Fifteenmile Watershed Assessment

Prepared by
Wasco County Soil and Water Conservation District

For
Fifteenmile Watershed Council

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Fifteenmile Watershed Council
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Copies of the Fifteenmile Watershed Assessment are available by contacting Wasco County SWCD at
2325 River Road, Suite 3, The Dalles OR 97058 or (541) 296-6178 x3.

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Acknowledgments:
Data and information was provided by the following individuals and organizations:

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- Wasco County Public Works, The Dalles OR.
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- Fifteenmile Watershed Council

Evaluation Committee:
Drafts of the Fifteenmile Watershed Assessment were provided to the following individuals for review:

- Doug Thiesies, Oregon Department of Forestry
- Bonnie Lamb, Oregon Department of Environmental Quality
- John Dodd, US Forest Service, Barlow Ranger District
- Gary Asbridge, US Forest Service, Mount Hood Ranger District
- Chris Rossel, US Forest Service, Barlow Ranger District
- Steve Springston, Oregon Department of Fish and Wildlife
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- Gary VanOrman, Fifteenmile Watershed Council
- Liz Turner, Associate Director, Wasco County SWCD

Bonnie Lamb (DEQ) provided most of the data and wording in the water quality section.

Gary Asbridge (MHNF) and the team from ODFW provided fish habitat data.

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Gary VanOrman took the lead for the watershed council in reviewing each draft. He deserves special credit for repeated review and exacting critique of the document. His comments stimulated discussion among the rest of the watershed council and the technical advisors.

Introduction

This document provides an assessment of critical watershed health parameters for the Fifteenmile Creek Watershed located in Northern Wasco County, Oregon. Fifteenmile Creek enters the Columbia River just downstream from The Dalles Dam and just upstream of the City of The Dalles, Oregon. The assessment was coordinated by Wasco County Soil and Water Conservation District (SWCD) at the request of the Fifteenmile Watershed Council. The watershed assessment will be used to set priorities for watershed restoration projects within the Fifteenmile Watershed. The assessment looks not only at the health of perennial streams, but also at the health of major seasonal reaches and upland areas, focusing on water quality and quantity issues, with their effects on aquatic habitat. Upland vegetation is addressed, although wildlife populations are not.

The Fifteenmile Watershed Assessment is a living document that can be updated and/or revised at the discretion of the Fifteenmile Watershed Council as new data emerges.

The watershed assessment generally follows the format and protocols described in the Oregon Watershed Assessment Manual, developed by Watershed Professionals Network for the Governor's Watershed Enhancement Board (now the Oregon Watershed Enhancement Board). The Assessment Manual was developed in support of the Oregon Plan for Salmon and Watersheds.

Wasco County SWCD had access to ArcView 3.2a Geographic Information Systems software and electronic data, including most significantly, georectified aerial photos and USGS topographic maps. These were used extensively in the assessment, and in some cases, the protocols described in the Assessment Manual were altered to take advantage of the electronic tools. Whenever possible, results of aerial photo analysis were verified with field visits. The entire assessment was conducted from September 2001 to February 2003, including review by the SWCD, Watershed Council and other natural resource agencies.

Copies of the Fifteenmile Watershed Assessment are available by contacting Wasco County SWCD at 2325 River Road, Suite 3, The Dalles OR 97058 or (541) 296-6178 x3.

1) Watershed Description

The Fifteenmile Creek Watershed is located on the east slope and in the eastern foothills of the Cascade Range. The area considered by this report includes the Fifteenmile Watershed, including its principal tributaries, Eightmile Creek, Fivemile Creek, Dry Creek, Ramsey Creek and Larch Creek. The total drainage area is 236,689 acres, or approximately 370 square miles. Fifteenmile Creek originates within the Mount Hood National Forest near Lookout Mountain (highest point in Watershed, 6,525 feet). Eightmile Creek originates north of Fifteenmile, and Fivemile Creek originates immediately north of Eightmile. All three flow toward the northeast. Fifteenmile then curves north, then west, before merging with Eightmile and turning northwest for the final two miles to the Columbia River. The elevation at the mouth of Fifteenmile is 78 feet. Fivemile Creek flows into Eightmile one mile up from the mouth of Eightmile Creek. Dry Creek originates on the north side of Tygh Ridge, and flows northward, before turning northeastward and paralleling Fifteenmile for approximately three miles, collecting most of the runoff from Tygh Ridge (maximum elevation 3,200 feet) before joining Fifteenmile at the historic site of Rice.

The stream network was divided into five individual sub-watersheds varying in size from 26,988 acres to 62,917 acres. The five subwatersheds were designated Upper Fifteenmile, Lower Fifteenmile, Eightmile, Fivemile and Dry Creek. The portions of these watersheds within the Mount Hood National Forest were analyzed together as a separate watershed for comparison with private lands. Watershed and sub-watershed boundaries used in the Assessment are shown in Figure 1-1. Sub-watershed boundaries used in this assessment were digitized based on USGS topographic maps.

Conditions in the creeks are controlled by the geology, climate, hydrology and land use of their surrounding drainage area from ridge-top to ridge-top. The Watershed is a dynamic system with steep terrain.

Generally, the geology of Fifteenmile Watershed is dominated by north-tilting basalt lava flows that are cumulatively more than 3,000 feet thick. Tygh Ridge, an anticline or fold in the geologic layers, forms the south boundary of the watershed. From there, the landscape slopes gradually to the north. Fifteenmile Creek and its major tributaries cut through the geologic layers, forming a landscape of rolling ridges and valleys.

Fifteenmile Creek Watershed includes areas of The Dalles Formation and Bretz flood sediments. The Dalles Formation is a unit of mixed sedimentary material and volcanic ash deposited on top of the underlying basalt. Fifteenmile, Eightmile and Fivemile Creeks collect sand and fine sediments from The Dalles Formation.

Climate varies across the Watershed because of its wide range of elevations and transitional location between weather dominated by wet marine airflow from the west and the dry continental climate of eastern Oregon. Areas of climate and landscape similarity called ecoregions have been defined as a common framework for ecosystem management in the U.S. (Pater et al. 1998). The headwaters of the Watershed are located in three separate ecoregions: Cascade Crest Montane Forest, Grand Fir Mixed Forest and Oak/Conifer Eastern Cascades Foothills (table2-1). The eastern part of the watershed is located in the Columbia Plateau and Pleistocene Lake Bottom ecoregions, characterized by bunchgrass prairie with small mixed hardwood trees in the riparian zones. The average annual rainfall varies from 45-70 inches at the headwaters of Fifteenmile Creek, down to 11 inches or less near the mouth (Figure 1-2). This system of ecoregions is used by the Oregon Watershed Assessment Manual as defined by the Oregon Natural Heritage Foundation (http://www.gis.state.or.us/data/alphalist.html).

Fifteenmile Watershed is located at the eastern end of the Columbia Gorge. Due to its transitional location, the Fifteenmile Watershed, along with the Columbia Gorge, is ecologically very diverse. The Columbia Gorge is home to fifteen endemic (occurring nowhere else) species of wildflower, five of which are found in the pine-oak woodlands (Jolly, 1988).

Figure 1-1. Watershed and sub-watershed boundaries used in the Assessment.

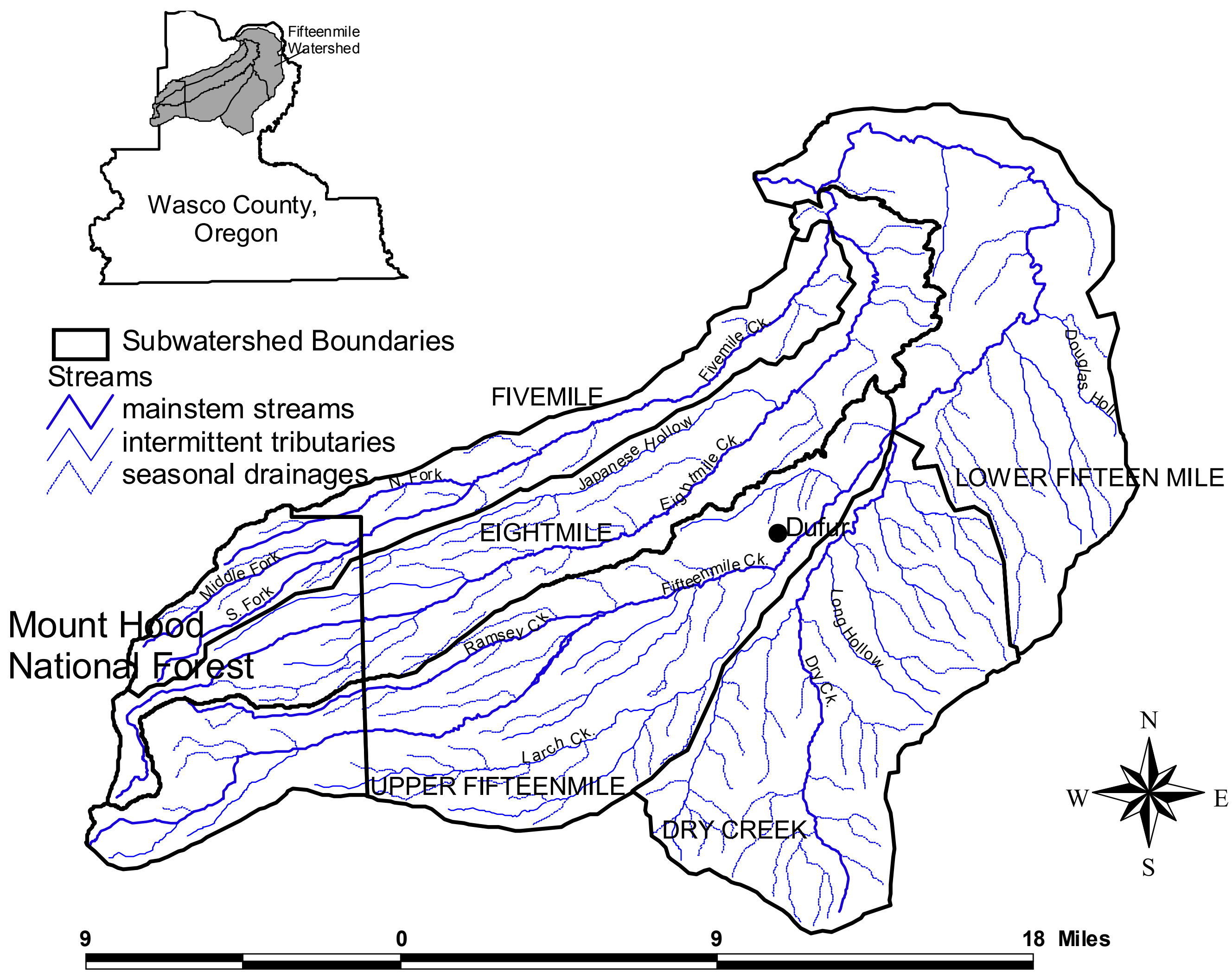
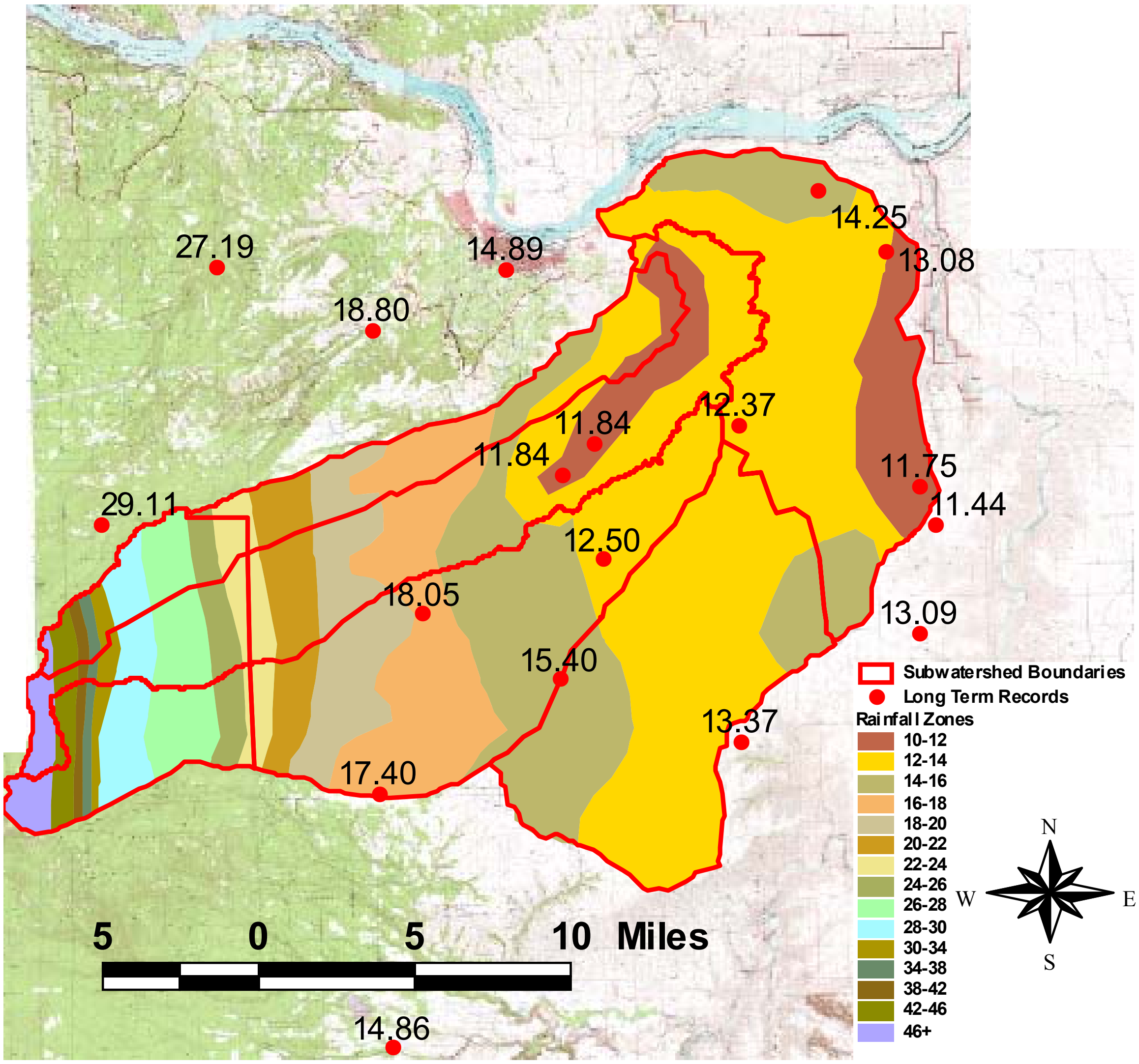


Figure 1-2: Rainfall records have been kept for up to 30 years by local cities, landowners, and other entities. Oregon State University Extension Service in The Dalles compiled existing data in 1994. Rainfall zones are estimated based on recorded data and topography.



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1.1) Social and Economic Background

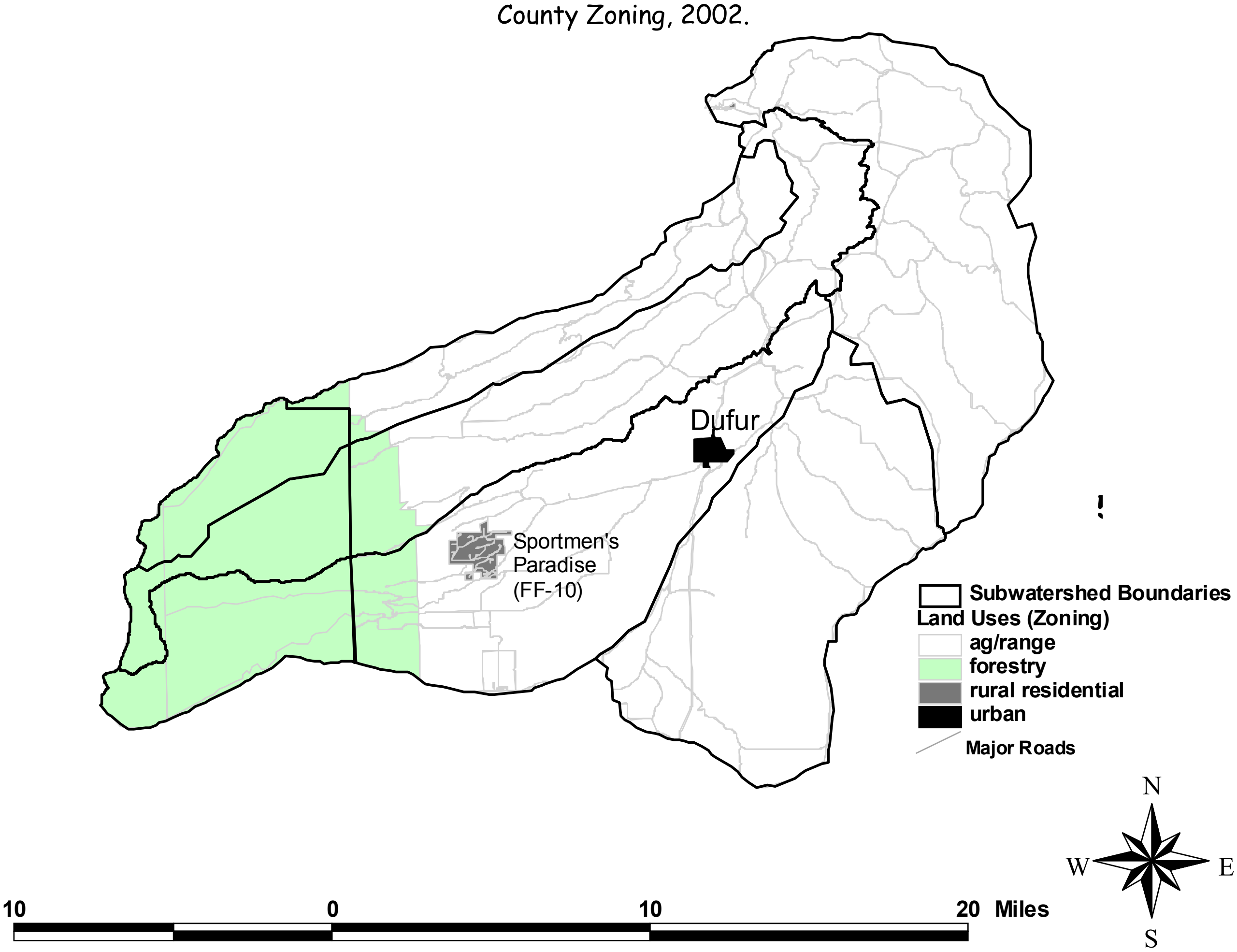
Population

Wasco County had a population of 23,791 in Year 2000. Of the total county population, less than half - 11,635 - lived outside the City of The Dalles. Dufur, the only incorporated city in Fifteenmile Watershed, had a population of 588. The County population rose 9.7% between 1990 to 2000. The average population density in Wasco County is 10 people per square mile (CGEDA website 2001: http://www.cgeda.com/).

Land Use, Ownership and Treaty Rights

For this assessment, land use has been grouped into four categories: agriculture-range, forestry, rural residential and urban (fig. 1-3). Land use was based on Zoning regulations from Wasco County Planning Department.

Figure 1-3. Current land use as defined for the watershed assessment. Based on Wasco County Zoning, 2002.



Wasco County Planning Department zones most of the eastern two thirds of the Fifteenmile Watershed (187,497 acres) for agricultural land use with 160-acre minimum lot size (A1-160) (fig. 1-3).

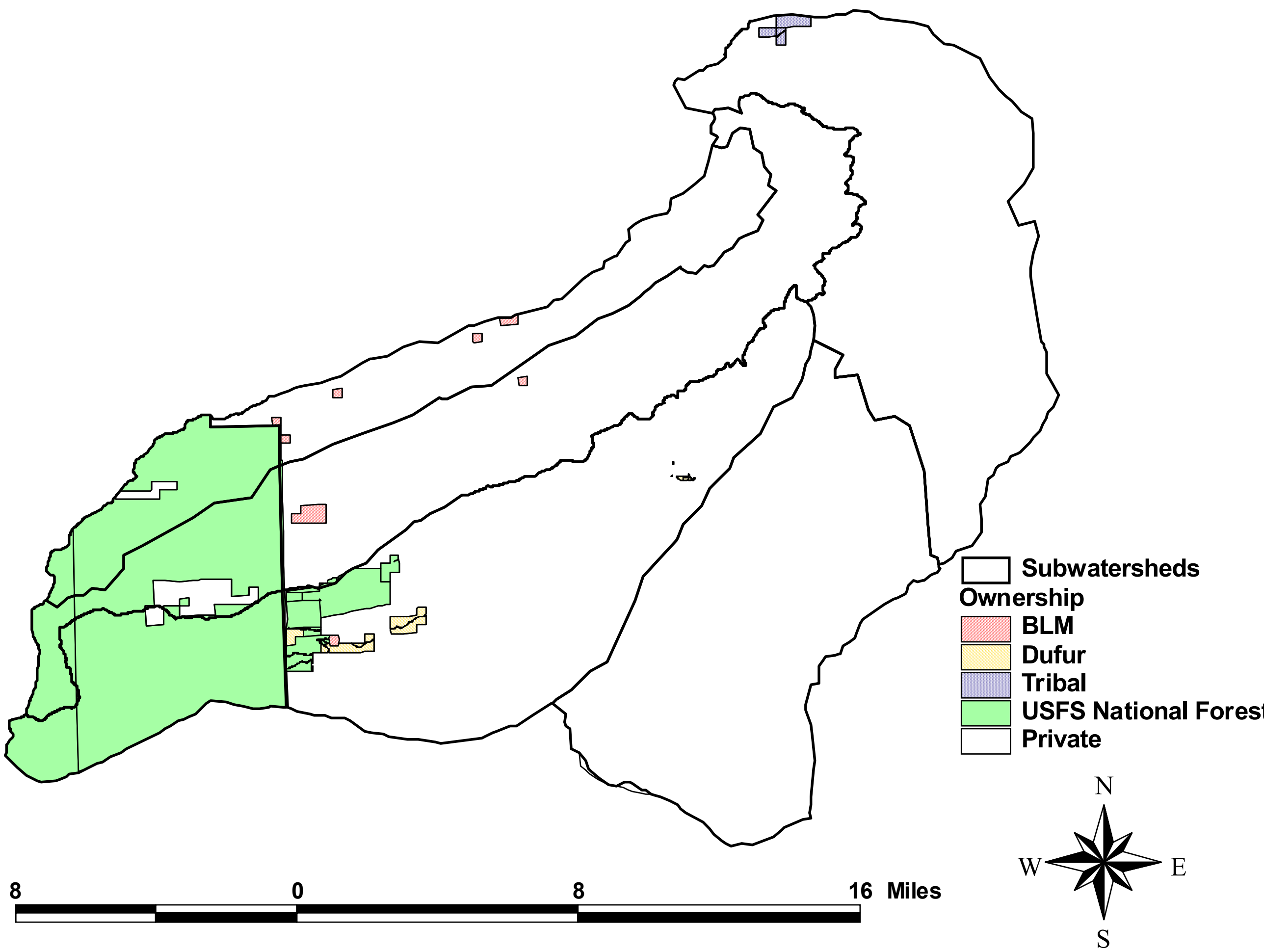
Dry cropland makes up 117,260 acres. Approximately 7,440 acres are used for irrigated agriculture (hay, pasture, or orchards). Most agricultural lands are located on land below 2,800 feet in elevation. In the last decade (1993-2003), orchards have expanded from approximately 200 acres to approximately 2100 acres, most of them irrigated from groundwater (Jim Bishop, USDA Farm Service Agency , pers. comm., 2003).

The western third of the watershed, including the Mount Hood National Forest, is zoned for commercial forestry, 80-acre minimum lot size (F1-80 or F2-80). Outdoor recreation and tourism is concentrated on the National Forest, as are most remaining commercial forestry activities. The City of Dufur is the only urban area, at 530 acres. Rural residential areas are zoned for 10-acre lot sizes, and total 1,278 acres.

