincup Creek
Mislatnah Creek
Lower Chetco Mainstem (2)
Granite & Carter Area
Eagle Creek
Upper Chetco Mainstem (1)
Boulder Creek
Box Canyon Creek
North Fork Chetco
Quail Prairie Creek
Middle Chetco Mainstem
Upper Chetco Mainstem (2)
South Fork Chetco
Emily Creek
Lower Chetco Mainstem (1)
Chetco Coastal Area
Jack Creek
Chetco Subwatersheds
Chetco Winter Steelhead Distribution
Chetco Streams
N
W
E
S
4
0
4
8 Miles


Chetco River Coho Distribution
Tincup Creek
Mislatnah Creek
Lower Chetco Mainstem (2)
Granite & Carter Area
Eagle Creek
Upper Chetco Mainstem (1)
Boulder Creek
Box Canyon Creek
North Fork Chetco
Quail Prairie Creek
Middle Chetco Mainstem
Upper Chetco Mainstem (2)
South Fork Chetco
Emily Creek
Lower Chetco Mainstem (1)
Chetco Coastal Area
Jack Creek
N
W
E
S
Chetco Subwatersheds
Chetco Coho Distribution
Chetco Streams
4
0
4
8 Miles



Chetco River Fall Chinook Distribution
Tincup Creek
Mislatnah Creek
Lower Chetco Mainstem (2)
Granite & Carter Area
Eagle Creek
Upper Chetco Mainstem (1)
Boulder Creek
North Fork Chetco
Box Canyon Creek
Quail Prairie Creek
Middle Chetco Mainstem
Upper Chetco Mainstem (2)
South Fork Chetco
Emily Creek
Lower Chetco Mainstem (1)
Chetco Coastal Area
Jack Creek
N
W
E
S
Chetco Subwatersheds
Chetco Fall Chinook Distribution
Chetco Streams
4
0
4
8 Miles

VII WATER QUALITY ASSESSMENT

A BACKGROUND (GWEB 1999 and OSU 1998)

A combination of natural watershed processes and the effect of human activities determine water quality at a particular site on a stream or river. All water contains some dissolved chemical elements, particulate matter, and organic matter. The amounts of these substances vary with different watershed conditions. Water quality is described in terms of the beneficial uses of water and the level of quality needed to support those uses. Measures of water quality – the criteria or indicators – provide the connection between the beneficial uses of water and the natural and human sources of watershed inputs.

Beneficial Uses of Water

The streams and rivers in the diverse landscapes of Oregon support different uses of water. To focus the water quality assessment, it is necessary to identify the beneficial uses of water that are important in a watershed as well as those that are specifically identified in the Oregon water quality standards. Beneficial uses determine which water quality criteria apply. For example, assessment for drinking water primarily focuses on the presence of pathogens that can cause disease or chemicals that can contribute to long-term health effects such as cancer risk. Assessment for water that supports fish populations focuses on elements of the stream system such as temperature, dissolved oxygen, metals, nutrients, and chemical contaminants.

Criteria and Indicators

Water quality criteria provide a warning system when activities in a watershed are limiting beneficial uses. Water quality criteria are specifically established in the State Water Quality Standards by major river basin. Water quality indicators are used when the state standards do not specify numerical criteria. Water quality concerns can be grouped into several major categories for analysis: temperature, dissolved oxygen, pH, nutrients, bacteria, turbidity and toxics. Water quality status can also be evaluated indirectly by examining the health of the aquatic community using aquatic invertebrates and fish populations.

Stream Temperature

Cool water temperatures are necessary features of streams that support salmonid fish and the associated aquatic community. Suitable temperature ranges have been evaluated for all life history stages of salmonids – adult migration, spawning, egg incubation, embryo development, juvenile rearing, and juvenile migration. Growth and reproduction are adversely affected when water temperature is outside of the range to which these organisms were adapted.

The biological rationale for temperature criteria is based on laboratory and field studies. Laboratory studies evaluate egg development rate and juvenile survival under constant temperatures. Field studies evaluate the effect of water temperature on adult and juvenile migration behavior and adult spawning behavior. Oregon water quality standards are established to protect fish populations based on sublethal effects on fish, such as susceptibility to disease, inability to spawn, reduced survival rate of eggs, reduced growth and survival rate of juveniles, increased competition for limited habitat and food, and reduced ability to compete with other species. A general numerical standard of 64° Fahrenheit (7-day moving average of maximum temperatures) was established in Oregon on the basis of preventing these sublethal effects. Several documents (Boyd and Sturdevant 1997, Oregon Department of Environmental Quality 1995) have been published by state agencies to help understand the technical basis for the standard, and what managers and land owners can do to meet the standard.

The evaluation criteria for stream temperature is a daily maximum 64° F standard that is applied to the average of the maximum temperatures for the warmest 7 consecutive days (known as the "7-day max"). The daily maximum temperature is determined from readings at hourly or half-hour intervals for each day during the monitoring period, usually mid-June through mid-September. The difference between the coolest and warmest temperature during the warmest 7 consecutive days is known as ΔT. High ΔT values result from solar exposure, and may be used to indicate reaches where additional shade can limit the sun's ability to warm the stream. Quite strictly, shade does not lower temperature it simply blocks the sun from warming the stream.

Dissolved Oxygen

High dissolved oxygen is a basic physiological requirement of cold-water fishes such as native salmon and trout. Critical dissolved oxygen levels for various life stages have been evaluated in laboratory and field studies. The early larval stages of fish are wholly dependent on the transfer of oxygen within the redd, the salmonid gravel nest. When oxygen is below saturation, salmonid embryos are smaller than usual and hatching is either delayed or is premature. Salmonid juveniles survive in dissolved oxygen less than saturation, but growth, food conversion efficiency, and swimming performance are adversely affected. Water quality criteria are established to provide for the natural fluctuations below saturation while assuring sufficient dissolved oxygen to protect aquatic life. The concentration of dissolved oxygen is a function of many factors: water temperature, surface and intragravel water interchange, water velocity, substrate permeability, and the oxygen demand of organic material. The content of oxygen in water is directly related to water temperature and barometric pressure, and therefore, temperature and pressure (estimated through elevation) must be measured at the same time.

The Oregon Water Quality Standards contain a number of dissolved oxygen criteria. More restrictive criteria are specified for dissolved oxygen during the period that salmonid fish are spawning (11 mg/l). Also, the standards specify a dissolved oxygen concentration (8 mg/l) in the gravel used by spawning fish. For the purposes of this assessment, the evaluation criteria is set at a minimum of 8 mg/l in the water column for cold water fish.

pH

The pH is a measure of the hydrogen ion concentration of water. pH is measured in a logarithmic scale, with pH below 7 indicating acidic conditions and pH above 7 indicating alkaline conditions. PH of water is important in determining the chemical form and availability of nutrients and toxic chemicals. Measurement of pH is especially important in mining areas because there is potential for both generation of heavy metals and a decrease in pH. Metal ions shift to a more toxic form at lower pH value. The pH of waters varies naturally across Oregon due to the chemical composition of the rock type in the watershed and the amount of rainfall. Eastside basins generally will have more alkaline water than westside or coastal basins.

The Oregon Water Quality Standards specify the expected pH range for all basins in Oregon. For the purposes of this assessment, the evaluation criteria is set at 6.5 to 8.5 for all westside basins. It should be recognized that, like dissolved oxygen, pH also varies in streams naturally throughout the day due to the photosynthesis and respiration cycles of attached algae.

<u>Nutrients</u>
Nutrients refer to chemicals that stimulate growth of algae and aquatic plants in water. In fast-moving streams, algae grow attached to the substrate and are called "periphyton." Algae and aquatic plants are a necessary part of the stream ecosystem and act as the primary producers in a stream – processing the sun's energy into food for stream fish. Excess algae and aquatic plant growth, however, becomes a problem in slow moving streams and rivers, and in still waters such as ponds and lakes. The excessive growth can result in low or no dissolved oxygen and interfere with recreation, and certain algae can produce chemicals that are toxic to livestock and wildlife. Phosphorous and nitrogen are the major growth-limiting nutrients in water, and are therefore the focus of a water quality evaluation.

Total phosphorous measures primarily phosphates in the water column and phosphorous in suspended organic material. Total nitrate (commonly measured as nitrite plus nitrate) provides a measure of the majority of nitrogen present in surface waters. Evaluation criteria are based on literature values that have been identified as causing excessive plant growth.

For the purposes of this assessment, the evaluation criteria is set at 0.05 mg/l for total phosphorous and 0.30 mg/l for total nitrates.

<u>Bacteria</u>
Bacteria in the coliform group are used as indicators to test the sanitary quality of water for drinking, swimming, and shellfish culture. Bacteria in the coliform group are found in wastes associated with warm-blooded animals, including humans, domestic animals, and other mammals and birds; these bacteria are indicators of contamination of surface waters by sewage, feedlots, grazing, and urban runoff. The State of Oregon specifies the use of <u>Escherichia coli</u> (E.coli) as the bacterial indicator for water contact recreation, such as swimming, and fecal coliform bacteria as the indicator in marine and estuarine waters for shellfish growing. E.coli is a more specific test for organisms that occur in warm-blooded animals. The fecal coliform procedure tests positive for some bacteria

that occur naturally in the environment, but has generally been accepted as a good screening tool.

Fecal coliform bacteria enter streams from many sources associated with human and animal wastes in urban and agricultural watersheds. In rangelands, bacterial contamination occurs primarily from direct deposition of fecal material in streams. Good vegetative cover on the upslope areas and dense riparian vegetation impedes contaminated runoff from reaching streams. Once coliform bacteria enter streams, the majority settles to the bottom and is attached to sediment particles. The stream sediments can act as a reservoir for fecal coliform bacteria; bacteria are resuspended when bottom sediments are disturbed through increased turbulence or animal movement.

For the purposes of this assessment, the evaluation criteria is set at 406 E. coli/100ml in fresh waters and 43 fecal coliform/100ml in marine waters.

Turbidity/Suspended Sediment

Turbidity is a measure of the clarity of water. In most cases, water is cloudy due to runoff of sediment, and therefore turbidity is a useful surrogate for measuring suspended sediment. However, turbidity can also be caused by other sources of suspended material such as algae. Suspended sediment can directly affect fish by damaging their gills and reducing the feeding ability of sight-feeding fish such as salmonids. Suspended sediment is a carrier for other pollutants (nutrients, pesticides, and bacteria) and is therefore a concern for water quality in general. In addition, suspended sediment interferes with recreational uses and the aesthetic quality of water.

Turbidity varies naturally with the soil type in a landscape. The small particle sizes, silts and clays, will stay suspended for long periods and cause turbidity. Soils that break down into sand size fractions will settle to the bottom and result in comparatively low turbidity values. Turbidity in a stream will increase naturally during storm and runoff events. This high variability makes it difficult to establish a simple, meaningful criterion. For the purposes of this assessment, the evaluation criteria is set at 50 NTU. Turbidity at this level interferes with sight-feeding of salmonids and therefore provides a direct indicator of biological effect. *The unit of measure, an NTU (nephelometirc turbidity unit), is based on the original measurement device and has no direct meaning.*

Toxic Contaminants: Organic Compounds, Pesticides, and Metals

The term “contaminants” refers to chemicals that may cause toxicity in aquatic organisms. Due to the lack of data pertaining to toxic contaminants in the Chetco River watershed no further assessment was conducted.

B INTRODUCTION

The water quality assessment is based on a process that first identifies the beneficial uses that occur within the watershed (See Table 16). Evaluation criteria that apply to these uses are then identified and finally, water quality conditions are identified by comparison of existing data with these criteria. This conceptual framework is consistent with the guidelines established by the U.S. Environmental Protection Agency (EPA)under the authority of the federal Clean Water Act and the water quality programs of the Oregon Department of Environmental Quality (ODEQ). The goal of the federal Clean Water Act, *"to protect and maintain the chemical, physical and biological integrity of the nation's waters,"* establishes the importance of assessing both water quality and the habitat required for maintaining fish and other aquatic organisms.

The requirements for in-stream water quality are based on protection of recognized uses of water. In practice, the sensitive beneficial uses drive the evaluation of water quality and are the basis for establishing best management practices.

Aquatic species, particularly salmonid fish, are often considered the most sensitive beneficial uses in a watershed. Salmonid species are adapted to cold water, high gradient habitats where temperatures are cool and dissolved oxygen is high. Salmonids have highly variable life histories but display similarity in laying eggs in gravels and have fry and juveniles that rear close to where they hatch from the egg. These early life stages are particularly sensitive to changes in water quality. Water quantity affects water quality parameters and subsequently fish, especially during summer low flow conditions. Extracting too much water from a system is just as harmful to fish as are certain water-quality parameters.

Table 16 South Coast Beneficial Uses

Beneficial Uses	Estuaries & Adjacent Marine Waters	All Streams & Tributaries
Public Domestic Water Supply (1)		X
Private Domestic Water Supply (1)		X
Industrial Water Supply	X	X
Irrigation		X
Livestock Watering		X
Anadromous Fish Passage	X	X
Salmonid Fish Rearing	X	X
Salmonid Fish Spawning	X	X
Resident Fish & Aquatic Life	X	X
Wildlife & Hunting	X	X
Fishing	X	X
Boating	X	X
Water Contact Recreation	X	X
Aesthetic Quality	X	X
Hydro Power		X
Commercial Navigation & Transportation	X	X

(1) With adequate pretreatment (filtration and disinfection) and natural quality
to meet drinking water standards. SA\Table\WH5291.5 (ODEQ web site)

Water Quality Limited Streams 303(d) List

The ODEQ is required by the federal Clean Water Act to maintain a list of steam segments that do not meet water quality standards. This list is called the 303(d) List because of the section of the Clean Water Act that makes the requirement. The U.S. Environmental Protection Agency has approved ODEQ's 1998 list. (ODEQ web site)

Table 17 illustrates the Water Quality Limited Streams that pertain to the Chetco River watershed. The 7-day maximum temperatures listed below reflect the highest on record as of 2000.

Table 17 Chetco Water Quality Limited Streams

Tributary / Reach	Boundary	Parameter	Listing Status	Highest As of 2000	
				7-day max	Hrs >64 F
Little Chetco River	Mouth to Headwaters	Temperature	Need data		
Little Chetco River	Mouth to Headwaters	Habitat Modification	Need data		
Tincup Creek	Mouth to Headwaters	Temperature	Need data		
Tincup Creek	Mouth to Headwaters	Flow Modification	Need data		
Tincup Creek	Mouth to Headwaters	Sedimentation	Need data		
Chetco River	Mouth to Box Canyon Creek	Temperature	303(d) List	76 in 1995	1,869 at ford
Chetco River	Mouth to Box Canyon Creek	Sedimentation	Need data		
Chetco River	Mouth to Box Canyon Creek	Habitat Modification	Need data		
Chetco River	Mouth to Box Canyon Creek	Flow Modification	Need data		
Hawk Creek	Mouth to Headwaters	Temperature	Need data		
Hawk Creek	Mouth to Headwaters	Sedimentation	Need data		
Eagle Creek	Mouth to Headwaters	Temperature	Need data	66 in 2000	54
Eagle Creek	Mouth to Headwaters	Sedimentation	Need data		
South Fork Chetco	Mouth to Headwaters	Sedimentation	Need data		
South Fork Chetco	Mouth to Headwaters	Flow Modification	Need data		
North Fork Chetco	Mouth to Headwaters	Temperature	303(d) List	76 in 1995	1,245 (in 98)

North Fork Chetco	Mouth to Headwaters	Sedimentation	Need data		
North Fork Chetco	Mouth to Headwaters	Flow Modification	Need data		
Bravo Creek	Mouth to Headwaters	Temperature	303(d) List	72 in 1995	
Bravo Creek	Mouth to Headwaters	Sedimentation	Need data		
Jack Creek	Mouth to Headwaters	Sedimentation	Need data	68 in 1998	374

Water Quality Criteria Applicable to the Sensitive Beneficial Uses
Evaluation criteria are based on an interpretation of narrative and numeric standards in the Oregon Water Quality Standards. Where numerical criteria are not provided in the state standards, evaluation indicators have been identified based on the literature. Indicators are useful for evaluating water quality conditions, but do not have any regulatory standing.

Summary of Water Quality Criteria and Evaluation Indicators

Water Quality Attribute	Evaluation Criteria	Evaluation Indicator
Temperature	Daily maximum of 64° (7 day moving average)	
Dissolved Oxygen	8.0 mg/l	
pH	6.5 to 8.5 units	
Total Phosphorous		0.05 mg/l
Total Nitrate		0.30 mg/l
E. coli	406 E. coli/100ml (no single sample can exceed the criteria)	
Fecal coliform	43 fecal coliform/ 100ml (not more than 10% of samples)	
Turbidity		50 NTU maximum

C METHODOLOGY

- Water quality conditions were evaluated using available data from the ODEQ's ambient water quality monitoring site at the Chetco River USGS gage. Data was collected approximately once every three months from 1995 to 2000. To facilitate the compilation of data, two datasets were combined: "Ambient" and "Lasarface". Some water quality data were also obtained by searching an unformatted database known as STORET. *(The Lasarface dataset contains ODEQ's comprehensive records of water quality data. The Ambient spreadsheet was used for calculating the Water Quality Index for 1989 to 1998 but only includes eight water quality parameters.)*
- Flow data from the Chetco River USGS gage was provided, where available, to provide a context regarding hydrologic influences.
- Water quality data were compared to evaluation criteria or indicators.
- The percent exceedance of criteria was calculated for each water quality parameter.
- An impairment category from the following table was assigned for each parameter.

Criteria for Evaluating Water Quality Impairment

Percent Exceedance of Criteria	Impairment Category
(<15%)	**No Impairment** No or few exceedances of criteria
(15-50%)	**Moderately Impaired**

	Criteria exceedance occurs on a regular basis
(>50%)	**Impaired** Exceedance occurs a majority of the time
Date lacking/insufficient	**Unknown**

D RESULTS

Table 18 Water Quality Data Evaluated from Ambient and Lasarface Databases
(See Appendix)

Table 19 Evaluation of Water Quality Conditions

Statistic	Dissolved Oxygen (mg/l)	pH (SU)	Total Nitrate (mg/l)	Total Phosphorous (mg/l)	Fecal Coliform (MPN)	E. coli (cfu/100 ml)	Turbidity (NTU)
Samples	58	58	59	59	56	7	9
Minimum	7.5	5.9	0.01	0.005	1	2	0.7
Maximum	12.5	8.1	0.1	0.28	285	14	3
Median	11.2	7.6	0.02	0.02	15	2	1.20
# Exceedance	1	5	0	13	6	0	0
% Exceedance	**1.7**	**8.6**	**0**	**22**	**10.7**	**0**	**0**

Table 20 Summary of Water Quality Impairment

Monitoring Site*	DO (mg/l)	pH (SU)	Total Nitrate (mg/l)	Total Phosphate (mg/l)	Fecal Coliform (MPN)	E. Coli (cfu/100 ml)	Turbidity (NTU)	Summary of Miles Impaired**
Chetco River @ USGS gage	None	None	None	Moderately Impaired	None	None	None	10.8

**Summary of Miles Impaired: If any box is rated as Moderately Impaired or Impaired, the Summary is rated as Impaired.*

<u>Stream Temperature</u>
Many streams in Curry County currently exceed the state's temperature standard and have been subsequently listed as "water quality-limited" on the 303(d) list. In the Chetco River watershed there are three locations that are officially recognized on this list. They include the Chetco River mainstem, from the mouth to Box Canyon Creek; the North Fork, from its mouth to its headwaters; and Bravo Creek, from its mouth to its headwaters.

Under the Clean Water Act, water quality management plans are required to lower stream temperatures to meet the standard over time, or to justify setting a new standard to be met. The collection of stream temperature data and corresponding flow data has helped landowners and agencies establish realistic, watershed-specific targets for shade and water temperature.

Since 1995, the South Coast Watershed Council has received funding from the Oregon Watershed Enhancement Board and Oregon Department of Environmental Quality to support monitoring for the Oregon Salmon Plan. Standard methods and accuracy checks were used for deploying recording thermographs (thermometers) as described in the *Stream Temperature Protocol* chapter of *Water Quality Monitoring Guide Book*. A Quality Assurance Project Plan provides direction for procedures.

Stream temperature data is collected to assist watershed council members and interested citizens assess where to focus efforts on restoring streamside vegetation in order to reduce exposure to the sun. The South Coast Watershed Council has monitored stream temperature and corresponding streamflow in the Chetco River basin since 1995. Stream temperature monitoring provides baseline data, long-term trend data and educational opportunities. As a result, stream reaches can be prioritized to voluntarily plant or manage vegetation in order to produce adequate shade. Monitoring also assists to measure the effectiveness of riparian restoration projects.

The following tables represent key characteristics of summarized data compiled by the South Coast Watershed Council's Monitoring Program, Siskiyou National Forest, BLM and the Oregon Department of Fish and Wildlife. Table 21 illustrates the 7 Day Max Values that represent annual trends from 1995 to 2000. Table 22 illustrates the locations, number of days and associated years that exceed the state's temperature standard. All data was obtained from the Monitoring Program's Stream Temperature Report. In most cases on public lands, resource personnel from the agencies listed above measured the 7-day max values. For more details please contact the South Coast Watershed Council's Monitoring Coordinator.

Table 21 Annual Trends – 7-Day Max Values (Degrees Fahrenheit)

Location	**2000**	**1999**	**1998**	**1997**	**1996**	**1995**
Mainstem above Babyfoot				72.5	73.2	
Mainstem Above Boulder	72.9	70.9	73.9		73.3	
Boulder Creek	65.6	64.6			65.6	
Mainstem Above Eagle	74.7					74.6
Eagle Creek at mouth	65.9					65.9
Mainstem at low water crossing	75.3	74.6			74.5	
South Fork Chetco	68.6	68.1	68.4	69.3		68.5
Mainstem @2nd Bridge					73.8	73.9
Emily Creek	65.9	60.5	67.0	68.1		67.2
Mainstem @ Willow Bar					73.1	76.0
Mainstem @ Social Security Bar					73.1	73.8
North Fork Chetco: Bosley Creek	62.9					62.3
North Fork Chetco at bridge (gage) above gorge						64.5
North Fork near mouth	72.1	**71.3	74.1			*75.7
Jack Creek below fish trap	***64.7	65.4	68.2			

* BLM site is downstream of the North Fork near mouth site used in 1998 and 1999.
** Thermometer deployed on August 5th, likely missed earlier 7-day max
*** Last temperature recorded on August 3rd, likely missed 7-day max

Table 22 Days >64º F (7-day max values)

Location	2000 Days > 64º	1999 Days > 64º	1998 Days > 64º	1997 Days > 64º
Chetco above Boulder Creek		71		
Boulder Creek		13		
Mainstem @ low water ford		81		
South Fork		52		
Emily Creek		0		
North Fork @ BLM Gage		1	26	
North Fork near mouth		42	68	
Jack Creek below fish trap		27	58	
Jack Creek above golf course			0	

Oregon Water Quality Index (ODEQ 2000)
The Oregon Department of Environmental Quality Laboratory maintains a network of ambient water quality monitoring sites. These sites were selected to provide representative statewide geographical coverage, and to include major rivers and streams throughout the state. There are currently 156 monitoring sites in the network. One site is situated on Chetco River at the USGS gage, river mile 10.8. ***Note:*** *Water quality data collected at this site is the same data used above.*

Water quality data collected at these sites, in water years 1989-1998, were included in the Oregon Water Quality Index (OWQI). The index was developed for the purpose of providing a simple, concise and valid method for expressing the significance of regularly generated laboratory data, and was designed to aid in the assessment of water quality for general recreational uses. *(C. Cude, ODEQ)*

The OWQI analyzes a defined set of water quality variables and produces a score describing general water quality. The water quality variables included in the index are temperature, dissolved oxygen (percent saturation and concentration), biochemical oxygen demand, pH, total solids, ammonia and nitrate, nitrogen, total phosphorous, and fecal coliform. OWQI scores range from 10 (worst case) to 100 (ideal water quality).

