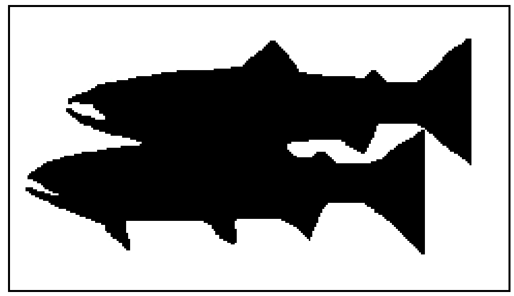
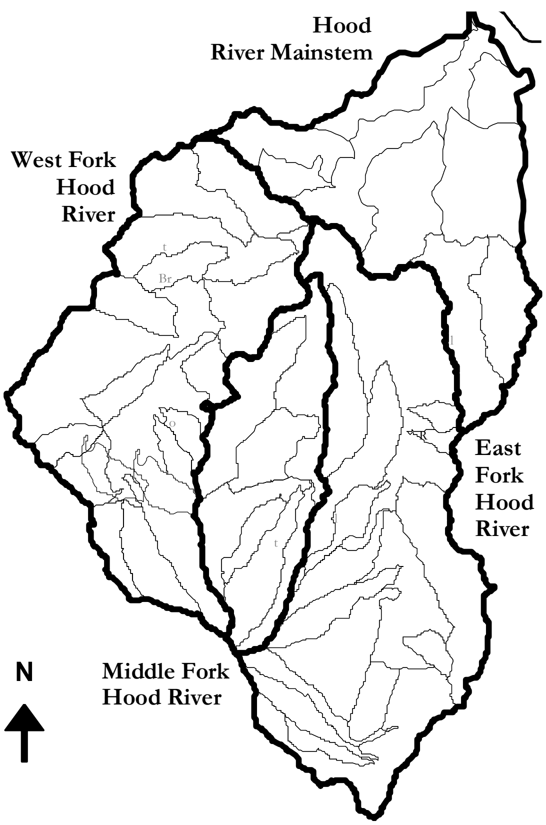
HOOD RIVER WATERSHED GROUP

Hood River Soil &
Water Conservation District



Hood River Watershed Assessment



December 1999

This page blank intentionally

Acknowledgements

The Hood River Watershed Assessment is a project of the Hood River Watershed Group and the Hood River Soil and Water Conservation District, whose members are dedicated to working together locally to improve the sustainability and health of natural resources in the Hood River system. Financial assistance was provided from the Oregon Watershed Enhancement Board, Confederated Tribes of the Warm Springs Reservation and For the Sake of the Salmon Foundation. Invaluable technical assistance was received from the U.S. Forest Service Hood River Ranger District, Oregon Department of Environmental Quality, Confederated Tribes of the Warm Springs Reservation, Natural Resources Conservation Service, the Oregon Fish and Wildlife Department and the Oregon Watershed Enhancement Board.

Prepared by

Holly Coccoli, Hood River Watershed Group

Contributors

Bonnie Lamb, Oregon Department of Environmental Quality
Karen Hale, U.S. Forest Service
Ed Salminen, Watershed Professionals Network
Monica Burke
John Wells, U.S. Forest Service
Holly Coccoli, Hood River Watershed Group

Reviewers

Dennis Carlson, Hood River County
Brian Nakamura, Hood River Grower Shipper Association
Jim Newton, Steve Pribyl and Rod French, Oregon Department of Fish & Wildlife
Mick Jennings and Mike Lambert, Confederated Tribes of the Warm Springs Reservation
Larry Toll, Oregon Water Resources Department
Rick Ragan, U.S. Forest Service Hood River Ranger District
John Buckley, East Fork Irrigation District
Bill Stanley and Brian Conners, Middle Fork Irrigation District
Jerry Bryan, Farmers Irrigation District
Steve Hansen, Longview Fibre Company
Randy Johnston, City of Hood River
Linda Prendergrast, PacifiCorp
Larry Hoffman, Oregon Department of Forestry
John Bartlett, Hood River Soil & Water Conservation District
Chuck Gehling, Hood River Soil & Water Conservation District
Mike Udelius, Hood River Soil & Water Conservation District
Anne Saxby, Hood River Soil & Water Conservation District

TABLE OF CONTENTS

1. INTRODUCTION

Purpose and Need for the Watershed Assessment

The Hood River Watershed Assessment was prepared by the Hood River Watershed Group (HRWG), a forum of landowners, businesses, growers, sport fishers, irrigation/water districts, individuals, state, federal and tribal agencies, and local government working cooperatively for a healthier environment and sustainable natural resources. The HRWG is one of 84 locally-formed "watershed councils" statewide that are a key part of the Oregon Plan for Salmon and Watersheds. The Oregon Plan is designed to improve the health of the state's aquatic resources. In contrast to Endangered Species Act and environmental protection emphasizing regulations, the Oregon Plan relies on voluntary action, government coordination , monitoring and accountability, public education and the prioritized enforcement of environmental laws.

The purpose of the assessment is to characterize watershed and stream habitat conditions to support planning for watershed health and fish recovery efforts. It will be used to develop a Watershed Action Plan in the year 2000 that will prioritize cooperative habitat protection, restoration, monitoring and education projects for implementation. Watershed assessments and analyses use a science-based, ecosystem approach to identify areas that need protection or rehabilitation. The Hood River watershed assessment generally follows the Oregon Watershed Assessment Manual prepared for the Oregon Watershed Enhancement Board (Watershed Professionals Network, 1999). Its geographic scope covers the whole Hood River subbasin.

The Hood River is located on the east slope of the Cascade Range and enters the Columbia River 22 miles above Bonneville Dam. Its 339-square mile watershed supports bull trout, spring chinook salmon, summer and winter steelhead, rainbow and cutthroat trout, and lesser numbers of fall chinook and coho salmon. Hood River fish populations have declined markedly in the last decades. Native Hood River spring chinook became extinct in the early 1970s, along with native coho and fall chinook stocks. In 1998, steelhead and bull trout in the Hood River were listed as Threatened under the Endangered Species Act. Presently, all but the lower 4 miles of the Hood River are closed to salmon and steelhead angling. Several stream sections are listed under the Clean Water Act as water quality-impaired. In the Hood River as throughout the Pacific Northwest, loss and damage to spawning and rearing habitat are not due to a single factor, but are caused by the combination of many impacts over time. Dams, diversions, agriculture, timber harvest and other land use practices - have all contributed to the decline of Hood River salmon and steelhead habitat (BPA 1996). While parallel measures regionwide and in the Hood River target other contributing factors affecting native fish populations (e.g., overharvest, hatchery interactions, predation) – the watershed assessment focuses on freshwater habitat conditions.

Social and Economic Background

The watershed lies within Hood River County and has a current (1999) population of approximately 19,000. The County experienced an annual growth rate of 2.04% between 1990 and 1995 (CGEDA 1998). The County population is projected to increase by 3,000 to 4,000 people every five years, reaching an estimated 36,483 by the year 2040. Approximately 65% of the watershed is publicly-owned, with 51% in federal ownership. Of the private land, a large percentage is zoned as either Exclusive Farm Use (one third) or Forest Land (one half). An overview of current land use is provided in Figure 1-1. The County is neither urban or rural, but somewhere in between with small urban centers in Odell, Parkdale, and the City of Hood River. The population is dispersed, with 67% of County residents living outside of urban growth boundaries Zoning under the current Comprehensive Land Use Plan will allow an estimated 4,200 new lots and parcels that will accommodate about 10,000 additional people outside of City limits (USFS 1996a).

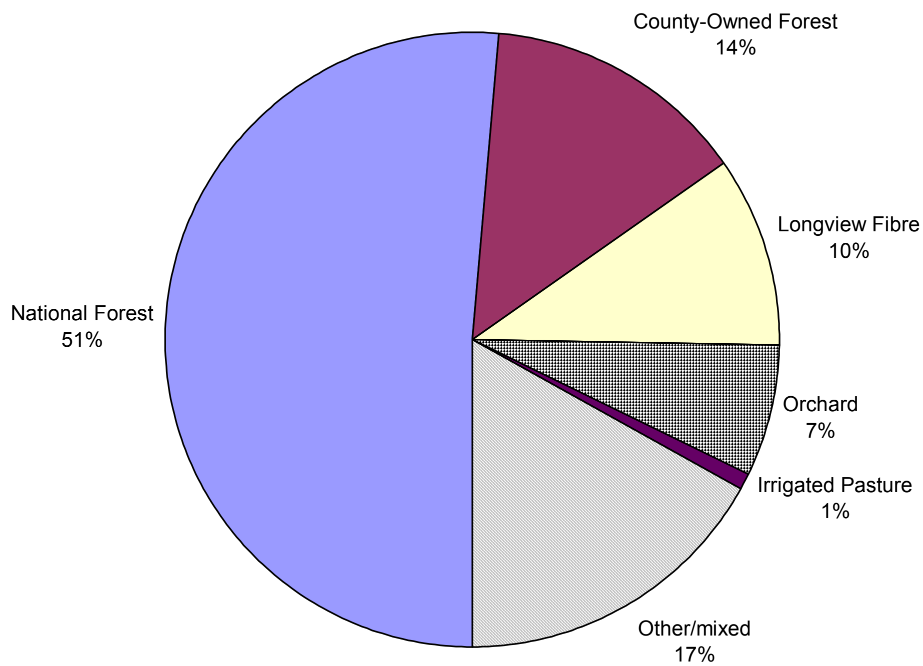


Figure 1-1. Generalized land use for the Hood River Watershed showing percent of ownership or use by category. The *Other/Mixed* category includes other farms, residential uses, urban, commercial and industrial lands.

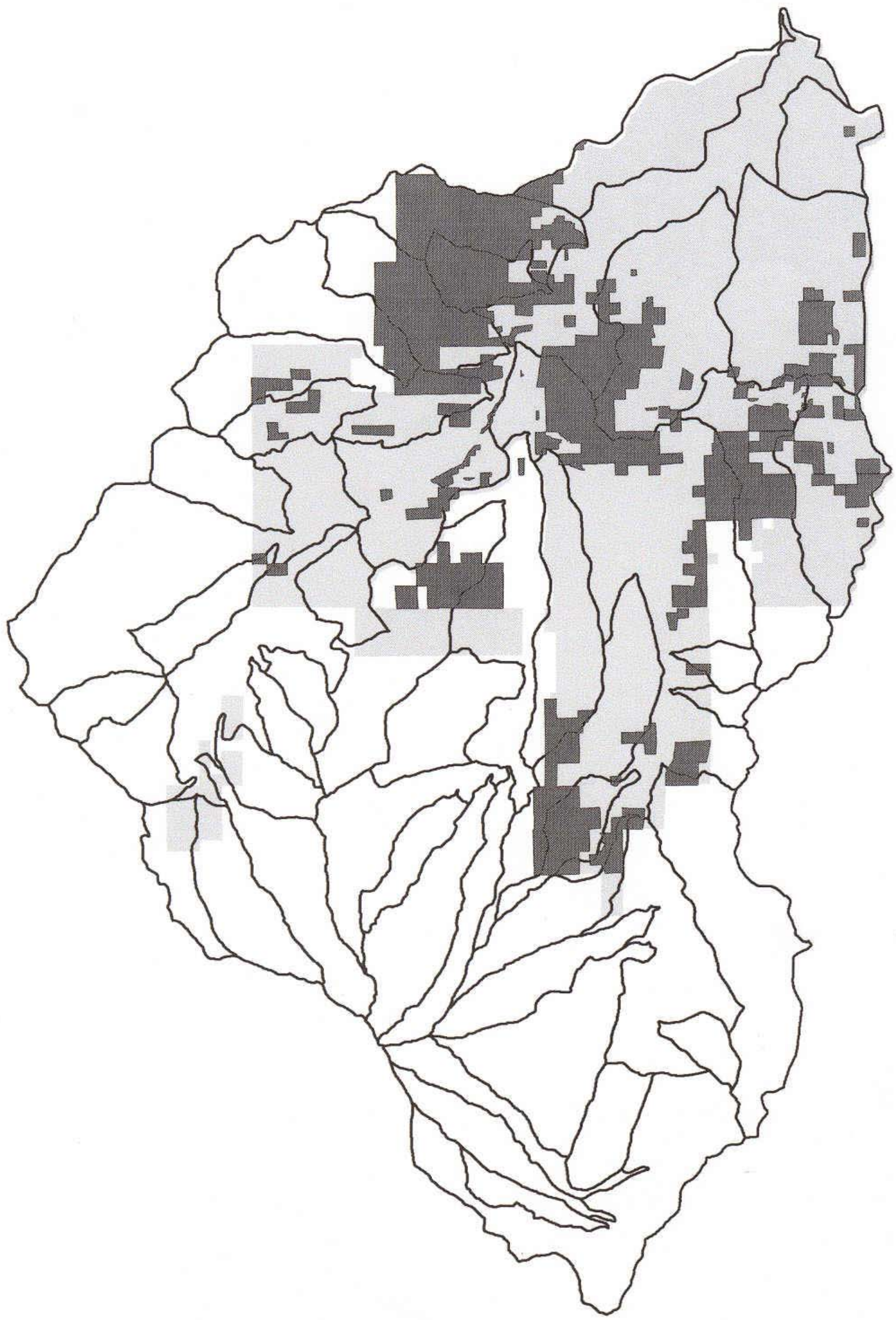


Figure 1-2. Public and private land ownership in the Hood River Watershed in reference to drainage area boundaries. Light shaded area is private land, dark shaded area is County-owned forest land, while unshaded area is federally-owned.

Agriculture is the leading industry in the watershed followed by tourism and forestry. Irrigated orchards growing mostly pears and apples make up approximately 15,000 acres (Niederholzer, OSU County Extension Agent, *pers comm.*). The Hood River Valley contributes about a third of the U.S. winter pear crop. Cherries, peaches, wine grapes and produce are also grown in smaller amounts. The fruit industry generates $65 to 70 million annually for the local economy and directly employs between 1,000 to 2,800 people depending on time of year (Nelson, HR Grower-Shippers Association, *pers. comm*). Among the 305 farms in the County with sales of $10,000 or more, the average farm size is 73 acres. Of these, more than half are less than 49 acres (Seavert 1994). Other agricultural activities include a number of farms raising livestock, one commercial dairy, and a single grazing allotment on the Mt. Hood National Forest (MHNF). Approximately 2,000 acres of pasture lands are irrigated. Most agricultural lands are located on land below 2,000 feet in elevation.

Outdoor recreation and tourism has expanded into the second biggest economy in the watershed. Recreational use of the MHNF is rising as population grows in Portland and the Columbia River Gorge area. The MHNF, Mt. Hood Meadows Ski Resort and Cooper Spur Ski Area draws visitors, while the City of Hood River is an international windsurfing destination. The lower river lies within the Columbia River Gorge National Scenic Area. Whitewater kayaking, angling, hiking, general tourism, camping, backcountry snow sports and mountain biking are increasing watershed uses. Sportfishing remains a popular activity in the area among residents. A strong link between tourism and land development in the Hood River valley is noted by historians and continues today (USFS 1996b).

The Confederated Tribes of the Warm Springs Reservation (CTWS) hold federally-reserved fishing rights in the Columbia River and the Hood River watershed. These rights arise from the Treaty with the Tribes of Middle Oregon signed June 25, 1855. The CTWS is the legal successor to signatories of the 1855 Treaty, under which seven bands of Wasco and Sahaptin-speaking Indians ceded ownership of ten million acres of tribal land, including the Hood River watershed, to the United States (BPA 1996). In exchange for these lands, the Treaty reserved to the Tribes an exclusive right to fish within Indian reservation boundaries and the right to fish in common with other citizens at all other usual and accustomed places including ceded lands. Ceremonial, commercial and subsistence fishing remains an essential part of tribal culture and economy. Treaty fishing opportunity has become severely restricted because of low abundance and the need to protect weak or threatened stocks. Tribal and non-tribal fishing affecting Hood River stocks is regulated or co-managed by CTWS and the Oregon Department of Fish and Wildlife (ODFW). The tribal co-management authority is derived from the 1855 Treaty and subsequent court rulings. As co-managers, the CTWS is actively involved in habitat protection, restoration, fisheries enforcement, enhancement and research activities.

Forestry continues to be an important economic activity, with two lumber mills currently in operation. About half the watershed lies within the MHNF where timber harvest is guided by the 1994 Northwest Forest Plan. The MHNF is involved in substantial habitat restoration and monitoring activities in the basin. Hood River County owns approximately 30,000 acres of dedicated forest land in the watershed (Figure 1-2). Timber sales revenue from County-owned forest lands contribute about 12.5% of the County budget (USFS 1996b). Longview Fibre Company owns 22,000 acres held in two main blocks - Fir Mountain in the Neal Creek drainage and along the West Fork Hood River, with some holdings along Tony Creek.

PacifiCorp operates a hydroelectric project on the Hood River at Powerdale Dam (locally called Copper Dam) at river mile 4.5. A fish ladder and trap is operated at the dam by Oregon Department of Fish and Wildlife (ODFW) in conjunction with the Confederated Tribes of the Warm Springs Reservation to track anadromous fish populations and implement wild fish protection and recovery measures. PacifiCorp has applied to the Federal Energy Regulatory Commission for a new license to continue operating after its current license expires in March 2000. The new license is expected to improve existing conditions for fish in the project area, and includes increased summer and fall minimum flow requirements below the dam and new fish screen facilities.

Watershed Description

The Hood River flows north from Mt. Hood and empties into the Columbia as little as thirty miles from its headwaters. The watershed is bounded on the west by the Cascade Range, on the south by the Sandy and White Rivers and on the east by the Mosier, Mill, Threemile, Rock creek and Fifteen Mile drainages. Watershed elevation varies from 11,245 feet to 74 feet above sea level. Its headwaters drain into three main tributaries - the East, Middle and West Forks, which converge to form the Hood River mainstem about 12 miles from the Columbia River. The total drainage area is 217,337 acres, or 339 square miles. For the purpose of this assessment, the East Fork Hood River begins at the West Fork confluence as named on U.S. Geological Survey (USGS) quadrangle maps. In addition to the Hood River mainstem and the East, Middle and West Forks, major tributaries include Green Point, Lake Branch, Ladd, Tony, Evans, Neal Creek and Dog River. Major tributaries of the Hood River are shown in Figure 1.3.

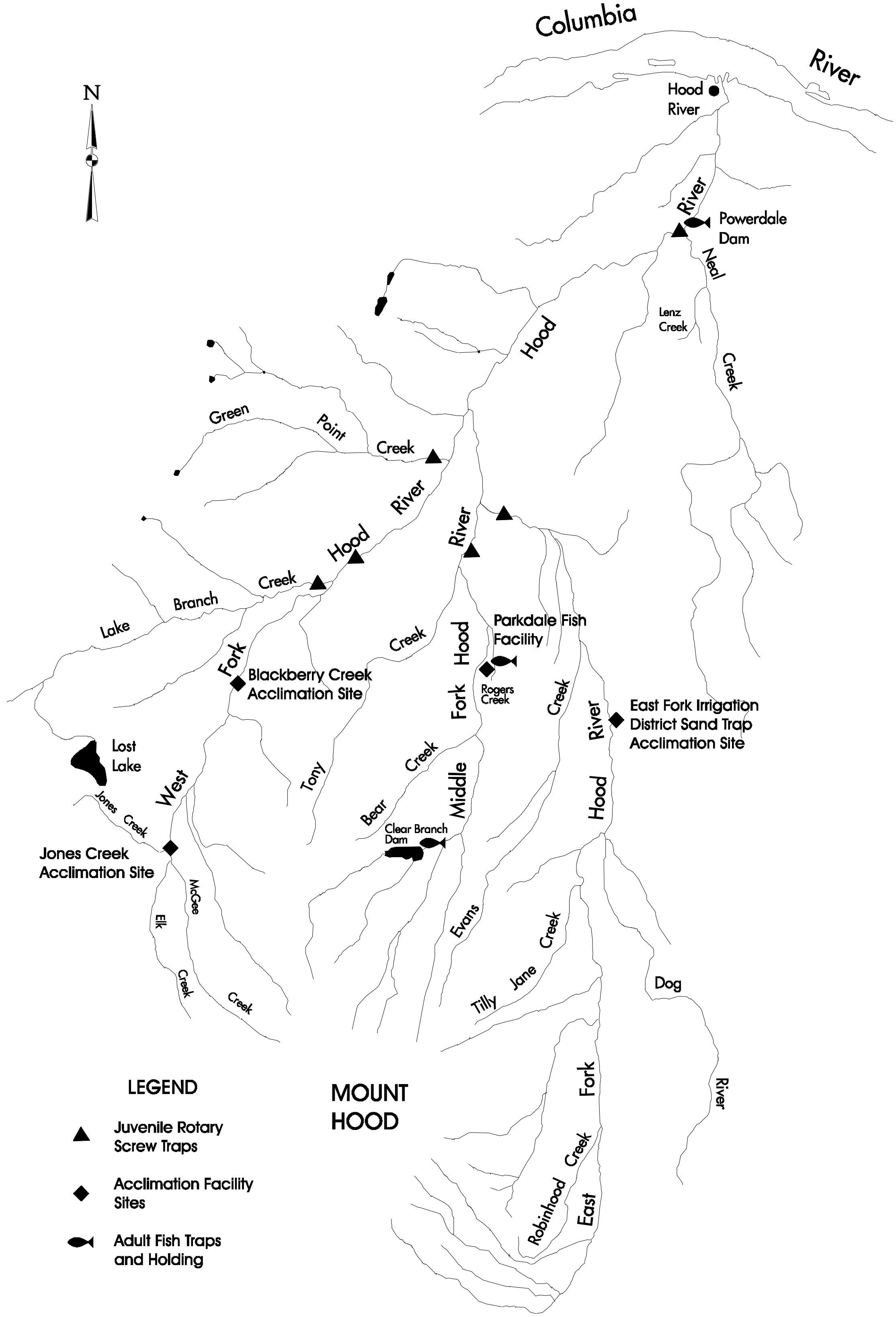


Figure 1.3. Diagram of major Hood River tributaries with locations of Hood River Production Program facilities.

Conditions in rivers and creeks are controlled by the geology, climate, hydrology and land use of their surrounding drainage area from ridgetop to ridgetop. To assess habitat conditions, the stream network is divided into individual watersheds or groups of smaller watersheds with similar characteristics.

Because the word "watershed" can be used to refer to both large and small drainages, confusion can be created about what land area is being discussed. To avoid confusion, the Oregon Watershed Assessment process assigns specific terms to different drainage levels using the U.S. Geological Survey Hydrologic Unit Code (HUC) system. This system is based on a watershed hierarchy and size. The Hood River subbasin - hereafter referred to as the "**W**atershed" - is a Fourth-field HUC watershed. The Hood River Watershed consists of four principal sub-basins, each of which corresponds to a "Fifth-field" watershed with an average size of around 60,000 acres. These 5^{th} field watersheds are (1) West Fork Hood River; (2) Middle Fork Hood River; (3) East Fork Hood River; and (4) Hood River Mainstem – the lower river and its tributaries.

The smallest level used in this assessment is the "subwatershed" corresponding to 6^{th} field HUC watersheds having an average size of around 5,000 acres. A total of fifty 6^{th} field subwatersheds make up the Hood River Watershed. The 6^{th} field subwatershed boundaries used in this assessment were adopted from the US Forest Service Watershed Analysis for the West, Middle and East Fork Hood River and were delineated for the Hood River Mainstem. Watershed and subwatershed boundaries used in the Assessment are shown in Figure 1-3.

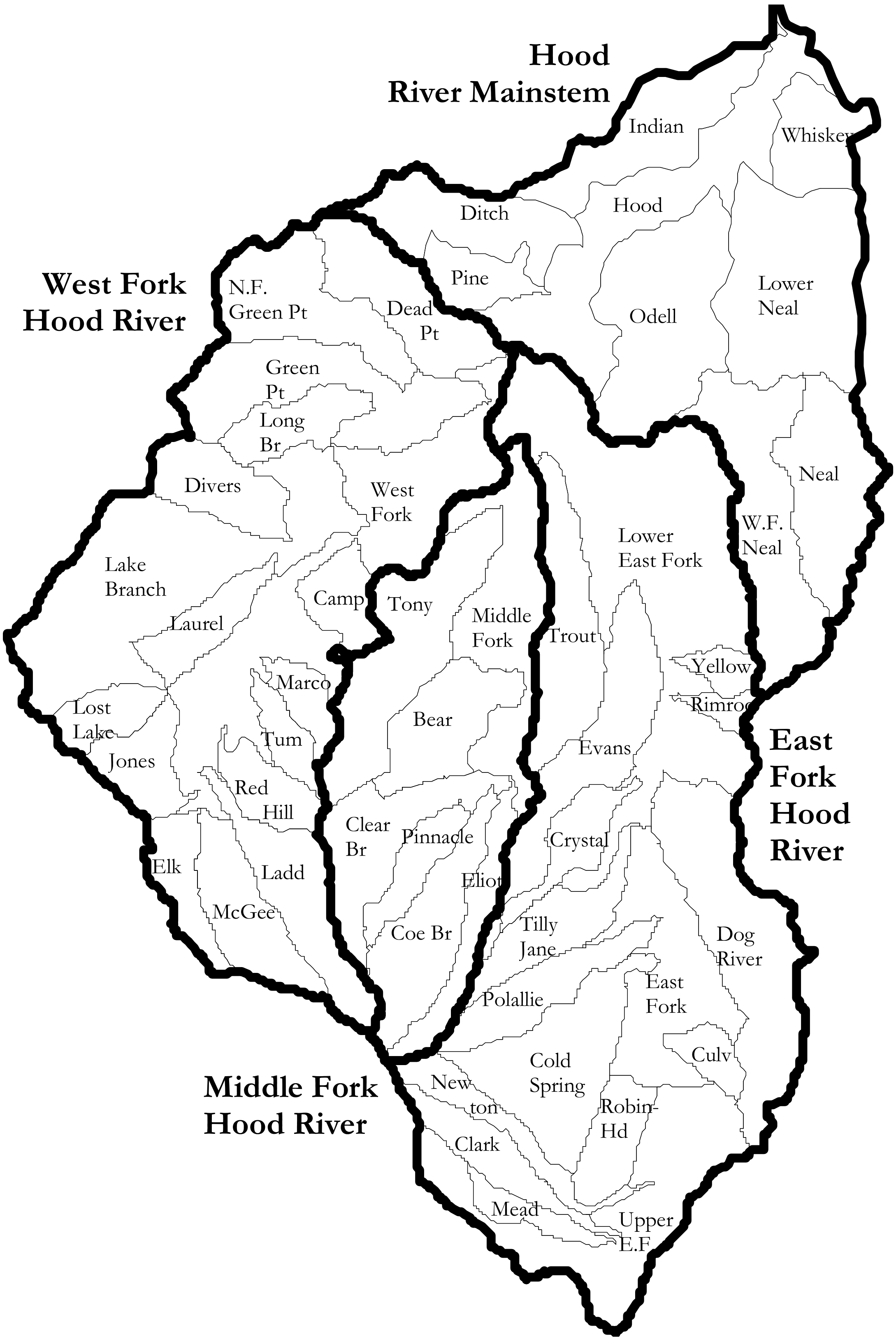


Figure 1-4. Fifth-field watersheds and sixth-field subwatersheds in the Hood River basin.

The Hood River is a dynamic, glacially influenced system within steep terrain (USFS, 1996a). Pleistocene glaciation produced most of the topographic features that form the Hood River valley landscape, while Mt. Hood glacial meltwater and Holocene-era floods produced terraces of fluvial clay, silt, sand, gravel and boulders (PacifiCorp 1998). Bedrock channel formations of basalt and basaltic andesite occur in the West Fork and its tributaries. Basin rock formations are primarily volcanic, with the Columbia River basalt the most widespread (ODEQ 1988).

Five upper tributaries are fed by glacial sources that drain approximately one third of the total glacial ice on Mt. Hood (USFS 1996b). These are Newton and Clark creeks in the East Fork watershed, Coe and Eliot Branch in the Middle Fork, and Ladd Creek in the West Fork watershed. During high flow events, large amounts of bedload and sediment are transported in these tributaries and in the mainstem. Glacial melt increases water turbidity in the form of suspended silt or glacial flour during summer and early fall. Glacial sediment is more prevalent in the Hood River mainstem and the Middle and East Forks, while glacial sediment in the West Fork is contributed only by a single small tributary, Ladd Creek.

While the mainstems of the Hood River and its West, Middle and East Forks (below RM 22.7) have an average channel gradient of less than 2% (NPPC 1990), most stream channels in the watershed have moderate or high gradients and are confined in narrow valleys or between terraces. The headwaters of the Middle and West Forks contain several important low gradient stream reaches. The East Fork Hood River forms a glacial “U-shaped” valley. Most streams are single-thread channels of low sinuosity and have a limited floodplain area. Boulder-rubble substrates dominate most streambeds (USFS 1996a).

The area locally known as the Hood River Valley is actually three distinct geographic areas. The “lower” valley is a gentle, broad north-sloping bench immediately adjacent to the Columbia River. While the land is generally gentle in relief, Hood River and many of its tributaries cut deeply into this bench forming steep canyons. The central feature of the Valley is Middle Mountain, a 2,642-foot massif that bisects the Valley east to west. Middle Mountain is rugged terrain unsuited to agricultural uses. The “upper” valley is situated between the northeast shoulder of Mt. Hood and Middle Mountain. This area, like the lower valley, is gently north-sloping but streams here are not deeply incised and have a greater tendency for channel meander (Wells 1999).

Climate varies across the Watershed because of its transitional location between weather dominated by wet marine air flow to the west and the dry continental climate of eastern Oregon. Areas of climate and landscape similarity called eco-regions have been defined as a common framework for ecosystem management in the U.S. (Pater et al. 1998). About two-thirds of the Hood River Watershed is within the Cascades eco-region and has a moist temperate climate. The northeast portion is in the Eastern Cascades Slopes and Foothills eco-region and has a dry continental climate. Level IV eco-regions for the Watershed and their locations are depicted below in Figure 1-5.

Cascades Eco-region:

4a. Western Cascades Lowlands and Valley: A network of steep ridges and narrow valleys. Elevations generally under 3200 feet. The wet mild climate promotes lush forests dominated by Douglas fir and western hemlock. One of the most important timber producing areas in the NW.
4b. Western Cascades Montane Highlands: Steep glaciated mountains dissected by high-gradient streams. Characterized by a deep annual snowpack. Soils support forests dominated by Pacific silver fir, western and mountain hemlock, Douglas fir and noble fir.
4c. Cascade Crest Montane Forest: Undulating plateau punctuated by volcanic buttes and cones that reach elevations of about 6500 feet. Its Pliocene and Pleistocene volcanics were glaciated leaving numerous lakes. Extensive forests with mountain hemlock and Pacific silver fir.
4d. Cascades Subalpine/Alpine: High, glaciated, volcanic peaks rising above subalpine meadows. Elevations up to 12000 feet. Active glaciation occurs on the highest volcanos and decreases southward. Winters are cold and growing season short. Flora and fauna are adapted to high elevations and include herbaceous and shrubby subalpine meadow vegetation and patches of mountain hemlock, subalpine fir and whitebark pine.

Eastern Cascades Slopes and Foothills Eco-region:

9c. Oak/Conifer Eastern Cascades Columbia Foothills: Soil, climate and landforms are highly variable and contribute to a mosaic of vegetation types that includes grasslands, Oregon white oak woodlands, Douglas-fir/ponderosa pine forests, and western hemlock/Douglas-fir forests. Maritime weather systems sometimes enter via the Columbia River Gorge and moderate its otherwise continental climate.

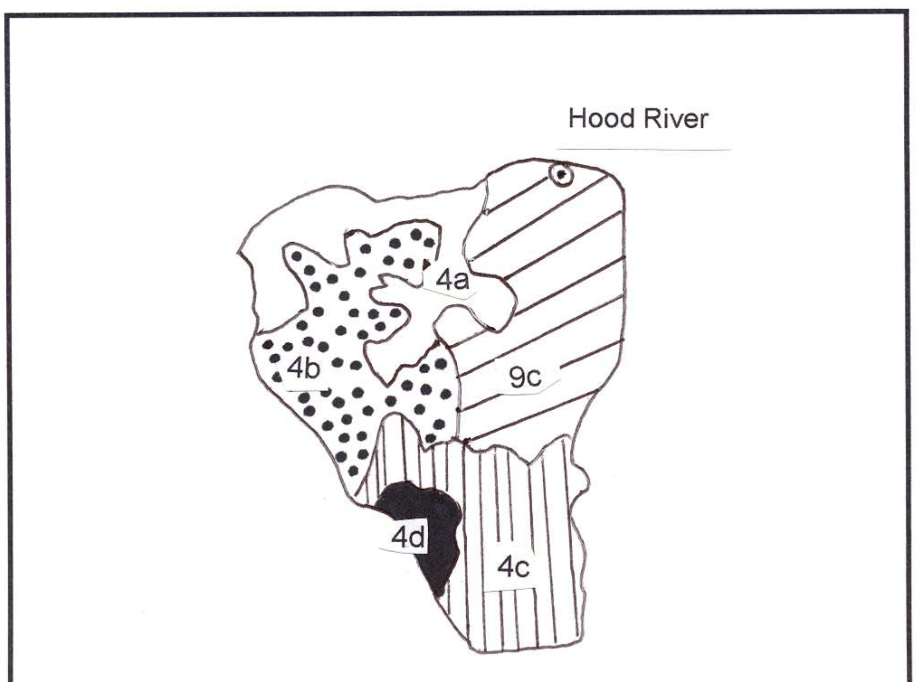


Figure1-5. General location of eco-regions depicted for Hood River County (from Pater et al. 1998).

About the Hood River Watershed Group

An awareness that Hood River fish populations were declining has generated concern among biologists, water users and anglers for the last decade. The Hood River Watershed Group was formed in 1993 by the Hood River Soil and Water Conservation District (SWCD) to promote watershed improvement. The main catalyst in its creation was the expected listings of fish under the Endangered Species Act. The prevailing view was that local solutions to habitat problems would be preferable and more effective than federal regulatory controls. At the time the HRWG formed, some watershed restoration projects were already underway by irrigation districts, the Forest Service and others. In 1996, the Hood River County Board of Commissioners formally recognized the HRWG was as the subbasin's Watershed Council. Funding from For the Sake of the Salmon foundation and the Governor's Watershed Enhancement Board was obtained in 1996 to hire a full-time coordinator. Additional funding has since been provided by the Confederated Tribes of the Warm Springs Reservation.

The Group's mission statement reads: *"The purpose of the group is to sustain and improve the Hood River Watershed through education, cooperation and stewardship"*.

The HRWG makes decisions by consensus. A diverse 14-member Executive Committee represents the Group in an official capacity, and an Advisory Committee provides technical assistance. Citizen participation in meetings and volunteer activities are strongly encouraged. Committee memberships are listed below:

Executive Committee

Hood River County	U.S. Forest Service
City of Hood River	Irrigation Districts (2 positions)
Hood River Soil and Water Conservation District	Domestic Water and/or Sewer Districts
Industry	Forestry
Recreational Users	Environmental Groups
Small Business	Orchardists (2 positions)

Advisory Committee

Confederated Tribes of the Warm Springs Reservation

Oregon Department of Forestry	Oregon Department of Fish and Wildlife
Natural Resources Conservation Service	Oregon Department of Environmental Quality
Oregon Water Resources Department	Oregon State University Extension Service

2. HISTORICAL CONDITIONS

Introduction

This Chapter summarizes available information on historic and current land use effects on the natural watershed. While the Hood River Watershed has been altered and restoration to a pristine condition is not an option, a knowledge of historic conditions and the cumulative effects of land use can help guide restoration actions and improve chances for success. 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). Much of this Chapter was compiled from Forest Service Watershed Analysis reports (USFS 1996a; 1996b) which should be consulted for original citations. Added information was provided by valley residents of pioneer family origin, by John Wells of the USFS Hood River Ranger District, and by ecologist and historian Monica Burke of Parkdale.

Watershed Conditions at the Time of Settlement

Vegetation

Since few historical records are available to describe the landscape prior to Euro-American settlement, the USFS examined information from the turn of the century for use in watershed analysis. The USFS concluded that around the time of settlement, tree species in the Watershed were similar to those present today although their relative proportions differed. Douglas fir dominated the West Fork watershed, followed by western hemlock, red cedar, Pacific silver, noble and grand fir, and Englemann spruce. Large old-growth trees were found in Dee Flat and headwaters, on side slopes and canyons of Green Point Creek and Lake Branch, and on the valley floor of the West Fork Hood River. Government Land Office surveys from the 1880s suggest that dense understory brush was virtually everywhere in the West Fork. In the Middle Fork watershed, most of Tony and upper Bear Creek contained mature forest stands over 21 inches in diameter, while other areas had young or mixed age stands due to fire history. In 1901, the primary forest type in the East Fork drainage was a mix of sapling-pole and small tree conifer forest.

Historic photographs, relict trees, landscape features and place names can provide other clues to the nature of vegetation around the time of settlement (Burke 1999). On the drier east side of the lower Hood River valley, pine-oak forests were probably prevalent. Early photographs of Eastside Drive, the vegetation of undeveloped parcels, and a 1930 panoramic photograph taken from Wasco Point attest to this. Large oak trees still exist on the bench of Eastside Drive and relict pines stand near Pine Grove. The middle valley on the east side was certainly dominated by pine-oak stands on all but the north-facing slopes. Large old oak snags persist today beneath the conifer canopies in Booth Hill, the Neal Creek drainage and Fir Mountain. A panoramic photograph taken in the early 1930s from Twin Pine lookout near Neal Creek shows a mature Ponderosa pine forest.

On the west side of the lower valley, the landscape was likely one of more mixed vegetation types due to greater rainfall. Oak patches would have been common along with conifers, maple, alder, and wetland meadow patches. The place name "Oak Grove" attests to the presence of oak woodlands on the west side. (Burke 1999).

Fish Species, Abundance and Distribution

Little information about historic fish populations is available for the pre-1900 period. Pioneer accounts reported trout in Lost Lake, Lake Branch and the West Fork Hood River. Exploration parties in 1878 and 1880 noted that Lost Lake was "alive with trout" at dusk. In less than an hour, one man caught enough 8-12 inch trout from a single pool in Lake Branch to feed 7 people two meals apiece. On October 20, 1899, the Glacier newspaper commented on settler Chris Dethman's fishing luck in the mouth of Neal Creek stating that " his season's catch so far has amounted to 112 fine salmon trout" (Krussow 1989). Pat Moore, valley resident, recalls his grandfather saying that steelhead in Neal Creek were so numerous (circa 1915) that " you could stand there and pitchfork them out". Mr. Moore also remembers a run of searun cutthroat in Shelley Creek, a small tributary entering the Neal Creek on the east bank below Fir Mountain Road bridge at Highway 35. Longtime residents Jerry Routson and David Winans recall large numbers of salmon or steelhead migrating up into the West Fork over Punchbowl Falls even before 1957 fish ladder construction, noting that the scene "resembled Celilo Falls except on a smaller scale" and attracted crowds of tourists on warm weekends. Anadromous fish distribution and diversity was more extensive under historical conditions. Anadromous species reported to occur in the East Fork historically were steelhead, coho, searun cutthroat and Pacific lamprey. Steelhead were documented upstream as far as Cold Springs Creek and could have migrated much further. In the Middle Fork, coho and steelhead were documented upstream to Clear Branch above Pinnacle Creek by the Oregon Fish Commission. Predominant anadromous species in the West Fork were likely steelhead, searun cutthroat, spring chinook and Pacific lamprey.

Riparian, Wetland and Stream Channel Habitat Conditions

Downed wood and debris jams were common in the West Fork Hood River watershed and would have created greater hydraulic and stream habitat complexity than exists currently. As in the West Fork, the potential for large instream wood in the Middle and East Forks was substantially greater under historic conditions due largely to riparian forest composition. Large trees were transported into the stream by natural bank erosion, windfall, landslides, floods and other pathways. These trees formed numerous log jams and obstructions, trapped gravel, created pools and hiding cover for fish and a substrate for fungi, bacteria and invertebrates. Alder, willow and cottonwoods dominated gentler gradient floodplains while conifers dominated the riparian zone in higher gradient areas. Much of the lower East Fork Hood River consisted of a series of wide wetland complexes within a braided stream network where downed logs, side channels and continuous riparian forest stands were common. Little information on beaver was recorded for the Hood River Watershed generally, but beaver ponds were noted as a semi-common, small scale disturbance in the West Fork .

Three main depositional areas of low gradient, broad floodplain in the East Fork were mapped by the MHNF as likely to collect large woody material and allow development of high quality fish habitat. These areas in the East Fork mainstem were (1) between Baldwin and Tilly Jane Creeks; (2) a half-mile upstream of the Pollallie Creek mouth; and (3) from Cold Spring to Robinhood Creek. Two areas of the Middle Fork watershed had similar potential for high quality fish habitat development – (1) the lower mainstem between Tony and Bear Creeks; and (2) the reach of Clear Branch inundated by Laurance Lake. Tributary streams believed to have had large volumes of instream wood and heavy salmonid use were Tony Creek, lower Dog River and the lower East Fork tributaries.

