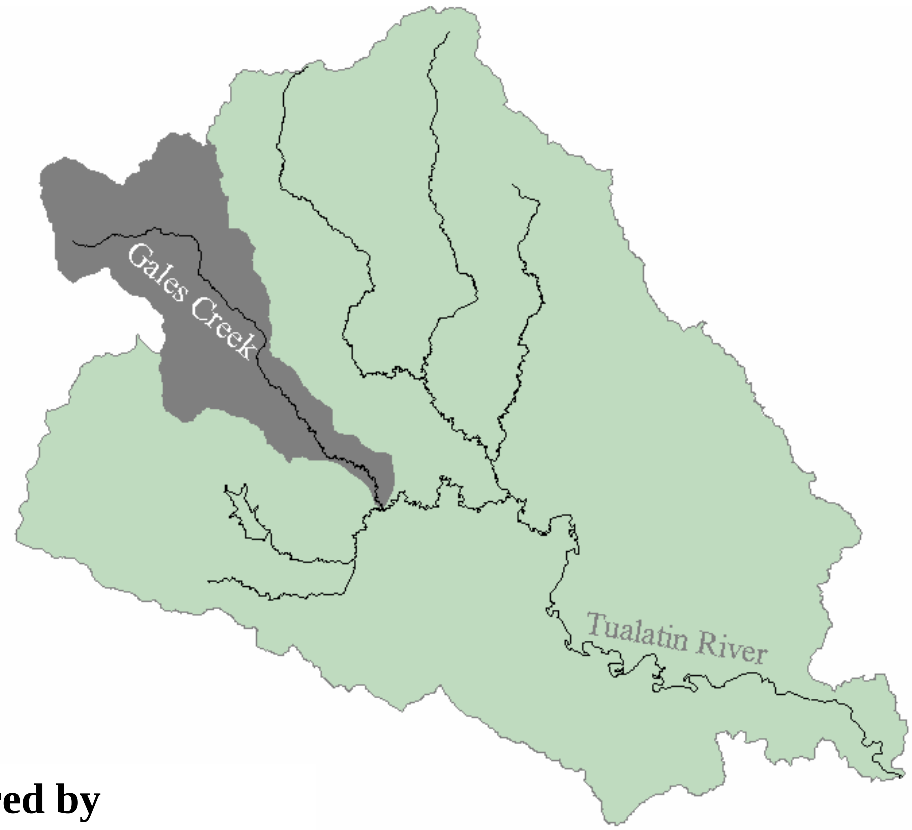
GALES CREEK WATERSHED ASSESSMENT PROJECT



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Tualatin River Watershed Council

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Abstract

This document is the Gales Creek Watershed Assessment Report prepared for the Tualatin River Watershed Council. This report contains detailed information about the Gales Creek Watershed and follows the guidelines described in the 1997 Draft Governor's Watershed Enhancement Board's Oregon Watershed Assessment Manual. It was written to partially satisfy the watershed assessment action item #1described in the Tualatin River Watershed Council's Action Plan. This report should be periodically updated, as new information becomes available.

Acknowledgement

The completion of the Gales Creek Watershed Assessment Project was accomplished through the combined efforts of private citizens, students, private and non-profit organizations, and local and state agencies. Production of this document was made possible with assistance from the Washington County Soil and Water Conservation District and Unified Sewerage Agency. Geographic Information System maps were compiled by Interrain Pacific.

Technical advice for the report was provided by the Tualatin River Watershed Council's Technical Assistance Committee made up of local and regional experts.

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Gales Creek Watershed Assessment Project

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Executive Summary

This assessment of the Gales Creek Watershed was prepared for the Tualatin River Watershed Council. It contains technical information about past and present conditions in the watershed, identifies data gaps, suggests further information gathering and recommends restoration activities. Many parties collaborated on this project including high school and college interns, federal and state agency staff, landowners, members of the Tualatin River Watershed Council and a Technical Assistance Committee review team.

The information found in this assessment has been compiled from technical reports, management plans, maps, engineer's drawings, aerial photographs and slides, field surveys and anecdotal information from personal interviews. References have been provided at the end of each chapter.

This assessment project follows the watershed assessment procedures described in the October 1997 Draft Oregon Watershed Assessment Manual, developed by the Governor's Watershed Enhancement Board (GWEB). The goal of this assessment process is to identify areas of the watershed in need of protection or restoration and to direct manual users to further data gathering if necessary.

<u>Watershed Concerns:</u>

Several concerns have been identified during the assessment of the Gales Creek Watershed:

- Fisheries habitat:
  habitat diversity, poor large woody debris placement, lack of adequate spawning, rearing and overwintering habitat, high water temperatures, low flows, presence of introduced species

- Fish migration barriers:
  Barriers to fish passage (stream crossings, bridges, culverts), non fish-friendly water diversions/screening, potential low stream flows, Balm Grove flashboard dam, water diversions in City of Forest Grove watershed, irrigation diversions, potential flooding

- Riparian conditions:
  lack of vegetation, lack of large trees for shading, excessive invasive plant species, insufficient large woody debris (LWD) input, eroded and unstable streambank conditions

- Channel modifications:
  Channel channel modification, instream gravel mining, agriculture channelization, Balm Grove flashboard dam, water diversions in City of Forest Grove watershed and irrigation diversions, potential flooding

- Land use impacts on hydrology:
  Increased runoff from urban, agriculture and forestry activities

- Water use impacts:
  illegal water diversions, over-allocation of water, inefficient irrigation systems

- Water quality status:
  303(d) listed streams, high water temperature, seasonally low dissolved oxygen (DO), seasonally high pH, high fecal coliform

- Sediment sources:
  Erosion from agriculture and forestry, impacts from abandoned (legacy) logging roads, poor road construction or re-construction, poor maintenance and road removal activities, upslope and instream mining and quarry activities, and other construction projects

Recommendations:

There are many social and economic constraints which must be considered before implementing the following recommendations. Any successful watershed protection, improvement and monitoring projects will involve the cooperative voluntary efforts of landowners, agencies and organizations.

- Restoration projects in low gradient floodplain channels and in moderate gradient channels should focus on maintaining or improving perennial riparian vegetation including trees along the mainstem and tributaries to increase bank stability.

- Few ODFW fish habitat surveys have been conducted in the Gales Creek watershed. In 1995, ODFW and USA completed a cooperative study to describe the status and characteristics of fish populations and aquatic habitat in the urban areas of the Tualatin Basin. The same survey procedures should be applied to the Gales Creek watershed. Not only would this survey provide valuable information, it would also provide a comparison of rural stream conditions to urban conditions.

- Results of surveys should be compared to ODFW and NMFS regional benchmarks (when these are available), to determine the range of good to poor habitat quality in the watershed. Potential ESA listing of steelhead and cutthroat trout as threatened in the Tualatin River Basin may provide new habitat benchmarks. The Council can use these benchmarks to determine where restoration efforts should be targeted and what types of restoration activities can help meet fish recovery goals. Future NMFS fish recovery plans and current plans such as the Oregon Plan for Salmon and Watersheds, ODFW Tualatin Basin plans and ODF management plans will direct restoration activities.

- Bank stability, shading and LWD recruitment potential need to be verified on the ground, especially in agricultural areas. Riparian conditions in upland areas, especially near recent timber harvests, need to be studied to determine potential adverse effects on water quality and stream shading.

- A comprehensive and coordinated survey of culverts, bridges, and water diversions needs to be developed throughout the watershed, on both public and private lands. Potential upstream habitat needs to be surveyed above the culverts to determine if reconstruction of culverts is cost-effective and will provide passage to a significant amount of fish habitat.