OWQI results were calculated for each site on all samples taken in Water Years 1989-1998. Seasonal averages were calculated for the summer season (June – September) and fall, winter and spring seasons (October – May). The minimum of these seasonal averages was used for ranking purposes; seasonal variability between river systems was considered.

A classification scheme was derived from application of the OWQI to describe general water quality conditions. OWQI scores that are less than 60 are considered very poor; 60-79 poor; 80-84 fair; 85-89 good; and 90-100 excellent. To account for differences in water quality between low-flow summer months (June-September) and higher-flow fall, winter, and spring months (October-May), average values for summer and fall, winter, and spring were calculated and compared. Rankings were based on the minimum seasonal averages.

Results for the Chetco River, during years 1986-1995, revealed a summer average score of 94 (excellent) and a fall, winter, and spring score of 93 (excellent). Results during years 1989-1998 revealed a summer average of 95 (excellent) and a fall, winter, and spring score of 90 (excellent). No trend analysis was conducted due to insufficient data.

E KEY FINDINGS

Dissolved Oxygen, pH, Total Nitrates, Total Phosphates, Fecal Coliform, E. coli, Turbidity, & Biological Oxygen Demand

- Total phosphates exceeded standards primarily in winter and predominantly during high flow events – enough to rate the Chetco moderately impaired for total phosphates.
- Dissolved oxygen was lowest in August and September although only one sample went below standard of 8 mg/l (7.5).
- Fecal coliform levels were above standards in 6 of 56 samples, primarily during high water events.
- PH dropped below 6.5 in 5 of 58 samples. (Among the rivers periodically monitored, the Chetco was the only river in Curry County in which pH exceeded standard either low or high.)
- Based on water quality of any watershed for which data was gathered in Curry County the Chetco River ranks second worst. (Floras Creek ranks the worst.)
- Estuary water quality is anoxic (deficient in oxygen) in summer.

Temperature

- Highest 7-day maximum in Chetco watershed was 76.0° F at Willow Bar.
- The Chetco mainstem comes out of the wilderness area above 64° F standard.
- The Chetco heats between the wilderness and the confluence with the South Fork despite being joined by several cooler tributaries. The 7-day minimums in this section often exceed the 64° F maximum standard.
- All major tributaries are cooler than the mainstem Chetco, although they all exceed the 64° F standard in most years.
- The warmest reach is the Chetco River mainstem above Eagle Creek (74.7° F).
- The coolest tributary is Bosley Creek (62.6° F).

Oregon Water Quality Index

- The Chetco River at the USGS Gage Station (river mile 10.8) is impacted during heavy precipitation by high total phosphates, biochemical oxygen demand, and total solids. On the average, OWQI results are excellent in the summer and poor in the fall, winter, and spring.

REFERENCES

GWEB 1999. Oregon Watershed Assessment Manual. Governor's Watershed Enhancement Board, July 1999

OSU 1998. Watershed Stewardship - A Learning Guide, Oregon State University Extension Service, July 1998

ODEQ 2000. Oregon's 2000 Water Quality Status Assessment Section 305(b) Report

VIII SEDIMENT SOURCES

A BACKGROUND (GWEB 1999)

Erosion that occurs near streams and on surrounding slopes is a natural part of any watershed. Fish and other aquatic organisms in a region are adapted to deal with a range of sediment amounts that enter streams. The amount of erosion in a watershed and the sediment load in the streams vary considerably during the year, with most sediment moving during the few days that have the highest flows. The most significant land-forming events occur during precipitation or snowmelt events that happen only once every decade or more.

Sediment is delivered and transported to stream channels by a variety of processes. Landslide types vary from rapid, shallow debris slides and flows on steep terrain to slow-moving episodic earthflows covering hundreds of acres. Erosion processes include overland flow, concentrating into rills and gullies as well as streambank erosion.

Effects of sediment on stream channels and aquatic habitat are related to the volume, texture, and rate of delivery (see diagram below), as well as the characteristics of receiving stream channels. Fine particles (sand, organics, and silt) deposited on the streambed may blanket spawning gravels and reduce survival of fish eggs incubating in the gravel. Fine sediment may cover the exposed rock surfaces preferred by aquatic insects, reducing the food supply to fish. Suspended sediments cause turbidity (clouding of water), which prevents fish from feeding. Large deposits of coarse sediments can overwhelm the channel capacity, resulting in pool-filling, burial of spawning gravels, and, in some cases, complete burial of the channel, resulting in subsurface streamflows.

Channel Response to Bedload Supply (Lisle USFS)

Bedload Supply →		
← → Incision Bank erosion	Armoring Embeddedness Fines in pools	Braiding Aggradation Bank erosion Pool filling by unsorted bedload Bar construction
Morphologic Response	Textural Response	Morphologic Response

The hardness of the underlying rock and its fracturing as the land is uplifted over long periods of time determine the rate of erosion. These geological processes also influence the pattern and density of streams in a watershed.

In addition to natural levels of erosion, human-induced erosion can occur from roads, landings, rock sources, and other land disturbances. Separating human-induced erosion from natural erosion can be difficult because of the highly variable nature of natural erosion patterns. Furthermore, human-caused erosion may also be highly variable in timing and spatial pattern. While it is nearly impossible to specify when a human-induced change in sediment is too much for a local population of fish and other aquatic organisms to handle, in general, the greater a stream deviates from its natural sediment levels the greater the chance that the fish and other aquatic organisms are going to be affected. Sediment in streams can have a human dimension, too. High sediment levels can increase the cost of treating drinking water, can be aesthetically displeasing, and can decrease fish angling access.

It is important to recognize that much eroding soil will deposit on a hill slope before it reaches the stream. This is good news, since there are a number of things that can be done to fix a site that is eroding before the sediment enters the streams. For example, water draining from a rutted road surface can be delivered onto a well-drained slope where the sediment will be filtered out, and the clean water can flow beneath the ground's surface to the stream.

Road-Related Erosion

The road network is potentially a significant erosion feature. Improperly placed roads can divert sediment-laden water to streams. Poor drainage of roads can lead to gullying and channeling of the road surface. Improper maintenance of inboard ditches can cause saturation of the roadbed, leading to mass wasting.

Road washouts also can occur when a road adjacent to the stream is undercut and a portion of the road drops into the stream, or at stream crossings during a high flow where there was either an undersized or plugged culvert or bridge. In steeper terrain, road washouts can create shallow landslides on unstable fill or cut-slopes failures. Appropriate sizing of culverts and bridges at stream crossings, locating roads away from streams, designing roads properly, and correctly disposing of soil during road construction on steeper slopes can prevent most road washouts.

B INTRODUCTION

The assessment of sediment within the Chetco River watershed was focused on the results of two analyses that serve as indicators of sediment related concerns. These indicators include an analysis of road density on steep slopes (>50%) and an analysis of road crossing density. Individually, each indicator can help direct land managers toward areas within the watershed that may warrant further investigation. Collectively, however, these indicators identify the relative risks of sediment impacts for each subwatershed throughout private lands in the basin.

The two indicators considered in this assessment (See Tables 23 & 24) focus on roads. They are designed to characterize past and future sediment delivery potential. These indicators represent processes that cause sediment delivery to stream channels, and should be interpreted with stream channel data, such as substrate and pool depth benchmarks used by ODFW. Data on cobble and dominant substrate at pool tail-outs are also available for channels of various gradients measured at several sites throughout private lands in the watershed. Although natural and harvest-related sediment sources are also present, they offer fewer opportunities for restoration and are therefore not included in this assessment.

Table 23 Roads on Slopes >50% (Indicator I)

Process: Failure of road fills, steep road surfaces and ditches concentrating runoff onto hillslopes.
Comments: Road failures result when road fill becomes saturated and/or incorporated woody debris decays. Prior to changes in the forest practice rules, roads were constructed by excavating and "sidecasting" road fill on slopes greater than 60%. Current practices call for excavating a "full bench" road and end-hauling the material to a stable landing. Although this indicator does not account for the age of the road, most roads were constructed before the change. Roads with well-maintained drainage systems may minimize the erosion, but large storms may move enough sediment to overwhelm the drainages.

Table 24 Road Crossings (Indicator II)

Process: Plugging of culverts, leading to wash-outs or diversions down the road and onto unprotected hillslopes.
Comments: Old forest practice rules required culverts to be sized for storms recurring every 25 years or less. Many of these older culverts cause water to pond during storms, and allow woody debris to rotate sideways and plug the culvert. Culverts that are substantially narrower than the stream channel are also more likely to plug. Crossings located on steeper stream channels are subject to higher stream power mobilizing sediment and wood in the channel, and on hillslopes when diverted. Debris flows are also more likely to be generated on steeper channels. **Note:** *Currently, this indicator has not been refined by considering the stream gradient or the stream junction angle that would factor in the likelihood of continued debris flow run-out. Also, not all culverts that are included in this indicator are likely to plug or fail.*

Ideally, the sediment indicators could characterize the probability of delivering an estimated volume of sediment with a known range of particle sizes. In reality, we can only infer the processes likely to deliver sediment, and identify locations where the processes are most likely to occur.

C METHODOLOGY

- <u>Roads on Slopes >50%</u>: USGS 7.5 Minute topographic maps and digital orthophoto quads were interpreted to generate a comprehensive watershed road map in GIS. Old roads were included on the map. Slopes >50% were generated from a slope class map (originally from 10 meter digital elevation models) prepared by the Rogue Valley Council of Governments' GIS department. The length of all roads with slopes >50% were calculated for each subwatershed.
- <u>Road Crossings</u>: USGS 7.5 Minute topographic maps and digital orthophoto quads were interpreted to generate a comprehensive watershed road crossing map in GIS.

Crossings were identified at sites where contours or road configuration indicated the presence of distinct channels. (Larger drainage areas are required to create channels on more gentle slopes.) Old roads were included on the map. Crossings on these old roads may already be washed out, or no longer accessible for restoration, but their effects may be reflected in stream channel conditions below.

- For each subwatershed and each indicator a rating of sediment impacts was assigned based on comparisons of all south coast subwatersheds considered in this assessment. A percentile rating of 0-100 was established to represent the relative risk of each indicator for each subwatershed relative where 0 = lowest possible risk and 100 = highest possible risk. The percentile rating was further divided in the following categories: 0-19 (low); 20-39 (moderately-low); 40-59 (moderate); 60-79 (moderately high) and 80-100 (high).

D RESULTS

Table 25 Summary of Sediment Impacts

Subwatershed	Non USFS Acres	Roads on Slopes>50%			Road Crossings		
		Total Road Miles	Density/ Sq Mi	Roads on Slopes >50% Percentile	Total # of Crossings	Density/ Sq Mi	Road Crossings Percentile
Chetco Coastal Area	4868	5.61	0.74	59	135	17.75	94
Eagle Creek	1935	0.00	0.00	0	34	11.25	57
Jack(s) Creek	3923	2.29	0.37	30	87	14.19	74
Lower Chetco Mainstem (1)	3531	1.43	0.26	21	65	11.78	60
Middle Chetco Mainstem	8817	3.16	0.23	18	228	16.55	87
North Fork Chetco	25724	10.82	0.27	22	374	9.30	47
Quail Prairie Creek	864	-	-	-	2	1.48	2
Upper Chetco Mainstem (1)	576	-	-	-	12	13.33	69

E KEY FINDINGS

<u>Density of Roads on Slopes >50%</u>

- Except for the Chetco Coastal Area all subwatersheds received moderately-low to low risk ratings of density of roads on slopes >50%. The Chetco Coastal Area received a moderate risk rating (59%) of density of roads on slopes >50%.

<u>Density of Road Crossings</u>

- The Chetco Coastal Area and the Middle Chetco Mainstem rank second (94%) and third (87%) respectively for the highest density of road crossings among a total of 48 subwatersheds throughout the South Coast basins. Both subwatersheds received high risk ratings.
- Jack(s) Creek, Lower Chetco Mainstem (1), and Upper Chetco Mainstem (1) each received moderately high risk ratings of density of road crossings.
- The North Fork and Eagle Creek both received moderate risk ratings whereas Quail Prairie Creek received a low risk rating of density of road crossings.

F OTHER

Although not available at this time, an analysis of roads within 100 feet of stream channels will serve as a third indicator in the near future. Data, produced by the Rogue Basin Restoration Technical Team, should be available in the near future.

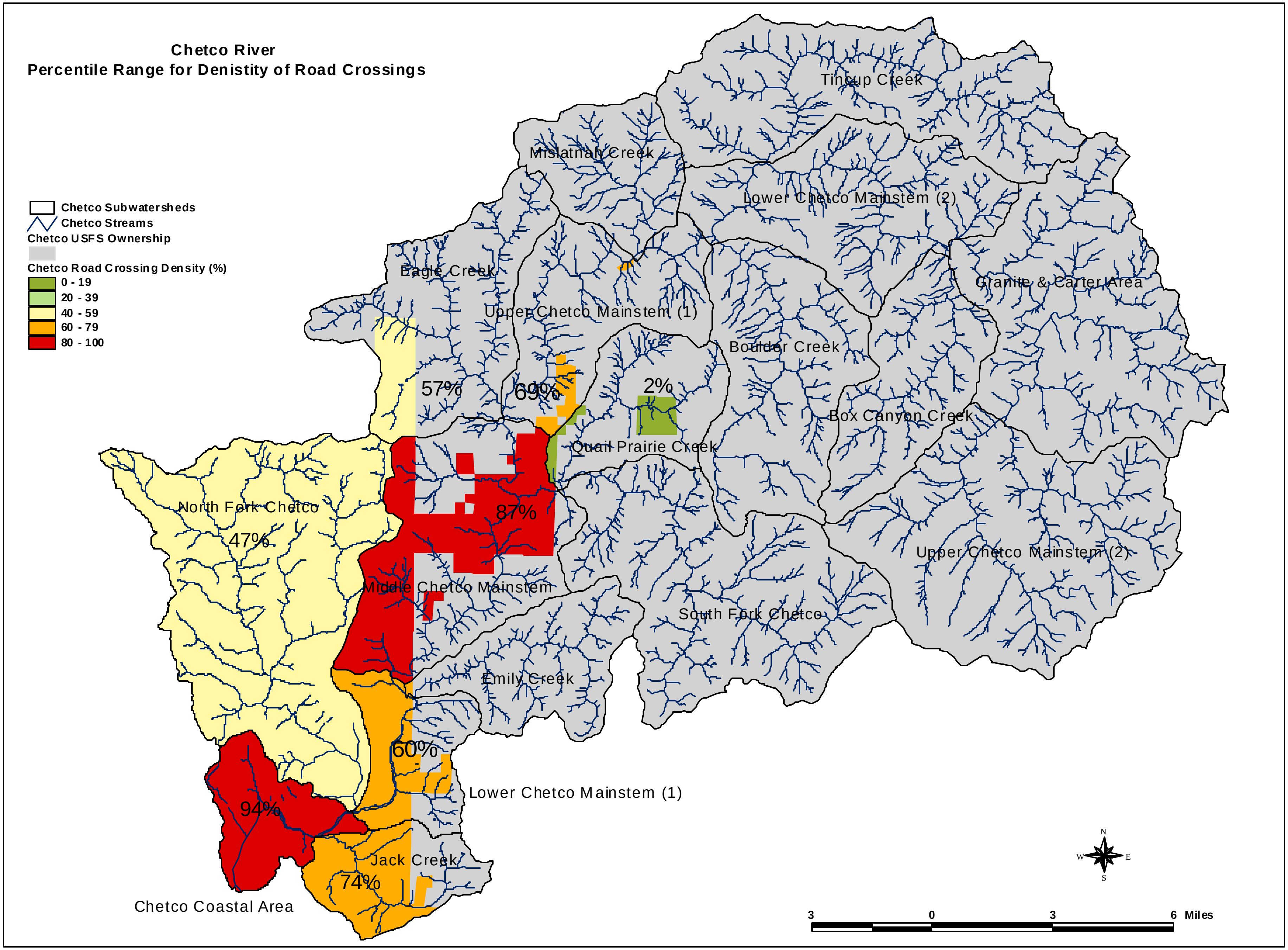
Table 26 Roads Within 100 feet of Stream Channels (Indicator III)

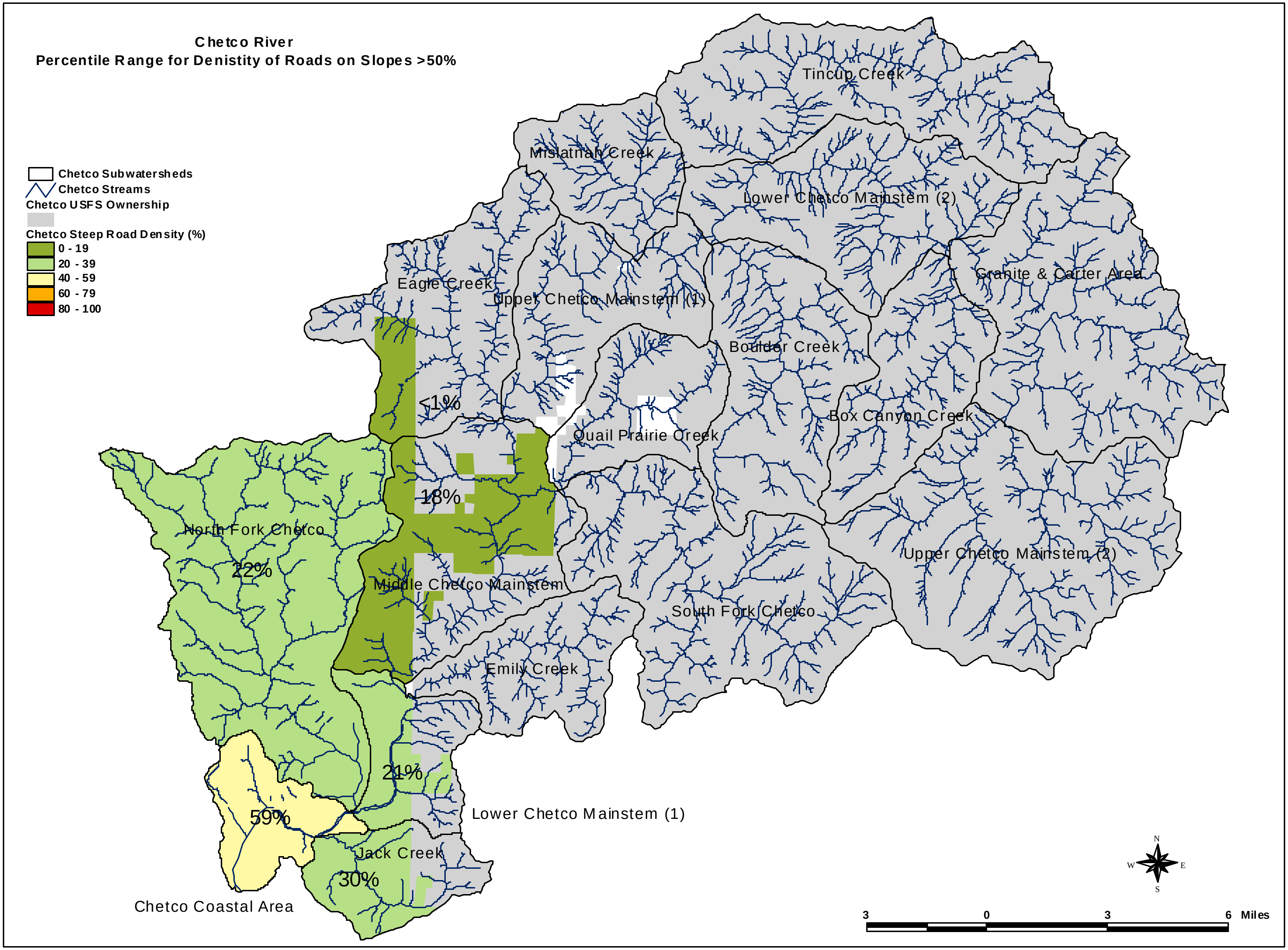
Process: Ditch erosion delivered directly to streams at crossings and at ditch relief culverts (less opportunity for fines to deposit on slopes), fill failures more frequent in wet toe-slope position and more likely to deliver to channels. Removal of large wood from channels.
Comments: The amount of fines generated from the road surface and ditch is related to the traffic and season (e.g. wet weather haul), frequency of disturbance including grading, and quality of the surfacing on the road. These factors however are not taken into account by this indicator.

REFERENCES

GWEB 1999. Oregon Watershed Assessment Manual. Governor's Watershed Enhancement Board, July 1999

Lisle USFS. Tom Lisle, USFS, Redwood Sciences Laboratory, Arcata, California


Chetco River
Percentile Range for Denistity of Road Crossings
Chetco Subwatersheds
Chetco Streams
Chetco USFS Ownership
Chetco Road Crossing Density (%)
0 - 19
20 - 39
40 - 59
60 - 79
80 - 100
Tincup Creek
Mislatnah Creek
Lower Chetco Mainstem (2)
Eagle Creek
Granite & Carter Area
Upper Chetco Mainstem (1)
Boulder Creek
57%
69%
2%
Box Canyon Creek
Quail Prairie Creek
North Fork Chetco
87%
47%
Upper Chetco Mainstem (2)
Middle Chetco Mainstem
South Fork Chetco
Emily Creek
60%
Lower Chetco Mainstem (1)
94%
Jack Creek
74%
Chetco Coastal Area
N
W
E
S
3
0
3
6 Miles



Chetco River
Percentile Range for Denistity of Roads on Slopes >50%
Chetco Subwatersheds
Chetco Streams
Chetco USFS Ownership
Chetco Steep Road Density (%)
0 - 19
20 - 39
40 - 59
60 - 79
80 - 100
Tincup Creek
Mislatnah Creek
Lower Chetco Mainstem (2)
Granite & Carter Area
Eagle Creek
Upper Chetco Mainstem (1)
Boulder Creek
<1%
Box Canyon Creek
Quail Prairie Creek
18%
North Fork Chetco
22%
Middle Chetco Mainstem
Upper Chetco Mainstem (2)
South Fork Chetco
Emily Creek
21%
59%
Lower Chetco Mainstem (1)
Jack Creek
30%
Chetco Coastal Area
N
W
E
S
3
0
3
6
Miles

IX RIPARIAN ASSESSMENT

A BACKGROUND (GWEB 1999)

A riparian area or zone is a term that is often difficult to define. At its simplest, it is a green area along a body of water such as a stream or river. Riparian areas generally have higher levels of soil moisture than adjacent upland areas, and usually are well-vegetated. A wide variety of hydrologic, geomorphic, and biotic processes determine the character of a riparian zone.