Natural Disturbance Patterns

Natural disturbance types that occur in the Watershed include floods, fires, mudflows, landslides, beaver ponding, and insect and disease epidemics. Evidence suggests that most natural disturbance processes in the West Fork watershed are driven primarily by climate. Stand-replacing fire historically was a large-scale but rare event. Below 4,000 feet, fire return is driven by seasonal drought combined with prolonged drought. A rain-on-snow flood was documented as early as 1887 in Neal Creek (Krussow 1989). Most streams in the West, Middle and East Fork Hood River lie entirely within the rain-on-snow elevation zone, which usually is under 4500 feet, but due to its orientation and the influence of Mt Hood, the entire East Fork watershed is subject to rain on snow flooding (USFS 1996b). Catastrophic landslides and debris flows are common in several upper East Fork Hood River tributaries. These large scale events have significantly affected habitat conditions in affected stream channels, resulting in less instream wood and less mature riparian vegetation than would be found in the absence of such disturbances. One to 25-year floods are frequent in the West Fork and 25–50 year flood events are semi-frequent, as are mass wasting or landslides. These events are a major force in shaping riparian and aquatic habitat conditions. Mudflows in Ladd Creek are a large-scale and semi-frequent to rare disturbance event. Because of shallow, rocky, well-drained soils, climate fluctuations have greater effect on disturbance processes in the Green Point drainage compared to other West Fork subwatersheds. As a result, insect epidemics and rain-on-snow flood events have caused larger scale impacts in Green Point than elsewhere in the West Fork system. Beaver ponding was historically considered a small-scale, semi-rare event in the West Fork and was not noted to occur in the Green Point subwatershed. No other information about beaver ponding elsewhere was found.

Patterns of Land Development and Resource Use

Established trails were used by Native Americans and later by non-Indian settlers as trade routes and access to hunting, gathering and fishing grounds. Native houses were located at the Hood River mouth and at nearby sites. Major trails went from the upper valley to the slopes of Mt. Hood, through prairies and meadows along Surveyors Ridge, up the West Fork Hood River over Lolo Pass, and from Bald Butte to The Dalles. Intentional burning by Native Americans to maintain travel routes and berry patches is well documented. Native Americans maintained huckleberry fields in meadows around Lost Lake and Indian Mountain. They collected camas, bear grass and other plants, hunted deer, elk and other game, and fished in the tributaries and main forks of the Hood River. Temporary camps were set up to collect and prepare foods. Peeled cedars are still found in the East and Middle Forks, the bark of which was used for clothing and basketry.

Sheep herding and cattle grazing was common on the upper slopes of the East Fork in meadow areas during early settlement and continued into the 1950s or later. Around 1880, orchards and strawberry fields began to progress gradually up the valley as acres of forest were transformed into pasture and fruit crops. Camas fields in the upper valley were drained in the 1890s to plant strawberry crops. The results of a Geological Survey in Forest Conditions in the Cascade Range Forest Reserve, Oregon (Langille 1903) were reviewed for this assessment by John Wells of the Hood River Ranger District. Langille said in his report of Township 2 North, Range 10 East in the lower Hood River Valley:

> *"It is all good agricultural land, and is thickly settled below the hills. Most of the timber has been cut, and the land is being cleared at a rapid rate and set to fruit trees or berries."*

In the upper valley, the majority of which is located in Township 1 North, Range 10 East, Langille wrote:

> *"The greater part of it is comparatively level land, well adapted to agriculture and fruit growing, and all of the areas except the hills along the eastern side [Surveyors Ridge] and in the northwestern sections are located upon, and the work of clearing is going on as rapidly as the circumstances of the settlers will permit."*

Extensive fires of 1,000 acres or more were intentionally set by homesteaders in the lower East Fork valley. The use of drain tiles and ditches to drain wet areas for agriculture and roadways was extensive and continues to the present. Many wetlands and stream channels have been drained or diverted to reduce saturated soil conditions. Roads were constructed adjacent to and across streams. Possibly the biggest factor altering the vegetative pattern in the lower Watershed was the growth of the fruit industry, where orchards have replaced coniferous forest and riparian habitat networks (USFS 1996b).

Beginning in 1861, water-powered sawmills, dams and mill ponds operated in Neal Creek, the East Fork Hood River at Hines Dam, Hood River and in Green Point Creek. At the same time, streams began to be diverted into hand-dug irrigation canals and ditches. Logs were transported in river channels or by flumes, horse teams and later railroads. By 1909, Powerdale Dam was built across the lower Hood River to generate hydroelectric power. By 1913, the area around Parkdale had been logged and the flat land between the East and Middle Forks was being cut. Timber harvest did not begin in the East Fork on National Forest lands until 1940s, where historic logging focused mainly on mature stands within the Pocket, Culvert, Engineers and Dog River drainages. While headwater areas have been subject to less alteration, management activities have significantly altered the lower East and Middle Fork watersheds. The availability of contiguous mature forest habitat in the East Fork watershed has been reduced by management-related fragmentation.

Historic timber harvest has resulted in fish habitat with fewer pieces of instream wood and less variation in water velocity and substrate sizes than that which once existed. Extensive use of splash dams is well documented in the Hood River watershed through the 1940s. During the 1960s and 1970s, stream clean out was an encouraged practice and was believed to benefit fish passage. All large instream and riparian wood was cleared from the East Fork Hood River channel between Robinhood and Sherwood campgrounds as recently as 1979. In much of the watershed, the structural habitat capable of supporting historic population levels of anadromous fish is limited today. The loss of the former natural wood supply into stream channels has resulted in higher flood velocities, less interaction between streams and floodplains, and a deficiency of pool habitat. This lack of instream wood and slow water areas makes it difficult for gravel to deposit and be retained in the low-water channel where it is needed for spawning. As a result, many channels in the Watershed are deficient in gravel substrate suitable for spawning. Portions of channels in the West Fork watershed have cut down to bedrock and are disconnected from their floodplain. Down cutting, floodplain abandonment, channel widening and agradation is visible in the East Fork Hood River suggesting a stream system out of balance.

Visitor use of the National Forest has multiplied due to regional population growth and the increasing popularity of outdoor recreation including hiking, angling, whitewater kayaking, mountain biking, skiing, snowboarding, backcountry snow sports, off-road motorcycling, camping and general tourism. Residential development activity is increasing within the watershed.

Historical Conditions Outline

- **10,000 years ago to present:** Indian people living in Hood River watershed and use its natural resources
- **1830s:** Hood River named Dog River when cattlemen stranded by river ate dogs to stave off hunger
- **1854:** Nathaniel Coe and family first settlers to remain in Hood River. Mary Coe changes name of Dog River to Hood River
- **1855:** Indian lands in Hood River watershed ceded to U. S. in Treaty with Tribes of Middle Oregon
- **1858 to 1861:** First homesteaders in towns of Mt. Hood and Dee
- **1861:** First sawmill in valley built on Neal Creek at Dethman Ridge Road with dam and log pond
- **1870:** Census lists 85 residents in Hood River
- **1876:** Water Supply Company of Hood River acquires water rights to Dead Point Creek
- **c.a. 1879:** Fire burns 2000 to 3000 acres on Lost Lake Butte eastward
- **1887:** Flood in Neal Creek after Chinook rain on deep snowpack destroys sawmill at Dethman Ridge Road. Dam operates as feedmill until 1903.
- **1890s:** Flume built in West Fork Hood River for logging and irrigation.
- **1895:** East Fork Irrigating Company forms
- **1897:** Farmers Ditch completed. Rainy Lake dammed, flume built to Green Point Mill. Timber harvest begins on Mt. Defiance
- **1901:** Splash dams constructed in East Fork
- **1898-1903:** Log drives down East & West Forks to Lost Lake Lumber Co. Mill at Hood River mouth
- **1905-1908:** Hood River Irrigation Co. files water rights in Green Point drainage, reforms as Farmers Irrigation Co. and constructs Lowline Ditch
- **1906:** Oregon Lumber Co. builds Hines Dam across the lower East Fork for sawmill at Dee. Timber harvested from Dee Flat, cut-over land sold for orchards. Mt Hood Railroad completed to Dee
- **1907:** State fishing license required, limit set at 125 trout per day
- **1908:** Oregon National Forest created by new USDA Forest Service
- **1916-1918:** Forest Service conducts 7,000-acre sale along the West Fork appraised at 480 MBF. Railroad logging begins in National Forest
- **1920:** State fish hatchery built on Dead Point Creek
- **1923:** Powerdale Dam constructed across Hood River at river mile 4.5
- **1925:** Highway 35 built in East Fork Hood River floodway channel
- **1930 to 1940s:** Lower Green Point Creek splash-dammed to drive logs
- **1933:** Large flood in Hood River
- **1950s:** Era of intensive clearcutting begins in Forest Service
- **1957:** Punchbowl Falls laddered to improve upstream fish passage
- **1961:** September flash flood in Ladd Creek transports huge sediment load killing juvenile and adult steelhead. Creek mouth moves one mile upstream
- **1964:** Christmas Flood measures 33,000 c.f.s. at Tucker Bridge
- **1966:** Hines Mill Dam breached
- **1969:** Clear Branch Dam and Laurance Lake Reservoir constructed
- **1960s to 1971:** Native spring chinook become extinct
- **1971:** Skyhook fire burns 3,000 acres in Green Point drainage
- **1972:** Timber harvest doubles on National Forest, intensive road building era begins
- **1979:** Timber salvage operation removes all instream wood in East Fork Hood River from Robinhood to Sherwood campgrounds
- **1980:** Polallie Creek slide and dam-break flood. Massive debris flow sends 100,000 CY of material into East Fork causing one fatality. Portions of Highway 35 realigned, $13 million in damage
- **1985:** Moving Falls fish ladder built in West Fork near river mile 3.7 at falls formed by downcutting
- **1994:** Northwest Forest Plan amends forest management plans within northern spotted owl range
- **1996:** February flood measures 23,000 c.f.s. at Tucker Bridge. East Fork Irrigation District builds fish screen on East Fork diversion

Historical Conditions - Key Findings

- The diversity, abundance and distribution of fish species in the Hood River Watershed were much greater historically than today.

- Natural disturbance events historically occurring in the Watershed include rain on snow floods, dam-break floods from glacial lakes, fire, landslides, mud and lava flows, beaver ponding, insect and disease epidemics.

- Native Americans maintained huckleberry fields and trails, collected plants, hunted game and fished in the Watershed, and kept houses at the Hood River mouth and vicinity. The Hood River Watershed was included in the one million acres of land ceded to the U.S. in the 1855 Treaty with the Tribes of Middle Oregon by the ancestors of the Confederated Tribes of the Warm Springs Reservation.

- Around 1880, orchards and strawberry fields began to progress up the valley as the natural landscape pattern of conifer forest and riparian habitat was transformed into pasture and fruit crops. Drainage of wet areas for agriculture and other land uses has occurred throughout much of the valley.

- Water-powered saw mills, dams and mill ponds operated in Neal and Green Point creek, and the lower East Fork and mainstem Hood River as early as 1861. Logs were transported in rivers or by flumes, horse teams and later railroads. Before 1900, streams began to be diverted into canals and ditches for irrigation.

- Historic timber harvest cleared streams and riparian corridors of fallen trees and large woody debris that formerly created productive fish habitat. Use of splash dams occurred through the 1940s. During the 1960s and 1970s, cleaning wood out of streams was encouraged and believed to help fish passage. Riparian areas were logged right down to the streambanks. These activities have had long-lasting effects. Currently, a shortage of large instream wood causing a scarcity of deep pools, hiding places and slow-moving water areas for young fish., and retention of spawning-size gravel in stream beds.

- Visitor use of the Watershed has multiplied due to population growth and increasing outdoor recreation and tourism. Conversion of forest and pasture to residential development is occurring. These land use trends are expected to continue.

Although restoration to a fully natural watershed is not expected or possible, an awareness of historic habitat conditions can help guide watershed protection and restoration actions.

3. CHANNEL HABITAT TYPES IN THE HOOD RIVER WATERSHED

Introduction

The Oregon assessment method uses the channel structure of a stream to evaluate restoration potential and effects of land use practices. The Oregon Watershed Assessment Manual presents a classification system to divide streams into "channel habitat types" in order to evaluate habitat conditions and productive potential (Watershed Professionals Network 1999). This classification system uses features such as valley shape, degree of confinement, gradient, substrate, channel pattern and geology and is illustrated in Figure 3-1. Its most influential factors are stream gradient and channel confinement.

Each channel habitat type has predictable attributes that influence fish use, sensitivity to disturbances, and the potential for improvement and recovery (USFS 1996a). Gradient determines whether a particular stream reach (i.e., segment) is predominantly a *deposition, transport*, or *source* area for sediment and large woody debris. Low gradient reaches (less than 2%) are depositional zones for woody debris and sediment, including spawning gravel. Depositional areas are highly productive for fish. The primary spawning and rearing habitat used by anadromous fish typically occurs in areas averaging less than a 2% gradient (NPPC 1990). Moderate gradient reaches (2-4 %) are transitional transport areas for sediment and wood and are moderately productive for fish. High gradient reaches (4-10%) are transport zones with only a fair productivity for fish, but high productivity for amphibians. Reaches with gradients over 10% are often not naturally fish-bearing (USFS 1996a).

Many stream segments in the Watershed are *confined* between hillslopes, bedrock canyons, or terraces that restrict the streams lateral movement and prevent development of meanders and wide floodplains. Lateral movement affects habitat quality and is also of prime concern to land managers (Watershed Professionals Network 1999).

	UNCONFINED		VARIABLE CONFINE-MENT	CONFINED						
Channel Habitat Type SYMBOL	FLOODPLAIN MED/ LG SMALL STREAMS **FP2, FP3**	ALLU-VIAL FAN **AF**	MODERATE TERRACE /HILLSLOPE CONFINEMENT **MM**	LOW GRADIENT CON-STRAINED **LC**	MODERATE GRADIENT CON-STRAINED **MC**	MODERATE-LY STEEP, NARROW VALLEY **MV**	BEDROCK CANYON **BC**	STEEP HEAD-WATER **SV**	VERY STEEP HEAD-WATER **VH**	MODERATE GRADIENT HEAD-WATER **MH**
Valley Shape	Broad, well-defined floodplain	Trans. between hillslope and valley floor	Broad valley; moderately confined between terraces and/or open to mod V-shape valley	Low to moderate gradient hillslopes, limited floodplain	Gentle to narrow v-shape valley, minimal floodplain	Narrow moderate V-shape valley; narrow floodplain	Very narrow steep v-shape valley	Steep v-shape	Steep v-shape	Open v-shape; gentle-to mod. land forms, broad divides
Channel Pattern	Meander-ring, single occasion-ally split channel	Single to multiple channel in fan pattern	Single channel, low sinuosity to relatively straight; braided w/high sediment supply	Single channel; low sinuosity to straight	Single, rel. straight or conforms to hillslope	Single channel, relatively straight, same as valley	Straight	Relativ. straight ; same as valley	Relativ. straight	Low sinousity straight
Profile Position in Drainage										
Gradient	<2%	2 -12%	1- 6%	<2%	2-4%	3-10%	4 - >20%	8 -16%	>16%	1-6%
Substrate Size	Gravel & sand to cobble	Gravel to small boulders	Large gravel to small boulders; bedrock	Boulder, cobble, bedrock, pockets of gravel/cob	Coarse gravel to bedrock	Cobble, boulder, bedrock	Bedrock; large boulders	Boulder, cobble bedrock	Boulders, bedrock	Variable; wetland peat to boulders
	SEDIMENT DEPOSITION			**SEDIMENT TRANSPORT**				**SEDIMENT SOURCE**		

Figure 3-1. Oregon channel habitat type classification scheme for the Hood River (adapted from Watershed Professionals Network, 1999)

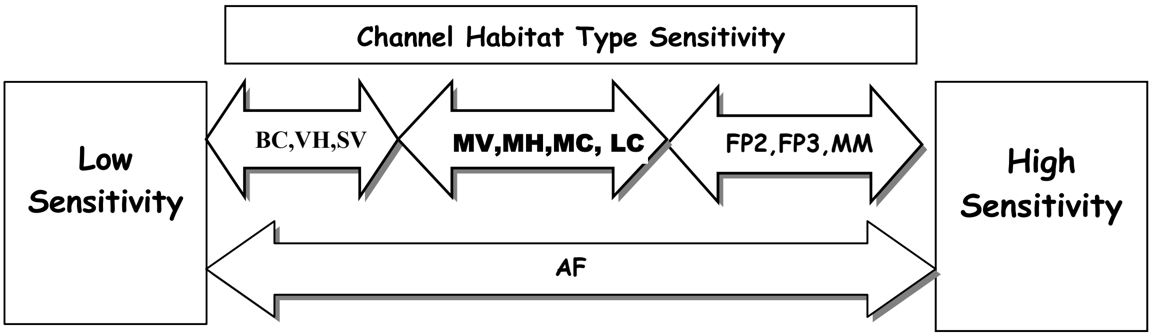


Figure 3-2. Channel habitat type sensitivity to land management activities and restoration efforts (adapted from Watershed Professionals Network 1999).

Different channel types vary in how they adjust to changes in flow, sediment, woody debris and other inputs, and some channel habitat types are more sensitive to land use activities and restoration activities than others (Figure 3-2 and Table 3-1). More responsive areas are most likely to show physical changes in channel pattern, location, width, depth, sediment storage, bed roughness from land use effects and from restoration attempts. Research indicates that high gradient, highly confined channels are more resistant to human impacts including timber harvest and woody debris additions than lower gradient reaches (USFS 1996a). Most low to moderate gradient, unconfined to moderately confined areas respond well to large woody debris additions to create habitat. As a result, the USFS recommended that lower gradient areas be prioritized for this kind of habitat restoration.

Table 3-1. Channel response descriptions (adapted from Watershed Professionals Network 1999).

Sensitivity Rating	Large Woody Debris	Fine Sediment	Coarse Sediment	Peak Flows
High	Critical element to maintain channel form, pool formation, gravel trapping/sorting, bank protection	Fines are readily stored. Increases in sediment input result in pool filling and loss of bed form complexity.	Bedload deposition dominant active channel process; channel widening, general decrease in substrate size, conversion to plane bed 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 that contributes to pool formation and gravel sorting.	Increases in sediment would result in minor poor filling and streambed changes.	Slight change in overall morphology, localized widening and shallowing	Detectable changes in channel form, minor widening and scour.
Low	Not a primary element, often found only along margins	Temporary storage only. Most sediment is transported through with little impact.	Temporary storage only. Most sediment is transported through with little impact.	Minimal change.

Methods and Results

Channel habitat types were delineated for 384 miles of perennial stream using topographic maps, ODFW stream surveys, USFS Watershed Analysis or survey information, Department of Forestry stream size maps, consultation with local and regional experts, and some field verification. Channel types and associated data were recorded in an Excel spreadsheet and mapped (see Appendix). Local geology confounded the classification of elongated glacial outwash channels found on Mt Hood including Ladd, Newton, Clark and Robinhood creeks. While these channels lack a classic alluvial fan shape, the Alluvial Fan (**AF**) category was recommended as the best fit within the Oregon classification system (Denman and Raines, Watershed Professionals Network, *pers. comm*).

Eleven channel habitat types were identified in the Hood River Watershed. In order of prevalence, these are **SV** (steep headwater confined), **MV** (moderately steep, narrow valley), **VH** (very steep headwater), **MM** (moderate-gradient moderately confined), **MC** (moderate-gradient constrained), **AF** (alluvial fan), **MH** (alpine meadow), **FP3** (floodplain small stream), **LC** (low-gradient constrained), **FP2** (floodplain, medium size stream) and **BC** (bedrock canyon). In addition, reservoir inundates an estimated 1.4 miles of stream habitat.

Low and moderate gradient stream reaches in the Watershed include five channel habitat types: **MM**, **MC**, **LC**, **FP2** and **FP3**, and **MH**. However, important localized areas of low gradient can occur within channel habitat types with steeper average gradients, for example in those designated as **MV** (moderately steep, narrow valley), **AF** (alluvial fan) or at the mouths of steep streams.

Table 3-2. Summary of channel habitat types for perennial stream channels in the Hood River by 5th Field Watersheds.

5th Field Watershed	FP2	FP3	AF	MM	LC	MC	MV	BC	SV	VH	MH
Mainstem	1.2	4.4	0	12.4	4.3	5.6	22.1	0	15.9	1.8	5.1
West Fork	0	0	2.4	10.8	0	8.0	26.6	1.1	39.6	15.7	1.9
Middle Fork	0	0	5.0	7.4	0	5.4	16.1	0	6.7	14.4	0
East Fork	0	2.3	16.1	28.4	0.8	17.5	27.6	0	22.5	28.3	5.0
Total miles	1.2	6.7	23.5	59.1	5.0	36.6	92.4	1.1	84.8	60.2	12.0
Percent of Basin	<1	2%	6%	15%	1%	10%	24%	<1	22%	16%	3%

Table 3-3. Stream segments reported as especially significant spawning, rearing and adult holding habitat and Channel Habitat Type (CHT) designation.

LOCATION	CHT	SPECIES/ LIFE STAGE	SOURCE
Hood River mouth to Powerdale Dam	MM, MC	Coho spawning Sp. chinook- adult holding F. chinook- spawning S. steelhead- adult holding	French, ODFW* PacifiCorp, 1998
Hood River- Powerdale Dam to Tucker Park	MM, FP2	Bull trout- adult holding (S. chinook spawning suspected)	Fieldler, USFS* CTWS, 1998
WF Hood R. below Punchbowl Falls	MC	Bull trout- adult holding Sp. chinook –adult holding & spawning S. steelhead – adult holding	Fieldler, USFS*
West Fork Mainstem	MM	Sp. chinook, steelhead - spawning	CTWS, 1998
Lower Lake Branch	BC	Sp. chinook- spawning	CTWS, 1998
Green Point Creek NF Green Point Ck	MV SV	Rainbow trout- rearing & spawning Winter steelhead	Pribyl, ODFW*
Middle Fork Mainstem	MM, MC	Bull trout overwintering	Fieldler, USFS*
Laurance Lake	RESERVOIR	Bull trout rearing	Fieldler, USFS*
Compass and Pinnacle Ck	MC, SV, AF	Bull trout rearing	Fieldler, USFS*
East Fork Mainstem below Dog River	MM, MC	W. Steelhead spawning and rearing	Pribyl, ODFW*
Robinhood Ck	AF	Cutthroat- rearing and spawning	ODFW

* *pers. comm*

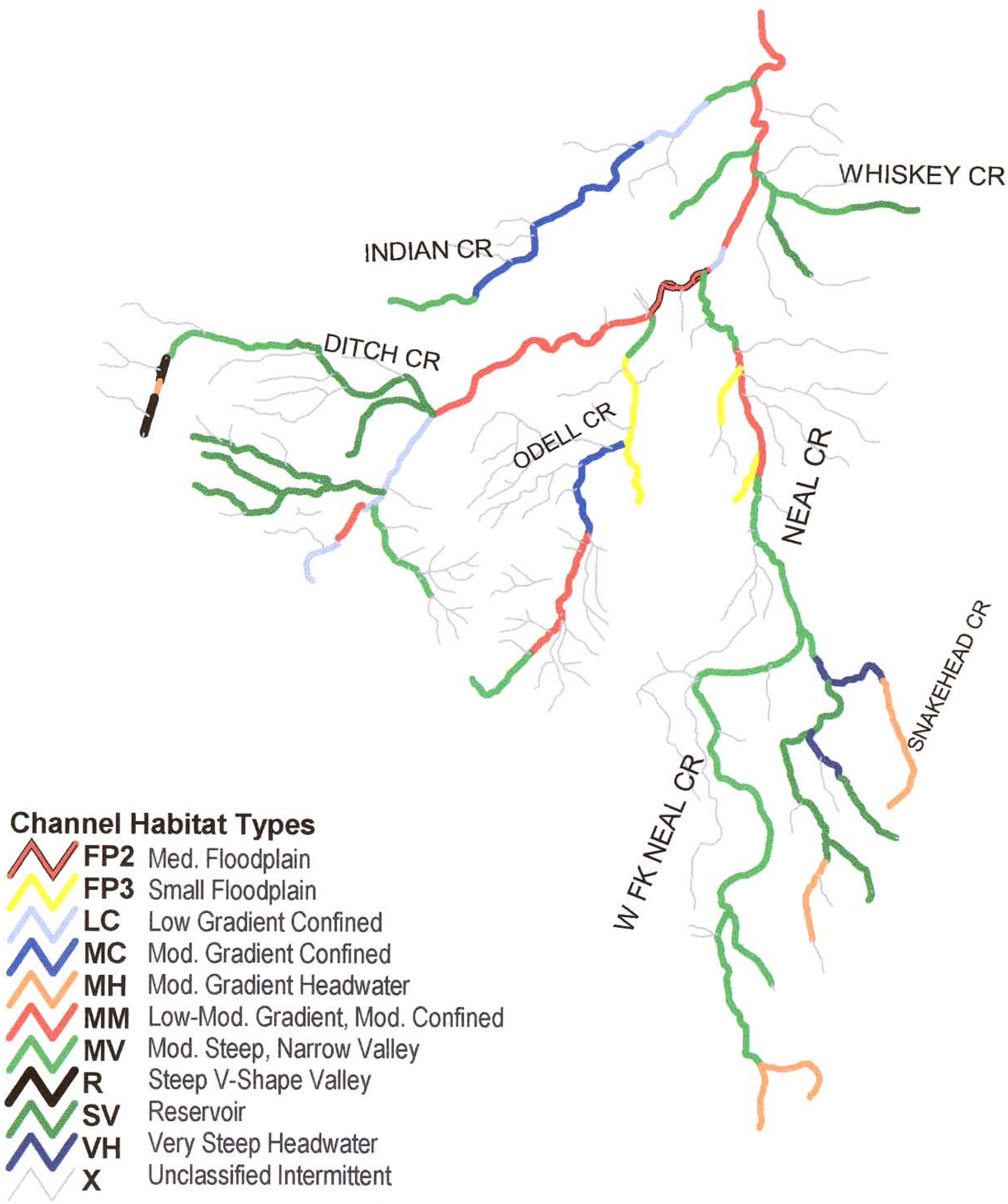


Figure 3.2. Channel habitat types designated for Mainstem Hood River watershed streams per the Oregon Watershed Assessment Manual classification (Watershed Professionals Network, 1999, and Nonpoint Source Solutions, 1997). Refer to Figure 3-1 table for full descriptions.

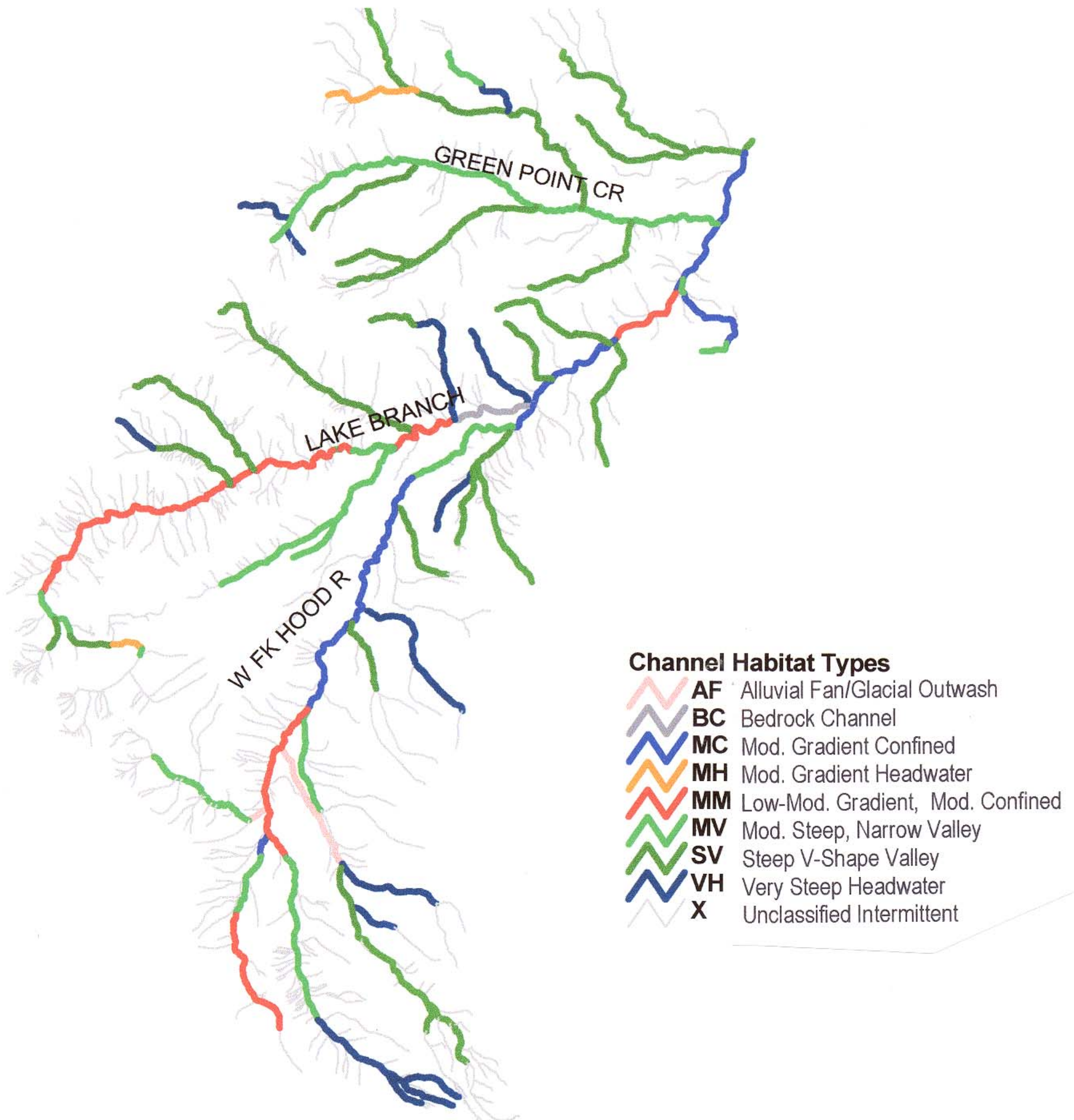


Figure 3.3. Channel habitat types designated for the West Fork Hood River watershed streams per the Oregon Watershed Assessment Manual classification (Watershed Professionals Network, 1999, and Nonpoint Source Solutions, 1997). Refer to Figure 3-1 table for full descriptions.

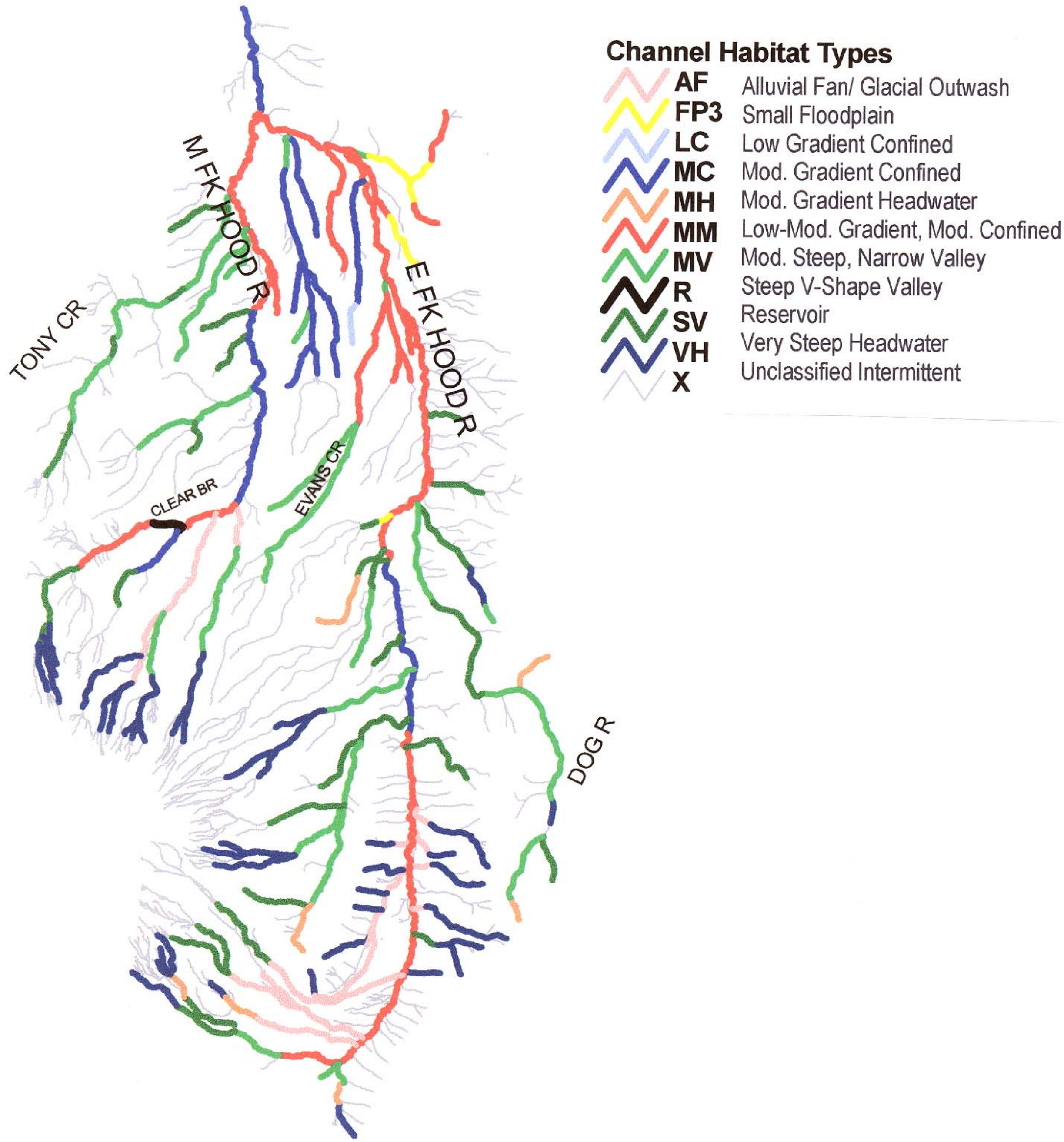


Figure 3.4. Channel habitat types designated for Middle Fork and East Fork Hood Riverwatershed streams per the Oregon Watershed Assessment Manual classification (Watershed Professionals Network, 1999, and Nonpoint Source Solutions, 1997). Refer to Figure 3-1 table for full descriptions.

Channel Habitat Types - Key Findings

1. Eleven channel habitat types were identified using the OWEB classification scheme and are given below in order of their prevalence in the Hood River Watershed:
   - **MV moderately steep, narrow valley**
   - **SV steep headwater**
   - **VH very steep headwater**
   - **MM low-to-moderate gradient, moderately confined by terrace/hillslope**
   - **MC moderate gradient constrained**
   - **AF alluvial fan**
   - **MH moderate gradient headwater**
   - **FP3 floodplain small stream**
   - **LC low gradient constrained**
   - **FP2 floodplain medium/ large stream**
   - **BC bedrock canyon**

2. Most fish bearing channels in the Watershed are confined by hill slopes or terraces and have a limited floodplain area. Of the total stream length, 77% is made up of habitat types classified as *confined*.

3. Forty one percent of the total stream length consists of habitat types classified as a *sediment source*, 36% as *sediment transport*, and 23% as s*ediment deposition* zones.

4. Lower gradient and unconfined to variably-confined stream segments are important depositional areas for wood and sediment. These areas have the greatest potential for high quality fish habitat development. Channel habitat types with these characteristics in the Hood River Watershed are **MM** (59 miles) **, FP2/ FP3** (8 miles), and **AF** (23.5 miles).

5. While **MM** channels most likely serve as the primary spawning and rearing habitat in the Watershed, pockets of important spawning and rearing habitat occur within other habitat types such as **MC, BC, MV, LC, AF.**

<u>Notes</u>

- Narrow glacial outwash channels, such as Robinhood, Clark, and Coe Branch on the slopes of Mt Hood slopes do not easily fit in the Oregon classification system.

- Small floodplain stream channels were sometimes difficult to categorize due to channelization or entrenchment.

4. Fish Population Status and Distribution

Anadromous Fish

Introduction

Anadromous salmonids present in the Hood River Watershed include chinook (*Oncorynchus tshawytscha*) and coho salmon (*O. kisutch*), sea run cutthroat trout (*O. clarki*) and steelhead trout (*O. mykiss iridius*). Pacific lamprey (*Lamptera tridentata)* are present below Powerdale Dam although none have been documented upstream in since the 1960s. Trap counts, catch data, anecdotal and historic accounts indicate that anadromous fish populations in the Hood River are less diverse and are severely depressed compared to historic levels. Since 1992, all adults migrating upstream into the Hood River have been trapped at Powerdale Dam (river mile 4.5) on a continuous basis by ODFW. Trap counts were made at the dam between 1963 and 1971 but these records are not complete (Pribyl, ODFW, *pers com*). Hood River indigenous coho, spring chinook and fall chinook stocks are extinct, and steelhead were listed as Threatened under the Endangered Species Act in 1998. Little is known about the status and distribution of sea run cutthroat trout.

An estimated 100 miles of stream in the Hood River Watershed are currently accessible to anadromous fish. In addition to the Mainstem and Forks, major tributaries accessible to anadromous fish include Green Point, Lake Branch, Ladd, Tony, Evans, Neal Creek and Dog River. A computer model developed by the Northwest Power Planning Council estimated the natural production potential of existing watershed habitat to be 24,000 spring chinook, 32,000 summer steelhead and 31,000 winter steelhead smolts annually (ODFW and CTWS 1990). The current smolt production is much lower - the total wild steelhead smolt outmigration was estimated at 6,313 to 13,222 per year between 1994 and 1997 (Olson and French 1998). The 1998 outmigration was notably higher - an estimated 24,485 wild steelhead smolts left the system by mid-June (ODFW, unpub. data, 1999).

Hood River Production Program Description

The Hood River Production Program (HRPP) is a major salmon and steelhead recovery effort initiated in the Hood River system in 1991. The HRPP is part of a program funded by the Bonneville Power Administration to mitigate impacts of the Columbia River hydrosystem on anadromous fish. The HRRP is jointly implemented by ODFW and CTWS. Its goals are to (1) establish naturally self-sustaining spring chinook salmon population in the Hood River subbasin using Deschutes River stock; (2) rebuild naturally self-sustaining runs of summer and winter steelhead; (3) maintain the genetic characteristics of wild anadromous populations; (4) restore degraded fish habitat; and (5) contribute to tribal and non-tribal fisheries, ocean fisheries, and the Northwest Power Planning Council interim goal of doubling Columbia Basin salmon runs (CTWS 1998). Monitoring and evaluation is a central program element and includes adult and juvenile trapping, creel surveys, spawning surveys, electrofishing, adult radiotracking and genetic sampling (BPA 1996). Key facilities are a fish ladder trap at Powerdale Dam and an adult holding and acclimation facility near Parkdale. Six rotary "screw" traps are sampled daily from March to November to monitor natural and hatchery smolt production from each part of the Watershed.

A small number of wild, native-origin summer and winter steelhead returning to the Hood River are taken for propagation. Annual smolt releases consist of 125,000 spring chinook salmon, 40,000 summer steelhead and 50,000 winter steelhead. Incubation and extended rearing occurs at hatchery facilities in the Deschutes River Basin, after which the smolts are transported to the Hood River where they are acclimated for 1-2 weeks at upriver sites and volitionally released. Spent hatchery carcasses are distributed in the upper Watershed to benefit the aquatic and terrestrial food chain.

Early-action habitat restoration projects have been completed under the HRPP and include riparian livestock fencing, bank stabilization and modifications to water diversion facilities. The combination of HRPP smolt supplementation and habitat restoration is intended to achieve the full natural and hatchery production potential of the Hood River Watershed (Lambert, CTWS, *pers comm*).

Table 4-1**.** Hood River Production Program Annual Goals for Returning Adults

Species	Wild or Natural	Hatchery
Spring chinook	400	1,300
Winter Steelhead	1,200	3,800
Summer Steelhead	1,200	6,800
Fall Chinook	1,200	N/a
Coho	600	N/a

Winter Steelhead

Population Status

Winter steelhead are native to the Hood River. The population includes both wild and hatchery fish. Steelhead were listed as Threatened under the Endangered Species Act in March 1998 along with genetically similar steelhead in the Lower Columbia Basin. From 1962 -1976, fingerling releases of Nestucca and Alsea stocks were made periodically (ODFW 1998) while from 1978-1986, Big Creek stock smolts were released. Since 1991 however, all hatchery releases have been the progeny of wild Hood River stock. As of the 1991-92 return year, only Hood River-origin winter steelhead are allowed above Powerdale Dam to spawn. Hood River steelhead are incubated and reared in Deschutes Basin facilities and volitionally released as full-term smolts into the East and Middle Fork Hood River after acclimation. In the East Fork, CTWS in cooperation with East Fork Irrigation District has used a section of the East Fork sand trap facility to acclimate steelhead since 1998. On the Middle Fork, part of the Parkdale Fish Facility is also used for winter steelhead acclimation. The first acclimated smolt releases in the Middle Fork occurred in 1999.

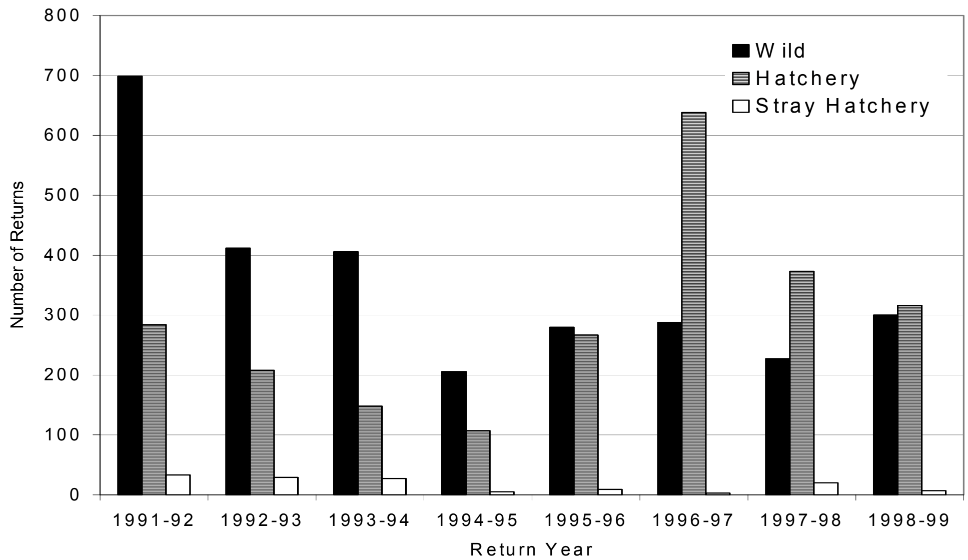


Figure 4-1. Winter steelhead returns to Powerdale Dam, 1992 -1998.