Table 1-1: Land Ownership (Source: Wasco County Assessor's Office, 2002)

Private Ownership	199,012 acres
U.S. Forest Service	36,008 acres
City of Dufur	711 acres, not including 500+ acres urban area
BLM, Prineville District	592 acres
Tribal: CTWSRO	373 acres

Figure 1-4. Ownership in Fifteenmile Watershed (Source: Wasco County Assessors Office, 2002)



The majority of the watershed is privately owned (figure 1-4). The US Forest Service is the largest single public owner, with 15% of the watershed (Mount Hood National Forest, Barlow Ranger District). Other public owners are the city of Dufur, Bureau of Land Management and Confederated Tribes of the Warm Springs Reservation of Oregon (CTWSRO). In addition, the Confederated Tribes hold federally-reserved rights in their ceded lands. The 1855 Treaty with the Tribes of Middle Oregon reserved to the Tribes an exclusive right to hunt and fish within Indian reservation boundaries and the right to hunt and fish in common with citizens of the USA at all other usual and accustomed places in ceded lands. The entire Fifteenmile Watershed is part of CTWSRO's ceded lands. Tribal and non-tribal fishing 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 of surrounding watersheds, the CTWSRO is actively involved in habitat protection, restoration, fisheries enforcement, enhancement and research activities.

1.2) Fish Species

Fifteenmile Creek is home to native runs of winter steelhead (*Onchorhynchus mykiss gairderi*). Mid-Columbia steelhead are listed as a threatened species by the National Marine Fisheries Service, and are the species of primary concern in management decisions by State, Federal and Tribal natural resource agencies. Other native species include Coho salmon (*Onchorhynchus kisutch*), Pacific lamprey (*Lampetra tridentata)*, Western brook lamprey (*Lampetra richardsonii)* resident redband trout (*Onchorhynchus mykiss gairderi*), cutthroat trout (*Oncorhynchus clarkii*) sculpins (*cottid* family), dace (*Rhinichthys spp*), redside shiner, chiselmouths, northern pike minnow (last four are members of the *cyprid* family), mountain suckers and largescale suckers (*catastomid spp*). Chinook salmon have been found in the watershed since 1998, but were not documented in modern times prior to that. It is not known whether these fish represent a native stock or hatchery strays (personal communications, Gary Asbridge USFS, Rod French, Steve Springston, ODFW, 2002).

Steelhead and Redband Trout

Fifteenmile is home to the easternmost run of wild winter steelhead (*Oncorhynchus mykiss gairdneri*) in the Columbia Basin. Steelhead are found in Fifteenmile Creek, Ramsey Creek, Eightmile Fivemile and Dry Creeks, as well as many intermittent streams. Steelhead are listed as threatened throughout the Mid-Columbia River Evolutionarily Significant Unit (http://www.nwr.noaa.gov/1salmon/salmesa/pubs/1pgr.pdf). Resident redband trout (*Onchorhynchus mykiss gairdneri*) are the same species as steelhead and probably interbreed with them. Both are from the Eastern Cascades subspecies (Appendix F, USFS 1994).

In order to estimate the relative abundance of steelhead, Oregon Department of Fish and Wildlife and the US Forest Service both conduct steelhead spawning surveys on about 30-35 miles of stream. Sporadic spawning survey data goes back to 1964 in the Dufur Valley and to 1985 on Eightmile, Ramsey and Fivemile Creeks. Spawning surveys have been consistent in all surveyed reaches since 1998.

Based on the redd survey data, it is known that steelhead are spawning in Upper Fifteenmile, Eightmile, and Ramsey Creek. Only two steelhead redds have been found in Fivemile Creek since surveys began. Within the surveyed areas, the following reaches appear to be particularly productive for steelhead: Eightmile Creek from US 197 to Walston Grade, the lower seven miles of Ramsey Creek, Fifteenmile Creek from US 197 to one mile above Dufur City Intake.

Neither Fifteenmile Creek nor Eightmile Creek have been surveyed downstream of US 197, although redds have been seen in these reaches (Steve Springston, pers. comm., 2003). Fivemile Creek has been surveyed only upstream of the Forest Service boundary.

From 1998 to 2000, ODFW maintained a screw trap near the mouth of Fifteenmile to monitor out-migrating smolts. A screw trap is a juvenile fish trap that is placed in the stream and rotates, so that fish are herded into a chamber at the head of the trap, and can not find their way out. They are counted, marked and released. Counts of fish that are captured more than once allow statistical estimates of overall population. This was used to estimate numbers of steelhead smolts migrating from the basin, as well as abundance of other salmonids. ODFW estimated the combined population of redband and steelhead over 150mm in length at 5,835 (+/-4,439) in 1998 and 2,110 (+/-8,505) in 1999 (ODFW, 2000b). Both of these estimates are extremely tentative. Based on the margin of error (95% confidence level), fish populations could have been as high as 10,000, or could have been near zero. Smolt to adult survival is unknown in Fifteenmile Watershed, but is estimated at 5-7% in the Hood River (Olson and French, 2000).

Salmon

Coho salmon (*Onchorhynchus kisutch*) have been documented spawning in the lower part of Fifteenmile Creek, as far as and above Seufert Falls. They are thought to spawn only in the lower few miles of the creek (Rod French, pers. comm. 2002).

Chinook salmon have been sighted in recent years in Fifteenmile Creek. A total of 34 chinook were captured in the screw trap in 1998, and 101 captured in 1999, with a population estimate of 928 (+/-609) juvenile downstream migrants in 1999 (ODFW, 2000b). One carcass and one adult chinook were seen in Fifteenmile Creek above the Dufur City Intake in 1998 (Steve Springston, Rod French, ODFW, pers. comm., 2003). Prior to 1998, chinook had not been documented in Fifteenmile Watershed. The origin of these fish is uncertain.

Cutthroat Trout

According to the Miles Creeks Watershed Analysis, the only identified populations of resident cutthroat trout in Fifteenmile Watershed are in the Middle Fork and South Forks of Fivemile Creek. Cutthroat are found in the smallest headwater streams. Typically, resident cutthroat inhabit smaller streams than redband, but no natural barriers exist in Fivemile that would separate the two species , and they can hybridize (Appendix F, USFS, 1994). In 1998 and 1999, a total of 14 cutthroat trout were captured in the ODFW screw trap study at the mouth of Fifteenmile Creek (ODFW, 2000b). These fish may or may not represent an anadromous population.

Lamprey

Both Pacific lamprey and brook lamprey inhabit the Fifteenmile Watershed. Pacific lamprey are an Oregon State sensitive species. Juvenile lamprey captured in the screw trap in 1998 totaled 890. Eighty-six juvenile and 9 adult lamprey were caught in the screw trap in 1999 (ODFW, 2000b and Rod French, ODFW pers. comm., 2003). Larval lamprey and redds have been found in Fifteenmile Watershed from the mouth to above Dufur City Intake. The historic range of Pacific lamprey in the Columbia Basin was coincident with anadromous salmonids. Lamprey use the same spawning gravel as anadromous salmonids. Rapid or prolonged water withdrawals that dry out edgewater habitat are the greatest risk to larval lamprey (Appendix F, USFS, 1994).

Other Native Species

Sculpins, speckled and longnosed dace, and mountain suckers are the only non-salmonid coldwater fishes in the mid-watershed. Sculpins have been found on the National Forest, but dace and suckers have not. Northern pike minnow occupy the lower watershed where summer temperatures exceed lethal limits for salmonids (>24°C or 75°F) (USFS 1994, Appendix F).

Introduced Trout

Rainbow trout were stocked by ODFW in Fifteenmile Creek at the Tailorville bridge until 1974 and the downtown Dufur bridge until 1991. Rainbow were also stocked by ODFW in Hanel Lake reservoir on the Wolf Run Ditch from 1992 to 1994 (Appendix F, pp 6-8, USFS, 1994). Wolf Run Ditch is screened, preventing migration of stocked fish out of the reservoir. Rainbow trout can interbreed with redband and steelhead, but gene pool dilution is believed to have been minimal (Appendix F, USFS, 1994). The particular stock of rainbows used for these introductions were believed not to survive the summer due to susceptibility to naturally occurring diseases (Rod French, pers. comm. 2002).

2) Watershed Conditions at the Time of Settlement

This chapter summarizes available information on historic conditions and changes in land use. While the Watershed has been permanently altered and restoration to a pre-1800's condition is not a goal, knowledge of historic conditions and the cumulative effects of land use can help guide restoration actions and improve their chances for success. Documenting how natural, unmanaged streams interact with the streamside forest allows us to see how far we have altered the prior condition of the watershed. Much of this chapter was compiled from historical records, local written histories and notes from land surveys conducted between 1858 and 1892.

2.1) Forest, Fire and Streams

Ecoregions can be used to determine riparian vegetation, runoff patterns, upland vegetation, etc. The Oregon State Geospacial Data Clearinghouse provides a map of ecoregions from the Oregon Natural Heritage Foundation (http://www.gis.state.or.us/data/alphalist.html). For the Fifteenmile Watershed, this system was checked against historic vegetation data from the second half of the 19th century.

Information from early public land surveys (1856-1890) was examined to define historic vegetation (figure 2-1). This information is available throughout most of the State from the USDI Bureau of Land Management. The Wasco County Public Works Department keeps copies of this data, as well. Survey data agree fairly closely with the Ecoregions defined by the Oregon Natural Heritage Foundation.

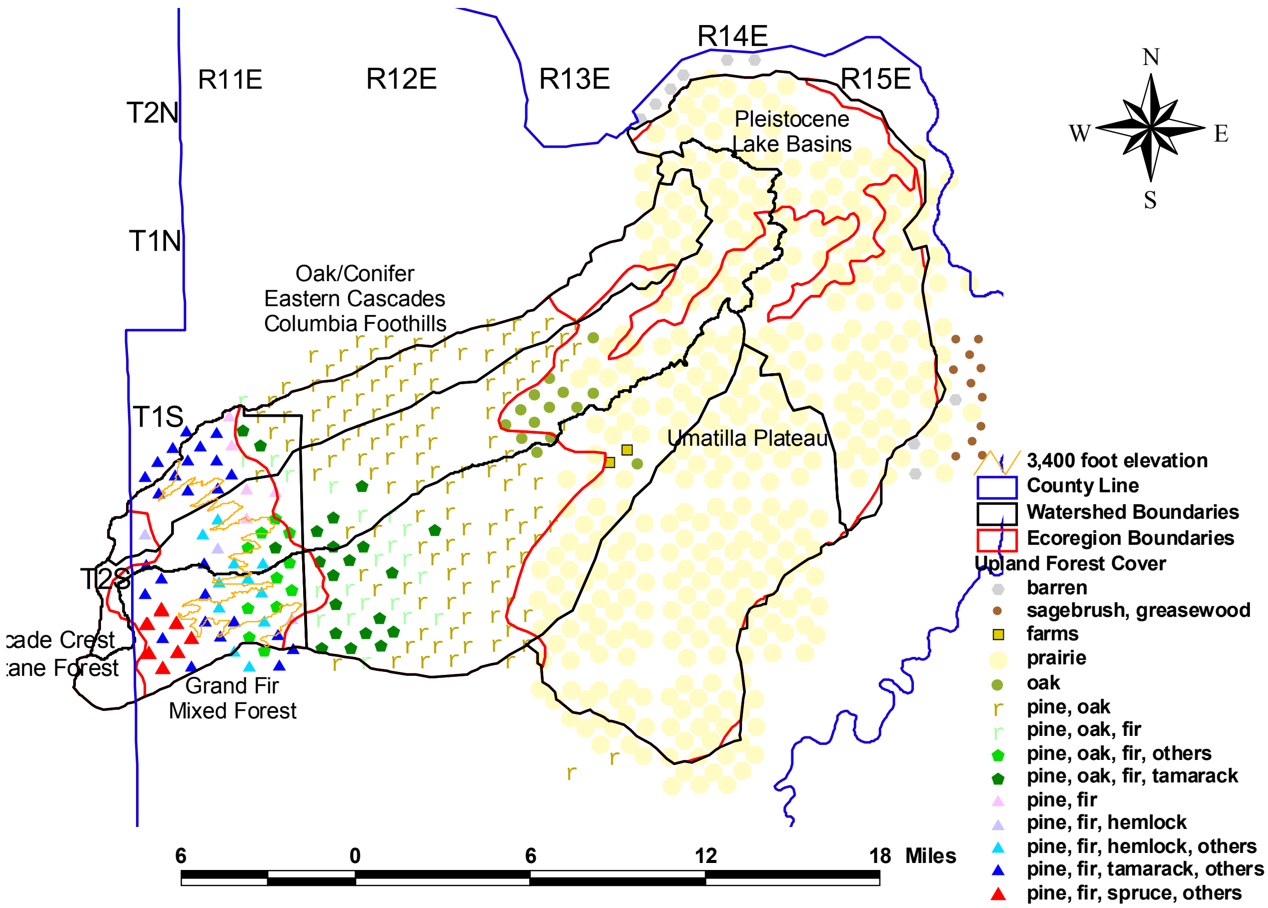
Nineteenth century surveyors described the prairie region as consisting of good quality bunchgrasses on the uplands, with woody riparian vegetation along the creeks. Riparian vegetation in the prairie regions consisted primarily of willow, alder, cottonwoods, and various understory species.

Downed wood and log jams are common in undisturbed Oregon forest streams. Historically, large woody debris probably created greater hydrologic and stream habitat complexity than exists currently. Large woody debris can form numerous log jams and obstructions, trapping gravel, creating pools and hiding cover for fish and a substrate for fungi, bacteria and invertebrates. Many stream channels historically had greater sinuousity than today, and wound from one side of the valley to the other. In many places, the stream channel has downcut and incised (Chris Rossel, USFS Barlow Ranger District, pers. comm.). Previously, streams in lower gradient reaches were probably closely connected to the floodplain, frequently overtopping their banks and providing for much wider riparian corridors.

Table 2-1: Ecoregions in the Fifteenmile Watershed as defined by the Oregon Natural Heritage Foundation (www.gis.state.or.us/data/alphalist.html)

ECOREGION	Upland Vegetation
Cascade Crest Montane Forest	Mountain Hemlock, Pacific Silver Fir, Engelmann Spruce, Lodgepole Pine
Grand Fir Mixed Forest	White Fir, Douglas Fir, Ponderosa Pine
Oak/Conifer & Eastern Cascades/Columbia Foothills	Eastern: Ponderosa Pine and Oregon White Oak Western: Douglas Fir and Western Hemlock
Umatilla Plateau	Bluebunch Wheatgrass, Idaho Fescue, other grasses and shrubs
Pleistocene Lake Bottom	Big Sagebrush, Bluebunch Wheatgrass

Figure 2-1. 19th Century Forest Cover. Source: public land survey records, 1856-1883. Points represent observations of the 19th century surveyors. Ecoregion boundaries shown in red represent the boundaries defined by the Oregon Natural Heritage Foundation.



Forest type in the transitional zone between "East-side" and "West-side" ecoregions is determined not only by temperature and rainfall patterns, but also by fire regime. Ponderosa pine, Oregon white oak, and Douglas fir are all considered fire resistant species. Stand-replacing fires were a rare event in ponderosa pine habitat; however, frequent natural or man-made low-level fires regularly cleared underbrush, young trees and less fire-resistant species, such as white fir, spruce and tamarack (Steve Hansen, Longview Fibre Co., pers. comm.). In wetter areas, where fire is less common, fir and spruce eventually shade out pine and oak, replacing them, until a catastrophic stand replacing fire occurs, once every 100-250 years (USFS, 1994). The boundaries between these two forest types are complex, and depend not only on elevation and rainfall, but also on slope, aspect and human land management. The Miles Creeks Watershed Analysis (USFS, 1994) speculates that the Dry Grand Fir/Douglas Fir forest zone was previously dominated by open ponderosa pine stands below 3,600 feet (figure 2-1).

Department of Forestry personnel describe an unharvested ponderosa stand in Northern Wasco County. The pines are widely spaced, and more than 300 years old. In the last century, under the influence of human fire suppression efforts, Douglas fir and white fir have grown into a thick understory in some areas (Doug Theises, ODF, pers. comm.).

Oak forests featured larger trees than they typically do now. Steamboats valued firewood from Mosier, where they could collect straight 8' long oak logs. Under current fire suppression practices, oaks grow thicker and remain smaller than historically.

Floods, fires, mudflows, landslides, beaver ponds and insect and disease epidemics all occur in the Cascade Mountains. Most natural disturbance processes in the Watershed are driven by climate. Rain-on-snow flooding and debris flows are common. Large-scale events can significantly shape riparian and aquatic habitat conditions by transporting large woody debris and sediment to and from the stream. Historically this factor would have added to the in-stream habitat diversity. Less mature riparian vegetation may be found near such disturbances.

Beaver were more common in the Northwest before the fur companies trapped them out between 1795 and 1838 (see historical section, p15) and had a vast impact on the hydrology of the streams (David Childs, USFS hydrologist, pers. comm.).

2.2) Patterns of Resource Use and Development

This section will look at the settlement and development of resource use of the watershed, focusing on the last 150 years (figure 2.2). Joanne Ward, Columbia Gorge Historical Society, assisted in the research for this section. Further information is available on the internet at http://www.wasco-history.r9esd.k12.or.us.

Archaeological evidence shows that Wasco County has been inhabited for at least 10,000 years. During the early part of the 1800's, most of the Fifteenmile Watershed was utilized by the Tenino or Warm Springs Sahaptin People, who had a winter village in Tygh Valley. They numbered about 1,200 with a territory that covered Sherman, Wheeler, Jefferson, and most of Wasco Counties (Thomas, 1986.). The Wasco, or Dalles Chinookans, inhabited the area along the Columbia River from Celilo on downstream (O'Donnell, 1991).

The Tenino lived a semi-nomadic life, subsisting primarily by fishing, with hunting and gathering also being important. They did not practice agriculture, but they did use fire to manage grass lands and maintain meadows in forestlands. Wintertime activities included hunting and trapping, fishing, fuel gathering, and the manufacture of tools. The winter village consisted of substantial permanent dwellings located in a protected spot that provided both water and fuel. In late March, the village in Tygh Valley moved to Sherar's Falls. In 1826, Peter Skene Ogden reported about 20 families at Sherar's Falls, catching and drying salmon. In early July, the traveling group returned to the village with venison and berries. After July, half the village went to the Cascades to gather berries and nuts and hunt until September. In September, the hunters traveled up the Deschutes River. The women gathered late-ripening roots and berries and smoked meat brought back by the men. A special group would gather tule reeds for mats in October. Then the summer structures were taken down and the people returned to the winter village. (Thomas, 1986.)

Salmon, particularly Chinook, were the most important food source to the Tenino, who caught many fish at Sherar's Falls on the Deschutes River. Fresh water mussels and lamprey were also utilized. Fifteenmile Creek was an important fishery for both steelhead and lamprey. The Tenino hunted deer, elk, antelope, bear, and mountain sheep. Rabbits, beaver, birds and other small animals were captured with nets and snares. (Thomas, 1986.)

Food plants included camas, bitterroot, biscuitroot, *Lomatium cous*, Black Tree Lichen, balsam root, mint, and lupine. Important root gathering locations included the Shaniko and Wapinitia areas. Pine and sunflower seeds, chokecherries, acorns, serviceberries and huckleberries were all gathered near Mount Hood in the fall. The Indians used fire to maintain grasslands and open forest meadows for berry gathering. Medicinal plants included Prince's Pine, and *Heuchera cylindrica* (Winegar, 1986).

Salmon, whitefish, meat, salmon eggs, and some roots were dried and stored. (Thomas, 1986.)

On June 25, 1855, members of the Tenino and Wasco people signed a treaty with the US Government in which they ceded most of their homelands to the US Government and agreed to relocate to the Warm Springs Reservation. Most of the Tenino moved to the reservation in 1857, and settled in the vicinity of Simnasho.

Westward migrating American pioneers first arrived in numbers in the Fifteenmile Watershed after establishment of the Barlow Road in 1846. Commercial fishing, livestock grazing, agriculture and logging were well established by 1900. Riparian areas were heavily used for wood, fuel, irrigation, cropland, roads, and livestock forage and water (USFS, 1994).

Settlement has introduced several factors to the area, including noxious weeds, bullfrogs, and eastern brook trout (USFS, 1994). Fire suppression was established in the early 1900's and led to significant changes in forest composition, eliminating the open stands of ponderosa pines, in favor of dense stands of Douglas fir, ponderosa pine, and grand fir, with a significant component of fire-sensitive species, such as white fir. The Miles Creeks Watershed Analysis speculates that widespread channel downcutting occurred in the mid-1800's (USFS Appendix F, p13, 1994).

Table 2.2: Settlement and Development Timeline

DATE:	EVENT:	SOURCE:
10,000 or more years ago to present	Indian people present in the Watershed and use its natural resources. They practice controlled burning to maintain grasslands and open meadows. Village/camp sites include "Winquatt" (now The Dalles) and Petersburg.	Thomas, 1986; Wagenblast, unpub.
1805, 1806	Lewis and Clark camp at Rock Fort, October 25-28, 1805. On return trip, they camp at same site from April 15-16, 1806.	Journals of Lewis and Clark, Discovery Center Historical Files
1813	Northwest Company took over Pacific Fur Company trade up river from Winquatt (The Dalles). Beaver trapping becomes extensive and highly systematic. NWC merges in 1821 with Hudson Bay Co.	Corning, 1956
1837	Methodist mission established at "Dalles City".	Howell, 1966
1838	Fur trade in Northwest began to decline due to decline of the beaver population.	Corning, 1956
1843	"The Great Migration" crosses the plains on the Oregon Trail from Independence, MO and arrives in present day site of The Dalles enroute to Willamette Valley. Estimates vary from 455 (Lenox, 1904) to 900 (WCHS & CCHS, 1991) members on the wagon train.	Lenox, 1904; Wasco Co. Historical Society & Clackamas Co. Historical Society, 1991
1845	Barlow, Palmer and Rector come to "Dalles City" in wagon train led by Samuel Tethrow, search for overland route to Willamette Valley.	WCHS & CCHS, 1991.
1846	Barlow Trail opens land route to Oregon City.	WCHS & CCHS, 1991.
1847	Fort Dalles established in response to Whitman incident. Fort maintained until 1867.	USDA, 1986
1852	First homestead at site of present-day Dufur, then known as Fifteen Mile Crossing.	Dufur Historical Society, 1993
1854	Establishment of Wasco County; approximately 35 permanent non-indian residents in "Dalles City".	Carey, 1971
1855	Indians cede lands in Watershed to U.S. in Treaty with Tribes of Middle Oregon. Some Wascos at Celilo will not cede lands.	O'Donnell, 1991;
1856	Daniel Bolton homesteads near present-day Boyd.	McNeal, 1953
1857	"Dalles City" incorporated.	USDA, 1986
1858	Five Mile House established at site of present-day Petersburg by Steve Hodgdon.	Wagenblast, unpub.
1858	First steamboat on Columbia upstream of The Dalles, "The Colonel Wright".	Discovery Center Historical Files
1859	Oregon statehood.	Corning, 1956

Table 2.2 (continued): Settlement and Development Timeline

DATE:	EVENT:	SOURCE:
1859	Gold discovered in Idaho.	Wagenblast, unpub.; Corning 1956;
1862	Canyon City gold mines open up in Eastern Oregon.	Corning, 1956
Circa 1863	Horace Rice plants grain in uplands of Fifteenmile Creek, 1st in Wasco County. Neighbors laugh at him. Around the same period, Rev. Washington Walker established a flour mill at Dufur.	McNeal, 1953; Anon. 1905
1863	David Imbler establishes Fifteen Mile House, an inn at Fifteen Mile Crossing. Dufur provided both good water and good camping for immigrants on the Barlow Trail.	Dufur Historical Society, 1993
1867	The Dalles-Klamath Agency Road built.	
1872	A. J. Dufur farm established near present day location of City of Dufur.	Dufur Historical Society, 1993
1878	Flour mill established at Boyd by James M. Allen.	Zopf, 2001
1882	Flour mill sold to T. P. Boyd, from whom the area took its name. Mill operated under various ownerships until 1936.	Zopf, 2001
1884	Post office established at Boyd.	Zopf, 2001
1893	Cascade Forest Reserve Established.	Friends of Maupin Library, 1986
1893	City of Dufur incorporated.	Dufur Historical Society, 1993
1894	The "Great Flood" at The Dalles originates from all local streams, lasts from April 9th through mid-June.	Discovery Center Historical Files.
1900-1930's	Beginning of mechanized crop production and shift away from horse-powered operations.	USDA NRCS, 2002
1900-Present	Fire suppression and logging of large ponderosa pines causes extensive changes to forest canopy, increasing understory and prevalence of fire-sensitive species, such as white fir.	USFS, 1994
1905	Great Southern Railroad establishes stops at Petersburg, Fairbanks, Fulton, Brrokhouse, Freebridge, Neabeck, Emerson, Wrentham, Rice, Boyd, Dufur and Friend.	USDA, 1986
1908	Cascade Forest Reserve broken into various National Forests, including Oregon National Forest (Name changed in 1924 to Mount Hood National Forest).	Friends of Maupin Library, 1986
1908	Dog River Fire burns 13,000 acres in headwaters of Fifteenmile, Eightmile, Fivemile and Dog River (Hood Basin)	USFS, pers. comm.
1910	Wasco County Population, 16,191.	Internet: http://usgenweb.com
1916	Dufur Orchard Company harvests apples for several years. However, without sufficient moisture, fruit did not mature properly.	Dufur Historical Society, 1993
1916-1918	World War I creates greater market for wheat. New farms established.	USDA NRCS, 2002
1938	Bonneville Dam completed –first federal dam on the Columbia River.	https://www.nwp.usace.army.mil/history.htm
1939-1945	World War II creates increased demand for wheat. New farms established. Mount Hood National Forest Harvest, 27 million board feet per year.	NRCS, 2002; USFS 1994
1942	First Soil and Water Conservation District established in Wasco County.	Wasco County SWCD website, http://www.wasco.oacd.org/

Table 2.2 (continued): Settlement and Development Timeline

DATE:	EVENT:	SOURCE:
1948	Mount Hood National Forest Management Plan called for harvest of 27 million board-feet per year.	Friends of Maupin Library, 1986
Circa 1950	Maximum extent of croplands in Fifteenmile Watershed.	USDA NRCS, 2002
1957	The Dalles Dam completed.	https://www.nwp.usace.army.mil/history.htm
1964	Floods throughout Northwest motivate construction of terraces and sediment control basins.	USDA NRCS, 2002
1974	Floods along Fifteenmile Creek motivate channel straightening and stream cleaning efforts with federal assistance.	SWCD records
1985	Food Security Act ("Farm Bill") ties commodity payments to adoption of erosion control plans on highly erodible lands. Residue management, terraces and sediment control basins widely adopted in compliance with these plans.	NRCS, 2002
1980's	Mount Hood National Forest harvesting 52 million board feet per year (though only a small percentage came from Fifteenmile).	Friends of Maupin Library, 1986
1993	Northwest Forest Plan leads to sharp dip in timber harvests.	USFS pers. comm.
1995	Two summer thunderstorms create flash floods originating on Tygh Ridge and affecting the eastern watershed (Lower Fifteenmile and Dry Creek Subwatersheds).	SWCD records
1996	Floods throughout Northwest.	SWCD records
1997	Formation of Fifteenmile Watershed Council.	Fifteenmile Watershed Council Minutes
1997-2002	Environmental Quality Incentives Program (EQIP) offers cost-share and incentive payments for adoption of conservation practices in Fifteenmile Geographic Priority Area. Wasco County SWCD offers additional funding for conversion to direct-seed. Direct-seed adopted on 40,000+ acres.	SWCD records
2000	On August 22, 2,600 gallons of the herbicide, Goal 2XL were accidentally spilled into Fifteenmile Creek, when a truck overturned on I84, where it passes over the creek. The lower 1,100 feet of Fifteenmile Creek were subject to a massive cleanup effort directed by EPA.	Morgan, 2001

3) Channel Types

The Oregon Watershed Assessment Manual presents a classification system to divide streams into "channel habitat types" 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. The most influential factors are stream gradient and channel confinement.