Riparian vegetation influences fish habitat and water quality in a number of ways. Riparian vegetation may act as a filter in some areas, keeping sediment and pollutants out of streams. The roots of riparian vegetation stabilize streambanks by reducing erosion and preventing stream channels from downcutting. Streamside vegetation provides habitat for insects, some of which fall in the water and provide a food source for fish. In addition, vegetative litter is an important source of nutrients to the stream. During high stream flows, riparian vegetation may slow and dissipate the energy of floodwaters, preventing erosion. Although all of these are important functions of riparian vegetation, they are difficult to quantify and are beyond the scope of this assessment. This assessment focuses only on the functions of riparian areas in providing a source of large wood to the stream, and in providing shade for temperature control. Riparian zones that are functioning to provide these two key inputs typically provide many other valuable functions and processes attributed to these dynamic areas.

Large Wood Recruitment

Riparian areas are an important source of large woody debris (LWD) that enters, or is recruited to, the stream channel. LWD, including tree boles, root wads, and large branches, is recruited to the stream by bank erosion, mortality (e.g. disease or fire), or wind throw. Also, trees from both riparian and upland areas may also be carried into the stream by landslides.

In the stream channel, LWD diverts and obstructs flow, thereby increasing channel complexity (i.e., the large wood creates pools and riffles that provide areas of different velocity and depth). This complexity provides cover from predators, creates rearing areas, and develops refuge areas for fish during high stream flows. LWD also creates storage sites for sediment in all sizes of streams. In small headwater streams, wood controls sediment movement downstream. In larger streams, accumulation of sediment behind LWD often provides spawning gravels. LWD plays an important role in stream nutrient dynamics by retaining leaf litter and needles, making these energy supplies available for consumption by aquatic insects that ultimately serve as food for fish.

Riparian Shade

Although other processes besides shading affect heating and cooling of water (such as groundwater inflows), shade can have the largest affect because it counteracts the most important source of stream heating during the summer – solar radiation. Riparian enhancement efforts that provide shade have a high potential to contribute to temperature moderation as well as provide direct benefits to fish and wildlife habitat.

Shade provided by riparian vegetation affects stream temperature by reducing the inputs of solar radiation to the water surface. Although the vegetation itself will radiate heat to the stream, the increase in water temperature due to radiation from this source is very small compared with heating from direct solar radiation. Radiation from vegetation is important, however, because it decreases fluctuation of water temperatures on a daily (or diurnal) basis in forested streams compared with streams that have no canopy cover. The slope and aspect of a site also affect the amount of radiation received. In some areas (e.g. deep canyons) the topography of the land can also provide significant shade.

Role of Ambient Air Temperature

In most streams, evaporation of moisture is a primary mechanism of stream cooling; the heat is used to turn water into vapor. Turbulent streams will cool faster than slow streams with smooth surface conditions, due to the higher evaporation rate. Inputs of cool groundwater are also a significant source of stream cooling in some areas.

Stream temperatures are cooler than the ambient air temperature because of the higher specific heat of the water, and the cooling processes associated with evaporation and the inflow of groundwater. The daily patterns in stream temperature follow the daily change in air temperature. Typically, the maximum daily temperature occurs in the late afternoon and the minimum occurs late at night or early morning.

In many streams in Oregon, late-summer streamflows are lowest when the net heat gain is the greatest, resulting in the warmest water temperatures of the year. This phenomenon reflects the fact that the maximum water temperature is a result of both the net heat received and the amount of water that is heated. Consequently, the maximum annual stream temperatures may be higher in low-flow or drought years even though the stream receives the same level of heating each year.

Stream Order (OSU 1998)

A basic description of stream order is essential to understand the relationship of existing, potential, and potential increase in shade on perennial stream reaches. Stream order is a useful way to classify streams because within a given climatic and geologic region, certain stream orders tend to share many features and processes. The most common stream order classification system is to call the initial channel where a small stream first appears a first-order stream, and then to increase the order with each successive downstream junction with a stream of equal or higher order. Thus, small streams have low order numbers, while large streams and rivers have high order numbers.

B INTRODUCTION

Riparian vegetation has been removed along streams throughout the Chetco River watershed for a variety of management practices and also naturally, through streambank erosion. Historically, many riparian zones within the Chetco River basin contained large conifers that were later harvested. In many cases, alder (*Alnus rubra*) dominant riparian communities have succeeded in the years following these harvests. Conifers typically grow taller and live longer than alders. The act of converting these present-day alder dominant communities back to mixed stands that include conifers (alder conversion) will undoubtedly provide increased shade for the long term.

The removal of riparian vegetation has reduced shade and subsequently increased the amount of sunlight reaching the stream. As noted previously, shade is one of the factors that controls summer stream water temperatures. In-stream flow and groundwater, as well as channel width/depth, and bedrock/substrate heating are other factors to be considered, but are not included in this assessment.

In 2000, an assessment of shade was conducted to estimate the existing and potential shade on perennial streams within the Chetco River watershed. Existing shade is defined as shade that is currently present as evidenced by aerial photograph interpretation and selected field measurements. Potential shade is defined as the amount of shade that can be produced over time based on the site's potential to grow trees. The results of these two analyses were compared to estimate the potential increase in shade throughout the watershed.

A summary of the riparian assessment is presented in Tables 27 to 29. The Key Findings portion of this assessment highlights significant attributes of each table. **Note:** the Riparian Assessment evaluated riparian zones and streams only on private and BLM lands within the Chetco River watershed.

C METHODOLOGY

- Topographic maps (USGS 7.5 minute quads) and aerial photos (1997 BLM) were compiled to divide streams into numerous reaches (segments) based on differences in riparian vegetation, orientation (aspect), size and gradient.

- Riparian vegetation was characterized into several different classes. These classes and their attributes include the following: Mature = coniferous trees >121 feet; High (reproduction) = coniferous trees 91 – 120 feet; Low (reproduction) = coniferous trees 31 to 90 feet; Hardwood = deciduous and evergreen hardwood trees >31 feet; Brush = shrubs < 30 feet; and Pioneer = bare or nearly bare ground.

- Field visits, conducted at several sites, included the following measurements: summer low flow width, bankfull channel width, distance from bankfull to riparian vegetation, streambank slope, various tree heights, percentage of overhanging vegetation, and shade density. The existing percentage of shade was also measured at each site in the middle of the bankfull channel with an instrument known as the Solar Pathfinder. This device allows the user to estimate the percent of solar radiation shaded by riparian vegetation for any given day of the year. **Note:** *Additional Solar Pathfinder measurements could be used to validate the SHADOW results or to modify assumptions used to date. Although there is a lack of channel data for numerous* *small streams (not necessarily perennial) in the watershed, these contribute the least flow and require the shortest vegetation to provide shade. Sensitivity analysis for the variables used in SHADOW would help focus attention on those least certain data fields.*

- Existing shade was estimated using a computer spreadsheet program known as SHADOW. SHADOW considered the angle of the sun on August 1st in determining how far a tree projects a shadow across a stream during each hour of the day. For each stream reach, information was obtained from maps, photos, and field measurements to estimate a low flow channel width (wetted width) and existing tree height. SHADOW estimated shade for each stream reach based on its aspect, characterized as diagonal, north-south, or east-west.

- Average channel widths and tree heights were used to create the Existing Shade map overlay. Local conditions differ from assumed conditions and will determine the actual shade along any particular stream reach. Landowners can obtain more specific estimates of Potential Shade for any set of field conditions. SHADOW can also be used to calculate widths of riparian vegetation that are shading in the primary (11:00 AM-1:00 PM) and secondary (before 11:00 AM and after 1:00 PM) zones.

- The process for estimating potential shade was identical to that of estimating existing shade, with the added assumption that a tree can grow to a certain height over time. Based on field measurements of mature stands of mixed conifers and hardwoods in several watersheds on the south coast it was assumed that trees could grow an average of 132'.

- The percentage of existing shade was mapped (on mylar), in 20% increments, to illustrate the current condition on all perennial streams within the watershed. Similarly, the percentage of increased shade was mapped (on mylar), in 20% increments, to illustrate the potential condition on all perennial streams within the watershed. Increased shade was determined by subtracting the existing shade from the potential shade.

- **Note:** The North Fork was subdivided into four areas per BLM request.

D RESULTS

Table 27 Miles of Stream by Perennial Stream Reach & Stream Order

Perennial Stream Reach	Stream Order						Total Miles of Stream (All Stream Orders)
	1	2	3	4	5	Mainstem	
Mainstem	2.7	10.2	9.9	2.7	0.0	7.3	32.8
Lower Chetco Mainstem	0.4	2.2	2.6	0.4	0.8	4.6	10.9
Chetco Coastal Area	0.9	1.7	3.2	1.5	0.0	4.9	12.1
Upper North Fork	0.0	2.8	5.5	5.9	0.0	0.0	13.7
Morton Area	0.0	1.1	3.1	5.4	1.7	0.0	11.2
Lower North Fork	0.4	5.5	4.4	2.2	4.8	0.0	17.2
Bravo Creek	0.4	4.1	6.8	6.4	0.0	0.0	17.7
Jack(s) Creek	0.0	2.8	5.3	5.2	0.0	0.0	13.3
Total Miles	4.8	30.4	40.8	29.7	7.3	16.8	128.9

Table 28 Average Existing Shade (%) by Perennial Stream Reach & Stream Order

Perennial Stream Reach	Stream Order						Total Averages for All Stream Orders
	1	2	3	4	5	Mainstem	
Mainstem	96	93	91	78	-	33	78
Lower Chetco Mainstem	100	96	91	92	50	29	63
Chetco Coastal Area	94	86	82	84	-	34	64
Upper North Fork	69	94	91	75	-	-	85
Morton Area	-	94	92	79	73	-	83
Lower North Fork	93	93	92	87	37	-	77
Bravo Creek	97	94	85	77	-	-	84
Jack(s) Creek	-	95	88	77	-	-	85

Table 29
Average Potential Shade Increase (%) by Perennial Stream Reach & Stream Order

Perennial Stream Reach	Stream Order						Total Averages for All Stream Orders
	1	2	3	4	5	Mainstem	
Mainstem	2	5	4	9	-	8	5
Lower Chetco Mainstem	0	3	2	2	13	6	5
Chetco Coastal Area	6	13	13	6	-	6	9
Upper North Fork	25*	5	3	12	-	-	7
Morton Area	0	3	2	8	11	-	6
Lower North Fork	2	3	2	4	26	-	9
Bravo Creek	2	4	8	11	-	-	8
Jack(s) Creek	-	4	6	13	-	-	8

* less than 0.1 mile of stream.

E KEY FINDINGS

Table 27

- Approximately 129 miles of streams, located on private lands within the Chetco River watershed, were evaluated in this assessment. Of the total stream miles assessed the majority were located along the Chetco Mainstem. Other perennial stream reaches considered in this assessment include: Lower Chetco Mainstem, Chetco Coastal Area, Upper North Fork, Morton Area, Lower North Fork, Bravo Creek and Jack (s) Creek.
- Stream orders in the Lower Chetco River watershed range from 1st to >5th. In order of greatest occurrence the percent of stream orders found throughout the lower basin are 3rd order (31.6%); 2nd order (23.6%); 4th order (23.0%); >5th order (13.0%); 5th order (5.7%); and 1st order (3.7%).

Table 28

- In general, existing shade percentages are highest in 1st order streams and lowest on mainstem reaches (>5th order streams). The highest existing shade is 100% on 0.4 miles of 1st order streams in the Lower Chetco Mainstem. The lowest existing shade is 29% on 7.1 miles of the Lower Chetco Mainstem.

Table 29

- The stream reaches within the Lower North Fork have the highest potential shade increase (9%) on average for all stream orders.
- The highest potential shade increase on 1st order streams is 6% on 0.9 miles of the Chetco Coastal Area.
- The highest potential shade increase on 2nd order streams is 13% on 1.7 miles of the Chetco Coastal Area.
- The highest potential shade increase on 3rd order streams is 13% on 3.2 miles of the Chetco Coastal Area.
- The highest potential shade increase on 4th order streams is 12% on 5.9 miles of the Upper North Fork; 13% on 5.2 miles of Jack(s) Creek; and 11% on 6.4 miles of Bravo Creek. *(**Note**: Shade estimates were from 1997aerial photos, which were taken prior to the development of the golf course).*
- The highest potential shade increase on 5th order streams is 25% on 4.8 miles of the Lower North Fork.
- The highest potential shade increase on mainstem reaches (>5th order streams) is 8% on 7.3 miles on the Chetco Mainstem.
- Individual stream reaches have higher potential increases in shade than the averages for the corresponding stream order. For example, one reach along upper Bravo Creek can potentially increase shade by 20-30%. These specific locations are illustrated on mylar overlays located in the Curry County Soil and Water Conservation District Office.

Other

- Mature and High vegetation classes are concentrated along upper Jack Creek, Mill Creek, Upper Panther Creek, the west slope of Bravo Creek, and the west slope of Upper North Fork Chetco above Bravo Creek. ***Note:*** *The evaluation of riparian vegetation classes by perennial stream reaches was not complete at the time of the writing of this assessment. The key findings identified here are based on visual interpretation of mylar overlays.*

REFERENCES

GWEB 1999. Oregon Watershed Assessment Manual. Governor's Watershed Enhancement Board, July 1999

OSU 1998. Watershed Stewardship - A Learning Guide, Oregon State University Extension Service, July 1998

X WETLANDS

A BACKGROUND (GWEB 1999 and OSU 1998)

Wetlands are often considered ecological "hot spots." They play a role disproportionate to their size in supporting endangered species and maintaining biodiversity. When considering wetland assessments and associated restoration projects it seems prudent to first understand a regulatory definition of a wetland as used by the U.S. Army Corps of Engineers and the Oregon Division of State Lands: **Wetlands are those areas that are inundated or saturated by surface or groundwater at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted to life in saturated soil conditions.**

Wetlands provide a variety of important functions, including water quality improvement, flood attenuation and desynchronization, groundwater recharge and discharge, and fish and wildlife habitat. These functions are described below.

<u>Water Quality Improvement</u>

Wetlands aid in water quality improvement by trapping sediment, and contaminants that may be attached to these sediments. Dense wetland vegetation tends to slow the rate of movement of water, which allows sediments to settle out. Although deposition of sediments is beneficial to downstream resources, excessive sedimentation may have negative impacts on the wetland itself. When a wetland is subjected to ongoing sediment deposition, the bottom elevation of the wetland will change; over time, this will lead to wetland loss. This process is exacerbated by human induced factors that increase sedimentation.

Vegetation within wetlands also can assimilate certain nutrients and some toxins, thereby protecting downstream resources. The anaerobic environment of many wetland soils breaks down nitrogen compounds and keeps many compounds in a nonreactive form. The ability of a wetland to provide this function is limited: At a certain point, toxins can build up to lethal levels in the wetland community and decrease the wetlands capacity to metabolize the nutrients entering from upstream sources. In addition, plant die-back and decay can re-release nutrients or toxins back into the system, although many toxins are actually converted to less harmful forms or bound in sediments.

<u>Flood Attenuation and Desynchronization</u>

Wetlands can help alleviate downstream flooding by storing, intercepting, or delaying surface runoff. Wetlands within the floodplain of a river can hold water that has overtopped river-banks. Floodwater desynchronization occurs when wetlands higher in the watershed temporarily store water, reducing peak flows. The most effective wetlands at providing desynchronization are generally located in the middle elevations of the watershed; these wetland locations are far enough away from the receiving water to create delay, but are low enough in the watershed to collect significant amounts of water.

Groundwater Recharge and Discharge

Wetlands are intimately associated with groundwater, and some wetlands can function to recharge underlying aquifers. Wetlands are sources of groundwater discharge that may help extend streamflows into the drier summer months. In eastern Oregon, restoring wet meadows in stream headwaters has extended the seasonal duration of streamflow.

Fish and Wildlife Habitat

Wetlands provide habitat and food for a variety of aquatic and terrestrial plant and animal species. Many species rely on wetlands for all or a portion of their life cycle. In addition to directly providing habitat, wetlands can directly support fish through some of the functions, discussed previously, that protect water quality and channel stability. Estuarine wetlands provide important feeding and holding areas for out-migrating salmon smolts.

B INTRODUCTION (GWEB 1999 and OSU 1998)

Wetlands are protected by federal, state, and local regulations. In order to plan for growth and development in a watershed, it is necessary to know where these resources are located. In addition, wetlands can contribute to critical functions in the health of a watershed as mentioned above. Determining the approximate location and extent of wetlands may be essential in solving problems within the watershed.

Purpose

The purpose of the wetland characterization is to gain specific information on the location and attributes of wetlands in the watershed, including size, habitat type, surrounding land use, connectivity, and opportunities for restoration. This process will also assist in determining the relationship between wetlands and problems in the watershed that are identified through other components in this assessment. In addition, this inventory will help watershed councils determine whether it is appropriate or necessary to collect additional data on wetland function.

National Wetlands Inventory and the Cowardin Classification System

The most widely available and comprehensive wetlands information in the United States is the U.S. Fish and Wildlife Service's National Wetlands Inventory (NWI). The NWI has located and classified wetlands as well as mapped the entire aquatic ecosystem network. NWI maps contain information on location in the watershed, water regime, vegetation class or subclass, morphology, and sheet versus channel flow. The NWI is based on the Cowardin Classification System, which was published as the *Classification for Wetland and Deepwater Habitats of the United States*. It has four objectives:

1. To describe ecological units whose natural attributes are fairly homogenous
2. To arrange these units in a system that will help people make decisions about resource management
3. To provide information for inventory and mapping
4. To create standard concepts and terminology for use in classifying aquatic ecosystems

A major weakness of the Cowardin system and the NWI is that the descriptions of mapped units often don't relate consistently to ecosystem functions. Because of the system's reliance on plant types as identifying criteria, wetlands that function very differently often are grouped into the same Cowardin class simply because they have the same vegetation.

Cowardin Classification's five major systems:

1. Marine (ocean): Consists of the open ocean overlying the continental shelf and its associated high-energy coastline. Marine habitats are exposed to the waves and currents of the open ocean and the water regimes are determined primarily by the ebb and flow of oceanic tides.
2. Estuarine (estuaries): Deepwater tidal habitats and adjacent tidal wetlands that are semi-enclosed by lands but have open, partially obstructed, or sporadic access to the open ocean, and in which open water is at least occasionally diluted by freshwater runoff from the land.
3. Riverine (rivers): Includes all wetlands and deepwater habitats contained within a channel, except: (1) wetlands dominated by trees, shrubs, persistent emergents, emergent mosses, or lichens, and (2) areas with water containing ocean-derived salts in excess of 0.5 parts per thousand.
4. Lacustrine (lakes): Includes wetlands and deepwater habitats with all of the following characteristics: (1) situated in a topographic depression or a dammed river channel; (2) lacking trees, shrubs, persistent emergents, mosses, or lichens with greater than 30% areal coverage; and (3) total area exceeds 8 hectares (20 acres).
5. Palustrine (marshes): Includes all nontidal wetlands dominated by trees, shrubs, persistent emergents, emergent mosses, or lichens, and all such wetlands that occur in tidal areas where salinity due to ocean-derived salts is below 0.5 parts per thousand.

These systems are divided into subsystems, which reflect water flow regimes (subtidal, intertidal, etc.). The subsystems are then divided into many different classes, which reflect structural vegetative characteristics (e.g. RB Rock Bottom, UB Unconsolidated Bottom, etc.). The classification of a mapped wetland is coded by a series of letters and numbers. The first letter of the code represents the system, the subsequent number represents the subsystem and the next two letters indicate the class. All Cowardin codes have more than three letters and/or numbers. These additional characters represent more specific information about each wetland. Generally, however, the first three letters and numbers of each code are the most important for the purpose of this assessment. A summary of the Cowardin Classification Codes is provided below. These codes will be helpful in identifying restoration opportunities within the Chetco River watershed.

Due to the common occurrence of Palustrine wetlands, specific descriptions of five common classes are provided as follows:

1. EM Emergent: Dominated by rooted herbaceous plants, such as cattails and grass.
2. FO Forested: Dominated by trees taller than 20 feet.
3. OW Open Water: No vegetation evident at the water surface.
4. SS Scrub-Shrub: Dominated by shrubs and saplings less than 20 feet tall.
5. UB Unconsolidated Bottom: Mud or exposed soils.

Summary of Cowardin Classification Codes

System	Subsystem	Class	
M= Marine	1 = Subtidal	RB Rock Bottom UB Unconsolidated Bottom AB Aquatic Bed	RF Reef OW Open Water/Unknown Bottom
	2 = Intertidal	AB Aquatic Bed RF Reef	RS Rocky Shore US Unconsolidated Shore
E= Estuarine	1 = Subtidal	RB Rock Bottom UB Unconsolidated Bottom AB Aquatic Bed	RF Reef OW Open Water/Unknown Bottom
	2 = Intertidal	AB Aquatic Bed RF Reef SB Streambed RS Rocky Shore	US Unconsolidated Shore EM Emergent Wetland SS Scrub/Shrub Wetland FO Forested Wetland
R= Riverine	1 = Tidal	RB Rock Bottom UB Unconsolidated Bottom AB Aquatic Bed SB Streambed	RS Rocky Shore US Unconsolidated Shore EM Emergent Wetland OW Open Water/Unknown Bottom
	2 = Lower Perennial	RB Rock Bottom UB Unconsolidated Bottom AB Aquatic Bed RS Rocky Shore	US Unconsolidated Shore EM Emergent Wetland OW Open Water/Unknown Bottom
	3= Upper Perennial	RB Rock Bottom UB Unconsolidated Bottom AB Aquatic Bed	RS Rocky Shore US Unconsolidated Shore OW Open Water/Unknown Bottom
	4 = Intermittent	SB Streambed	
L= Lacustrine	1 = Limnetic	RB Rock Bottom UB Unconsolidated Bottom	AB Aquatic Bed OW Open Water/Unknown Bottom
	2 = Littoral	RB Rock Bottom UB Unconsolidated Bottom AB Aquatic Bed RS Rocky Shore	US Unconsolidated Shore EM Emergent Wetland OW Open Water/Unknown Bottom
P= Palustrine		RB Rock Bottom UB Unconsolidated Bottom AB Aquatic Bed US Unconsolidated Shore ML Moss-Lichen Wetland	EM Emergent Wetland SS Scrub/Shrub Wetland FO Forested Wetland OW Open Water/Unknown Bottom

Source: Cowardin, L.M., V. Carter, F.C. Golet, and E.T. LaRoe. 1979. Classification of Wetlands and Deepwater Habitats of the United States. US Fish and Wildlife Service, FWS/OBS-79-31, Washington DC.