- Water diversions in the City of Forest Grove watershed need to be assessed for potential fish barriers. The Balm Grove dam also needs to be inspected for potential fish passage problems.

- Stream shading should be mapped with particular focus on the mainstem of Gales Creek and Clear Creek since these streams do not meet DEQ water temperature criteria.

- Improving riparian areas by promoting the planting of native tree and shrub species should be a high priority of the Council. The Council, Washington County SWCD and NRCS can work with willing landowners to investigate and implement riparian vegetation plantings which are economically feasible.

- Poor riparian areas, especially along RM 0-3 and RM 7-14, should be investigated for tree and shrub plantings, if landowners are willing and if economically feasible.

- Developing a coordinated and comprehensive training program of fish-friendly culvert construction and maintenance throughout the watershed would improve fish passage, reduce potential sediment sources and keep roads from washing out. When new construction or repairs are necessary, fish-friendly designs should be explored and installed if economically feasible.

- Securing minimum stream flows for fish use should be a high priority and will probably be required if steelhead trout or other fish species are listed by NMFS. Water rights holders who conserve water should be rewarded and incentives should be provided to those who wish to keep water instream. The Council could promote conservation practices and support the leasing or buying of water rights for instream use.

- Water quality monitoring efforts by local agencies and organizations (i.e. SWRP) should be supported and expanded if possible.

- Conduct an in-depth characterization of sediment transport and sediment source types (i.e. mass wasting, bank erosion, surface erosion, forest harvest, agriculture, grazing, mining and urban areas).

Abbreviations and Acronyms

BMP	Best Management Practice
cfs	cubic feet per second
DEQ	Department of Environmental Quality
DO	Dissolved Oxygen
EPA	Environmental Protection Agency
ESA	Endangered Species Act
ESU	Evolutionarily Significant Unit
EQIP	Environmental Quality Incentive Program
FEMA	Federal Emergency Management Agency
GIS	Geographic Information System
GWEB	Governor’s Watershed Enhancement Board
LWD	Large woody debris
Metro	Metropolitan Service District
N	Nitrogen
NMFS	National Marine Fisheries Service
NRCS	Natural Resources Conservation Service
OAR	Oregon Administrative Rules
ODA	Oregon Department of Agriculture
ODF	Oregon Department of Forestry
ODFW	Oregon Department of Fish and Wildlife
ODSL	Oregon Division of State Lands
OGI	Oregon Graduate Institute
ODOT	Oregon Department of Transportation
OWRD	Oregon Water Resources Department
P	Phosphorus
Pacific	Pacific University
RM	River mile
SB1010	Senate Bill 1010 (Agricultural Water Quality Mgmt. Area Plan)
SWCD	Soil and Water Conservation District (Washington County)
SWRP	Student Watershed Research Project
TAC	Technical Assistance Committee
TMDL	Total Maximum Daily Load
UGB	Urban Growth Boundary
USA	Unified Sewerage Agency
USGS	United States Geological Survey

1.0 Introduction

1.1 Purpose

The first action item in the Tualatin River Watershed Council's 1998 Action Plan is: *Assess watershed conditions to help prioritize restoration activities*. The Council collaborates with local, state, and federal agencies to assist in watershed assessments throughout the Tualatin River Watershed. The information compiled from these assessments enables the Council to develop restoration projects that will improve watershed conditions.

Some assessments have already been conducted in urban areas of the Tualatin River Basin. As the surface water management utility for urban Washington County, Unified Sewerage Agency (USA) has conducted assessments to respond to water quality regulatory requirements. These assessments have been the basis for management plans for the urban watersheds of Fanno Creek and Upper Rock, Bronson, and Willow creeks. Currently Beaverton Creek Subbasin is under study. The goals of these management plans are to improve water quality and flood management, to identify restoration opportunities, and to include the watershed community in plan implementation.

The Tualatin River Watershed Council has identified the need for rural watersheds to be studied. The Gales Creek Watershed was chosen from among six major rural watersheds because of its size, its range of land uses (forestry, agriculture, urban), its relatively healthy state, and its existing and potential steelhead habitat. The National Marine Fisheries Service (NMFS) is currently deciding whether to list Tualatin Basin steelhead trout as a threatened species under the Endangered Species Act. An assessment of Gales Creek Watershed is a proactive approach to identify and manage potential steelhead trout habitat should such a listing occur.

1.2 Background

Physical Location

The Gales Creek Watershed is one of many large rural watersheds in the Tualatin River Basin. The 49,481 acre (77.9 sq. mi.) watershed is situated on the eastern side of the Coast Range Mountains and is entirely within the northwestern edge of Washington County, except for 2 small portions extending into Tillamook County. See **Fig. 1-1** and **Fig. 1-2** for the watershed's location and boundary.

The watershed ranges in elevation from a low of 159 ft. above sea level, at the confluence with the Tualatin River, to its highest point of 3,154 ft. Other high features in the watershed are Round Top (2,986 ft.), Gales Peak (1,800 ft.), Wildcat Mountain (1,760 ft.), Eagle Peak (1,600 ft.), and David Hill (1,165ft.).

The mainstem of Gales Creek is 23.5 miles long and flows in a southeasterly direction entering the Tualatin River about 1.5 miles south of the city of Forest Grove.

The watershed is divided into nine subwatersheds, from the headwaters to the confluence: Upper Gales Creek, Coffee Creek, South Fork Gales, Beaver Creek, Little Beaver Creek, Middle Gales Creek, Iller Creek, Clear Creek and Lower Gales Creek. See Fig. 1-2 showing the Gales Creek Watershed and its sub-watersheds.

Gales Creek has 17 tributaries, listed below, from lowest elevation to the headwaters. Tributaries range in length from 0.5 to 5.5 miles. See also **Table 3-6a**.

Prickett Creek
Roderick Creek
Kelly Creek
Godfrey Creek
Clear Creek
Iller Creek (also spelled Iler, Ihler, Eiler)
Fir Creek
White Creek
Lyda Creek
Bateman Creek
Little Beaver Creek
Beaver Creek
Coffee Creek
Finger Creek
Low Divide Creek
South Fork Gales
North Fork Gales

Land Use

According to the Washington County Rural and Natural Resource Plan, existing rural land uses in the watershed are Exclusive Forest and Conservation (EFC), Exclusive Farm Use (EFU), Agriculture and Forest (AF-5,10, 20), Rural Residential (RR-5), Rural Commercial (R-Com) and Land Extensive Industrial (MA-E). These designations promote the rural character of the watershed by limiting land uses to forestry, agriculture, scattered rural residences, and rural services. Industrial activity is limited to resource extraction (i.e. gravel mining and rock quarries), staging areas for industrial forest and agriculture activities, urban development in the city of Forest Grove and within Metro's urban growth boundary (UGB).

Almost two-thirds of the watershed is privately owned, either as industrial forestland (26%) or private agricultural or rural residential lands (38%). The Oregon Department of Forestry (ODF) owns and manages 28% of the watershed as part of the Tillamook State Forest. Private industrial forestland owners, mainly Stimson Lumber and Willamette Industries, own nearly one third of the watershed. Another 8% is owned by the city of Forest Grove: lands within its city borders and the City of Forest Grove Watershed (most of the Clear Creek sub-watershed) which is managed for municipal drinking water supply and potential timber harvest. There are no federal lands in the watershed. See **Fig. 1-3** for Land Ownership.