Each channel habitat type has predictable attributes that influence fish use, sensitivity to disturbance and potential for improvement. Gradient determines whether a particular stream reach or 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, offering a wide range of habitat elements. Moderate gradient reaches (2-4%) are transport areas for sediment and wood and are moderately productive for fish, although localized areas may be highly productive. High gradient reaches (4-10%) are transport zones with only fair productivity for fish, but high productivity for amphibians. Reaches with gradients over 10% are not usually fish-bearing (USFS, 1996b).

Confinement is also a factor in determining channel habitat type. Confinement refers to the ratio of the channel width to the floodplain width. Unconfined channels (those with a floodplain width more than 4 times the width of the channel) have room to meander, and thus develop more diverse instream habitat than confined channels (those with a floodplain no more than 2 times the width of the channel). Unconfined channels will also have wider riparian areas. Flood velocities will be buffered as the flow spreads over the wide floodplain. Moderately confined channels are those with floodplains between 2 and 4 times the width of the channel. Channels can be confined naturally by steep, narrow valley walls, or natural terraces. Channels can become confined due to downward erosion caused by flood events or by diking, removal of large woody debris, and channelization activities.

Channel habitat 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. Low gradient, less confined areas are most likely to show physical changes in channel pattern, location, width, depth, sediment storage, and 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, 1996b).

Intermittent streams were also classified in this analysis. The Miles Creeks Watershed Analysis (USFS, 1994) notes that intermittent reaches and tributaries may serve an important role as fish spawning and overwintering habitat by providing refugia from winter high flows.

3.1) Channel Habitat Type Classification

Methods and Results

Channel habitat types were delineated for 464 miles of streams, including perennial, intermittent and seasonal drainages, using USGS topographic maps (digital raster graphs viewed using ArcView 3.2). Channel habitat types were based on slope and confinement, as well as position within the watershed. Channel habitat type designations and related data were recorded in an ArcView database and mapped. The streams defined in this section were used throughout the later components of the watershed assessment. Aerial photographs were used to further determine confinement.

Eight channel habitat types were identified in the Watershed (table 3-1). In order of prevalence, these are MV (moderately steep, narrow valley), MC (moderate gradient, confined), LC (low gradient, confined), LM (Low gradient, moderately confined), MH (moderate gradient headwater), SV (steep headwater, confined), MM (moderate gradient, moderately confined) and VH (very steep headwater).

Low gradient stream reaches constitute 19% (99 miles) of the stream network and include two channel habitat types: LM, LC. However, localized areas of low gradient can occur within stream reaches designated by steeper channel habitat types. Moderate gradient stream reaches constitute 73.6% of the stream network and include four channel habitat types: MV, MC, MM, and MH. The remainder of the watershed consists of steep and very steep v-shaped (SV and VH) channels with gradients greater than

10%. These steepest channel types are mostly found on seasonal drainages, draining the uplands and ridges (table 3-2 and figure 3-1).

Table 3-1: Descriptions of channel habitat types found in Fifteenmile Watershed

		Stream gradient	Valley shape	Channel pattern	Confinement	Position in drainage	Dominant Substrate
MV	Moderately Steep, Narrow Valley	4-8%, may vary between 3-10%	Narrow, V-shaped valley	Single channel, relatively straight	Confined	Mid to upper	Small cobble to bedrock
MC	Moderate Gradient, Confined*	2-4%, may vary up to 6%	Gentle to narrow V-shaped valley	Single, straight or conforms to hill-slope	Confined	Middle to lower	Course gravel to bedrock
LC	Low gradient, confined*	<2%	Moderate gradient hill slopes w/ limited floodplain	Single channel, variable sinuosity	Confined by slopes or high terraces	Generally mid to lower in larger basin	Boulder, cobble, bedrock with pockets of sand, gravel, cobble
SV	Steep Narrow Valley	8-16%	Steep, narrow V-shaped valley	Single, straight	Tightly confined	Middle upper to upper	Large cobble to bedrock
LM	Low gradient, moderately confined**	<2%	Broad, generally much wider than channel	Single w/ some multiple channels	Variable	Mainstem & lower end of main tribs	Fine gravel to bedrock
MH	Moderate gradient Headwaters	1-6%	Open, gentle V-shaped valley	Low sinuosity to straight	Confined	Upper, headwater	Sand to cobble, bedrock; possibly some boulders
MM	Moderate Gradient, Moderately Confined**	2-4%	Narrow valley with floodplain or narrow terrace	Single channel, low to moderate sinuosity	Variable	Mid to lower	Gravel to small boulder
VH	Very Steep Headwaters	>16%	Steep, narrow V-shaped valley	Single, straight	Tightly confined	Middle upper to upper	Large cobble to bedrock
NOT FOUND TODAY, BUT HISTORICALLY IMPORTANT:							
FP3	Low Gradient, Small Floodplain	<2%	Broad, flat	Single to multiple channels	Mostly unconfined	Variable	Sand to small cobble

* "Confined" means floodplain no more than twice as wide as stream channel at bank-full.
** "Moderately confined" means floodplain two to four times as wide as stream channel at bank-full.

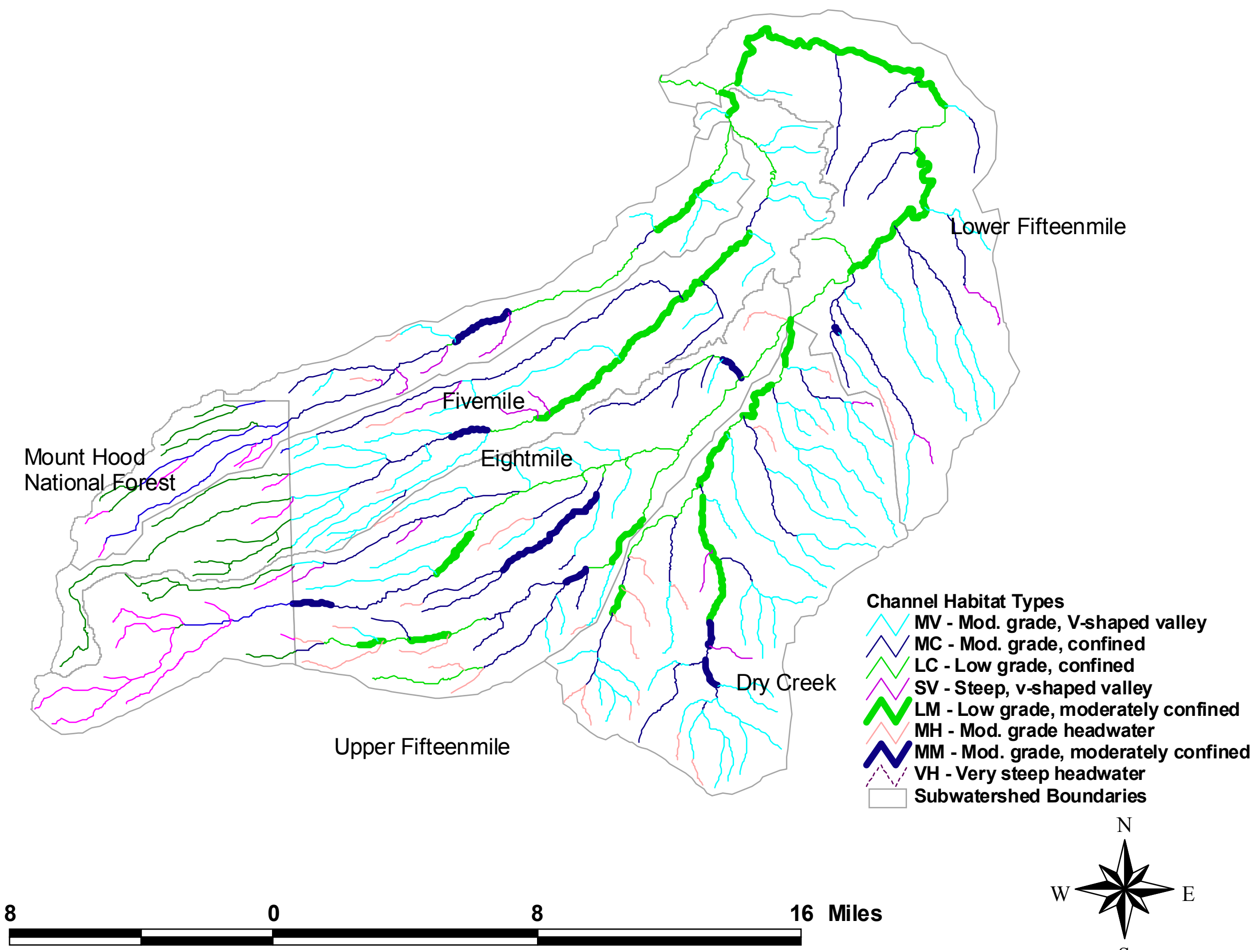
All channel habitat types in the Fifteenmile Watershed are confined (no floodplain or less than twice the channel width) except for two: MM and LM, which together constitute 10.6% of the watershed. Both of these are considered "moderately confined" and have floodplains that average two to four times the width of the channel itself. No channels were classified as entirely unconfined. However, 10% (61.36 miles) of the stream system appears to have been channelized, either by flood erosion or by human design. Prior to these changes, up to 48 miles of the stream may have been unconfined, defined as streams with a floodplain greater than four times the width of the channel (see section 3.2). Unconfined reaches would have previously been classified as a ninth channel habitat type, FP3 (Low Gradient Small Floodplain). These channels have become straighter, making them shorter and higher in gradient. The end result is faster streamflows, particularly during high flows, and more streambank erosion.

FP3 would have provided the highest quality spawning and rearing habitat in the Fifteenmile Watershed due to the variety of habitats available in a meandering, unconfined stream. LM channels most likely fulfill that roll today. Pockets of important habitat may also be found in MM, LC, MC and MV channels.

Table 3-2: Summary (in miles) of channel habitat types for stream channels in Fifteenmile Watershed. Channel habitat types listed in order of frequency.

Subwatershed	MV	MC	LC	SV	LM	MH	MM	VH	TOTAL
Mount Hood National Forest	42.1	16.9	0	28.7	0	0	0	0	**87.6**
Upper Fifteenmile	28.6	37.7	25.5	2.4	6.5	14.8	.7	0.15	**122.3**
Lower Fifteenmile	26.7	29.4	9.5	3.0	16.1	1.7	0.26	0	**86.7**
Eightmile	48.6	22.3	5.5	4.7	10.6	1.8	1.2	0	**94.8**
Fivemile	8.5	10.0	7.3	4.6	2.4	1.3	2.0	0	**36.1**
Dry Creek	70.7	19.0	5.1	3.6	10.5	13.1	1.7	0	**123.8**
Total miles	**225.2**	**135.3**	**52.9**	**47.0**	**46.1**	**32.7**	**11.86**	**0.15**	**551.1**
% of Watershed	*40.9*	*24.6*	*9.6*	*8.5*	*8.4*	*5.9*	*2.2*	*0.03*	***100***

Figure 3-1: Channel Habitat Types in Fifteenmile Watershed based on slope, floodplain width and position in watershed.



3.2) Channel Modification

"[Stream] channels are dynamic systems that modify themselves in response to changes in physical watershed features" (Oregon Watershed Assessment Manual, pVIIA). Such changes may be due to manmade or natural factors. Typical manmade channel modifications include dikes, riparian roads, stream crossings, dams, etc. Flooding is a natural factor that modifies the channel of a stream.

Generally, where a stream has adequate riparian vegetation and access to its floodplain, a flood will not change the channel habitat type, although it may change the location of specific meanders. On the other hand, an unusually large flood or one that occurs where riparian vegetation has been removed or suppressed may cause erosion and down-cutting, thus restricting the channel within a deep gully and cutting the stream off from its natural flood plain.

Where a stream is in close relationship with its floodplain, the water table of that floodplain is often close to the surface, resulting in a subirrigated state on the floodplain. The floodplain generally buffers the stream during large flood events, allowing the water to spread and slow down, reducing the power of the flow, and thus reducing streambank erosion. Stream channels with wide floodplains generally feature more meanders, slower flow, and a greater diversity of fish habitat (pools, riffles, oxbows, etc.) than streams without floodplains.

In cases where a stream loses access to its floodplain, either by a manmade structure or through downward erosion, the water table will drop, resulting in a loss of the subirrigated conditions and thus a loss of productivity on the floodplain. Furthermore, the stream flow is then confined within its eroded banks, even in high flows, resulting in further streambank erosion and/or downcutting, sedimentation of the stream, continued damage to riparian vegetation, and loss of fish habitat. In the absence of furthur disturbances, floodplain function will eventually reappear when streambank erosion has created a new floodplain at a lower elevation.

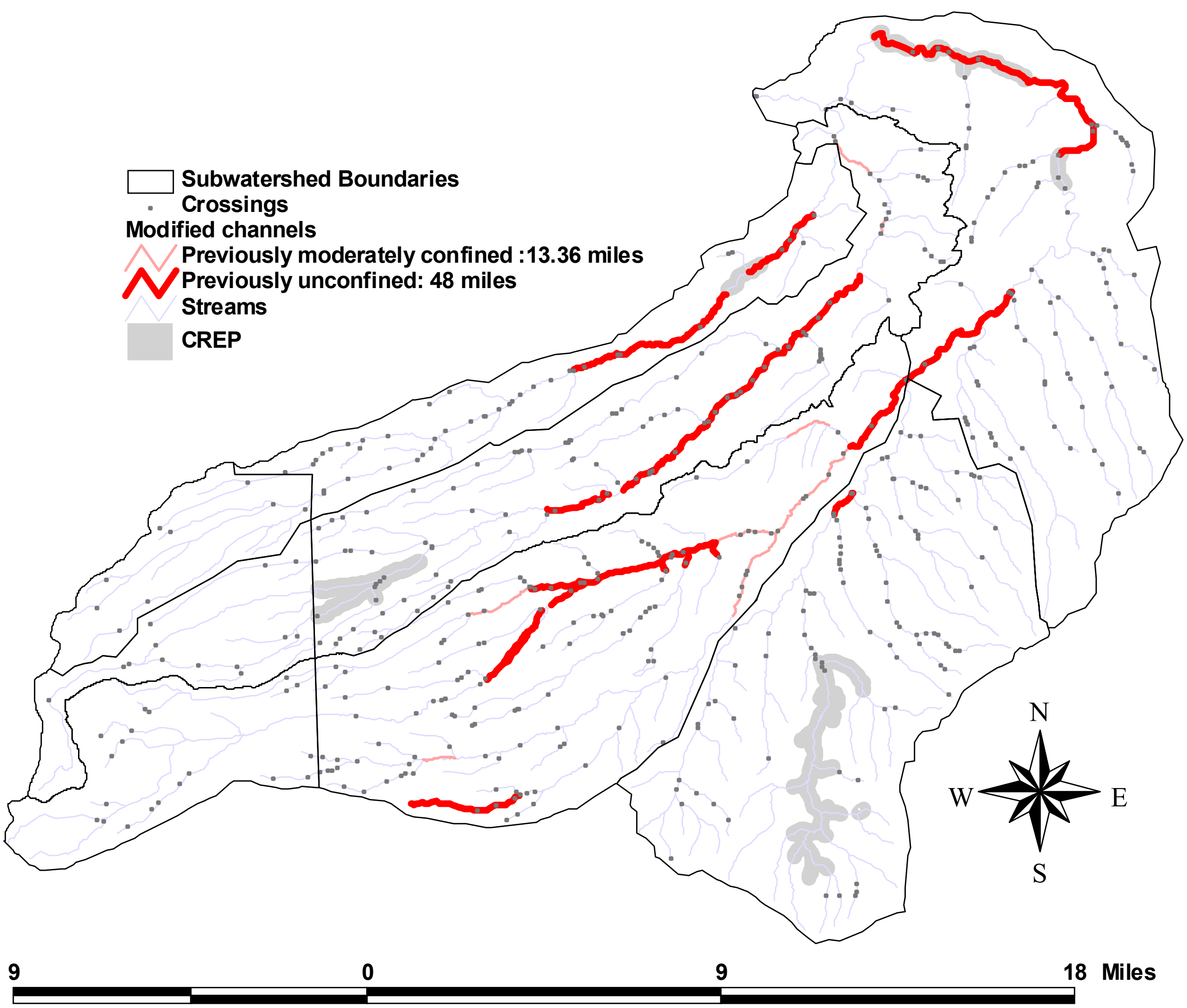
Floodplains have been extensively used for agriculture and residence. Stream channels have been manipulated in order to consolidate farm fields, protect infrastructure, and accommodate roads. During classification of channel habitat types (see section 3.1), 61.36 miles of modified channel were identified in Fifteenmile Creek, not counting such point modifications as road crossings and diversion sites (figure 3.2). Forty eight stream miles were identified as probably having previously been unconfined channels that are now confined or moderately confined within downcut channels, dikes or roadside ditches. An additional 13.36 miles appear to have previously been moderately confined (floodplain from 2-4 times the width of the channel) and are now confined (no floodplain or less than 2 times width of channel). This represents a major loss of fish habitat, and creates increased floodwater velocities, thus perpetuating or intensifying streambank erosion and incision. These results are somewhat higher than results published in the Miles Creeks Watershed Analysis, Appendix F (USFS, 1994) which states that 36 miles of creek downstream of the National Forest boundary have been destabilized and are in various stages of channel downcutting and recovery. The Miles Creeks Watershed Analysis speculates that widespread channel downcutting occurred in the mid-1800's (USFS Appendix F, p13, 1994).

Approximately 6.3 miles of modified channels have been addressed through the CREP program, and an additional 6.2 miles are subject to pending applications. By providing wide buffers and replanting, the CREP program can allow space for eventual recovery of floodplain function and ecology, although the original floodplain may, in some cases, never recover.

During the '60s and '70s streams were commonly cleared of large woody debris (LWD) as an encouraged practice (USFS, 1996A). Resource managers believed that logjams were fish passage barriers, while many landowners considered the debris to be flood hazards. Since that time, studies have shown LWD to be important fish habitat elements. Hydrologists now believe that large woody debris and other roughness elements slows stream velocities and thus reduces the erosive power of flood events – although individual logs may act in unpredictable ways depending on their location and movement in flood flows. The US Forest Service has recently completed a major project along approximately two miles of Ramsey Creek in which logs were placed in stream and on the floodplain. The project includes a "trash rack" to prevent logs from migrating downstream onto private lands. Results of this project will be evaluated over the coming years. The Forest Service proposes a similar project for the low gradient reach of Fifteenmile Creek upstream of the City of Dufur water intake.

Stream crossings also represent a channel modification, in that the channel is "locked" in place at that point. Figure 6-1 shows stream crossings identified in the course of this assessment. On the National Forest, there is an average of 2.15 miles between crossings, whereas the private lands have a much greater density of crossings at 0.99 stream miles per crossing. No data has been collected as to the type or condition of these crossings, although the Miles Creeks Watershed Analysis (USFS, 1994) identified a culvert on Road 4430 at Eightmile Crossing Campground as a potential passage problem. This culvert was replaced with an arch in 2002, as well as three others (4430, 4440, and 4300-150) on Eightmile . The Forest Service has found that almost all culverts are a potential passage barrier to juvenile coho – the weakest swimmers of all the anadromous species (Gary Asbridge, US FS Barlow Ranger District, pers. comm. 2003). Culverts can become fish passage barriers due to grade, "perch" (where the outlet is too high above the stream for a fish to leap), or by creating excess velocity by constricting flow.

Figure 3-2: Modified Channels and stream crossing sites in Fifteenmile Watershed. Most of the modified channels shown represent areas where the stream appears to have been straightened, diked and/or down cut and has lost access to its floodplain. Information from 1995 aerial photos.



4) Stream Flow, Runoff and Erosion

This chapter characterizes climate conditions and flow 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, municipal and other uses, and assesses their potential impact on fish habitat conditions.

4.1) Stream Flow History

Elevation varies between 80 feet and 6,525 feet, locating the upper watershed in the spring snowmelt runoff zone, and the lower watershed (below 4000 feet) in the rain-on-snow runoff zone. Mean annual precipitation varies from 60 inches near the headwaters (HRCDF, 2001. Figure 1-2) to only 11 inches near the mouth. The US Geological Survey maintained several stream flow gages on Fifteenmile, Eightmile and Fivemile Creeks. The highest peak flows typically occur between January and March . The highest flows were recorded in February 1983, when peak winter flows exceeded 2,200 cfs near Rice (Table 4-1). No gages were active in 1964, locally considered the heaviest flood in the last 50 years. Summer base flows at all gaging stations often fall below 1 cfs in August (Oregon Water Resources Department website, www.wrd.state.or.us). Average monthly discharge rates are summarized in table 4-1.

In addition to the streams noted in table 4.1, Water Resources Department provides streamflow models for Douglas Hollow, Davis Creek, Jameson Canyon, Starveout Creek, Rail Hollow (south of Dufur) and Henderson Hollow. These streams all have zero or negligible natural flow from July to October. However, Rail Hollow, Henderson Hollow, Davis Creek and Jameson Canyon have sufficient flow from December to April to provide potential spawning habitat for fish.