C METHODOLOGY

1. NWI Maps: NWI maps (scale 1:24,000) were obtained for the majority of private lands within the Chetco River watershed. These maps were utilized as the base maps for identifying wetlands within the watershed. Wetlands considered in this assessment were labeled on corresponding NWI maps.
2. Wetland ID: Wetland IDs were determined by lumping or splitting individual Cowardin units. The lumping/splitting process was performed on the basis of vegetative and hydrologic similarities, land usage, buffer classification, and restoration potential of adjoining Cowardin units. A Wetland ID (1, 2, 3, etc.) was assigned to each group and labeled on the NWI map. Cowardin Classification Codes characteristic of each wetland were listed in Table 30. (Several Wetland IDs consist of more than one code.) Wetlands beginning with the letter "R" (riverine) were not considered due to the very complex NWI mapping that can occur near stream channels.
3. Color Code: Each Wetland ID was color-coded on the NWI maps to assist in locating a wetland listed on Table 30.
4. Size: The size of each wetland was estimated using a mylar template. The minimum size of a wetland assessed was approximately 1.5 acres. **Note:** A slight margin of error in size estimation was possible.
5. Connectivity: Surface-water connection between each wetland and stream was estimated. A wetland was considered connected if some part had a surface-water connection to a seasonal or perennial surface-water-body, including natural and man-made channels, lakes, or ponds. For terraces alongside major channels that are routinely flooded, the presence of a well-defined channel or depression that lacked vegetation but may potentially lead to a channel constituted a surface-water connection. Similarly, ditched pasture-land also qualified as connected.
6. Subwatersheds: Subwatersheds were identified for each wetland.
7. Buffer: Using aerial photographs, the dominant land use within 500 feet of a wetland's edge was characterized using the following codes: FO = forest or open space, AG = agriculture (pasture, crops, orchards, range land), R = rural (mix of small-scale agriculture, forest, and/or rural residential), or D = developed (residential, commercial, industrial). Where more than one land use exists, the dominant (>50% of the area) was listed.
8. Watershed Position: Using the USGS topographic maps, the watershed was divided into thirds to determine the general location of each wetland within the basin. The position of a wetland was characterized as highest, middle or lowest in position. Elevation changes were considered in determining the watershed position.
9. Restoration Potential: Restoration potential was interpreted as the "likelihood" of restoration based on physical and social conditions, not based on the criteria established in the GWEB Oregon Watershed Assessment Manual.
10. Other: Aerial photographs (1997 BLM) were used to assist in determining each wetland's connectivity to stream channel, adjacent land use, and ultimately for the determination of restoration potential and comments portions of the assessment.

D RESULTS

Table 30 Chetco River Wetland Attributes

E KEY FINDINGS

- An estimated 93 acres of wetlands were assessed in the Chetco River watershed. This acreage was divided into 25 *Wetland ID's*; each of which is comprised of one or more NWI delineated wetland.
- Wetlands were rated according to their restoration potential as follows: no potential, 13%; low potential, 60%; moderate potential, 8%; and protection potential (in its present state), 19%. *Percentages are based on total acres.*
- Distribution of wetlands occurs in the following subwatersheds as follows: Coastal Area, 72%; Lower Mainstem, 9%; Jack Creek, 11%; and North Fork, 8%. *Percentages are based on total acres.*
- The wetland buffers are as follows: agricultural, 25%; developed, 14%; forested, 14%; and rural, 47%. *Percentages are based on total acres.*
- Wetland connectivity to other waterbodies is as follows: connected, 92% and not connected, 8%. *Percentages are based on total acres.*
- All wetlands considered in this assessment were located in the lowest watershed position. *See Methodology for explanation of watershed position.*

F DISCUSSION

The GWEB Oregon Watershed Assessment Manual defines the "Restoration Potential" of a wetland based on its degree of alteration. This implies that a wetland considered to have a low degree of alteration, such as a properly functioning wetland, should be rated as low restoration potential. In contrast, a wetland considered to have a high degree of alteration, such as one currently managed for pasture, should be rated as high restoration potential. Although this method is a true characterization of a typical wetland it can be quite misleading because it overlooks certain socioeconomic factors. Often, the most altered wetlands are those that currently serve as prime agricultural lands and, in many cases, may realistically offer only low restoration opportunities. Therefore, the term "Restoration Potential" has been exchanged for a more accurate term – "Degree of Alteration".

The actual restoration of a wetland should be based on many considerations including opportunities to protect properly functioning wetlands and enhance marginal wetlands as well as the landowner's willingness to convert a pasture back to a wetland. Ensuring adequate protection for a properly functioning wetland will typically prove more cost effective than restoration of a non-functional wetland. However, in some cases, the physical and biological benefits associated with restoring a wetland may merit significant costs.

REFERENCES

GWEB 1999. Oregon Watershed Assessment Manual. Governor's Watershed Enhancement Board, July 1999

OSU 1998. Watershed Stewardship - A Learning Guide, Oregon State University Extension Service, July 1998

XI HYDROLOGY

A BACKGROUND (GWEB 1999)

Hydrologic Cycle

The hydrologic cycle describes the circulation of water around the earth, from ocean to atmosphere to the earth's surface and back to the ocean again. Oceans, covering 70% of the earth's surface, play a large role in the movement of water through this cycle. Solar energy evaporates water from the ocean, wind carries the water over the land surface, and water is precipitated by gravity back to the earth. Rain is the most common form of precipitation, but snow, hail, dew, fog, drip, and frost all can bring water into a watershed. Precipitation that reaches the earth can move through three different pathways. Water can:

- Be intercepted by vegetation and evaporated or transpired back to the atmosphere
- Move down-slope on the surface or through soil to a stream system, eventually returning to the ocean
- Be stored in snowpack, groundwater, ponds, or wetlands for a variable period of time

Land Use Impacts on Hydrology

Land use practices can modify the amount of water available for runoff, the routing of water to the streams, the lag time (delay between rainfall and peak streamflow), the flow velocity, or the travel distance to the stream. Land use practices that affect the rate of infiltration and / or the ability of the soil surface to store water are typically most influential in affecting the watershed's hydrology. Using this as an indicator for comparison among the land uses, forest harvesting produces the smallest change in the infiltration rate, thereby producing the smallest impacts to the hydrologic regime of a basin. Forest harvest practices have evolved such that land compaction can be minimized; however, roads and grazing in these watersheds decrease the infiltration rate. In contrast to forest harvest, agricultural practices, rangeland utilization for grazing purposes, and urban development can all involve compaction of the soils and / or paved surfaces, resulting in substantial alteration of the infiltration rate. Agricultural practices and urban development directly involve altering the shape of the drainage system by ditching, channelizing, or using piped stormwater networks which decrease the infiltration and the travel time of subsurface flow to reach the channel. This effect can be much worse in high-flow conditions. While forest harvest practices are not always practiced at sustainable rates, they are temporary conversions of vegetation, and the hydrologic effects diminish as vegetative regrowth occurs. Conversion of lands to agriculture or urbanization produces generally longer-lasting effects. Road construction, associated with all land uses, alters the rate of infiltration on the road surface and replaces subsurface flow pathways with surface pathways resulting in quicker travel time to the channel network.

B INTRODUCTION

The Hydrologic Condition Assessment is a "screening" process designed to identify land use activities that have the potential to impact the hydrology of the Chetco River watershed. Alterations to the natural hydrologic cycle potentially cause increased peak flows and/or reduced low flows resulting in changes to water quality and aquatic ecosystems. The degree to which hydrologic processes are affected by land use depends on the location, extent, and type of land use activities. When potential impacts are recognized, best management practices can be followed to minimize some of the potential hydrologic impacts; mitigation will be necessary to address other impacts.

The GWEB Oregon Watershed Assessment Manual provides a set of methods to prioritize those subwatersheds most likely to need restoration from a hydrologic perspective. Because hydrology is such a complex subject, the screening process only deals with the most significant hydrologic process affected by land use (i.e., runoff). The assessment does not attempt to address every hydrologic process potentially affected; the goal is to gain an understanding of the major potential impacts.

General Watershed Characteristics

A Geographic Information System (GIS) analysis was conducted to provide general watershed characteristics pertaining to the Hydrologic Condition Assessment of Chetco River. The GIS shapefile used in this portion of the assessment is titled "Precipitation, Average Annual", available from the Southwest Oregon Province GIS Data CD Minimum elevations, maximum elevations and maximum elevation locations were determined using USGS 7.5 Minute Quads.

Table 31 General Watershed Characteristics

Subwatershed Name	Subwatershed Area (square miles)	Mean Annual Precipitation (inches)	Minimum Elevation (feet)	Maximum Elevation (feet)	Maximum Elevation (Name)
Boulder Creek	21.83	122	480	4,640	Vulcan Peak
Box Canyon Creek	14.93	130	880	4,640	Vulcan Peak
Chetco Coastal Area	7.95	87	0	1,480	No Name
Eagle Creek	20.55	116	160	3,652	Mineral Hill
Emily Creek	12.48	90	70	2,930	Mt. Emily
Granite & Carter Area	32.89	128	920	5,098	Pearsoll Peak
Jack Creek	8.80	82	35	1,660	No Name
Lower Chetco Mainstem (1)	9.24	87	35	2,925	Mt. Emily
Lower Chetco Mainstem (2)	22.63	103	480	4,494	Tincup Peak
Middle Chetco Mainstem	25.44	97	70	2,400	Cashner Butte
Mislatnah Creek	10.98	106	400	4,150	"Big Craggies"
North Fork Chetco	40.19	100	35	3,432	Bosley Butte
Quail Praire Creek	11.48	112	200	3,033	Quail Prairie Mtn.
South Fork Chetco	31.81	121	150	4,520	Vulcan Peak
Tincup Creek	27.74	117	600	4,619	Craggie 2
Upper Chetco Mainstem (1)	16.60	107	160	3,033	Quail Prairie Mtn.
Upper Chetco Mainstem (2)	36.39	140	1,680	4,667	Chetco Peak
Totals	**351.92**				

Land Use Summary

A GIS analysis was conducted to determine land use using two shapefiles titled “Chetco River Subwatersheds”, available from the South Coast Watershed Council, and “Vegetation”, available from the Southwest Oregon Province GIS Data CD. This data was used to characterize land use by lumping several vegetation types into three categories: (1) Forestry and (2) Agriculture/Range and Rural Residential and (3) Urban.

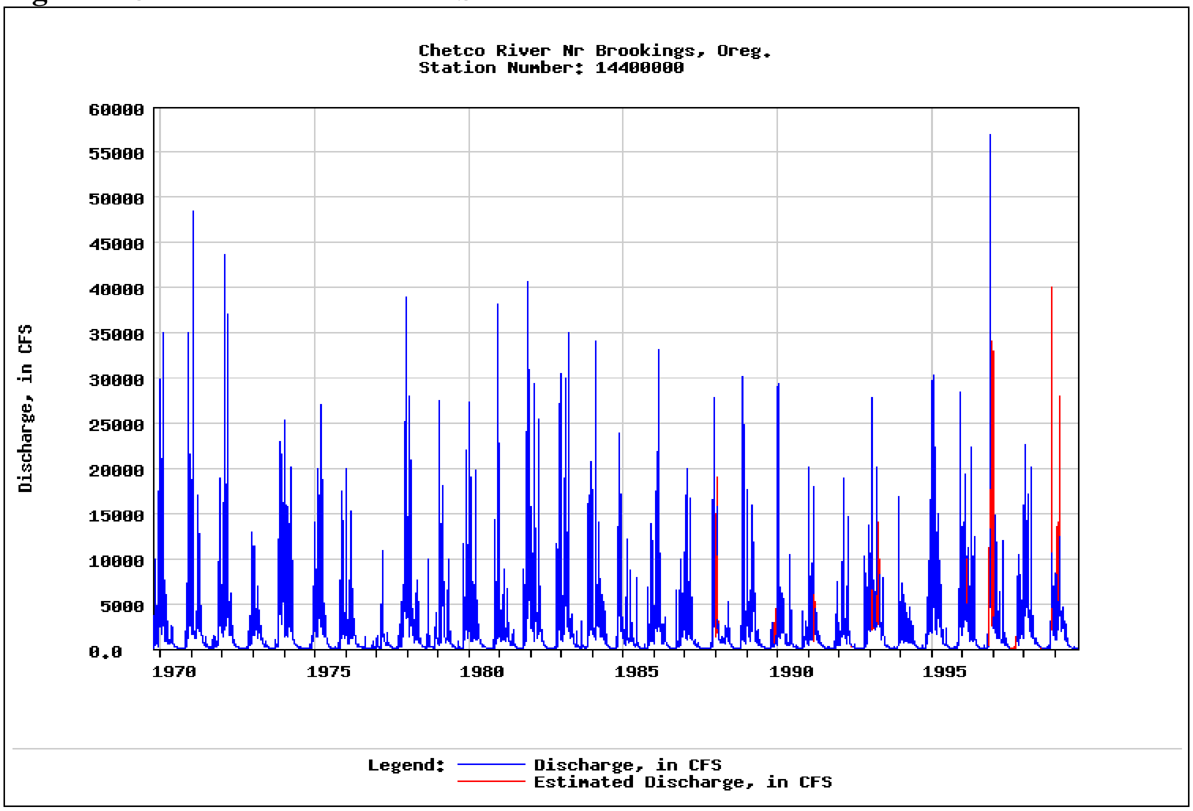
Note: Urban areas were confined to the Chetco Coastal Area subwatershed. Although some agricultural, range and rural residential areas are situated within this subwatershed it was beyond the scope of this assessment to determine the total area for each specific use. Therefore, all agricultural/rangeland, and rural residential areas, within the Chetco Coastal Area, were characterized as urban areas for this portion of the assessment.

Table 32 Subwatershed Land Use Summary

Subwatershed	Forestry		Agriculture/Range & Rural Residential		Urban		Total
	Acres	%	Acres	%	Acres	%	Acres
Boulder Creek	13,973	100.0		0.0		0.0	13,973
Box Canyon Creek	9,552	100.0		0.0		0.0	9,552
Chetco Coastal Area	2,895	56.8		0.0	2,004	39.3	5,093
Eagle Creek	13,148	100.0		0.0		0.0	13,149
Emily Creek	7,984	100.0		0.0		0.0	7,984
Granite & Carter Area	21,039	100.0		0.0		0.0	21,044
Jack Creek	4,350	77.3	1,279	22.7		0.0	5,631
Lower Chetco Mainstem (1)	4,588	77.6	1,222	20.7		0.0	5,915
Lower Chetco Mainstem (2)	14,481	100.0		0.0		0.0	14,481
Middle Chetco Mainstem	16,017	98.4	16	0.1		0.0	16,281
Mislatnah Creek	7,029	100.0		0.0		0.0	7,029
North Fork Chetco	24,255	94.3	1,457	5.7		0.0	25,713
Quail Prarie Creek	7,346	100.0		0.0		0.0	7,346
South Fork Chetco	20,282	100.0		0.0		0.0	20,282
Tincup Creek	17,750	100.0		0.0		0.0	17,750
Upper Chetco Mainstem (1)	10,609	99.9		0.0		0.0	10,622
Upper Chetco Mainstem (2)	23,190	100.0		0.0		0.0	23,190
Totals	**218,488**	**97.1**	**3,974**	**1.8**	**2,004**	**0.9**	**225,035**

Figure 4 Flow Summary
A flow chart was obtained from the Oregon Department of Water Resource's web site illustrating discharge and estimated discharge in cubic feet per second. The period graphed reflects a summary of approximately 30 years of flow data, from 1969 to 1999.

Figure 4 Chetco River Historical Streamflow



Individual Screening Procedures
Four separate screening procedures were developed to evaluate land use impacts on hydrology in the Chetco River watershed:

C FORESTRY
D AGRICULTURE/RANGELANDS
E FOREST AND RURAL ROADS
F URBAN

C1 FORESTRY IMPACTS ON HYDROLOGY

The potential effects of forest practices on hydrology include changes in peak flows, water yield, and low flows. There are two primary mechanisms by which forest practices in the Pacific Northwest watersheds impact hydrologic processes: (1) the removal and disturbance of vegetation, and (2) the road network and related harvesting systems.

Removal of vegetation reduces interception and evapotranspiration, both of which allow additional water to reach the soil surface during rainstorms. Additionally, open areas accumulate more snowpack which can potentially produce an increase in water yield. Forestry-related effects on peak flows may be a function not only of harvest and vegetative cover issues, but also of the type of hydrologic process that occurs in a basin. Increased peak flows, associated with rain on snow events present the greatest likelihood of problems caused by timber harvest. While rain on snow conditions can occur at almost any elevation, given a specific combination of climatic variables, the probability of rain-on-snow enhancement of peak flows differs with elevation and, to a lesser degree, aspect. The highest probability of encountering rain-on-snow conditions occurs at mid-elevations where transient snowpacks develop but not at great depths. The lowest probability occurs in the lowlands, where snowpack rarely occurs and, at the higher elevations, where winter temperatures are too cold to melt snow. The elevation of the lower boundary of the rain-on-snow zone will vary geographically and often by ecoregion.

C2 METHODOLOGY

1. The screen for potential forestry impacts on hydrology was focused on timber harvest. A GIS analysis was conducted to determine total area of transient snow elevation zones by subwatershed. The GIS shapefile used in this portion of the assessment is titled "Transient Snow Elevation Zones", available from the Southwest Oregon Province GIS Data CD.
2. Peak flow generating processes were identified for each subwatershed and characterized as rain or rain-on-snow. Peak flow generating processes within elevation zones of 0' to 2,500' are characterized as rain. In the relatively high elevations snow accumulations are considered transient; snow levels may fluctuate daily, weekly or monthly throughout the winter season. The peak flow generating process in these higher elevations (>2,500') is characterized primarily as rain on snow. However, only occasional storms result in peak flows generated by rain-on-snow conditions (Weinhold USFS). Furthermore, the lack of diurnal variation in streamflow, measured on the Chetco River at the USGS gage (river mile 10.8) suggests that spring snowmelt is not typically considered a peak flow generating process in the watershed (Lloyd Van Gordon, ODWR).

C3 RESULTS

Table 33 Transient Snow Elevation Zones and Peak Flow Generating Processes

		Rain Zone		Rain on Snow Zone		Rain on Snow Zone		Rain on Snow Zone		Rain on Snow Zone	
Subwatershed Name	**Area (acres)**	**0'-2500' (acres)**	**% Area**	**2500'-3000' (acres)**	**% Area**	**3000'-3500' (acres)**	**% Area**	**3500'-4000' (acres)**	**% Area**	**>4000' (acres)**	**% Area**
Boulder Creek	13,973	7,694	55.1	3,369	24.1	2,131	15.3	652	4.7	127	0.9
Box Canyon Creek	9,553	3,684	38.6	2,321	24.3	2,515	26.3	881	9.2	152	1.6
Chetco Coastal Area	5,091	5,091	100.0	0	0.0	0	0.0	0	0.0	0	0.0
Eagle Creek	13,150	11,659	88.7	1,327	10.1	160	1.2	4	0.0	0	0.0
Emily Creek	7,986	7,915	99.1	71	0.9	0	0.0	0	0.0	0	0.0
Granite & Carter Area	21,047	7,565	35.9	4,257	20.2	3,836	18.2	3,283	15.6	2,106	10.0
Jack Creek	5,630	5,630	100.0	0	0.0	0	0.0	0	0.0	0	0.0
Lower Chetco Mainstem (1)	5,914	5,853	99.0	61	1.0	0	0.0	0	0.0	0	0.0
Lower Chetco Mainstem (2)	14,481	9,979	68.9	2,261	15.6	1,560	10.8	551	3.8	130	0.9
Middle Chetco Mainstem	16,281	16,281	100.0	0	0.0	0	0.0	0	0.0	0	0.0
Mislatnah Creek	7,027	4,529	64.5	1,362	19.4	975	13.9	157	2.2	4	0.1
North Fork Chetco	25,723	25,241	98.1	439	1.7	43	0.2	0	0.0	0	0.0
Quail Prairie Creek	7,349	6,675	90.8	622	8.5	52	0.7	0	0.0	0	0.0
South Fork Chetco	20,359	17,344	85.2	1,307	6.4	930	4.6	621	3.1	157	0.8
Tincup Creek	17,753	7,761	43.7	3,177	17.9	2,819	15.9	3,019	17.0	977	5.5
Upper Chetco Mainstem (1)	10,621	10,355	97.5	232	2.2	34	0.3	0	0.0	0	0.0
Upper Chetco Mainstem (2)	23,288	4,328	18.6	6,727	28.9	6,675	28.7	4,607	19.8	951	4.1
Totals	225,226	157,584	70.0	27,533	12.2	21,730	9.6	13,775	6.1	4,604	2.0

C4 KEY FINDINGS

- Results indicate that 70% of the Chetco River watershed is located within the lowest elevation zone of 0’ to 2,500’. Peak flow generating processes in this elevation zone are rain dominant. Elevation zones of the remaining 30% of the watershed are located within rain on snow zones between 2,500’ and 5,000’.

- The GWEB Oregon Watershed Assessment Manual suggests characterizing subwatersheds with more than 75% in the rain category as low potential risk of peak flow enhancement. Ten of the seventeen subwatersheds are predominantly (>75% of area) situated within the lowest elevation zone where rain is considered the peak flow generating process. Thus, a low potential risk of peak flow enhancement was assigned for the following subwatersheds:

1. Chetco Coastal Area
2. Eagle Creek
3. Emily Creek
4. Jack Creek
5. Lower Chetco Mainstem (1)
6. Middle Chetco Mainstem
7. North Fork Chetco
8. Quail Prairie Creek
9. South Fork Chetco
10. Upper Chetco Mainstem (1)

- Seven subwatersheds contain >25% of their area within higher elevation zones of 2,500’ to 4,000’ where peak flow generating processes are characterized as rain-on-snow. However, due to the limitations of this assessment, no further analysis was conducted. Thus, the risk of peak flow enhancement is unknown in the following subwatersheds:

    1. Boulder Creek
    2. Box Canyon Creek
    3. Granite & Carter Area
    4. Lower Chetco Mainstem (2)
    5. Mislatnah Creek
    6. Tincup Creek
    7. Upper Chetco Mainstem (2)

- Further analysis of forestry and surface runoff effects should be conducted on those subwatersheds where >50% of the hydrologic soil groups are in classes C and D.

C5 DISCUSSION (Stewart 2001)

Peak flows and low flows are the hydrologic processes most significantly impacted by land use activities. By removing more than 30% of a forested landscape the amount and timing of runoff can be altered. This concept is more evident in small local drainages, where some important spawning and rearing of salmonids occur, than at the mouth of a main river.

In addition to land use impacts that cause increased flows from timber harvest, the reduced infiltration capacity of the soil is also a concern. Impervious surfaces and roads are good indicators of urbanization and subsequent impacts to the hydrology of a watershed. However, this is only part of the problem. One needs to determine the percent of land surface compacted during forest harvest. Most literature cites 12% of land in a compacted state to be capable of increasing surface runoff. Many of the south coast watersheds were logged with ground based equipment or cable systems known for poor suspension of logs (Hi-Lead). These harvest systems could have compacted 20-40% of the land surface to a point where infiltration would be impaired and runoff increased.

Compounding the area of harvest and impacts to infiltration from the harvest method, the natural state of the soil in some portions of the watershed is very poor. Hydrologic Soil Group (HSG) ratings C and D have minimum infiltration rates of 1-4 and 0-1 mm/hr. respectively. Converting 0.1 inches of rain/hr. to mm/hr. equals 2.54 mm/hr. One-quarter (0.25) inch of rain/hr. exceeds the infiltration capacity of HSG-C by about 50% and HSG-D by over 600%. Given that these soil groups also correspond with areas of high precipitation the runoff effects are naturally high. Harvest removal and compaction further increase this effect.

Further analysis is warranted to look at the level of timber harvest within the watershed. Simply stating that forested areas within rain-dominated areas have a low risk of increasing peak flows is simply untrue. Past practices may still be impacting the routing of water and causing channel modifications or increased sediment routing/turbidity conditions. This would be detrimental to fish habitat and/or fish populations. One suggestion is to obtain and interpret historical photos of the watershed. When viewed on a large scale, specific areas of impact may stand out and provide some indication of historical levels of compaction and timber harvest.