Winter Steelhead Spawning Distribution and Timing

Winter steelhead enter the Powerdale Dam fish trap beginning in December and continue through June. The median migration date (50% complete) is from mid April to mid May. The hatchery run timing tends to mirror the natural run timing (Newton, ODFW, *pers. comm*). Spawning occurs from February through June. Winter steelhead spawn primarily in the East and Middle Fork watersheds, and in Green Point Creek in the West Fork. Radiotagged winter steelhead have been detected in Neal Creek up to its West Fork confluence. Winter steelhead also spawn in the bypass reach below Powerdale Dam (ODFW 1995). Historically, steelhead were present in the East Fork Hood River at least up to Cold Spring Creek near river mile 16.5 or higher. In the Middle Fork, steelhead were likely found upstream to Clear Branch above Pinnacle Creek (USFS 1996b).

Summer Steelhead

Population Status

Summer-run steelhead are native to the Hood River. The population includes wild and hatchery fish as a result of smolt releases starting in 1958 (ODFW and CTWS 1990). Hood River steelhead are considered *depressed* by ODFW and CTWS, and were listed under the ESA in March 1998 as a Threatened Species. Return estimates from the 1960s indicate that several thousand summer steelhead returned to Hood River each year. Between 1980 and 1990, the annual sport harvest of summer steelhead ranged from 2,406 and 4,455 (O'Toole and ODFW 1991). A locally-adapted Hood River summer steelhead run is being developed from returning wild fish collected at the Dam. The first group of Hood River stock hatchery summer steelhead releases was made in 1999. Non-indigenous, i.e., out of basin stock hatchery summer steelhead have not been allowed above Powerdale Dam since August of 1997. Approximately 19,500 smolts were acclimated and volitionally released from a portable acclimation raceway on the upper West Fork Hood River. Approximately 40,000 Skamania stock hatchery smolts are released annually below the dam to provide fishing opportunity.

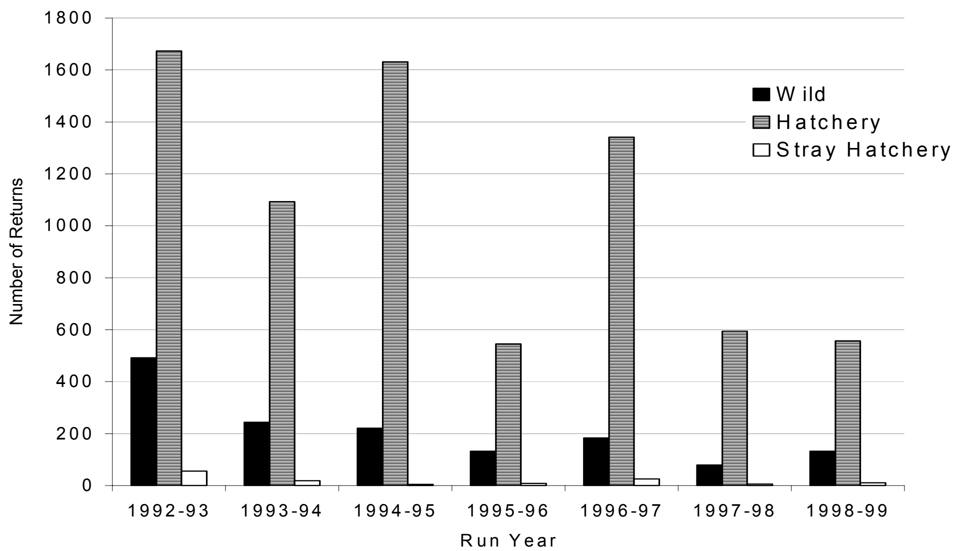


Figure 4-2. Summer steelhead returns to Powerdale Dam, 1992-1998.

Summer Steelhead Spawning Distribution and Timing

Summer steelhead begin entering the Powerdale fish ladder in the last two weeks of March. The median migration date occurs during July for the wild run and from late June to early July for the hatchery run (Olson and French 1996). Summer steelhead spend up to a full calendar year in the Hood River prior to spawning. Spawning occurs from mid-February through early April, with the typical peak spawning period during March. Summer steelhead spawn primarily in the West Fork watershed and the Hood River mainstem. Summer steelhead also spawn in the bypass reach below Powerdale Dam (ODFW 1995). Naturally spawning summer steelhead are thought to be predominately from native stock (O' Toole and ODFW 1991).

Spring Chinook Salmon

Population Status

The Hood River native spring chinook run has been extinct since the early 1970s (CTWS and ODFW 1991) and was officially declared extinct in 1991 by ODFW. From 1986 to 1990, releases of spring chinook from Carson hatchery broodstock were made in the Hood River. Current natural production is limited (BPA 1996). An effort is underway to establish a locally-adapted spring chinook run in the Hood River using Deschutes River stock. Deschutes River spring chinook smolt releases began in 1993 and were released at Dry Run Bridge in the West Fork from an ODFW liberation truck. Starting in 1996, CTWS began acclimating and volitionally releasing 125,000 spring chinook smolts using portable raceways. In 1999, a portion of these smolts were acclimated on the Middle Fork and volitionally released from the Parkdale Fish Facility.

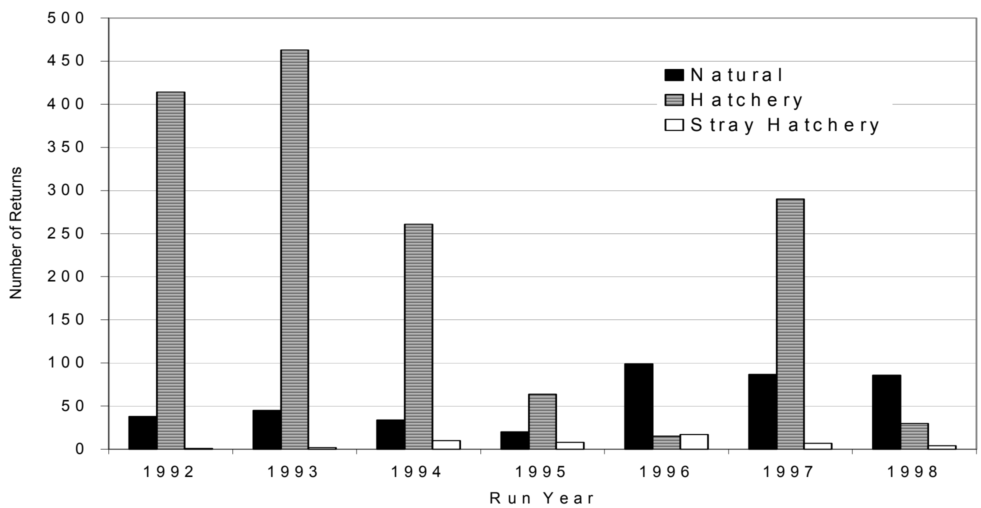


Figure 4-3. Spring chinook returns to Powerdale Dam, 1992-1998. Source: Olson and French 1999

Spring Chinook Spawning Distribution and Timing

Spring chinook enter the Hood River from approximately April to September. Spawning occurs from mid-August through late September. Spring chinook spawning is documented in the West Fork Hood River and Lake Branch Creek, but may occur in additional areas. In 1997, spawning surveys conducted by the CTWS estimated 48 spring chinook redds in the West Fork watershed, with the highest concentrations in lower Lake Branch, the West Fork Hood River below Punchbowl Falls, and from Ladd Creek upstream to Elk and McGee Creeks (CTWS 1998). Because only 48 redds were found while 158 female and 90 male spring chinook passed Powerdale Dam, the 1997 survey suggests that spawning may occur in the mainstem Hood River (CTWS 1998). Chinook juveniles have been found in lower Elk Creek and in lower Neal Creek during electrofishing surveys by ODFW and CTWS.

Fall Chinook Salmon

Population Status

Fall chinook are native to the Hood River and occur in low numbers. Indigenous fall chinook are extinct and current natural production is believed to be the progeny of hatchery strays. Between 1992 and 1998, fall chinook escapements to the Powerdale trap have ranged from 6 to 36 naturally-produced fish with 2 to 7 hatchery strays (Olson and French 1999). No hatchery releases of fall chinook are made in the Hood River.

Fall Chinook Spawning Distribution and Timing

Natural fall chinook enter the Hood River from early July through October, and spawn in late September through early November. The majority of fall chinook entering the Hood River spawn below Powerdale Dam, with some spawning in the East Fork Hood River (BPA 1996). Juvenile chinook have been found in Neal Creek.

Coho Salmon

Population Status

Coho salmon are native to the Hood River and are present in low numbers. Hood River and lower Columbia River coho are classified as a sensitive species by ODFW. The indigenous population of coho salmon is determined to be extinct by ODFW (BPA 1996). For the 1992 to 1998 run years, coho salmon escapements to Powerdale Dam ranged from 0-24 naturally produced fish and from 6-79 hatchery strays (Olson and French 1996). Natural coho returning to the Hood River are believed to be the progeny of hatchery strays. Hatchery coho juveniles were released in the basin in 1967, 1971 and 1977. Coho juveniles have been found in the East Fork Hood River, East Fork Irrigation Canal fish salvages, Baldwin, Neal, and Lenz creeks and the Hood River mainstem (Olsen et al. 1996).

Coho Spawning Distribution and Run Timing

Coho enter the Hood River from September to December (ODFW 1998). Coho spawn in the Hood River mainstem above and below Powerdale Dam, in the mouth of Whiskey Creek, in Neal Creek, the East Fork Hood River and its tributaries and the Middle Fork Hood River. Adult coho have been observed in Dog River. Coho spawning distribution in the watershed was likely more extensive under pre-development conditions than it is today. Coho spawning was documented during the mid-1960s in Clear Branch within the stream reach now inundated by Laurance Lake (USFS 1996b). An early account in the Glacier newspaper October 20, 1899, reported “salmon trout” caught in the mouth of Neal Creek in October (Krussow 1989), suggesting that coho used Neal Creek in larger numbers. East Fork tributaries such as Evans, Emil, Griswell, and Wishart Creeks potentially support some coho spawning and/or rearing.

Sea-Run Cutthroat Trout

Population Status

Coastal cutthroat trout are native to the watershed, and are most numerous as resident fish in the upper tributaries of the East Fork. The anadromous form of cutthroat may be severely depressed in the Hood River. Juvenile plants of sea-run cuthhroat from various hatchery stocks were made in the watershed between 1973-1988 (BPA 1996). Sea-run cutthroat are listed as a sensitive species by ODFW. In 1992, five adult sea run cutthroat trout passed Powerdale Dam and three were counted by ODFW in 1997, otherwise recent returns have been zero. In 1995 and 1996, only 16 and 24 downstream migrant cutthroat were captured in the migrant traps.

Sea-run Cutthroat Trout Spawning Distribution and Timing

The present or historic spawning distribution of sea-run cutthroat trout is unknown. One anecdotal account suggests a large run of sea run cutthroat trout used Shelley Creek in the early part of the century (P. Moore, Moore Orchards, *pers. comm).* Shelley Creek is a small eastern tributary to Neal Creek a quarter mile below the Fir Mountain Road bridge.

River Lamprey

Pacific lamprey (*Lamptera tridentata)* are an anadromous fish and a culturally important food to Native Americans. A 1963 Oregon State Game Commission report noted that lamprey were found “throughout the basin” (USFS 1996a). It is believed that their numbers have declined dramatically compared to historic population levels (BPA 1996). Lamprey are reported as extirpated from the West Fork watershed (USFS 1996a). Lamprey have been observed in recent years below the Powerdale Dam (PacifCorp 1998; Jennings, CTWS, *pers. comm*).

Resident Salmonids

Bull Trout

Bull trout (*Salvelinus confluentus*) are native to the Hood River Watershed and are a species of special concern. Bull trout were listed under the Endangered Species Act as a Threatened Species in 1998. DNA analysis found that Hood River bull trout are genetically distinct from other bull trout in Oregon (Spruell and Allendorf 1997). The Hood River bull trout population, including juveniles, is believed to number less than 300, and is classified as "*at high risk of extinction*" by ODFW (Buchanan et al. 1997).

Bull trout are primarily found in the headwater streams of the Middle Fork within the Mt. Hood National Forest. The largest proportion of the population are found in Clear Branch above the Dam and in Laurance Lake itself. Bull trout are also observed in Pinnacle, Compass, Coe, Eliot and lower Clear Branch Creeks. Their narrow distribution in the watershed makes bull trout vulnerable to a catastrophic event such as a major wild fire or volcanic activity affecting the Middle Fork basin (Pribyl et al. 1996).

Since 1991, the Forest Service and ODFW with help from Middle Fork Irrigation District have monitored the number, distribution and life history of bull trout. Information is collected in adult traps at Powerdale and Clear Branch Dams, juvenile migrant traps, snorkel surveys, and radio telemetry. A Bull Trout Conservation Plan is being prepared by the interagency Hood Basin Bull Trout Working Group, and a Recovery Plan by the U.S. Fish and Wildlife Service is required under ESA. Oregon State Police fisheries enforcement targets bull trout protection along with other species in the Hood River.

Hood River bull trout remain in freshwater throughout their life history and exhibit 3 life history patterns represented by *fluvial, adfluvial* and *resident* fish. A *fluvial* population migrates between small tributaries used for spawning and early rearing, using larger streams such as the main forks, mainstem Hood River and the Columbia River for late juvenile or adult rearing. An *adfluvial* population spawns and rears in small streams and uses Laurance Lake for late or adult rearing. *Resident* bull trout generally confine their migrations within their natal stream (Buchanan et al. 1997).

Adult bull trout were captured in low numbers at Powerdale Dam from 1962 to 1971, suggesting that a small fluvial population has existed in the mainstem for years (Pribyl et al. 1995). An adult bull trout was captured in the West Fork at Punchbowl Falls in 1963, while other sightings were made in Evans Creek and Lake Branch in the 1990s. An adult bull trout was radio-tracked in and out of Tony Creek in 1998. Most bull trout trapped at Powerdale Dam eventually move up into the Middle Fork (Fieldler, USFS, *pers comm*).

The majority of the population has become isolated above Clear Branch Dam. The USFS has operated a fish trap at the base of Clear Branch Dam since Spring 1997. Eight adults were captured at this trap between September 2, 1997 and Jan 1, 1998, with the highest catch in October. Starting in 1999, every other fish entering the trap will be passed above the dam. Bull trout can use the dam spillway to migrate downstream when there is surface spill (Feidler 1999). During snowmelt, 300 to 400 c.f.s. is spilled from April until as late as July in high water supply conditions (B. Conners, Middle Fork Irrigation District, *pers comm*). The reservoir outlet is 80 feet deep and is considered unsafe for fish passage.

Table 4-2**.** Peak Counts of Adult Bull Trout Above and Below Clear Branch Dam/Laurence Lake Reservoir. Source: C. Fieldler, USFS, *unp data*.

Year	Upper Clear Branch Creek	Lower Clear Branch Creek
1991	15 + (partial sample)	2
1992	19	2
1993	37	2
1994	6 (+29 at Lake delta)	2
1995	5	1
1996	18	0
1997	20	3
1998	30	0

Table 4-3**.** Adult bull trout captured at Powerdale Dam fish trap. Source: C. Fieldler, USFS, *unp data*.

Year	Count	Recaptured
1992	6	0
1993	2	1
1994	11	1
1995	11	1
1996	18	4
1997	6	1
1998	18	2

Other Resident Salmonids

Native rainbow and cutthroat trout are present in the Watershed, along with mountain whitefish. ODFW and CTWS have sampled fish in 15 tributaries since 1994 to determine species distribution, growth and relative abundance. Since no accurate visual method can distinguish rearing steelhead from resident rainbow trout, the survey categorizes them as "rainbow-steelhead". Rainbow-steelhead were found at all sites except Robinhood Creek, where cutthroat trout were the only salmonid. Tony and Tilly Jane creeks were the most productive sites in the Watershed based on total biomass of rainbow-steelhead and cutthroat, while Green Point Creek has had the highest productivity for rainbow-steelhead with 631 fish per 1000 square meters of stream.

A small, isolated population of genetically-pure interior redband rainbow trout exists in North Fork Green Point Creek (Greg and Allendorf 1995). The redband rainbow trout is listed by the State and the USFS as a sensitive species. The US Fish and Wildlife Service is conducting an ESA status review of interior redband trout throughout its range. Cutthroat are the dominant species in Bear, Tilly Jane and Robinhood creeks. Robinhood Creek has had the highest density of cutthroat trout in the Watershed with up to 610 cutthroat per 1000 square meters of stream (Olsen and French 1996). Cutthroat are common throughout Clear Branch above and below Laurance Lake reservoir. An isolated population cutthroat was recently found above a falls on Clear Branch a few miles above Laurance Lake (Asbridge, USFS, *pers. comm).*

Other Native Fish Species in the Hood River

Sculpin and dace are other indigenous species that occur in the Watershed with sculpin being the most numerous. Along with these, stickleback, northern pikeminnow, and suckers are found below the Powerdale powerhouse at river mile 1.5 (PacifiCorp 1998).

Table 4-4. Distribution of indigenous resident fish in the Hood River Watershed.
Source: BPA Hood River Fisheries Project EIS (DOE/EIS-0241) 3/ 96

Species	Spawning/adult holding areas	Rearing areas or juveniles present
Bull trout	Middle Fork Mainstem Clear Branch Coe Branch and tributaries Pinnacle and CompassCreek	Middle Fork Mainstem Clear Branch Coe Branch and tributaries Pinnacle and CompassCreek
Rainbow trout	Entire subbasin	Entire subbasin
Cutthroat trout	Entire subbasin	Entire subbasin
Mountain whitefish	Mainstem Hood River	East Fork Hood River West Fork Hood River Middle Fork Hood River
Sucker	Below Powerdale Dam	Below Powerdale Dam
Sculpin	Entire subbasin	Entire subbasin
Longnose dace	Unknown	Unknown

Species Interactions

Introduced and exotic (non-native) fish may compete with, predate upon or interbreed with native fish or otherwise alter the aquatic ecosystem. Little is known about the significance or extent of species interactions in the Watershed. Historic and current stocking or introductions are shown in Table 4-5.

Exotic or non-native fishes in the Watershed include brown and brook trout, smallmouth bass, kokanee, and brown bullhead. Brown bullhead have been found in the mouth of Neal Creek. Natural spawning of brown trout has been observed in the Watershed. Recently, smallmouth bass were found in Laurence Lake (Asbridge, USFS, *pers. comm*), the result of an illegal introduction. Brook trout are stocked bi-annually in Rainy, Black, and Scout lakes in the West Fork watershed and have distributed into Gate, Cabin and Dead Point creeks. Brook are found in Lake Branch, Rogers Spring and Tilly Jane creeks (Newton, ODFW, and Jennings, CTWS, *pers. comm*) and in Cold Springs Creek upstream of Tamanawas Falls (Pribyl, ODFW, *pers. comm)*. Kokanee, the non-anadromous form of sockeye salmon, were historically planted in Laurance and Lost lakes. By replacing amphibians as the dominant predator, introduced fish likely have altered the food chain in historically fishless high elevation lakes (USFS 1996a).

Table 4-5. Fish species stocked or introduced in the Hood River Watershed.

Species	**Watershed or Release Location**	**Comments**
Searun Cutthroat	East Fork Hood River	Historical
Rainbow Trout	Lost Lake*, Laurance Lake*, East Fork Hood River, West Fork Hood River, Clear Branch, Middle Fork, Pollallie Creek, Trout Creek	*Current & Historical
Brook Trout	Ottertail**, Black, Rainy, Scout, Lost lakes	Current & **Historical
Brown Trout	High elevation lakes & Lost Lake	Historical
Summer Steelhead	West & Middle Fork Hood River, East Fork Hood River**	Current & **Historical
Winter Steelhead	East Fork Hood River, Tony Cr, Bear Cr, Laurance Lake, Evans Cr, Dog R	Historical
Spring Chinook	West & Middle Fork Hood River	Current
Coho	Lenz Creek, Lost Lake, Clear Branch, Middle Fork Hood River	Historical
Smallmouth Bass	Laurance Lake	Illegally introduced
Brown Bullhead	Neal Creek, and various locations	Poss. escaped from ponds
Kokanee	Laurance Lake, Lost Lake	Historical
Sockeye	Lost Lake	Historical

Sources: USFS 1996a; 1996b, Olsen et al, 1995; Asbridge USFS and Lambert CTWS, pers. comm

Brook trout are observed in Gate and Rainy Creeks which flow into North Green Point Creek. Potential rearing competition between brook and redband rainbow trout in North Fork Green Point is a concern. Since brook trout spawn in the fall when bull trout spawning occurs, potential interbreeding and competition between native bull trout and introduced brook trout is a concern in the Middle and East Forks Hood River (USFS 1996b).

Protection of the genetic integrity of pure strains of rainbow and cutthroat trout is of concern. Pure cutthroat strains exist in upper East Fork tributaries including Dog River, Tilly Jane, Robinhood, Pocket, and Bucket creeks. Pinnacle Creek fish are largely cutthroat with some rainbow hybridization (USFS 1996b). Dog River, Emil, Robinhood, Pocket and Bucket creek cutthroat were found to have the genetic characteristics of pure cutthroat trout (Greg and Allendorf 1995). A relatively isolated interior redband rainbow population is found in North Fork Green Point Creek. Native rainbow and cutthroat trout co-exist naturally in most of the Watershed and appear to have interbred in some streams. Fish with characteristics of both cutthroat and rainbow trout are found but it is not known whether such hybridization is natural or the result of hatchery plants. Genetic samples were taken in 1994 and 1995 to learn more about hybridization between these species (CTWS & ODFW 1996) but that data is not yet available. ODFW stopped stocking rainbow trout into flowing water in the Hood River Watershed after 1996.

The State of Oregon Wild Fish Management Policy prioritizes the protection and enhancement of wild fish over hatchery fish. Each fish trapped at Powerdale Dam is classified as hatchery or wild based on fin marks or scale analysis. Policy guidelines allow half of a spawning population to consist of hatchery fish provided they are genetically similar to the wild population. Fish not classified as *wild Hood River* or *subbasin hatchery stock* are classified as strays and are trucked downstream to the river mouth for the sport fishery. Because Hood River-origin hatchery winter steelhead are genetically similar to wild fish, up to half are passed above Powerdale Dam to spawn. ODFW also gives a high priority to protection of wild populations that have evolved over time above natural barriers. Current ODFW policy is that only artificial or man-made barriers are modified for fish passage purposes (Newton 1996, unpub).

Monitoring the effects of HRPP hatchery smolt releases on indigenous fish populations is ongoing. While interactions between wild and hatchery fish are not well understood, the potential for adverse competitive interaction from the current chinook and steelhead supplementation program are considered low for the following reasons (BPA 1996):

1. Native broodstock are used for summer and winter steelhead. For spring chinook, a Hood River broodstock from Deschutes stock is being developed because the native stock is extinct
2. Smolt release numbers are low and represent a reduction compared to past hatchery releases
3. Fish are released as full term smolts to reduce the time they are in habitat potentially competing with wild fish
4. Hatchery fish are acclimated before release and leave the ponds volitionally ready to migrate seaward
5. The streams selected for release are believed to be below carrying capacity
6. The number of hatchery fish allowed to spawn naturally would be kept in balance to reduce competition on spawning grounds

Habitat Conditions Summary

In summer 1993 and 1994, ODFW Aquatic Inventories Project (AIP) surveys were conducted along a total of 63 stream miles in the Hood River watershed. ODFW analyzed the data collected during these surveys to assess riparian and stream channel conditions. The 1993 and 1994 data was the most recent summarized data available for use in this assessment, although habitat conditions may have changed after the February 1996 flood in some streams. The following stream segments were included in the 1993 and 1994 surveys:

1. **Hood River Mainstem** – mouth to confluence with West Fork
2. **Green Point Creek** - mouth to RM 2.9
3. **Neal Creek** - mouth to RM 8.7 at MHNF boundary
4. **West Fork Neal Creek** - mouth to RM 2.0
5. **Evans Creek** - mouth to RM 0.75
6. **Middle Fork Hood River** - mouth to RM 3.8
7. **East Fork Hood River** - mouth to RM 11.8
8. **Dog River** - mouth to RM 0.8 at MHNF boundary
9. **West Fork Hood River** - mouth to confluence with McGee Creek
10. **Lake Branch Creek** - mouth to Lost Lake

ODFW compared habitat measurements in each survey reach against regional habitat benchmark values shown in Table 4-6. Regional habitat benchmarks are intended for use as guidelines only and should not be viewed as values to which every reach of every stream should or could necessarily adhere. Overall habitat ratings for the Watershed are shown in Table 4-7. The Oregon watershed assessment manual examines other habitat characteristics such as large woody debris and shade in subsequent Chapters.

Table 4-6. Oregon Department of Fish and Wildlife Aquatic Inventory Project regional habitat benchmarks for selected characteristics. Source: ODFW 1995

Habitat Characteristic	UNDESIRABLE	DESIRABLE
Pool Area (% of reach)	< 10	>35
Pool Frequency (No. of active channel widths per pool)	>20	<8
Gravel Availability (% gravel in riffles)	<15	≥ 35
Gravel Quality (% Fine Sediment in Gravel)	> 25	< 10

Pool area is the percentage of the survey reach classified as pool habitat. *Pool frequency* is a measure of the spacing of pools calculated in terms of active channel width (the distance across the channel at the annual high water line). The fewer the number of active channel widths in between pools - the more desirable the habitat. *Gravel availability* is used a measure of potential spawning habitat and refers to the percentage of substrate in riffles that consists of gravel. *Gravel quality* is a measure of the percent of fine sediment in the riffle areas of a stream.

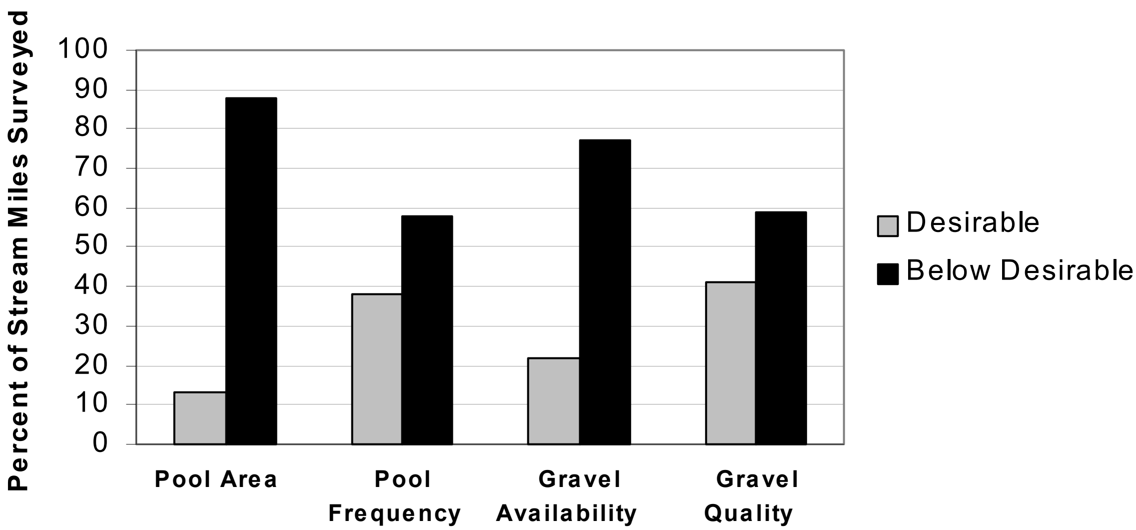


Figure 4-4. Overall habitat ratings for 62 miles of stream surveyed in 1993 and 1994 in the Hood River Watershed. Data source: ODFW, 1995

The overall ratings indicate that pool area is lacking in the Watershed. Eighty-eight percent (55 miles) of the stream length included in the survey rated as undesirable or below desirable levels. Only 13% or eight miles had a desirable amount of pool area, while just under 40% of the total stream length surveyed had a desirable pool frequency. Gravel availability did not meet desirable levels over 75% of the habitat surveyed, while gravel quality was better with 41% having a desirable rating.

Only portions of Lake Branch, the West Fork Hood River mainstem, Green Point Creek and the Hood River mainstem were rated as having desirable pool area. Neal Creek and parts of the East Fork Hood River had very poor pool area and pool frequencies, upper Neal Creek in fact had no pool area in one survey reach. Portions of Evans Creek had a poor gravel quality rating, but nearly all of the West Fork Hood River had a good gravel quality rating.

A comparison of averaged habitat quality values from AIP survey data among 5th field Watersheds are shown in Figure 4-5. Data by reach and channel habitat type is provided in the Technical Appendices.

The USFS has surveyed over 155 miles of anadromous, resident and non-fish bearing Watershed streams within National Forest boundaries. The USFS surveys use different measurements and methods than ODFW and were not available in summary form. As a result, this information was not incorporated into the Assessment at this time.

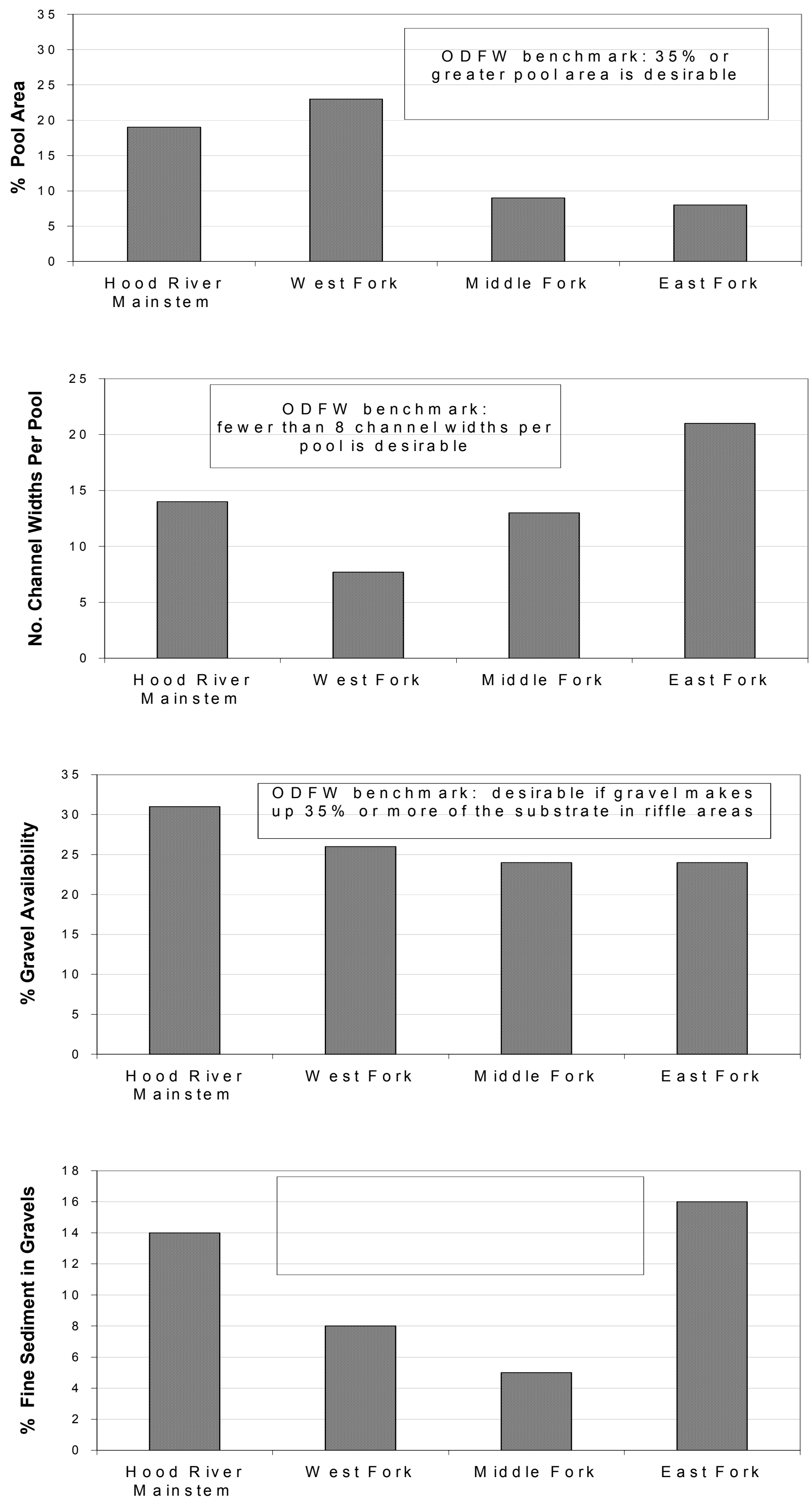


Figure 4-5. Comparison of averaged habitat quality measures pool area, pool frequency, gravel availability, and gravel quality for Aquatic Inventory Project survey reaches by 5th field watershed. Adapted from: ODFW, 1995.

Status of the Aquatic Food Chain

Little is known about the health and status of the aquatic food supply in the Watershed with regard to natural nutrient cycling, algal growth, detrital processes, and invertebrate production. The role of marine nutrients from spawned-out anadromous fish carcasses in the stream food chain has been the subject of study in recent years. Researchers have found that fish carcasses are an important source of nutrients to the aquatic food chain as well as to wildlife and riparian vegetation. Juvenile fish rearing in streams with adequate carcass supply have a faster growth rate. In western Washington streams sampled, the amount of marine-derived nitrogen in juvenile coho salmon tissue increased rapidly with increased density of spawning fish up to a limit of 124 fish per mile (Bilby et al. 1997). The researchers suggest that this information, together with data on stream habitat characteristics, could be used to determine basin-specific escapement goals to maintain or enhance watershed productivity.

As a result of low fish populations in recent years, e.g. 1993 to 1998 - the combined fish carcass density in the Hood River Watershed (all species) has been less than 20 fish per anadromous stream mile based on total adult returns to the Powerdale Dam fish trap facility. Since 1998, ODFW and CTWS have placed a small number of spent hatchery carcasses from Hood River-origin fish into the upstream areas in an effort to restore marine nutrients and enhance stream productivity.

Fish Passage Problems

This section addresses man-made structures or conditions that obstruct, delay or interfere with or harm migrating fish. Man-made fish passage problems in the Watershed include (1) inadequate fish screens at irrigation and hydro diversions; (2) delay or poor function at fish ladders; and (3) culvert barriers at road crossings. Three large dams - Hines, Powerdale, and Clear Branch - have historically had the greatest impacts on upstream fish migration in the Watershed. Hines Mill Dam was built in 1907 spanning the East Fork Hood River at river mile 1.4 at Dee. It had a wood fish ladder that often malfunctioned and blocked passage into the East Fork (USFS 1996b). The Hines Mill Dam was breached in 1966. Fish passage conditions at the remaining dams and other diversions are described below.

PacifiCorp's Powerdale Dam diverts up to 500 c.f.s. from the Hood River at river mile 4.5 for power generation. Presently, upstream passage is provided on the east side of the dam by a fish ladder operated and maintained by PacifiCorp. A fish trap in the ladder was installed as part of the Hood River Production Program and is operated by ODFW. PacifiCorp volunteered use of the facility and the land. There is concern that upstream migration conditions need further improvement, although re-entry of steelhead and bull trout into the ladder after release above the dam has been observed, as has re-entry of hatchery fish released back downstream for the sport fishery (Newton, ODFW, *pers. comm*). Discharge on the west bank is often much greater than the fish ladder attraction flow on the east bank. As a result, fish are more strongly attracted to the spill on the west bank and are seen jumping up onto the concrete spillway. The agencies and Tribes have consulted with PacifiCorp to improve attraction into the ladder entrance. The influence of dam passage conditions and/or handling stress at the trap on the pre-spawning mortality rates of chinook and steelhead are of potential concern.

A two-year radio telemetry study by CTWS and PacifiCorp investigated how long it took salmon and steelhead to migrate through the bypass reach and locate the fish ladder. In 1995 spring chinook held 66.0 days and summer steelhead 28.3 days in the vicinity of Powerdale Dam, and only 21% and 31% of radiotagged fish successfully passed the dam (CTWS 1997). Because of poor attraction to the fish ladder, the flow was modified to exit the bottom pool in the ladder. This measure helped fish find the ladder more quickly - in the 1996 study, spring chinook held 21.0 and steelhead 25.2 days, with 67% and 52% dam passage success rate. Further downstream, the powerhouse discharge (tailrace) at river mile 1.5 can attract fish and delay migration (PacifiCorp 1998). Tagged chinook and steelhead spent an average of 4.5 and 8 days per fish respectively near the tailrace in 1995 but dropped to 1.6 and 3.1 days per fish in 1996 after short-term modifications to the tailrace area were made.

Clear Branch Dam was built in 1969 for irrigation storage and is a complete barrier to the upstream migration of anadromous and resident fish, and has isolated a bull trout population above the dam. Beginning in 1997, the USFS in cooperation with Middle Fork Irrigation District has operated an upstream fish trap at the base of the dam. Eight adult bull trout were captured at this location between September 2, 1997 and Jan 1, 1998. Current policy is to transport every other fish entering the trap to Clear Branch upstream of the reservoir.

Fish screens meeting state and federal fish protection criteria are mandatory in Oregon for diversions of 30 c.f.s. or greater. Under existing state law, screens are voluntary for diversions under 30 c.f.s. but the Endangered Species Act could require mandatory actions. State cost-share programs are available to help private water users screen diversions. In 1996, the East Fork Irrigation District constructed a new screen facility at its 127 c.f.s. East Fork Hood River canal. The diversion was operated for decades without screens except briefly in the 1960s during which chronic mechanical problems forced the EFID to abandon the screens. The new screens (Coanda type) are designed to handle high glacial sediment loads. A screen upgrade is needed at the Farmers Irrigation District 80 c.f.s. diversion from the Hood River. Fish salvage operations have found spring chinook, rainbow/steelhead, cutthroat and mountain whitefish juveniles trapped in Farmers Canal despite an existing rotary drum screen.

The screens at the Powerdale diversion do not meet NMFS or ODFW criteria for fish protection (Pribyl et al. 1996). Testing in 1995 by PacifiCorp found that a proportion of outmigrant salmonids were swept into the power canal (PacifiCorp 1998). PacifiCorp proposes to replace the fish screens once the new license is issued and accepted. The project license expires in March 2000; however, the timing of screen replacement is uncertain and may be delayed by relicensing, permitting and design proceedings. PacifiCorp indicates it may take 2 years after a new license is issued and accepted by the utility before actual screen construction will begin (Prendergrast, PacifiCorp, *pers comm*). Screen upgrade completions at all other major water diversions in the Watershed is anticipated by the year 2001. Because of its downstream location and the large volume of water diverted (average monthly diversion of up to 80% of streamflow), delay in screen replacement at Powerdale Dam will undermine subbasin-wide habitat restoration, fisheries enforcement, and supplementation efforts and will slow the recovery of anadromous fish in the Hood River (Jennings, CTWS, *pers comm*).

ODFW is finalizing a subbasin-wide survey of screens in need of upgrade to meet current fish protection criteria (Hartlerode, ODFW, *pers. comm*) and will offer financial aid to eligible landowners. The ODFW survey included small private pumps as well as irrigation and water district diversions.

A number of other known or potential fish passage problems exist in addition to those at dams described above. Presently, 14 migration barriers (excluding road culverts or small private withdrawals) are known or suspected to affect anadromous fish or bull trout passage in the Watershed. These passage barriers are identified and summarized in Table 4-7. Road culvert barriers are described later in this Chapter.

Table 4-7. Known or potential migration barriers primarily affecting anadromous fish or bull trout in the Hood River Watershed, excluding road culverts and small pumped withdrawals. Source: ODFW & CTWS, *pers. comm.*

ENTITY	STREAM NAME	RIVER MILE	BARRIER TYPE	COMMENTS/ STATUS
East Fork I.D.	East Fork Hood River	8.6	Water diversion - low flow barrier during critical summer low flows.	Cooperative solutions to be developed with EFID
East Fork I.D.	Neal Creek	5.0	Irrigation diversion. Fails screening criteria. Canal flow can overtop screen. Upstream passage impaired.	Preliminary design in progress
Middle Fork I.D.	Eliot Branch Diversion	1.0	Irrigation diversion. Possible barrier to steelhead. Design challenge-heavy sediment and debris load	Design and permit in progress. Major debris torrent November 1999
Middle Fork I.D.	Evans Creek	2.0 3.6 5.3	Three miles of steelhead and coho habitat blocked by lower two diversions.	MFID plans piping installation to eliminate diversions; cost-share with CTWS
USFS	Lake Branch Creek	0.9	Natural boulder cascade – anadromous passage varies with flow	Excellent, low gradient upstream habitat
ODFW	West Fork Hood River-	0.25	Punchbowl Falls fish ladder inadequate maintenance may impede upstream migration of sp. Chinook and steelhead	Needs annual maintenance and site access; may need additional water supply
Middle Fork I.D	Coe Branch	0.75	Irrigation Diversion. Upstream passage of bull trout impeded, fails screen criteria[1]	Design and Permitting in progress-scheduled 2000
Middle Fork I.D	Clear Branch Dam	1.1	Storage Reservoir and Dam at Laurance Lake. Upstream passage barrier. Unscreened deep outlet - potential loss of bull trout into pressurized pipe system[2]	Adult fish trap & haul operated. Spillway modified in 1992 & tested by ODFW . Tagged bull trout passed spillway & survived
Dee I.D.	West Fork Hood River	6.1	Irrigation diversion. Possible barrier to spring chinook at low flows[3]. Screen & bypass under remediation.	ODFW building screen and bypass to install by spring 2000. Upstream passage not resolved.
Farmers I.D.	Hood River	11.5	Irrigation diversion. Fails screening criteria[1] for approach velocity	Design & permitting in progress
PacifiCorp	Hood River @ Powerdale Dam	4.5	Hydroelectric diversion. Existing screens fail screen criteria[1]. Downstream migrants swept into flume. Potential upstream passage problem and delay, SOP's & design improvements under discussion	Screens awaiting replacement in FERC relicensing ~2002 or beyond. Modified spillway on ladder side in conceptual design
Dee Forest Products	Tony Creek	0.75	Diversion Dam. Screening internal or absent. Barrier at most flows; 1.5 foot outfall drop onto bedrock	Interim remediation Completed in 1998 by CTWS
Unknown	Indian Creek	~1.0	Old Diamond Fruit dam prevents fish passage	Resident fish passage

[1] Bull trout fry criteria screening listed as Potential Conservation Action for Bull Trout in Pribyl, et al 1996
[2] Listed as Potential Conservation Action for Bull Trout in Pribyl, et al 1996 [3] CTWS, December 1998

Fish Passage Barriers at Road Crossings

In 1998, the Oregon Department of Transportation in cooperation with ODFW surveyed stream culverts in need of remediation along state Highways and county-owned public roads (not including forest roads) in the Watershed. ODFW identified 46 culverts that inhibit fish passage, and ranked them according to affected species and quality of existing upstream habitat (Table 4-8). Eighteen culverts were ranked as medium priority for remediation generally due to anadromous fish presence and availability of good or medium quality habitat upstream. Sixteen of these are located along County-owned public roads.