Table 4-1. Stream Gages and Recorded High Flows in Fifteenmile Basin. Source: Oregon Water Resources Department website: http://www.wrd.state.or.us

Stream Gage	Dates of Records	Highest Flow (cfs)	Date of High Flow
Fifteenmile near NF boundary	12/1971-01/1974	302	21-Jan-72
Fifteenmile above Ramsey Creek	11/1926-12/1931	380	30-Mar-31
Fifteenmile near Boyd	01/1918-09/1918	220	18-Jan-18
Fifteenmile near Rice	1946-1953, 1970-1984	2200	18-Feb-83
Eightmile near Dufur	02/1926-12/1931	96	30-Mar-31
Eightmile near The Dalles	04/1968-12/1973	400	21-Jan-72
Fivemile near The Dalles	11/1925-05/1931	170	30-Mar-31

Figure 4-1. Average natural monthly stream flows on Fifteenmile Creek at mouth (from table 4-2)

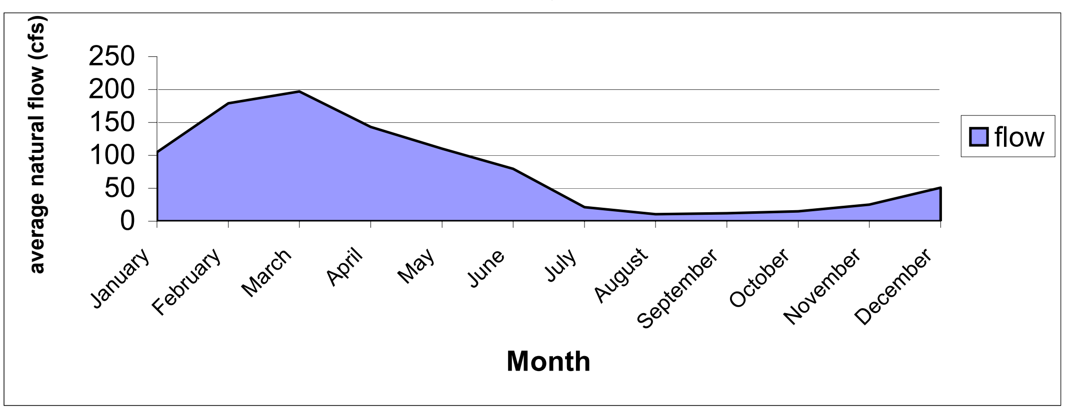


Table 4-2. Estimated average stream flows in cfs at the mouth of perennial streams assuming no withdrawals. (based on hydrologic modeling, Oregon Water Resources Department. Models are calibrated with historic gaging station data where available)

	Upper Fifteen-mile[1]	Lower Fifteen-mile	Eight-mile	Fivemile	Dry Creek	Japanese Hollow[2]	Pine Creek[3]	Ramsey Creek[4]
January	62.1	105.0	39.5	27.6	9.8	1.77	7.61	10.0
February	91.6	179.0	76.5	47.6	19.8	4.74	14.0	13.5
March	78	197.0	99.1	56.8	19.3	7.41	13.0	8.61
April	64	143.0	76.4	46.1	7.24	5.03	12.9	8.17
May	65	110.0	44.8	21.3	4.9	1.3	10.5	12.7
June	49.6	79.7	29.9	7.39	3.23	0.44	6.25	12.4
July	12.8	21.5	8.67	2.67	0.59	0.10	1.16	2.72
August	5.9	10.7	4.76	1.76	0.15	0.08	0.31	.070
September	6.1	12.1	5.98	1.58	0.10	0.08	0.31	0.76
October	7.9	15.1	7.19	2.19	0.031	0.12	1.00	2.08
November	11.2	25.1	13.8	6.51	0.56	0.35	1.56	3.27
December	23.1	50.9	26.2	19.2	2.35	0.94	2.20	3.21

[1]This flow actually represents Fifteenmile Creek above Jameson Canyon, somewhat downstream from the break between upper and lower Fifteenmile used in the rest of this assessment.
[2]Tributary of Eightmile Creek, north of mainstem.
[3]Tributary of Upper Fifteenmile, south of mainstem.
[4]Tributary of Upper Fifteenmile, north of mainstem.

4.2) Land Use Effects

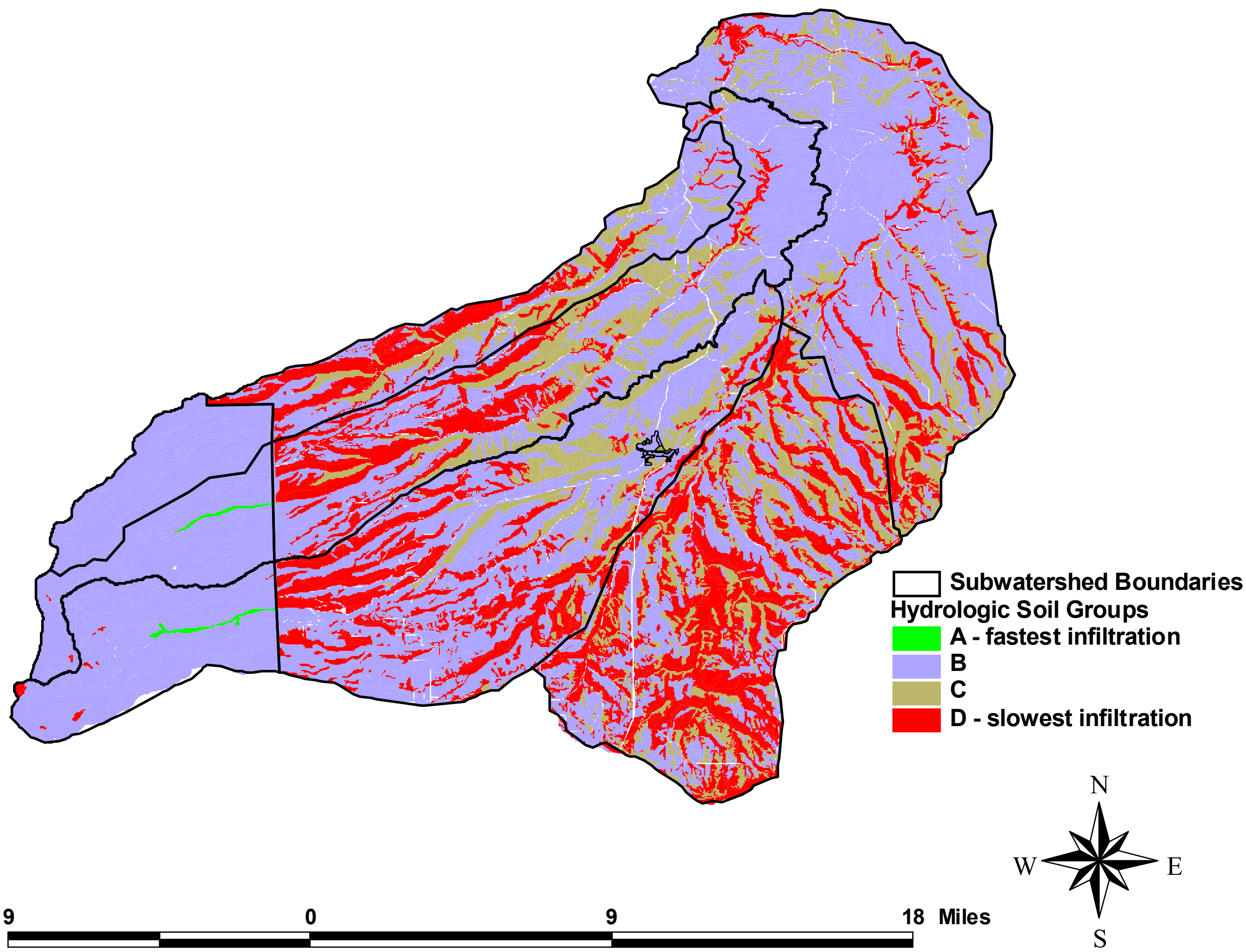
Effects on Runoff Due to Land Use

Runoff is the difference between precipitation and storage. Storage takes place primarily in the soil. Where soil infiltration rates are high, and soil moisture holding capacity is high, runoff may not occur except in very intense storms. Changes in soil structure or vegetation that affect the infiltration rate will alter runoff intensity. These changes can affect magnitude, duration and impact of floods. Land use changes that lead to widespread changes in the type of vegetation on a landscape, such as agriculture, fire, grazing, or timber harvest, can be a significant factor in altering runoff patterns. This analysis will model historical changes to runoff levels in the part of Fifteenmile Watershed zoned for agriculture. This model is based on the USDA Soil Conservation Service Technical Release 55 (June 1986) runoff model, “Urban Hydrology for Small Watersheds” and the Engineering Field Manual, Chapter 2, “Estimating Runoff and Peak Discharge” (August 1989).

Methods

Soils were mapped using data from the Northern Wasco County Soil Survey (USDA, 1986) and Mount Hood National Forest (USFS, 1977). Soils were grouped into four categories, A, B, C, D, based on texture and depth. “A” soils have the fastest infiltration rates and the least surface runoff. In the Fifteenmile Watershed, “A” soils were only found on a few soils on the Mount Hood National Forest. “B” soils have the second fastest infiltration. Typically, “B” soils are deep silt-loams. Most croplands in the Fifteenmile Watershed are on “B” soils. “D” soils have the slowest infiltration rates and the most runoff. “D” soils tend to be the heavier or shallower soils in the Fifteenmile Watershed, typically clay loams and “scabs” (figure 4-2). “C” soils are intermediate in all properties, and are typically “loam” soils.

Figure 4-2: Hydrologic Soil Groups in Fifteenmile Watershed. Note discontinuity at Forest Service Boundary. This discontinuity represents a difference in the soil surveys for private land and federal lands, rather than a true difference in soils. Sources: Northern Wasco County Soil Survey (USDA, 1986); Mount Hood National Forest Soil Resource Inventory (USFS, 1977).



Cover types were determined using aerial photos and records from the Farm Services Agency. Cover types included small grain, grass, open canopy woods, closed-canopy woods, irrigated crops, orchards, hay, brush and buildings. Figure 4-3 shows cover types for 1850 and for the current condition.

Based on soil, cover and quality, "Runoff Curve Numbers" were assigned which vary from 1-99, based on the infiltration rate of the soil-cover combination. Higher numbers imply lower infiltration rates and thus higher runoff levels. Lower numbers retain moisture in the landscape, and thus mitigate both flood and drought events. 1 would mean that there is 100% infiltration, i.e. zero runoff under any circumstances. This state is impossible to achieve. Open water and solid rock have the highest runoff curve numbers (99). Bare soil has a runoff curve number between 77 and 94, depending on soil texture. Brush or closed-canopied woods in good condition have the lowest runoff curve numbers – as low as 30 on porous soil. Table 4-3 shows runoff curve numbers used for agricultural soils.

Table 4-3. Runoff Curve Numbers for Selected Cover Types and Soils in Fifteenmile (NRCS TR 55, 1986)

Practice/Cover Type	"B" – (sandy/silt loam)	"C" – (loam)	"D" – (clay loam)
No residue, "Clean-till"	81	86	90
Residue management, "minimum till"	77	84	87
Annual Grass or Direct Seed, "No-till"	70	79	84
CRP or Bunchgrass	62	74	84
Open canopied forest and orchard	58	72	79
Closed canopied forest	55	70	77
Brush (thick)	48	65	73

Based on the runoff curve number, the projected runoff depth was calculated in inches for the two-year, 24-hour precipitation event (heaviest one-day storm for an average year). Runoff depth was then calculated for various points in history based on historic vegetation, and changes in farming practices through time. The most common type of agriculture in Fifteenmile Watershed is dryland grain production with a two-year rotation in which the land is fallowed for half the year. Fallow has very poor hydrologic behavior, particularly when the land is "clean-tilled" with a moldboard plow. Local farmers have moved from "clean tillage" to "minimum-till" since the 1950's, with the most progress being made since the Food Security Act of 1985 required conservation plans on highly erodible lands (table 4-4, figure 4-4).

Since 1996, nearly 45% of the cropland in the Fifteenmile Watershed has been converted from "minimum till" to "no-till" or "direct seed" farming techniques (table 4-4, figure 4-4). Knowledge of these historic trends in agricultural management allowed runoff to be modeled for 1860, 1950, 1985, 1996, 2002 and the projected state with all croplands under direct seeding. Figure 4-5 maps runoff curve numbers for 1850, 1950, current and projected values.

Runoff for the national forest and the city of Dufur was modeled for only two periods – 1996 (based on aerial photos) and 1850 (based on survey records). No information was collected regarding the condition of these areas for other time periods.

Results

Table 4-5 shows that, according to this model and these assumptions, runoff levels have increased in all subwatersheds since 1850, but most significantly in Lower Fifteenmile, where the percentage of cropland is greatest. Runoff levels in 1950 were 652% higher than in 1850. They have since fallen to 343% of the 1850 levels due to changes in cropland management. With 100% application of direct seed practices, the runoff levels in Lower Fifteenmile Watershed can be reduced to 259% of the 1850 level. Further reductions would require widespread conversion to perennial crops.

Historic runoff from the Mount Hood National Forest was relatively high due to the higher precipitation in the western portion of the watershed. However, the change in runoff from 1850 to 1996 was negligible (10% increase) compared to the changes seen on private lands. This result agrees closely with the Forest Service's own analyses (pp45-57, USFS, 1994).

Runoff from the City of Dufur is modeled at 495% of the level of runoff from the same area before construction of the town. This is due to the extent of impervious surfaces, including roads, driveways, sidewalks, rooftops, pathways, etc. Dufur has stormwater systems in some areas of the city and not in others. The City has stormwater sewers on Main Street and Heimrich Street with outlets to Fifteenmile Creek at the bridge. The new subdivision at the north end of town has a stormwater control system with a sediment pond and a 2" outlet to the city drainage ditch. This system is designed to remove sediment and control the rate of release of stormwater originating from the new subdivision. Other than these two areas, stormwater runs overland to Fifteenmile Creek. The City of Dufur is just beginning work on an emergency response plan for both its drinking water and sewage systems (Gay Melvin, City Superintendent, pers. comm., 2003). The area covered by the city is small enough however, that the city contributes only about 0.0085 acre-feet of runoff in a two-year storm event. This may be negligible over the entire watershed, but could have a strong localized effect on Fifteenmile Creek. [1]

Agricultural land use practices have a significant impact on the risk of major flood events. For instance, the 1996 storm event (approximately a 25-year event) would have yielded 28% less runoff from Lower Fifteenmile Watershed had 100% of the cropland been under direct-seed practices. The 1964 event (100-year storm) would have produced 34% less runoff under direct-seed farm practices than what occurred in 1964.

Confidence Level

This analysis was carried out at a very fine scale, but was not field verified. Rangelands were assumed to be in “good” condition, i.e. bunchgrasses, whereas a high percentage of them are probably in “fair” condition, due to invasion of nonnative annual grass species. Thus, runoff is probably somewhat higher than modeled here for all years from 1950 onward. In addition, runoff curve numbers have not been established for direct seed. The runoff curve numbers assigned in this analysis assume that direct seeded lands have similar runoff characteristics to annual grasses (range or pasture land in fair condition) at the time that the watershed is most vulnerable. This assumption was based on personal communications in 2002 with Jeff Repp, Claudia Sheer, Larry Goertz, & Dusty Eddy, all of NRCS.

[1] Multiply 0.218 inches (Table 4-4) by .085 feet/inch by .47 acres (Table 4-7) to get acre-feet.

Figure 4-3. Historic and current cover types for Fifteenmile Watershed. Current cover types were determined with aerial photography and some field verification. Historic cover types were inferred from current vegetation and historic survey records.

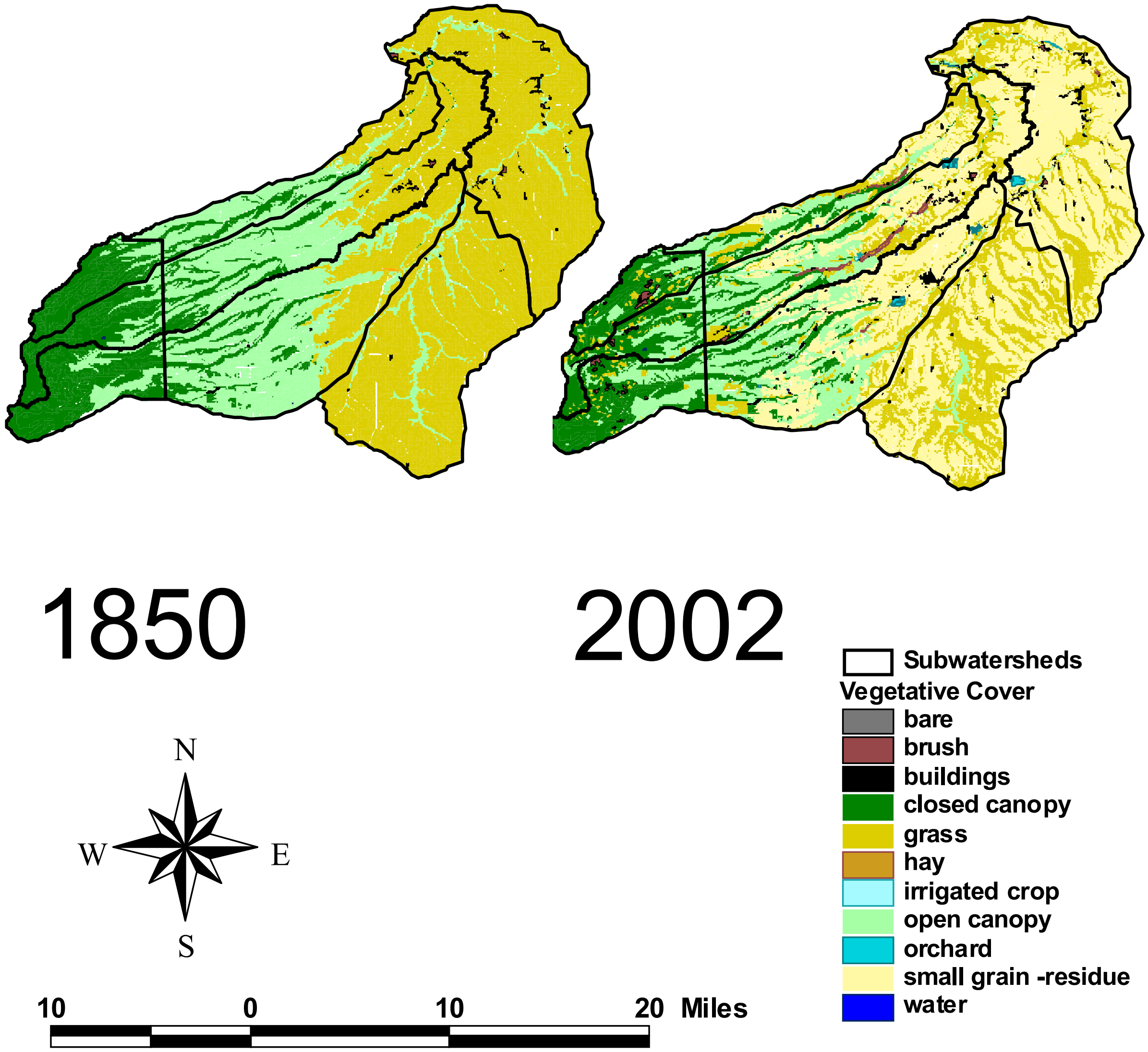


Table 4-4. Historical assumptions used in the Fifteenmile Hydrologic Model.

YEAR	Historic Assumptions
1850	Native vegetation, very little farmland
1950	Maximum extent of croplands (102,148 acres), little or no residue management or structures
1985	20% adoption of residue management, some structures
1996	16,000 acres CRP, 100% Highly Erodible Land (HEL) under residue mgt, some structures
2002	All 1996 assumptions plus 46,000 acres Direct Seed(Figure 4-5)
Goal	Assume 16,000 acres CRP and all other croplands in Direct Seed

Figure 4-4: Current croplands in the Fifteenmile Watershed, broken down by management.

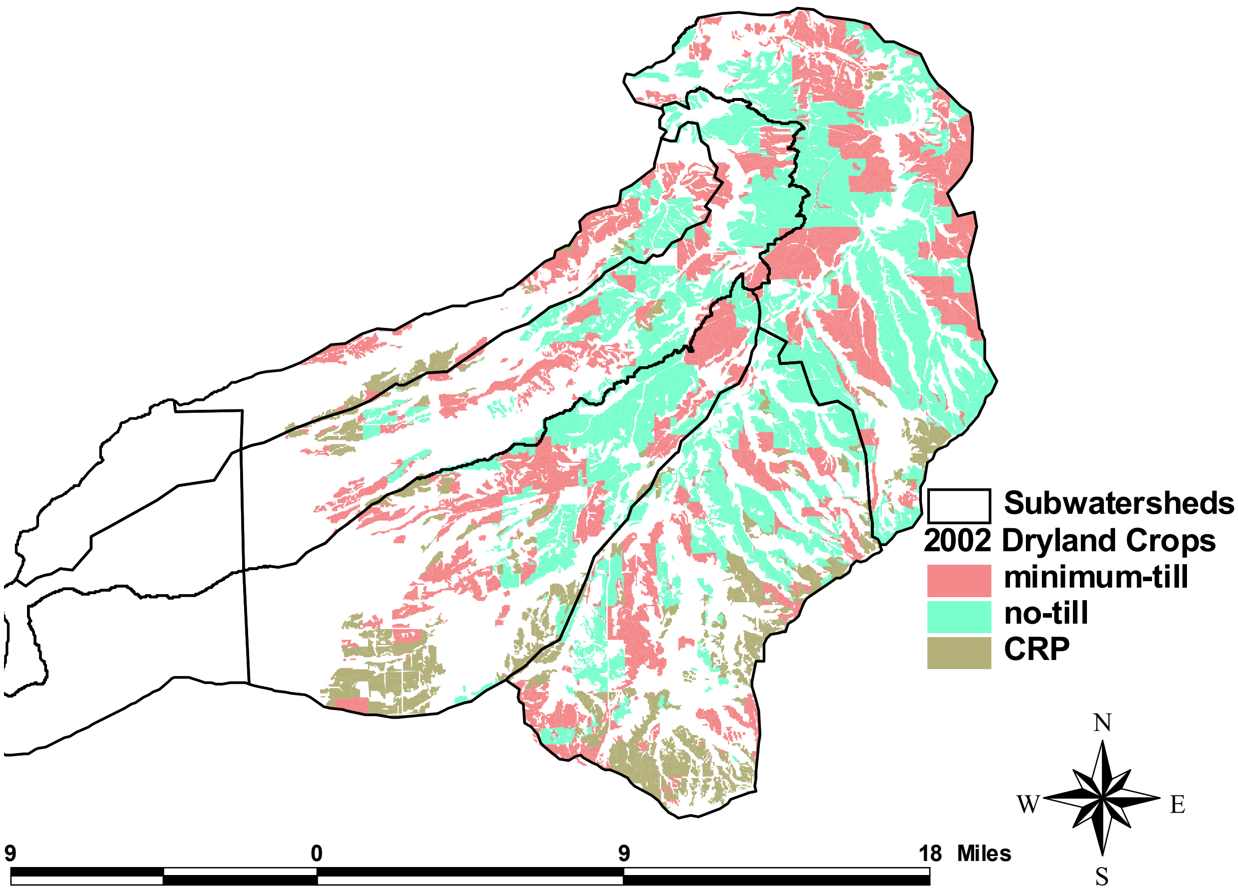
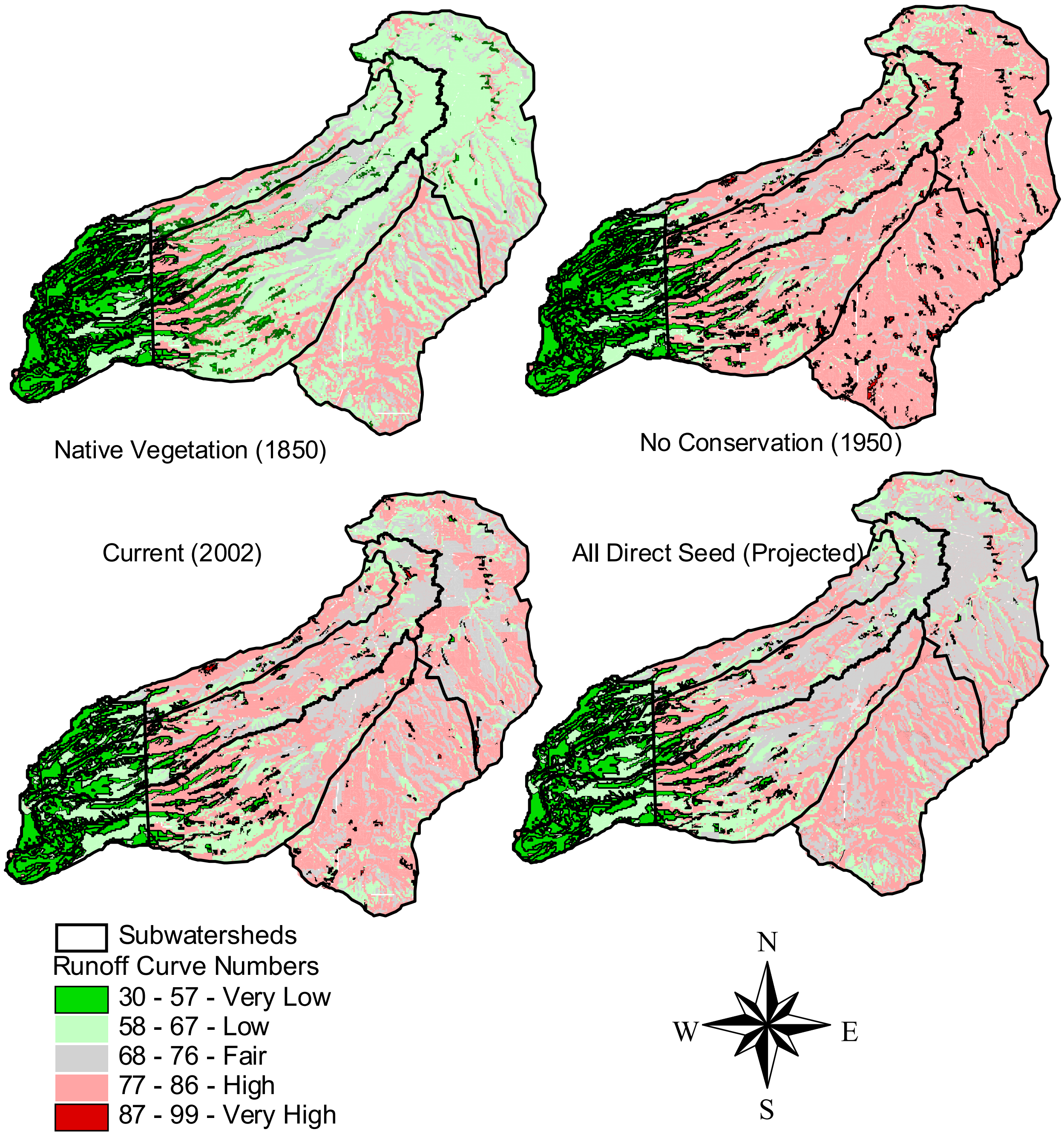