D1 AGRICULTURAL & RANGELAND IMPACTS ON HYDROLOGY

Agricultural practices have most often been implemented along valley bottoms, floodplains, and other adjacent low-gradient lands. An often long-lasting change in the vegetative cover occurs from the conversion of the landscape from forested woodlands, prairie grasslands, or other natural environs, to agricultural use. Clearing for pasture or crop production has also entailed land-leveling or topographic changes of the landscape. Leveling and field drainage has resulted in the elimination of many wetlands and depressions that previously moderated flood peaks by providing temporary storage. Without wetlands and depressions, surface and subsurface runoff move more quickly to the channel network.

Common channel modifications such as ditches, constructed to drain land, and channel straightening were created to maximize agricultural land use. These practices result in increased velocities of surface and subsurface flows that correspondingly decrease infiltration opportunities. Decreased infiltration produces increased runoff and subsequent decreased baseflows during the low-flow season.

The impact of agriculture on hydrology is dependent on specific practices such as the type of cover and management treatments, as well as the characteristics of the soil being farmed. Practices that change infiltration rates are most likely to change the hydrologic regime. The infiltration rates of undisturbed soils vary widely. Agriculture has a greater effect on runoff in areas where soils have a high infiltration rate compared to areas where soils are relatively impermeable in their natural state (USDA 1986).

The Natural Resources Conservation Service (NRCS) has characterized and mapped the soils throughout the state. As part of the mapping process, soils are classified into one of four hydrologic soil groups primarily as a function of their minimum infiltration rate on wetted bare soil. As part of the NRCS methods (USDA 1986), runoff curve numbers are assigned to areas for each of the combination of three parameters: (1) soil group, (2) cover type, and (3) treatment or farming practice.

NRCS Hydrologic Soil Group Classification (USDA 1986)

Low Runoff Potential	Hydrologic Soil Group	Soil Characteristics	Minimum Infiltration Rate (mm/hr)
	A	High infiltration rates even when thoroughly wetted. Deep, well-drained sands or gravels with a high rate of water transmission. Sand, loamy sand, or sandy loam.	8 – 12
	B	Moderate infiltration rates when thoroughly wetted. Moderately deep to deep, moderately well-drained to well-drained, moderately fine to moderately coarse textures. Silt loam or loam.	4 – 8
	C	Slow infiltration rate when thoroughly wetted. Usually has a layer that impedes downward movement of water or has moderately fine to fine textured soils. Sand clay loam.	1 – 4
High Runoff Potential	D	Very low infiltration rate when thoroughly wetted. Chiefly clay soils with a high swelling potential; soils with a high permanent water table; soils with a clay layer near the surface; shallow soils over near-impervious materials. Clay loam, silty clay loam, sandy clay, silty clay, or clay.	0 – 1

Runoff curve numbers are used as part of a simplified procedure for estimating runoff in small agricultural and urban watersheds (USDA 1986). Curve numbers are assigned based on factors such as soils, plant cover, and impervious area. Rainfall is converted to runoff using Curve numbers.

Certain soil conditions can make farming difficult, so amending the soil structure by adding organic matter becomes a way in which farmers can maximize the use of their land. This practice can actually change the hydrologic soil group from, say, a C to a B. In this example, it is possible to reduce the runoff rather than increase it. To detect these changes at this screening level of assessments will be difficult. Voluntary actions and implementation of best management practices to improve soil texture and water holding capacity can be a benefit to the farmer as well as to the hydrology of the watershed. Grazing animals impact rangelands in two ways: (1) removal of protective plant material, and (2) compaction of the soil surface. Both of these actions affect the infiltration rate (Branson et al. 1981). Cattle grazing on sparsely forested lands can have similar impacts and should be considered under this heading. In general, moderate or light grazing reduces the infiltration capacity to 75% of the ungrazed condition and heavy grazing reduces the infiltration by 50% (Gifford and Hawkins1979). Soil compaction, which decreases the infiltration rate, correspondingly increases the overland flow or surface runoff.

Impacts associated with the use of range lands can be assessed in a similar manner as agricultural lands. There is no statistical distinction between the impact of light and moderate grazing intensities on infiltration rates. Therefore, they may be combined for purposes of assessment. (Gifford and Hawkins 1979).

D2 METHODOLOGY

Table 34 (See Below)

1. Using a GIS shapefile titled "Soils" (SWOP CD), hydrologic soil groups were identified in agricultural and rangeland areas in each subwatershed.
2. Using two GIS shapefiles titled "Chetco River Subwatersheds", available from the South Coast Watershed Council, and "Soils", available from the Southwest Oregon Province GIS Data CD, hydrologic soil groups (HSGs) were identified in agricultural and rangeland areas for each subwatershed.
3. Cover types and treatment practices were identified for the primary hydrologic soil groups of each subwatershed. Cover types and treatment practices were also identified for secondary hydrologic soil groups where each HSG accounted for 20% or more of the subwatershed area. **Caution:** Due to the limitations of the available GIS data, no distinction was made between agricultural, rangeland or rural residential areas.

Table 35 (See Appendix)

4. Hydrologic condition classes of good, fair, or poor were determined for each cover type/treatment practice by referring to Table 36 (See Appendix). Hydrologic condition of "Good" was assigned to all HSGs in all subwatersheds based on the criteria of >75% ground cover and lightly or only occasionally grazed.
5. A curve number was selected based on the cover type/treatment practice and hydrologic condition in columns 3 and 4 of Table 35. The selected curve number was then entered in column 5 of Table 35.
6. Background curve numbers were determined from Table 36. The background curve numbers in all cases were based on "woods" in "good" condition. The curve number for the proper hydrologic soil group was then selected and the results were entered in column 6 of Table 35.
7. The 2-year, 24-hour precipitation (i.e., annual maximum 24-hour precipitation with a recurrence interval of 2 years or 50% probability of occurring in any given year) was estimated for each subwatershed. This information was obtained using a GIS shapefiles titled "2-Year, 24-Hour Precipitation", available from the Southwest Oregon Province GIS Data CD. Results were then entered in column 7 of Table 35.
8. Using the current curve number in column 5 and rainfall depth in column 7, runoff depths were identified from Table 37 (See Appendix) for each cover type / treatment combination. Values were interpolated to obtain runoff depths for curve numbers or rainfall amounts not shown. Results were entered in column 8 of Table 35.
9. Using the background curve number in column 6 and rainfall depth in column 7, the runoff depth from Table 37 was identified. Results were identified in column 9 of Table 35.
10. Change in runoff depth from background conditions to current conditions was calculated by subtracting the Background Runoff Depth (column 9) from Current Runoff Depth (column 8). Results were entered in column 10 of Table 35.

Table 38 (See Appendix)

11. The average change from background was calculated (sum of column 10, Table 35, divided by number of HSGs) from all the combinations of cover type / treatment and hydrologic condition. Results were entered in column 3 of Table 38. Percentages from Table 34, column 4 (A, B, C or D) were transferred to column 2 of Table 38.
12. Where more than one hydrologic soil group is dominant in a subwatershed steps 3 through 11 were repeated. Results were entered in column 5, 7, and 9 of Table 38. Percentages from Table 34, column 4 (A, B, C or D) were transferred to column 4, 6, and 8 (respectively) of Table 38.
13. Weighted averages were computed and results entered in column10 of Table 38.
14. Using the subwatershed average change from background (column 3, Table 38) or the weighted average (column 10, Table 38) the potential hydrologic risk was selected and entered into column 11 of Table 38.

Potential Risk of Agriculture and/or Rangelands

Change in Runoff From Background (inches)	Relative Potential for Peak-Flow Enhancement
0 to 0.5	Low
0.5 to 1.5	Moderate
>1.5	High

D3 RESULTS

Table 34 Agricultural Land Use and Rangeland Use Summary

	Total Area	Area in Ag or Range Use		Hydrologic Soil Groups in Agricultural Lands or Grazed Lands							
				A		B		C		D	
Subwatershed	**(acres)**	**(acres)**	**(%)**	**(acres)**	**(%)**	**(acres)**	**(%)**	**(acres)**	**(%)**	**(acres)**	**(%)**
Boulder Creek	13,973		0.0		0		0.0		0.0		0.0
Box Canyon Creek	9,553		0.0		0		0.0		0.0		0.0
Chetco Coastal Area*	5,091		0.0		0	402	20.1	1,419	70.8	185	9.2
Eagle Creek	13,150		0.0		0		0.0		0.0		0.0
Emily Creek	7,986		0.0		0		0.0		0.0		0.0
Granite & Carter Area	21,047		0.0		0		0.0		0.0		0.0
Jack Creek	5,630	1,279	22.7		0	290	22.7	964	75.4	26	2.0
Lower Chetco Mainstem (1)	5,914	1,222	20.7		0	269	22.0	883	72.3	73	6.0
Lower Chetco Mainstem (2)	14,481		0.0		0		0.0		0.0		0.0
Middle Chetco Mainstem	16,281	16	0.1		0	8	50.0	5	31.3	3	18.8
Mislatnah Creek	7,027		0.0		0		0.0		0.0		0.0
North Fork Chetco	25,723	1,457	5.7		0	414	28.4	404	27.7	636	43.7
Quail Prairie Creek	7,349		0.0		0		0.0		0.0		0.0
South Fork Chetco	20,359		0.0		0		0.0		0.0		0.0
Tincup Creek	17,753		0.0		0		0.0		0.0		0.0
Upper Chetco Mainstem (1)	10,621		0.0		0		0.0		0.0		0.0
Upper Chetco Mainstem (2)	23,288		0.0		0		0.0		0.0		0.0
Total Acres & Percents	**225,226**	**5,978**	**2.7**		**0**	**1,383**	**23.1**	**3,675**	**61.5**	**923**	**15.4**

Table 35 Curve Number and Runoff-Depth Summary Table for Primary/Secondary Hydrologic Soil Groups (See Appendix)

Table 38 Agriculture/Rangeland Risks of Peak Flow Enhancement (See Appendix)

D4 KEY FINDINGS

- A moderate level of risk to peak flow enhancement was determined for the following subwatersheds: Jack(s) Creek, Lower Chetco Mainstem and the North Fork. The Middle Chetco Mainstem was also rated as moderate, however, the amount of agriculture/rangeland area within this subwatershed was relatively insignificant.
- All areas in agriculture or range use can be considered in compacted state and elevating percent of runoff. However, more information is needed to determine an accurate estimate of agriculture or range use.

E1 FOREST AND RURAL ROAD IMPACTS ON HYDROLOGY

Road networks associated with forestry can alter the rate of infiltration on the road surface and potentially change the shape of the natural drainage. The surface of most forest roads is compacted soil that prevents infiltration of precipitation. Forest road networks primarily increase streamflow by replacing subsurface with surface runoff pathways (e.g., roadside ditches) (Bowling and Lettenmaier 1997). Roads can also intercept and divert overland flow and shallow subsurface flow, potentially rerouting the runoff from one small sub-basin to an entirely different subbasin (Harr et al. 1975 and 1979). Roads can potentially impact peak flows during rainfall events, rain-on-snow events, or spring snowmelt; therefore, the determination of percent of basin occupied by roads provides useful information regardless of the way in which peak flows are generated.

Rural roads associated with either agriculture or rangelands can also affect streamflow and will be characterized in a similar manner as forest roads. Roadside ditches are more structured and maintained along rural roads and can significantly extend the stream network density, because their presence is additional to the natural channel. However, if natural channels are altered through straightening or channelizing, the stream network length may decrease. Channelizing streams results in increased velocities and potentially increases erosion rates of the banks and bed.

Roads along stream channels restrict lateral movement and can cause a disconnection between the stream or river and its floodplain. Restricting lateral movement can result in down-cutting of the channel and decreased accessibility of flood waters to over-bank storage, resulting in decreased flood peak attenuation.

E2 INTRODUCTION

The focus of the road assessment is to determine the quantity of roads within the watershed but does not account for the condition of the roads. A more refined scale to separate out well-built roads that do not accelerate the delivery of water or sediment to the channel from roads that are poorly constructed is beyond the scope of this section. For example, extension of the surface-water drainage network by roadside ditches is often a major influence of increased flows. Roads with proper culvert placement and frequency may alleviate some of these impacts.

The assessment of forest and rural road impacts on hydrology in the Chetco River watershed is designed to determine what area of the forestry-designated portion of each subwatershed is occupied by roads, as well as by rural roads in agricultural or rangeland areas, and to rate subwatersheds for potential hydrologic impacts.

Potential Risk for Peak-Flow Enhancement

Percent of Forested Area in Roads	Potential Risk For Peak-Flow Enhancement
< 4%	Low
4% to 8%	Moderate
> 8%	High

E3 METHODOLOGY

<u>Tables 39 & 40</u> (See Appendix)

1. Total watershed area (square miles) and total area of forestry and rural use (acres & square miles) of each subwatershed was determined using GIS analysis. See Land Use Summary for details. Results were entered in columns 2 through 4 of Tables 39 and 40.
2. Total linear distance of forest roads and rural roads were determined using GIS analysis. Results were entered in columns 5 of Tables 39 and 40.
3. Area of each subwatershed occupied by roads was determined by multiplying column 5 by the width of the road (in miles). The average width for forest roads was assumed at 25 feet (0.0047 miles). The average width for rural roads was assumed at 35 feet (0.0066 miles). Results were entered in column 6 of Tables 39 and 40.
4. The percent of area occupied by forest and rural roads in each subwatershed was computed. Results were entered in column 7 of Tables 39 and 40.
5. A relative potential for forest and rural road impacts was assigned to each subwatershed. Results were entered into column 8 of Tables 39 and 40.

E4 RESULTS

Table 39 Forest Road Area Summary (See Appendix)
Table 40 Rural Road Area Summary (See Appendix)

E5 KEY FINDINGS

- All subwatersheds rank low with respect to relative potential for impact to peak flows from forest roads.
- Three subwatersheds rank moderate for impacts to peak flow enhancements from rural roads. They include Jack(s) Creek, Lower Chetco Mainstem and North Fork. The level of potential is at the lower end of the scale. The Middle Chetco Mainstem ranks high however, the amount of rural area (only 16 acres) within this subwatershed was relatively insignificant.
- The relative potential for impact largely depends on the extent of roads identified in the analysis. In this assessment a significant amount of roads were not identified because, at the time, they were not available in GIS format. If this analysis were to be repeated using an updated and more complete road coverage the relative potential of impact on hydrology from roads would only increase. *(This updated road coverage is available as of June 2001.)*

F1 URBAN IMPACTS ON HYDROLOGY

The urban assessment relies on results from several studies in which the percent of imperviousness in a watershed was related to stream quality. Research has identified that the altered hydrologic regime of a watershed under urban conditions is the leading cause of physical habitat changes (May et al.1997). Schueler (1994) reviewed key findings from 18 urban stream studies relating urbanization to stream quality and concluded that stream degradation occurs at relatively low levels (10%) total impervious area.

Imperviousness is the most common measure of watershed development; however, it can be a time consuming exercise and costly to calculate. As such, a more economical method was selected in this assessment and was based on a relationship between watershed urbanization and subwatershed road density. This relationship was used to represent the percent imperviousness. In urban areas, when road densities equal or exceed 5.5 miles/square miles, percent total impervious area probably exceeds 10%. Road densities of 4.2 miles/square miles were associated with a percent total impervious area in a subwatershed of approximately 5%.

Estimating the area in the Chetco Coastal Area subwatershed that is impervious was the basis for determining potential hydrologic impacts from urbanization.

F2 METHODOLOGY

1. Total area (square miles) and total area of urban use (acres & square miles) of each subwatershed was determined using GIS analysis. See Land Use Summary for details. Results were entered in columns 2 through 4 of Table 41.
2. Total linear distance of urban roads was determined using GIS analysis. Results were entered in column 5 of Table 41.
3. Road density was calculated by dividing the total linear distance of urban roads by the urban area (square miles). Results were entered in column 6 of Table 41.
4. A relative potential for peak-flow enhancement (column 7) was assigned to the Chetco Coastal Area subwatershed.

F3 RESULTS

Table 41 Urban Road Density Summary

1 Subwatershed	2 Area (square mi)	3 Area Urban (acres)	4 Area Urban (square mi)	5 Total Linear Distance of Urban Roads (miles)	6 Road Density Col. 5/4 (mi/square mi)	7 Relative Potential for Peak Flow Enhancement
Chetco Coastal Area	8.0	2,004	3.13	36.9	11.8	High

F4 KEY FINDINGS

- The Chetco Coastal Area subwatershed was assigned a high probability of peak flow enhancement. Further investigation is warranted.
- The relative potential for impact largely depends on the extent of roads identified in the analysis. In this assessment a significant amount of roads were not identified because, at the time, they were not available in GIS format. If this analysis were to be repeated using an updated and more complete road coverage the relative potential of impact on hydrology from roads would only increase. *(This updated road coverage is available as of June 2001.)*

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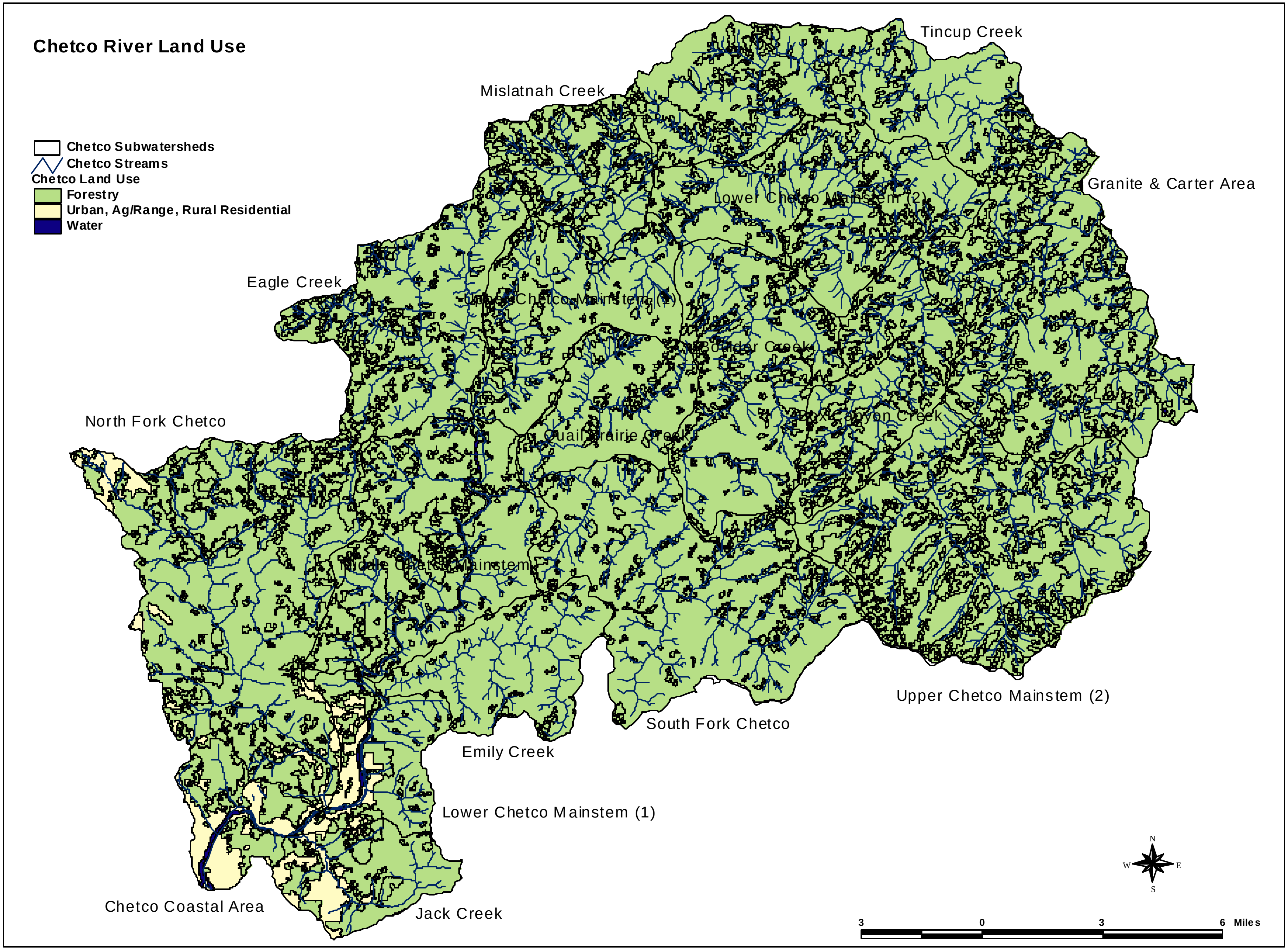

Chetco River Land Use
Chetco Subwatersheds
Chetco Streams
Chetco Land Use
Forestry
Urban, Ag/Range, Rural Residential
Water
Tincup Creek
Mislatnah Creek
Granite & Carter Area
Lower Chetco Mainstem (2)
Eagle Creek
Upper Chetco Mainstem (1)
Boulder Creek
North Fork Chetco
Box Canyon Creek
Quail Prairie Creek
Middle Chetco Mainstem
Upper Chetco Mainstem (2)
South Fork Chetco
Emily Creek
Lower Chetco Mainstem (1)
Chetco Coastal Area
Jack Creek
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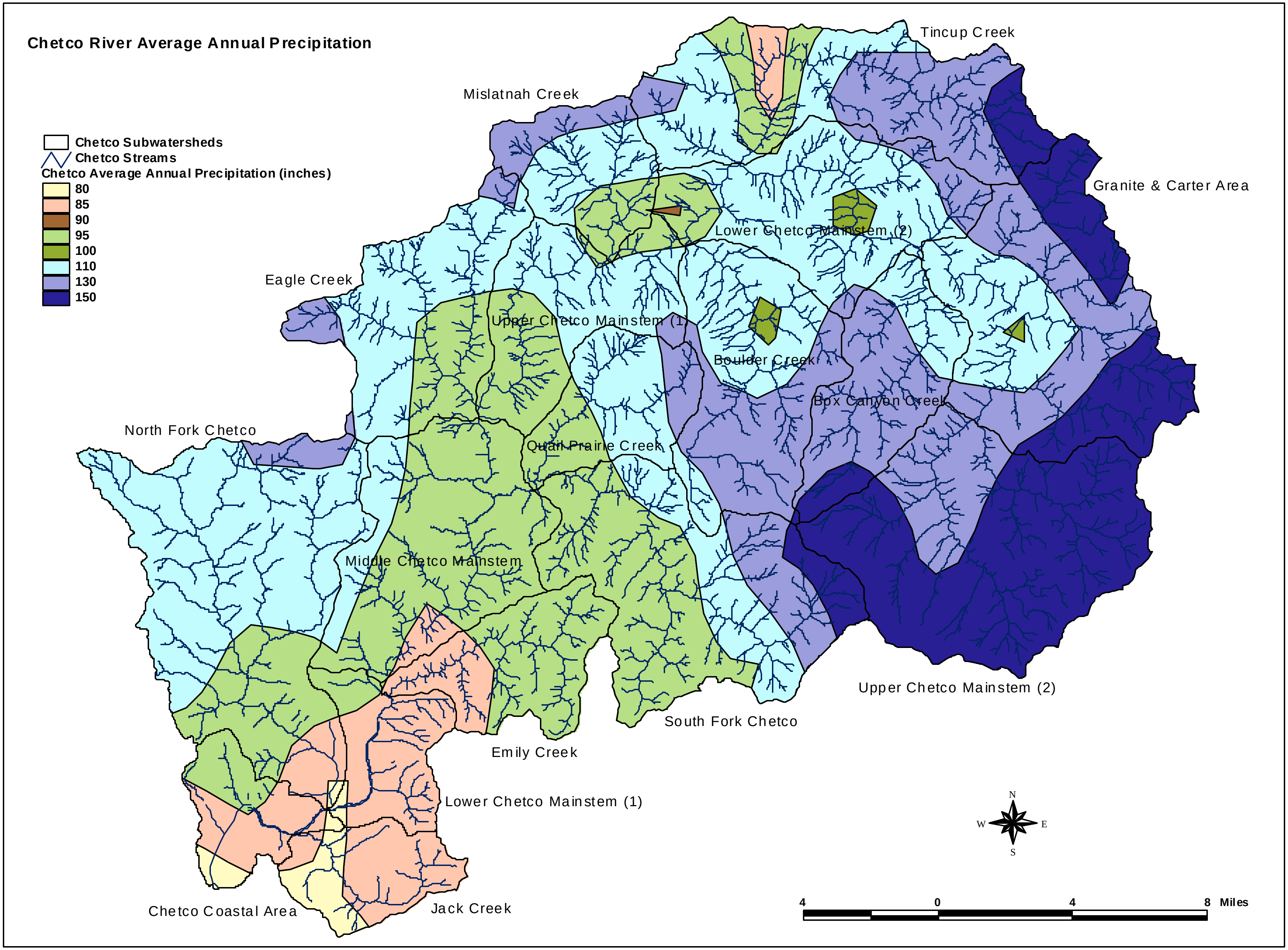
Miles