Additional passage problems at road culverts are likely to be identified in the future. No culvert barrier inventory is currently available for National Forest roads, however, the MHNF plans a forest-wide field survey within the next few years. County forest roads are in need of surveys for potential fish passage barriers as well. In 2000, the Hood River Ranger District intends to replace a road culvert with a bridge at the Pinnacle Creek mouth at Laurance Lake reservoir to improve bull trout passage during low reservoir and flow conditions (G. Asbridge, USFS, *pers. comm*). A second culvert barrier on Pinnacle Creek near river mile 1.0 was removed in 1999.

Table 4-8. Culvert passage remediation needs on County and State roads for Hood River 5th field watersheds. Source: ODOT and WDFW, 1998 (ODFW and ODOT, 3/23/1998)

County Rd # or State Hwy	Subbasin/ Stream	Stream Mile	Species	Habitat Quality	Priority	Comments
Hood River Mainstem						
101 Brookside	Indian Creek/ Unnamed Cr	1.4	Cutthroat	Poor	Low	Velocity barrier. Juvenile step barrier.
129	Indian Cr	2.4	Cutthroat	Poor	Low	Velocity barrier.
201	Whiskey Cr	2.1	Cutthroat	Fair	Low	
HWY 35	Whiskey Cr	2	Cutthroat	Fair	Low	Step/velocity barrier
202	Whiskey Cr	0.2	cutthroat	Fair	Low	Velocity barrier. Juvenile step barrier.
306	Neal Cr/ Lenz Cr	0.9	Coho, Cutthroat	Fair	Med	Velocity inhibits/prohibits fish passage.
209	Neal Cr/ Unnamed Cr	0.3	(Steelhead)	Fair	Med	Step/velocity barrier.
209	Neal Cr /Unnamed Cr	2.5	St, Cutthroat	Fair	Med	Velocity inhibits passage. Juvenile step barrier.
315	W. Fk Neal Cr/ Unnamed Cr	0.7	cutthroat	Poor	Low	High velocity water.
320	Odell Creek	0.2	Cutthroat	Fair	Low	Velocity limits passage. Step barrier for juvenile fish.
322	Odell Cr	1.8	Cutthroat	Fair	Med	New culvert. Velocity inhibits/prohibits fish passage.
305	Odell Creek/ Unnamed Cr	2.3	Cutthroat	Fair	Low	Velocity barrier. Landowner says small culvert leads to flooding.
320	Odell Cr	2.3	Cutthroat	Fair	Low	2 culverts. Velocity barrier. Juvenile step barrier.
West Fork Hood Rive						
Lost Lake 501	Deer Creek	2.0	Cutthroat	Fair	Low	Velocity/Step barrier.
Middle Fork Hood Riv						
417	Rogers Cr	0.2	Cutthroat	Good	Low	Lower 10' of pipe is corroded through in a number of places.

Table 4-8, *continued.* Culvert Problems on County and State roads for Hood River 5th field watersheds.

East Fork Hood River						
County Rd # or	Subbasin/ Stream	Stream	Species	Habitat	Priority	Comment
421	Trout Cr	0.5	Cutthroat	Good	Low	Velocity barrier. 20" step out of culvert over dam.
401	Trout Cr	5.4	Cutthroat	Good	Low	Juvenile step barrier. Adults are limited by velocity.
418	Trout Cr	1.6	Cutthroat	Good	Low	Velocity barrier.
423	Trout Cr	3.2	Cutthroat	Good	Low	Velocity barrier.
421	Evans Cr	0.6	St, coho	Good	Med	Retaining wall creates pool, siphons creek through 1' opening, then
424	Evans Cr	1.6	St, coho cutthroat	Fair	Med	Juvenile step barrier. Velocity barrier.
429	Evans Cr	3	St, coho cutthroat	Fair	Low	Velocity barrier.
421	Evans Cr/ Griswell Cr	1	St, coho cutthroat	Good	Med	Velocity and step prohibit juveniles, inhibit adults.
426	Evans Cr/Griswell Cr	1.5	St, coho cutthroat	Good	Med	Step/velocity barrier.
Laurance Lake	W. Fk Evans Cr	14	St, coho cutthroat	Fair	Low	Velocity barrier.
Cooper Spur 428	Doe Cr	3.3	Cutthroat	Good	Med	Step/velocity barrier.
HWY 35	Tilly Jane Ck.	3.4	Cutthroat	Fair	Low	Step/velocity barrier
Cooper Spur 428	Tilly Jane Ck.	4.6	Cutthroat	Good	Med	Juvenile step barrier. Debris inhibits fish passage.
HWY 35	Crystal Spr. Ck	4.5	St, cutthroat	Fair	Med	Step/velocity barrier
414	East Fk Hood R.	0.2	St, coho cutthroat	Fair	Med	Step/velocity barrier.
415	Emil Creek	0.8	St, coho cutthroat	Fair	Med	Velocity inhibits/prohibits fish. Juvenile step barrier.
HWY 35	Baldwin Cr/ Tieman Cr	2.0	Cutthroat	Fair	Low	Velocity barrier
411	Baldwin Cr/ Unnamed Cr	0.6	Cutthroat	Fair	Low	Velocity barrier. Juvenile step barrier.
428	Baldwin Cr /Unnamed Cr	0.3	Cutthroat	Fair	Low	Juvenile step/velocity barrier. 5' concrete slide inhibits passage as well.
412	Baldwin Cr	0.6	St, coho	Fair	Med	Velocity barrier.
405	Wisehart Cr	0.3	St, coho Cutthroat	Fair	Med	Double culvert. Water cascades down rock for 2' before reaching pool.
406	Wisehart C	0.5	St, coho, Cutthroat	Fair	Med	Velocity barrier.
411	Wisehart C	0.9	St, coho, Cutthroat	Fair	Med	Water cascades down rock for 5' before pool.
HWY 35	Meadow Ck	2.1	Cutthroat	Good	Low	Boulders in pool, drop & velocity limit passage
HWY 35	Clark Ck	6.4	Cutthroat	Good	Low	Velocity barrier, double culvert
HWY 35	Ash Ck	1.4	Cutthroat	Good	Low	Juvenile step barrier/ vel. barrier
HWY 35	Pollalie Ck	7.0	Cutthroat	Good	Med	Velocity barrier, double culvert
HWY 35	Unnamed Ck	1.8	Cutthroat	Good	Low	Step/velocity barrier
HWY 35	Birdie Ck	2.6	Cutthroat	Fair	Low	Step/velocity barrier
HWY 35	Engineers Ck	1.8	Cutthroat	Good	Low	Step/velocity barrier
HWY 35	Hellroaring Ck	1.6	Cutthroat	Good	Low	Step/velocity barrier

Fish Population Status and Distribution - Key Findings

1. The abundance and range of anadromous fish in the Hood River Watershed has declined compared to historical conditions. Native spring chinook, coho and fall chinook stocks have become extinct.

2. Bull trout and steelhead were listed as Threatened in 1998 under the Endangered Species Act. The sea-run cutthroat population is classified as depressed by ODFW. River lamprey were commonly found throughout the Watershed as recently as the 1960s, but are no longer found above Powerdale Dam.

3. A joint effort by ODFW and the Confederated Tribes of the Warm Springs Reservation is underway to rebuild native summer and winter-run steelhead and reintroduce a spring chinook population into the Hood River using Deschutes River stock. Habitat protection and improvement is critical to meet the goals of this program including the attainment of self-sustaining anadromous fish runs.

4. Overall Habitat Condition indicated by 1993-1994 ODFW survey data:
    - Pool area and pool frequency is rated as *below desirable* conditions
    - Gravel availability is rated *as below desirable* conditions
    - Fine sediment levels are rated as *desirable* in most reaches

5. Inadequate fish screens and upstream barriers exist at several water diversions and are a major habitat problem. Because of its downstream position and the volume of water diverted, prompt replacement of the Powerdale Hydroelectric Project fish screens is especially important to fish recovery.

6. ODFW surveys found 34 County road culverts needing fish passage remediation, and 12 culverts on State Highway 35. Eighteen of these culverts were assigned a medium priority ranking for remediation by ODFW.

Data Gaps

- Culvert barriers on private roads and National Forest lands
- Habitat surveys for streams not yet surveyed. Re-surveys needed on those streams most impacted by the 1996 flood
- Summarized habitat data comparable to ODFW stream surveys for National Forest lands
- Status of benthic macroinvertebrates and the health of the aquatic food chain
- The causes for lamprey decline in the Hood River
- Habitat use patterns and requirements of sea-run cutthroat trout in the Hood River

5. Channel Modifications

Introduction

- *Where are the locations of channel and wetland modifications?*
- *Where are the locations of historic channel disturbances such as splash damming, hydraulic mining and stream cleaning?*
- *Where are there known locations of current channel disturbance such as channel widening, extensive bank erosion, large sediment bars, etc.?*
  What stream habitat types have been impacted by channel modification?

Channel modifications and some historic land use and in-channel activities have reduced the quality and/or quantity of aquatic habitat resources from pre-land use conditions. In the absence of documentation on pre-land use conditions, the impact to aquatic resources from the channel modification can be inferred from the type of modification and the channel habitat type affected.

Channel gradient can be used to predict zones of potential channel impacts due to declining transportability and sediment deposition, making channel disturbances, such as channel widening, extensive bank erosion or large gravel deposits, with no apparent adjacent cause, response indicators of changes in upstream channel input factors which may be related to land use activities.

This Chapter locates known sites of historic or continuing disturbance or modification of stream channels. Examples of channel modifications in the Hood River Watershed include bank stabilization, roads or railways constructed along streams, channel realignment, reservoirs, ditching and wetland drainage. Historic modifications like splash dams and stream clean-out are important because of long lasting effects on habitat conditions. Extensive bank erosion, downcutting and expanding sediment bars can in some cases form in response to upstream channel modification and can aggravate downstream flooding impacts.

Diking, road fill, rip-rap and other development encroachments narrow the stream channel and limit stream meandering and movement within its floodplain. In response the stream length shortens, water velocities rise, and sediment movement and stream-floodplain interactions are disrupted. Channel modifications can result in a loss of channel and floodwater storage capacity, channel incision, streambed armoring or loss of gravel deposition, and the loss of side channels, pools, and other types of habitats needed by fish.

Historic and Existing Channel Modifications

Topographic maps, ODFW stream surveys, watershed analysis reports, and other information was used to identify the locations and number of miles of historic and current channel modifications in the four Hood River fifth-field watersheds. Where more than one modification type occurred in the same reach, only the principal modification was counted. For the most part, an effort was made to include only those roads known to encroach upon the channel or floodplain.

Table M-1: Channel modification summary for Hood River Mainstem watershed.

S	Road	Realign-ment	Railway/ Pipeline	Other*	Dikes, Rip-rap, Channelization	Total Affected Miles
Hood River			2		1.7	**3.7**
Whiskey Creek	.3		1.4			**1.7**
Indian Creek	.2					**.2**
Lower Neal	.5		1.3		1.5	**3.3**
Upper Neal	1.2					**1.2**
WF Neal	3.3					**3.3**
Odell	.8	.1		.2		**1.1**
Ditch	.6			.9		**1.5**
Pine	0					**0**
Total Miles	**6.9**	**.1**	**4.7**	**1.1**	**3.2**	**16.0**

* includes a gravel pit and the Green Point reservoirs.

Approximately 16 miles of stream channel modifications in the Hood River Mainstem Watershed were identified. Road construction along streams affected the greatest distance (6.9 miles) while railroad grades and pipelines were the second most prevalent modification (4.7 miles). The Hood River mainstem, and the Lower and West Fork Neal Creek subwatersheds were the most affected by channel modification. ODFW survey field notes indicate that bank armoring was very common along Lower Neal Creek. Channel modifications continue to interact with frequent large natural flood events in Neal Creek to create a deeply incised stream that is cut off from its historic floodplain along much of its length.

Table M-2. Channel modification summary for the West, Middle and East Fork Hood River watersheds.

5 W	Road	Re-align-ed	Reservoir Impounded	Gravel Pit	Splash Dam or Clean Out	Rail-road	Riprap Channel-ization	al Miles Affect ed
West Fork	0		0	X	2.0	0		2.0
Middle Fork	.5		.8	X	2.0	0		3.1
East Fork	7.8	.4	0	XX	3.9	.9	.5	13.5
Total Miles	**8.3**	**.4**	**.8**		**7.9**	**.9**	**.5**	**18.6**

In the West Fork watershed, the 2 lower miles of Green Point Creek are affected by historic splash damming and large wood clean out (USFS, 1996a) that continues to influence in-stream structure, riparian development, gravel and flood retention and groundwater recharge potential. The BPA powerline access road is influences several hundred feet of the upper West Fork mainstem.

In the Middle Fork watershed, the Clear Branch Dam functions as a barrier for sediment transport and limits spawning-size gravel in downstream areas (USFSb). The reservoir inundates an estimated 0 .8 miles of a former meandering, low gradient stream that was possibly the most productive coho and steelhead spawning area in the Middle Fork (USFS, 1996b).

In the East Fork Hood River watershed, Highway 35 construction realigned and confined the East Fork mainstem and profoundly impacted stream function (USFS, 1996b). Unable to meander within its floodplain, the river is constrained into a single, narrow channel bordering the highway. As a result the East Fork has become steeper in gradient with fewer slow water areas and is prevented from stabilizing within the valley floor. Approximately 7.8 miles of the East Fork are affected by road construction and bank armoring, most of which is associated with Highway 35 from Dog River to Baseline Road and The Narrows. Headwater areas in the East Fork Hood River are subject to frequent natural landslides and debris torrents. The capacity of the confined East Fork river channel to handle debris flows has been reduced. Highway 35 is afflicted with a high maintenance requirements to reduce chronic safety hazards from washouts, landslides and rock fall. State and county transportation planners have recommended cost and feasibility studies to elevate or realign Highway sections out of the floodplain including The Narrows canyon (cite recent County transportation study). .Diking and relocation for recent highway widening affects about .5 mile of the Graham and Baldwin Creek channels in the Lower East Fork subwatershed.

Approximately 4 miles of the East Fork channel have been affected by stream clean out. In 1979, the USFS removed all instream and riparian large wood debris between Robinhood and Sherwood campgrounds. Streams and wetlands in the Lower East Fork subwatershed have been subject to substantial channelization due to agricultural and roadway development (USFS, 1996b). Emil Creek appears to be channelized along much of its length. One mile of Wisehart Creek is potentially affected by a railroad grade.

Only 1984 FEMA floodplain maps are available and need to be updated or improved as they do not accurately represent potential flood hazards in the Hood River valley area (Bill Stanley, MFID, *pers comm*). Specific example of map deficiencies include Evans Creek south of Baseline Road. Removal of woody vegetation from small or intermittent streams within orchards for air drainage has created mono-typical incised stream channels (S. Pribyl, ODFW, *pers. comm*). Numerous beaver dams and beaver activity is common along the lower East Fork and along the lower Evans Creek (ODFW, 1995). Channel widening and aggradation is occurring below the East Fork diversion, requiring bank revetment and sediment removal to protect the EFID diversion canal fish screen and sand trap facility. In Neal Creek, upstream road and agricultural drainage activities are eroding private pastureland downstream. An old dam associated with a fruit packing plant impounds a portion of Neal Creek aggrading sediment and accumulating debris (Ratkeiwich, R. 1996).

Key Findings - Channel Modifications

1. Road and railroad bed confinement is the most prevalent modification to stream channels in the Watershed in terms of stream length affected **(20.8 miles).** Streams most severely affected include the upper East Fork Hood River and lower Neal Creek.

2. Neal Creek is heavily impacted by channelization, confinement and bank stabilization as a result of agricultural land use and road construction. These modifications have caused increased flood scour and channel incision that has largely separated the creek from its floodplain.

3. Confinement of the East Fork Hood River due to construction, reconstruction and maintenance of State Highway 35 is a significant and continuing impact to aquatic habitat particularly along The Narrows and below Dog River to Baseline Road.

4. Drainage and stream channelization likely have altered channel conditions in small streams in agricultural areas compared to historic conditions.

5. Affected channel habitat types include FP3, MM, MV, SV, MC, and LC.

Data Gaps/ Further Analyses

- Updated FEMA floodplain maps

- A channel migration analysis for lower Neal Creek, lower East Fork and potentially other stream segments

- Analysis of historic aerial photos and General Land Survey maps to identify locations of former stream realignment and channelization for restoration purposes

- Not all “problem” sites (e.g. erosion and channel shifting) are identified

- Locations of bridge crossing fills were not identified

6. HYDROLOGY AND WATER USE

Introduction

This Chapter characterizes climate conditions and the low flow and flood history of the Watershed, and assesses the potential effects of land use on natural watershed hydrology. It also describes the nature and extent of water storage and withdrawals for agriculture, power generation, municipal and other uses, and assesses their potential impact on habitat conditions experienced by fish.

Climate and Streamflow

The Hood River Watershed is located in a transition area between the temperate maritime and semi-arid continental zones. The average land elevation is 3,050 feet and climate varies widely within the Watershed. Parkdale, near its center, has an average annual temperature of 47°F and a July air temperature of 63.5°F. Precipitation ranges from an average of 130 inches per year along the Cascade crest to less than 30 inches along the east boundary, with the majority of precipitation falling November through January (Sceva 1966). Snowfall is heavy at high elevations and can reach 30 feet deep at timberline on Mt. Hood (SWRB 1965).

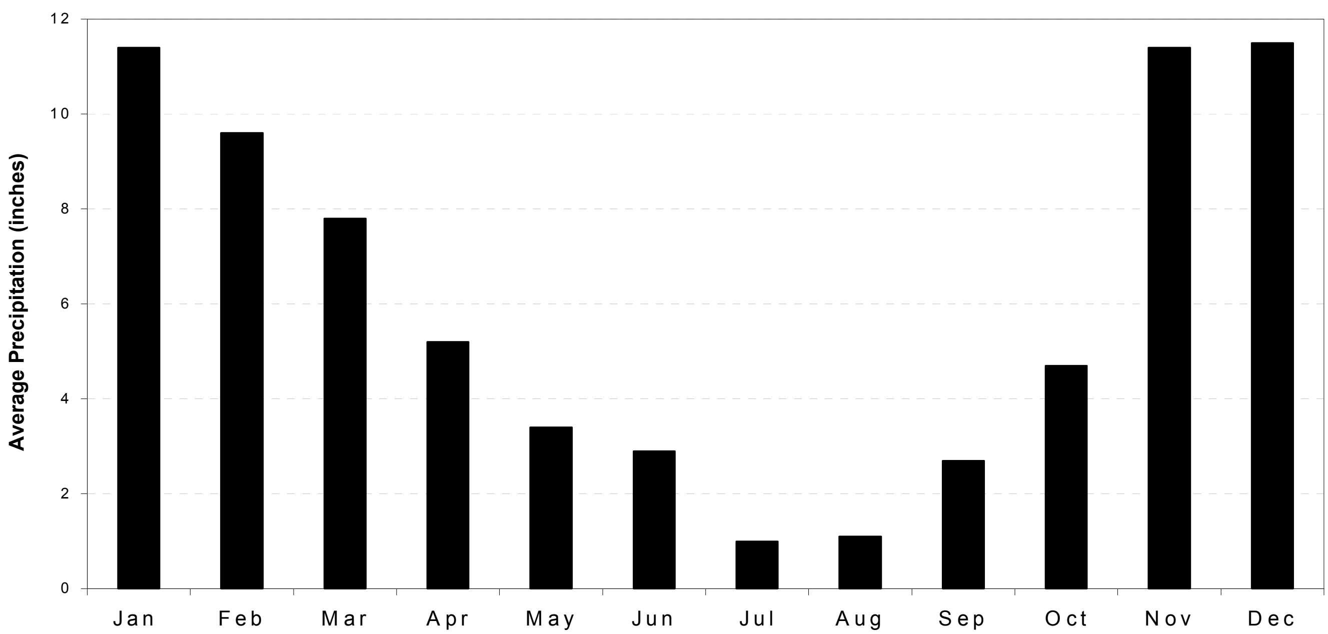


Figure 6-1. Average monthly precipitation for the Hood River Watershed as a whole.
Source: Rick Cooper, Oregon Water Resources Department

Table 6-1. Drainage area, stream length, elevation range, annual precipitation and mean annual discharge for major Hood River drainages. *Data sources: ORD WRIS watershed characteristics, ORWC, 1965, USFS 1996*

Drainage Name	**Drainage Area** (sq mi)	**Stream Length*** (mi)	**Minimum Elevation** (ft)	**Maximum Elevation** (ft)	**Mean Annual Precipitation** (in)	**Mean Annual Discharge**** (c.f.s.)
Hood R Watershed @ mouth	339	500	74	11235	73	1192
Odell Cr	13.3	13.3	360	2552	30	17
Neal Cr	30.2	39.1	320	4119	38	39
Indian Cr	6.4	12	114	2115	26	18
West Fk Hood R	102.5	136.6	760	8286	103	595
Lake Branch	29.2	28.4	1200	4589	108	196
Green Pt Cr	20.7	26.8	920	4519	76	83
Middle Fk Hood R	45.9	71.2	960	10743	79	218
Tony Cr	10.23	27.1	1260	4880	78	30
Evans Cr	5.2	11.5	1560	5840	88	12
Clear Branch	6.5	25.2	2640	7280	93	144
East Fk Hood R @ WF conf Nr Dee	157.4	256	760	11235	90	557
Dog River	12.5	13.3	2080	6279	82	19

* Stream length = total mainstem + tributaries measured upstream from the stream mouth.
** Estimated natural discharge

Two streamflow gaging stations are active in the Watershed. The USGS has operated a gage at river mile 6.1, Hood River at Tucker Bridge (USGS #14120000) continuously since 1965, with some records as early as 1897. The other active station is at river mile 0.4 on the West Fork Hood River near Dee (USGS #14118500) and has been operated by the Oregon Water Resources Department (WRD) since 1992. A continuous flow record from 1933 to the present is available for this station. Limited records from inactive stations on other streams are also available.

Watershed runoff is highly variable. The average monthly flow of the Hood River at Tucker Bridge ranges from 415 c.f.s. in September to 1,639 c.f.s. in February. Peak snowmelt generally occurs in April and sustains relatively high discharge through May.

Flood Characteristics

The relatively short, steep configuration of the Watershed results in flood peaks that are brief in duration, a runoff characteristic sometimes described as *flashy*. Runoff is especially rapid during early winter storms before freezing conditions arrive at high elevations (SWRB 1965). The USGS reports the Hood River flood threshold as 4,500 c.f.s. and 8 feet in stage at Tucker Bridge. The maximum flood of record is 33,200 c.f.s. which occurred December 22, 1964. Peak floods occurred most often in January and December from 1964 to 1997. A February 7, 1996 flood measured 23,300 c.f.s. and severely damaged roads, irrigation and other structures. The estimated return interval for the 1996 flood is 25 years, while the return interval for the 1964 flood exceeds 200 years (Ed Salminen, Watershed Professionals Network, *pers. comm*). The record maximum daily discharge in the West Fork Hood River was 15,000 c.f.s. on December 23, 1964 (USGS 1987).

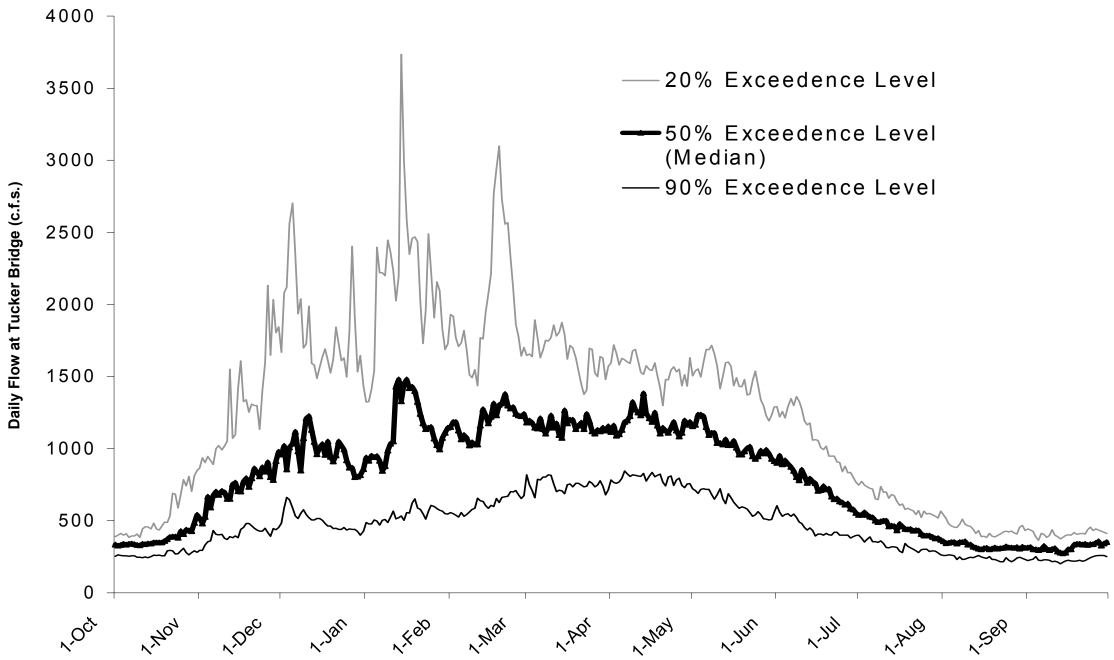


Figure 6-2. Summary hydrograph of the Hood River using daily streamflows at Tucker Bridge, USGS No. 14120000 - water years 1965 to 1997. Exceedence levels note the percent of time that streamflow was greater than the amount shown.

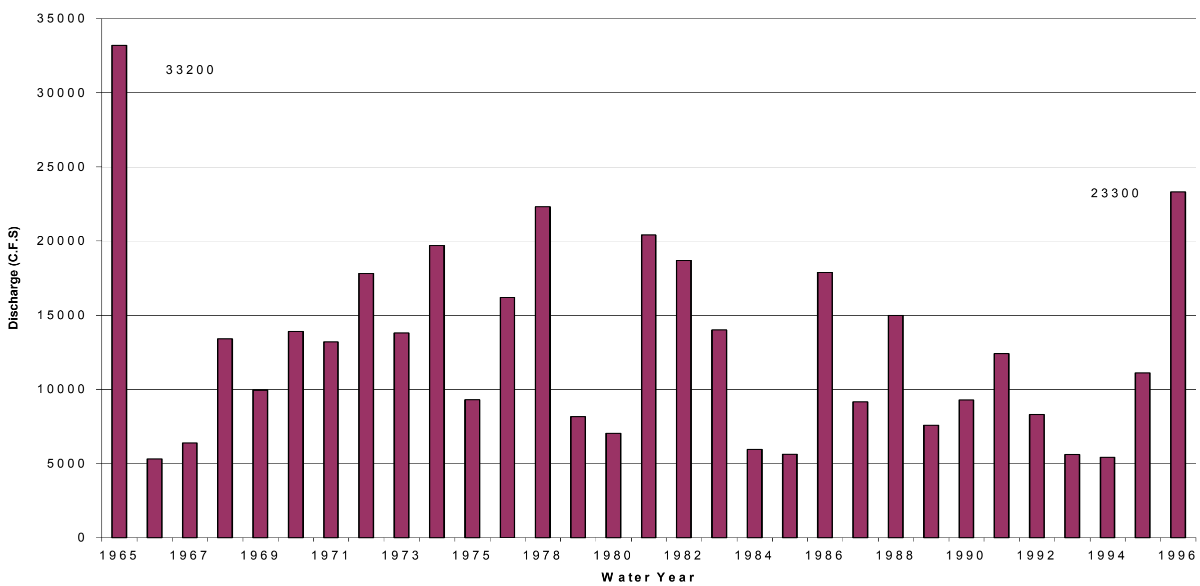


Figure 6-3. Annual peak flow of Hood River at Tucker Bridge (U.S.G.S. No. 14120000) between 1964 and 1996. Average daily streamflow for this period was 984 c.f.s.

Warm rain on top of a snowpack rapidly raises peak flows and increases potential erosion activity from both intermittent and perennial streams (USFS 1996b). In the Cascade Range, the *rain-on-snow zone* is usually reported as between 1,150 feet and 4,000 feet elevation. Subwatersheds with a large proportion of area in this elevation range include Neal, Tony, Lake Branch, Green Point and North Green Point creeks. Rain-on-snow flood damage in Neal Creek was first documented in 1886 when a “Chinook wind and a torrential rain” melted a heavy snowpack, washing out a sawmill and dam at Dethman Ridge Road (Krussow 1994). Rain-on-snow events cause flashy, high volume floods. The Green Point and North Fork Green Point subwatersheds especially vulnerable due to widely fluctuating air temperatures and large, open slopes that can accumulate deep snowpacks (USFS 1996a). In the Middle and East Fork Hood River watersheds, rain-on-snow events have occurred at elevations of up to 6,500 feet.

Periodically, natural dams created by moraines at receding glaciers on Mt. Hood break causing floods and debris flows. Landslides originating on the slopes of Mt Hood are common. Ladd, Coe, Pollalie, Eliot, Clark and Newton Creeks have a history of these events, which can be triggered by intense rainstorms. On December 25, 1980, a landslide and massive debris dam break in Pollalie Creek caused one fatality, obliterated sections of Highway 35, and damaged the East Fork Hood River for miles. Effects of the 1980 flood on the East Fork channel are still readily observed. A major washout in Ladd Creek occurred September 1, 1961. Mudflows carried huge boulders and uprooted trees in a path 250 feet wide, destroying roads and damaging the Bonneville Power Line (OWRC 1965). Newton Creek experienced a similar event in November 1991. A large mudflow in Eliot Branch occurred Thanksgiving 1999, wiping out a bridge and a diversion dam.

Low Flow Characteristics

Minimum stream flows generally occur during September or October. Many Watershed tributaries have very low summer flows, while tributaries with glacial sources maintain higher summer flows. Approximately 20% of the stream channel length in the Watershed dries up during summer, with most intermittent streams originating at low elevations or on easterly slopes (SWRB 1965).

Table 6-2. Low flow observations on selected ungaged streams.

Stream Name	**Location**	**Flow** (cfs)	**Date**	**Source**
Dog River	R.M. 3	9.0	July 20, 1972	USFS
Puppy Cr	Mouth	0.1	July 20, 1972	USFS
Lake Branch	Mouth	39.7	August 31, 1998	DEQ
Tony Cr	Mouth	7.7	September 24, 1997	DEQ
Odell Cr	R.M. 0.5	11	October 5, 1998	DEQ
Whiskey Cr	Mouth	7	October 5, 1998	DEQ
Indian Cr	R.M. 0.3	3.7	October 5, 1998	DEQ
Neal Cr	Mouth	13.0	October 5, 1998	DEQ
East Fk Neal Cr	Mouth	1.4	October 5, 1998	DEQ
East Fk Hood River	At conf. w/MF	70.6 29.3	August 28, 1998 August 20, 1992	DEQ ODFW
Eliot Cr	abv diversion	3.9	November 12, 1998	MFID
Coe Br	abv diversion	15.8	November 12, 1998	MFID
Clear Br	abv Lake	11.5	November 12, 1998	MFID
Green Point Ck	Nr Dee	5.4	Sept. 1920	ORWD
Elk Cr	R.M. 0.7	1.0	July 20, 1972	USFS

The minimum 7-day average low flow of the Hood River at Tucker Bridge was 155 c.f.s. and occurred September 10 - 16 in 1994. The lowest daily flow was 144 c.f.s. on September 13, 1994. Between 1965 and 1997, 1977 was the lowest water year with 47% of average runoff. The lowest water years in sequence occurred between 1936 and 1945, and 1985 to 1994.

Wetlands

Wetlands store runoff and reduce flood impacts to property and streams, recharge water supplies, augment base streamflows, form important wildlife habitats, and improve water quality by trapping sediment and nutrients. Aside from 1981 National Wetlands Inventory maps that use aerial photography and typically under-locate small wetlands (see Chapter 8), very little information is available about Watershed wetlands from which to characterize their hydrological function or significance. Wet meadows greater than 10 acres were considered as special habitats in the desired future conditions in Mt Hood Forest Plan. Examples include the Hood River, Elk, and Horsethief meadows. Horsethief Meadow is a Key Site protected area in the Northwest Forest Plan. Drainage of small wetlands for agriculture and other land uses continues in the Hood River valley. The 1984 Hood River County Comprehensive Plan Background Document states that no significant wetlands are found in the central valley area, although no local wetland inventory has been made. Statewide Planning Goal 5 calls for a wetlands inventory and functional assessment within the Urban Growth Boundary, and development of a either a wetlands ordinance or a conflicting use analysis.

On a basinwide scale, the habitat potential for beaver may be limited in the Hood River Watershed by high gradients and peak flow characteristics. As a result, beaver ponding was not likely to influence overall basin hydrology but probably had some influence on smaller tributaries (Torland, ODFW, *pers. comm)* and in local floodplain habitats.

Changes in Hydrology From Land Use

Peak flow alterations are driven by changes in type and density of vegetation, and in infiltration rates. These changes can affect the magnitude, duration and impact of floods. Openings such as clearcuts or burns accumulate a deeper snowpack and produce more runoff during rain on snow events than forested areas. Closed-canopy (i.e., mature) stands intercept more snow from falling to the ground and insulate the snowpack, resulting in less accumulation and a slower melt than in open areas or deciduous stands (USFS 1996a).

The MHNF compared the potential for increased flood damage due to logging activity in the Middle, East and West Fork watersheds using an Aggregate Recovery Percentage (ARP) model. Stand age and harvest data were used to determine the percentage of drainage area in a hydrologically recovered state, and to assign a risk of watershed damage from forest management. Recovery is assumed at a 70% canopy closure and 8-inch average stand diameter, conditions associated with a 35 to 40 year-old forest in the west Cascades. In general, an ARP of over 75% is considered recovered (Christner 1982) with 65% an accepted value for the eastside. The Mt Hood Forest Plan prohibits reductions in recovery below 65% in all USFS-managed subbasins (USFS 1996b). The Forest Plan also adjusted hydrologic recovery values according to sensitivity to mass wasting. As a result, Lake Branch is considered more sensitive to harvest activities and its recovery threshold was adjusted upward to 82%. The Forest Plan requires corroboration of ARP values with other information such as stream surveys to confirm actual effects (Ragan, USFS, *pers. comm*). An average ARP of 71.5% suggested that increased peak flow was a concern for the West Fork generally. Trout and Evans were found to be the least recovered subwatersheds in the East and Middle Forks followed by Tony Creek and Lower East Fork. Dog River, Bear and Crystal Spring Creeks are at or slightly above recovery. The remaining East and Middle Fork subwatersheds are well above the recovery threshold and pose little risk of peak flow erosion hazard. In considering the results of Table 6-3 below, the year of the vegetation data used in the model should be considered since recovery can be quick depending on the age of the "unrecovered" stands. If the majority of forest stands are in the 20-year age bracket, a few years of growth will rapidly increase hydrologic recovery compared to younger stands (Ragan, USFS, *pers comm*).

Table 6-3. East, Middle and West Fork subwatersheds ratings for peak flow damage based on hydrologic recovery (ARP) values using vegetation data from 1991 satellite imagery.

Subwatershed Name	**Watershed**	**ARP Value %**	**Threshold of Concern** (% recovery target)	**Risk Rating**
West Fork Hood R.	WF	69.0	75	CONCERN
Red Hill Cr	WF	70.5	75	CONCERN
Marco Cr	WF	69.7	75	CONCERN
Tumbledown Cr	WF	74.9	75	CONCERN
Long Branch	WF	62.4	75	**AT RISK**
Green Point Cr	WF	71.0	75	CONCERN
Dead Point Cr	WF	74.3	75	CONCERN
Lake Branch	WF	66.1	82	**AT RISK**
Laurel Cr	WF	66.9	82	CONCERN
Divers Cr	WF	56.0	82	**AT RISK**
Tony Cr	MF	66.8	75	CONCERN
Lower East Fk Hood R	EF	68.1	75	CONCERN
Trout Cr	EF	50.1	75	AT RISK
Evans Cr	EF	41.1	75	AT RISK

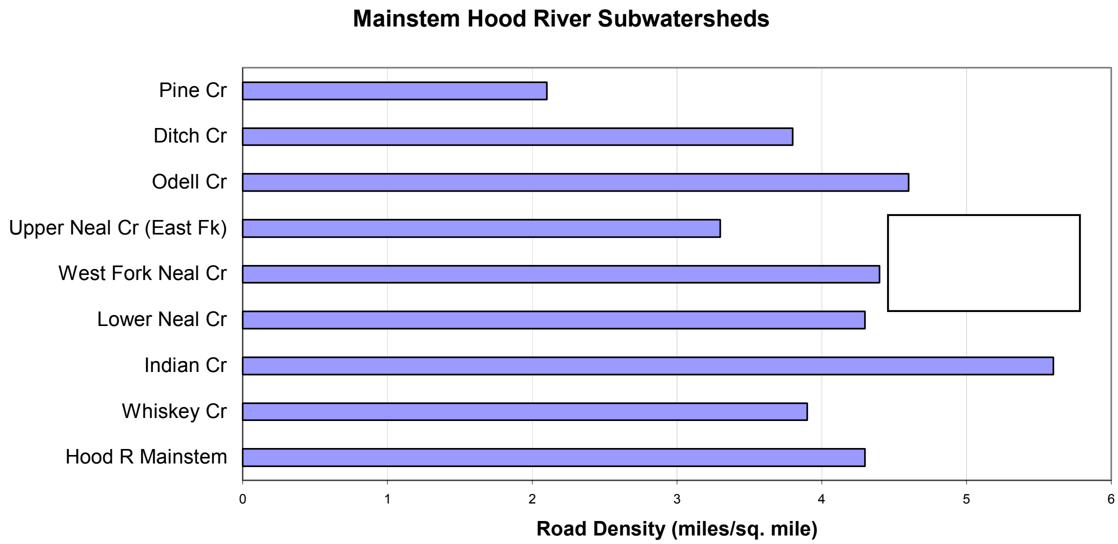
Road Density

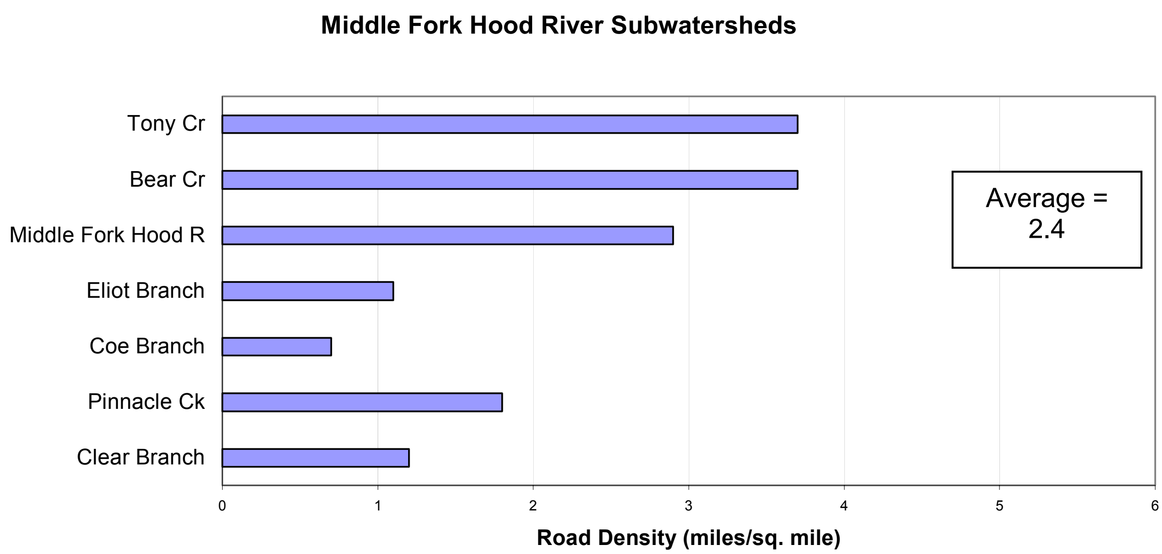
Road density is an indicator of potential for hydrologic change (and sediment delivery) within a watershed. Urban, rural and forest roads alike convert forest areas into permanent openings and compacted surfaces with low or no infiltration. As watershed road density increases, the stream "network" is extended by the ditches affecting the capacity of the watershed to slow and store runoff. Roadside ditches intercept, channel and re-route subsurface and surface runoff - causing it to enter streams more quickly. Few studies have focused on the specific effect of road density on either peak or low flows, although one study found that forest roads began to raise peak flows at a density of 6 to 8 mi/mi2 (Bowling and Lettenmaier 1997).