Forestry is the dominant land use in the watershed with agriculture a close second. Agricultural enterprises include a variety of irrigated crops (vegetables, berries, orchards, corn silage, hay, and nurseries) and large-scale non-irrigated crops (grain, grass and clover seed, vineyards and Christmas trees). Small scale animal operations of beef cattle, horses, llamas, pigs, and other livestock occur in the watershed and there is also one dairy farm.

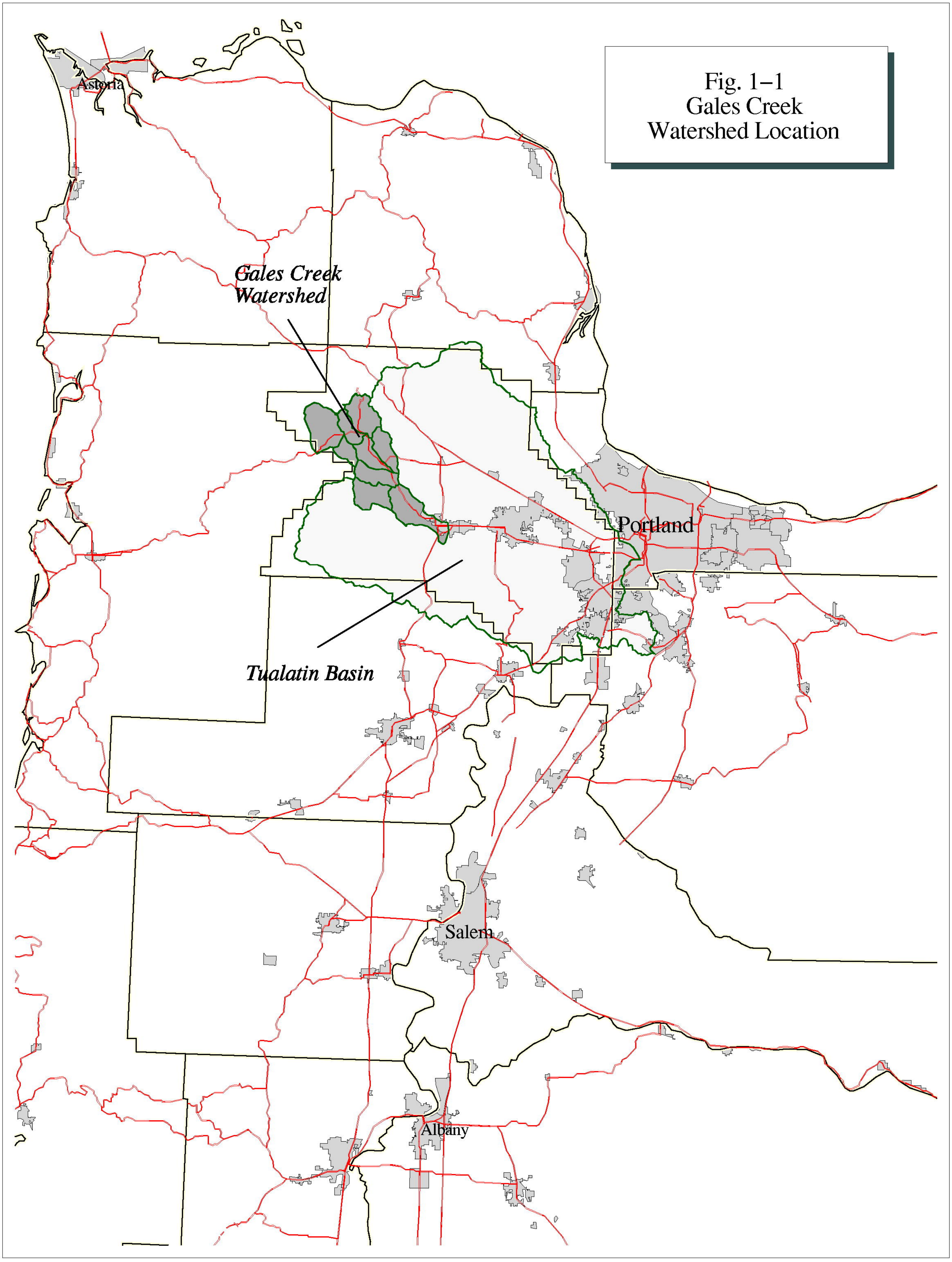
Fig. 1–1
Gales Creek
Watershed Location
Astoria
Gales Creek
Watershed
Portland
Tualatin Basin
Salem
Albany