Table 4-5. Average depth of 2-year, 24-hour runoff events by subwatershed in inches and as a percentage of 1850 values.

year	1850	1950	1985	1996	2002	DIRECT SEED
Mount Hood NF	0.223	No data	No data	0.246	No data	--
Upper 15mile	0.109	0.287	0.285	0.217	0.197	0.168
8mile	0.102	0.280	0.266	0.232	0.202	0.169
5mile	0.115	0.259	0.237	0.209	0.194	0.166
Dry Creek	0.104	0.280	0.249	0.222	0.172	0.150
Lower 15mile	0.033	0.214	0.194	0.155	0.113	0.085
City of Dufur	0.044	No data	No data	0.218	No data	--
Percentage of 1850 Values						
year	**1850**	**1950**	**1985**	**1996**	**2002**	**DIRECT SEED**
Mount Hood NF	100%	No data	No data	110%	No data	--
Upper 15mile	100%	263%	261%	199%	181%	154%
8mile	100%	275%	261%	227%	198%	166%
5mile	100%	225%	206%	182%	169%	144%
Dry Creek	100%	239%	239%	214%	165%	144%
Lower 15mile	100%	652%	590%	471%	343%	259%
City of Dufur	100%	No data	No data	495%	No data	--

Figure 4-5. Runoff ratings based on vegetative cover and soil types in Fifteenmile Watershed, showing impact of cropland conservation practices on hydrology.



Cropland Erosion

Cropland erosion is a potential contributor to stream sedimentation. Cropland erosion occurs in two characteristic patterns: as either sheet and rill erosion or as concentrated flow ("gully erosion"). The first is a gradual process of downhill creep across the entire field. It is difficult to detect and difficult to measure except under controlled experimental conditions. Such experimental conditions have been used for more than 50 years by the USDA Agricultural Research Service to develop and improve the Revised Universal Soil Loss Equation (RUSLE – NRCS Field Office Technical Guide 2002). RUSLE is used to predict the long-term average soil loss due to sheet and rill erosion from any given field under a particular crop rotation and management style. Sheet and rill erosion does not translate directly into stream sedimentation, because soil lost from a field may not all be delivered to a stream. The delivery ratio is a factor of distance from a stream and intervening topography, land cover, and other factors. It is not well understood and is too complex to be modeled here.

Concentrated flow or gully erosion is erosion caused by flowing water collected in streams in a vulnerable field. It leads to clearly visible and measurable gullies in the field, and has a very high sediment delivery ratio, usually near 100%. This is a very site-specific phenomenon. Practices that reduce sheet and rill erosion also tend to reduce gully erosion, as do structural practices. Because it is so visible and disruptive to farm operations, gully erosion has been substantially addressed over the years by both vegetative and structural practices, such as sediment basins, terraces and grassed waterways.

This assessment used RUSLE to predict soil loss due to sheet and rill erosion in tons per acre per year based on soil erodibility, length and slope of field, vegetation and rainfall equivalent.

Methods

The Revised Universal Soil Loss Equation is represented as:

$$A=(Req)(LS)(C)(K)(P)$$

where A is *soil loss* in tons per acre per year,

Req is a *rainfall equivalent* that takes into account both annual rainfall levels and local rainfall patterns,

LS is a combination of the average *length* and *slope* of the field,

C is the *vegetative cover factor*, which is determined by the crop and crop rotation (table 4-6),

K is the *inherent erodibility* of the soil. Each soil in the soil survey is assigned a K value. K values in Fifteenmile varied from 0.10 to 0.49, with 96% of the cropland soils having values of 0.43 or 0.49.

P is the *practice factor* that takes into account such things as terraces, strip cropping and contour plowing. Structural practices are not well mapped in the Fifteenmile Watershed. According to RUSLE, structural practices such as those used in Fifteenmile Watershed reduce sheet and rill by no more than 10%. Therefore, P was held at 1 in this calculation.

Table 4-6. Crop Rotation and Vegetative Cover ("C") Factors used in this Assessment

Crop Rotation	Assumption	"C"
Winter Wheat/Summer Fallow with Moldboard Plow	Typical practice in 1950.	0.180
Winter Wheat/Summer Fallow with Chisel Plow & 20% residue after planting	"Minimum Till", Typical practice in 1996.	0.100
Winter Wheat/Chemical Fallow with no tillage and standing stubble after planting	"Direct Seed": 46,000 acres in 2002 (figure 4-4)	0.020
Perennial grass	CRP or native grass	0.001

The database developed for the hydrology model (see above) was clipped to include only lands currently in dryland crop production (figure 4-4). Each farm field or portion thereof was assigned Req, LS, C and K factors. These were multiplied together to get A, the predicted long-term soil loss under current conditions. C factors were then assigned for the each farm field under 1850, 1950, 1996, and All Direct Seed conditions (table 4-6), to provide a historic trend. Req, LS and K are all environmental factors that would change only negligibly over time.

Results

Figure 4-6 shows long-term average erosion levels for dryland crop fields from 1850, 1950, present day, and projected under all direct seed conditions. Blue colors indicate fields with less than 5 tons per acre per year. Five tons per acre per year is considered sustainable soil loss on deep soil in Wasco County, and is the standard in **[OAR 603-095-0640(2)(a)(C)]** in the proposed Lower Deschutes Agricultural Water Quality Management Area Rules. Dark blue indicates fields with less than 2 tons per acre per year of soil loss, a level considered sustainable on *all* soils in Wasco County. Fields marked in red have soil loss of at least 10 tons per acre per year, and dark red indicates soil loss of at least 15 tons per acre per year.

Table 4-7 shows average erosion rates and acreages at various levels of erosion for 1850, 1950, 1996, present day and all direct seed conditions. Out of a total of 102,045 acres, 52% have erosion rates below 2 tons per acre per year. This includes all fields enrolled in the Conservation Reserve Program, and a majority of the lands under direct seed. 15,229 acres (15%) have erosion rates between 2 and 5 tons per acre per year. 24,084 acres (24%) have erosion rates from 5-10 tons per acre per year, while only 8,756 acres have erosion rates greater than 10 tons per acre per year.

The adoption of direct seed methods has reduced soil erosion rates markedly. In 1950, 78,593 acres (77%) had erosion rates over 10 tons per acre per year – reaching as high as 34 tons per acre per year (table 4-7). In 1996, just prior to the widespread adoption of direct seed methods, when most fields were managed under minimum-till conditions, 20,241 acres still had erosion rates in excess of 10 tons per acre per year. If Direct Seed were to be adopted on all crop fields in the Fifteenmile Watershed, no field would have erosion higher than 3.8 tons per acre per year.

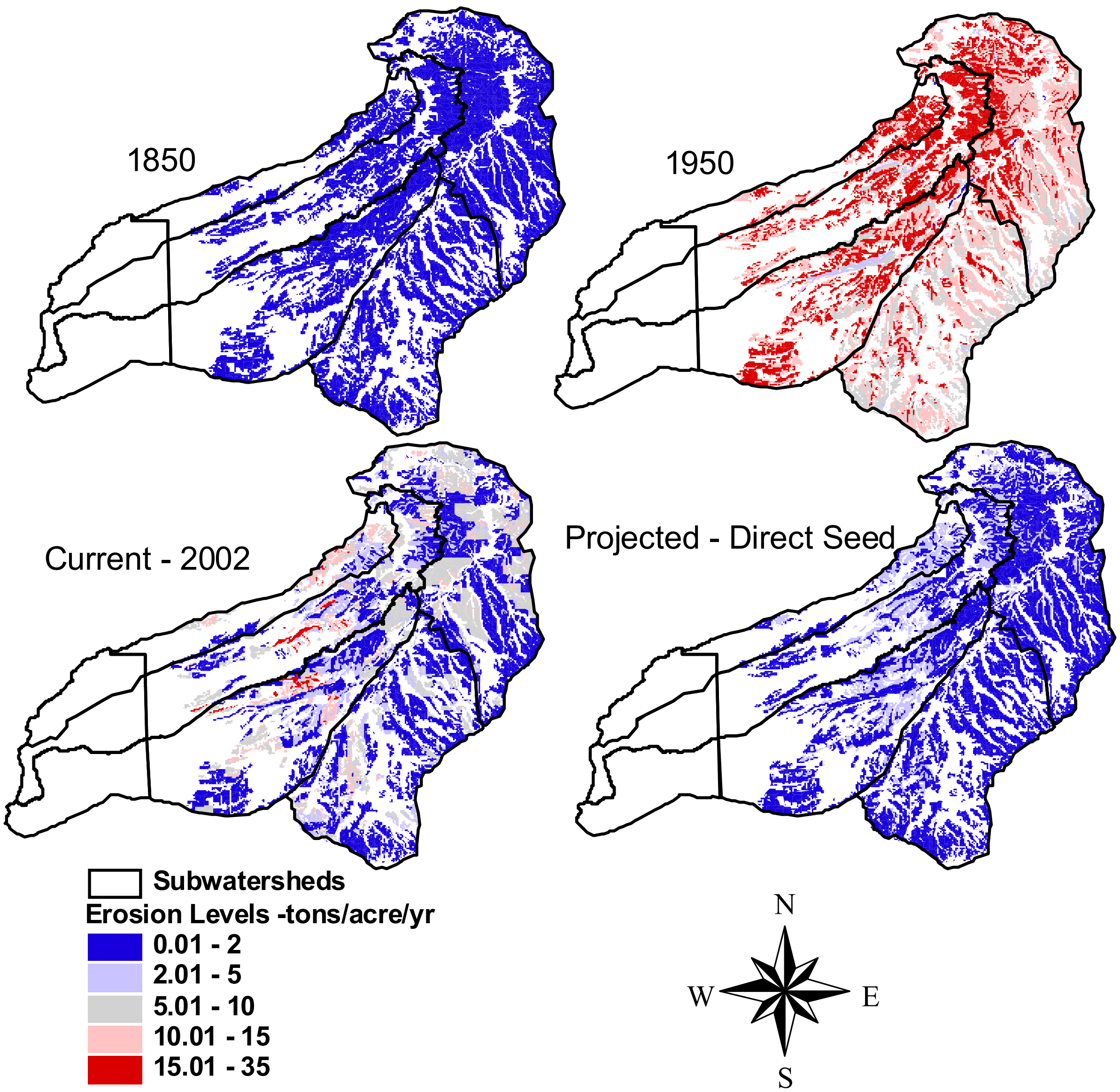
Confidence Level

Cropland in Fifteenmile Watershed is very well mapped by the USDA Farm Services Agency. C factors and all other RUSLE factors are well established by research conducted over 60 years in the Inland Northwest. Therefore, this portion of the assessment has a high level of confidence. The only uncertainty in this section is in the exact extent of direct seed fields, and in the extent of various crop rotations at various points in history. In addition, as noted in the methods section, structural practices were not taken into account. On individual crop fields where terraces and sediment basins have been installed, erosion levels may be as much as 10% lower than shown here.

Table 4-7. Average erosion levels and acreages at various erosion levels through time.

Erosion Levels	**1850**	**1950**	**1996**	**2002**	**All Direct Seed and CRP**
Ave (t/ac/yr)	*0.08*	*14.34*	*7.97*	*4.20*	*1.39*
Range:	*0.009 - 0.19*	*1.62 – 34.08*	*0.90 – 18.93*	*0.01 – 18.93*	*0.012 – 3.79*
Breakdown of erosion levels:					
<2 t/ac/yr	100%	0.2%	1.8%	52%	81%
2-5 t/ac/yr	0	23%	16%	15%	19%
5-10 t/ac/yr	0	20%	62%	24%	0
10-15 t/ac/yr	0	37%	18%	7.3%	0
>15 t/ac/yr	0	40%	2.2%	1.2%	0

Figure 4-6. Long-Term Average Erosion Levels for Crop Fields in Fifteenmile Watershed.



4.3) Roads

Roads were analyzed for two different effects in this assessment. Overall density of roads and impervious surfaces may have an effect on peak flows, while individual roads within 200 feet of a stream may have a localized effect on sediment delivery to a stream.

Overall Density of Roads and Impervious Surfaces

Road density is an indicator of potential hydrologic change (and sediment delivery) within a watershed. Urban, rural and forest roads alike convert natural areas into permanent openings and compacted surfaces with little or no infiltration. Roadside ditches intercept, channel and re-route subsurface and surface runoff, allowing it to enter streams more quickly. As watershed road density increases, runoff is funneled quickly and directly to streams, affecting the ability of the watershed to slow and store runoff. Different types of roads have greater or lesser effects on hydrology, depending on their width, degree of compaction, and the amount of impervious surface associated with a given amount of roads.

Methods

ArcView GIS was used to build and refine a roads data layer for each subwatershed based on black and white aerial photography from 1995. All roads of any kind that could be seen or inferred on the aerial photos were digitized, along with roads marked on USGS topographic maps. This included paved and unpaved roads, forest roads, “jeep trails”, driveways, and major traffic areas in orchards. Roads were not differentiated based on size or surface, as this information was incomplete. See figure 4-7 for a map of all identified roads.

Subwatersheds were analyzed separately. Based on studies conducted in Pacific Northwest watersheds (Bowling and Lettenmeier, 1997), the Oregon Watershed Assessment Manual assigns a high degree of concern in rural areas when more than 8% of a given watershed is covered by roads. The Assessment Manual assumes that roads in rural areas average 35 feet in width, including hardened area, shoulders and ditches. Such an assumption is probably relatively accurate for county roads, but exaggerates the size of farm and field roads. Based on the previous two assumptions, a subwatershed was rated high potential for impact if road densities exceeded 12.2 mi./mi^2 (This equals 8% of the surface area). Medium ratings were assigned for half the density of a high rating (6.1 mi./mi^2).

The City of Dufur was analyzed separately because it is an urban area. In urban areas, most roads are paved and experience high use. In addition, urban areas feature a high percentage of impervious surfaces other than roads, such as parking lots, driveways, homes, sidewalks, etc. May et. al. (1997) determined that peak flows in urban areas may be increased when road density exceeds 5.5 mi./mi.^{2}. Road density of 4.2 mi./mi.^{2} represents approximately half the impact of 5.5 mi./mi.^{2}.

More information regarding the basis for this analysis is available online from the Oregon Watershed Assessment Manual (www.oweb.state.or.us).

Results

Road densities in various watersheds and land use zones are summarized in table 4-8. Analysis shows a low overall potential for impact from rural roads. Localized effects may still occur. In particular, see the section on sedimentation for an analysis of riparian roads.

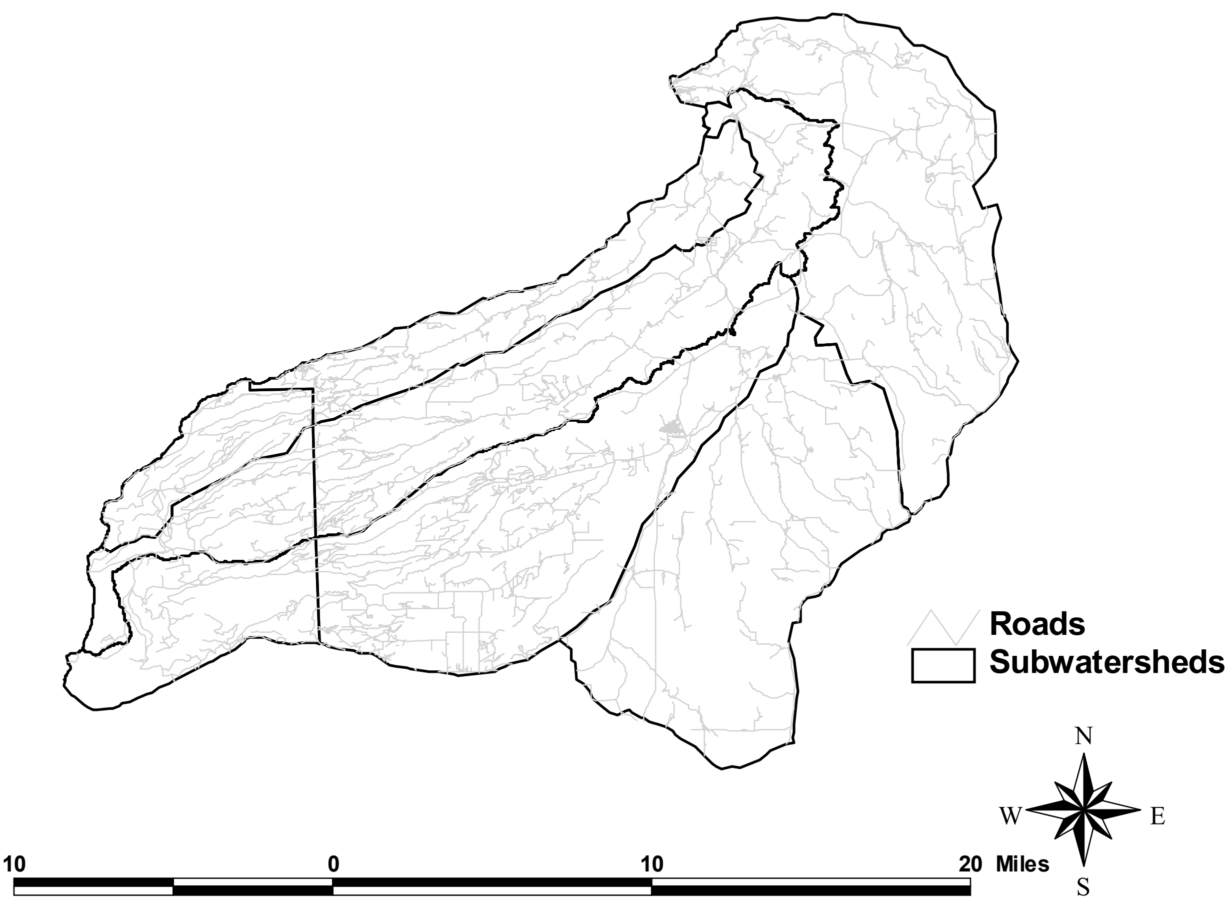
Road density within the developed area of Dufur was 26.7 miles per square mile. This corresponds to a high potential for impact, since a high percentage of city roads are paved, and are associated with other impermeable surfaces, such as roofs, sidewalks, parking lots, etc. See also table 4-4, which shows Dufur having a runoff level almost 5 times higher than presettlement conditions. As noted on page 28, the City has a stormwater control system on Main Street, Heimrich, and the new subdivision at the north end of town, but does not have any stormwater system for the rest of town.

Table 4-8. Roads Density Summary.

Subwatershed	Miles Roads	Area (mi.^{2})	Road Density *(mi./mi^2)*	Potential for Impact*
National Forest – Upper Fifteenmile	61.46	23.52	2.61	Low
National Forest – Eightmile	59.14	16.52	3.58	Low
National Forest - Fivemile	59.40	14.35	4.14	Low
Upper Fifteenmile	245.13	74.79	3.28	Low
City of Dufur	12.55	0.47	26.70	High
Lower Fifteenmile	157.22	76.39	2.06	Low
Eightmile	170.73	59.41	2.87	Low
Fivemile	89.70	27.82	3.22	Low
Dry Creek	127.32	77.03	1.65	Low

* A medium potential for impact corresponds to 6.1-12.2 mi/mi^2 in rural zones (8% of surface area – Bowling and Lettenmeier, 1997), and 4.2-5.5 mi/mi^2 in urban zones (May, et. al, 1997).

Figure 4-7. Roads map used for road density calculations. Source: 1995 Aerial photography.



Confidence Level

Roads data used in this analysis were based primarily on roads visible on aerial photography from 1995. Since 1995, new roads may have been built, and some roads may have been abandoned. In addition, some roads may exist which were invisible in aerial photographs due to dense tree canopy. Rural roads were assumed to average 35 feet in width, while private roads on farms and in forests may actually be as narrow as 12 feet wide.

Sediment Delivery due to Individual Road Placement

Fine sediments can enter a stream through a variety of natural and human-related causes. Natural sources include landslides and burns. Sedimentation can also be related to land use through road runoff (urban or rural) or road failure, and surface erosion on crop or rangeland. This portion of the assessment focused on sedimentation due to location of roads near to streams and on steep slopes.

Rural roads in poor repair can add sediment to the streams by triggering landslides. Culverts in poor repair can trigger road failure (Figure 3-2). Oregon Department of Forestry has developed a protocol for road and culvert condition surveys. They make this protocol available to private foresters and local forestry agencies. Such a survey has not been conducted in the majority of the Fifteenmile Watershed, though the Forest Service has surveyed its culverts for fish passage.

Riparian Roads

While the last section looked at overall roads density throughout the watershed, this section looks at road density within the riparian corridor. Roads within 200 feet of the stream can contribute significant amounts of sediment through concentrated road runoff, even when the road itself is in good repair. The Oregon Watershed Assessment Manual provides a protocol for quantifying this effect by cataloging all roads within 200 feet of the stream, and then further categorizing them based on the steepness of the slope above them. Roads on or below slopes greater than 50% pose a worse potential problem, because they are more prone to failure and collect more sediment than do roads on shallower slopes.

Methods

The USDA streams data layer (that used throughout this assessment) was updated carefully for accuracy against the USGS topographic maps and aerial photos using ArcView. Where the two did not agree, the streams layer was updated to agree with the aerial photo. The updated roads layer was clipped based on the streams, creating a data layer that only included roads with 200 feet of a stream. The riparian roads layer was then carefully examined with the topographic layer in the background. Each road segment was catalogued as to whether the slope above it was more or less than a 50% slope. The density of riparian roads was calculated in terms of road miles per stream mile to give an intuitive measurement of relative impact.