Road density estimates for sixth-field subwatersheds were developed by the USFS using digitized 1994 and 1997 USGS quad maps without air photo verification. As a result, actual road density may be higher than assessed here as the USGS maps may depict perhaps two-thirds of actual roads (Watershed Professionals Network, 1999).

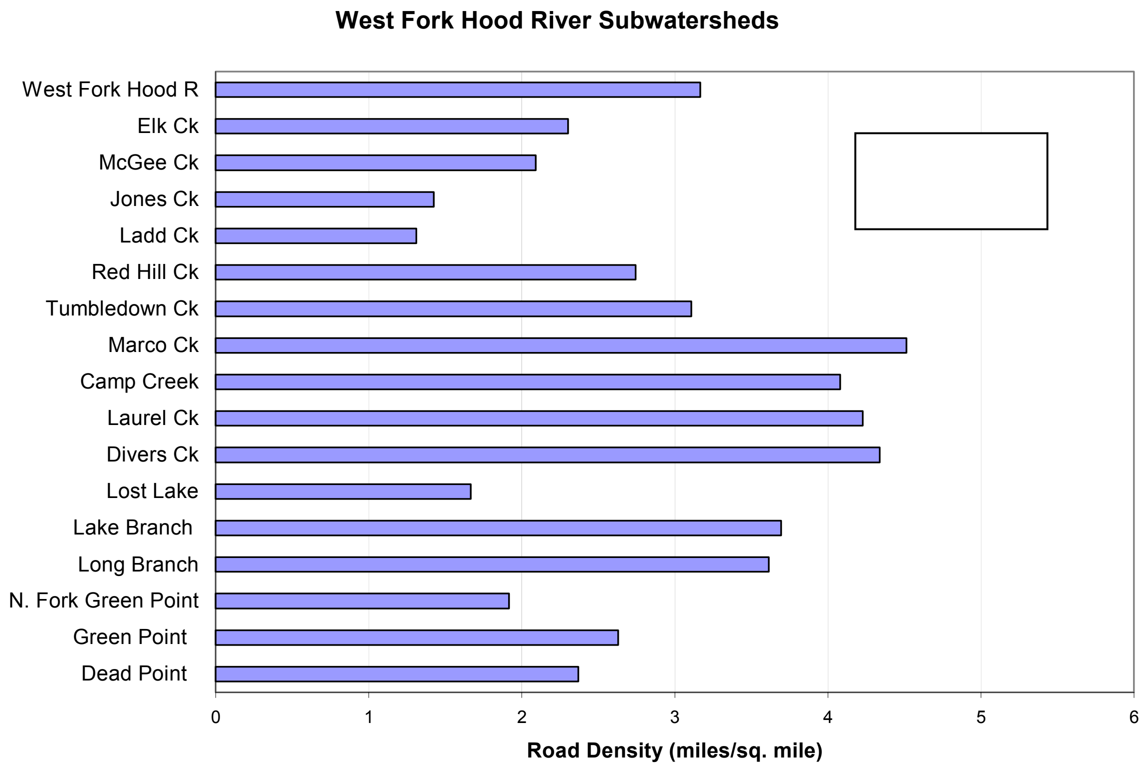
The USFS Mt. Hood Forest Plan uses a road density goal of 2.5 mi/mi2 for wildlife protection and assumes that this goal also protects against adverse hydrologic change (Ragan, USFS, *pers comm*). The West Fork and the Mainstem Hood River have the highest road densities among 5th field watersheds in the subbasin (Figures 6-4 and 6-5). Pine Creek is the only Hood River Mainstem subwatershed that meets the USFS goal of 2.5 mi/mi2 or less. Ten of the 17 West Fork subwatersheds fail this standard, compared to eight of 17 in the East Fork and three of 7 in the Middle Fork. Indian Creek had the highest road density in the Watershed at 5.6 miles/mi2, while Evans Creek had the second highest density at 4.9 miles/mi2. All subwatersheds in the lower East Fork valley have road densities greater than 3 miles/mi2.

Forest road construction around meadows and within wet soils have changed the hydrology in the Tony Creek headwater areas (USFS 1996b). As a result, road obliteration or preparation of roads for perpetual self maintenance is a high restoration priority in upper Tony Creek for the MHNF. Timber harvest and high road density place Long Branch, Divers Creek and Lake Branch at high risk of increased peak flow in 1 to 10- year events. Upland harvest has likely elevated peak flows in 2 to 5 year events changing them to a chronic habitat disturbance (USFS 1996a).





Figures 6-4a and 6-4b, above. Subwatershed road densities within the Mainstem and Middle Fork Hood River watersheds.



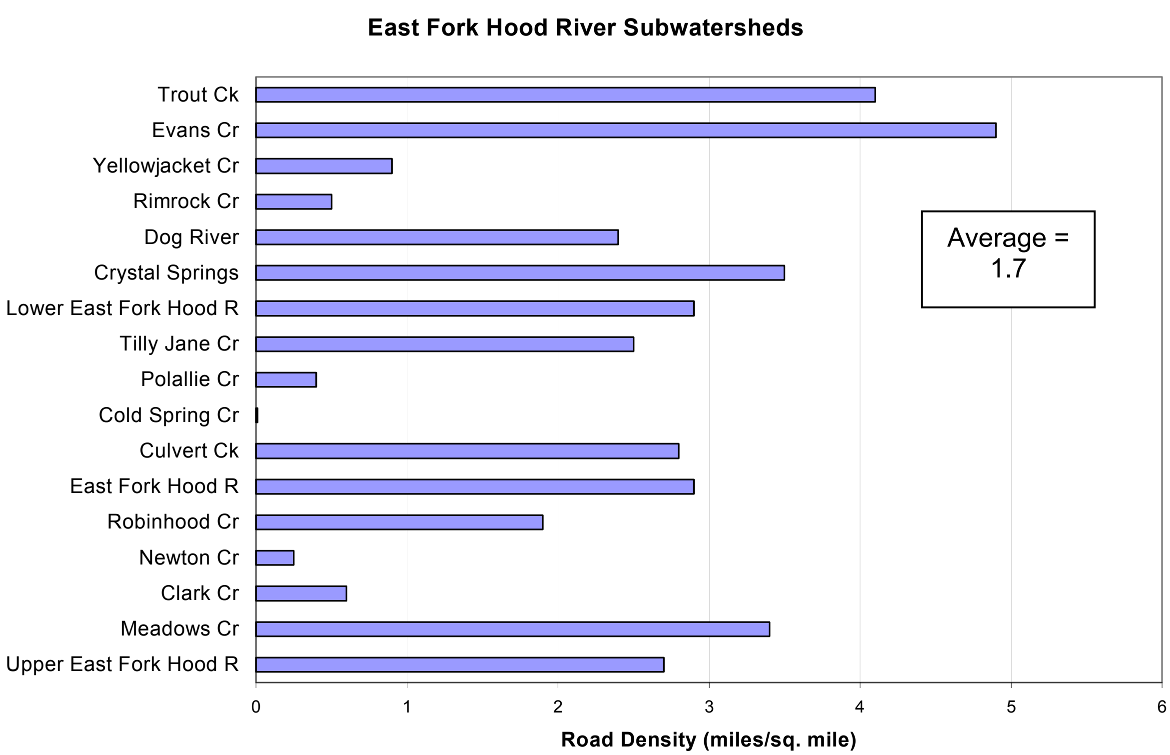


Figure 6-5a and 6-5b, above. Subwatershed road densities within the West and East Fork Hood River drainages.

The Forest Service found that the risk of damage from landslides has been elevated in West Fork and Lake Branch subwatersheds as a result of harvest rate, roads, poor potential for instream wood recruitment, and removal of downed logs from intermittent channels (USFS 1996a). The West Fork has one of the highest rates of debris torrents on the MHNF, with the majority associated with clearcuts and roads.

Splash damming, riparian logging, stream clean-out and the 1964 flood eliminated much of the natural instream and riparian downed wood throughout the Hood River Watershed. Historically, large wood is believed to have played a crucial role in providing the habitat structure capable of producing large anadromous fish runs in the Hood River's flashy, high flow environment (USFS 1996b). Large wood slows moving water and tends to desynchronize the timing of peak inflow from the outflow, lowering the peak flow (Watershed Professionals Network 1999). The Forest Service postulated that forest management in the West Fork, especially roads and removal of wood from channels, has increased peak flows over natural conditions, although flow records are not available for confirmation (USFS 1996a).

Impervious and semi-pervious surface area from urban development (asphalt, lawns, rooftops, etc.) impedes infiltration of rainfall and snowmelt, causing rapid runoff with higher peak flows and lower base streamflows. Several studies found chronic stream habitat degradation when total impervious area exceeds 5 to 10% within a drainage (e.g., Schueler 1994; May et al. 1997). The Oregon Watershed Assessment Manual assigns a high potential for impact at a threshold of 10%, and a moderate potential above 5% imperviousness. A 5.1% impervious land area was calculated for Indian Creek assuming that no surface runoff occurs from orchard lands that comprise more than half the subwatershed. Indian Creek is the only 6th field subwatershed in the Hood River where urbanization presents even a moderate risk of hydrologic impact.

Wetlands temporarily store water and release it slowly to streams and aquifers, thereby moderating peak flows. Wetlands most effective at storing water are generally located in the middle elevations of a watershed (Watershed Professionals Network 1999). These wetlands are far enough away from receiving channels to delay runoff, but low enough in the system to collect significant amounts of water. Under natural conditions, wetlands and associated groundwater recharge likely provided greater summer baseflow support in the Watershed compared to present conditions (Ragan, USFS, *pers comm*).

Drainage of wet areas was historically used in the middle to lower Watershed for agriculture and other land uses. Ditching and drain tiling continues to be a common land use practice. Information is not available to assess the cumulative effects of drainage activities on Watershed hydrology.

Water Rights and Water Use

The natural flow of water in the Hood River Watershed is interrupted by irrigation, domestic and municipal withdrawals, and diversions for power generation facilities (USFS 1996b). Principal consumptive water uses are irrigation and municipal supply, while hydropower is the largest single non-consumptive use (Figure 6-4). Little groundwater is developed since most domestic and irrigation water is supplied by springs and surface water. The majority of consumptive use is supplied by several large special purpose districts. Demand for irrigation water is relatively stable, while demand for domestic water is growing at a rate similar to population growth, or about 2% per year within the Ice Fountain Water District (Chandler, IFWD, *pers. comm*).

The total volume of all legally appropriated water rights for out-of-stream uses is approximately 678,094 acre feet, or 94% of the estimated median natural stream flow at the Hood River mouth (from Parrow 1998). Actual water use at any given time is less than the amount appropriated. However, simultaneous use of consumptive water rights could result in zero instream flow on some streams during critical low flow periods (OWPRB 1985). The estimated magnitude of potential consumptive water uses, e.g., irrigation and domestic uses, for the months of July through September is 220 c.f.s. (Parrow 1998) or 37% of median natural flow of the Hood River during that period.

No information on illegal water use was found. To help meet habitat protection objectives, fisheries managers have encouraged OWRD to more actively monitor withdrawals at each diversion and insure compliance with maximum rates and quantities allowed by certificates and permits (ODFW and CTWS 1990).

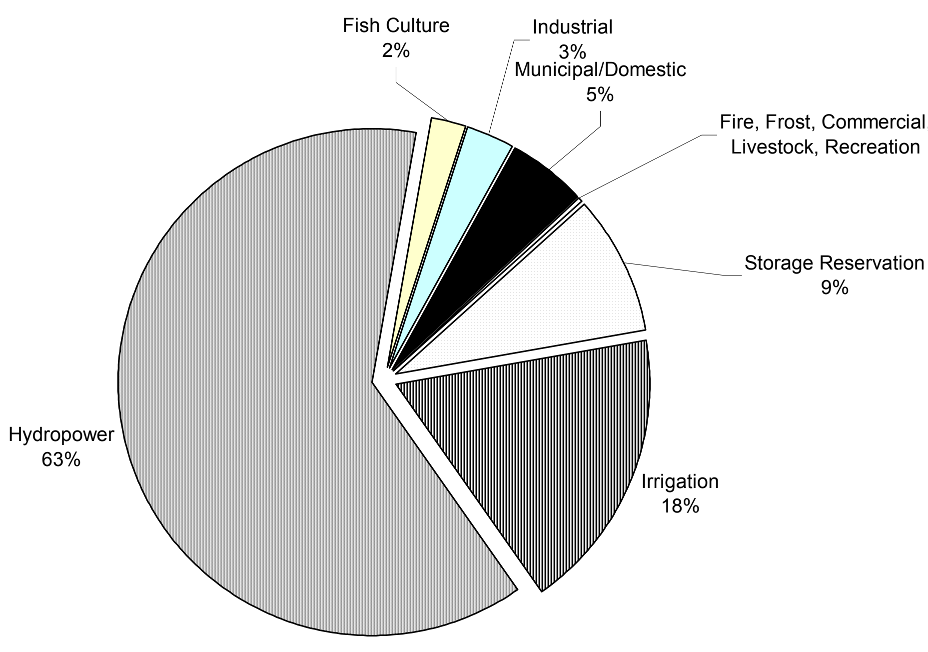


Figure 6-6. Summary of water rights for the Hood River Watershed by use not including instream rights. Source: Table 12 ODFW and CTWS (1990), revised using

municipal/domestic and storage reservation rights of 36,705 and 64,000 acre feet, respectively.

Irrigation

Irrigation is the second largest water use in the Watershed, which contains 32,696 acres of lands with irrigation water rights, 90% of which are served by irrigation district deliveries. Approximately 23,720 acres are actively irrigated (Hood River News 1995), 15,000 of these in orchard and 2,000 in pasture (Neiderholzer, OSU Extension, *pers comm*). The main irrigation season is April 15 to October 1 with peak usage in July. If all lands with irrigation rights were irrigated simultaneously, the maximum allowable diversion would total 409 c.f.s. (Bailey 1997), an amount equal to 80% of the median natural flow of the Hood River in the month of August.

To achieve operational and environmental gains, irrigation districts are replacing open ditches and canals with pressurized pipe, eliminating end-spill and reducing the number of diversion points. Farmers Irrigation District (FID) has adopted a Water Conservation Plan (FID 1995) that favors use of conservation strategies to satisfy demand increases and use of surplus conserved water for stream restoration. Large water savings to date have eased dependence on supplemental sources, enabled elimination of 18 diversion points, and produced economic returns. Pressure pipe lessens the need to pump water, saving some landowners $600 - $1,000 in yearly energy costs, and recovery of canal leakage has increased hydropower revenues. The Middle Fork Irrigation District (MFID) estimates that 10 c.f.s. could be saved by eliminating end-spill in their system (Stanley, MFID, *pers comm*). The East Fork Irrigation District (EFID) has piped numerous open laterals and small canals and plans to continue, and to improve their large canals as funds allow. This helps conserve water and reduce grower pumping expenses (Buckley, EFID, *pers.comm*). On-farm efficiency using soil moisture monitoring and micro-sprinklers is increasing. Of 300 orchards, around 30 are using soil moisture sensors to irrigate based on actual crop requirements (Nakamura, Hood River Grower-Shippers As., *pers comm*).

Table 6-4. Primary water rights and peak use of irrigation districts for irrigation, stock, spray, frost and fire control - excluding water rights for power generation. Complete district water rights are listed in the Technical Appendices. *Data sources: OWRD; Conners, MFID; Bryan, FID*

Irrigation District	**Water Source**	**Water Rights** (c.f.s.)	**Estimated Peak Use***
East Fork I.D.	EF Hood River	157.2	113
Mount Hood I.D.	EF Hood River	34.91	12
Middle Fork I.D.	Clear Branch	75	80 all sources combined
	Roger Sp Cr	5.17	
	Other Middle Fork Tributaries	34.83	
	Evans Cr	8.3	
	Trout Cr	4.46	
	Wishart, Griswell Cr	1.87	
	West Fk Hood River	11.1	13

Dee Flat I.D	Camp, Alder, No Name, Deer Cr	13.5	all sources combined
Farmers I.D.	Hood River	80.04	41
	West Fk Tributaries including Green Point Cr	72.19	25
Aldridge Irr Co.	Tony Creek	**0.96 c.f.s.**	No data

** not including hydroelectric uses*

Instream habitat in the East Fork Hood River is affected by the withdrawal of up to 127 c.f.s. below the EFID diversion point. During critical low flows and high demand, streamflow between the diversion down to the Middle Fork confluence (6.5 miles) is impaired (USFS 1996b). An instream water right of 100 to 150 c.f.s. was established for the East Fork but is superceded by the EFID irrigation water right. A low flow of 29.3 c.f.s. in the East Fork just above the Middle Fork confluence was measured on August 20, 1992 (Pribyl, ODFW, *unp data*) while surface streamflow immediately below the diversion was essentially zero. Low flow conditions in this reach influence water temperature, rearing habitat, juvenile and adult migration, and food production. The impact on adult anadromous fish passage is uncertain given the present species distribution in the East Fork (Pribyl, ODFW, *pers. comm*). The timing of maximum depletion occurs in mid to late summer. This does not coincide with adult migration of winter steelhead, the dominant anadromous species in the East Fork.

Leakage from the Dee Flat Irrigation District mainline canal is identified as a problem on the West Fork. The district has been unable to maintain its delivery system in good condition and canal leakage is substantial even in summer (USFS 1996a).

Streams are used as conveyance to transfer irrigation water between watersheds at several sites. Neal Creek conveys water from the East Fork Hood River to orchards and pastures in the lower east valley. Rogers Creek and East Fork tributaries Emil, Griswell, Trout, Evans and Wishart Creeks transfer water from Coe and Elliot Branch. These transfers import glacial silt into otherwise clear streams during summer melt. The MFID believes that instream and operational benefits could be achieved by abandoning its East Fork sources in favor of new piping relying on their Middle Fork sources alone. Because some of the District's oldest water rights are in the East Fork tributaries, a water right trade or other mechanism is needed to allow a change in water sources without loss of water rights priority (MFID 1998).

Water is considered over-allocated on an ecological basis in Green Point tributaries (USFS 1996a). Summer baseflow is considered inadequate for fish and diversions may have reduced the width of the riparian zone. The FID has recognized the need for a higher summer baseflow in Green Point Creek. Part of the FID strategy to address this need includes watershed restoration to improve natural water retention and storage (FID 1995).

<u>Hydroelectric Generation</u>

The single largest diversion and the single largest water right in the Hood River is the PacifiCorp Powerdale Dam diversion. Up to 500 c.f.s. is diverted at RM 4.5 and is returned 3 miles downstream. Minimum flow requirements for the bypass reach below the dam were established by the state in 1965 and modified in 1983. Under existing minimum flows, between 10% and 74% of the monthly average flow at Tucker Bridge is diverted with the greatest proportional flow reduction in late July. In August 194, prior to instream requirements, streamflow below the dam dropped to 3 c.f.s. due to diversion by Pacific Power & Light Company (ORWD 1965). As part of their pending Federal Energy Regulatory Commission (FERC) relicensing application, PacifiCorp has agreed to maintain higher instream flows in spring, summer and fall to improve anadromous fish habitat below their diversion. To offset financial losses, PacifiCorp is seeking an additional water right to divert up to 620 c.f.s. during November through April.

Error! Not a valid link.

Figure 6-7. Existing and future recommended flow requirements for the Hood River below Powerdale Dam agreed to PacifiCorp and state, federal and tribal agencies.

Farmers and Middle Fork Irrigation Districts operate 5 small hydro plants year round along their irrigation canals and pipelines. Water not used for irrigation after power generation is returned instream various distances from the points of withdrawal. Their combined generation water rights total 158 c.f.s, although actual peak use varies. The maximum winter hydro diversion is 45 c.f.s. from Middle Fork sources (Conners, MFID, *pers comm*). FID has a water right to use 73 c.f.s. from the Hood River for power generation. A small hydro plant is operated by a private individual on Odell Creek near its mouth.

<u>Municipal, Domestic and Industrial Water Supply</u>

Springs supply the majority of drinking and domestic water in the watershed. Cold and Stone Springs on Lake Branch supplies the City of Hood River. The City has explored the feasibility of a hydro plant to utilize their full water right of 25.5 c.f.s., however no current plans exist to build the project (Bradsy, City of Hood River, *pers comm*). Full use of the City water right would likely impact low flows in lower Lake Branch (Newberry 1995).

Crystal Springs supplies domestic water to the east valley, and Ice Fountain Spring in the Middle Fork serves the west valley. Other springs supply the towns of Odell and Parkdale. A number of wells are used by landowners and fruit processors, however the quantity of groundwater use is small. Industrial water has been diverted in the past from Tony Creek at river mile 0.7 for the Dee Mill.

The City of The Dalles diversion on the Dog River at river mile 6.0 is the only out of basin transfer. Between 3 and 12 c.f.s. is withdrawn to provide 70% of The Dalles water supply on an annual average basis. Operations legally dewater Dog River below the diversion each summer. A few hundred feet downstream, cutthroat and rainbow trout are found where surface flow reappears (Anderson, City of the Dalles, *pers comm*).

Table 6-5. Municipal and water district rights and present use. *Data sources: R. Bradsby, City of Hood River; Crystal Springs W.D.; Don Chandler, Ice Fountain W.D..*

Source	**Watershed**	**Water District/ Municipality**	**Water Right** c.f.s.	**Present Use** c.f.s.	**Priority Dates**
Cold Spring	West Fork	City of Hood River	20	2.2 average 4.1 summer	1923
Stone Springs	West Fork	City of Hood River	5.5		1940-41
Laurel Creek	West Fork H.R.	City of Hood River	5	None	1923
Tucker Park Spr	Hood R. Mainstem	City of Hood River	2	None	1909
Crystal Springs	Lower East Fk H.R.	Crystal Springs WD	7.65	2.6 mgd ave	1930 1964&1967
Ice Fountain Springs	Middle Fork Hood R.	Ice Fountain WD	3	0.62 average 0.93 summer	x
Trout Creek Spring	Middle Fork Hood R.	Parkdale Water Co, Inc.	1.5	x	1971
Davis Spring Odell Spring	Mainstem Hood River	Odell Water Co.	- 1.35	x	x
Dog River	East Fk Hood R.	City of The Dalles	All available flow	3 to 12	1870

Reservoir Storage

Total reservoir storage in the Watershed is limited to approximately 4,600 acre feet, or under 1% of average annual discharge at Tucker Bridge. In 1992, the Oregon Department of Agriculture reserved the right to a total of 64,000 acre feet of unappropriated water for storage in the Hood River in multipurpose reservoirs (WRD, 1996). While no plans currently exist to build new reservoirs, a water rights reservation secures this potential as far as water rights are concerned. Ultimately, any new storage proposal would be subject to cost-benefit, safety and environmental review.

Laurance Lake in Clear Branch of the Middle Fork Hood River is presently the largest reservoir in the Watershed and has a volume of 3,550 acre-feet. Laurance Lake is cited as the largest single disruption to hydrologic processes in the Middle Fork watershed (USFS 1996b). The reservoir was built in 1968 by MFID for irrigation. The MFID is required to maintain a minimum pool volume of 150 acre-feet and minimum flow releases of 3 c.f.s. from May 15 to August 31, 15 c.f.s. from September 1-15, and 30 c.f.s from September 16 until reservoir refill in fall and winter. Natural streamflow is passed downstream during the non-irrigation season.

Farmers Irrigation District stores a total of 1,000 acre-feet in Upper and Lower Green Point Reservoirs for irrigation. Preliminary dam safety analysis indicates that increased storage at these reservoirs is not an option. A cost/benefit study of new reservoir capacity found little economic or water supply benefit compared to piping options. The FID concluded that distribution and on-farm efficiency could offset the need for expanded storage and suggested that watershed restoration could enhance supply by increasing natural retention (FID 1995).

Water Availability and Instream Water Rights

The cumulative demands placed on the water resource in the Hood River during the irrigation season cause streamflow to drop to critical levels, water temperatures increases, and sections of stream channel to become intermittent in several places (ODFW and CTWS 1990). Natural and human-caused low flow conditions can limit fish populations in the following ways:

- impede migration
- reduce rearing, spawning and adult holding area
- disconnect side channels
- lower food production
- increase competition, predation, disease and stress
- strand and trap juveniles, adults and aquatic invertebrates
- elevate water temperature or cause freezing
- aggravate poor water quality
- de-water incubating eggs
- reduce smolt outmigration survival

Instream water rights are established to protect aquatic life and are held in trust for the people of Oregon by the Oregon Water Resources Department. Instream rights that are junior in priority have no practical effect on water rights with older priority dates. When low flows coincide with high water use, instream rights are not reliably met in the East, Middle or West Fork Hood River, Neal Creek or Dog River.

Table 6-6 . Existing instream water rights in the Hood River Watershed (c.f.s.). The compliance location is at the stream mouth unless otherwise noted.

INSTREAM WATER RIGHT LOCATION	OCT	NOV	DEC	JAN TO MAR	APR	MAY	JUN	JUL	AUG	SEP	Priority Date
Hood R. blw Powerdale	45 100*	45 100*	45 170*	45 270*	45 270*	45 170*	45 130*	45 100*	45 100*	45 100*	9/22/65 11/3/83
W. Fork Hood R	100 195*	100 255*	100 280*	100 150*	100 255*	100 255*	100 255*	100 150*	100 180*	100 176*	9/22/65 12/6/91
Lake Branch	35.7	67	67	67	168	113	66.9	44.8	38.6	37.1	2/6/91
E.Fork Hood R. abv M. F.	150	150	150	100	150	150	150	100	100	100	11/3/83
Neal Creek	20	20	13	13	20	20	20	13	13	5	11/3/83
Dog River	7.79	14.7	12	12	20	20	20	12	7.01	6.05	12/6/91
M. Fork Hood R.	10	10	10	10	10	10	10	10	10	10	9/22/65

** earlier priority date for a portion of the flow*

Other instream flow requirements are established by the state through permit conditions for power generation water rights. Below Clear Branch Dam, a minimum of 3 c.f.s. is required from May 15 to August 31, with 15 c.f.s. from September 1-15, and 30 c.f.s from September 16 until reservoir refill. A minimum flow for anadromous fish rearing and spawning was established in Green Point Creek for 20 c.f.s. from October 15 to

December 31, and 40 c.f.s. from January 1 to April 15. No summer minimum flow standard presently exists in Green Point Creek. Summer streamflow in Green Point is reported as a concern by the MHNF (USFS 1996a) and by the FID itself (Bryan, FID, *pers comm*). No minimum flow standards are in effect at other FID sources, but potential net water gains from pressure pipe projects and watershed restoration may make improved streamflow protection achievable at no detriment to agriculture (FID 1995).

The Oregon Water Resources Department determines water availability by individual drainage units or "Water Availability Basins" based on instream rights plus the sum of all certificates, permits or approved uses in relation to estimated natural flow that is exceeded 80% of the time. A "no water availability" determination is in effect for East Fork Hood River above the Middle Fork from May-December, and for Middle Fork from April-December (Bailey 1997). No new consumptive water rights are available from the West Fork from June- November. The OWRD is developing statewide streamflow restoration priorities by rating the level of optimism that streamflow can be increased considering the type, value and size of water uses, water availability by season, and the potential for flow restoration strategies such as conservation, leases and transfers, distribution, and measurement improvements.

Key Findings – Hydrology and Water Use

1. Instream water rights are established at 7 locations and are consistently met at 2 of these: the Hood River below Powerdale Dam and Lake Branch. Instream rights, being junior to other water rights with earlier priority dates, are frequently not met in summer and fall in the following streams:

    - West Fork Hood River
    - Middle Fork Hood River
    - East Fork Hood River above the Middle Fork
    - Neal Creek
    - Dog River

2. During critical conditions, summer low flows are diminished or depleted by use of senior water rights in the East Fork Hood River from the EFID diversion to the Middle Fork confluence. Effects include increased water temperatures, a potential migration barrier, reduced rearing area and aquatic food production.

3. Summer streamflow restoration in Green Point Creek was identified as a need by Farmers Irrigation District and the US Forest Service.

4. Given the rapid runoff characteristics of the Hood River Watershed, a lack of woody debris has eliminated the aquatic habitat structure necessary to produce historic fish population abundance.

5. West Fork Neal, Upper Neal, Green Point, and Tony creek subwatersheds are especially vulnerable to rain-on-snow peak flow events due to a large proportion of drainage area between 1500 and 4000 feet elevation.

6. The US Forest Service reported a high risk of watershed damage from forestry or land use activities in Divers, Trout, Evans and Long Branch due to large gaps in the forest canopy (i.e. low hydrologic recovery values).

Data Gaps

- Cumulative or local effects of roadway, irrigation ditches and wetland drainage on peak flow and summer base flows

7. WATER QUALITY

Introduction

This Chapter identifies water quality concerns in the Hood River Watershed based on available information about dissolved oxygen, pH, nutrients, bacteria, pesticides, turbidity and water temperature. Land use practices that potentially influence water quality as covered in this Chapter include water storage and diversion, agricultural and livestock runoff, failing septic systems, wastewater treatment and other discharges, toxic spills and soil erosion. A list of piped discharges in the Watershed regulated and administered by Oregon Department of Environmental Quality (DEQ) is provided in the Appendix.

Beneficial Uses and Water Quality Criteria

The Department of Environmental Quality establishes water quality standards to protect beneficial uses of the State's waters. The designated beneficial uses listed for waters in the Hood River Watershed are: public and private domestic water supply, industrial water supply, irrigation, livestock watering, anadromous fish passage, salmonid fish rearing, salmonid fish spawning, resident fish and aquatic life, wildlife and hunting, fishing, boating, water contact recreation, aesthetic quality and hydro power. Aquatic life, particularly salmonid spawning and rearing, is considered one of the most sensitive beneficial uses. Based on State of Oregon water quality standards, water quality limited stream segments were identified by DEQ (Table 7-1) and included on the 1998 303(d) list (DEQ 1998).

Monitoring Efforts

Water quality monitoring is routinely conducted at a variety of locations by the following natural resource agencies and groups in the Hood River Watershed:

- **DEQ**: bimonthly ambient monitoring on Hood River at the footbridge downstream from I-84 (river mile 0.5) (1993-present)
- **US Forest Service (USFS), Confederated Tribes of the Warm Springs Reservation (CTWS), Farmers Irrigation District (FID), Middle Fork I.D. (MFID), Hood River Watershed Group (HRWG), Mt. Hood Meadows Ski Resort:** continuous temperature monitoring at least during the summer for the past 2-9 years depending on group
- **Mt. Hood Meadows Ski Resort**: continuous to quarterly monitoring for a variety of parameters (1992-present)

Table 7-1. Water Quality Limited Stream Segments in the Hood River Watershed per the DEQ final 1998 303(d) list.

Stream Segment	**Listed Parameters** (season)	**Criteria**
Lake Branch – Rivermile 10 to Lost Lake	Temperature (summer)	Fish Rearing 64°F (17.8°C)
Clear Branch – Mouth to Laurance Lake	Temperature (summer)	Oregon Bull Trout 50°F (10°C)
Middle Fork Hood River – Mouth to Clear Branch	Temperature (summer)	Oregon Bull Trout 50°F (10°C)
Neal Creek – Mouth to East/West Fork confluence	Temperature (summer)	Fish Rearing 64°F (17.8°C)
Whiskey Creek – Mouth to Headwaters	Temperature (summer)	Fish Rearing 64°F (17.8°C)
Indian Creek – Mouth to Headwaters	Temperature (summer)	Fish Rearing 64°F (17.8°C)
Hood River – Powerdale Powerhouse to Diversion Dam	Temperature (summer) pH (summer)	Fish Rearing 64°F (17.8°C) pH range of 6.5-8.5

Recent water quality studies conducted in the Hood River Watershed are listed below.

1. PacifiCorp Federal Energy Regulatory Commission (FERC) relicense application for Powerdale Dam hydroelectric project (PacifiCorp 1998). PacifiCorp collected water quality data in the bypass reach and in selected tributaries during 1995 and 1996. This data included temperature, pH, dissolved oxygen, and nutrients. DEQ and PacifiCorp anticipate conducting additional pH and possibly nutrient sampling during April-June, 2000 to better assess pH standard violations observed in the bypass reach.

2. Hood River Watershed Group (HRWG) (Coccoli 1999). Baseline monitoring was conducted from June 1997-June 1998 with community volunteers. Measurements included dissolved oxygen, pH, turbidity and temperature. Nutrient samples were collected in spring and summer 1998 and analyzed by the U.S. Bureau of Reclamation in Boise.

3. DEQ mixing zone studies of the Odell fruit packing plant discharges. Various chemical and biological parameters were analyzed in Lenz and Neal creeks in 1992 and 1995. This study will be expanded to include Odell and Emil creeks in 1999 to address discharge permit renewal requirements.

4. DEQ mixing zone studies of municipal wastewater treatment plants (WWTPs). Various chemical and biological parameters were analyzed in 1998 at selected sites upstream and downstream of the Odell and Parkdale WWTP discharges in Odell and Trout creeks, and the Mount Hood Meadows WWTP discharge in the East Fork Hood River. Data will be used to address discharge permit renewal requirements.

5. DEQ intensive water quality monitoring. DEQ conducted intensive baseline monitoring at 39 sites in the Hood River Watershed during 1998 to prepare for development of a Total Maximum Daily Load (TMDL) plan. Maps of the 1998 sampling sites are included in Appendix 7. The Hood River Watershed was prioritized for a TMDL plan primarily due to Endangered Species Act (ESA) listings for steelhead and bull trout. A local Hood River Water Quality Technical Committee was convened in early 1998. The Committee identified temperature, pH and nutrients, bacteria, toxics and sediment as concerns to be evaluated in the TMDL process. DEQ will convene a local stakeholder Advisory Committee during 2000 to develop TMDLs for stream segments where water quality standards are not met.

Summary of Available Water Quality Data and Concerns

An overall summary of water quality impairment as determined by monitoring described above is provided in Table 7-4 near the end of this Chapter. Individual parameters are discussed below.

Temperature

Elevated water temperature is detrimental to cold water fish species and other aquatic life. According to Oregon Administrative Rule (OAR) 340 41 525 (2) (b) (A):

> ***"...no measurable surface water temperature increase resulting from anthropogenic activities is allowed in the Hood River basin if surface water temperatures: (i) exceed 64°F (17.8°C) during times of salmonid rearing; (iii) exceed 55°F (12.8°C) during times of salmonid spawning, egg incubation and fry emergence from the egg; and (iv) exceed 50°F (10°C) in waters determined to support or be necessary to maintain the viability of native Oregon bull trout."***

These numeric criteria are based on a seven-day moving average of the daily maximum temperatures (7DMA). Temperature increases were measured in stream segments influenced by water diversion, reservoir storage, natural lake storage and reduced riparian (streamside) shade. A data summary is provided in the Appendix. Riparian shade conditions are treated separately in Chapter 9 per the Oregon Watershed Assessment Manual (Watershed Professionals Network 1999). Temperature was identified as a concern in the following stream segments:

- **Lake Branch –** The segment below Lost Lake to the Road 13 bridge near river mile 10 is included on the 1998 303(d) list for temperature (rearing criteria of 64°F) based on USFS data collected at the Road 13 bridge. Data was collected in 1995, 1996, and 1998 at this site and the 64°F criteria was exceeded all three years. Additional USFS data collected between 1994 and 1998 suggest that the river cools to below 64°F by the USFS boundary (river mile 3.5). Natural lake storage may be one factor in the heating observed in upper Lake Branch.

- **Clear Branch -** Clear Branch below Laurance Lake reservoir is included on the 1998 303(d) list for temperature (bull trout criteria of 50°F) based on USFS data collected at the USGS Gaging Station below the dam since 1994. Data collected by MFID in Clear Branch directly downstream of Coe and Eliot Branches show exceedences of the 50°F criteria in 1997 and 1998. Review of data collected by the USFS and MFID in Clear Branch above Laurance Lake indicates that this segment should also be listed from the lake upstream to river mile 4.0 based on the 50°F bull trout criteria. This criteria was exceeded at two sites– directly upstream from the lake in 1997 and 1998 and at the 2840-640 bridge (approximately river mile 4.0) in 1994, 1995 and 1998. Laurance Lake creates a heat sump that significantly warms Clear Branch below the dam (Buchanan et. al., 1997) during parts of the year. It is hypothesized that bull trout would not be able to spawn successfully in Clear Branch immediately below the dam because of the warm temperatures. The causes of the heating in Clear Branch above the lake are unknown. Questions exist as to whether the 50°F criteria is an appropriate or naturally attainable standard in some streams in the Watershed.

- **Middle Fork Hood River** – The Middle Fork Hood River is included on the 1998 303(d) list for temperature (bull trout criteria of 50°F) for its entire length. Data collected by the USFS and CTWS at the Road 16 bridge (approximately river mile 4.5) show that the 50°F criteria was exceeded every year from 1994 -1998.

- **Compass Creek** – The lower portion of Compass Creek is designated by ODFW as supporting bull trout spawning, rearing and adult residence (ODFW 1997). Based on data collected by the USFS and MFID at the mouth of Compass Creek, the 50°F bull trout criteria was exceeded in 1996, 1997 and 1998. As in upper Clear Branch, questions have arisen as to whether the 50°F criteria is naturally attainable or realistic in this stream.

- **East Fork Hood River** – Data collected by CTWS at the Trout Creek railroad bridge near river mile 0.6 shows that the 64°F criteria was exceeded in 1990, 1992, 1994, 1996 and 1998. This data suggests that the lower East Fork Hood River should have been included on the 303(d) list for temperature. The HRWG collected data at the EFID head gate (near river mile 9.5) in 1998. The maximum 7DMA at this site was 61.9°F. In the Watershed Analysis of the East Fork Hood River, a comparison of temperatures among monitoring sites in the East, Middle, and West Forks and the Hood River at Powerdale Dam found that the East Fork contributed the hottest temperatures (USFS, 1996). The USFS suggested that probable causes are: (1) the substantial withdrawal of the East Fork into the EFID irrigation canal which can occasionally divert 100% of streamflow during the low flow season; and (2) the lack of riparian shade along much of the East Fork system.

- **Odell Creek** – Data collected by the HRWG in 1998 show that the 64°F temperature criteria was exceeded in 1998 at approximately rivermile 1.0. Continuous temperature data was also collected from Odell Creek at Sylvester Drive (maximum 7DMA of 63.5°F). The probe appeared to have been buried during most of July, so it is possible that the criteria would have been exceeded at this site as well. The data suggests that temperature is an issue for Odell Creek along most of its length, and that it should have been included on the 303(d) list.

- **Neal Creek** – Neal Creek is included on the 303(d) list for temperature (rearing criteria of 64°F) from the mouth to the confluence of the East and West Forks. The listing is based on data collected by PacifiCorp near the mouth of Neal Creek in 1996. Data collected by the HRWG and CTWS in 1998 support this listing, with an observed maximum 7DMA of 69.3°F at the mouth. Data collected by the HRWG in 1998 at the mouths of the East and West Forks Neal Creek indicate maximum 7DMAs of 58.6°F and 62.6°F, respectively, indicating a greater heat contribution from the West Fork.

- **Whiskey Creek/Spring Creek** – Whiskey Creek is included on the 303(d) list for temperature (rearing criteria of 64°F) for its entire length based on PacifiCorp data collected at the mouth in 1996. Data collected by the HRWG in 1998 support this listing, with maximum 7DMAs of 66.2°F at the mouth and 68.2°F above the confluence with Spring Creek. 1998 HRWG data indicated that the rearing standard was also exceeded at the mouth of Spring Creek (64.9°F). Spring Creek should also have been included on the 303(d) list based on this data.

- **Indian Creek** – Indian Creek is included on the 303(d) list for temperature (rearing criteria of 64°F) for its entire length based on PacifiCorp data collected at the mouth in 1996. Data collected by the HRWG in 1998 support this listing with a maximum 7DMA of 64.4°F observed near the Union Avenue power station.

- **Hood River** – The lower Hood River from the Powerdale powerhouse to the diversion dam is included on the 303(d) list for temperature (rearing criteria of 64°F) based on PacifiCorp data collected in 1995 and 1996. This data shows that daily maximum temperatures increase within the bypass reach by up to 2-3^0 F. PacifiCorp plans to increase instream flow during summer and fall as a mitigation measure in the new hydropower license with a goal of decreasing temperatures in the bypass reach. Data collected by the CTWS and HRWG suggest additional temperature concerns upstream of Powerdale Dam. CTWS monitoring begun in 1990 immediately above the dam indicated temperatures exceeding the criteria in 1991, 1994, and 1998. In 1998, the HRWG collected data near Tucker Bridge and observed a slight exceedence of the 64°F criteria (maximum 7DMA of 64.4°F).

During 2000, DEQ will convene a local Advisory Committee to develop a TMDL for temperature for the Hood River system. Additional stream segments may be identified through the TMDL process, particularly as compliance with the 55°F spawning criteria has not yet been evaluated.

Nutrients and pH

"Nutrients" refer to the elements phosphorous and nitrogen that stimulate algae and plant growth in water. Algae and aquatic plants process sunlight into food for aquatic insects and other organisms and are an important part of the stream ecosystem. However, excessive inputs of nutrients can over-stimulate plant growth and harm beneficial uses by raising the pH level, biological and biochemical oxygen demand, creating nuisance algae in irrigation canals, and changing aquatic communities. The State of Oregon standard for aquatic weeds and algae (DEQ 1999) states that:

> "... ***the development of fungi or other growths having a deleterious effect on stream bottoms, fish or other aquatic life, or which are injurious to health, recreation or industry shall not be allowed***."

Phosphorus and nitrogen are the principal growth-limiting nutrients in water. Potential sources of these nutrients from human activities include wastewater discharge, agricultural and livestock runoff, and failing septic systems. Although no State numeric standard for either nitrogen or phosphorus presently exists, target concentrations in the Hood River may be established as part of the TMDL process. An indicator value of *0.30 mg/L for total nitrates* is recommended for water quality evaluation purposes (Watershed Professionals Network 1999). An indicator value of *0.10 mg/L for total phosphorus* is recommended for prevention of eutrophication nuisances in flowing waters (i.e. streams) that do not discharge directly to a lake or reservoir (USEPA Quality Criteria for Water 1986).