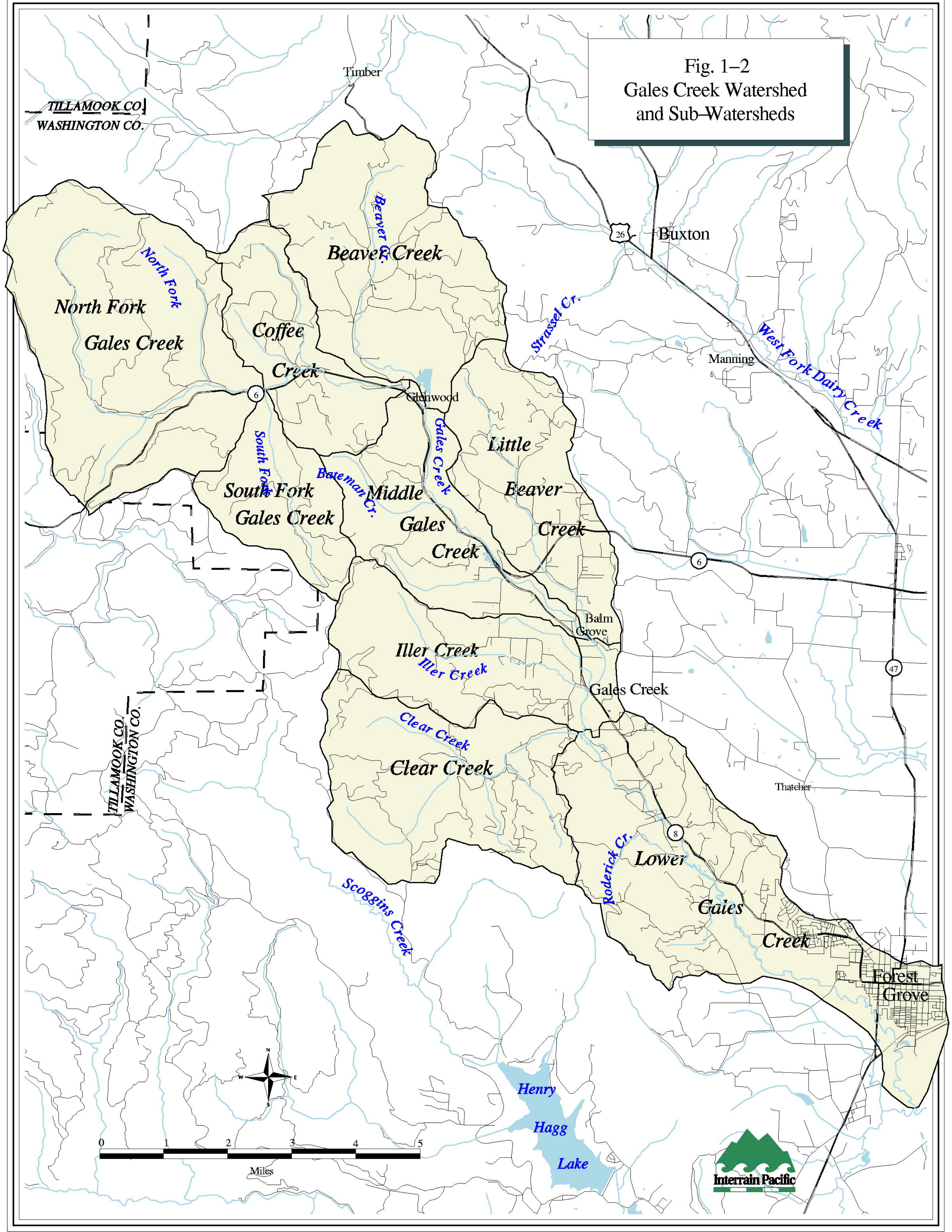

Fig. 1–2
Gales Creek Watershed
and Sub–Watersheds

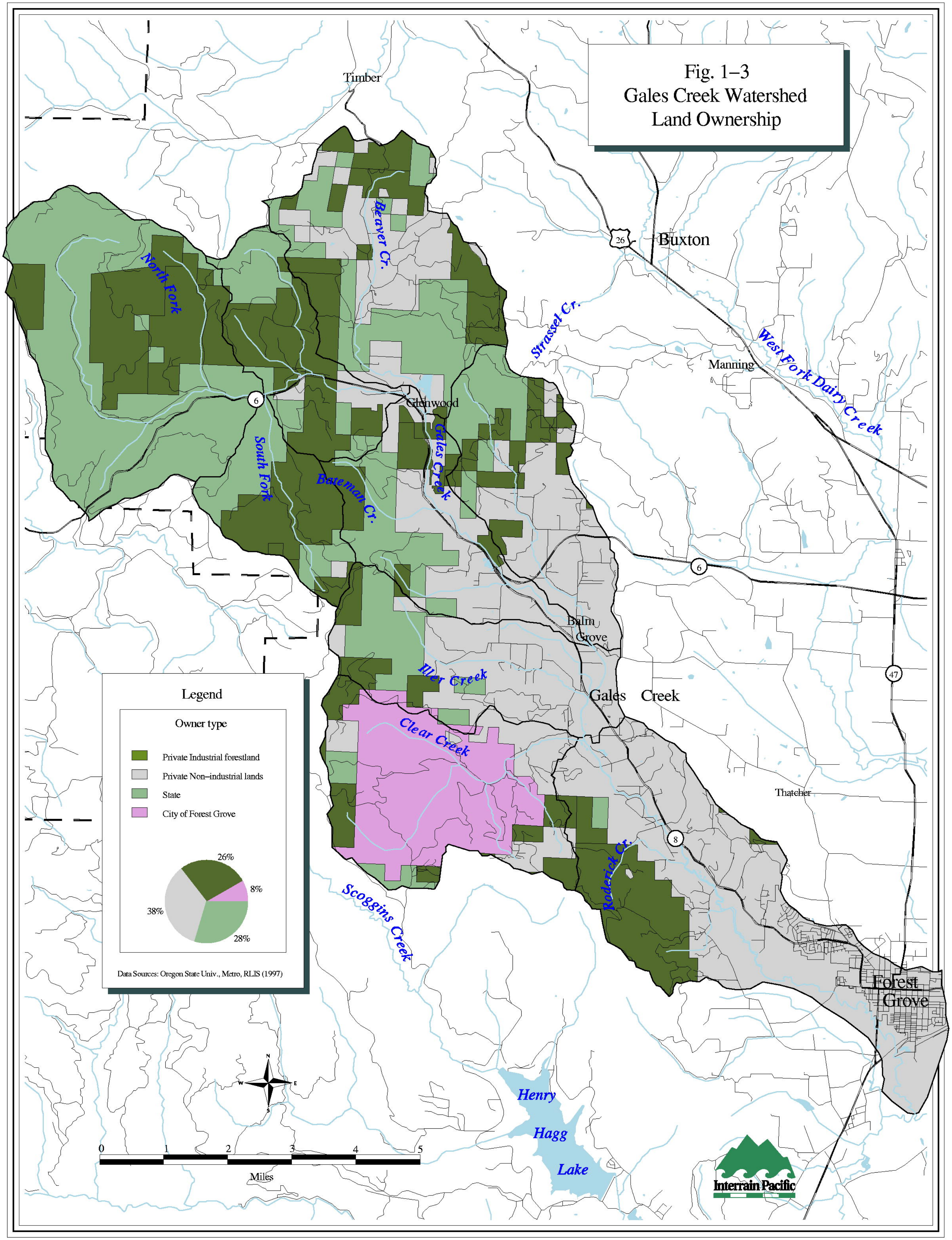

Fig. 1–3
Gales Creek Watershed
Land Ownership
Timber
Buxton
26
North Fork
Beaver Cr.
Strassel Cr.
Manning
West Fork Dairy Creek
6
Glenwood
South Fork
Gales Creek
Bateman Cr.
6
Balm
Grove
Iller Creek
Gales Creek
47
Clear Creek
Thatcher
8
Roderick Cr.
Scoggins Creek
Forest
Grove
Henry
Hagg
Lake
Legend
Owner type
Private Industrial forestland
Private Non–industrial lands
State
City of Forest Grove
26%
8%
38%
28%
Data Sources: Oregon State Univ., Metro, RLIS (1997)
N
W
E
S
0
1
2
3
4
5
Miles
Interrain Pacific

Population

A small part of Forest Grove, the only incorporated city within the watershed, is located at its southeastern edge. Forest Grove's population was 15,965 in 1997. Small rural communities include Gales Creek, Balm Grove, and Glenwood. Rural residences are scattered throughout the watershed, with most homes located near the banks of the mainstem of Gales Creek. See **Fig. 1-4** Population Density. Because the dominant land use is zoned for forestry and exclusive farm use, population growth in the watershed is fairly limited. According to a City of Forest Grove planner, housing development pressures will increase. The majority of future growth will be in Forest Grove, mostly outside the watershed boundary. This growth will have its effects on watershed resources as demand for water from Gales Creek and its tributaries increases, as land uses intensify, and as people recreate and travel in the watershed. Gales Creek Road and Highway 6, which parallel Gales Creek, are major transportation routes connecting Washington County residents to Tillamook and the Oregon coast.

Climate and Topography

The climate is marine-influenced with an extended winter rainy season. Summers tend to be hot and dry with little rainfall. Streams are fed primarily by precipitation. Snow and icy conditions commonly occur in the higher elevations, with melting usually within days after any snowfall. Rain-on-snow events are infrequent but can result in flood events such as in February 1996. Many streams exhibit "flashy" characteristics in which high rainfall quickly elevates water levels which drop just as quickly when storms pass. Annual rainfall ranges from 110 inches in the higher, western parts of the watershed to about 45 inches in the lowest areas, near Forest Grove. Snowfall and precipitation have been consistently measured near Forest Grove since 1910. Precipitation and snowfall measurements are discussed in detail in the Hydrology section of this report.

The Coast Range Mountains form the upper north and western boundaries of the watershed, separating it from the Pacific Ocean to the west. The mountain slopes tend to be steep with high gradient streams. The hillsides then transition into low rolling hills with medium gradient and sinuous (s-shaped) streams. The landscape then gradually levels off to form fluvial terraces which historically included wetlands and ponds with flat, sluggish and meandering streams. Most streams in the low lying parts of the watershed have been channelized and wetland areas drained for agricultural use. **Fig. 1-5** shows the topography of the watershed and its land cover types.