Results

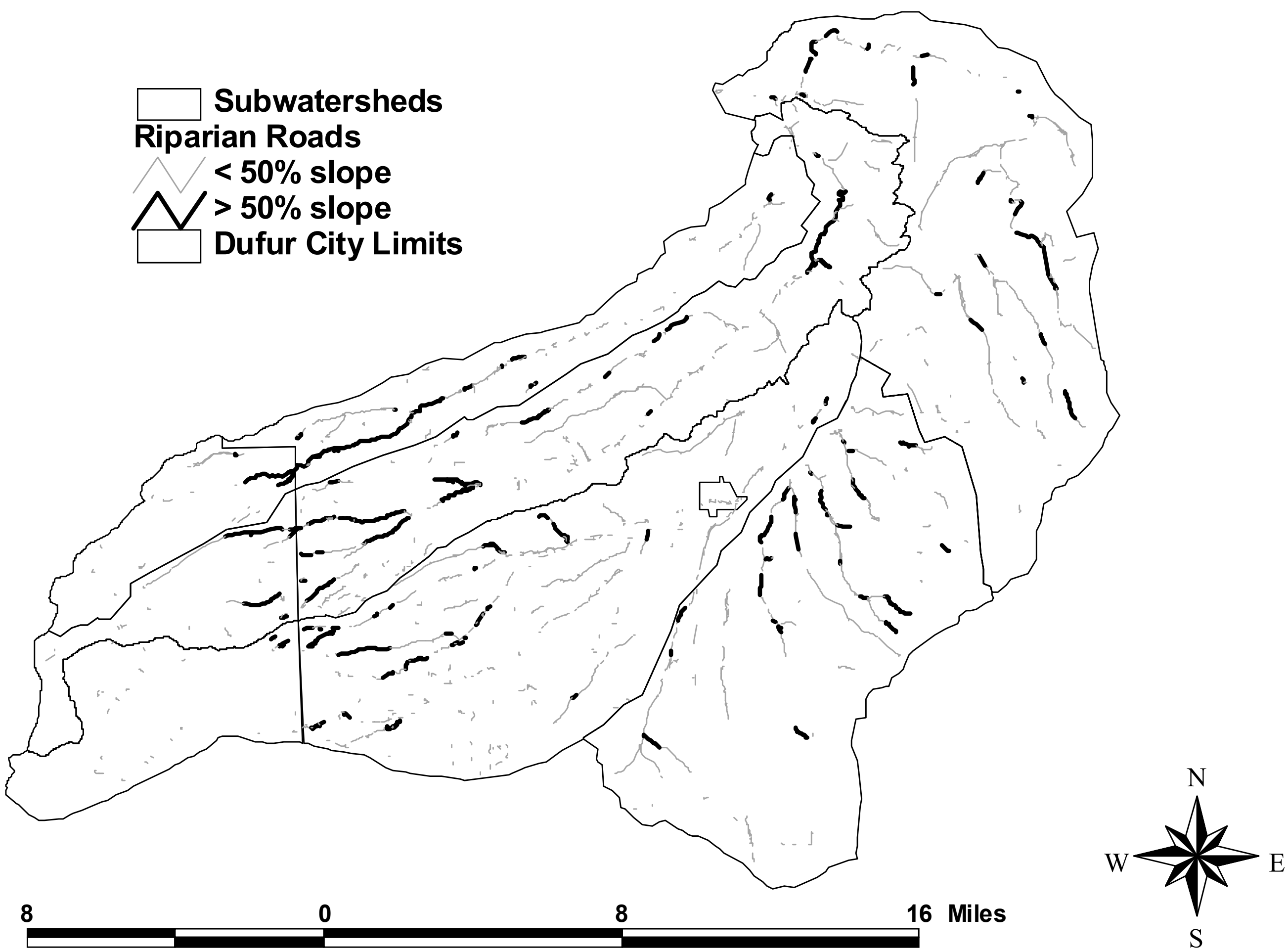
Results are summarized in table 4-8 and mapped in figure 4-8. Roads can be identified on this map that parallel streams, and others can be identified that cross streams. The former are referred to as "Stream-adjacent parallel roads" in the Washington State Forest and Fish Agreement (Steve Hanson, Longview Fibre, pers. comm. 2001). Stream adjacent parallel roads lead to a much higher density of riparian roads than do crossings. Analysis shows that the highest densities of roads within 200 feet of the streams are in Fivemile, Eightmile and Lower Fifteenmile Creeks, each of which has more than half a mile of riparian road for every mile of stream. The highest density of riparian roads on steep slopes is found in Fivemile, with Eightmile not far behind. Whether these roads cause a problem is something that should be determined on a site-specific basis. Fivemile and Eightmile Watersheds would be a priority for further study.

Mount Hood National Forest had a much lower density of riparian roads than the private lands, but a higher percentage was on steep slopes.

Table 4-9. Riparian Road Densities and Riparian Roads on Steep Slopes (>50%)

Subwatershed	Stream Length	Riparian Roads (within 200'of stream)		Riparian Roads with slope >50%	
	Miles	Miles of riparian road	mi. roads per mi. stream	Miles of steep roads	% riparian roads
Mount Hood NF	87.63	19.1	0.22	6.24	33%
Upper Fifteenmile	122.33	57.83	0.47	9.30	16%
Lower Fifteenmile	86.75	46.97	0.54	7.31	16%
Dry Creek	123.81	46.64	0.38	8.76	19%
Eightmile	94.77	52.96	0.56	14.19	27%
Fivemile	36.14	20.50	0.57	6.18	30%
OVERALL	**551.43**	**244.00**	**0.44**	**51.98**	**21%**

Figure 4-8. Riparian Roads with note of those on or below slopes greater than 50%.
Source: USGS topographic maps and aerial photos, 1995.



5) Surface Water Use

Water rights have become more intensely monitored in recent years, as meters and other measuring devices are installed on diversions that are more efficient than in years past. Stream flow in Fifteenmile Watershed is diverted for irrigation and residential use. Low flows can present problems for fish spawning and rearing by drying up critical reaches, cutting off fish passage and raising stream temperatures. The Oregon Water Resources Department (WRD) maintains a database of water rights and water availability throughout the State of Oregon. The WRD divides watersheds into 19 water availability basins (WABs). They then model the streamflow in each basin (WAB) to determine the average flow (also called 50% exceedance level) and under drought conditions (80% exceedance, referring to the streamflow that will be exceeded 80% of all years). These models look at natural streamflow (prior to withdrawals) and after all legal water rights are met.

Table 5-1 summarizes water availability for the subwatersheds used in this assessment in an average year (i.e. 50% exceedance level) for each month. Zero or negative water availability indicates that this reach can legally be completely dewatered in an average year. Table 5-1 can be compared to Table 4-1 to judge how water withdrawals affect natural stream flows. Table 5-1 shows that August and September stream flows are extremely low throughout the watershed, and that Dry Creek is expected to run completely dry in an average water year. Flows at the mouth of Fifteenmile Creek are depleted from a natural level of 10.7 cubic feet per second down to 3.45 cubic feet per second.

Table 5-1. Expected stream flow (after consumptive use and storage) in cubic feet per second for average year (50% exceedance level) at the mouth of each subwatershed. Source: Oregon Water Resources Department website: www.wrd.state.or.us .

	Upper Fifteen-mile[1]	Lower Fifteen-mile	Eight-mile	Fivemile	Dry Creek	Japanese Hollow[2]	Pine Creek[3]	Ramsey Creek[4]
January	61.6	104.0	39.2	27.5	9.74	1.77	7.6	10.0
February	91.1	178.0	76.2	47.5	19.7	4.74	14.0	13.5
March	77.5	196.0	98.8	56.7	19.2	7.40	13.0	8.61
April	54.1	123.0	69.6	45.1	7.04	5.02	12.9	7.38
May	38.5	56.9	26.8	18.9	4.44	1.29	10.5	10.5
June	27.2	35.2	14.9	5.37	2.84	0.43	6.24	10.6
July	5.74	7.87	4.19	2.04	0.44	0.09	1.15	2.21
August	2.00	3.45	2.45	1.42	0.05	0.07	0.31	0.45
September	2.10	4.65	3.60	1.23	-0.01	0.07	0.31	0.50
October	7.41	14.3	6.93	2.12	0.25	0.12	1.00	2.08
November	10.7	24.3	13.5	6.44	0.50	0.34	1.56	3.27
December	22.6	50.1	25.9	19.1	2.29	0.94	2.19	3.21

[1]This flow actually represents Fifteenmile Creek above Jameson Canyon, somewhat downstream from the break between upper and lower Fifteenmile used in the rest of this assessment. It therefore includes contributions from Dry Creek.

[2]Tributary of Eightmile Creek, north of mainstem.

[3]Tributary of Upper Fifteenmile, south of mainstem.

[4]Tributary of Upper Fifteenmile, north of mainstem.

6) Riparian and Wetlands Condition

This chapter summarizes a riparian vegetation assessment and presents a list and map of wetland areas in the Fifteenmile Watershed.

6.1) Riparian Vegetation

Riparian vegetation is important as a source of shade and large woody debris, and to filter out sediment from storm events. Large woody debris (large tree trunks, stumps or branches) is an important structural element for fish habitat. Shade affects stream temperature. Riparian vegetation serves to filter out fine sediments carried by runoff that can choke spawning gravels, and is the source for organic matter needed by the aquatic food chain. Trees, shrubs and other riparian vegetation also help stabilize streambanks.

The purpose of this assessment is to evaluate current riparian vegetation along stream channels in the Watershed compared to the site potential. This information can be used to identify areas where riparian vegetation has been degraded and where it is in good condition, and thus prioritize areas for riparian restoration or protection.

Methods

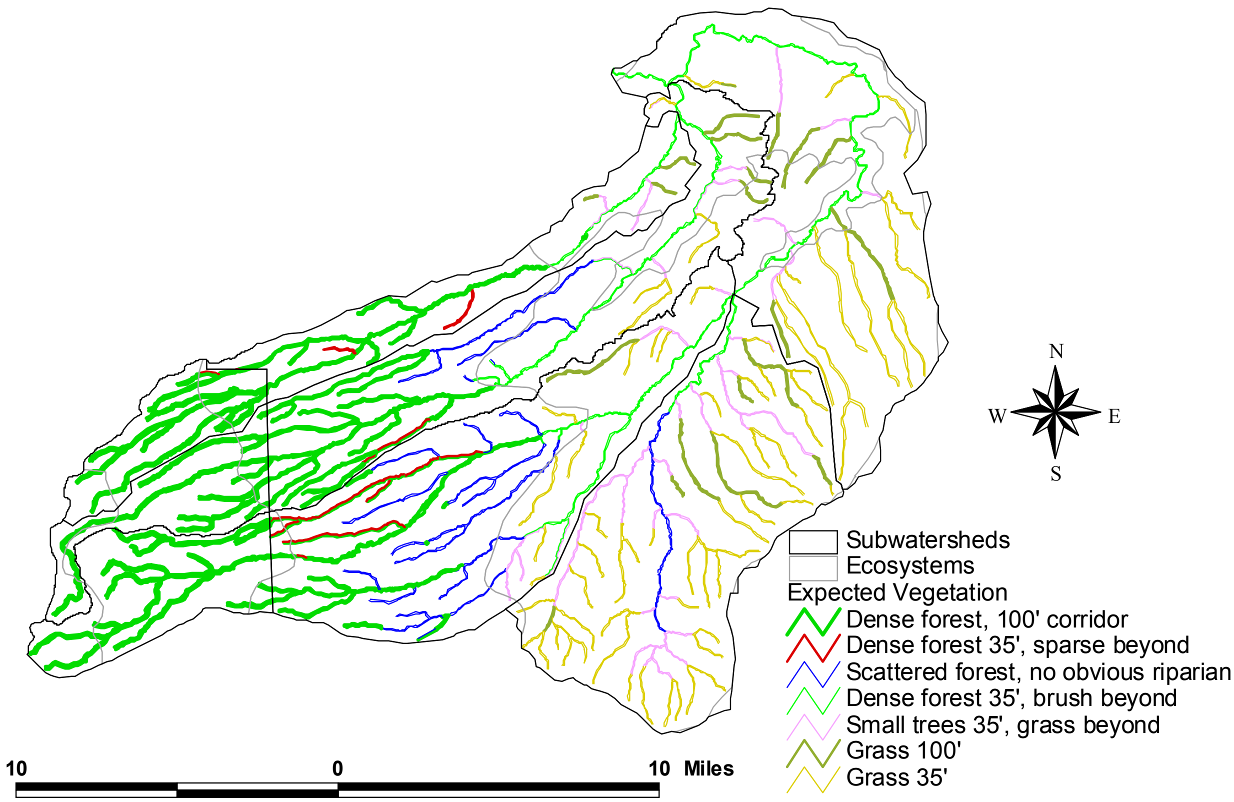
This analysis looked at all streams and channels, including intermittent streams and seasonal drainages. Riparian vegetation was evaluated using black and white aerial photography taken in summer 1995. Riparian condition units (RCUs) are segments of the riparian area for which vegetation type, size and density remain approximately the same. Each side of the stream was evaluated separately. Riparian vegetation was considered up to 100 feet from the stream. Each RCU was classified by its vegetation type (conifer, hardwood, mixed, brush, grass or none), tree size class (<4 inches trunk diameter, 4-12 inches, 12-24 inches, >24 inches or nonforest), and stand density (<1/3 ground exposed, >1/3 ground exposed or nonforest). Each RCU was classified twice, once for the vegetation within 35 feet of the stream, and once for the vegetation 35 to 100 feet away from the stream.

Each RCU was then classified by Expected Vegetation (figure 6-1), based on historic forest data, ecosystem and observation of surrounding areas in the aerial photos. In seasonal drainages, the expected vegetation was typically the same as the upland vegetation – grass or upland forest. Tree species was difficult to determine from aerial photos, and was therefore not considered in defining expected vegetation.

Each RCU was then rated by whether it had the expected vegetation or not. Riparian restoration efforts undertaken since 1995 by the Natural Resources Conservation Service, Soil and Water Conservation District and Oregon Department of Fish and Wildlife were mapped. Where the condition of the riparian vegetation did not meet expectations, and no known restoration efforts have been undertaken in the last six years, recommendations for potential restoration efforts were given.

As an example: A typical RCU might have been classified thus: The near-stream code might be "CMD", which would mean ***C****onifer,* ***M****edium size trees,* ***D****ense canopy*, while the 35-100ft code might be "CMS" (***C****onifer,* ***M****edium size,* ***S****parse*). This would be compared to an expected vegetation code of "MD-MS", meaning that the expected vegetation was medium size and dense within 35 feet, and medium size and sparse beyond that. This RCU would therefore meet expectations.

Figure 6-1: Expected Riparian Corridor, based on ecosystem, observation, and historic survey data.



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Results

Results are tabulated in tables 6-1 and 6-2 and mapped in figures 6-2 to 6-4. Out of 1,082 total streambank miles (right and left banks), 667.4 met expectations for riparian vegetation in 1995 (table 6-1, figure 6-2). Fifteenmile Creek, both upper and lower, had the lowest percentage of riparian area meeting expectations with only 49% meeting expectations (table 6-1). By contrast, the percentage meeting expectations on the National Forest was 86%.

Of the miles not meeting expectations, 128.41 miles have been restored in some manner either by ODFW, Wasco County SWCD or NRCS (figure 6-3). Another 26.62 miles have applied for the Conservation Reserve Enhancement Program (CREP), but have not yet received a contract.

In some cases, more than one restoration activity has been applied to the same stream reach. For instance, ODFW often provides fencing materials for a CREP project. CREP projects have been undertaken where ODFW had conducted instream restoration efforts. In this case, the stream reach would be listed under the CREP column, as that is the more protective category (figure 6-3). In addition, several stream miles on Fifteenmile Creek are excluded from riparian grazing by agreements between ODFW and the landowner, even though no additional fence was built. These miles are not shown on the map.

Table 6-2 and figure 6-4 summarize recommendations for stream miles that did not meet expectations and have not been treated or proposed for restoration activities. This analysis shows a potential for 152.77 miles of forested riparian buffers. 71.66 of these miles would qualify for the CREP program. 82.11 more miles would not qualify for CREP, but could qualify for continuous CRP). Timber harvest impacted 41.52 miles primarily on the National Forest. These areas could be restored through reforestation practices. 113.6 miles of ephemeral drainages could be protected with grassed waterways.

Confidence rating

This component was not field verified. Impacts to underbrush, such as would be typical from livestock grazing, were not visible from aerial photos in areas with mature trees. The 1995 aerial photos date from the same summer as the Twin Flash Floods of 1995, and may therefore represent a stream system that was quite recently damaged by high flows. Floods occurred again in 1996 and to a lesser degree in 1997. Since that time, regeneration is known to have occurred in many areas. Regeneration is particularly likely in timber harvest sites. Within the next few years, The Dalles USDA field office expects to have access to georectified color aerial photography from 2001. When this resource becomes available, an updated riparian assessment can be undertaken.

Figure 6-2. Stream reaches meeting and not meeting expectations based on 1995 aerial photos.

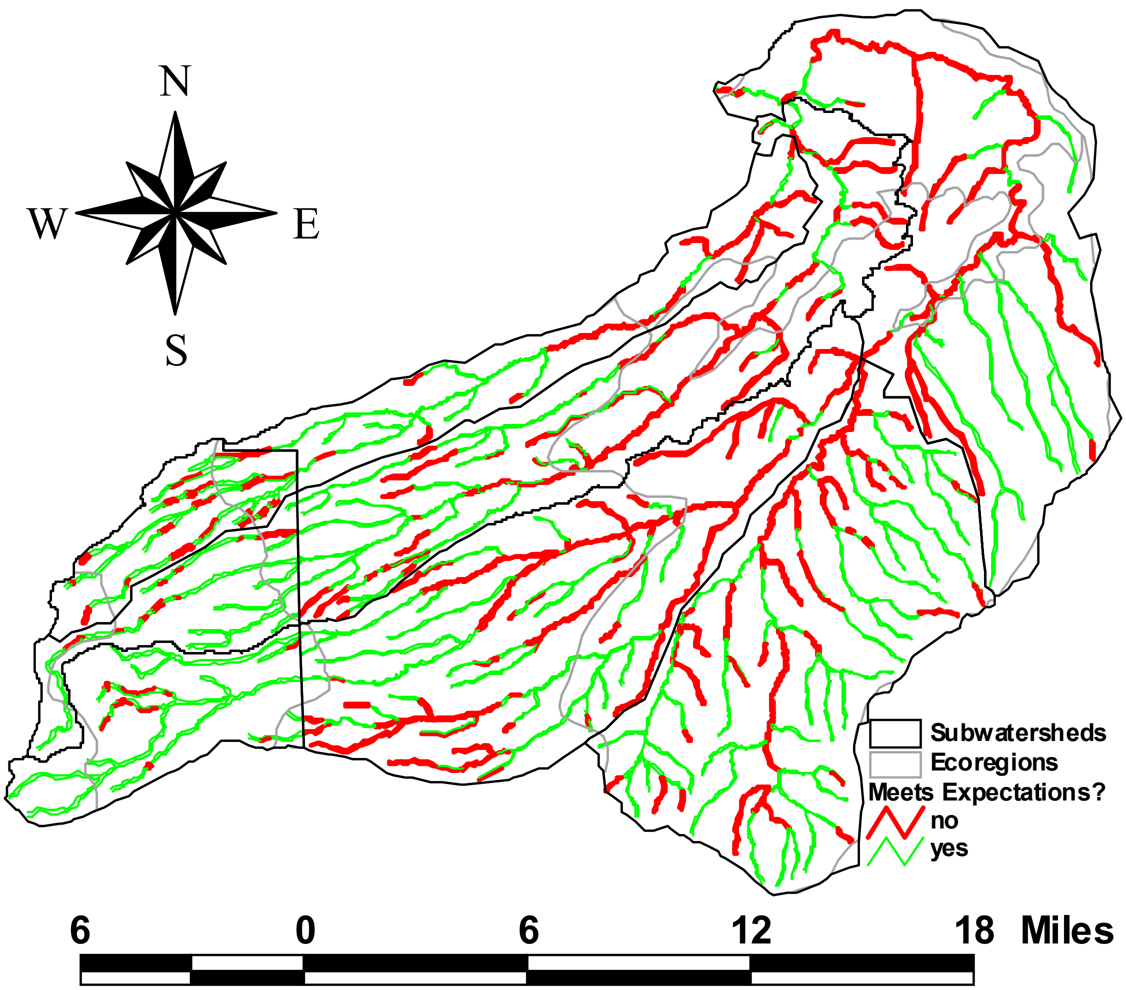


Table 6-1. Stream miles meeting vegetative expectations and restoration activities undertaken from 1995 to 2001 (miles of stream) Note that miles covered by more than one activity are credited to the most protective category.

	TOTAL Miles	**Meeting expectations as of 1995**	CREP (miles)	CCRP (miles)	CREP Applications (miles)	ODFW Stream Fencing (miles)	ODFW Instream Projects (miles)
MHNF	175.26	150.30 (86%)	0.00	0.00	0.00	0.00	0.00
Upper 15mile	244.66	119.02 (49%)	0.00	0.00	0.00	37.87	3.95
8mile	189.54	103.60 (55%)	9.68	0.56	20.81	6.37	5.20
5mile	72.28	44.12 (61%)	2.27	0.00	0.88	1.84	0.00
Dry Creek	247.62	164.78 (67%)	20.71	3.80	0.00	0.00	13.23
Lower 15mile	173.50	85.58 (49%)	8.75	0.00	4.93	5.04	9.14
TOTAL	**1,102.86**	**667.40 (61%)**	**41.41**	**4.36**	**26.62**	**51.12**	**31.52**

Figure 6-3. Restoration Efforts through ODFW, Wasco County SWCD and/or NRCS, 1995-2001.