The pH of water is a measure of the concentration or activity of hydrogen ions in the water expressed as the negative log of free hydrogen ions. Values from 0 to 7 indicate acidic waters and from 7 to 14 indicate alkaline waters. Spawning and rearing of salmonid fish species are the most sensitive beneficial uses affected by pH. Values of pH outside the range in which a species evolved may result in both direct and indirect toxic effects. Elevated pH levels can cause dramatic increases in toxicity of other pollutants and cause fish kills. The pH standard in the Hood Basin (DEQ 1999) states that:

> ***"...pH values should not fall outside the range of 6.5 to 8.5***. "

To date, pH and nutrient data has been collected by PacifiCorp (1999), DEQ, and by the HRWG (1999). Data from the 1998 DEQ intensive monitoring study are in the Technical Appendices. The available data indicates potential nutrient enrichment problems in the Hood River Watershed, particularly in its lower portions. Possible sources of nutrient enrichment include: fertilizer use; on-site septic systems; WWTP discharges; and soil erosion. Areas of potential concern for nutrients and pH are listed below.

- **Hood River below Powerdale Dam -** The mainstem Hood River below the Powerdale Dam is included in the 303(d) list for pH. As part of their pending FERC relicensing process, PacifiCorp investigated water quality upstream and downstream of Powerdale Dam and in Whiskey, Indian, Odell and Neal creeks in 1995 and 1996. The pH standard of 8.5 was exceeded in the downstream end of the bypass reach in May 1995 (pH of 8.9 observed in a grab sample) and in June 1996 (daily maximum pH of greater than 8.5 observed regularly in diel studies, maximum pH of 8.97). PacifiCorp scientists hypothesized that these pH violations are caused by increased photosynthesis by attached algae in the bypass reach. Increased algal activity is believed to be stimulated by the combined effect of flow modification in the bypass reach and associated temperature increases, and elevated nutrient inputs from Odell, Neal, Whiskey and Indian creeks. Both the PacifiCorp study and monitoring conducted by DEQ and the HRWG indicate that the evaluation criteria of 0.30 mg/L for total nitrates and 0.10 mg/l for total phosphorus were exceeded in Indian, Whiskey, Neal, Lenz, Odell, and McGuire creeks at some point during each study. During these studies, no violations of the pH standard were observed in these tributaries.

- **East Fork Hood River Watershed** – The Hood River Technical Committee identified the East Fork Hood River watershed as another area where nutrient enrichment and pH might be a problem. This concern was based on observations of nuisance algae in the lower East Fork and the EFID canal. Trout and Wishart creeks were identified as tributaries with high potential nutrient contributions. Data collected in the 1998 DEQ intensive study confirmed that Wishart and Trout creeks had high nutrient concentrations, with nitrate concentrations well above the evaluation criteria of 0.30 mg/L. Baldwin Creek had slightly elevated nitrate concentrations. No violations of the pH standard were observed. Nutrients in the East Fork mainstem were well below indicator values, except for the monitoring site located downstream of Newton Creek, which had elevated total phosphorus levels.

Dissolved Oxygen

Adequate dissolved oxygen (D.O.) is essential to fish, invertebrates, and other aquatic life. Some aquatic species including salmonids are sensitive to reduced concentrations of D.O., especially during early life stages as eggs and alevins (hatchlings prior to developing into free-swimming fry) . D.O. concentrations in the water column vary naturally over the course of the day due to changes in temperature and photosynthesis. D.O. levels in the water are typically lowest during the early morning hours. The D.O. level within gravels (intergravel D.O., or I.G.D.O.) directly affects the survival of salmonid eggs. I.G.D.O concentrations are influenced by water column D.O. concentrations, the percentage of fine sediment in the gravel pores, sediment oxygen demand, and oxygen demand of the eggs. The water quality standard for dissolved oxygen is somewhat complicated, taking into account the salmonid life stage present, the I.G.D.O. concentrations, barometric pressure, altitude and temperature. The standard (DEQ 1999) is summarized as follows:

> ***"During the periods from spawning until fry emergence, D.O. in the water column shall not be less than 11.0 mg/L. However, if the minimum I.G.D.O., measured as a spatial mean, is 8.0 mg/L or greater, then the water column D.O. criterion is 9.0 mg/L. During periods of salmonid rearing, D.O. in the water column shall not be less than 8.0 mg/L."***

D.O. data has been collected by DEQ and PacifiCorp (1999). Based on results of the 1998 DEQ intensive monitoring study, D.O. concentrations in the Watershed ranged from 8.3 – 11.7 mg/L in June, from 7.8 – 10.7 mg/L in August, and from 8.0 – 11.8 mg/L in October. The lowest D.O. concentration observed during each sampling period was from the site on Lenz Creek near the Stadelman Drive WWTP pump station. This was the only site that violated the rearing criteria of 8.0 mg/L. As with temperature, determination of compliance with water quality criteria for D.O. is contingent on the final resolution of spawning, incubation and rearing times and species usage in each stream reach. The state and tribal fisheries agencies will resolve this matter with the Hood River Water Quality Technical Committee.

Bacterial Contamination

Water contact recreation is the beneficial use most directly affected by bacterial contamination of surface waters. The bacteria standard for surface waters (DEQ, 1999) states:

> ***"...organisms of the coliform group commonly associated with fecal sources must not exceed the following limits: (a) a 30-day log mean of 126 E. coli organisms per 100 ml, based on a minimum of five samples; or (b) 406 E. coli organisms per 100 ml based on one single sample."***

No Watershed stream segments are presently on the 303(d) list for bacteria based on data collected to date. Routine bacterial monitoring is not conducted by the County Health Department or other entity, except for a DEQ monthly ambient monitoring site near the Hood River mouth where significant bacterial contamination has not been observed. Limited bacterial data was collected by DEQ and PacifiCorp in studies noted earlier. PacifiCorp (1999) observed no violations of the bacterial standards in the lower Hood River in 1995 or 1996. DEQ did observe exceedence of the standards in its 1992, 1995 and 1998 studies based on the single grab sample criteria of 406 *E.coli* organisms per 100 ml. While not enough data was collected to include any stream segments on the 303(d) list for bacteria, this data does indicate areas of possible concern to be investigated further.

DEQ also sampled for bacteria in 1998 in relation to wastewater treatment plant (WWTP) permits for the Odell WWTP discharge into Odell Creek, the Parkdale WWTP discharge into Trout Creek, and the Mount Hood Meadows Ski Resort WWTP discharge into the East Fork Hood River. These data will be evaluated by DEQ in 1999 to address discharge permit renewal.

- **Wishart Creek** – Wishart Creek was monitored during the DEQ intensive water quality sampling in June and August 1998. Samples were collected near Woodworth Drive and near Perron Point Road. The bacteria standard was exceeded at the Perron Point Road site on August 5th.

- **Baldwin Creek** - Samples were collected from 2 sites during the DEQ intensive water quality sampling in 1998. One site was at the Highway 35 crossing and the other downstream at the end of Baldwin Creek Road. The *E. coli* standard was exceeded at the Highway 35 crossing on June 4th. At the end of Baldwin Creek Road, the standard was exceeded on August 5th and October 7th.

- **Odell Creek** – Samples were collected at 3 Odell Creek sites during the 1998 DEQ intensive water quality study –the Sylvester Road crossing, upstream of the confluence with McGuire Creek near John Weber Park, and at a site about 0.5 miles downstream of Dethman Ridge Drive and Odell WWTP (river mile 1). The *E. coli* standard was exceeded at least one of these sites each sampling period. At Sylvester Drive, the standard was exceeded on August 6th; at John Weber Park on June 4th and August 6th; and downstream from the Odell WWTP on October 5th. The October 5th exceedence appeared to be related to a malfunction at the Odell WWTP.

- **McGuire Creek** – Samples were collected at 2 sites during the DEQ 1998 study – at the Davis Drive crossing and upstream of the confluence with Odell Creek near John Weber Park. Samples were collected at two other locations during the 1992 and 1995 fruit packing plant study above and below the Diamond Odell plant discharge. *E. coli* counts at the Davis Drive site were less than 100 organisms/100 ml on all three sampling days in 1998. Downstream near John Weber Park, however, the *E. coli* standard was exceeded August 6th and October 8th in 1998. In the 1992 packing plant study, the *E. coli* standard was exceeded upstream and downstream of the Diamond Odell plant September 15th. On October 4th in 1995, the standard was met at both sites.

- **Neal Creek** – Samples were collected at 2 sites during the 1998 DEQ intensive study – at the Highway 35 crossing and near the mouth. The *E.coli* standard was not exceeded in any samples collected. During the 1992 and 1995 fruit packing plant study, samples were collected in Neal Creek upstream and downstream of Lenz Creek. The *E. coli* standard was exceeded in both years at the upstream site and only in 1992 at the downstream site.

- **Lenz Creek** – Samples were collected at the mouth and near the Stadelman Drive WWTP pump station during the 1998 DEQ intensive study. The *E. coli* standard was not exceeded for any samples collected at either site. Samples were also collected at the mouth of Lenz Creek during the 1992/1995 fruit packing plant study. The *E. coli* standard was exceeded at in 1992 but not in 1995.

- **Whiskey Creek and Spring Creek** – During the 1998 DEQ intensive study, samples were collected near the Whiskey Creek mouth, the mouth of Spring Creek, and Whiskey Creek upstream of Spring Creek. Samples were not collected at the latter two sites during June. The *E. coli* standard was exceeded at the upstream Whiskey Creek site on August 6th; the Spring Creek mouth on August 6th and October 8th; and near the mouth of Whiskey Creek on August 3rd.

- **Indian Creek** – Samples were collected at 3 locations during the 1998 DEQ intensive study – at Country Club Road, Alameda Road crossing, and near the PPL power station on Union Avenue. Samples were not collected from the upper two sites during June sampling. The *E. coli* standard was exceeded on August 6th and October 8th at Alameda Road, and on August 3rd at Union Avenue, but was not exceeded at Country Club Road on any sampling dates.

Turbidity

Turbidity is a measure of water clarity using light penetration through a water sample. In many streams, turbidity serves as a surrogate for measuring suspended sediment - the smaller particles of soil such as silts and clays carried along in the water column. Suspended sediment interferes with the sight-feeding ability of fishes and can damage gill tissue. Suspended sediment can carry other pollutants and may interfere with recreation, irrigation, and aesthetics. Deposition of sediment can fill in pools or gravel interstices and affect salmonid incubation and invertebrate communities. The state standard for turbidity (DEQ 1999) specifies that:

> ***"...no more than a ten percent cumulative increase in natural stream turbidities as measured relative to a control point immediately upstream of the turbidity causing activity."***

This standard is useful when assessing a point source (i.e. individual or end-of-pipe) discharge, but does not fully address nonpoint source (i.e. runoff) concerns. DEQ is considering a review of state sediment standards during an upcoming standards review process. The Oregon Watershed Assessment manual recommends using an *evaluation criteria of 50 NTU* as the level at which sight feeding of salmonids is negatively affected.

Assessment of turbidity in the Hood River Watershed is complicated by natural seasonal glacial melt and occasional natural landslides in steep terrain. Glacial melt occurs between July and October in most years. Potential human-caused sources of turbidity identified by the Hood River Water Quality Technical Committee included: (1) sediment runoff from roads and construction sites; (2) return flow from eroding irrigation ditches; (3) denuded livestock areas that drain to streams; (4) winter sanding of roads and the Mount Hood Meadows parking lots; and (5) landslides from forest or irrigation activities. Chapter 9 assesses sediment sources separately as per the Oregon Watershed Assessment Manual.

The highest turbidities in the 1998 DEQ intensive study were observed during August sampling, while the highest turbidity was observed in April by the HRWG. It is likely that some of the higher turbidity readings are due to glacial runoff – for example, near the mouth of the Middle Fork Hood River (44 NTU), below Newton Creek in the East Fork Hood River (44 NTU), and in the Hood River mainstem (33-37 NTU). In contrast, high turbidity values observed in some of the lower tributaries are potentially due to soil erosion. Sites of potential concern include:

- **Wishart Creek** – Wishart Creek had the highest turbidity level measured during the 1998 DEQ intensive study. On August 5th 1998, a 50 NTU turbidity level was observed at Parrons Point Road while 28 NTU was measured on the same day upstream at Woodworth Drive.
- **Odell Creek** – Elevated turbidity was measured during August and October sampling. On August 6th, the turbidity was 17 NTU at the Sylvester Road site, decreasing to 10 NTU downstream from the Odell WWTP. On October 5th, the highest turbidity observed in October sampling (30 NTU) was in Odell Creek below the WWTP. This relatively high turbidity was probably related to an apparent malfunction at the WWTP.

- **McGuire Creek** – An NTU reading of 17 NTU was observed at John Weber Park on August 6th 1998. Turbidities were less than 15 NTU on all other sampling dates in the DEQ intensive monitoring study and DEQ fruit packing plant surveys in 1992 and 1995.
- **Neal Creek –** Elevated turbidities were observed in Neal Creek by both DEQ and the HRWG volunteers. During the September 1992 DEQ fruit packing plant survey, a turbidity of 62 NTU was observed both upstream and downstream of Lenz Creek. From June 1997 to June 1998, the HRWG (1999) monitored turbidity at 6 sites. The median turbidity value at all sites was less than 10 NTU, however peak values ranged from 9 NTU in the West Fork Neal Creek to **377 NTU** (April 13, 1998) at the Neal Creek mouth. During the 1998 DEQ intensive study, the highest turbidities were observed in August sampling: 35 NTU at the West Fork Neal Creek mouth, 28 NTU at the East Fork Neal Creek mouth, and 18 NTU at the mouth of Neal Creek.
- **Whiskey Creek** – A relatively high turbidity of 22 NTU was observed at the mouth of Whiskey Creek on June 2, 1998. This site had turbidities of 15 and 12 NTU in August and October sampling, respectively.
- **Indian Creek** –The only Indian Creek site with elevated turbidity during the 1998 intensive was at Alameda Road where turbidity was 30 NTU on August 6.

Toxics

Pesticides. Pesticides, herbicides and fungicides are widely used in apple and pear orchards, residential and silvicultural uses, and in right-of-way and road maintenance. A total of 719,188 pounds of 43 different pesticides were used in Hood River County in 1987 (Reinhold et al. 1989).

Hood River Water Quality Technical Committee members were concerned that pesticide use in orchards, forest land, right-of-ways, and residential properties might directly or indirectly contribute to reduced fish populations in the Hood River. A direct fish kill in Odell Creek occurred in the past from pesticide spraying (J. Newton, ODFW, *pers comm*). Oregon Department of Agriculture (ODA) technical staff identified carbaryl, diazinon, malathion, 2-4D, diuron, and endosulfan as pesticides used in the Watershed with the greatest potential toxicity to aquatic organisms. Three of these compounds are organophosphate (OP) insecticides, which can be highly toxic to fish.

OP pesticides are used on orchards in the winter, spring, and summer and may be used year round in urban areas. Use times overlap with mature wild winter steelhead migration upstream to spawn, spawning, early life stage development, and juvenile steelhead migration downstream. Although OPs degrade relatively quickly (soil half-life <40 days) there is potential for exposure to aquatic life and even low doses can be neurotoxic to fish. The inhibition of the enzyme acetylcholine esterase (AchE) in fish tissue can be measured and correlated with the exposure and toxicity of organophosphate and carbamate pesticides (Foster 1998).

Limited testing for pesticide contamination in the aquatic environment has occurred in the Hood River watershed to date. Quarterly sampling conducted by PacifiCorp in 1995 found no detectable levels of pesticides in the Powerdale dam study area (PacifiCorp 1998). Water, sediment and fish tissue samples were collected at five locations by DEQ in May 1998: Hood River above Powerdale dam, West Fork Hood River at Lost Lake Road, and the mouths of Neal Creek, East Fork Hood River and Middle Fork Hood River. Sampling was not timed with any known periods of pesticide use on the land. Samples were analyzed for PCBs, selected chlorinated pesticides (such as DDT and DDT-metabolites) and OP insecticides. DDT and/or its metabolites were found in sediment samples at all five locations. In addition, lindane and diazinon were observed in the water sample collected from the mouth of Neal Creek. The fish tissue samples will be analyzed for AchE inhibition, although this analysis is not yet complete.

Because use of pesticides in orchards was raised as a potential concern, a cooperative pilot study was initiated in 1999 by DEQ, OSU Cooperative Extension, and the Hood River Grower Shipper Association. A limited number of water samples were collected from six locations in the Hood River Basin in March, April and June of 1999. Samples were collected from: the mouth of Neal Creek, the mouth of Indian Creek, Hood River below the PacfiCorp tailrace, West Fork Hood River at Lost Lake Road, East Fork Hood River at the Trout Creek railroad bridge, and Trout Creek near the mouth. Sampling was timed to coincide with the times of pesticide use in the orchards and occurrence of anadromous salmonids in the adjacent streams. These samples were analyzed for total (DEQ laboratory) and dissolved (ODA laboratory) OP pesticides.

Chlorpyrifos (Lorsban) was detected in the March and April samples at all locations but not all samples (Table 7-2). Chlorpyrifos concentrations in Neal and Indian Creeks were above both the acute and chronic state water quality criteria (DEQ 1999). The criteria sets the following chlorpyrifos concentration limits to protect freshwater aquatic life:

"***Chronic criteria = 41 ng/L, Acute criteria = 83 ng/L***"

Azinphos methyl (Guthion) was detected in samples collected in June at Neal Creek, Indian Creek, Hood River, and Trout Creek (Table 7-3). Azinphos methyl concentrations in Neal and Indian Creeks and the Hood River were above the chronic water quality criteria for Guthion (DEQ 1999). The criteria sets the following Guthion concentration limits to protect freshwater aquatic life:

"***Chronic criteria = 10 ng/L, Acute criteria = none set***"

Based on the results of this pilot study, collaborative efforts are now underway in the Watershed to find funding to conduct a more comprehensive pesticide monitoring program. The proposed work would include assessing whether pesticide concentrations in surface waters are adversely affecting aquatic life, determining the mechanism by which pesticide residues are reaching surface waters, and implementing best management practices to prevent pesticide contamination of surface waters.

Table 7-2. Hood River Basin water samples collected in March/April 1999 and analyzed for chlorpyrifos (ng/L).

A. Total chlorpyrifos (ng/L) analyzed using the liquid-liquid extraction EPA Method - Method detection limit 100 ng/L.

Location	D/N	Min (ng/L)	Max (ng/L)	Median
Neal Creek	5/7	0	**400**	200
Indian Creek	3/7	0	**200**	0
Hood River	0/7	0	0	0
WF Hood River	0/7	0	0	0
EF Hood River	0/1	0	na	na
Trout Creek	0/1	0	na	na

B. Dissolved chlorpyrifos (ng/L) analyzed using the USGS Solid Phase Extraction Method - Method detection limit 10 ng/L.

Location	D/N	Min (ng/L)	Max (ng/L)	Mean
Neal Creek	6/6	20	**482**	61
Indian Creek	6/6	42	**75**	61
Hood River	6/6	11	39	18
WF Hood River	1/6	0	5	0
EF Hood River	1/1	15	na	na
Trout Creek	1/1	30	na	na

D/N = Number of detects/total number of samples.
Min = Minimum value detected.
Max = Maximum value detected (values in bold indicate exceedance of state water quality criteria)
ng/L = Nannograms per liter (parts per trillion)
Water Quality Criteria for protection of aquatic life: Freshwater Chronic Criteria = 41 ng/L, Freshwater Acute Criteria = 83 ng/L
Nondetects treated as zero.
na = not applicable

Table 7-3. Hood River Basin water samples collected in June 1999 and analyzed for azinphos methyl (ng/L)

A. Total azinphos methyl (ng/L) analyzed using the liquid-liquid extraction EPA Method - Method detection limit 100 ng/L.

Location	D/N	Min (ng/L)	Max (ng/L)	Median
Neal Creek	5/5	100	**900**	200
Indian Creek	1/4	0	**100**	0
Hood River	1/5	0	**200**	0
WF Hood River	0/5	0	0	na
EF Hood River	0/5	0	0	na
Trout Creek	0/5	0	0	na

B. Dissolved azinphos methyl (ng/L) analyzed using the USGS Solid Phase Extraction Method - Method detection limit 10 ng/L.

Location	D/N	Min (ng/L)	Max (ng/L)	Mean
Neal Creek	4/4	129	**173**	137
Indian Creek	3/3	26	**85**	51
Hood River	3/4	0	**69**	20
WF Hood River	0/4	0	0	na
EF Hood River	0/4	0	0	na
Trout Creek	1/4	0	21	0

D/N = Number of detects/total number of samples.
Min = Minimum value detected.
Max = Maximum value detected (values in bold indicate exceedance of state water quality criteria)
ng/L = Nannograms per liter (parts per trillion)
Water Quality Criteria for protection of aquatic life: Freshwater Chronic Criteria = 10 ng/L, Freshwater Acute Criteria = none set
Nondetects treated as zero.
na = not applicable

Accidental Toxic Spills

Several fish kill incidents have been reported due to accidental spills or releases of fuels or other toxic substances. On Easter Sunday 1995, a toxic spill occurred in Neal Creek when a diesel fuel line used for frost control smudge pots ruptured. In1997, a fish kill occurred when fresh cement spilled into Neal Creek as part of a water pipeline construction project. In 1996, hydraulic fluid spilled from machinery used during Highway 35 widening entered Baldwin Creek via a roadside ditch. As population and vehicle traffic increases in the Watershed, the potential for accidental spills and fish kills may rise as well.

Table 7-4. Summary of Water Quality Impairment: Number of Miles Impaired and Severity of Impairment
(s)=slight impairment, (m)-moderate impairment, (v)=severe impairment

Stream	Temperature*	Nutrients	pH	Dissolved Oxygen +	Bacteria	Turbidity	Toxics
West Fork Hood River Sub-watershed							
Lake Branch	1.0 mile (m)	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown
Ladd Creek	None	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown
McGee Creek	None	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown
Gate Creek	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown
N. Fork Greenpoint Creek	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown
Green Point Creek	None	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown
Dead Point Creek	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown
West Fork Hood River	None	None	None	Unknown	None	None	Unknown
Middle Fork Hood River Sub-watershed							
Clear Branch above Lake	4.0 miles (s)	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown
Clear Branch below Lake	1.0 miles (m)	None	None	Unknown	None	None	Unknown
Pinnacle Creek	None	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown
Coe Branch	None	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown
Compass Creek	2.0 miles (s)	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown
Eliot Branch	None	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown
Bear Creek	None	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown
Tony Creek	None	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown
Middle Fork Hood River	9.0 miles (m)	None	None	Unknown	None	9.0 miles (m)	Unknown

* *Analysis of 55°F spawning criteria has not yet been completed, which may increase the number of impaired stream miles.*

\+ *D.O. samples were collected, however final determination of spawning/rearing periods need to be completed before criteria can be accurately assessed.*

Table 7-4. Summary of Water Quality Impairment: Number of Miles Impaired and Severity of Impairment (continued)

Stream	Temperature*	Nutrients	pH	Dissolved Oxygen +	Bacteria	Turbidity	Toxics
East Fork Hood River Sub-watershed							
Mitchell Creek	None	None	None	Unknown	None	None	Unknown
Meadows Creek	None	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown
Robinhood Creek	None	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown
Dog River	None	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown
Tilly Jane Creek	None	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown
Evans Creek	None	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown
Baldwin Creek	Unknown	1.0 miles (m)	None	Unknown	1.0 miles (m)	1.0 miles (s)	Unknown
Wishart Creek	Unknown	1.0 miles (m)	None	Unknown	0.5 miles (s)	0.5 miles (m)	Unknown
Trout Creek	None	4.5 miles (m)	None	Unknown	None	None	Unknown
East Fork Hood River	6.0 miles (m)	None	None	Unknown	None	18.0 miles (s)	Unknown
Main Stem Hood River Sub-watershed							
Odell Creek	7.0 miles (s)	7.0 miles (s)	None	Unknown	7.0 miles (m)	7.0 miles (m)	Unknown
McGuire Creek	Unknown	0.5 miles (v)	None	Unknown	0.3 miles (m)	0.3 miles (m)	Unknown
Neal Creek	6.0 miles (m)	6.0 miles (s)	None	Unknown	2.0 miles (s)	6.0 miles (s)	6.0 miles (m)
West Fork Neal Creek	None	None	None	Unknown	None	2.0 miles (m)	Unknown
East Fork Neal Creek	None	None	None	Unknown	None	? miles (m)	Unknown
Lenz Creek	Unknown	1.5 miles (v)	None	Unknown	1.5 miles (s)	1.5 miles (s)	Unknown
Whiskey Creek	1.5 miles (m)	0.2 miles (s)	None	Unknown	1.5 miles (s)	1.5 miles (s)	Unknown
Spring Creek	1.0 miles (s)	1.0 miles (s)	None	Unknown	1.0 miles (m)	1.0 miles (s)	Unknown
Indian Creek	2.0 miles (s)	5.0 miles (m)	None	Unknown	2.0 miles (s)	2.0 miles (m)	5.0 miles (m)
Hood River	6.0 miles (s)	None	4.5 mls (m)	Unknown	None	12.0 miles (m)	Unknown

* *Analysis of 55°F spawning criteria has not yet been completed, which may increase the number of impaired stream miles.*

\+ *D.O. samples were collected, however final determination of spawning/rearing periods need to be completed before criteria can be accurately assessed.*

Water Quality – Key Findings

1. The 64°F salmonid rearing temperature criteria is exceeded in portions of Indian, Whiskey, Neal and Odell creeks; in the Hood River below Tucker bridge; in the East Fork Hood River below the EFID diversion, and in Lake Branch below Lost Lake.

2. The 50°F bull trout temperature criteria is exceeded in Middle Fork Hood River, Clear Branch above and below Laurance Reservoir, and lower Compass Creek. Questions exist as to whether 50°F is naturally attainable for Compass Creek and Clear Branch above the reservoir.

3. The pH standard of 8.5 was exceeded in the lower end of the bypass reach below the Powerdale Dam in spring 1995 and 1996, but no exceedences were found in the Watershed during sampling by DEQ in 1998 and 1999.

4. Elevated nitrogen and phosphorus (nutrient) levels exceeding recommended criteria were found in Odell, McGuire, Neal, Lenz, Trout, Wishart, Whiskey and Indian creeks during 1998 DEQ monitoring, in Neal and Lenz creeks during 1998 sampling by the HRWG, and in several of these tributaries and the Hood River mainstem during 1995/1996 monitoring by PacifiCorp.

5. Based on 1998 DEQ monitoring study results, dissolved oxygen (D.O.) concentrations in the Watershed ranged from 8.3 – 11.7 mg/L in June, 7.8 – 10.7 mg/L in August, and 8.0 – 11.8 mg/L in October. Because the state D.O. standard relies on a determination of salmonid spawning vs. rearing periods for each stream reach, further analysis and input from fisheries agencies is needed to assess where and when D.O. standards apply.

6. Bacterial contamination was found in several middle and lower Watershed tributaries in 1998. A more comprehensive study would be needed to identify contamination sources.

7. Only one of 34 sites (Wishart Creek) sampled during the 1998 DEQ intensive study exceeded the recommended turbidity evaluation criteria of 50 NTU. However, most sampling by DEQ occurred during dry weather conditions. Sampling in the mouth of Neal Creek by the HRWG after a heavy rain 1998 sampling measured 337 NTU.

8. Pesticide and herbicide use on orchard, forest, right-of-way and residential properties was identified as a potential concern by the Hood River Water Quality Technical Committee. A preliminary study conducted in cooperation with the Hood River Grower-Shipper Association in spring 1999 found that concentrations of chlorpyrifos, an organophosphate insecticide, exceeded the state standard in Neal and Indian Creeks. In June 1999, concentrations of azinphos methyl, another organophosphate pesticide, exceeded the state standard in Neal and Indian Creeks and near the mouth of the Hood River.

Data Gaps or Further Study Needs:

- Based on the 1999 monitoring results, expand pesticide monitoring program to better assess transport mechanisms and toxicity to aquatic organisms.
- Followup on bacterial contamination observed during the 1998 intensive study
- Identify natural nutrient sources and clarify the relationship between algal growth and pH
- Resolve fish species spawning and rearing areas by river reach to determine appropriate use of specific temperature and dissolved oxygen criteria

8. RIPARIAN AND WETLANDS CONDITIONS

Introduction

This Chapter summarizes a riparian (streamside) conditions assessment completed for the Hood River Mainstem watershed - the lower Hood River and its tributaries- and presents results of a wetlands assessment for the Hood River Watershed as a whole. Both were contributed by Ed Salminen, forest hydrologist and Parkdale resident. Data collected for these assessments are available by request.

Hood River Mainstem Watershed Riparian Assessment

The purpose of this assessment was to evaluate current riparian vegetation[1] conditions for their ability to provide recruitment[2] of large wood[3] and shade. This information can be used in prioritizing stream restoration projects. Large woody debris is an important natural structural element that creates and maintains good fish habitat. Shade affects how much sunlight is received by a stream and can influence water temperature. The critical questions for this section are:

- *What are the current conditions of riparian areas in the Hood River Mainstem watershed?*
- *How do current conditions compare to pre-development conditions for this area?*
- *How can the existing riparian areas be grouped within the watershed to better understand what areas need protection and what appropriate restoration or enhancement opportunities might be?*

Methods

Large wood recruitment potential and shade levels were assessed along 83 miles of stream using 1:12,000 scale color aerial photographs (1995) and spot field verification. The methods used are described in the Oregon Watershed Assessment Manual (Watershed Professionals Network 1999). All year-round streams shown on USGS topographic maps were included as well as some larger intermittent streams. The width of the area examined along the streams was 100 feet on each side. Each side of the streams were evaluated separately for vegetation type, size, and density and other characteristics. The basic mapping unit for data collection was called a Riparian

---

[1] **Riparian vegetation** *refers to the vegetation found on stream banks and adjoining floodplain*
[2] **Recruitment,** *in the context of riparian function, refers to the natural addition over time of new large wood pieces to a stream channel from riparian forests. It is the physical movement of large wood from stream-side forest into the stream channel.*
[3] **Large wood***, as used in this context, refers to pieces of wood (either tree trunks, stumps, or large branches) greater than 6 feet long and greater than 4 inches in diameter. As a general rule, the larger the piece size the more functional it will be in the stream. Large wood is important in the formation of channel structure, and consequently, in creating and enhancing fish habitat.*

Condition Unit or RCU. An RCU is a segment of the riparian area for which the vegetation type, size, and density remain approximately the same. RCUs were grouped into similar categories to evaluate the potential of the riparian zone to contribute large wood to the stream, and to identify riparian areas with similar characteristics that may be treated alike for protection and enhancement purposes. Using aerial photographs and indicators of stream shading, shade levels for each RCU were estimated. Stream orientation and topography were not considered due to the difficulty in evaluating their importance from aerial photos. Shade estimation indicators are shown in Table 8-1.

Table 8-1. Indicators of stream shading used in the riparian conditions assessment.

Indicator	Shade	Category
Stream surface not visible, slightly visible, or visible in patches	>70%	High
Stream surface visible but banks are not visible	40-70%	Medium
Stream surface visible; banks visible or visible at times	<40%	Low

The Oregon watershed assessment method uses designated eco-regions and channel types to describe the potential riparian vegetation likely to occur under natural conditions. The Hood River Mainstem Watershed falls within 3 eco-regions described in Chapter 1: the Western Cascades Lowlands and Valleys; Western Cascades Montane Highlands; and the Oak/Conifer Eastern Cascades-Columbia Foothills. Riparian vegetation also varies by channel type. For example, in low gradient unconfined reaches with wet soils, the probable potential vegetation is predominately hardwoods. Conversely, steep v-shaped valleys would be more likely to have large conifers right down to the stream, except where landslides have occurred. The potential streamside vegetation in the Hood River Mainstem Watershed is similar for all 3 eco-regions and consists of either dense stands of large conifers, or dense stands of large mixed conifers/hardwoods, with small hardwoods or brush in a strip closest to the bank. The width of this strip varies and tends to be narrower in steep, confined channels and broader in gentler gradient, unconfined channels.

To determine whether the trees in a streamside forest were big enough to contribute at least some large wood instream, an average tree stand diameter of 12 inches was used as the criterion above which tree stands were designated "adequate". As a general rule, however, the larger the piece of wood - the more functional it will be in the stream.

The approach used to assess current riparian areas for wood recruitment potential involves defining what the natural potential would likely have been, and comparing the existing vegetation against this benchmark to decide if current conditions are "satisfactory" (i.e., areas that should be protected and where no enhancement is needed), and what factors limit wood recruitment potential in areas that are not "satisfactory". Riparian recruitment situations are defined for the Hood River Mainstem watershed in the following text box.

Riparian Recruitment Situations defined for the Hood River Mainstem Watershed

Satisfactory: Current riparian recruitment potential is satisfactory. No enhancement needed. Many of these stands are close to the threshold size used to define "large" trees (i.e., greater than 12-inch average stand diameter), and should not be considered to represent the most desirable riparian conditions possible. However, these stands generally provide some amount of recruitable wood and, if protected, will provide more desirable conditions over time.

Small stands: Stands that are too small to provide recruitment under current conditions due to past riparian harvest. Conditions include some stands that need no manipulation to become satisfactory, only time to grow, but are mostly small dense hardwood stands, small sparse hardwood conifer or mixed stands, and areas of brush or non-forest vegetation. Appropriate restoration techniques may include simply letting the conifer-dominated stands grow, releasing the conifer component in mixed-species stands, or converting the hardwood-dominated stands to conifer. In a few cases where there are narrow buffers of large hardwoods or large sparse mixed stands, the areas could possibly be under-planted or otherwise enhanced. In areas that have a brush component afforestation may be a restoration approach.

Large hardwood stands: These stands are generally large enough to provide satisfactory recruitment potential, but are either dominated by dense hardwoods where the potential vegetation is conifer or mixed stands, or conditions are sparse. Appropriate restoration/enhancement techniques may be to convert some of these areas over time to conifer stands, or under plant with conifer in the sparse stands. Many of these stands provide some recruitment potential at present, and any conversion should be paced to ensure that some recruitment potential remains.

Agriculture: The land use associated with these stands is agriculture (orchards, pasture, etc.). These are the areas that have no, or very narrow, buffers between agricultural land and the streams. Appropriate restoration/enhancement techniques may be to plant the non-forest areas with conifer, or under plant with conifer in the sparse stands.

Development: The land use associated with these stands is primarily rural-residential development, with some areas of industrial development, and golf course (Indian Creek). The majority of these riparian areas are dominated by brush and grass, or have no riparian vegetation; while the remainder has sparse hardwood/mixed stands. Appropriate restoration/enhancement techniques may be to plant the non-forest areas with conifer, or under plant with conifer in the sparse stands.

Infrastructure: These are areas where riparian conditions are limited by roads, railroads, pipelines, powerlines, dam-related structures, gravel pits, and sewerage treatment plants (Odell Creek). Long-term restoration may not be practical as it would involve removal of the associated structures from the riparian zone. However, opportunities for partial restoration exist in the short term to enhance the narrow buffer areas that exist between the stream and the structure.

Site Conditions: These areas have poorly developed riparian stands due to rocky ground and/or steep dry south-facing slopes (fire-prone), landslide-prone slopes, or wetland conditions. Stands are generally small and sparse. Enhancement opportunities are most likely limited.

Results - Riparian Shade

Shade levels among all streams in the Hood River Mainstem Watershed were found to be High (>70% shade) along 51% or 42 miles of the total length of riparian areas, Medium (40-70% shade) along 21% or 18 miles of the total length, and Low (<40% shade) along 28% or 23.2 miles of the total riparian area length assessed. The results of the shade assessment by 6th field subwatershed in the Lower Hood River Mainstem watershed are shown in Figure 8-1.

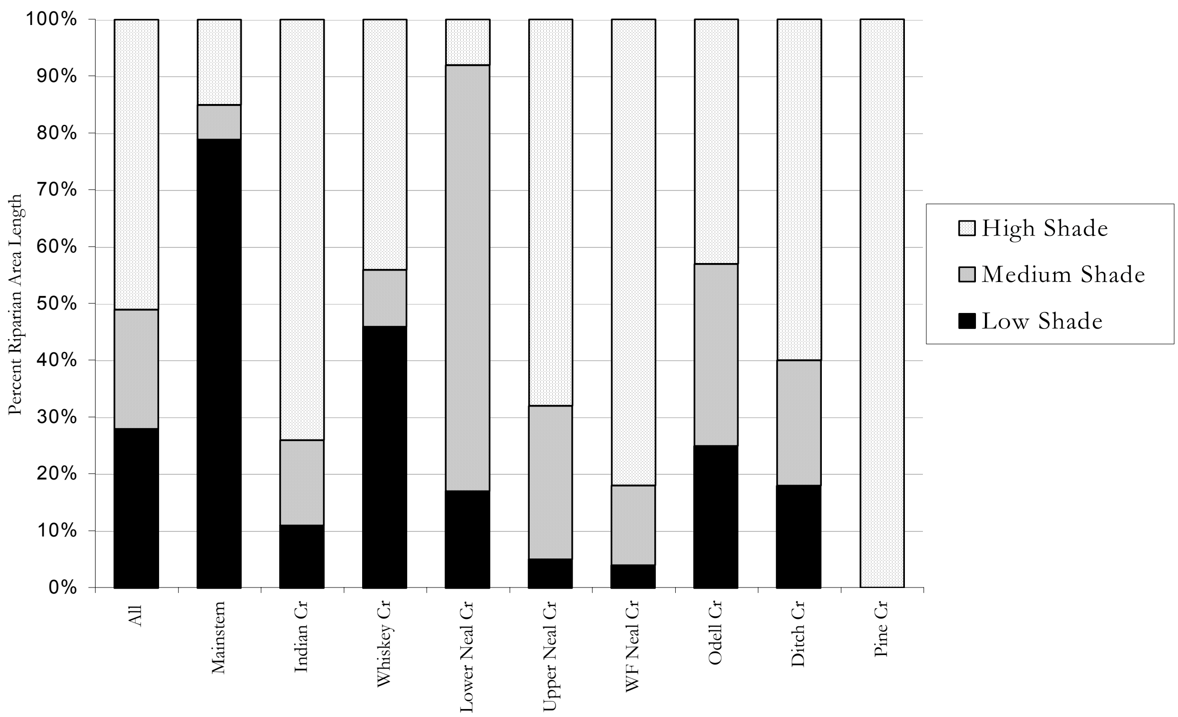


Figure 8.1. Riparian shade distribution among the nine subwatersheds in the Lower Hood River Mainstem watershed.

Results - Riparian Large Wood Recruitment

Table 8.2 lists the length, and percentage of length, of all riparian areas in the Hood River Mainstem Watershed by riparian recruitment situation. Figure 8.2 below shows the distribution of riparian recruitment situations by the nine 6th field HUC subwatersheds that comprise the Hood River Mainstem Watershed.

Table 8.2. Summary of riparian wood recruitment situations.

Riparian Recruitment Situation	Length* of Riparian area affected (miles)	Percentage of total length* of Riparian area affected
Satisfactory	61 miles	36%
Small stands	26 miles	16%
Large hardwood stands	8 miles	5%
Agriculture	25 miles	15%
Development	10 miles	6%
Infrastructure	22 miles	13%
Site conditions	15 miles	9%

* Length of riparian areas = 2 x stream length because each side of the stream is assessed independently

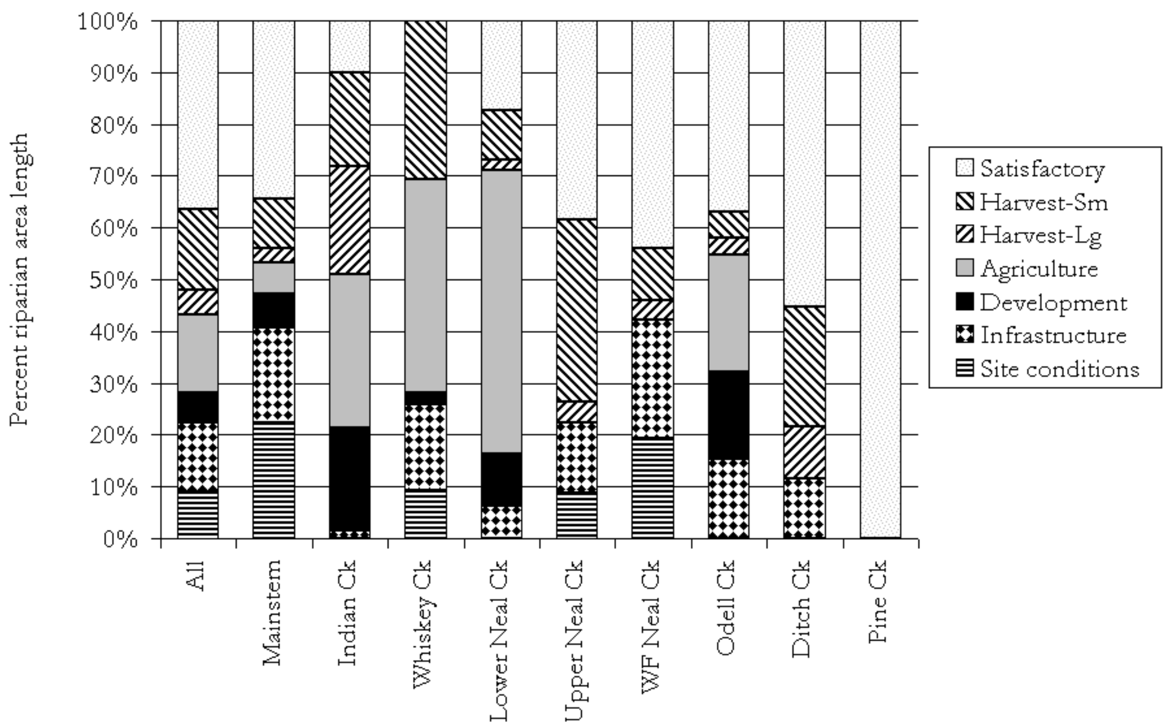


Figure 8.2. Distribution of riparian wood debris recruitment situations by 6th field subwatersheds in the Hood River Mainstem.