Elevations in the Gales Creek Watershed range from a minimum of 159 ft. at the confluence with the Tualatin River to a maximum of 3,154 ft. The mainstem of Gales Creek has a low gradient and is slow moving for about ten miles from the confluence; then, above the community of Gales Creek, it rises fairly steeply. The average stream slope from the confluence to Balm Grove is 12 feet increase in elevation per mile. In the upper reaches of the watershed the slope becomes much steeper, with gradients over 15%. Individual stream profiles, **Fig 3-1a, 3-1b** and **3-1c**, can be found in the Channel Habitat Typing section of this report. These profiles illustrate the changeable stream gradients and can be useful in directing potential restoration activities.

Geology

The oldest geologic materials in the Gales Creek Watershed are volcanic and sedimentary rocks formed during the Eocene and Oligocene ages of the Tertiary period. The volcanic rocks are mostly basaltic lavas and tufts, overlain by sedimentary rocks made up of shale, claystone, sandstone, and siltstone. Several depositional events have occurred over time, with the most recent being the Missoula Floods of the Pleistocene.

There are 11 soil associations listed in the Natural Resources Conservation Service (NRCS) Soil Survey of Washington County. Soils in the Coast Range are well-drained silt loam and cobbly loam. The steep to moderately-steep terraces are described as silt loam and silty clay loam. The nearly level flood plains consist of young alluvium, silt, and clay deposits approximately 20 to 30 feet thick. The historic wetland areas have eight hydric soil types which are generally very deep, poorly drained, and have slow surface runoff. The entire watershed is underlain by sandstone 400 feet thick.

Vegetation

The Gales Creek Watershed contains a mosaic of native and exotic plant species. The original forested uplands, most of which was logged 40 to 80 years ago or burned in two stand-replacing fires (1933 and 1945) known as the Tillamook Burn, have been replaced with Douglas-fir forests which are intensively managed. Black cottonwood, bigleaf maple, Oregon ash, vine maple, and elderberry are the dominant plant species in the riparian zone of upper reaches of Gales Creek. The lower elevation valley foothills were originally Oregon white oak and Douglas-fir but are now dominated by woodland, pastureland, vineyards, Christmas tree farms, and orchards. The flat flood plain lands of the watershed are almost exclusively used for agricultural crops, including container nurseries. Some wetland species exist in a few small patches, mostly along the mainstem of Gales Creek and Little Beaver Creek. Riparian vegetation in the lower reaches of Gales Creek includes a mix of native and introduced species: Douglas-fir, western red cedar, willows, red alder, big-leaf maple, and black cottonwood. Understory species are red osier dogwood, Himalayan blackberry, snowberry, hawthorn, Douglas spirea, ninebark, oceanspray, cascara, horsetail, sedges, and reed canary grass.

Wildlife

Human activity throughout the watershed has significantly altered the historic habitats of wildlife species. Typical wildlife species presently found in the higher elevations of the Coast Range Mountains are black-tailed deer, Roosevelt elk, black bear, mountain lion, bats, beaver, mink, river otter, raccoon, nutria, quail, and grouse. The mid-elevation foothills include the same species as well as frogs, toads, salamanders, snakes, raptors, geese, ducks, and cold water anadromous and resident fish species. The lowest part of the watershed tends to have species which can tolerate the sluggish warm waters of lower mainstem Gales Creek. Some animal species listed on the Oregon Department of Fish and Wildlife (ODFW)'s sensitive species list may be present in the watershed. These include Townsend's big-eared bat, Willow flycatcher, Western