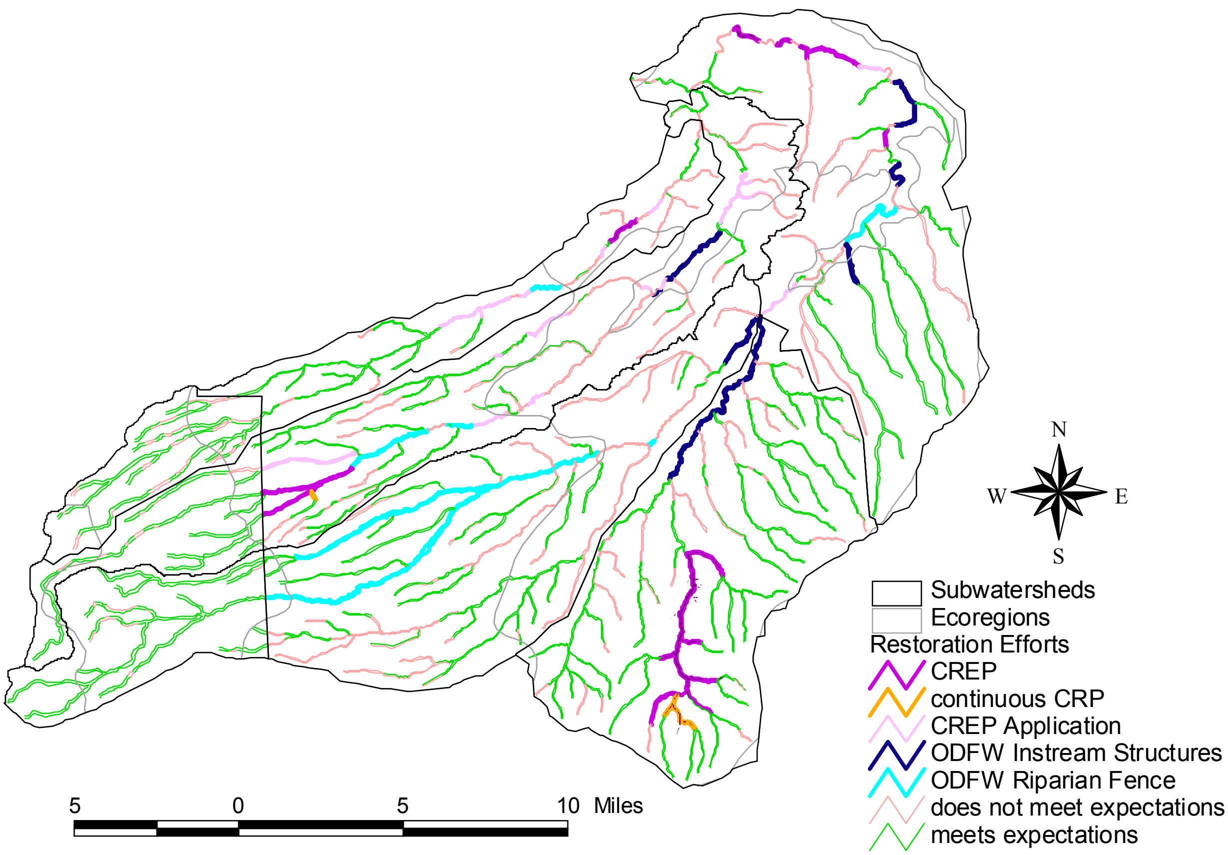
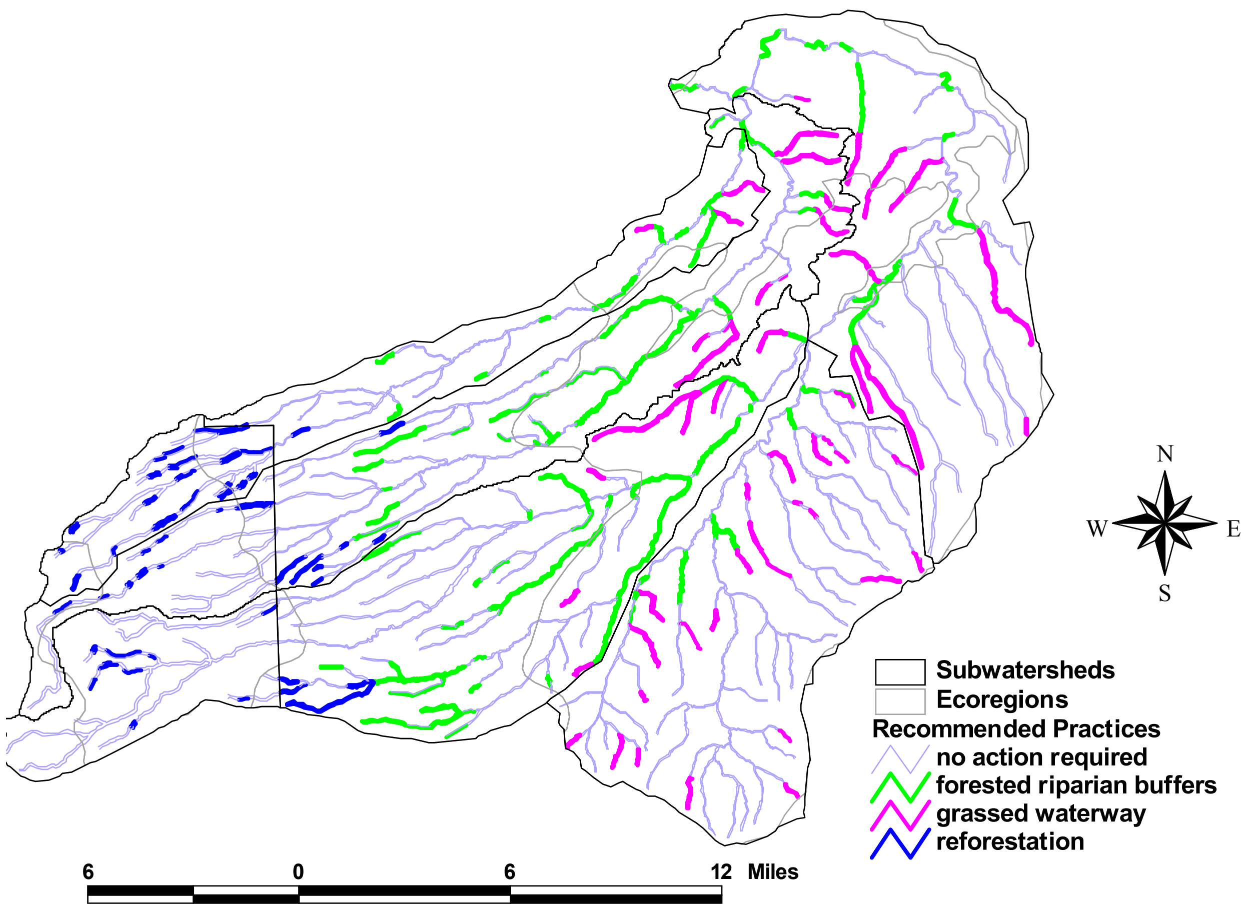


Table 6-2. Recommended restoration activities for remaining streambank miles not meeting vegetative expectations.

	TOTAL Miles	**Action required (miles)**	CREP (miles)	Forested Riparian Buffers (miles)	Reforestation (miles)	Grassed Waterways (miles)
MHNF	175.26	22.95	0.00	0.00	22.95	0.00
Upper 15mile	244.66	92.32	26.00	39.48	9.49	17.35
8mile	189.54	68.67	20.97	18.68	8.05	20.97
5mile	72.28	21.46	7.02	7.95	1.03	5.46
Dry Creek	247.62	48.43	3.37	7.46	0.00	32.35
Lower 15mile	173.50	60.31	14.30	8.54	0.00	37.47
TOTAL	**1,102.86**	**314.14**	**71.66**	**82.11**	**41.52**	**113.6**

Figure 6-4. Recommended restoration activities for remaining streambank miles not meeting vegetative expectations.



6.2) Wetlands

Wetlands contribute to critical functions in the health of a watershed. Wetlands are protected by federal, state, and local regulations. Determining the location and extent of wetlands in the watershed is necessary to plan for growth, development or any kind of project. The purpose of this assessment was to inventory wetland locations, acreage, and characteristics within the Watershed using existing data. No attempt was made to characterize wetland condition or restoration opportunities. If wetland restoration is identified as a priority by the Fifteenmile Watershed Council, further studies will be necessary.

Wetlands are defined as areas with a permanently or seasonally saturated soil, which can be identified by the presence of plants adapted to saturated soil conditions. Wetlands include areas commonly referred to as bogs or swamps. For the purposes of this assessment, seasonal or permanent pools, including man-made ponds, were considered wetlands. Soils that develop under saturated conditions are known as hydric soils. Hydric soils typically indicate that an area either is or once was a wetland. Riparian areas are generally considered wetlands where hydric soils are present. On the other hand, a riparian area in which the soil does not typically experience saturated soil conditions would not necessarily be considered a wetland.

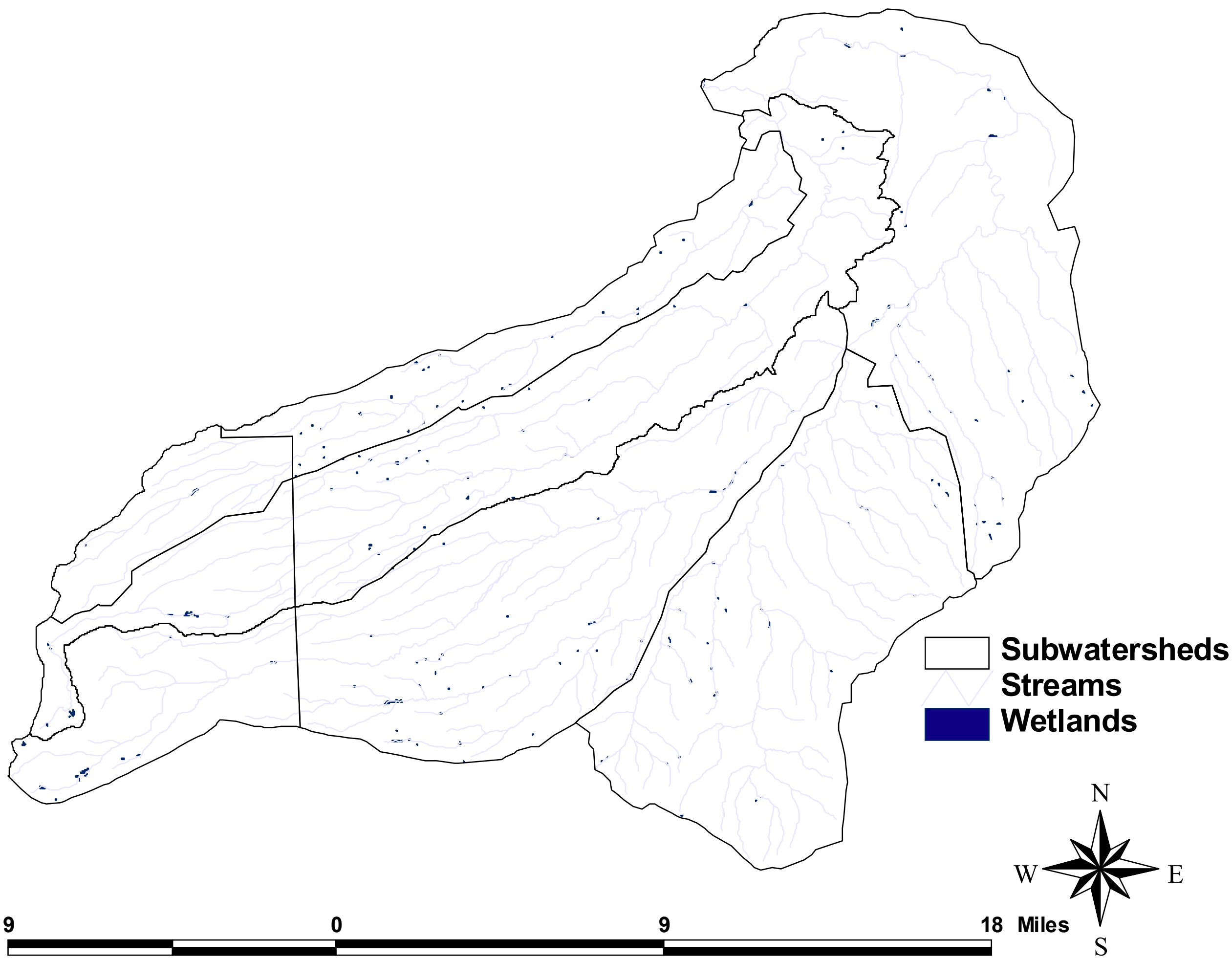
The major source for this inventory was the National Wetlands Inventory (NWI). NWI data is available from the internet (www.nwi.fws.gov), and includes information on the substrate, vegetation and seasonality of the wetlands. NWI data includes not just "swamps", but also open water, such as reservoirs, farm ponds, lakes, etc. Wetlands are further categorized by natural versus constructed. Local NRCS offices update NWI data in the process of providing technical assistance to private landowners. Thus, the most up-to-date wetlands information is actually available in NRCS field offices.

The wetlands inventory showed a total of 369 individual wetlands in the Fifteenmile Watershed. These wetlands covered 175.5 acres, or less than one one-thousandth of the watershed area (Table 6-3, figure 6-5). Of these, 102.9 acres were naturally occurring, while the remainder were constructed ponds and sediment basins with wetlands characteristics. 54.6 acres consisted of permanent or semipermanent open water, such as ponds and reservoirs. Seasonal marshes and pools made up 120.9 acres. Upper Fifteenmile and Eightmile had the highest percentages of wetlands, while Fivemile had the lowest.

Table 6-3. Wetland acreage by Subwatershed (including Mount Hood National Forest)

	Upper Fifteenmile	Lower Fifteenmile	Eightmile	Fivemile	Dry Creek	**TOTAL**
Natural	44.17	18.78	18.89	7.74	13.31	**102.9**
Constructed	22.08	7.06	23.76	16.38	3.16	**72.6**
Total acres:	*66.25*	*25.95*	*42.65*	*34.12*	*16.47*	***175.5***
% of subwatershed	0.105%	0.053%	0.088%	0.013%	0.034%	**0.074%**

Figure 6-5. Wetlands in the Fifteenmile Watershed. Source: National Wetlands Inventory, US Fish and Wildlife Service – http://www.nwi.fws.gov.



7) Water Quality

The term "water quality" includes a number of factors that can negatively affect beneficial uses of water. These factors include chemical contamination, temperature, algae, and others.

The Oregon Department of Environmental Quality (ODEQ) is required by the Federal Clean Water Act (1972) to establish water quality standards to protect the beneficial uses of the State's waters. Based on the water quality standards, ODEQ is then required to: identify stream segments where the standards are not being met, develop a list of these water-quality limited water bodies (called the 303(d) list from Section 303(d) of the Clean Water Act); and develop a Total Maximum Daily Load (TMDL) allocation for each water body included on the 303(d) lists. The TMDL describes the maximum amount of pollutants (from all sources) that may enter a specific water body without violating water quality standards. The most current 303(d) list for Oregon is dated 1998, although a new one will be released before the end of 2002.

Concerns about the quality of the water in streams are based on concerns about the potential impacts on the beneficial uses of the water in that stream. The designated beneficial uses listed for the waters in the Fifteenmile Watershed are: public and private domestic water supply, industrial water supply, irrigation, livestock watering, anadromous fish passage, salmonid fish rearing, salmonid fish spawning, water contact recreation, aesthetic quality and hydro power (OAR 340-41-522). Aquatic life, particularly salmonid spawning and rearing, is considered the most sensitive beneficial use.

In 1998, stream reaches in Fifteenmile Watershed were included on the 303d List for not meeting the state's water quality standards for stream temperature, sediment, habitat modification and flow modification (1998 303(d) list) (table 7-1). TDMLs for stream temperature and sedimentation in the Fifteenmile Watershed are slated for completion in 2003. TMDLs will not be developed for habitat modification or flow modification. The U.S. EPA has determined that habitat and flow modification are not "pollutants" for which a load allocation can be developed. In the draft 303(d) list for 2002 (ODEQ, 2002), stream segments that were listed for flow modification and/or habitat modification in 1998 have been removed from the list, although they are still identified as water quality limited.

On August 22, 2001, 2,600 gallons of the herbicide, Goal 2XL, were accidentally spilled into Fifteenmile Creek, when a truck overturned on I84, where it passes over the creek. The lower 1,100 feet of Fifteenmile Creek were subject to a massive cleanup effort directed by EPA. Results from an extensive monitoring effort incorporating day and night snorkeling surveys, remote video, temperature monitoring, and spawning survey analysis conducted by Inter-Fluve, Inc. from January to May, 2001 indicate that steelhead successfully passed through the spill zone (Morgan, 2001).

Table 7-1: Water Quality Limitations in the Fifteenmile Watershed (1998 Oregon 303(d) list).

Reach	Parameter	Supporting Data
Fifteenmile – *Mouth to Orchard Ridge Ditch*	Flow Modification	Portions of stream run dry due to withdrawals. (USFS, 1994)
	Habitat Modification	Sites below desired conditions for large woody debris and channel morphology. (USFS, 1994)
	Sedimentation	Sites >20% surface fines, <6mm. (USFS, 1994)
	Temperature (64°F Criterion for Salmonid Rearing)	7 day moving average of daily maximum temperatures reaches 72-78 degrees. (ODFW, 1992-1994)
Fifteenmile – *Orchard Ridge Ditch to Headwaters*	Habitat Modification	Sites below desired condition for channel morphology. (USFS, 1994)
	Sedimentation	Sites >20% surface fines, <6mm. (USFS, 1994)

Table 7-1 (cont.): Water Quality Limitations in the Fifteenmile Watershed

Reach	Parameter	Supporting Data
Eightmile – *Mouth to Wolf Run Ditch*	Flow Modification	Flows do not meet desired conditions at Forest Service boundary (USFS, 1994)
	Habitat Modification	Sites below desired conditions for large woody debris and channel morphology. (USFS, 1994)
	Sedimentation	Sites >20% surface fines, <6mm. (USFS, 1994)
Eightmile – *Mouth to USFS Boundary*	Temperature (64°F Criterion for Salmonid Rearing)	7 day moving average of daily maximum temperatures reaches 73-78 degrees (ODFW, 1992-1994)
Eightmile – *Wolf Run to Headwaters*	Habitat Modification	Sites below desired conditions for large woody debris and channel morphology (USFS, 1994)
	Sedimentation	Sites >20% surface fines, <6mm. (USFS, 1994)
Ramsey Creek – *Mouth to Headwaters*	Sedimentation	Sites >20% surface fines, <6mm. (USFS, 1994)
Ramsey Creek – Mouth to Old USFS Boundary RM5	Temperature (64°F Criterion for Salmonid Rearing)	7 day moving average of daily maximum temperatures reaches 66-70 degrees (ODFW, 1992-1994)
Fivemile – *Mouth to Forks*	Habitat Modification	Sites below desired conditions for large woody debris. (USFS, 1994)
	Sedimentation	Sites >20% surface fines, <6mm. (USFS, 1994)

7.1) Temperature

The most commonly documented water quality problem in the state of Oregon is temperature. Elevated water temperatures are detrimental to cold water fish species and other aquatic life. Elevated temperatures can kill fish directly through the breakdown of physiological regulation of vital bodily processes such as respiration and circulation (Heath and Hughes, 1973). The most common and widespread cause of thermally induced fish mortality, however, is attributed to indirect effects, such as: interactive effects of decreased or lack of metabolic energy for feeding, growth or reproductive behavior; increased exposure to pathogens (viruses, bacteria and fungi); decreased food supply (impaired macroinvertebrate populations); and increased competition from warm water tolerant species (Brett, 1952; Hokanson et.al., 1977). Cold water fish include trout, salmon and steelhead, all of which are present in the Fifteenmile Watershed. Warm water fish include bass and carp, nonnative species found in the Columbia River, as well as the native, northern pike minnow.

Stream temperature is affected by both natural and human-related factors, such as the climate, geographic location, temperature of the groundwater and springs feeding the streams, stream flow volume, stream morphology and levels of shade afforded by streamside vegetation. While climate and geographic location are outside of human control, riparian condition, channel morphology and stream flow volume are affected by land use activities. Specific land use activities which can increase summertime stream temperatures in the Fifteenmile Watershed include:

- Riparian vegetation disturbance reduces stream surface shading via decreased riparian vegetation height, width and/or density, thus increasing the amount of solar radiation reaching the stream surface;
- Reduced summer stream flows due to withdrawals for irrigation or domestic water supply;
- Localized channel widening increases the stream surface area exposed to solar heating;

- Impoundment of water behind dams may increase or decrease the temperature of the water downstream of the dam depending on how and when water is released from the dam.

Given that a stream is fed by a spring with a fairly steady year-round temperature, water will heat up more the longer it is exposed to air and sunlight. A stream with lower flows or less shade will heat faster than a stream with higher flows or more shade. In addition, channel morphology affects the rate of heat transfer. Given the same volume, a wide, shallow stream will heat faster than a narrow, deep stream, due to the greater surface area exposed to heating sources, such as warm air and sunlight. Lateral erosion during a high flow event can create wide, shallow stream channels with minimal vegetation, and thus cause an increase in the summer temperature of the stream. Recovery occurs over time as riparian vegetation is reestablished, reinforcing the banks, narrowing the active channel, and reducing exposed surface area.

Temperature Standard

The stream temperature standard is designed to protect cold water fish rearing and spawning as the most sensitive beneficial use. Several numeric and qualitative trigger conditions invoke the standard. Numeric triggers are based on temperatures that protect various salmonid life stages, such as 64°F for salmonid rearing and 55°F for salmonid spawning, egg incubation and fry emergence. The salmonid spawning period is defined as occurring from October 1-June 30 in the portion of the Hood Basin which includes the Fifteenmile Watershed (ODEQ, 2002). These numeric triggers are based on a seven-day moving average of the daily maximum temperatures. The use of this type of average recognizes that fish can likely tolerate a day or two of higher temperatures, as long as elevated temperatures are not sustained for a longer period of time (such as a week).

Qualitative triggers specify conditions that deserve special attention, such as the presence of threatened or endangered cold water species, dissolved oxygen violations and/or discharge into natural lake systems. The occurrence of one or more of the stream temperature triggers will invoke the temperature standard.

Once the temperature standard is invoked, a water body is designated as water quality limited for temperature (Table 7-1). For such water quality limited water bodies, the temperature standard specifically states that "no measurable surface water temperature increase resulting from anthropogenic activities is allowed" (OAR 340-41-525(2)(b)(A). In the development of a TMDL for temperature, the natural thermal dynamics of the system and anthropogenic contributions to stream heating are assessed.

Monitoring

Wasco County SWCD, Oregon Department of Fish and Wildlife (ODFW) and the Mount Hood National Forest have collected summer temperature data in Fifteenmile Creek since 1999. The Forest Service and ODFW had collected data since 1992 and earlier at some sites. Figures 7-1 and 7-2 shows 2001 data for Fifteenmile Creek and Eightmile Creek collected by the Wasco SWCD and ODFW. These figures demonstrate that the summer temperatures in both creeks exceed the salmonid rearing criterion of 64°F at all sites for some portion of the year. It also shows that the salmonid spawning criterion of 55°F was exceeded at all sites for some portion of the spawning period (October 1-June 30). These figures do not include data collected by the Mt. Hood National Forest. Temperatures tend to increase as one goes downstream, as would be expected. While overall stream temperatures vary from year to year, the geographic pattern is consistent in every year that data has been collected. Oddly, temperatures drop in Eightmile Creek downstream of US 197 (Figure 7-2). Cool water may be entering the stream at distinct springs, or the effect may be due to groundwater influences throughout the area. Wasco County SWCD has secured funds from the Oregon Watershed Enhancement Board to use Forward Looking Infrared (FLIR) photography to search for cooling and heating influences in Fifteenmile Creek, Eightmile Creek and Ramsey Creek during the summer of 2002.

Figure 7-1. Temperature data (seven-day moving average of daily high temperatures) for selected sites in Fifteenmile Creek, 2001. Source: USFS and Wasco County SWCD, The Dalles OR.

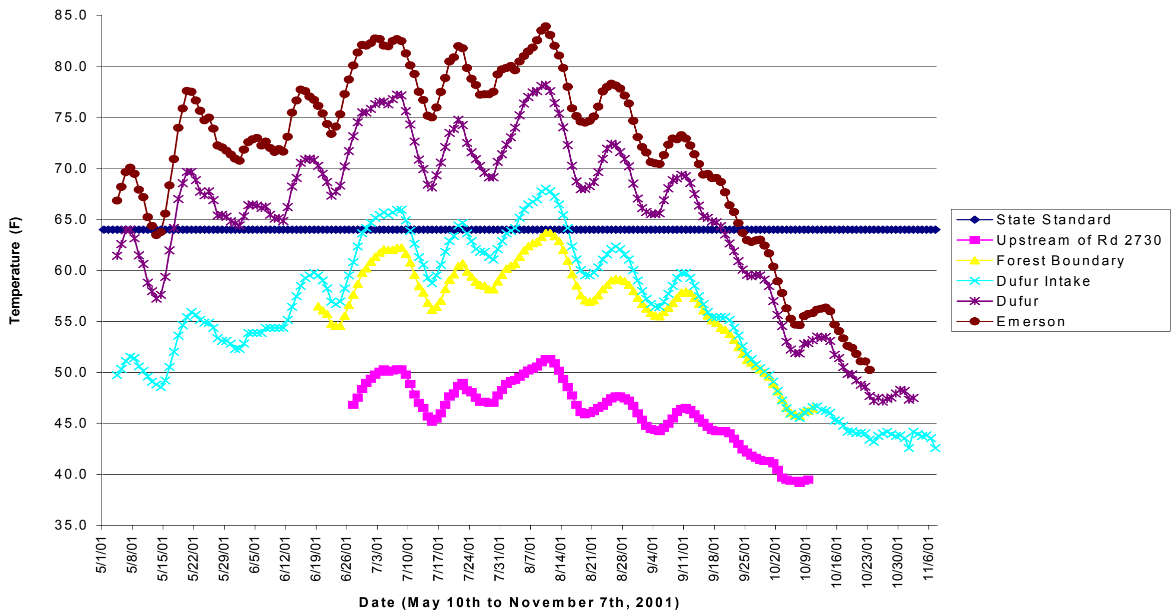
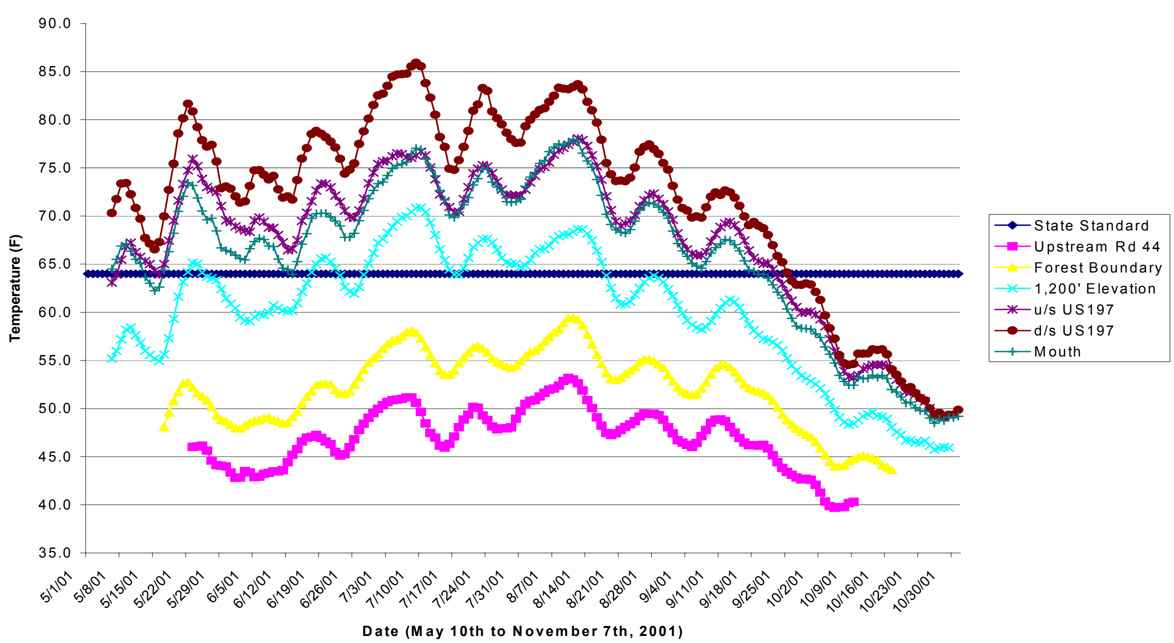


Figure 7-2. Temperature data (seven-day moving average of daily high temperatures) for selected sites in Eightmile Creek, 2001. Source: USFS, ODFW, Wasco County SWCD, The Dalles OR.