The entire Pine Creek subwatershed was classified as having satisfactory current riparian recruitment potential. Most this subwatershed contains mature second-growth forest. Ditch, Odell, West Fork Neal, Upper Neal (East Fork Neal) creeks, and the Hood River Mainstem all had over 30% of the riparian length in a satisfactory condition. Indian and Lower Neal creek have only 10% and 15% satisfactory riparian forests respectively.

Only the Whiskey Creek subwatershed had no riparian vegetation classified as satisfactory current recruitment potential.
Small and large stands impacted by past riparian harvest are distributed throughout all subwatersheds with the exception of Pine Creek. This situation is often, although not always, associated with forest management. Consequently, subwatersheds with a high percentage of forestry land-use (e.g., Ditch Creek and Upper Neal Creek) have a higher percentage of riparian vegetation in this condition. Impacts due to agricultural practices are found primarily in Indian, Whiskey, Lower Neal, and Odell creeks. Most of these impacts are due to a lack of any significant buffer between orchards and the streams.

Development impacts are most pronounced in Indian and Odell creek subwatersheds. A smaller percentage of riparian length is also impacted from development in the Mainstem and Whiskey Creek. Infrastructure impacts are distributed throughout all subwatersheds except for Pine Creek. Indian Creek has a relatively low percentage of impacts due to infrastructure, primarily because roads generally do not parallel the creek. Natural site conditions limit large wood recruitment potential along much of the Hood River due primarily to rocky ground, while site limitations in Whiskey, West Fork Neal, and Upper Neal creek subwatersheds are primarily associated with dry, steep, south-facing slopes.

Riparian Recruitment Situations by Channel Habitat Type

One way to discriminate among streams that are most "important" to fish use is to look at the distribution of riparian recruitment conditions by channel habitat type (CHTs). The MM (low to moderate gradient, moderately confined), FP2 (medium-large floodplain), and FP3 (small floodplain) habitat types make up only 38 miles (23%) of the total length of riparian area in the Hood River Mainstem Watershed, however, these are probably the most responsive CHTs to large wood recruitment. A breakdown of the percent length of riparian areas by riparian recruitment situation among these most responsive channel types is given in Figure 8.3 below.

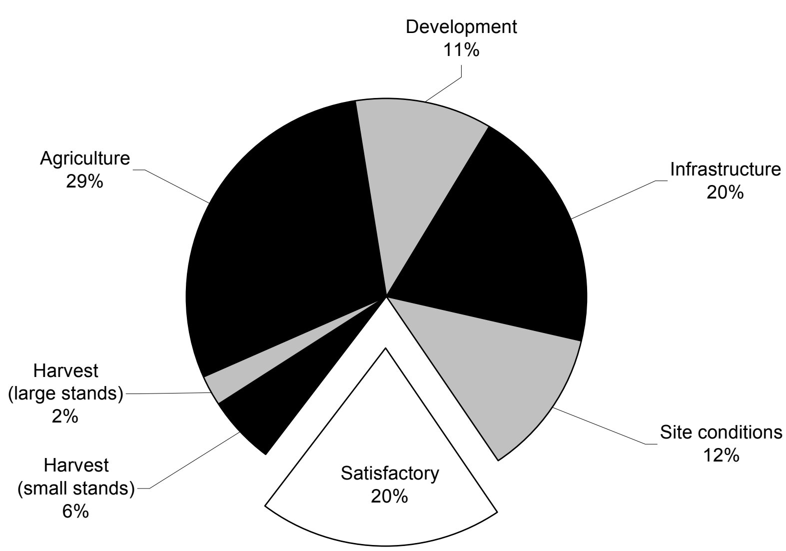


Figure 8.3. Percentage of riparian length among channel habitat types most responsive to large wood (medium-large floodplain, low-to-moderate gradient, moderately confined broad valley types -FP2, FP3, MM).

Along the streams that are within channel habitat types most responsive to large wood, Agriculture presents the largest impact to current riparian recruitment, affecting 29% of the total length of riparian areas. Infrastructure impacts another 20% and development 11% of the riparian length within those CHTs most responsive to large wood. Harvest (both small and large stands) impacts only 8% of the total length of riparian areas. Impacts from site conditions (12% of length) are primarily due to wetlands. Only 20% of the total length of riparian areas in these CHTs currently provides “satisfactory” recruitment potential.

Wetlands Assessment

Introduction

The purpose of this assessment was to identify wetland locations within the entire Hood River Watershed, summarize available data on current wetland conditions, and provide recommendations on further wetland assessments. The critical questions were:

- *Where are the wetlands in the watershed?*
- *What are the general characteristics of wetlands within the watershed?*

The following critical questions are included in the Oregon Watershed Assessment Manual but were not considered in this assessment due to a lack of information:

- *Where are the priority wetlands within the watershed?*
- *What opportunities exist to restore wetlands in the watershed?*

No attempt was made to identify wetland restoration opportunities in this analysis. If wetland restoration is identified as a goal for the Hood River Watershed Group, additional analysis will be required.

Methods

The methods used in this assessment follow those described in the Oregon Watershed Assessment Manual (Watershed Professionals Network 1999) except as noted. Local wetland inventory information is currently unavailable for Hood River County. All information about wetland locations and current conditions was derived from digital National Wetland Inventory (NWI) data produced by the US Fish and Wildlife Service. Additional GIS data layers were supplied by the US Forest Service, Mt. Hood National Forest. Information was organized by the 4 fifth-field watersheds and 50 sixth-field subwatersheds delineated for the Hood River drainage (Table 8-3). All NWI wetlands were included regardless of distance from stream channels, however, wetlands that appear as line features, i.e., riparian wetlands, were not included. Information identified in the Oregon Watershed Assessment Manual not collected in this assessment included surface-water connections between wetlands and streams, buffer condition, and wetland position in the watershed.

Table 8.3. Percent area in wetlands per NWI information for the Hood River Watershed.

Subwatershed	Area (sq. miles)	% area in wetlands
Neal Creek	8.1	0.1%
West Fork Neal Creek	10.7	0.4%
Ditch Creek	6.7	1.5%
South Pine Creek	2.9	-
Odell Creek	12.1	0.2%
Indian Creek	7.7	0.4%
Whiskey Creek	4.5	0.1%
Lower Neal Creek	13.3	0.4%
Hood River Main Stem	13.6	2.8%
Dead Point Creek	6.7	-
Green Point Creek	9.7	0.1%
North Fork Green Point Creek	7.5	0.9%
Long Branch Creek	3.4	-
Lake Branch	18.8	0.4%
Lost Lake	2.5	17.3%
Divers Creek	4.5	0.1%
Laurel Creek	3.1	-
Camp Creek	2.9	-
Marco Creek	2.0	-
Tumbledown Creek	1.9	0.03%
Red Hill Creek	2.9	2.0%
Ladd Creek	6.4	0.9%
Jones Creek	3.6	0.7%
McGee Creek	5.4	0.02%
Elk Creek	3.2	0.9%
West Fork Hood River	17.8	1.1%
Tony Creek	10.2	0.1%
Bear Creek	5.5	0.1%
Clear Branch	6.5	2.9%
Coe Branch	6.6	0.2%
Pinnacle Creek	2.5	1.3%
Eliot Branch	3.8	0.01%
Middle Fork Hood River	9.5	0.4%
Trout Creek	7.4	0.7%
Evans Creek	8.1	0.1%
Yellowjacket Creek	1.3	-
Rimrock Creek	1.0	-
Dog River	12.7	0.2%
Crystal Springs	2.9	0.03%
Tilly Jane Creek	4.5	-
Polallie Creek	4.5	0.3%
Cold Spring Creek	9.1	1.3%
Culvert Creek	1.6	0.3%
Robinhood Creek	3.2	0.4%
Newton Creek	3.2	0.8%
Clark Creek	3.5	0.4%
Meadows Creek	1.7	6.1%
Upper East Fork Hood River	12.7	1.4%
East Fork Hood River	9.1	1.4%
East Fork Hood River (Lower Reach)	26.2	1.7%
Entire Hood River Basin	**339.6**	**0.9%**

Results - Wetland Distribution

A total of 783 wetlands covering 1,950 acres were identified by the NWI in the Hood River Basin. Wetland density (area occupied by wetlands divided by the area of subwatershed) ranged from zero to 17% in the Lost Lake subwatershed, and was less than 1% overall (Table 8.3). Actual acreage of wetlands in the Hood River Watershed are probably underestimated by the NWI. For example, in a field-verified wetland inventory of 100,000 acres of forest land in the Puget Sound area, Sargent and Salminen (1996) found approximately twice the acres of wetlands that was inventoried by the NWI. Salminen (1999) suggests that actual wetland acreages are probably underestimated.

Of the total wetland acreage in the Watershed identified by the NWI, 23% is in the Riverine[4] System, 21% in the Lacustrine[5] System, and 56% in the Palustrine[6] System (Figure 8.4). The Palustrine System consists primarily of the Forested Class (22% of total wetland acreage), the Emergent Class (15%), and the Scrub/Shrub Class (14%); the remaining 5% being distributed among other Palustrine Classes.

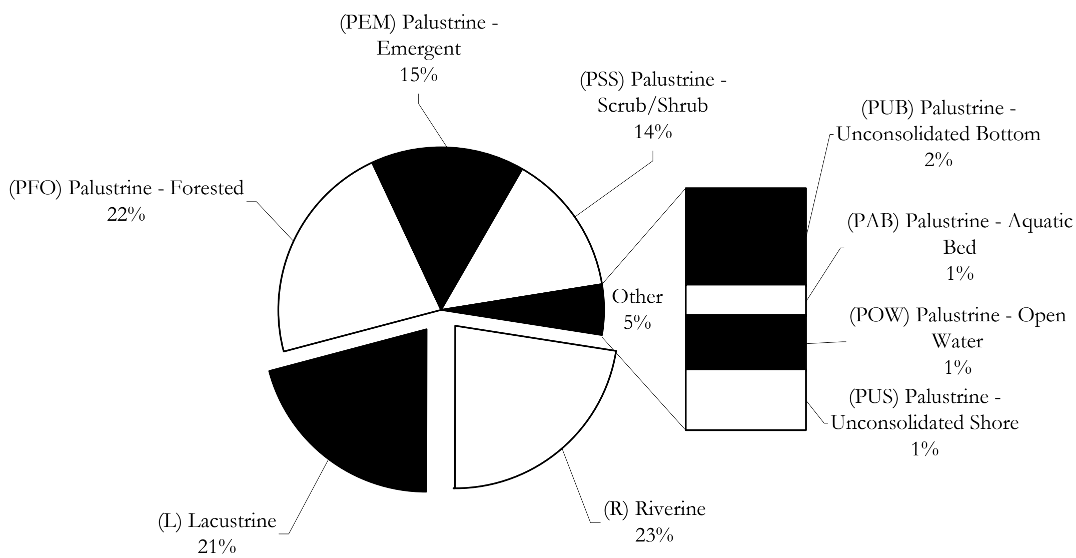


Figure 8.4. Distribution of wetland acreage in the Hood River Watershed by System and Class per the NWI classification system. System refers to the wetland classification while Class refers to vegetation type.

---

4 **Riverine** means wetlands that are associated with flowing waters ,i.e. rivers and streams
5 **Lacustrine** refers to lakes
6 **Palustrine** refers to marshes

Wetland Ownership

Among the four fifth-field watersheds that make up the Hood River drainage, wetland ownership in the Hood River Mainstem watershed is almost entirely non-federal, while wetland ownership in the remaining watersheds are primarily federal: West Fork Hood River (70%), Middle Fork (88%), and East Fork (55%) Hood River .

Wetland Disturbance

The National Wetlands Inventory identified wetlands that have been modified by human activity. The only disturbances noted for the Hood River Watershed were wetlands that have been drained/ditched. Only 10 wetlands (31 acres) have been identified in the NWI as having been drained/ditched in the Watershed (Table 8.4). Based on local observations, the NWI appears to significantly underestimate wetland disturbance in the Hood River Watershed.

Table 8.4. Summary of wetlands identified in the NWI as drained/ditched in the Hood River basin.

Watershed	Subwatershed	Number of wetlands	Acres
Hood River Mainstem	Indian Creek	2	8.3
East Fork Hood River	Lower East Fork Hood River	8	22.8

More information on wetland location, condition and function is needed in order to prioritize wetland protection and restoration efforts in the Hood River Watershed. It is recommended that a comprehensive wetland inventory and functional assessment be conducted. Approximately 45 wetland inventories have been completed by communities in Oregon. Examples of these and assistance in developing an inventory can be obtained from the Oregon Division of State Lands. Because of the large federal ownership of the upper Watershed, it may be most sensible to complete a inventory and functional assessment in two phases - with the Mt. Hood National Forest acting as the lead agency in inventorying federal lands, while Hood River County should be the lead entity on non-federal lands.

Key Findings- Riparian Area and Wetlands

1. Riparian shade levels on all streams in the Hood River Mainstem watershed were found to be **High** along **51%** of the total length of riparian areas, **Medium** along **21%** and **Low** (<40% shade) along **28%** of the total length.

2. Riparian woody debris recruitment situations for the Hood River Mainstem watershed were found to be as follows:

   - **Satisfactory (61 miles; 36% of total riparian length):** Current large wood recruitment potential is satisfactory. No enhancement needed.

   - **Limited (106 miles; 64% of total riparian length):** Current wood recruitment restricted by the following limitations:

     Small stands (26 miles; 16%)

     Hardwood stands (8 miles; 5%)

     Agriculture (25 miles; 15%)

     Development (10 miles; 6%)

     Infrastructure (22 miles; 13%)

     Site conditions (15 miles; 9%)

3. Wetland density is low in the Hood River Watershed. Based on National Wetland Inventory (NWI) information, less than 1% of the basin is occupied by wetlands.

4. The actual area of wetlands in the Watershed is probably underestimated by the NWI.

5. Human-caused disturbances within wetlands appear to be significantly underestimated by the NWI. Data is not available to assess the actual extent or impact of wetland losses in the Watershed.

6. A lack of information on existing wetland locations and conditions presently precludes our ability to prioritize wetland protection or restoration efforts.

Further Work Needed

- Conduct riparian condition assessments for the remaining 5^{h}-field watersheds

- Summarize Forest Service information on riparian conditions for streams within National Forest lands.

- A wetland inventory and functional assessment is needed in order to identify and prioritize wetland protection and restoration opportunities.

9. SEDIMENT SOURCES

Introduction

Erosion, sediment movement and deposition are natural watershed processes. Many streams in the Hood River Watershed have a naturally high sediment load due to geology, terrain and glacial runoff. Aquatic organisms have evolved along with the local natural rate and pattern of erosion and sedimentation. In contrast, human activity can accelerate the natural erosion rate and alter the timing of sediment delivery to streams. Most natural sediment transport occurs only every decade or so during the highest storm flows, and lasts a few days (Watershed Professionals Network 1999). In contrast, sediment delivery related to human activity occurs during smaller, more frequent storms and can be a chronic disturbance to stream environments.

Chronic sediment delivery to streams alters habitat quality and can interfere with agricultural and other water uses. Large increases in sediment loading can harm or even eliminate fish and aquatic invertebrate habitat (MacDonald et al. 1991). Direct effects include changes in bed sediment sizes, filling of pools, increased turbidity, and channel agradation or widening. Fine sediment particles tend to fill in the interstitial spaces between coarser particles – reducing critical habitat space for small fish, invertebrates and other organisms, and lowering the permeability of the streambed and intergravel dissolved oxygen. The shape of sediment particles from sources such as road sanding or construction runoff is often angular and tends to interlock more than the rounded particles typical of most river and glacial sediments. Survival of salmonid eggs can decrease rapidly when the proportion of surface fine sediment (particle sizes <6 mm or ¼ inch diameter) in spawning areas exceeds 20% (Bjornn and Reiser 1991). Since many nutrients and other chemical constituents are sorbed onto fine particles, sediment loading is often directly related to loading of other contaminants (MacDonald et al. 1991).

This Chapter uses existing information to (1) locate natural sediment sources; (2) identify land uses that may raise sediment input to streams above natural rates; and (3) assess their degree of significance if possible. Limitations on time and information did not allow as detailed an assessment as outlined in the Oregon Watershed Assessment manual in this report. Instead this Chapter presents a preliminary treatment of sediment sources subject to additional work and future refinement.

Natural Sediment Sources

Glaciers, landslides and unstable slopes form the principal supply of natural sediment to streams in the Hood River Watershed. The Hood River is a dynamic glacial system with seasonally high amounts of suspended silt and sand. Glacial melt occurs intermittently between July and October. Glacial-origin sediment deposited in stream channels may be transported and re-deposited at other times of the year - especially during fall storms. Five tributaries originate from glaciers: Coe and Eliot Branch in the Middle Fork Hood

River, Newton and Clark creeks in the East Fork Hood River, and Ladd Creek in the West Fork Hood River. The percentage of glacial-origin sediment is greater in the Middle Fork Hood River mouth (23%) than in the East Fork Hood River (5%) mainly due to differences in dilution (USFS 1996b). Glacial influence is relatively minor in terms of sediment loading in the West Fork. As sight-feeders, rearing salmonids in glacial streams depend on the spring and late fall "shoulder seasons" before and after glacial melt to put on the most growth (G. Koonce, Inter-Fluve, *pers. comm*), and also are likely to use non-glacial tributaries and springs during periods of high glacial turbidity.

High precipitation, an abundance of weak rock and unconsolidated material, confined drainages and steep slopes all contribute to frequent landslides in parts of the Watershed. The long steep gradients on the flanks of Mt Hood allow mass-wasting events to gain size and destructive force prior to reaching gentler terrain. The 1980 Pollalie Debris Flow is an example of the type of catastrophic event that can occur following even a medium sized landslide (USFS 1996b). In general, areas of steep gradient within the following subwatersheds were identified by the Forest Service as being prone to landslides, mudflows and debris torrents:

- McGee Creek
- Tilly Jane
- Cold Springs
- Polallie (1980)
- Clark
- Newton (1991)
- Clear Branch
- Ladd Creek (1961)
- Lake Branch (upper)
- Coe Branch
- Pinnacle
- Compass
- Eliot Branch (1999)*(Parentheses = year of most recent event)*

The Forest Service watershed analyses for the East and Middle Fork Hood River watersheds rated certain landform types as having a high potential for debris flows. These landforms were slope deposits, unconsolidated material-steep slopes, weak rock-steep slopes, and resistant rock-steep slopes. A Benda-Cundy Debris Flow Model was used to group East and Middle Fork 6th field watersheds into 3 debris flow hazard types, and estimated the potential frequency of such events for each hazard type (USFS 1996b).

Type 1: Pollalie, North Fork Cold Spring and Tilly Jane creeks. Initiation slide ranging from 1000 to 5000 cubic yards. Long channels of steep enough gradient to scour, an abundance of erodible material in the channels, and entry into larger order stream at an angle greater than 70 degrees. Subsequent debris dam at the junction of the East Fork Hood River could form and develop a catastrophically large debris flow. **Potential occurrence intervals: 30 to 50 years**

Type II: Coe and Eliot branches, Compass, Newton, Engineers, Hellroaring, Culvert, Cat, Rimrock and Birdie creeks. Initiation slide ranging from 1000 to 5000 cubic yards. These drainages tend to be intermediate in length and the scour zone is not long enough to entrain catastrophic volumes of material. Periodic debris flows are released that will probably not dam the larger order streams they enter. **Potential occurrence intervals: 30 to 40 years**

Type III: All those not mentioned above. Not usually susceptible to initiation slides larger than 2000 cubic yards. Short steep channel generally not capable of accumulating an abundance of material in the channel. **Potential occurrence intervals: 20 to 30 years**

Areas of high soil erosion hazard are shown in Figure 9-1 based on selected USDA Hood River County soil survey (Green 1981) and Mt Hood National Forest (MHNF) 1979 Soil Resource Inventory map data. The former covers nonfederal land and the latter covers federally-owned lands. Unfortunately, each coverage uses different map units and hazard categories. Because additional work is required before a uniform interpretation can be developed, only the highest risk categories from each data source is depicted. Areas with soils classified as having both a *high* erosion hazard and *rapid* runoff from the Hood River County soil survey map are shown. For MHNF, only the following erosion categories and risk ratings are shown: "surface soil erosion potential - *moderately severe*, *severe* or *very severe,* "sedimentation yield potential - *high*" and "subsoil erosion potential - *high*".

Soil resiliency is defined as the capability of a site to recover following natural or land-use related disturbance (USFS 1996b). Forest Service watershed analyses for the Middle and East Fork Hood River watersheds identified the following subwatersheds as having a large proportion of basin area with low resiliency soils: Robinhood (71%) , Clark (42%), Newton (54%), and Upper East Fork (52%) and Cold Spring Creek (39%) and Lower East Fork Hood River (39%).

Sediment Sources from Land Use

Potential sediment sources from land use and human activity in the Watershed consist principally of forest and rural roads[7] and open irrigation ditches. Locations where livestock are concentrated along streams can be locally significant sediment sources, along with exposed soils at construction sites, camping or recreation sites, trails, and drainage ditches.

Roads and Culverts

As in most forested watersheds, roads and undersized culvert problems are likely responsible for most of the human-caused sediment load in the Watershed (USFS 1996b). Data collected in the West, Middle and East Fork Hood River watersheds suggested that roads and timber management-related debris flows are the principal sediment sources (USFS 1996a; USFS 1996b). The West Fork Hood River watershed has one of the highest rates of debris torrents on the Mount Hood National Forest with most of these associated with clearcuts and roads (USFS 1996a). A chronic road-related sediment problem was noted at the confluence of Elk and McGee creeks.

[7] Rural roads are those that access farmlands and rural homes including county and state highways.

Several risk factors can be used to indicate the potential for road sediment delivery to streams in each subwatershed. These include the (1) density of unpaved roads; (2) number of road miles potentially routing sediment to streams, i.e., the sum of stream crossings and roads closely paralleling streams; (3) amount of land with steep slopes; (4) percentage of area with potential to contribute sediment from landslides and soil erosion; and (5) the degree of road traffic or usage.

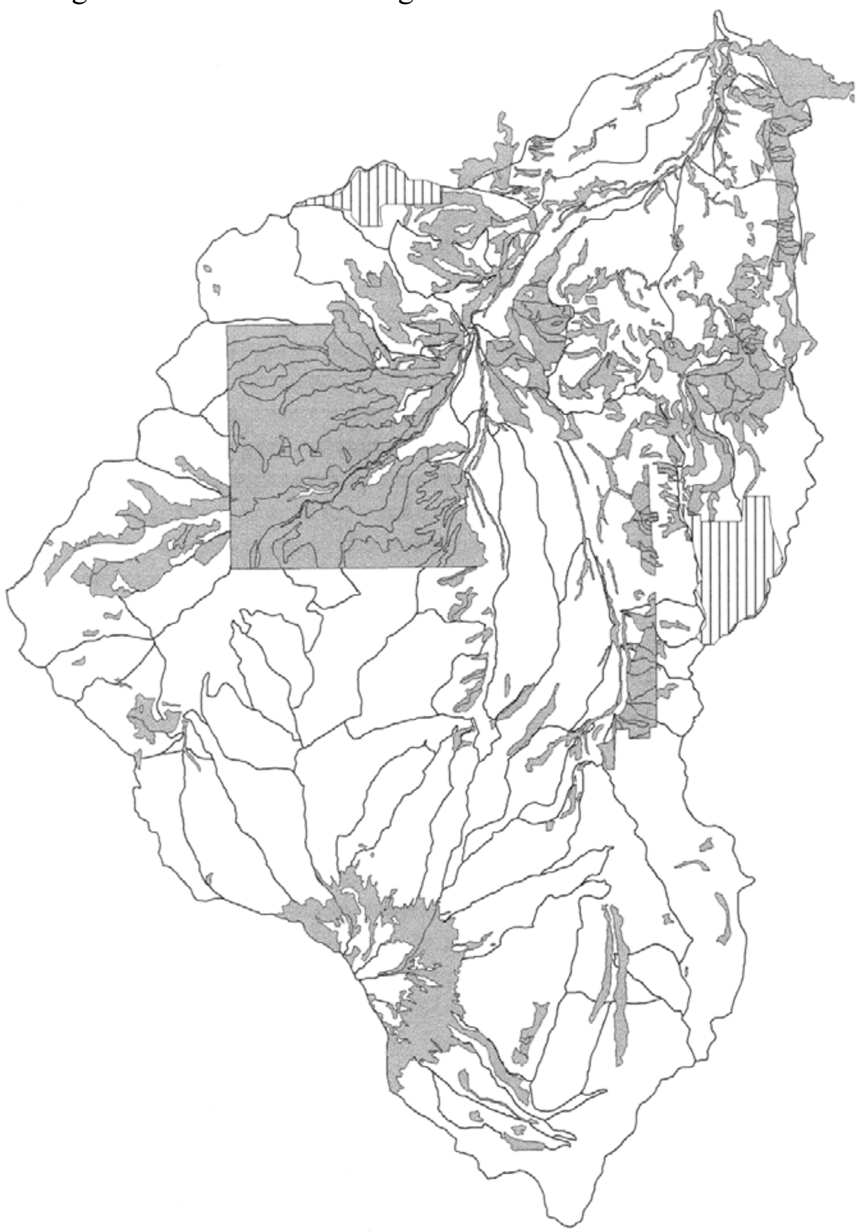


Figure 9-1. Areas of naturally high soil erosion hazard and/or sediment delivery potential relative to subwatershed boundaries using USDA Hood River County Soil Survey (Green 1981) and MHNF Soil Resource Inventory data (Howes 1979). For non-federal lands, soils classified as *high erosion hazard -rapid runoff* are shown. For federal lands, only soils classified as "surface soil erosion potential - *moderately severe*, *severe* or *very severe,* "sedimentation yield potential - *high*" and "subsoil erosion potential - *high*" are shown.

The Forest Service examined the sediment delivery potential of MHNF roads in the West Fork Hood River watershed based on soil erosion hazard and proximity to streams and stream crossings. A summary of results is shown in Table 9-1.

Table 9-1. Sediment delivery potential for forest roads in the West Fork Hood River watershed within the National Forest Boundary. Source: from USFS 1996a (Table 5.13).

DELIVERY POTENTIAL	**EROSION POTENTIAL**			
	Road Surface Material	Soil Resource Inventory Erosion Hazard		
		High	**Medium**	**Low**
Miles of roadway within 400 feet of a stream crossing	Native	2.5 miles	4.4 miles	0.1 mile
	Other	9.6 miles	26.1 miles	2.9 miles
Miles of roadway within 200 feet away from stream	Native	0.4 mile	0.1 mile	0.1 mile
	Other	1.5 miles	4.9 miles	0.3 mile

Subwatershed area, road density and numbers of stream crossings are given in Table 9.2 on the following page. Additional work using Geographic Information System mapping and analyses tools to complete the sediment assessment outlined in the Oregon Watershed Assessment Manual is recommended.

Undersized culverts are susceptible to plugging by debris during large storm events and are a common cause of road washouts and stream sedimentation. Excessive turbidity in the upper East Fork Hood River in June 1995 was traced to an plugged upstream culvert that washed away part of a road (USFS 1996b). Undoubtedly, a number of other local road washouts have been caused by undersized culverts. No inventory of undersized culverts for the Watershed is available at present.

Eleven chronic road maintenance problem sites were identified for the West Fork Hood River watershed within National Forest lands (USFS 1996a) ranging from road fill failure and debris flows to rockfill and drainage problems. Inadequate drainage and culvert maintenance at various other roads posed a near-future risk of blowouts and washouts. Cutbank erosion and failures were reported on cutbanks with greater than a 65% slope.

Table 9-2. Subwatershed area, road density, total stream crossings and the number of stream crossings per square mile of basin area. Road density values include both paved and unpaved roads using available digitized maps.

Subwatershed	**Area** *Square miles*	**Road Density** ***Miles/sq. mile***	**Total No. of Crossings**	**Crossings per Sq. Mi Area**
Indian Cr	7.7	5.6	16	2.1
Evans Cr	8.1	4.9	29	3.6
Odell Cr	12.1	4.6	19	1.6
Marco Ck	2.0	4.5	10	5.0
West Fork Neal Cr	10.7	4.4	14	1.3
Divers Ck	4.5	4.3	2	0.4
Hood R Mainstem	13.6	4.3	16	1.2
Lower Neal Cr	13.3	4.3	18	1.3
Laurel Ck	3.1	4.2	4	1.3
Trout Ck	7.4	4.1	20	2.7
Camp Creek	2.9	4.1	4	1.4
Whiskey Cr	4.5	3.9	10	2.2
Ditch Cr	6.7	3.8	8	1.2
Bear Cr	5.5	3.7	12	2.2
Tony Cr	10.2	3.7	13	1.3
Lake Branch	18.8	3.7	17	0.9
Long Branch*	3.4	3.6	7	2.1
Crystal Springs	2.9	3.5	6	2.0
Meadows Cr	1.7	3.4	4	2.3
Upper Neal Cr (East Fk)	8.1	3.3	17	2.1
West Fork Hood R	17.8	3.2	28	1.6
Tumbledown Ck	1.9	3.1	9	4.8
East Fork Hood R	9.1	2.9	8	0.9
Lower East Fk Hood R	26.2	2.9	40	1.5
Middle Fork Hood R	9.5	2.9	10	1.0
Culvert Ck	1.6	2.8	4	2.5
Red Hill Ck	2.9	2.7	9	3.1
Upper East Fk Hood R	12.7	2.7	20	1.6
Green Point	9.7	2.6	17	1.8
Tilly Jane Cr	4.5	2.5	13	2.9
Dog River	12.7	2.4	5	0.4
Dead Point*	6.8	2.4	12	1.8
Elk Ck	3.2	2.3	2	0.6
Pine Cr	2.9	2.1	4	1.4
McGee Ck	5.4	2.1	5	0.9
N. Fork Green Point	7.5	1.9	2	0.3
Robinhood Cr	3.2	1.9	2	0.6
Pinnacle Ck	2.5	1.8	1	0.4
Lost Lake*	2.5	1.7	1	0.4
Jones Ck	3.6	1.4	2	0.6
Ladd Ck	6.4	1.3	3	0.5
Clear Branch	6.5	1.2	3	0.5
Eliot Branch	3.8	1.1	1	0.3
Yellowjacket Cr	1.3	0.9	1	0.7
Coe Branch	6.6	0.7	2	0.3
Clark Cr	3.5	0.6	1	0.3
Rimrock Cr	1.0	0.5	1	1.0
Polallie Cr	4.5	0.4	2	0.4
Newton Cr	3.2	0.3	2	0.6
Cold Spring Cr	9.1	0.01	0	0.0

**Road-related erosion hazard considered minimal for MHNF lands in these subwatersheds(USFS 1996a)*

Another potential sediment source is rural road maintenance activity, i.e., winter sanding and ditch cleaning. Sand and gravel applied to Forest Service Road 3555 for winter road safety is reported to ultimately end up in the East Fork Hood River and Stringer Meadows (USFS 1996b). Sand and gravel entering streams from State Highway 35 or other roads has been raised as a concern, but little information is available to determine the significance or location of impacts for this assessment. Oregon Department of Transportation (ODOT) places approximately 1000 cubic yards of aggregate per year on the portion of Highway 35 from Parkdale to Bennet Pass, while the same amount is used to sand the 3.6 miles of access roads to Mt Hood Meadows. Hood River County conducts sanding along some roads during snowfall, but the amounts applied have been limited due to costs and availability of materials. In order to reduce gravel transport from parking lots and roadways into the adjacent headwaters of the East Fork Hood River, Mt Hood Meadows Ski Resort is working to obtain approvals for a new stormwater system. Interim measures such as settling basins, straw bales and check dams have been installed. In 1998, ODOT installed several sand traps along Highway 35 near Pollalie Creek to control sediment delivery into the East Fork Hood River.

Road ditch erosion is a potentially important contributor of sediment to Watershed streams. Sites where significant amounts of sediment can enter stream channels along rural roads should be identified so that appropriate management practices can be applied to reduce sediment delivery to streams.

Sediment Sources Related to Irrigation Systems

Open irrigation ditches and canals in the Watershed can deliver sediment to streams through canal failure, slope failure, ditch erosion, end flow, and inter-basin transfer of glacial silt loads into non-glacial streams. Some open canals traverse slopes and hillsides prone to landslide under storm and saturated soil conditions. These canals can transfer large amounts of sediment into streams. In the February 1996 flood, Farmers Irrigation District Lowline Canal failed and caused a landslide sending sediment into Ditch Creek and the West Fork Hood River. Farmers Canal suffered a catastrophic failure in the winter of 1964-5 and again in spring 1988 (FID 1995). The District reports that the upper reach of Highline Canal is in poor condition and is at a high risk of failure (J. Bryan, FID).

The Neal Creek stream channel is used to convey irrigation water from the glacially influenced East Fork Hood River before it is diverted into the East Side Lateral, introducing a glacial silt load not natural to Neal Creek, as well as erosion from the ditch itself and runoff from local land uses. Similarly, Evans Creek is used as an irrigation conveyance for water from Coe and Eliot glacial sources.

Irrigation return flow or end flow carries sediment to streams at a number of sites. One of these sites is on Neal Creek near river mile 5.

Key Findings – Sediment Sources

1. Primary natural sources of sediment delivery to streams in the Hood River Watershed include glacial sediment, landslides and dam break floods originating on the slopes of Mt. Hood.

2. Sediment input to streams due to human activity is primarily related to roads, undersized culverts at road crossings, and irrigation ditches.

3. Sediment delivery from open irrigation ditches and canals is noted as a specific problem in the Watershed. Sediment transport to streams is likely to continue as a result of canal failures, landslides, ditch erosion, and inter-basin transfer of glacial silt loads into non-glacial streams.

4. Rural road maintenance activities including ditch cleaning and winter sand/gravel applications are probable local sediment sources but more information is needed to identify locations and significance of impacts.

5. The US Forest Service sediment monitoring data analysis suggested that most fine sediment production in the West, Middle and East Fork Hood River watersheds was related to forest roads and forest management-related debris flows.

Further Work Needed/ Data Gaps

- Identify and map forest road maintenance needs including undersized culverts on non-federal lands

- Identify and map sediment sources and hazard areas specific to irrigation systems

- Conduct a more detailed assessment of sediment sources including identification of ditch segments with a significant potential for sediment delivery to streams, and continue sediment source analyses and mapping per the Oregon Watershed Assessment Manual.

- Update road maps for all land ownerships using aerial photos

10. UPLAND VEGETATION AND WILDLIFE HABITAT

Introduction

Healthy native plant and wildlife communities are part of a sound watershed ecosystem. While conditions of upland forest and wildlife habitat on National Forest lands are described in Forest Service reports (USFS 1996a; USFS 1996b), this Chapter focuses on private and non-federal land in the Hood River Valley. It is not intended as a comprehensive look at wildlife habitat or native plant status but instead discusses selected topics and voluntary opportunities to assist wildlife on private lands. Information was provided by John Wells, wildlife biologist, USFS; Jim Torland, wildlife biologist, ODFW; Dean Guess, Forester, Hood River County, and Monica Burke, Parkdale resident, naturalist and historian.

Landscape Changes

Vegetation and wildlife habitats that once existed in the Hood River Valley area have been substantially altered in the last 150 years by human development. Agricultural, residential uses and roads now dominate the valley landscape. The Hood River Valley is a "working" environment where people continually manipulate plant and animal environments to meet human needs (Wells 1999). The most obvious change from historic conditions is the replacement of conifer forest with apple and pear orchards. Although trees are still the dominant vegetation of the valley, trees covering lower elevation lands and the valley floor today are deciduous, uniformly spaced, and planted in single-species monotypes.

It is not so much the spatial or compositional change in vegetation that is important, but rather the absence of certain structural features in orchards and residential environments. Deciduous trees do not provide the year-round hiding, thermal and snow accumulation cover or shelter for birds and mammals that conifers provide. The result is a net loss of shelter for resident birds and mammals, especially in winter, at elevations under 2,500 feet. Another structural attribute of native forests, missing in fruit orchards and most rural residential properties are damaged live trees, standing dead trees, and large-diameter downed trees that provide nesting cavities, scanning perches, and insect-feeding substrate for birds and a variety of other wildlife. While remnant forest patches are present among cultivated and developed lands in the lower and upper Valley, these are often fragmented. In many areas, streamside or riparian vegetation is the last stronghold of native plant form and function in the Hood River Valley (Wells, 1999).

Pine-Oak Woodlands

The following was excerpted from *Maritime*, an essay by Hood River valley resident Monica Burke (1999) describing the origin and status of the unique pine-oak forests in the Hood River area, many of which are found on private land.

> "Our savannas, the pine-oak woodlands of the Gorge, are both sublime and quickly disappearing. ..They are disappearing because fires do not come often enough to keep fir trees from overshadowing the gentle oaks. Development has left its mark. In places like the Upper Hood River Valley, the pine-oak woodlands are disconnected and almost gone. Beyond the loss of aesthetics, the disappearance and fragmentation of this ecosystem is significant. It is the habitat for a guild of animals and plants that are among the most rare in Oregon and Washington: the Western Pond Turtle, the *Violet suksdorfia*, ball-head waterleaf, the Oregon poppy. The pine-oak woodlands are the winter habitat of deer and elk and their predators.
>
> The oaks in these woodlands are Oregon white oaks (*Quercus garryana*). University of Oregon Paleobotanist Leroy Detling postulated that the Oregon white oaks and many of its associated flowers migrated northward from the Rogue valley in southern Oregon during a xerothermic period that began at the end of the last Ice Age and peaked about 6,500 years ago. The oaks and plants moved up the Willamette Valley and east through the Columbia River Gorge. As the climate gradually cooled again, some of these plants were able to survive in the Gorge, especially in the drier east end, and became isolated. Still, the oaks in the Gorge are a bit of an anomaly. The marine influence allows the oaks to grow out here in the eastern hinterlands of their range in Oregon. The marine influence map and the map of the historic distribution of Oregon white oak overlap. When I think of the pine-oak woodlands, I see the absolute glory of fields of balsam root, and the tenacity of grass-widow wildflowers poking up through the snow. I see the fact that there isn't much of it; that the oaks can move in geologic time, but not fast enough to withstand the pace of change".

Deer and Elk

ODFW management objectives for deer and elk include maximizing deer and elk populations on public lands and finding a balance between the needs of landowners and the needs of wildlife on private lands, as opposed to managing deer and elk out of existence (Torland, ODFW, *pers comm*). State land use planning objectives for wildlife seek to direct dense residential development away from wildlife habitat to enable hunting activities and minimize human-wildlife interactions, including bear and cougar encounters.

The winter range of large migratory animals like deer and elk in the Hood River valley floor has been usurped by human habitation (Wells 1999). Half the remaining winter range of deer and elk in the Watershed as a whole is on private land. These areas are mapped by ODFW and provided to the Hood River County Planning Department to assist with land use planning (Figure 10-1). Wildlife populations are managed by

ODFW primarily through use of hunting regulations. Hood River valley deer and elk populations are managed for 140 wintering elk and 400 wintering deer. The number of deer and elk during summer and fall are higher due to in-migration from nearby areas.

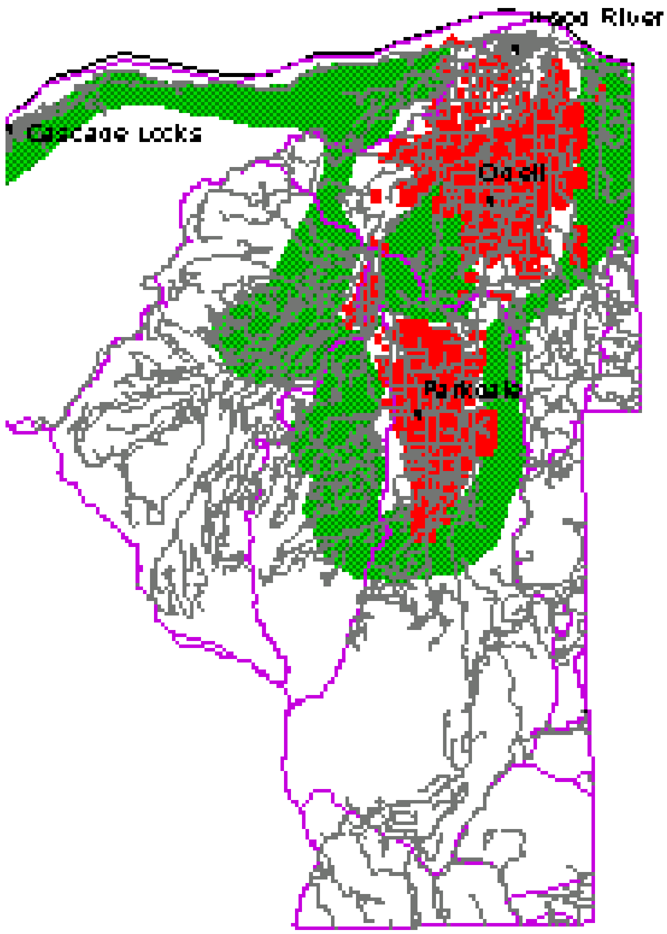


Figure 10-1. Approximate deer and elk winter range habitat delineated for Hood River County (green shaded area) to assist land use planning. Deer and elk may travel beyond these “boundaries” depending on the harshness of the winter. Red color depicts agricultural lands. Source: ODFW, unpublished

Noxious Weeds and Invasive Plants

The Weed and Pest Division of the Hood River County Parks and Buildings Department keeps track of invasive plant species on public and private land and employs control measures on contract for landowners such as Longview Fibre and the Forest Service. Noxious weeds or invasive plant species are commonly recognized as a serious threat to croplands and livestock. Noxious weeds are also a threat to native ecosystems, as they can crowd out and compete with native vegetation depended upon by indigenous wildlife. All ecosystems are vulnerable to invasion by noxious weeds - urban, suburban and rural, forest, riparian areas, wetlands and range lands. The noxious weed situation in the U.S. has been described as "a biological disaster, an explosion in slow motion" by the Wyoming Department of Agriculture. An estimated 6 to 7 million acres on National Forest lands are presently infested and increasing at a rate of up to eight to twelve percent per year (USDA 1998).