Chetco River Average Annual Precipitation
Chetco Subwatersheds
Chetco Streams
Chetco Average Annual Precipitation (inches)
80
85
90
95
100
110
130
150
Tincup Creek
Mislatnah Creek
Granite & Carter Area
Lower Chetco Mainstem (2)
Eagle Creek
Upper Chetco Mainstem (1)
Boulder Creek
Box Canyon Creek
North Fork Chetco
Quail Prairie Creek
Middle Chetco Mainstem
Upper Chetco Mainstem (2)
South Fork Chetco
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Chetco Coastal Area
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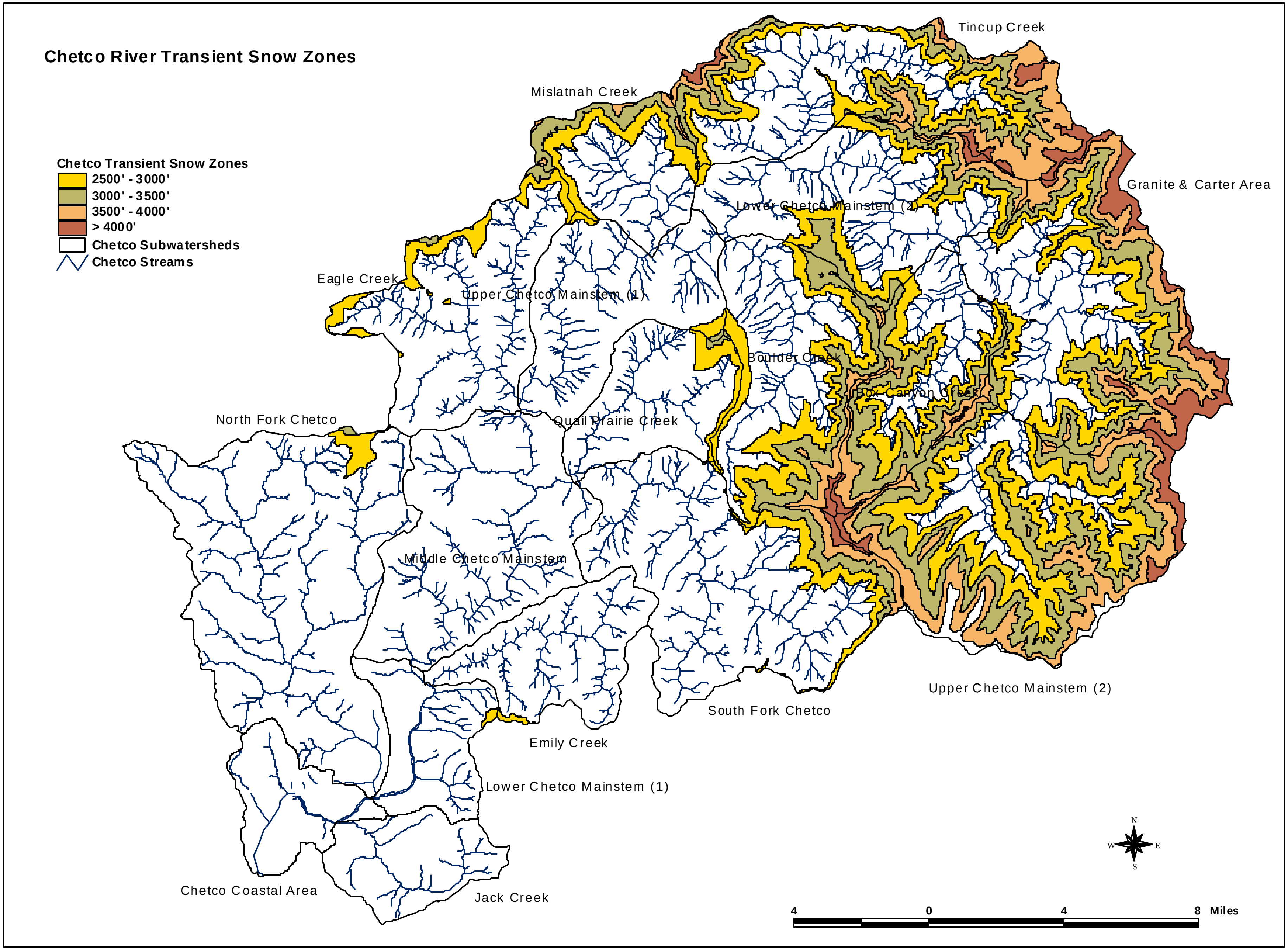

Chetco River Transient Snow Zones
Chetco Transient Snow Zones
2500' - 3000'
3000' - 3500'
3500' - 4000'
> 4000'
Chetco Subwatersheds
Chetco Streams
Tincup Creek
Mislatnah Creek
Granite & Carter Area
Lower Chetco Mainstem (2)
Eagle Creek
Upper Chetco Mainstem (1)
Boulder Creek
Box Canyon Creek
North Fork Chetco
Quail Prairie Creek
Middle Chetco Mainstem
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South Fork Chetco
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Lower Chetco Mainstem (1)
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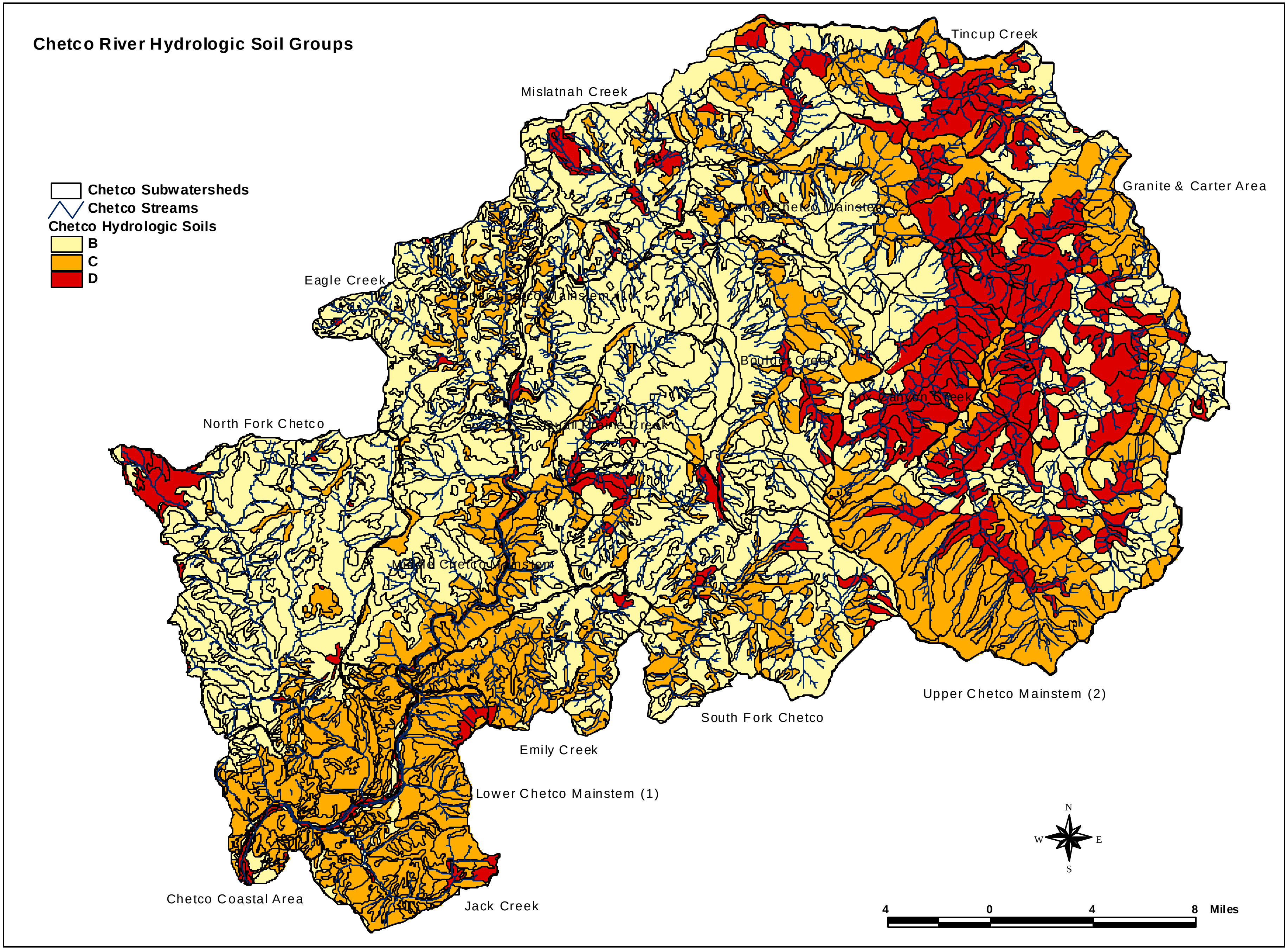

Chetco River Hydrologic Soil Groups
Chetco Subwatersheds
Chetco Streams
Chetco Hydrologic Soils
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Tincup Creek
Mislatnah Creek
Granite & Carter Area
Eagle Creek
Boulder Creek
North Fork Chetco
Upper Chetco Mainstem (2)
South Fork Chetco
Emily Creek
Lower Chetco Mainstem (1)
Chetco Coastal Area
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XII WATER USE

A BACKGROUND (GWEB 1999)

Water Law and Water Use

Any person or entity withdrawing water from a stream or river must have a water right from the Oregon Water Resources Department (OWRD). These water rights are in various levels of use and certification or adjudication. For example, there are certificates, applications for certificates, water rights on record and not being used, and rights not using their entire full entitlement. Each water right has an instantaneous flow amount (the maximum rate at which water can be withdrawn at any point in time), an annual volume restriction (water duty), and a designated beneficial use, including agriculture, domestic, urban, industrial, commercial, fish and wildlife, power, recreation, etc. Water law in the State of Oregon is based on the Prior Appropriation Doctrine or "first in time, first in right," subject to the physical availability of water and the ability to put it to beneficial use without waste. The most senior appropriator (the right with earliest date) has a right to divert water prior to any junior right (a later date). The most senior right is the last one to be shut off from diverting water during low stream flows.

In general, agriculture places the greatest demand on our water resources compared to other uses. Water is required for irrigation of crop lands (e.g., cranberry production), pasture and stock watering. In most cases, the period of high demand for irrigation coincides with the period of low streamflow; crop water requirements tend to peak in August, when streamflows are usually the lowest. Water withdrawals are applied to the crop lands for irrigation, and part of that water is used by the crop (evapotranspiration), a portion percolates to deep ground water, and a portion may be returned to another watershed. The total portion not returned to the river is called consumptive use. The portion of the diversion that returns to the stream system through surface and subsurface avenues at points downstream is called return flow.

Urban water supply can provide for residential, commercial, and some industrial uses. Water is diverted, treated, and then distributed throughout a municipality. Subsequently, the wastewater is delivered to a sewage treatment facility where it is treated to a "primary" or "secondary" level and discharged to a stream or bay at a distinct location. In residential settings, for example, water is not actually consumed but returned to the stream network from wastewater facilities. An exception to this is lawn watering which may infiltrate to groundwater. Lawn-irrigation return flow occurs through subsurface avenues.

National forests, national parks, US Bureau of Land Management lands, Indian reservations, etc., are federal reservations. These entities maintain federal reserved rights for the purposes for which the reservations were established. Their priority date is the date the reservation was created. In many cases, reservations were established in the mid to latter part of the 19th century. Many of the federal reservation rights have been tried in the courts of law, and, more often than not, case law has set precedent of adjudicating (to settle judicially) federally reserved water rights. (Winters Doctrine).

Water Rights

There are three primary types of surface water rights: (1) out-of-stream rights, (2) storage rights, and (3) in-stream rights. Out-of-stream rights are also called “direct flow” or “run of the river” diversions. These rights entail withdrawing water directly from the channel with subsequent application for a specific beneficial use such as irrigation, domestic or urban water supply, industrial use, etc. Storage rights can be for on-stream or off-stream reservoirs. On stream reservoirs capture water as it flows into the reservoir. Water is stored until it is needed for the specified beneficial use, at which time it is released either into the channel and withdrawn downstream or released into the river to the storage site, and subsequent release and conveyance to the point of use. In-stream rights are those that require a designated quantity of water to remain in the stream or river for a specified beneficial use, most often for aquatic resources, wildlife, or aesthetics.

Water withdrawals reduce streamflows, potentially resulting in a negative impact on the biologic resources, particularly during the low-flow season. In recent years, in-stream water rights have become more common as a means of protecting the biologic resources. In-stream water rights did not exist in Oregon prior to 1955. Minimum flows were established by administrative rule in 1955, but they did not carry the full weight of a water right. Between 1955 and 1980, the Oregon Department of Fish and Wildlife conducted basin investigations from which minimum flows were recommended and adopted by rule. In 1987, the legislature changed the administrative rulemaking into an application process for a water right. OWRD holds the water right, but ODFW, Department of Environmental Quality, and State Parks can apply for an in-stream right. Minimum flows were changed into in-stream rights, and the date minimum flows were adopted became the priority date. The in-stream rights can have the value up to but not exceeding the median flow. In-stream rights tend to be junior to the majority of the out-of-stream water rights; this reduces their ability to maintain effective streamflows in the channel. If federal reserved rights for in-stream flows have been adjudicated, they would usually have the most senior right in the basin, because federal reservations were established before the implementation of the Prior Appropriation Doctrine.

Water users with large demands generally have storage rights, because reservoirs provide a more certain supply during low-streamflow conditions. The ability to capture streamflow during the high flows and use it during low flows can be a significant benefit to water users. In some instances, reservoirs are constructed as flood control facilities to provide attenuation of the peak flows and reduce downstream flooding and damage.

Groundwater rights are those attached to the withdrawal of water from a well. With some exceptions, all water users extracting groundwater as the source of supply must have a water right for the legal use of water. There are exempt uses that do not require a right. The most significant of these is rural residential water users; these users are limited to 15,000 gallons per day for noncommercial use and irrigation of less than 0.5 acres.

Groundwater has the potential to influence surface water by what is called hydraulic continuity. Depending on the location of the well and the geology in the area, water withdrawn can have a corresponding effect on the streamflow. In other words, it is possible for the extraction of groundwater to dry up a nearby stream during low flows. Consequently, the State of Oregon manages surface and groundwater rights conjunctively, which means there are times at which groundwater withdrawals will be shut down due to low flows in the channel.

Storage

Man-made storage facilities such as water supply reservoirs, flood control reservoirs, or multipurpose reservoirs impact the peak flows downstream of the impoundment. Each reservoir has its unique operating scheme, and therefore requires more detailed hydrologic investigations, often including release schedules, reservoir routing, etc.

Water Availability

The OWRD has developed a computer model, Water Availability Report System (WARS), which calculates water availability for any of their designated water availability basins (WABs) in the state. Water availability, as defined by the OWRD, refers to the natural streamflow minus the consumptive use from existing rights. It is the amount of water that is physically and legally available for future appropriation. If water is available, additional in-stream or out-of-stream rights may be issued. This value is dynamic and is often updated to account for issuance of new water rights.

The WARs program produces both the 80% exceedance and the 50% exceedance flows, along with the associated water availability under each condition. The 50% exceedance flow is the same as the median flow value. The median flow value means half the time the natural flows are above this value and half the time flows are below this value. The 50% exceedance flows were those used as an upper limit in developing in-stream rights for aquatic species and other in-stream beneficial uses. Water rights for out-of-stream use are issued only when water is available at the 80% exceedance level. (*This assessment considered only water availability at the 50% exceedance flows.)*

Salmonid Fish Considerations

Potential channel dewatering (zero flow in the channel) can present problems for spawning and fish passage. Typically, the spawning period that coincides with the lowest flow begins on approximately September 1 and extends through October. Rearing habitat in the summer also requires flow levels to be maintained. While these are the critical times of the year, flow levels throughout the year need to be maintained to cover all life stages of all species present in a watershed.

Streamflow Restoration Priority Areas

Oregon's Departments of Fish and Wildlife and Water Resources collaborated to develop the Streamflow Restoration Priority Areas (SRPA). This effort was an outcome of the Oregon Plan (1997), which is the broader framework for the Coastal Salmon Restoration Initiative (CSRI). The CSRI mission is to restore coastal salmon populations and fisheries to sustainable levels. Three major factors were identified in CSRI as exacerbating the loss of fish populations: (1) fish resources, (2) fish habitat, and (3) loss of streamflow. The loss of streamflow is the focus of the SRPA analysis.

The identification of priority areas was based on a combination of biological factors and water use. ODFW identified priority areas to enhance fish populations. A rank was assigned to three categories under fisheries: (1) fish resources; (2) habitat integrity; and (3) risk factors such as listing under the Endangered Species Act, in-stream flow protection, or natural low-flow problems. OWRD identified areas in which an opportunity existed to enhance in-channel flows, situations under which water could by saved through conservation, efficiency of use, etc. The criteria for water resources was assigned to two categories: (1) consumptive use by percentage of the median (50% exceedance) streamflow, and (2) number of months an in-stream water right is not met. A priority was established based on the combination of the two resulting factors: "need" (fisheries) and "optimism" (water resources). Determination of the South Coast Flow-Restoration Priorities requires that the "need" rank 3 or 4 and the "optimism" rank 2, 3, or 4. In the need and optimism column, 1 is the lowest rank and 4 is the highest.

Basin	**Flow Restoration**		
	Need	**Optimism**	**Priority**
South Coast	1 or 2	1	No
	3 or 4	2,3 or 4	Yes

B INTRODUCTION

Water use is generally defined by beneficial use categories such as municipal, industrial, irrigated agriculture, etc. The Water Use Assessment summarizes the water rights in the Chetco River watershed and intends to provide an understanding of what beneficial uses these water withdrawals are serving. The assessment of water use is primarily focused on low-flow issues. While low-flow issues can be extremely important, they are difficult to characterize at the screening level. Water use activities can impact low flows, yet the low flows can be enhanced through adopting water conservation measures to keep more water in the stream system.

The basis for the water use assessment is the output from the Water Availability Reports System (WARS) and other data provided by the OWRD. Their system has accounted for consumptive use and presents the best available information at this time.

C METHODOLOGY

Figure 5 Storage Rights

- Storage rights (measured in Acre Feet) were identified in the Chetco River watershed.

Figure 6 Out-of-Stream Rights

- Water rights information was obtained from the OWRD Water Rights Information System (WRIS) files. Although not presented in this document, information relevant to the assessment of water use was summarized, sorted and listed by date.
- Figure 6 illustrates the total out of stream water rights (CFS) by type of use for the Chetco River watershed.

Table 42 In-Stream Rights

- In-stream Rights were obtained by request from the OWRD.

Table 43 Streamflows

- Streamflows measured by the South Coast Watershed Council and Oregon Department of Water Resources during the summer months of 1998 to 2000 were listed.

Table 44 Water Availability Summary (See Appendix)

- Water Availability Reports were obtained from the OWRD web site.
- Net water available, at the 50% exceedance level, for each month and for each Water Availability Basin (WAB) within the watershed was listed. **Note:** WABs do not typically correspond to subwatershed boundaries.
- For each month and each WAB the "net water available" less than or equal to zero was highlighted to indicate that water is not available at the 50% exceedance level.

Table 45 Streamflow-Restoration Priority Areas (See Appendix)

- Priority WABs, designated as streamflow restoration priority areas, were identified for each applicable season.