7.2) Sediment

Sediment is another water quality parameter of concern because of the effects it can have on aquatic life. Sediment can harm aquatic life in two different ways.

1) Sediment can be suspended in the water column. In this form, it reduces visibility and may reduce fish survival by affecting their ability to find food or breath. High levels of suspended sediment can reduce macroinvertibrate production (Rod French, pers. comm. 2002). Suspended sediment can be measured by filtering a sample of water and measuring the particulate material collected on the filter. Suspended sediment can also be measured indirectly by analyzing the turbidity of the water. Turbidity is a measurement of how well light passes through a sample and it is much easier and cheaper to measure than suspended sediment. A correlation between suspended sediment and turbidity can be developed for a particular stream so that turbidity measurements can be used to estimate suspended sediment. Suspended sediment can also be a factor for drinking water quality. High suspended sediment concentrations in the Fifteenmile Watershed generally occur during and following high flow events, when streambank erosion or overland run-off occurs, or due to point source pollution, such as construction or spills.
2) Sediment eventually settles to the bottom. Fish require clean gravels to spawn. They lay their eggs in the gravel, in riffles, where the oxygenated water can flow through the gravel, and the eggs and fry can breath. Where excess sedimentation has occurred, fry may die of asphyxiation. In addition, excess fine sediment can reduce macroinvertibrate production in riffles. Generally, the category of sediment that is of concern is inorganic sands and silts smaller than 1-2mm in size (Gary Asbridge, comments to Fifteenmile Watershed Council, December 10^{th}, 2002).

Sedimentation Standard

The water quality standard for sedimentation is a qualitative, narrative standard [(OAR 340-41-525(2)(j)]. It states: "The formation of appreciable bottom or sludge deposits or the formation of any organic or inorganic deposits deleterious to fish or other aquatic life or injurious to public health, recreation, or industry shall not be allowed". To be listed for sediment, there must be documentation that sedimentation is causing impairment for a beneficial use. Fifteenmile, Eightmile, Fivemile and Ramsey Creeks are all included on the 303(d) list for excess sedimentation based on US Forest Service surveys of spawning gravels (Table 7-1).

ODFW considers fine sediment in spawning gravel above 25% to be undesirable in low gradient reaches, and above 15% to be undesirable in medium or high gradient reaches (Moore, ODFW, 1997).

Monitoring

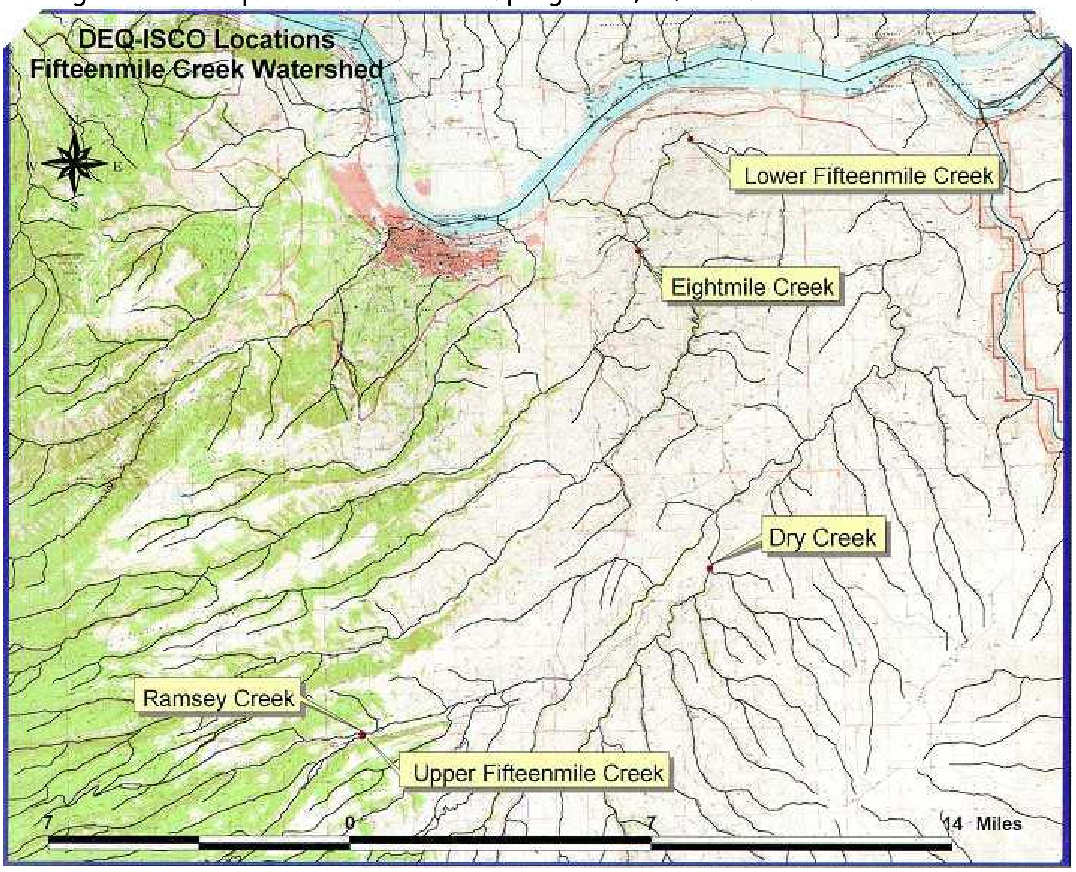
In preparation for developing a TMDL for sediment, ODEQ conducted a sediment study of Fifteenmile Creek and its tributaries. This study involved the collection of both water column suspended sediment data and spawning gravel data (figure 7-3). Even though the 303(d) listings in the Watershed are based on substrate sedimentation, ODEQ felt that the water column data was more easily measured, could be more accurately modeled and developed into a load allocation, and did have a direct relationship to substrate sedimentation. The study involved the use of ISCO automatic samplers to take water samples at five locations (Figure 7-3). The samplers were programmed to collect composite grab samples from November through March in the winters of 2000/2001 and 2001/2002. The goal of the study was to collect turbidity and water column suspended sediment data during storm events. For computer modeling purposes, bank-full storm events (events which fill the active stream channel, typically occurring every 1.5-2 years) were desired. In addition to the ISCO data, spawning gravel surveys were also conducted by the Forest Service for use in developing the sediment TMDL.

During the winter of 2000-2001, all samples were collected and sent to the lab for analysis of turbidity and total suspended sediment. That winter was an extraordinary drought year, however, and no high flow events occurred. During the second season, samples were only sent to the lab for analysis following a storm event. Data was collected following two storm events, only one of which was close to a bank-full event. Such data was insufficient to calibrate the model.

In 2002, The Fifteenmile Watershed Council requested that ODEQ collect sediment data for one more year, believing that the storm events sampled from 2000-2002 were not bank-full events. The Council's concern was that if the model was developed without adequate measurements to calibrate the model, then the residents of the watershed could be held to an impossibly strict standard. In January and February 2003, DEQ collected data from two storm events. Flows on January 4th were approximately bank-full, and flows on January 30 and 31 were slightly higher. ISCOs were left in place in hopes of capturing one more event by spring 2003.

See *Temperature,* (above) for an explanation of TMDL's.

Figure 7-3: Suspended sediment sampling sites, Fifteenmile Creek Watershed.



8) Fish Habitat

A survey of fish habitat in Fifteenmile Watershed was published in the Fifteenmile Basin Fish Habitat Improvement Implementation Plan completed jointly by ODFW and US Forest Service in 1987. This has become the basis for fish habitat improvement efforts on both private lands and national forest. Figure 8-1 summarize data from both ODFW and USFS.

8.1) Private Lands

This document formed the basis of the ODFW riparian fencing and habitat restoration efforts noted in table 6-1 and figure 6-3. Instream fish habitat improvements implemented by ODFW included large woody debris and boulder placements, diversion screening, and fish passage improvements. Fencing and subsequent recovery of riparian vegetation has also had an effect of improving fish habitat.

Since the 1987 document was written, the 1995, 1996 and 1997 flood events caused extensive streambank erosion and loss of riparian vegetation, further modifying conditions that were documented in the Fifteenmile Basin Fish Habitat Improvement Implementation Plan. ODFW conducted a follow-up stream survey in 2001 and 2002. They completed their survey of Fifteenmile Creek, from the mouth to the current forest service boundary, from July 3 to September 18th 2001 (ODFW, 2001). In 2002, they completed surveys of Eightmile, Ramsey, and the perennial reaches of Fivemile Creeks (ODFW, 2002). Habitat issues identified in these surveys are summarized in figure 8-1.

8.2) National Forest

The Mount Hood National Forest, Barlow Ranger District, has conducted habitat surveys on Fifteenmile Creek (USFS, 1996c), Fivemile Creek (USFS, 2000), South Fork Fivemile (USFS, 1997), Middle Fork Fivemile (USFS, 1997), Ramsey Creek (USFS, 1997) and Eightmile Creek (USFS, 1999). Habitat issues identified in these surveys are summarized in figure 8-1.

The US Forest Service has also been active since 1987 with instream habitat improvement projects. Of particular interest are two recent projects on newly acquired lands downstream of the former National Forest Boundary on both Fifteenmile and Ramsey Creeks. These projects placed large quantities of large woody debris along the stream to create pools, riffles, meanders, and to restore floodplain function in these reaches. This work has been completed since the habitat surveys were completed (figure 8-1).

Figure 8-1: Issues Identified in Various Habitat Surveys by ODFW and USFS from 1996 to 2002.

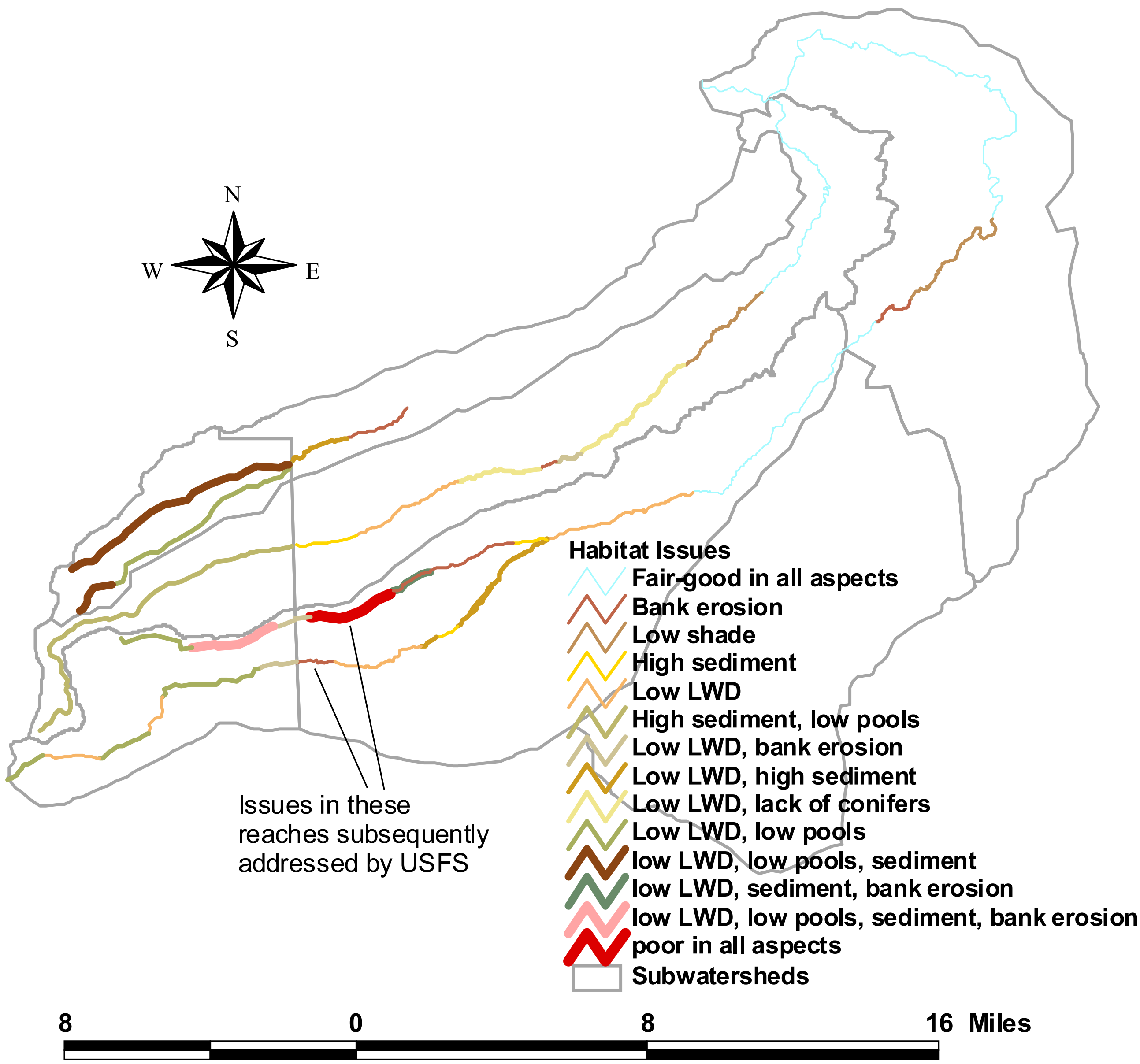


Table 8-1: ODFW Habitat Benchmarks (Kelly Moore, ODFW, 1997) and the range found in Fifteenmile Creek

Issue	Desirable and Undesirable Ranges	Units	Range in Fifteenmile Creek	Why is this a concern?
Active bank erosion	No standard	% bank	0-11%	Some bank erosion is natural, but high levels add sediment to stream and threaten surrounding land uses
Stream Shading	Desirable: >50% Undesirable: <30%	% cover	28-70%	Function of ecosystem and land use. High levels of shade help control stream temperature
Large Woody Debris (LWD)	Standard only applies to forested ecosystems Desirable: >20 Undesirable: <10	Total/100m, all pieces longer than 3m (10 ft)	0.8-16.9	LWD adds to habitat complexity and reduces flood velocities
Large Woody Debris (LWD) – KEY PIECES	Standard only applies to forested ecosystems Desirable: >3 Undesirable: <1	Total/100m, all pieces longer than 10m (33 ft)	0-0.3	Larger pieces of woody debris are more stable, create longer-lasting, higher quality habitat..
Width to Depth ratio	Desirable: <10 Undesirable: >30	Width of stream divided by depth	13.7-29.8	Wide, shallow streams subject to wider temperature fluctuations; are often caused by flood erosion and deposition.
Pool frequency	Desirable: 5-8 Undesirable: >20	Channel widths per pool	2.6-11.7	Pools provide cool water refugia in summer; tailouts of pools are typically where spawning occurs
Residual Pool Depth	Desirable: >0.5m Undesirable: <0.2m	meters	0.36-0.72m	Deeper pools needed for low fish refugia during low flows, high temperatures
Beaver Dams	No standards	Dams per mile	0-2.5	Beavers add to habitat diversity, slow flood velocities, trap sediments, reconnect streams to floodplains.
Conifers	Standard only applies to coniferous ecosystems Desirable: >300 Undesirable: <150	Number >20inch diameter / 1000 feet	0-1306	Conifers provide the largest and most critical large woody debris to streams in forested ecosystems.

Table 8-1 (continued): ODFW Habitat Benchmarks (Kelly Moore, ODFW, 1997) and the range found in Fifteenmile Creek

Issue	**Desirable and Undesirable Ranges**	**Units**	**Range in Fifteenmile Creek**	**Why is this a concern?**
Gravels	Desirable: >35% Undesirable: <15	% wetted area	10-34%	Clean gravel is required for spawning
Fines (Sand, silt and organic matter	**Low gradients:** Desirable: <12% Undesirable:>25% **Medium to high gradient:** Desirable: <8% Undesirable: >15%	% wetted area	11-22%	Clean gravel is required for spawning. Fine sediments can clog gravel so that eggs and fry can not breath.

9) Upland Habitat

9.1) Native Plants

The Columbia Gorge is a transitional area between the maritime climates of Western Oregon and the dry, continental climate of Eastern Oregon and the Great Basin. Fifteenmile Watershed is located in the eastern end of the Gorge, where Cascade forest types phase into Columbia Plateau Steppe habitat. It therefore boasts a high level of ecological diversity, as well as some unique species of plants. According to Russ Jolly's *Wildflowers of the Columbia Gorge* (1988), the Gorge is home to fifteen endemic wildflower species. The pine-oak woodlands, found in the middle elevations of the Fifteenmile Watershed, may be home to five: two desert parsleys (*Lomatium suksdorphii, Lomatium columbianum*), Poet's Shooting Star (*Dodecatheon poeticum*), Broad-leafed Lupine (*Lupinus latifolius v. thompsonianus*), and Hood River Milk Vetch (*Austragalus hoodianus*).

Barbara Robinson, Columbia Gorge Native Plant Society, gives the following guidelines for recognizing good condition native habitats in pine-oak habitats (pers. cond.):

- Meadows: look for perennial bunch grasses, balsam root, and lupine. In addition to the grasses noted above, look for June grass (*Koleria cristata*) and big blue wild rye (*Elymus glaucus*). In shallow soil, look for poet's shooting star, and in rocky locations, desert parsley.
- Wetlands: Look for camas (*Zigadenus* spp), which grows in vernal wetlands.
- Woodlands: Look for orchids. Orchids rely on relationships with surrounding plants to survive, as they do not produce all their own food. Some do not even photosynthesize. Therefore, they are extremely sensitive to soil disturbance, and serve as an indicator species. Notable species include Fairy Slipper (*Calypso bulbosa*), Coral root (*corallorhiza* spp) and rein orchids (*Habenaria* spp).

9.2) Noxious Weeds

Noxious weeds are a threat throughout the Western United States. Noxious weeds are plants that are not native to a particular location, have few or no natural enemies in the ecosystem, and spread rapidly, displacing native species. Noxious weeds provide little or no benefit to wildlife or livestock, generally cause economic losses to commercial agriculture, and often do not perform as well hydrologically as the species that they displace.

Wasco County maintains a Weed and Pest office, whose charge is to control noxious weed infestations along public right-of-ways, and to provide assistance to landowners who request it. According to Wasco Weedmaster, Merle Keyes, the following weed problems have been identified in the Fifteenmile Watershed:

Yellowstar thistle (*Centaurea solstitialis*)– found particularly from Petersburg to Kelly Cutoff Road.

Scotch thistle (*Onopordum acanthium*) and hoary cress aka white top (*Cardaria draba*)– Merle Keys notes this species mostly within riparian zones within grazing exclosures. Because it is a rhizominous plant, it takes advantage where control is minimal.

Knapweed (*Cetaurea spp.*) – found particularly along road shoulders.

Rush Skeletonweed (*Chondrilla juncea*) - widespread.

Russian Thistle (*Salsola iberica*) – found in road right-of-ways throughout watershed (not listed as a noxious weed in Wasco County, but very difficult to control, and develops resistance quickly).

10) Evaluation

Table 10-1 shows the major issues identified in this assessment by subwatershed. Table 10-2 shows data gaps that still exist. These two tables can be used to develop a monitoring and action plan for the Fifteenmile Watershed Council.

Table 10-1. Major issues identified by watershed assessment and potential responses.

Issue	Where	Why	Potential Responses
Runoff	Crop lands and urbanized lands	Greater than 60% increase in runoff levels from 1850 conditions	Encourage conservation plan development and implementation of appropriate cultural, structural, and vegetative practices, including direct seed and perennial crops.
Erosion	Croplands with erosion greater than 5 tons per acre	Erosion exceeds tolerable soil loss and state standards	
Water Availability	Lower Fifteenmile and Dry Creek	All or nearly all summer flow is allocated to consumptive use.	Encourage irrigation efficiency, and/or water leasing
Riparian Vegetation	Private lands	50% of riparian corridors do not meet expectations for riparian vegetation, affecting fish habitat and bank stability	Develop forested riparian buffers through reforestation efforts, CRP, CREP, ODFW lease agreements and grassed waterways in ephemeral draws
Riparian Roads	Fivemile, Eightmile, Lower Fifteenmile	Potential sediment source: Over half mile of riparian roads per mile of stream.	Survey road and culvert conditions, look for opportunities for road improvements or realignment
Channel Modification	60 miles of modified channels in floodplains	Loss of fish habitat, increased flood velocities and power	Develop wide forested riparian buffers through CRP or CREP; minimize use of streambank hardening
Stream Temperature	Upper Fifteenmile, Lower Fifteenmile and Eightmile	Exceeds state standards for salmonid rearing habitat	Improve riparian vegetation and increase summer baseflows
Fish Habitat – protection or restoration	Upper Fifteenmile, Eightmile, Fivemile and Ramsey	Multiple habitat issues identified	LWD placements, road maintenance or realignment, actions to prevent sedimentation, tree planting, etc.
Noxious Weeds	throughout	Economic impacts and loss of ecological diversity and function	Continue support for city, county, and federal noxious weed control efforts

Table 10-2. Data gaps and recommended further studies:

Parameter	**Current and potential responses**
No-till or Direct Seed Runoff Curve Numbers	The Agricultural Research Service would need to carry out these studies. A recommendation would probably have to be passed through the NRCS.
Disagreement between soil classifications on National Forest and Private Lands – identified in hydrologic assessment	Recommend new soil survey using consistent methodology throughout watershed
Fine Sediments and Turbidity	ODEQ completing analysis with assistance from local agencies Local agencies should develop a long-term sediment study that looks at the relationship between turbidity and fine sediment in spawning gravels.
Steelhead spawning – Extent of spawning is unknown in lower watershed. In upper watershed, spawning surveys have not been consistent enough to make conclusions about trends.	ODFW and USFS develop standardized annual spawning surveys that include the lower watershed.
Instream Fish Habitat (in progress)	ODFW currently updating fish habitat survey; expect written report by March 2003. ODFW needs to conduct follow-up studies of the instream habitat projects implemented since 1987.
Fish population – Population levels and trends of anadromous fish has still not been determined with any statistical precision.	Continue screw trap study at the mouth of Fifteenmile Creek.
Changing land use trends – Land use trends show approximately ten-fold increase in acreage of orchards. The potential impacts of this trend is not covered by this document.	Orchard impacts are currently under study in the neighboring Mill Creek Watershed, where orchard density is much higher. If concerns are identified there, studies could be expanded to Fifteenmile Watershed.
Range Cover Quality	Range surveys completed by NRCS on some individual ranches, but overall condition of watershed has never been summarized for the public.
Road and Culvert conditions – This study would look at roads and culverts both for fish passage and for sediment and floodwater passage concerns.	USFS has completed studies for fish passage. Wasco County Roads Department, USFS and individual landowners may complete detailed studies of road and culvert conditions.
Wetlands Conditions	Appropriate agencies could include USFS, ODFW, SWCD, other partners.

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