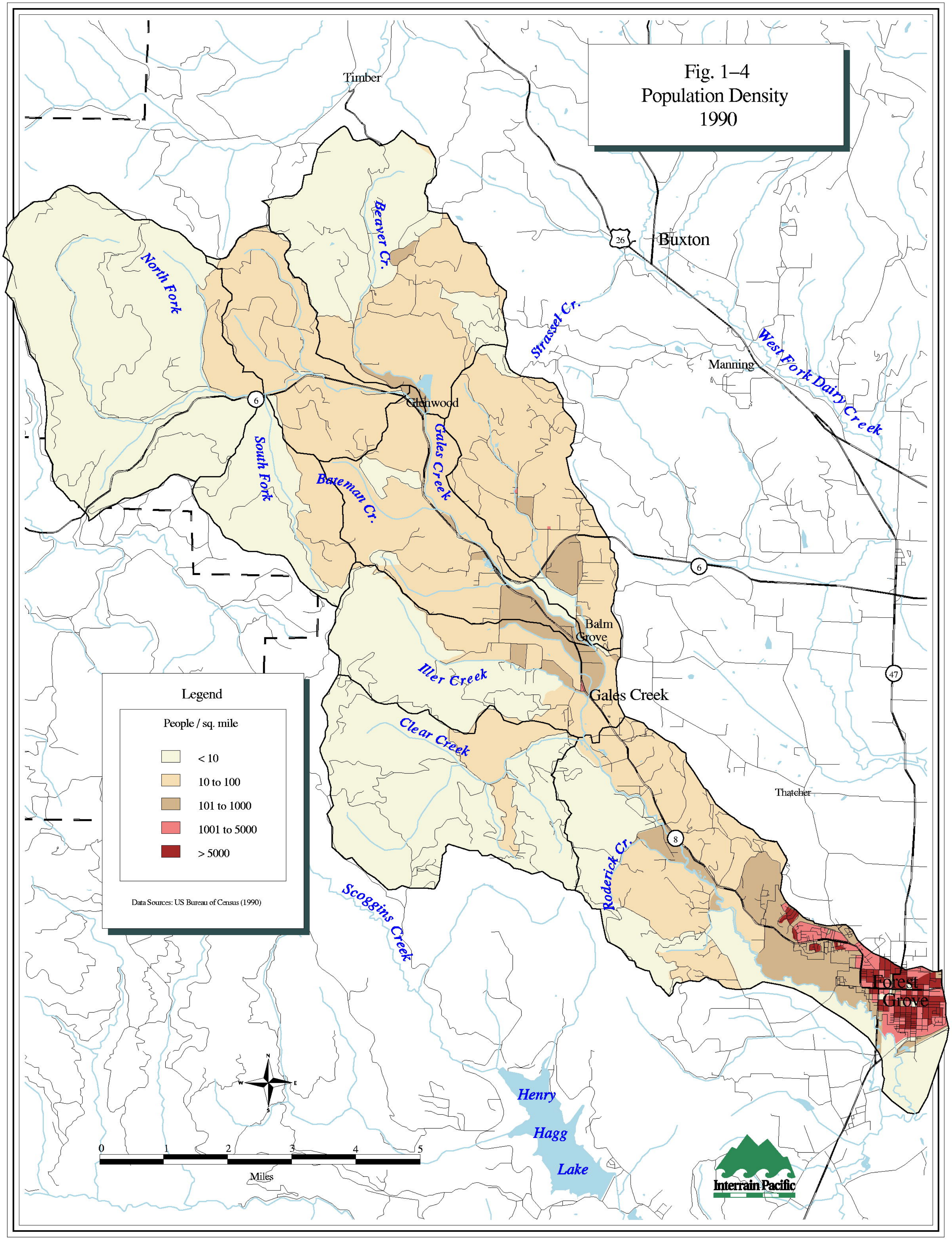

Fig. 1–4
Population Density
1990

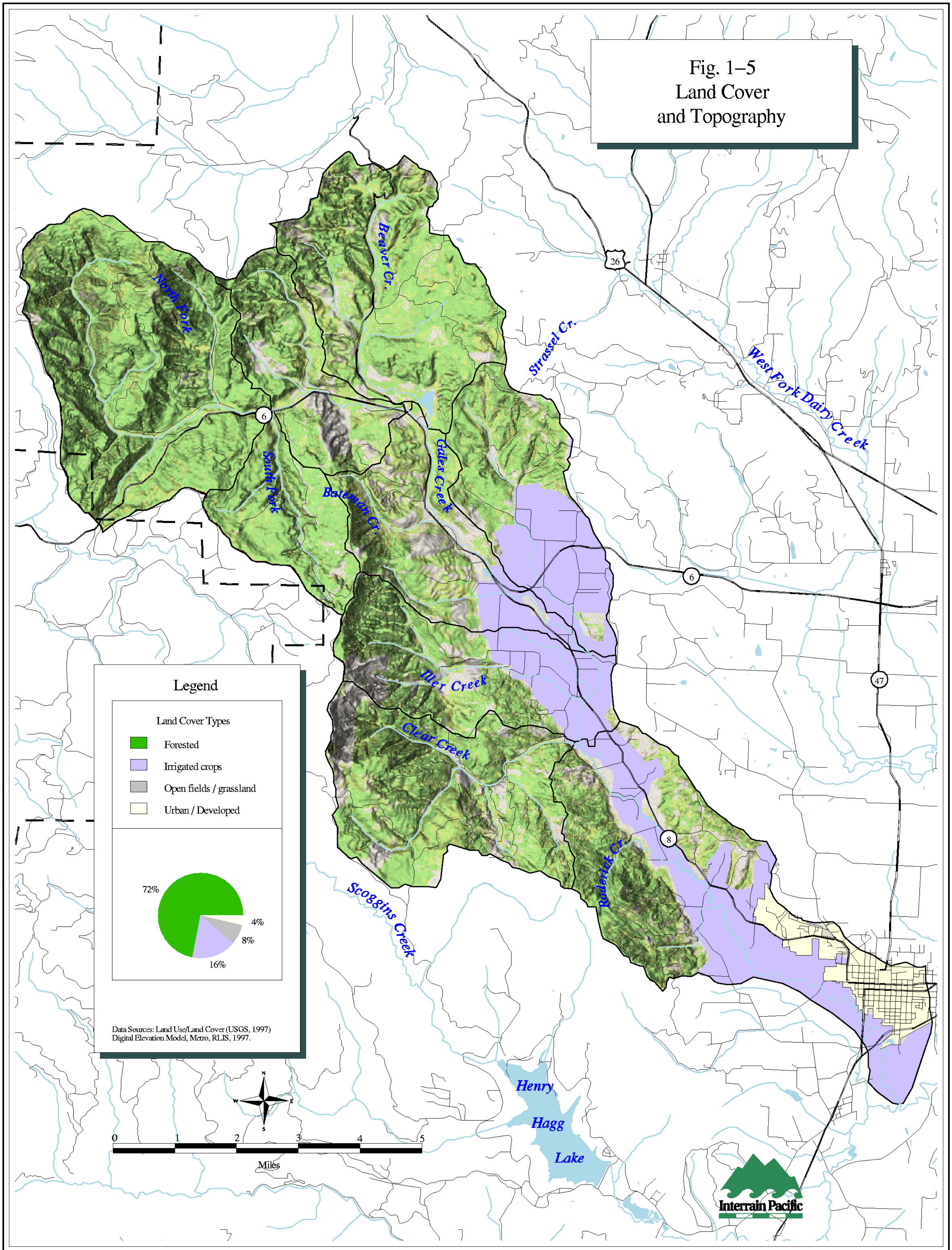
Fig. 1–5
Land Cover
and Topography
North Fork
Beaver Cr.
South Fork
Bateman Cr.
Gales Creek
Strassel Cr.
West Fork Dairy Creek
Iler Creek
Clear Creek
Roderick Cr.
Scoggins Creek
Henry
Hagg
Lake
26
6
8
47
Legend
Land Cover Types
Forested
Irrigated crops
Open fields / grassland
Urban / Developed
72%
4%
8%
16%
Data Sources: Land Use/Land Cover (USGS, 1997)
Digital Elevation Model, Metro, RLIS, 1997.
N
W
E
S
0
1
2
3
4
5
Miles
Interrain Pacific

bluebird, Western pond turtle, Northern red-legged frog, and inland steelhead. Fish species are discussed in detail in the Fisheries section of this report.

1.3 GWEB Draft Oregon Watershed Assessment Manual

This assessment project follows the watershed assessment procedures described in the October 1997 Draft Oregon Watershed Assessment Manual. This manual, still under development, was written by NonPoint Source Solutions, consultants hired by the Governor's Watershed Enhancement Board. The final manual, due in December 1998, will contain several sections: an identification of watershed issues, a detailed description of watershed processes, guidelines for the watershed assessment itself, and a section on monitoring and evaluation.

The purpose of the GWEB manual is to provide local citizens groups and watershed councils throughout the state with a consistent methodology to assess their watersheds. The goals of this assessment process are to identify areas of the watershed in need of protection or restoration and to direct manual users to further data gathering if necessary.

The draft assessment manual admittedly focuses on salmonid fish habitat and in-stream and near-stream conditions because these areas are most readily addressed by watershed council restoration activities.

The draft GWEB manual provides methodologies to gather information about several important watershed components. These components include historical conditions, channel habitat type, fisheries, riparian and wetlands, channel modification, water quality, hydrology, water use, and sediment sources. A watershed summarization section then describes data gaps and the need for further information gathering. The draft manual directs users to staff and resources from local, state, and federal agencies. It provides data sheets to summarize information and evaluation forms to describe the confidence in the accuracy of compiled data. The final products consist of several maps describing these component locations, summaries about the conditions in the watershed and evaluations about the best areas to prioritize restoration activities.

The Gales Creek Watershed Assessment project follows the steps described in the draft manual fairly closely. The manual requires filling out data sheets, evaluating the accuracy of the data, and then transferring the data onto hand drawn maps. Instead, information gleaned from data sheets is presented as text in this report. Hand-drawn maps have been replaced by computer-generated maps. Technical reports, field surveys, completed data sheets, hand-drawn maps, and other materials compiled during this assessment project are available for review at the Tualatin River Watershed Council office.

The manual assumes that most watershed councils will not have geographic information system (GIS) capability. The Gales Creek Assessment project has been able to use the services of Interrain Pacific during the development of the Tualatin River

Watershed GIS Project. Several GIS maps and analyses, specifically for the Gales Creek Watershed, have dramatically improved the quality of this report. These maps were derived from information supplied by various federal, state, and local agencies. Some inconsistencies in the information, and thus in the resulting maps, are present. Field visits are essential to confirm the accuracy of these maps before restoration and management activities take place.