D RESULTS

Figure 5 Storage Rights (AF)

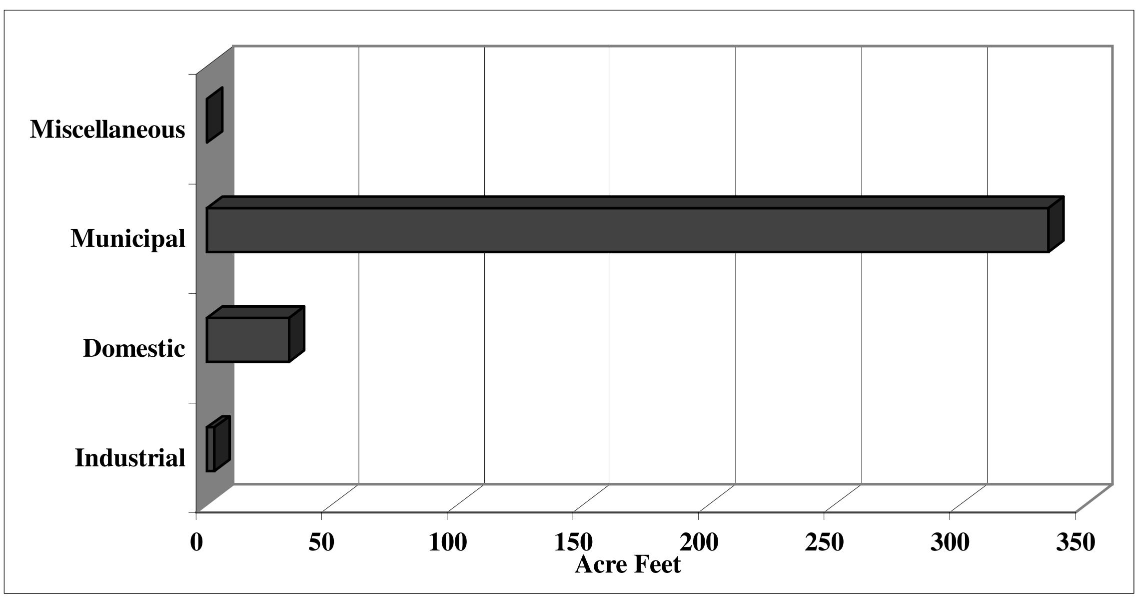

Figure 6 Out-of-Stream Rights (CFS)

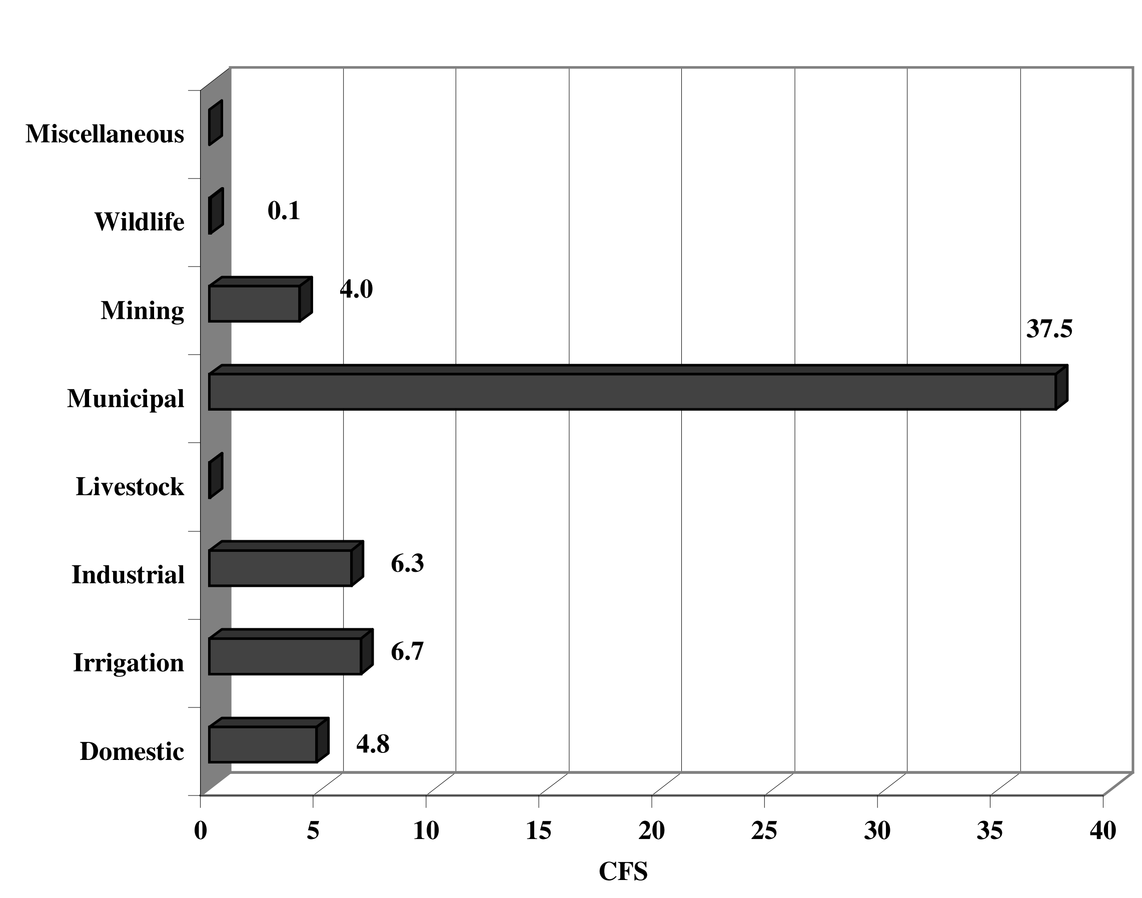

Table 42 In-Stream Water Rights

Location	Reach (From/To)	Certificate #	CFS			Priority Date
			July	August	September	
Mainstem	Below North Fk. / Tidewater	NA	80	80	80	5/22/64
Mainstem	Below North Fk. / Tidewater	NA	80	80	80	4/1/80
Mainstem	N. Fk. RM 5.4 / RM 0	73087	213	129	101	11/8/90
Mainstem	S. Fk. RM 18.2 / N. Fk. RM 5.4	72796	100	100	86.8	11/8/90
Mainstem	Broken Cot Crk. RM 55 / Little Chetco RM 50	72795	10	5.7	6.01	11/8/90
Mainstem	Little Chetco RM 50 / S. Fk. RM 18.2	72794	122	72.5	64.3	11/8/90
North Fork	Bravo Cr. RM 6 / RM 0	73081	26.5	15.2	8.98	11/8/90
South Fork	Coon Cr. RM 10 / RM 0	72780	21.7	13	10.3	11/8/90

Table 43 Streamflows

Location	2000 Date	Flow (cfs)	1999 Date	Flow (cfs)	1998 Date	Flow (cfs)
Mainstem at Low water crossing	August 3	100				
South Fork Chetco	August 3	20.8	July 26	19.6		
Mainstem at Chetco River gage			July 16	157	July 23	144
Mainstem at Chetco River gage	July 28		July 26	135	August 3	112
Mainstem at Chetco River gage	August 3		August 13	119	August 6	103
Mainstem at Chetco River gage	August 16		August 27	84		
Emily Creek	August 3	5.2	July 26	5.0		
North Fork Chetco near mouth	August 3	9.6				
Mainstem below North Fk. (ODWR)			July 16	160	July 23	156
Mainstem below North Fk. (ODWR)	August 3	130	August 13	130	August 3	112
Mainstem below North Fk. (ODWR)	August 31	82.1	August 27	97.4		
Jacks Creek (ODWR)	July 28	3.0	July 16	1.7	July 3	2.5
Jacks Creek (ODWR)	August 3	2.0	August 13	1.4	August 6	1.0
Jacks Creek (ODWR)	August 16	1.4	August 27	0.3		

**All flows from Oregon Department of Water Resources are provisional data pending final review.*

E KEY FINDINGS

Out-of-Stream Rights

- Total out of stream rights for the Chetco River watershed equal approximately 59 CFS. Water rights allocated after the establishment of the 1964 in-stream rights are considered "junior rights"; these rights total approximately 43 CFS.
- The majority of out-of-stream water rights (over 60%) in the Chetco River watershed are allocated for municipal use.

Storage Rights

- Storage Rights include all water rights allocated in Acre Feet (AF). Total storage rights equal approximately 370 AF.
- The majority of storage water rights in the Chetco River watershed are allocated for municipal use.

In-Stream Rights

- The 1964 in-stream right is 80 CFS during the summer months. All water rights considered "junior" to the 5/22/64 in-stream right may be regulated if streamflow falls below 80 CFS.

Water Availability Summary

- The net water available at the 50% exceedance level, from July to October, is less than or equal to zero for the entire Chetco River basin.

Streamflow Restoration Priority Areas

- According to the ODFW/OWRD Streamflow Restoration Priority Areas there are two priority Water Availability Basins in the Chetco River. They include Jack(s) Creek and Chetco River mainstem above the North Fork.

REFERENCES

GWEB 1999. Oregon Watershed Assessment Manual. Governor’s Watershed Enhancement Board, July 1999

XIII WATERSHED SYNTHESIS

The Chetco River watershed is dominated by the Coastal Siskiyous ecoregion, with some Serpentine Siskiyous, Southern Oregon Coastal Mountains, and a very small portion of Redwood Zone. The watershed has mostly high erosion, high runoff soil types both in the upper and lower portions of the watershed. In the upper watershed, rapid runoff and exposed serpentine in the inner gorge strongly influence water quality and hydrology in the Chetco River. More than eighty percent of the watershed is publicly owned.

Water temperatures increase dramatically through portions of the wilderness area and are not cooled completely by the cooler main tributaries. Mining is still active in the watershed both for gravel in the lower sections and minerals in the upper. Jetties have greatly altered the mouth of the river and how it functions as habitat for salmon migrating to the ocean.

High density of roads on steep slopes in the Coastal Area is a concern, as is the density of road crossings in all of the mostly private subwatersheds (lower five), and the private sections in the mostly Forest Service subwatersheds (Eagle Creek and Upper Chetco-1). The amount of urban and rural development in the lower watershed is a large concern for fish habitat in the future. As the urban and rural populations grow, so do the risks of peak flow enhancement, sediment inputs, riparian vegetation removal and water contamination.

Hydrology in the watershed is greatly affected by the high percentage of low infiltration soils, especially those in high altitudes with the potential for snowfall. Risk of peak flow enhancement (PFE) is rated moderate due to rural roads in Jack Creek, Lower Chetco (1), and the North Fork, and high in the Middle Chetco Mainstem. Risk of PFE is high in the Chetco Coastal Area due to urban roads. Risk of PFE is moderate to low in the four sub-watersheds with agricultural/residential areas.

The Chetco watershed has over 10 miles of highly responsive/sensitive channels that are fairly evenly distributed. Jack Creek and the North Fork have an abundance of channels that are sensitive to disturbance and can migrate. Channels in the upper watershed are mostly confined by hillslopes or other features and are subject to "flashy" streamflows.

Steelhead and cutthroat trout use the entire watershed. Chinook use is mostly in the lower mainstem channels (below Mislatnah), and coho extend slightly higher in distribution. Historically, coho populations were probably quite low, being on the southern end of their range.

A riparian assessment revealed pockets of large wood recruitment areas, and large potential increases in shade. The highest potential shade increases occur in two areas; along nearly five miles on the lower reaches of the North Fork (5^{th} order streams) and along nearly five miles of smaller streams (2^{nd} and 3^{rd} order) in the Chetco Coastal Area. Channel widening was documented on the North Fork, The South Fork, and Emily Creek, with increases in width recorded from 50 to 200 feet. Channel widening and canopies opening indicate sediment problems and channel instability in response to floods of 1955 and 1964. Channels are narrowing as they re-vegetate and recover.

Most of the 25 wetlands (93 acres) identified are within the Chetco Coastal Area, with some in the North Fork, Jack Creek, and the Lower Chetco Mainstem.

Water use in the Chetco rarely exceeds the in-stream water right of 1964. Nearly three-quarters of the out-of-stream rights are junior to in-stream water rights. The largest percentage of use is municipal, where conservation measures could be very effective in restoring higher in-stream flows.

Water quality rated low in the Chetco, not only from high temperatures but also sedimentation, phosphate levels, dissolved oxygen and pH.

Some of the limiting factors to fish production in the Chetco appear to be water temperature (reduced shade, especially in tributaries), sediment transport and storage, number of roads, and estuary habitat.

APPENDIX

Table 13 Riparian Habitat Condition Summary

Original Data Source: AQIP = ODFW Aquatic Inventory Project. Forest Service data available, not in usable format.
Rating Codes: D: Desirable, U: Undesirable, B: Between; ND: No Data

Source	Sub WA	Stream	Reach	Date	Width	Conifers # > 20 in dbh	Conifers # > 35 in dbh	Bench-	Opensky	Shade = 180 -	Bench-	Overall Riparian	Bank Erosion	Percent Secondary Channels
						Con_20plus	Con_36plus	mark	Opensky	Opensky	mark	Benchmark	Bankerosi*	Pctscchnla*
AQIP	NF	BOSLEY CREEK	1	7/20/95	5.5	0.0	0.0	U	22	158	D	*	0.9	1.9
AQIP	NF	BOSLEY CREEK	2	9/14/95	4.0	0.0	0.0	U	22	158	D	*	0.0	3.7
AQIP	NF	BRAVO CREEK	1	7/25/95	9.3	0	0	U	22	158	D	*	0	0.2
AQIP	NF	BRAVO CREEK	2	7/25/95	8.1	0	0	U	22	158	D	*	0	0
AQIP	NF	BRAVO CREEK	3	7/26/95	6.1	ND	ND	ND	22	158	D	*	0	0
AQIP	NF	BRAVO CREEK	4	7/27/95	7	0	0	U	22	158	D	*	0	0
AQIP	NF	BRAVO CREEK	5	8/7/95	6.2	30	30	U	22	158	D	*	0.9	3.4
AQIP	NF	BRAVO CREEK	6	8/8/95	5.9	122	0	U	22	158	D	*	0	0.1
AQIP	NF	BRAVO CREEK TRIBUTARY A	1	8/8/95	2.9	30.0	0.0	U	22	158	D	*	0.0	0.5
AQIP	NF	NORTH FORK CHETCO RIVER	1	7/12/95	13.8	30	30	U	22	158	D	*	4	3.3
AQIP	NF	NORTH FORK CHETCO RIVER	2	7/12/95	11.9	0	0	U	22	158	D	*	0.8	4.4
AQIP	NF	NORTH FORK CHETCO RIVER	3	7/18/95	10.1	0	0	U	22	158	D	*	0	0.6
AQIP	NF	NORTH FORK CHETCO RIVER	4	7/18/95	10.5	0	0	U	22	158	D	*	1.3	1.2
AQIP	NF	NORTH FORK CHETCO RIVER	5	8/10/95	4.5	0	0	U	22	158	D	*	0	0
AQIP	NF	RANSOM CREEK	1	9/5/95	3.9	81	81	U	24	156	D	*	0	6.3
AQIP	NF	RANSOM CREEK	2	9/7/95	3.1	122	61	U	24	156	D	*	0.7	0

*Benchmarks do not exist for these parameters; however, they provide some interesting information on general observed conditions.

Subwatershed Codes:

NF North Fork Chetco

Table 14 Pool Habitat Condition Summary

Original Data Source: AQIP = ODFW Aquatic Inventory Project. Forest Service data available, not in usable format.
Rating Codes: D: Desirable, U: Undesirable, B: Between, ND: No Data.

Source	Date	Stream	Reach	Length Sampled	Land Use	Gradient	Sub WA	Width	Pool Area		Pool Frequency		Residual Pool Depth		Complex Pools		Overall Pool Rating
				Prichnll	Luse1		Sub		Pctpool	Bench-mark	Cwpool	Bench-mark	Residpd	Bench-mark	Compool_km	Bench-mark	
AQIP	7/20/95	BOSLEY CREEK	1	2026	TH	6.8	NF	5.5	21.2	B	6.8	D	0.6	U	0	U	U
AQIP	9/14/95	BOSLEY CREEK	2	4845	ST	4.0	NF	4.0	36.2	D	4.7	B	0.4	U	0	U	U
AQIP	7/25/95	BRAVO CREEK	1	1976	MT	2.3	NF	9.3	28.8	B	6.2	D	0.6	U	0	U	U
AQIP	7/25/95	BRAVO CREEK	2	670	MT	11.5	NF	8.1	21.4	B	4.2	B	0.5	U	0	U	B
AQIP	7/26/95	BRAVO CREEK	3	542	MT	13.4	NF	6.1	42.5	D	3.1	B	1.8	D	0	U	D
AQIP	7/27/95	BRAVO CREEK	4	855	YT	3.8	NF	7	35.7	D	2.9	B	0.9	B	0	U	B
AQIP	8/7/95	BRAVO CREEK	5	2716	TH	1.6	NF	6.2	38.8	D	4.5	B	0.5	U	0	U	U
AQIP	8/8/95	BRAVO CREEK	6	3887	MT	4.6	NF	5.9	38.5	D	5.2	D	0.6	U	0	U	D
AQIP	8/8/95	BRAVO CREEK TRIBUTARY A	1	775	MT	8.9	NF	2.9	28.1	B	2.8	B	0.4	U	0	U	U
AQIP	7/12/95	NORTH FORK CHETCO RIVER	1	2241	AG	0.2	NF	13.8	31.8	B	6.1	D	1	B	0	U	B
AQIP	7/12/95	NORTH FORK CHETCO RIVER	2	5163	TH	1	NF	11.9	58.2	D	3.5	B	0.9	B	0	U	B
AQIP	7/18/95	NORTH FORK CHETCO RIVER	3	1996	TH	1.6	NF	10.1	45.3	D	3.2	B	1	B	0	U	B
AQIP	7/18/95	NORTH FORK CHETCO RIVER	4	5129	MT	1.2	NF	10.5	33	B	5.2	D	1	B	0	U	B
AQIP	8/10/95	NORTH FORK CHETCO RIVER	5	1509	TH	2.3	NF	4.5	26.4	B	6.2	D	0.3	U	0	U	U
AQIP	9/5/95	RANSOM CREEK	1	2862	ST	8.6	NF	3.9	17.7	B	6.6	D	0.4	U	0	U	U
AQIP	9/7/95	RANSOM CREEK	2	1569	OG	3.3	NF	3.1	35.4	D	6.3	D	0.4	U	0	U	D

Subwatershed Codes:

NF	North Fork Chetco

Landuse Codes:

AG	Agriculture
TH	Timber Harvest
YT	Young Timber
ST	Second growth Timber
MT	Mature Timber
OG	Old Growth

Table 15 Riffle and Woody Debris Habitat Condition Summary

Original Data Source: AQIP = ODFW Aquatic Inventory Project. Forest Service data available, not in usable format.

Rating Codes: D: Desirable, U: Undesirable, B: Between; ND: No Data

Source	Sub WA	Survey Date	Stream	Reach	Width/Depth Ratio		Gravel (% area)		Silt-sand-organics (% area)		Overall Riffle Rating	LWD Pieces/100 m		Volume LWD/100 m		Key Pieces/100 m		Overall LWD Rating
					Wdratio	Bench-mark	Pctgravel	Bench-mark	Pctsndor	Bench-mark		Lwdpiece1	Bench-mark	Lwdvol1	Bench-mark	Keylwd1	Bench-mark	
AQIP	NF	7/20/95	BOSLEY CREEK	1	24.7	B	15.0	B	1.0	D	B	13.9	B	46.6	D	1.70	B	B
AQIP	NF	9/14/95	BOSLEY CREEK	2	29.3	B	16.0	B	1.0	D	B	9.1	U	25.9	B	0.80	U	U
AQIP	NF	7/25/95	BRAVO CREEK	1	31	U	17	B	0	D	B	2.6	U	8.1	U	0.2	U	U
AQIP	NF	7/25/95	BRAVO CREEK	2	16.3	B	9	U	1	D	B	5.8	U	19.4	U	0.7	U	U
AQIP	NF	7/26/95	BRAVO CREEK	3	30	B	7	U	0	D	B	14.6	B	46.1	D	1.8	B	B
AQIP	NF	7/27/95	BRAVO CREEK	4	19.1	B	36	D	0	D	D	24.1	D	20.6	B	0	U	B
AQIP	NF	8/7/95	BRAVO CREEK	5	33.1	U	34	B	4	D	B	22.9	D	16.9	U	0.3	U	U
AQIP	NF	8/8/95	BRAVO CREEK	6	29.7	B	16	B	4	D	B	8.4	U	21.1	B	0.3	U	U
AQIP	NF	8/8/95	BRAVO CREEK TRIBU	1	18.0	B	14.0	U	4.0	D	B	26.5	D	15.8	U	0.00	U	U
AQIP	NF	7/12/95	NORTH FORK CHETC	1	73.6	U	83	D	14	B	B	3.5	U	1.4	U	0	U	U
AQIP	NF	7/12/95	NORTH FORK CHETC	2	27.9	B	22	B	10	B	B	1.7	U	1.8	U	0.1	U	U
AQIP	NF	7/18/95	NORTH FORK CHETC	3	32.1	U	18	B	8	D	B	4.9	U	10.2	U	0.5	U	U
AQIP	NF	7/18/95	NORTH FORK CHETC	4	52.6	U	20	B	5	D	B	6.2	U	6.1	U	0.1	U	U
AQIP	NF	8/10/95	NORTH FORK CHETC	5	22.7	B	26	B	4	D	B	28.2	D	18.5	U	0.4	U	U
AQIP	NF	9/5/95	RANSOM CREEK	1	14.8	D	12	U	1	D	D	9	U	47.3	D	1.2	B	B
AQIP	NF	9/7/95	RANSOM CREEK	2	26.3	B	28	B	3	D	B	6.9	U	20.3	B	1	B	B

Subwatershed Codes:

NF North Fork Chetco

Table 18 Water Quality Data from Oregon Department of Environmental Quality Laboratory

SOURCE	DATE	TIME	FLOW (CFS)	TEMP. (C)	TEMP. (F)	DO (mg/l)	DO (%Sat)	BOD-5 (mg/l)	pH (SU)	NO2+NO3 (mg/l)	Tot. PO4 (mg/l)	Fec. Coli (MPN)	E. COLI (cfu/100 ml)	TURBID. FIELD (NTU)	CHLOR-OPHYLL (ug/l)
Ambient*	10/22/80	1120	1,590	13.7	56.7	10.4	105.0	0.0	7.5	0.01	0.023	15	30K TOT	1	0.8
Ambient*	11/19/80	830	3,170	8	46.4	11.7	98.0	0.4	7.3	0.02	0.025	15	30K TOT	1	
Ambient*	12/17/80	730	1,180	7.5	45.5	12.0	99.0	0.8	7.3	0.02	0.024	15	11000L TOT	1	
Ambient*	1/28/81	830	6,000	8.5	47.3	11.6	99.0	0.5	7.1	0.02	0.06	15	36 TOT	16	
Ambient*	1/28/81	950	6,000	8.5	47.3	11.6	99.0	0.4	7.1	0.02	0.062	15	36 TOT	16	
Ambient*	2/25/81	715	2,340	7.7	45.9	11.8	98.0	0.6	7.6	0.02	0.019	15	30K TOT	2	
Ambient*	3/25/81	930	4,790	10	50.0	11.7	104.0	0.8	6.7	0.01	0.062	36	36 TOT	10	
Ambient*	5/20/81	743	980	11.3	52.3	10.7	98.0	0.5	7.4	0.01	0.015	91	91 TOT	1.0K	
Ambient*	6/17/81	830	745	13.5	56.3	10.2	97.0	0.3	7.6	0.01	0.025	15	30K TOT	1.0K	
Ambient*	7/22/81	700	159	18.5	65.3	8.3	88.0	0.4	7.0	0.02	0.024	15	30K TOT	1.0K	0.3
Ambient*	8/26/81	800	102	18	64.4	8.5	85.0	0.4	6.3	0.02	0.017	15	36 TOT	1.0K	0.2
Ambient*	9/23/81	845	83	14	57.2	9.2	88.0	0.6	7.3	0.03	0.018	15	30K TOT	1.0K	0.5
Ambient*	10/28/81	820	174	11	51.8	11.0	99.0	1.3	7.0	0.08	0.089	91	230 TOT	18	1.4
Ambient*	11/18/81	730	594	10	50.0	11.6	103.0	0.5	6.0	0.03	0.171	36	36K TOT	38	
Ambient*	12/16/81	725	1,770	7	44.6	12.0	98.0	0.9	6.0	0.03	0.169	15	30 TOT	52	
Ambient*	1/13/82	1425	2,340	8	46.4	12.4	104.0	1.3	6.3	0.02	0.029	15	30K TOT	3	
Ambient*	2/24/82	730	4,790	6	42.8	12.5	117.0	1.1	5.9	0.03	0.223	15	36 TOT	8	
Ambient*	3/24/82	1230	1,200	11.1	52.0	11.1	100.0	0.4	7.0	0.02	0.016	15	30K TOT	1	
Ambient*	8/25/82	810	72	19	66.2	7.5	80.0	0.1	7.9	0.01	0.024	15	30K TOT	1.0K	0.6
Ambient*	10/27/82	805	833	10.2	50.4	11.2	99.0	0.8	7.6	0.04	0.033	15	91 TOT	6	0.2
Ambient*	12/14/82	1718	23,900	9	48.2	12.0	103.0	1.0	7.3	0.01	0.045	15	30K TOT	13	
Ambient*	4/27/83	945	2,160	8.5	47.3	12.1	103.0	1.9	7.6	0.02	0.015	15	30K TOT	2	.1L
Ambient*	6/22/83	950	281	17	62.6	9.4	97.0	0.6	7.9	0.01	0.153	15	30K TOT	1	0.1
Ambient*	10/26/83	925	5,640	13.5	56.3	10.4	99.0	0.9	7.4	0.02	0.03	15	30K TOT	1.0K	0.3
Ambient*	1/25/84	900	1,860	10	50.0	11.6	103.0	0.6	7.1	0.01	0.02	15	36 TOT	1	
Ambient*	3/21/84	835	5,540	8.5	47.3	12.1	103.0	1.2	7.8	0.01	0.031	30	30J TOT	5	
Ambient*	7/25/84	930	171	20	68.0	8.7	95.0	0.4	7.9	0.01	0.026	15	36	1	0.4
Ambient*	11/28/84	840	3,440	9	48.2	12.4	107.0	1.2	7.4	0.04	0.103	15	430	42	
Ambient*	1/30/85	940	398	4	39.2	12.5	94.0	0.8	7.4	0.01	0.022	30	30J	1	
Ambient*	9/22/92	915	52	17.5	63.5	8.1	84.0	0.4	7.8	0.04	0.03	2		1.0K	0.4
Ambient*	12/16/92	1310	466	9	48.2	11.9	103.0	1.1	7.1	0.02	0.02	2		2	
Ambient*	3/9/93	1135	3,060	10.5	50.9	11.7	104.0	1.1	7.7	0.02	0.01	1		1.0K	