The Hood River County Weed and Pest Division uses Integrated Pest Management techniques to control noxious weeds, combining biological controls, herbicide use and mechanical mowing or removal. Currently, 23 invasive plant species are targeted for control or eradication in Hood River County. Their estimated infestation (% of land) in 1999 is shown in Table 10-1.

Tansy ragwort and knapweed both have become well established in the County and have infested 5% and 7% of lands, respectively. Tansy ragwort is very toxic to livestock, while knapweed aggressively displaces pasture feed grasses and other plants[8]. Hood River County focuses on attacking large concentrations of these weeds using biological or chemical methods. Isolated plants and small patches are hand pulled. Purple loosestrife was introduced as an ornamental plant and is now an aggressive pest that grows along the banks of lakes and streams, choking off native riparian vegetation and filling in aquatic habitat and waterways. Purple loosestrife causes economic losses and is the target of intensive control measures. Large numbers of this plant have been found along streams near Odell and are spreading into Neal Creek and parts of the East Fork Irrigation District canal system. The proliferation of Scotch broom, also introduced as an ornamental plant, is of growing concern and has infested 6% of the County. The goal for these species is "zero-tolerance" or eradication (Hood River News, June 9, 1999). Himalayan blackberry is another aggressive plant that can proliferate along streams in cleared areas, crowding out and competing with native plants for moisture.

---

[8] Use of gloves is strongly recommended when hand-pulling knapweed. Studies recently found a possible link between knapweed and cancer-like tumors after cuts or scrapes contact plant toxins. (S. Smith, Wasco County Weed and Pest Department, *pers. comm*)

Table 10-1. 1999 Hood River County weed list and classification with estimate of percent of lands infested. Source: Hood River County Weed and Pest Division.

"A" Pests

Rush Skeleton weed	less than 1% of lands
Yellow Starthistle	less than 1% of lands
Whitetop	less than 1% of lands
Leafy Spurge	less than 1% of lands
Gorse	none known
Russian Knapweed	none known

"A" Pests - weeds that could potentially cause economic loss, not known to occur in the county or occurs in small or restricted distribution making eradication practical.
Action – Infestations are subject to eradication by the County.

"B" Pests

Tansy Ragwort	5% of lands
Puncturevine	less than 1% of lands
Dalmation Toadflax	less than 1% of lands
Water Hemlock	less than 1% of lands
Scotch Thistle	None known
Houndstongue	less than 1% of lands
Purple Loostrife	less than 1% of lands

"B" Pests – a wee that causes economic loss and is of limited distribution and is subject to intensive control measures.
Action – Infestations are handled at the county's discretion with state assistance, as funds are available.

"C" Pests

Knapweed Complex	7% of lands
Canada Thistle	6% of lands
St. Johnswort	2% of lands
Russian Thistle	None known
Common Ragweed	2% of lands
Jimsonweed	None known
Kochia	None known
Scotch Broom	6% of lands
Poison Hemlock	less than 1% of lands
Sandbur	None known

"C" Pests – a weed of some economic importance, either not known to occur or of general distribution.

Action - Infestations are handled at the county's discretion with technical or advisory assistance from the state.

Sensitive Area Protection

Local governments are required by state law to prepare inventories of wildlife habitat, riparian corridors, wetlands and other significant habitats under Goal 5 of the Statewide Planning Program - Oregon Department of Land Conservation and Development (DLCD). Local governments use these inventories to determine which resources are most significant and to take steps to protect them (DLCD 1997). Hood River County has not yet prepared such inventories, potentially leaving wildlife and native plants at risk of incompatible development or inducing greater conflict between wildlife and people given continued population growth.

Opportunities for Wildlife Habitat Enhancement and Protection

Many opportunities exist to improve habitat conditions to benefit people and wildlife in and around agricultural and residential lands. Not all of these will be appropriate for all lands or landowners. Some landowners may have a greater ability to provide, enhance or protect wildlife habitats and native vegetation than others.

A number of sources in the Columbia Gorge area can provide information, advice, and assistance to persons interested in enhancing or protecting wildlife on private land, or help landowners minimize conflict with wildlife. Assistance ranges from low-cost native plant seedlings, low-cost nesting boxes or plans, technical advise, and program information for land donations or conservation easements to potential tax relief for voluntary protection of eligible habitat on private lands.

Potential wildlife enhancement opportunities are listed below:

1. Retain snags, dead trees and downed wood in wood lots and riparian areas to provide perching spots, a food supply and habitat for cavity nesting birds.

2. Keep or plant a native landscape on part or all of your lot instead of a large lawn. Once established, native landscaping requires a fraction of the upkeep and watering of a lawn and can provide food and shelter for small mammals and birds.

3. Eliminate noxious weeds on your land. Removal of invasive noxious weeds will not only improve your property, it will reduce the spread to neighboring properties. The County cannot do it all !

4. Encourage predators like red-tailed hawk, barn owl, great horned owl, American kestrel, long-tailed weasel, striped skunk and spotted skunk for assistance in controlling meadow mice (voles) and pocket gophers.

5. Hang up a bat house to encourage bats. Bats aid control of coddling moth, and other

orchard pests. Put up a scanning post or nest boxes to help birds.

6. Conserve native vegetation along streams, around ponds or in wet areas.

7. Big glass windows kill thousands of migratory and resident birds each year. Marking windows with strips of white tape or raptor silhouettes, using shades, and locating birdfeeders well away from windows prevents such kills. Screen chimney tops to prevent nesting inside - consult with a local fire safety expert to prevent any hazard.

8. Control pets that chase or kill birds, deer and other wildlife. Aside from direct kills, loose pets can prevent wildlife from using otherwise suitable habitat. Free-roaming cats are easy prey for cougar, coyote and fox and may cause predators to remain where they are unwelcome.

9. Diversify vegetation. Plant native species that offer shelter and food. A greater variety of vegetation can foil the spread of pest organisms which rely on a single plant species and enhance natural control of pests by providing predator habitat.

10. Maintain or enhance field and property buffers. Allowing native trees, scrub and grasses to grow at the borders of fields and along property lines can provide wildlife habitat while improving privacy and helping to buffer noise, sprays and trespass.

11. Co-exist with or tolerate beaver activity along streams if at all possible. Beaver ponds recharge groundwater and provide excellent winter habitat for young fish.

Contact these groups and agencies for further information:

Oregon Department of Fish and Wildlife District Office
Natural Resources Conservation Service
Hood River Soil and Water Conservation District
Wasco County Soil and Water Conservation District
Native Plant Society
Audubon Society
US Forest Service
Hood River County Weed and Pest Division

11. Watershed Condition Evaluation

This Chapter summarizes information collected in the assessment process in order to identify habitat restoration and protection opportunities, and outlines missing information or data gaps identified in the assessment process. Key findings and areas of habitat/ water quality concerns are described in summary tables at the end of this Chapter. Maps which overlay fish distribution, channel habitat types, habitat conditions and land use impacts and maps which show the locations of planned or recommended restoration actions will be used in the Action Plan development process. This information will be used to assist the development of a community-based Watershed Action Plan beginning in early 2000 by the HRWG with the help of a technical advisory committee made up of key stakeholders and agencies.

Various factors limit the biological potential of the Watershed. Several of these are associated with natural physical characteristics, while others are related to human activities. Primary physical constraints include glacial sediment loading, high stream gradients, valley confinement, rapid runoff and high peak flows. In addition, subbasin water chemistry has been characterized as having relatively low productivity reflected by low specific conductance, alkalinity, hardness and trace elements (O'Toole and ODFW 1991). Significant limiting factors related to human activities are summarized below:

1. **Upstream and downstream passage barriers:** The upstream migration of salmon, steelhead, and resident trout is blocked or impeded at numerous locations by diversion dams and other structures, resulting in the failure to seed historically utilized spawning and rearing habitat. Direct mortality of downstream migrant salmonids occurs in canals and ditches associated with unscreened or inadequately screened water diversions.

2. **Lack of habitat structure and diversity:** Given its rapid runoff and confined channel characteristics, the lack of instream habitat structure is believed to be an especially significant limitation. Historic timber harvest and other land use has resulted in simplified channels and riparian zones with little instream or recruitable large woody debris. Inadequate wood supply has reduced pool area, pool complexity and pool frequency. Flood refuge, hiding cover, over-wintering and productive early rearing habitats (i.e. shallow lateral habitats, side channels) are lacking. Sediment deposition and meander processes have been disrupted causing channels to downcut and disconnect from their floodplain, while others have widened and aggraded. Most channels lack structure to retain gravels for spawning and invertebrate production and are instead dominated by coarse boulder and rubble substrates. A current deficiency of gravel in the low-water channel for use by fall spawners is of particular concern.

3. **Water quality and riparian degradation:** Summer and early fall water temperatures exceed reported preferred ranges for salmonid life stages in a number of stream reaches. Elevated nutrients, high pH episodes and pesticide contamination have been measured. Road construction, power lines, livestock, forestry and agricultural land use have removed riparian vegetation decreasing shade, bank

stability and water retention capabilities; and raising summer water temperatures.

4. **Low summer/fall instream flows:** Low flow conditions below water diversions during critical periods diminishes or even dewaters aquatic habitat and may impede anadromous or resident fish migration. Low summer flows contribute to warm water temperatures and water quality impairment. Land use activities affecting subsurface storage and recharge have also likely contributed to lower summer flows.

5. **Increased sediment and turbidity:** Seasonally high turbidity and episodic sediment loading is natural to aquatic habitat given the Watershed's glacial characteristics. Controlling chronic sediment delivery and turbidity from human sources is critical to maximizing biological productivity. Chronic sources such as road runoff and landslides associated with roads, undersized culverts, streambank erosion, and irrigation ditches raise the natural sediment load and increase turbidity. Glacial silt is imported into several non-glacial tributaries used to convey irrigation water from East and Middle Fork Hood River sources.

6. **Channel modifications:** Channelization, road fill, bank armoring and other encroachment has narrowed stream channels and limits meander inside floodplains. This has created shorter channels, steeper gradients, higher velocities, loss of storage and recharge capacity, bed armoring, and entrenchment. Channel modifications in interact with each flood event to further aggravate these channel changes. Historic modifications like splash damming and stream clean-out also have had lasting effects on habitat development potential in the subbasin.

7. **Loss of marine nutrients:** Subbasin water chemistry has been characterized as having relatively low biological potential reflected by low specific conductance, alkalinity, hardness and trace elements (O'Toole and ODFW 1991). Loss of nutrients from anadromous adult spawning carcasses due to extremely low population levels and migration barriers further depresses the biological productivity of the subbasin.

8. **Upslope watershed conditions and altered peak flows:** Natural subbasin characteristics including steep gradients, low flood storage capacity, and a high proportion of area vulnerable to rain on snow cause especially rapid runoff and high peak flows. Because of these natural factors, low road densities and maintenance of a high percentage of closed-canopy forest cover are especially important in order to avoid chronic increases in peak flows that undermine productivity and potential for successful instream restoration.

A number of restoration project opportunities in the Hood River Watershed are relatively straightforward while other potential projects require further information. The following guidance is recommended in the Oregon Watershed Assessment Manual as a framework for watershed protection and restoration projects:

1. Protect stream reaches in relatively good condition - areas with relatively high-quality aquatic-riparian habitat, fish populations or water quality conditions

2. Restore stream reaches with habitat or fish populations that are currently in degraded condition but have the potential to support high quality habitat and fish populations - areas with low-quality aquatic-riparian habitat or limitations on fish presence or production, or water quality concerns where the impacts and sources are identified

3. Survey stream reaches where there is insufficient data to assess stream habitat quality or fish population status - areas where the aquatic-riparian condition, fish populations or water quality cannot be accurately determined and/or the links to impacts are not clear.

In general, desirable aquatic habitat conditions for the Hood River subbasin include the following elements:

- Anadromous or resident fish migration and distribution unimpeded by human factors
- Excellent water quality
- Natural streamflows preserved or restored to the degree feasible
- Healthy, mature riparian zones that provide shade and contribute large wood to stream channels
- Stream channels able to access and interact with their floodplains during high water
- Complex habitat structure, i.e., large wood, pools, side channels, diverse lateral habitats
- Abundant gravel supply
- Watershed disturbances are localized and infrequent
- High species diversity and abundance

Assessment Component	Summary of Key Findings	Data Gaps or Incomplete Information	Locations of Impacts Currently Constraining Habitat, Fish Populations, or Water Quality
Historical Conditions	• Historic fish distribution, abundance and species diversity was much greater than today • Heavy riparian timber harvest widespread; splash dams and woody debris clean-out documented for 7.9 miles of stream – impacts persist today • Stream structure was generally more complex and habitat quality greater with more instream large wood and spawning gravel in depositional areas	Quantitative data unavailable, limited historic records	Lower 2 miles of Green Point Creek heavily impacted by splash dams; Instream & riparian wood cleared from East Fork HR from Robinhood to Sherwood campground; historic wood supply lacking in most depositional reaches elsewhere Lower East Fork HR mainstem lacks its former side channels, debris jams and wetlands; Laurance Lake inundated historic habitat for anadromous fish including coho salmon
Fish & Fish Habitat	• Bull trout and steelhead listed ESA -Threatened • Native spring chinook extinct by mid-1970's – supplementation began in 1992 w/Deschutes stock • Native coho and native fall chinook extinct • Sea-run cutthroat classified "depressed" by ODFW • Pacific lamprey decline noted- common basin wide in 1960's but now seen below Powerdale Dam only • Pool area, pool frequency, gravel availability rated "below desirable" especially in East Fork Hood River • Inadequate fish screens/barriers at various sites • 34 county or state road culverts impede passage, 18 ranked as medium priority by ODFW	Status of lamprey and cause(s) for decline Some streams never surveyed; some surveys need updating (post 1996 flood) Summary data for MHNF streams comparable to ODFW habitat surveys Culvert barriers federal and private roads Health status of the aquatic food chain	Fish distribution maps completed by state Fish passage barriers map completed and digitized

Assessment Component	**Summary of Key Findings**	**Data Gaps or Incomplete Information**	**Locations of Impacts Currently Constraining Habitat, Fish Populations, or Water Quality**
Channel Habitat Type Classification	• Of 384 perennial stream miles - 23% were typed as predominantly depositional CHTs, 36% as sediment transport, and 41% as sediment source zones • 15% (59 miles) in productive "MM" or low-moderate gradient/ moderately-confined classification, of these, 28 miles were within the East Fork Hood River watershed • 77% of the total stream length was classified as narrowly confined by hillslopes or other features with limited floodplain area	*Note: Most segments typed as "MM" channels per the draft Oregon classification system could be nominally reclassified as "LM" (low gradient-variably confined) according to the June 1999 manual - CHT maps to be revised in future*	CHT maps completed and digitized
Hydrology & Water Use	• It is unlikely that urban land use has a significant effect on peak flows due to limited urban area and impervious surface • According to USFS hydrologic recovery ratings, forest harvest and roads could affect peak flows in some subwatersheds • Orchard irrigation and power generation are the largest water uses and largest direct alteration of the natural flow regime; reservoir storage minimal except in Clear Branch • Legally authorized irrigation and other withdrawals affect low streamflows • Instream water rights established at 7 locations but consistently met only at 2 of these	More refined analysis of land use and hydrology changes needed Hydrologic function of wetland areas	Irrigation withdrawals have depleted the East Fork Hood River below the EFID diversion during critical (dry) conditions Summer flow restoration needed in Green Point Creek below FID diversion Instream water rights not met consistently in East , Middle & West Forks of the Hood River; or Neal Creek

ASSESSMENT COMPONENT	SUMMARY OF KEY FINDINGS	DATA GAPS OR INCOMPLETE INFORMATION	LOCATIONS OF IMPACTS CURRENTLY CONSTRAINING HABITAT, FISH POPULATIONS, OR WATER QUALITY
Water Quality	• 4 stream segments listed on DEQ 1998 Clean Water Act 303-d list as exceeding state fish rearing temperature standard of 64°F in summer; 2 more stream segments for bull trout standard of 50°F; one stream segment also listed for exceeding pH standard range of 6.5-8.5 • 1999 DEQ pilot study found organophosphate pesticides *chlorpyrifos* and *azinphos methyl* exceeding criteria in 2 streams • Bacterial contamination noted in several areas at various times • Nitrogen and phosphorous exceeding recommended criteria in 9 stream segments	Confirm fish species spawning & rearing areas by reach to apply specific dissolved oxygen and temp. criteria Identify natural nutrient sources; clarify relationship between algal growth and pH Pesticide transport pathways; toxicity to aquatic organisms Turbidity data collected during wet season and/or storm sampling	Mapping completed by DEQ Temperature: Lake Br - RM 10 to Lost Lake; Clear Br- Mouth to Laurance Lake; M.F. Hood River - Mouth to Clear Branch; Neal Cr - Mouth to East/West Fk confluence; Whiskey Cr – Mouth to Headwaters; Indian Cr – Mouth to Headwaters Temperature and pH: Hood River – Powerdale Powerhouse to Dam Chlorpyriphos: Neal & Indian Cr Azinphos methyl: Neal & Indian Cr, Hood R mouth Nutrients: Neal, Odell, Lenz, McGuire; Trout; Wishart; Whiskey and Indian creeks, mainstem Hood River *E. coli:* Baldwin; Wishart; Odell; Indian; Whiskey; McGuire; Lenz
Channel Modification	• Preliminary estimate = 34.6 miles of stream channel modified. Road confinement is the most prevalent modification type affecting 15.2 miles, followed by pipeline and railway beds • Construction, reconstruction and maintenance of State Highway 35 severely confines the East Fork Hood River and continues to impact aquatic habitat particularly along The Narrows and below Dog River to Baseline Road	Updated FEMA floodplain maps Channel migration analysis for lower Neal Creek, East Fork and potentially other stream segments Not all historic stream realignment and channelization identified especially for small streams	Neal Cr from RM 1.5 to forks; West Fk Neal Cr from RM 1.7 to mouth; East Fork Hood River from Dog River to Baseline Rd and along the Narrows; Whiskey Cr along road, Lenz Cr

Assessment Component	Summary of Key Findings	Data Gaps or Incomplete Information	Locations of Impacts Currently Constraining Habitat, Fish Populations, or Water Quality
Channel Modification, *continued*	• Neal Creek is heavily confined by channelization and bank stabilization as a result of adjacent land use and road construction. This has contributed to scour and channel incision, cutting off the creek from its floodplain in areas • Affected channel habitat types=FP3, MM, MV, SV, MC, and LC	Not all "problem" sites (e.g. erosion, unusual bar development and channel shifting) identified Locations of substantial bridge crossing fills not identified	
Riparian & Wetlands Conditions	• In Hood River mainstem watershed, shade levels low along 28% of total length of perennial streams; medium along 21% • Riparian woody debris recruitment situations for Hood River mainstem watershed satisfactory along 61 miles or 36% of total riparian length; limited along 106 miles or 64% of total riparian length • Current wood recruitment potential limited by Small stands (trees too young); land use/ infrastructure/development; and natural site conditions National Wetlands Inventory information estimate = less than 1% of Hood River Watershed is occupied by wetlands; but this likely is a low estimate	Riparian assessment not completed for remaining Watershed (East, Middle, West Forks Hood River 5th field drainage basins) Wetland inventory and functional assessment not available	Shade and wood recruitment potential mapped on paper (USGS quad 1:24000 scale) completed for lower watershed; not digitized

ASSESSMENT COMPONENT	SUMMARY OF KEY FINDINGS	DATA GAPS OR INCOMPLETE INFORMATION	LOCATIONS OF IMPACTS CURRENTLY CONSTRAINING HABITAT, FISH POPULATIONS, OR WATER QUALITY
Sediment Sources	• Sediment delivery to streams from human activity is primarily related to roads, and open irrigation canals and ditches • Natural sediment sources include glacial melt, landslides and debris torrents originating on Mt Hood	Complete analysis per Oregon Assessment manual: e.g., locate undersized culverts, road maintenance needs, ditch/cutslope ravel for forest roads; locate potential sediment delivery to streams for nonforest roads; potential landslide/slope failures Updated road maps Consistent erosion hazard mapping and interpretation between County soil survey and MHNF SRI data Map sediment sources along irrigation systems e.g. return flow/end flow, historic canal failures	Subwatersheds of concern as indicated by both road density and number of stream crossings per mile of land area include: Evans Creek Marco Creek Trout Creek Tumbledown Creek

Reference List

Bailey, D. 1997. Memorandum to Water Resources Commission – Proposed extension of the Hood River basin irrigation season. Agenda Item D, November 21, 1997. Oregon Water Resources Department. Salem, OR.

Bilby, R., B. Fransen, J. Walter, J. Cedarholm and W. Scarlett. 1997. Spawning salmon and the maintenance of healthy stream ecosystems: How many fish do we need? Oregon Sea Grant *Restoration*. Fall 1997. Corvallis OR.

Bjornn, T.C. and D.W. Reiser. 1991. Habitat requirements of salmonids in streams. *In* W.R. Meehan, ed. Influences of forest and rangeland management on salmonid fishes and their habitat.

Bowling, L.C. and D.P. Lettenmaier. 1997. Evaluation of the effects of forest roads on stream flow in Hard and Ware creeks, Washington. TFW-SH20-97-001, Water Resources Series Tech. Rep. 155. Univ. of Washington, Seattle.

BPA. 1996. Hood River Fisheries Project Draft/Final Environmental Impact Statement (DOE/EIS-0241). July 1996. Bonneville Power Administration, Portland, Oregon.

Buchanan, D.V., M .L. Hanson, and R. M. Hooton. 1997. Status of Oregon's bull trout. Oregon Department of Fish and Wildlife. October 1997. Portland, Oregon.

Burke, M. 1999. Maritime. Unpub, essay. Parkdale, OR.

CGEDA. 1998. Columbia Gorge Economic Development Association. Online Internet website.

Christener, J. 1982. Changes in peak streamflows from managed areas of the Willamette National Forest. USDA Forest Service. Willamette National Forest. Eugene, OR.

Coccoli, H. 1999. Neal Creek Water Quality Monitoring Project, 1997-98. Prepared for the Hood River Watershed Group, Hood River, OR.

CTWS. 1998. Spring chinook spawning surveys, 1997. Confederated Tribes of the Warm Springs Reservation of Oregon , Hood River Production Program, Warm Springs, OR.

CTWS. 1998. Hood River and Pelton ladder evaluation studies. 1997 Annual Progress Report to BPA, Portland, Oregon. December 1998. Confederated Tribes of the Warm Springs Reservation. Warm Springs, Oregon.

DEQ. 1998. Oregon's final 1998 Section 303(d) list of water quality limited waterbodies. Oregon Department of Environmental Quality. Portland, OR.

DEQ. 1999. Oregon administrative rules (OAR) Chapter 340. Oregon Department of Environmental Quality. Portland, OR.

DLCD. 1997. Oregon statewide planning program. Oregon Department of Land Conservation and Development.

Feilder, C. 1999. 1998 summary packet for Hood Basin Bull trout working group, unpub. data . US Forest Service, Mt Hood National Forest. Parkdale-Mt Hood, OR.

FID. 1995. Water conservation and management plan. Version 8.0. March 17, 1995. Farmers Irrigation District. Hood River, OR.

Foster, E. 1998. Presence of organophosphate pesticides in the Hood River and effects on steelhead: sampling and analysis plan. Oregon Depart. of Environmental Quality, Portland, OR.

Green, G. L. 1981. Soil survey of Hood River County area, Oregon. USDA Soil Conservation Service. January 1981.

Greg, R. and F. W. Allendorf. 1995. Systematics of *Onchorynchu*s species in the vicinity of Mt. Hood: Preliminary report to Oregon Department of Fish and Wildlife. Univ. of Montana. Div.. Biol. Sci. December 1995.

Howes, S. 1979. Soil Resource Inventory. Forest Service USDA, Pacific Northwest Region. Mt Hood National Forest.

HRC. 1984. Hood River County Comprehensive Land Use Plan Background Document. Hood River County Planning Department.

Krussow, J.P. 1989. Pine Grove memories in the Hood River Valley. Hood River, OR . 148 pp.

Krussow, J.P. 1994. Editor. Aakki-daakki to Zoomorphic. An encyclopedia about Hood River country. Friends of the Hood River Library, Hood River, OR.

MacDonald, L.H. , A.W. Smart and R.C. Wissmar. 1991. Monitoring guidelines to evaluate effects of forestry activities on stream in the Pacific Northwest and Alaska. EPA 910/9-91-001.

Marshall, D. B. 1992. Sensitive vertebrates of Oregon. Oregon Department of Fish and Wildlife, June 1992. Portland, OR.

MFID. 1998. Middle Fork Irrigation District – system history and function. Unpub. Middle Fork Irrigation District. Parkdale, OR.

Newberry, D. 1996. Hydrology report. Appendix C. *In* USDA Forest Service, Pacific Northwest Region. West Fork of Hood River Watershed Analysis Report. Mt Hood National Forest. Parkdale-Mt Hood, OR.

Newton, J. 1996. Unpub. letter to Kim Titus, USDA Forest Service Hood River Ranger District September 17, 1996. Oregon Department of Fish and Wildlife. The Dalles. OR

Nonpoint Source Solutions, Inc. 1997. Draft Oregon Watershed Assessment Manual. October 20, 1997. Prepared for Governors Watershed Enhancement Board. Salem, OR.

ODFW. 1995. Oregon Department of Fish and Wildlife Aquatic Inventories Project: Physical Habitat Surveys, Fish Surveys, Hood River subbasin.

ODFW and CTWS. 1990. Hood River Subbasin Salmon and Steelhead Production Plan. Oregon Department of Fish and Wildlife and the Confederated Tribes of the Warm Springs Reservation. September 1990. Columbia Basin system planning.

Olsen, E. S., R.A. French and A. D. Ritchy. 1994. Hood River and Pelton ladder evaluation studies. Annual Progress Report to BPA, Portland, Oregon. Oregon Department of Fish and Wildlife, Portland OR.

Olsen, E .S. and R.A. French. 1996. Hood River and Pelton ladder evaluation studies. Annual Progress Report to BPA, Portland, Oregon. Oregon Department of Fish and Wildlife, Portland OR.

Olsen, E. S. and R.A. French. 1998. Hood River and Pelton ladder evaluation studies. Annual Progress Report to BPA, Portland, Oregon. Oregon Department of Fish and Wildlife, Portland OR.

Oregon State Game Commission. 1963. The fish and wildlife resources of the Hood Basin, Oregon, and their water use requirements. December 1963. Portland, OR.

O' Toole, P. and Oregon Department of Fish and Wildlife. 1991. Hood River production master plan. Final report of the CTWS and ODFW (Project 88-053, Contract DE-BI79-89BP00631) to Bonneville Power Administration, Portland, OR.

OWPRB. 1985. Findings and conclusions, stipulated modifications to Hood Basin Program before the Water Policy Review Board of the State of Oregon February 26, 1985. Oregon Water Policy Review Board. Salem, OR.

PacifiCorp. 1998. Powerdale Hydroelectric Project, FERC Project No. 2659. Application for new license for major project—existing dam. Vol. III, Exhibit E- environmental reports. Portland, OR. February 1998.

PacifiCorp. 1999. Application for Certification Pursuant to Section 401 of the Federal Clean Water Act. Portland, OR.

Parrow, D. 1998. Streamflow restoration priorities -Hood Basin spreadsheet data, unpublished. Oregon Water Resources Department. Salem, OR.

Pater, D.E., S.A. Bryce, T.D. Thorson, J. Kagan, C. Chappell, J. mernik, S.H. Azevedo, and A.J. Woods. 1998 . Ecoregions of Western Washington and Oregon. Map. USEPA and other cooperators. Corvallis OR.

Pribyl, S., C Ridgley, and J. Newton. 1996. Bull trout population summary Hood River subbasin. Third working draft. January 1996.

Ratkeiwich, R. 1996. Indian Creek stream survey. Unpublished notes. Hood River Watershed Group. Hood River, OR.

Reinhold, J. W. et al. 1989. Oregon pesticide use estimates for 1987. OSU Extension Service. Corvallis, OR.

Sceva, J.E. 1966. A reconnaissance of the groundwater respources of the Hood River valley and the Cascade Locks area, Hood River County, Oregon. State engineer ground water report No. 10. April 1966. Salem, OR.

Seavert, C. F. 1994. Hood River County statistical information. OSU Extension Service. August 1994. Hood River, OR.

Sedell, J.R. and K.J. Luchessa. 1981. Using the historical record as an aid to salmonid habitat enhancement. Paper presented at the Symposium on acquisition and utilization of aquatic habitat inventory information. October 23-28, 1991. Portland, OR.

Serres, C. 1996. 1996 Tony Creek Stream Survey Mt. Hood National Forest Hood River Ranger District. Sandy, OR.

Spruell, P. and F.W. Allendorf. 1997. Nuclear DNA analsys of Oregon bull trout. Final Report to ODFW. Rep. No. 97/5. Div. of Biol. Sci, Univ. of Montana. 28pp.

SWRB. 1965. Hood Basin. State Water Resources Board. April 1965. Salem, OR.

USDA. 1998. Stemming the invasive tide: Forest Service strategy for noxious and nonnative plant management". USDA Forest Service. 29 pp.

USEPA. 1986. *Quality Criteria for Water*. EPA 440/5-86-001. United States Environmental Protection Agency Washington, DC.

USFS. 1996a. Mt Hood National Forest. West Fork of Hood River Watershed Analysis. Mt. Hood-Parkdale, OR.

USFS. 1996b. Mt Hood National Forest. East Fork Hood River and Middle Fork Hood River Watershed Analysis. Mt. Hood-Parkdale, Oregon.

USGS. 1990. Statistical summaries of streamflow data in Oregon. Volume I. US Geological Survey Open File Report 90-118. Portland, OR.

Watershed Professionals Network. 1999. Oregon watershed assessment of aquatic resources manual. Draft January 1999. Prepared for the Governors Watershed Enhancement Board. Salem, Oregon.

Watershed Professionals Network. 1999. Oregon Watershed Assessment Manual. June 1999. Prepared for the Governor's Watershed Enhancement Board. Salem, OR.

Wells, J. 1999. Upland vegetation and wildlife habitat. Prepared for Hood River Watershed Group. US Forest Service, Hood River Ranger District. Unpublished draft.

WRD. 1996. Hood Basin Program - Oregon Administrative Rules, Chapter 690, Division 504. November 13, 1996. Oregon Water Resources Department.

WATER QUALITY APPENDIX

Bonnie Lamb
Oregon Dept. of Environmental Quality

Table A-1. Discharge permits in the Hood River Watershed regulated under the National Pollutant Discharge Elimination System (NPDES)

Permittee	Receiving Waters	Type of Permitted Waste
Parkdale Sanitary District	Trout Creek	Domestic Wastewater Treatment
Odell Sanitary District	Odell Creek	Domestic Wastewater Treatment
Mt. Hood Meadows Ski Area	East Fork Hood River	Domestic Wastewater Treatment
Hanel Lumber Company	Neal Creek	Sawmill
Lage Orchards	Neal Creek via ditch	Fruit Packing Plant – rinse water and condenser cooling water
Diamond Fruit – Van Horn Plant	Neal Creek via ditch	Fruit Packing Plant – rinse water and cooling water
Diamond Fruit – Parkdale Plant	Emil Creek	Fruit Packing Plant – rinse water and cooling water
Diamond Fruit – Odell Plant	Odell Creek	Fruit Packing Plant – rinse water and cooling water
Diamond Fruit – Central Plant	Lenz Creek via ditch	Fruit Packing Plant – rinse water and cooling water
Stadelman Fruit – Odell Plant	Lenz Creek	Fruit Packing Plant – wash water
Stadelman Fruit – Lenz Cold Storage	Lenz Creek	Fruit Packing Plant – non-contact cooling water, defrost water
Duckwall-Pooley Fruit – Odell Plant	Lenz Creek	Fruit Packing Plant – rinse water and cooling water
Duckwall-Pooley Fruit – Van Horn Plant	Neal Creek via ditch	Fruit Packing Plant – non-contact cooling water, defrost water

Note: With the exception of Hanel Lumber Company and Parkdale Sanitary District, all other permits listed above expired prior to 1998 and will be rewritten by DEQ as part of the Hood River TMDL process in 2000.

Table A-2. Maximum 7-day Moving Averages of the Daily Maximum Temperatures (7DMA) - Streams where state criteria have been exceeded

Monitoring location	Year	Agency[+]	Maximum 7DMA	When Max Observed
Lake Branch – based on Rearing Criteria of 64°F				
400 ft d/s Lost Lake	1998	USFS	67.1	September 1-7 (no data prior to 8/18)
Road 13 Crossing	1995 1996 1998	USFS USFS USFS	67.9 70.0 69.4	July 15-21 July 24-30 July 23-29 (no data after 8/4)
USFS Boundary	1994 1996 1997 1998	USFS USFS USFS USFS	62.0 60.2 59.5 60.8	July 22-28 July 25-31 August 2-8 August 9-15
Clear Branch/Middle Fork – based on Bull Trout criteria of 50°F				
2840-640 Bridge u/s Laurance Lake	1994 1995 1996 1997 1998	USFS USFS USFS USFS USFS	52.3 51.1 49.0 47.4 52.1	July 20-26 July 19-25 July 10-16 August 1-7 July 23-30
50 u/s inlet to Laurance Lake	1997 1998	MFID MFID	52.2 52.7	August 1-7 July 23-29
20 yds d/s fish trap below dam	1997 1998	MFID MFID	56.3 57.0	July 22-28 September 13-19
USGS Gage below dam	1994 1995 1996 1997 1998	USFS USFS USFS USFS MFID	56.9 57.2 54.3 57.9 57.9	September 1-7 May 28-June 3 June 3-9 July 23-29 September 14-20 (no data Aug 14-Sep 10)
10 yds d/s Coe Branch	1997	MFID	53.6	July 31-August 6
100 yds d/s Coe Branch	1998	MFID	55.2	September 9-15
10 yds d/s Eliot Branch	1997	MFID	51.3	July 1-7
100 yds d/s Eliot Branch	1998	MFID	52.2	June 3-9

\+ USFS = U.S. Forest Service; MFID = Middle Fork Irrigation District;
CTWS = Confederated Tribes of the Warm Springs Reservation;
MHM = Mount Hood Meadows; HRWG = Hood River Watershed Group
FID = Farmers Irrigation District; PPL = PacifiCorp

Table A-2, continued. Maximum 7-day Moving Averages of the Daily Maximum Temperatures (7DMA): Streams where state criteria have been exceeded

Monitoring location	Year	Agency	Maximum 7DMA	When Max Observed
Clear Branch/Middle Fork (continued)				
Rd 16 crossing *	1994	CTWS	56.6	July 8-14
	1995	USFS	55.2	July 14-20
	1996	CTWS	55.4	July 18-24
	1997	CTWS	55.0	July 12-18
	1998	CTWS	56.2	July 20-26
At mouth	1998	MFID	56.5	August 8-14 (no data July 1-13)
Compass Creek – based on Bull Trout Criteria of 50°F				
Above confluence with Coe Branch	1996	USFS	52.7	August 8-14
	1997	MFID	51.6	July 31-Aug 6
	1998	MFID	54.0	August 9-15
East Fork Hood River – based on Rearing Criteria of 64°F				
Routson Park	1994	USFS	60.6	July 19-25
	1996	USFS	55.9	August 8-14
	1997	USFS	55.4	July 31-August 6
Below EFID diversion @ sandtrap	1997	HRWG	58.3	July 31-August 6
Above EFID diversion	1998	HRWG	61.9	July 20-26
At Trout Creek Railroad bridge	1990	CTWS	69.0	August 4-10
	1992	CTWS	71.2	July 13-19
	1994	CTWS	69.3	July 14-20
	1996	CTWS	64.5	July 18-24
	1997	CTWS	62.7	July 29-August 4
	1998	CTWS	66.5	July 17-23
Odell Creek – based on Rearing Criteria of 64°F				
At Sylvester Drive	1998	HRWG	63.5	August 8-14 (no accurate data in July)
At Rivermile 1	1998	HRWG	66.6	July 20-26

* Note: both USFS and CTWS collected data from 1994-1997. Data was not included in this table for this location if there was not a full summer season of data.

Table A-2, continued. Maximum 7-day Moving Averages of the Daily Maximum Temperatures (7DMA): Streams where state criteria have been exceeded.

Monitoring location	Year	Agency	Maximum 7DMA	When Max Observed
Neal Creek – based on Rearing Criteria of 64°F				
West Fork Neal Creek at USFS boundary	1994	USFS	58.6	July 18-24
	1995	USFS	57.9	July 16-22
	1996	USFS	58.2	July 24-30
	1997	USFS	56.2	August 1-7
	1998	USFS	58.9	July 24-30
West Fork Neal Creek above confluence with EFID ditch	1997	HRWG	57.4	August 3-9
	1998	HRWG	58.8	July 26-August 1
West Fork Neal Creek at mouth	1998	HRWG	62.6	July 22-28
East Fork Neal Creek at mouth	1997	HRWG	56.8	August 2-8
	1998	HRWG	58.6	July 24-30
Neal Creek at mouth	1996	PPL	68.0	Jul 24-30
	1998	HRWG	69.3	July 22-28
	1998	CTWS	69.2	July 22-28
Whiskey Creek – based on Rearing Criteria of 64°F				
Spring Creek u/s confluence with Whiskey Creek	1998	HRWG	64.9	July 24-30
Whiskey Creek u/s confluence w/ Spring Creek	1998	HRWG	68.2	July 24-30
Whiskey Creek at mouth	1996	PPL	65.3	July 23-29
	1998	HRWG	66.2	July 23-29
Indian Creek – based on Rearing Criteria of 64°F				
Indian Creek d/s FID diversion & Country Club	1998	HRWG	58.8	August 8-14
Indian Creek near Union Avenue PPL station	1995	PPL	63.1	July 19-25
	1996	PPL	64.2	July 24-30
	1998	HRWG	64.4	July 22-28

Table A-2, continued. Maximum 7-day Moving Averages of the Daily Maximum Temperatures (7DMA): Streams where state criteria have been exceeded.

Monitoring location	Year	Agency	Maximum 7DMA	When Max Observed
Hood River – based on Rearing Criteria of 64°F				
Above FID diversion	1998	FID	61.7	August 9-15 (no data prior to 7/18)
Near Riverside Drive	1998	HRWG	63.7	August 8-14
At Tucker bridge	1995	PPL	61.2	June 25-July 1 (no data 7/11-9/15)
	1996	PPL	62.8	July 21-July 27
	1998	HRWG	64.4	August 8-14
Above Powerdale Dam	1990	CTWS	63.7	July 16-22
	1991	CTWS	64.4	August 15-21
	1993	CTWS	63.3	August 1-7
	1994	CTWS	65.6	July 17-23
	1995	CTWS	63.2	July 27-August 2
	1996	CTWS	63.6	July 18-24
	1997	CTWS	60.0	August 9-15
	1998	CTWS	64.2	July 21-27
50 meters below Powerdale Dam	1995	PPL	63.9	July 31-August 6
	1996	PPL	64.0	July 21-27 (no data 6/29-7/17)
50 meters below Whiskey Creek	1995	PPL	65.0	July 31-August 6
	1996	PPL	64.0	July 7-13 (no data in mid-July, most of August)
250 meters above Powerhouse	1995	PPL	66.4	July 20-26
	1996	PPL	67.3	July 21-27
Downstream Powerdale Powerhouse	1996	PPL	64.4	July 21-27
	1998	HRWG	66.0	July 21-27 (no data after 8/7)

Table A-3. Summary of Bacteria Results from 1998 DEQ Intensive Study: Streams where the *E. coli* standard of 406 organisms/100 ml was exceeded at some point during the study

Monitoring Location	Date Sampled	*E. coli* Levels
Baldwin Creek		
At Highway 35	June 4 August 5 October 7	**560** No sample 250
At end Badwin Creek Rd.	June 4 August 5 October 7	295 **830** **520**
Wishart Creek		
At Woodworth Rd.	June 3 August 5	92 200
At Parrons Point Rd.	June 3 August 5	265 **410**
Odell Creek		
At Sylvester Dr.	June 4 August 6 October 8	225 **1580** 220
At John Weber Park	June 4 August 6 October 8	**500** **630** 160
Downstream from the Odell WWTP	June 2 August 3 October 5	300 300 **>600**
McGuire Creek		
At Davis Dr.	June 4 August 6 October 8	28 32 84
At John Weber Park	June 4 August 6 October 8	240 **940** **>600**
Neal Creek		
At Highway 35	June 4 August 5 October 7	76 2 68
At the mouth	June 2 August 3 October 5	52 250 270

Table A-3, continued. Summary of Bacteria Results from 1998 DEQ Intensive Study: Streams where the *E. coli* standard of 406 organisms/100 ml was exceeded at some point during the study

Monitoring Location	Date Sampled	*E. coli* Levels
Whiskey and Spring Creeks		
Spring Ck. u/s Whiskey Ck.	June 2 August 6 October 8	No sample **680** **>600**
Whiskey Ck. u/s Spring Ck.	June 2 August 6 October 8	No sample **820** 84
Whiskey Ck. at mouth	June 2 August 3 October 5	360 **520** 380
Indian Creek		
At Country Club Rd.	June 2 August 6 October 8	No sample 90 106
At Alameda Rd.	June 2 August 6 October 8	No sample **>1000** **470**
Near Union Ave. PPL Power station	June 2 August 3 October 5	240 **470** 250