2.0 Watershed Concerns

Several concerns have been identified during the watershed assessment process:

- Fisheries habitat:
  Low habitat diversity, poor large woody debris placement, lack of adequate spawning, rearing and overwintering habitat, high water temperatures, water availability, presence of introduced species

- Fish migration barriers:
  Barriers to fish passage (stream crossings, bridges, culverts), non fish-friendly water diversions/screening, potential low stream flows, Balm Grove flashboard dam, water diversions in City of Forest Grove watershed, irrigation diversions, potential flooding

- Riparian conditions:
  Lack of perennial vegetation, lack of large trees for shading, excessive invasive plant species, insufficient large woody debris (LWD) input, eroded and unstable streambank conditions

- Channel modifications:
  Channel modification, instream gravel mining, channelization of streams through agricultural lands, Balm Grove flashboard dam, water diversions in City of Forest Grove watershed and irrigation diversions, potential flooding

- Land use impacts on hydrology:
  Increased runoff from urban, agriculture and forestry activities

- Water use impacts:
  Illegal water diversions, over-allocation of water, inefficient irrigation systems

- Water quality status:
  303(d) listed streams, high water temperature, seasonally low dissolved oxygen (DO), seasonally high pH, high fecal coliform

- Sediment sources:
  Erosion from agriculture and forestry activities, impacts from inaccessible or abandoned (legacy) logging roads, poor road construction or re-construction, poor maintenance and road removal activities, upslope and instream mining and quarry activities, and other construction projects

This assessment addresses most of these concerns. Data gaps and further data gathering are discussed in the watershed condition summary section. Field verification and improvement or restoration activities, when appropriate, are suggested for the Council and its partners to implement, as resources allow.

Economic and human health concerns are not specifically mentioned in the draft GWEB watershed assessment manual. However, they are important to acknowledge since many local restoration efforts and management plans do address these concerns.

- Economic concerns:
  Low agriculture and/or forestry profits, wildlife damage to crops, flood damage, production of useful commodities, transportation, recreational opportunities

- Human health:
  Safety, air quality, drinking water protection

The following is a list of federal, state, and local legislation and management plans pertaining to the Gales Creek Watershed. This list identifies the broad range of management programs and policies affecting activities within the watershed.

Information from this assessment may assist management agencies in the implementation of their plans.

Federal Legislation:

Endangered Species Act: NMFS Status Review of West Coast Steelhead from
Washington, Oregon and California, 1996

Clean Water Act of 1972 (US EPA) and Amendments

State Plans/Legislation:

State of Oregon: Oregon Plan for Salmon and Watersheds, 1998

Oregon Department of Agriculture (ODA): Senate Bill 1010
- Tualatin River Watershed Management Plan for Controlling Rural Nonpoint Source Pollution, 1991 (developed by Washington County SWCD)
- Tualatin River Subbasin Agricultural Water Quality Management Area Plan, 1996

Oregon Department of Environmental Quality (DEQ)
- Water Quality conditions / DEQ 303(d) list, 1998
- Water quality limited streams, Total Maximum Daily Loads (TMDLs)

Oregon Department of Forestry (ODF)
- Oregon Forest Practices Act of 1971 and Forest Practice Administrative Rules, Tillamook State Forest management plans

Oregon Department of Fish and Wildlife (ODFW)
State Threatened & Endangered designation (critical, vulnerable, naturally rare)
Tualatin River Subbasin Fish Management Plan, 1992
Fish and Wildlife Habitat Protection Plan for Washington County, 1977
Oregon Division of State Lands (DSL) (instream mining activities)
Oregon Water Resources Department (OWRD) (Water rights, water diversions)

Local Legislation/Plans:

Metro: Title 3, 1998 of Metro's 2040 Framework Plan (Riparian and flood plain management) and Greenspaces Program (open space land acquisition)
Washington County Comprehensive Plan: Rural/ Natural Resource plans, 1992, Goal 5 and other county provisions
City of Forest Grove Watershed Resource Management Plan, 1994 (hydrologic alteration, water quantity)
Unified Sewerage Agency: Fernhill Regional Wetlands Mitigation Bank Instrument 1998

3.0 Watershed Characterization and Assessment

3.1 Historical Conditions

Historical information was compiled by an AmeriCorps volunteer from Northwest Service Academy. Information was gathered from a variety of sources including the Washington County Historical Society, Pacific University Library archives, local libraries, and newspapers. Local historians and long-time residents of the watershed were interviewed and provided valuable insight into early European settler life.

Timeline

~12000BP	Catastrophic Missoula floods form the Tualatin Basin and deposit soils
~4000BP	Twality band of the Atfalati use Tualatin Basin as hunting and fishing grounds
1812	First European fur trappers come to the Tualatin Basin
Mid 1800s	Tualatin Indians died out from smallpox and other introduced European diseases
1840s	Undocumented natural fire in upper Gales Creek watershed
1841	Joseph Gale moves to "Smith's Fork" area in lower watershed
1843	Gale brings in area's first livestock, development of first grain and saw mills
1840s?-present	Wetland areas tiled and drained for agricultural use
1854-5	Salem-Astoria military road surveyed through watershed
1865	Gales Creek log drives to downstream mills
1871	Forest fire
1870s	First industrial logging, log drives downstream to sawmills
1874	Sawmill built at Glenwood, Gales Creek Post Office opened
1882	Steamboat runs aground on way to Forest Grove
1893	Stage line to coast opened, Lyda log dam built (RM 17)
1901	Lyda mill destroyed

1907	Probable last log drive on Gales Creek
1920-present	First gravel pit for Washington County road construction, legal and illegal instream gravel mining operations continue today
1917	Clear Creek tributary first used for Forest Grove water supply, railroad started
1922	Railroad is completed, State Game Commission fish hatchery opened
1930	Carnation Lumber facility built, hydropower station and log dams
193?	Dredging above town of Gales Creek
1932	Cox Forest Fire, mid-watershed
1933	First Tillamook Burn in upper watershed, near Gales Creek Campground
1940	Water gaging station built near town of Gales Creek
1945	portion of upper watershed is burned in series known as Tillamook Burn
1951	Last of lumber railroads removed
1956	Gaging station decommissioned
Late 1950s	Carnation powerhouse removed
1996	Significant flood event requiring emergency streambank repairs

The local Tualatin (or Twality) Indians, from the Atfalati tribe, resided mostly around the now-drained Wapato Lake to the south. They likely used the Gales Creek Watershed as hunting grounds and a route to coastal areas. There is evidence they fished the waters and resided in small settlements in the watershed. Diseases were introduced to local populations from contact with Europeans in the 1840s and resulted in the decimation of the native people.

The watershed is named after Joseph Gale, a former mountainman who moved into the area in 1841, residing north of a missionary's previous settlement. In 1844, Gale established the first saw mills and grist mills, seven miles north of the confluence with the Tualatin River. He imported the area's first livestock, Spanish longhorn cattle and 2,000 head of sheep.

Since early settlement, the waters of Gales Creek have been used for agriculture, log transportation, sawmills and drinking water. Other past uses include fish hatcheries, irrigation and running hydropower stations for logmills and gristmills. The waters have filled off-channel swimming ponds and transported people and cargo. Steamboats came up the Tualatin River as far as the town of Forest Grove, but it is unclear how far up Gales Creek they may have traveled.

A wagon trail to the coast crossed the upper watershed. The Salem-to-Astoria military road followed Gales Creek up from the Tualatin River. In 1893 the stagecoach line to the coast came through the community of Gales Creek, for a while boosting its hopes to become Gales City. Although it never grew beyond its current population, the voting precinct peaked in the 1910 census with a population of 1,319. It was then large enough to build its own post office the next year. When Highway 6 was constructed in 1942, it covered most of the wagon trail's path. Highway 6 was built during World War II as a quick route to the Tillamook coast which was thought to be a potential Japanese invasion site.

Humans have historically altered the watershed's forestlands. The Tualatins used fire to create clearings for easier hunting. The first European settlers cut trees for their building and heating needs. In 1874 a sawmill was built near the Beaver Creek confluence at Glenwood. Logging has been the main industry throughout the watershed.