Table 18 Water Quality Data from Oregon Department of Environmental Quality Laboratory

SOURCE	DATE	TIME	FLOW (CFS)	TEMP. (C)	TEMP. (F)	DO (mg/l)	DO (%Sat)	BOD-5 (mg/l)	pH (SU)	NO2+NO3 (mg/l)	Tot. PO4 (mg/l)	Fec. Coli (MPN)	E. COLI (cfu/100 ml)	TURBID. FIELD (NTU)	CHLOR-OPHYLL (ug/l)
Ambient*	6/8/93	1150	2,920	13	55.4	11.4	107.0	1.0	7.1	0.01	0.02	2		2	
Ambient*	9/21/93	1150	86	17.5	63.5	9.4	98.0	0.5	7.8	0.03	0.01	1		1.0K	0.2
Ambient*	12/7/93	1035	1,580	9	48.2	11.6	100.0	2.8	7.7	0.1	0.19	240		26	0.2
Ambient*	3/29/94	1145	1,280	11	51.8	11.9	107.0	1.3	7.8	0.02	0.005	2		1	
Ambient*	6/28/94	1105	311	18	64.4	9.3	98.0	0.1	7.9	0.04	0.01	1		1.0K	1.1
Ambient*	12/20/94	1230	1,480	10	50.0	11.1	98.0	0.2	7.7	0.05	0.03	2		8	
Ambient*	3/14/95	1150	14,900	11	51.8	11.9	107.0	0.9	7.7	0.01	0.28	11		63	
Ambient*	6/27/95	1130	560	18	64.4	9.5	100.0	0.8	7.8	0.03	0.01	1		1.0K	0.7
Ambient*	12/12/95	1130	28,500	11.7	53.1	11.2	102.0	0.8	7.6	0.02	0.26	285	105	167	
Ambient*	3/5/96	1340	11,200	8.5	47.3	12.2	104.0	0.7	7.6	0.02	0.05	52	32J	13	
Ambient*	6/18/96	1045	455	15.7	60.3	9.8	97.0	0.2	7.8	0.01	0.005	2	4K	1	0.4
Ambient*	6/17/97	1220	371	18.5	65.3	9.2	97.0	0.2	7.9	0.01	0.01	20	4J	1	0.6
Ambient*	9/10/97	1610	78	20.8	69.4	9.2	101.0	0.1	8.0	0.02	0.02	8	20J	1	0.9
Ambient*	12/9/97	1103	3,220	8.1	46.6	11.9	100.0	0.6	7.7	0.02	0.01	6	4J		
Ambient*	3/18/98	1220	1,980	10.8	51.4	11.6	105.0	0.3	7.7	0.02	0.01	1	2K		
Ambient*	7/14/98	1210	186	20.9	69.6	9.0	100.0	0.7	7.9	0.01	0.005	1	2K		1
Ambient*	9/22/98	1130	72	18.6	65.5	9.0	95.0	0.2	7.9	0.03	0.01	30	8J		0.4
Lasar*	1/12/99	15:21	1,060	8.6	47.5	11.9	101.0	1.3	7.3	0.02	0.02	<2	<2	2.00	
Lasar*	3/16/99	14:00	2,750	9.7	49.5	11.6	101.0	1.4	7.6	0.01	0.01	<2	<2	3.00	
Lasar*	5/5/99	11:25	1,970	9.1	48.4	12.3	106.0	1.3	7.6	<0.0050	<0.01	<2	<2	2.00	0.10
Lasar*	7/13/99	11:00	172	20.7	69.3	8.6	95.0	0.2	7.8	0.01	0.01	54.00	<2	<1	0.20
Lasar*	9/15/99	12:50	63	18.8	65.8	8.9	95.0	<0.1	8.0	0.03	0.02	2 Est.	<2	1.20	0.50
Lasar*	11/16/99	11:35	3,110	11.7	53.1	10.3	95.0	0.2	7.7	0.02	0.01	14 Est.	14 Est.	2.00	
Lasar*	1/25/00	12:03						0.5		0.01	0.06				
Lasar*	3/22/00	11:25						0.7		0.01	0.01				
Lasar*	7/25/00	12:30		20.9	69.6	8.7	97.0	<0.1	7.9			4EST	12EST	0.70	0.30
Lasar**	9/22/99	15:04	60	18.8	65.8	8.0		<0.1	7.9	0.01	<0.01			<1	
Lasar***	8/10/99	14:00	135	18.9	66.0	8.7		<0.1	8.1	<0.0050	<0.01			<1	

*Site = Chetco River @ USGS gage

**Site = Chetco River @ river mile 56.09

***Site = Panther Creek @ river mile .33

Table 30 Chetco River Wetland Attibutes

Wetland ID	7.5 Minute Quad	Subwatershed	Size (ac.)	Connected	Cowardin Code	Cowardin Code	Buffer	Restoration Potential	Color Code	Comments
1	Brookings	Coastal Area	1	Y	E2EMN		FO	None	B	good shape
2	Brookings	Coastal Area	2	Y	E2USN		FO	None	V	good shape
3	Brookings	Coastal Area	6	Y	E2EMN		R	Reduce Rds	B	roads and compaction
4	Brookings	Coastal Area	2	N	PEMA		R	None	G	agricultural land
5	Brookings	Coastal Area	2.5	Y	E2USN		FO	None	V	good shape
6	Brookings	Coastal Area	6	Y	PFOS		R	None	B	good shape
7	Brookings	Coastal Area	2	Y	E2EMN		R	Mod	G	compaction
8	Brookings	Coastal Area	5	Y	E2EMN		D	Low	B	gravel extraction operation
9	Brookings	Coastal Area	6	Y	E2USN		D	Low	V	trailer park
10	Brookings	Coastal Area	6	Y	E2USN		R	None	G	good shape
11	Brookings	Coastal Area	7	Y	PUBH		FO	None	G	reservoir
12	Mt. Emily	Coastal Area	3	Y	E2USP		R	None	V	roads developed
13	Mt. Emily	Coastal Area	2	Y	E2USN		R	Low	B	roads - compaction
14	Mt. Emily	Coastal Area	2	Y	E2USP		D	Low	G	roads - residential
15	Mt. Emily	Coastal Area	1.5	Y	PFOA		R	Low	V	roads - residential
16	Mt. Emily	Coastal Area & Jack Creek	7	Y	PFOA		AG	Low	V	agricultural land
17	Mt. Emily	Jack Creek	3	Y	PEMC		R	Low	G	golf course
18	Mt. Emily	Jack Creek	4	Y	PFOA		R	Low	B	golf course
19	Mt. Emily	Coastal Area	8	Y	PEMC	PFOC	R	Low	G	roads - gravel operation
20	Mt. Emily	Coastal Area	1.5	N	FEMB		AG	Low	B	agricultural land
21	Mt. Emily	Lower Mainstem (1) & North Fork	10	Y	PFOA		AG	Low	B	cleared for agriculture
22	Mt. Emily	North Fork	2	Y	PFOA		AG	Low	V	cleared for agriculture
23	Mt. Emily	Lower Mainstem (1)	1.5	N	PEMC	PEMA	AG	Low	V	converted to agriculture
24	Mt. Emily	Lower Mainstem (1)	1	N	PEMB		AG	Low	V	converted to agriculture
25	Mt. Emily	Lower Mainstem (1)	1	N	PUBH		FO	Low	V	converted to agriculture

Table 35 Curve Number and Runoff-Depth Summary Table for Primary/Secondary Hydrologic Soil Groups

1	2	3	4	5	6	7	8	9	10
Subwatershed	**Primary / Secondary Hydrologic Soil Group**	**Cover Type/Treatment**	**Hydrologic Condition**	**Curve Number**	**Background Curve Number**	**Rainfall Depth (in)**	**Current Runoff Depth (in)**	**Background Runoff Depth (in)**	**Change From Background Col. 8-9**
Jack Creek	C - Primary	Pasture, grassland or range - continuous forage for grazing	Good	74	70	8.25	5.04	4.46	0.58
	B - Secondary	Pasture, grassland or range - continuous forage for grazing	Good	61	55	8.25	3.33	2.78	0.55
	D - Secondary	Pasture, grassland or range - continuous forage for grazing	Good	80	77	8.25	5.63	5.04	0.59
Lower Chetco Mainstem (1)	C - Primary	Pasture, grassland or range - continuous forage for grazing	Good	74	70	8.67	5.95	5.33	0.62
	B - Secondary	Pasture, grassland or range - continuous forage for grazing	Good	61	55	8.67	4.1	3.49	0.61
	D - Secondary	Pasture, grassland or range - continuous forage for grazing	Good	80	77	8.67	6.57	5.95	0.62
Middle Chetco Mainstem	B - Primary	Pasture, grassland or range - continuous forage for grazing	Good	61	55	*9.5	4.1	3.49	0.61
	C - Secondary	Pasture, grassland or range - continuous forage for grazing	Good	74	70	*9.5	5.95	5.33	0.62
	D - Secondary	Pasture, grassland or range - continuous forage for grazing	Good	80	77	*9.5	6.57	5.95	0.62
	** Comment: Rainfall Depth rounded to 9.0"*								
North Fork Chetco	D - Primary	Pasture, grassland or range - continuous forage for grazing	Good	80	77	9.25	6.57	5.95	0.62
	C - Secondary	Pasture, grassland or range - continuous forage for grazing	Good	74	70	9.25	5.95	5.33	0.62
	B - Secondary	Pasture, grassland or range - continuous forage for grazing	Good	61	55	9.25	4.1	3.49	0.61

Table 36 Runoff Curve Numbers for Other Agricultural Lands [1]

Cover Type	Hydrologic Condition	Curve Numbers for Hydrologic Soil Group			
		A	**B**	**C**	**D**
Pasture, grassland, or range -continuous forage for grazing[2]	Poor	68	79	86	89
	Fair	49	69	79	84
	Good	39	61	74	80
Meadow -continuous grass; protected from grazing and generally mowed for hay	---	30	58	71	78
Brush -brush-weed-grass mixture with brush the major element[3]	Poor	48	67	77	83
	Fair	35	56	70	77
	Good	30[4]	48	65	73
Woods -grass combination (orchard or tree farm)[5]	Poor	57	73	82	86
	Fair	43	65	76	82
	Good	32	58	72	79
Woods[6] - Shaded area can be used as background if the land was originally wooded	Poor	45	66	77	83
	Fair	36	60	73	79
	Good	30	55	70	77
Farmsteads -buildings, lanes, driveways, and surrounding lots	---	59	74	82	86

1 Average runoff condition and $l_a = 0.2$ S

2 Poor: <50% ground cover or heavily grazed with no mulch.
Fair: 50 to 75% ground cover and not heavily grazed.
Good: >75% ground cover and lightly or only occasionally grazed.

3 Poor: <50% ground cover.
Fair: 50 to 75% ground cover.
Good: >75% ground cover.

4 Actual curve number is less than 30; use curve number = 30 for runoff computations.

5 Curve numbers shown were computed for areas with 50% woods and 50% grass (pasture) cover.
Other combinations of conditions may be computed from the curve numbers for woods and pasture.

6 Poor: Forest litter, small trees, and brush are destroyed by heavy grazing or regular burning.
Fair: Woods are grazed but not burned, and some forest litter covers the soil.
Good: Woods are protected from grazing, and litter and brush adequately cover the soil.

Source: USDA Soil Conservation Service, TR55 (2nd edition, June 1986); Table 2-2b, page 2-6.

Table 37 Runoff Depth for Selected Curve Numbers and Rainfall Amounts[1]

	Runoff Depth for Curve Number of….												
Rainfall	40	45	50	55	60	65	70	75	80	85	90	95	98
1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.03	0.08	0.17	0.32	0.56	0.79
1.20	0.00	0.00	0.00	0.00	0.00	0.00	0.03	0.07	0.15	0.27	0.46	0.74	0.99
1.40	0.00	0.00	0.00	0.00	0.00	0.02	0.06	0.13	0.24	0.39	0.61	0.92	1.18
1.60	0.00	0.00	0.00	0.00	0.01	0.05	0.11	0.20	0.34	0.52	0.76	1.11	1.38
1.80	0.00	0.00	0.00	0.00	0.03	0.09	0.17	0.29	0.44	0.65	0.93	1.29	1.58
2.00	0.00	0.00	0.00	0.02	0.06	0.14	0.24	0.38	0.56	0.80	1.09	1.48	1.77
2.50	0.00	0.00	0.02	0.08	0.17	0.30	0.46	0.65	0.89	1.18	1.53	1.96	2.27
3.00	0.00	0.02	0.09	0.19	0.33	0.51	0.71	0.96	1.25	1.59	1.98	2.45	2.77
3.50	0.02	0.08	0.20	0.35	0.53	0.75	1.01	1.30	1.64	2.02	2.45	2.94	3.27
4.00	0.06	0.18	0.33	0.53	0.76	1.03	1.33	1.67	2.04	2.46	2.92	3.43	3.77
4.50	0.14	0.30	0.50	0.74	1.02	1.33	1.67	2.05	2.46	2.91	3.40	3.92	4.26
5.00	0.24	0.44	0.69	0.98	1.30	1.65	2.04	2.45	2.89	3.37	3.88	4.42	4.76
6.00	0.50	0.80	1.14	1.52	1.92	2.35	2.81	3.28	3.78	4.30	4.85	5.41	5.76
7.00	0.84	1.24	1.68	2.12	2.60	3.10	3.62	4.15	4.69	5.25	5.82	6.41	6.76
8.00	1.25	1.74	2.25	2.78	3.33	3.89	4.46	5.04	5.63	6.21	6.81	7.40	7.76
9.00	1.71	2.29	2.88	3.49	4.10	4.72	5.33	5.95	6.57	7.18	7.79	8.40	8.76
10.00	2.23	2.89	3.56	4.23	4.90	5.56	6.22	6.88	7.52	8.16	8.78	9.40	9.76
11.00	2.78	3.52	4.26	5.00	5.72	6.43	7.13	7.81	8.48	9.13	9.77	10.39	10.76
12.00	3.38	4.19	5.00	5.79	6.56	7.32	8.05	8.76	9.45	10.11	10.76	11.39	11.76
13.00	4.00	4.89	5.76	6.61	7.42	8.21	8.98	9.71	10.42	11.10	11.76	12.39	12.76
14.00	4.65	5.62	6.55	7.44	8.30	9.12	9.91	10.67	11.39	12.08	12.75	13.39	13.76
15.00	5.33	6.36	7.35	8.29	9.19	10.04	10.85	11.63	12.37	13.07	13.74	14.39	14.76

1 Interpolate the values shown to obtain runoff depths for curve numbers or rainfall amounts not shown.

From USDA Soil Conservation Service, TR55 (2nd edition, June 1986) Table 2-1, page 2-3.

Table 38 Agricutlure/Rangeland Risks of Peak Flow Enhancement

1	2	3	4	5	6	7	8	9
Subwatershed	**Percent of Ag/Range Area in 1st Hydro Soil Group**	**Average Change from Background**	**Percent of Ag/Range Area in 2nd Hydro Soil Group**	**Average Change from Background**	**Percent of Ag/Range Area in 2nd Hydro Soil Group**	**Average Change from Background**	**Weighted Average Change from Background**	**Potential Risk of Peak Flow Enhancement**
	Table 34 Col. 4 (A, B, C or D)	**Table 35 Col. 10**	**Table 34 Col. 4 (A, B, C or D)**	**Table 35 Col. 10**	**Table 34 Col. 4 (A, B, C or D)**	**Table 35 Col. 10**	**(Cols. 2x3 + 4x5 + 6x7) / 3**	
Jack Creek	75.37%(C)	0.58	22.67%(B)	0.55	2.03%(D)	0.59	0.57	Moderate
Lower Chetco Mainstem (1)	72.26%(C)	0.62	22.01%(B)	0.61	5.97%(D)	0.62	0.62	Moderate
Middle Chetco Mainstem	50.00%(B)	0.61	31.25%(C)	0.62	18.75%(D)	0.62	0.61	Moderate
North Fork Chetco	43.65%(D)	0.62	28.41%(B)	0.62	27.73%(C)	0.61	0.62	Moderate

Table 44 Monthly Net Water Available by Water Availability Basin (cfs) (of 50% Exceedence)

Watershed ID#	Water Availability Basin	Stream	Tributary to	Location	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
70908	31000000	Chetco R	Pacific Ocean	Mouth	3190	3420	2730	1360	255	41	-29	-29	-27	-230	1190	3620
70889	31010000	Jack Cr	Chetco R	Mouth	22	28	12	-17	0	0	-29	-29	-27	-230	0	23
70887	31020000	N Fk	Chetco R	Mouth	239	268	188	33	0	0	-29	-29	-27	-230	4	264
70907	31030000	Chetco R	Pacific Ocean	Ab N Fk Chetco R	2920	3110	2560	1360	255	41	-29	-29	-27	-230	1180	3200
31731224	31031000	Chetco R	Pacific Ocean	Ab Elk Cr At Gage	2920	3110	2560	1360	255	41	-29	-29	-27	-230	1180	3200
70882	31031100	S Fk	Chetco R	Mouth	248	280	199	34	0	0	-29	-29	-27	-230	9	278
70884	31031110	Quail Prairie Cr	S Fk	Mouth	57	65	45	4	0	0	-29	-29	-27	-230	0	62
70905	31031200	Chetco R	Pacific Ocean	Ab S Fk Chetco R	1960	2100	1730	890	164	0	-29	-29	-27	-230	790	2260
70906	31031210	Chetco R	Pacific Ocean	Ab Little Chetco R	153	171	148	71	0	0	-29	-29	-27	-230	43	175

Note: Shaded Area = water not available at 50% exceedance level

Table 45 Streamflow Restoration Priority Areas

Watershed ID	WAB	Stream	Tributary To	Location	SUMMER			FALL		WINTER		SPRING	
					Priority	Needs	Optimism	Needs	Optimism	Needs	Optimism	Needs	Optimism
70908	31000000	Chetco R.	Pacific O.	Mouth		4	1	3	1	1	1	2	1
70889	31010000	Jack Cr	Chetco R	Mouth	X	3	2	1	1	1	1	1	1
70887	31020000	N. Fk.	Chetco R	Mouth		3	1	1	1	1	1	1	1
70907	31030000	Chetco R.	Pacific O.	Above N. Fk.	X	3	3	1	1	1	1	1	1
31731224	31031000	Chetco R.	Pacific O.	Above Elk Cr. @ Gage		1	1	1	1	1	1	1	1
70882	31031100	S. Fk.	Chetco R.	Mouth		1	1	1	1	1	1	1	1
70884	31031110	Quail Prairie Cr.	S. Fk.	Mouth		1	1	1	1	1	1	1	1
70905	31031200	Chetco R.	Pacific O.	Above S. Fk.		1	1	1	1	1	1	1	1
70906	31031210	Chetco R.	Pacific O.	Above Little Chetco		1	1	1	1	1	1	1	1

There are no priorities for fall, winter, or spring.

Table 39 Forest Road Area Summary

1 Subwatershed	2 Area (square mi)	3 Forested Area (acres)	4 Forested Area (square mi)	5 Total Linear Distance of Forest Roads (miles)	6 Roaded Area Col. 5 x *Standard Width (square miles)	7 Percent Area in Roads Col. 6/4*100	8 Relative Potential for Impact
Boulder Creek	21.83	13,973	21.83	15.01	0.07	0.32	Low
Box Canyon Creek	14.93	9,552	14.93	0.00	0.00	0.00	Low
Chetco Coastal Area	7.95	2,895	4.52	11.69	0.05	1.21	Low
Eagle Creek	20.55	13,148	20.54	40.50	0.19	0.93	Low
Emily Creek	12.48	7,984	12.48	18.46	0.09	0.70	Low
Granite & Carter Area	32.89	21,039	32.87	32.81	0.15	0.47	Low
Jack Creek	8.80	4,350	6.80	14.82	0.07	1.02	Low
Lower Chetco Mainstem (1)	9.24	4,588	7.17	20.00	0.09	1.31	Low
Lower Chetco Mainstem (2)	22.63	14,481	22.63	2.68	0.01	0.06	Low
Middle Chetco Mainstem	25.44	16,017	25.03	108.37	0.51	2.04	Low
Mislatnah Creek	10.98	7,029	10.98	10.22	0.05	0.44	Low
North Fork Chetco	40.19	24,255	37.90	104.70	0.49	1.30	Low
Quail Praire Creek	11.48	7,346	11.48	25.11	0.12	1.03	Low
South Fork Chetco	31.81	20,282	31.69	43.29	0.20	0.64	Low
Tincup Creek	27.74	17,750	27.73	0.00	0.00	0.00	Low
Upper Chetco Mainstem (1)	16.60	10,609	16.58	41.18	0.19	1.17	Low
Upper Chetco Mainstem (2)	36.39	23,190	36.23	8.21	0.04	0.11	Low
Totals	351.92	218,488	341.39	497.04	2.32	0.68	

Note: *Standard Width for Forest Roads = 25 feet (.0047 miles)*

Table 40 Rural Road Area Summary

1 Subwatershed*	2 Area (square mi)	3 Rural Area (Ag + Range) (acres)	4 Rural Area (Ag + Range) (square mi)	5 Total Linear Distance of Rural Roads (miles)	6 Roaded Area Col. 5 x *Standard Width (square miles)	7 Percent Area in Roads Col. 6/4*100	8 Relative Potential for Impact
Jack Creek	8.80	1,279	2.00	13.25	0.09	4.38	Moderate
Lower Chetco Mainstem (1)	9.24	1,222	1.91	12.89	0.09	4.46	Moderate
Middle Chetco Mainstem	25.44	16	0.03	0.74	0.00	19.41	Not Applicable
North Fork Chetco	40.19	1,457	2.28	16.29	0.11	4.72	Moderate
Totals	83.67	3,974	6.22	43.17	0.29	4.66	

Note: *Standard Width for Rural Roads = 25 feet (.0066 miles)*

*Only subwatersheds containing lands in "rural" areas are inlcuded in Table 40.