Industrial logging started in the 1870s and was at first muscle-powered, with men, horses, oxen and donkeys. Transportation of logs was later accomplished by floating on creeks, by steamboat, trains and most recently, trucks. An *Aurora* article from 27 May 1882 mentions the steamboat *Ajax* running aground on its way to Forest Grove. When the rails came in 1917, serving both the timber industry and as a common carrier, it paralleled Gales Creek.

Logs were transported down creeks by floating them during peak flows (or freshets), in the winter and spring or by using splash dams. Splash dams are temporary dams which build up water pressure and are then purposely burst to force logs down stream. Using two splash dams, lumbermen ran logs down Gales Creek until 1909. Records show many log drives in the watershed from the 1870s to the early 1900s. In 1879, McRoberts and Higgins of Upper Gales Creek obtained their logs from the creek. In 1888, four miles above Forest Grove, Lyda and Sons operated a sawmill that received logs transported on Gales Creek from Glenwood. A log drive in 1896 is documented on Beaver Creek just above Glenwood. At least 10 named lumbermills existed between 1890 and 1910 in the watershed. The last log drives occurred in 1907. They became obsolete when the railroad and trucking became more economical.

Gales Creek remains an erratic body of water. "We have spent thousands of dollars clearing out Gales Creek so that freshets can go through unmolested…The trouble with Gales Creek is that it rises within 24 hours and drops the same way," complained Mr. Patton, the Baseline Timber Company's spokesman in 1909. He was trying to justify in court the dynamiting of log jams, for which the local game warden had arrested him. Records show that during the time that Washington County maintained a water gaging station on the mainstem (1941-56), Gales Creek overran its banks most years and often many times in a year.

The aptly named town of Timber, which is just outside the Gales Creek Watershed, signifies the forestry industry's importance in the area. A survey done by Rev. K. Hines in 1893 explains: "Whole forests frequently average 250 feet in height and four to six feet in diameter. Trees 350 feet in height and eight to 10 feet in diameter are not infrequently found (including) cedar, spruce, oak, maple and alder…"

The first Tillamook fire, in August 1933, was the result of unsafe logging procedures during extreme low humidity conditions. This devastating fire started near the present Gales Creek Campground and burned more than 240,000 acres. Other major fires occurred in 1939, 1945, and 1951, blackening 355,000 acres. Parts of the upper Gales Creek Watershed were burned in 1933 and 1945. Originally called the Tillamook Burn, this entire area was officially renamed the Tillamook State Forest in 1973.

People have significantly altered Gales Creek and its tributaries. There are hundreds of small diversions throughout the watershed, for irrigation and domestic purposes. The city of Forest Grove has taken its drinking water from the 4,500 acre Clear Creek subwatershed since 1917. A 1927 engineer's sketch (found in Tualatin Basin Watermaster records of expired Gales Creek water rights) shows a log dam across Finger Creek used to generate hydropower for a sawmill.

Both private and state operators have maintained as many as a dozen small fish hatcheries, dating to the now-defunct state game commission hatchery, opened in 1923. Before the turn of the century, ceramic tiling was used to drain wetland areas for agricultural use. The mainstem of Gales Creek has been dredged in numerous places for gravel mining, (i.e., above the town of Gales Creek), to straighten its path for road and railroad construction, and to maximize usable agricultural lands. Four rock quarries have been operated in the watershed, of which two pits have taken gravel from the creek bed.

Floods, forest fires and ice storms have been documented in settlers' journals and newspaper articles. Most of the information regarding these events is anecdotal, and it is difficult to gauge their severity and extent. However they do appear to be common and recurrent.

The following watershed residents were interviewed for this report:
Megan Haven, Carpenter Creek Historian, Forest Grove, OR
Walter Parkin
ODF Historians: Larry Fink and George Martin
(Sources: Morris, W.G. 1935. *Details of the Tillamook Fire*
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3.2 Channel Habitat Typing

The GWEB assessment manual draws on several existing stream classification systems (including Rosgen, USFS and others) to develop a basic channel habitat type for Oregon streams. The manual uses a valley-segment scale to define channel habitat types. This scale is small enough to determine stream physical characteristics yet large enough to be identified using topographic maps. These channel types are described in **Table CHT-1** and **CHT-2,** in **Appendix B**.

Channel habitat types can be grouped by their channel gradient, channel pattern, degree of valley constraint, and stream size. Channel shape is the result of geomorphic processes such as landform development, the underlying geology, erosion, hydrology, and land practices in developed watersheds. Each channel habitat type will respond differently to inputs of large woody debris, to retention of sediment, to streambank and streambed stability, and to stream flows. These inputs are also influenced by the overall climatic and geologic setting of the watershed. Thus different stream habitats will form in each channel type.

There is a large variation in both temporal and spatial usage of these habitat types by plants and animals. For example, because salmonid fish are not evenly distributed throughout a watershed, the stream classification system helps to identify which portions of the watershed have the highest potential for fish utilization. In general, coho salmon are found in streams with less than 4% gradient, like the mainstem of Gales Creek. Steelhead trout use streams with less than 10% gradient. Cutthroat trout are found throughout the watershed but are the dominant species in headwater areas such as the North Fork Gales Creek, near the Gales Creek Campground.

Channel habitat types were determined by:

- Studying 7.5' USGS topographic maps and ODF stream size maps
- Determining stream gradient by measuring stream length between contour lines. The formula was: 40ft (or 80ft, depending on the USGS map used) contour line/stream length (rise over run) to get a percent
- Using Table CHT-1 and CHT-2 in the assessment manual to determine habitat type
- Driving the watershed for field verification

Oregon Graduate Institute students helped with the channel habitat typing of the mainstem of Gales Creek and field verified their results at five locations. Habitat types for the tributaries were determined later but have not been field-verified.

Eight USGS 7.5' topographic quadrangle sheets were used for the Gales Creek watershed (Laurelwood, Forest Grove, Buxton, Gales Creek, Cochran, Timber, Roaring Creek, Woods Point). After reviewing the topographic maps, six channel types were identified and are listed below, from lowest to highest elevation.

- Low-Gradient Floodplain Channel (FP2) - large to medium stream size
- Low-Gradient Floodplain Channel (FP3) – small
- Low Gradient Constrained Channel (LC) – large or medium
- Moderate gradient, moderately constrained (MM) – large and medium
- Moderate Gradient, constrained (MC) – small, medium and large
- Steep Narrow Valley Channel (SV) - small

Low-Gradient Floodplain Channel (FP2 and **FP3):**

FP2 consists of the main stem of a large to medium size meandering stream, and FP3 is a small stream. These two types of channel have similar characteristics: they may or may not have side channels; they have a broad, well-defined floodplain and a gradient of less than 2%. The channels are not confined by valley walls. Substrates tend to be gravel, sand or small cobbles.

These channel types are important steelhead trout, cutthroat trout and coho salmon rearing habitats. Spawning may occur in gravel areas with no sedimentation. Resident fish will use these channel types for spawning, rearing and overwintering. These channel types are prone to erosion, deposition of sediments and/or gravels, and flooding.

Low Gradient Constrained Channel (LC):

LC consists of low to moderate gradient hillslopes that confine the channel. The channel pattern is a single channel with a relatively straight or slightly sinuous shape. The stream gradient is less than 2% with a substrate of bedrock, cobble or gravels. These channel types are prone to erosion, deposition of sediment and other materials and flooding.

Moderate gradient, moderately constrained (MM)

MM has a moderately constrained, broad valley shape with alternating hillslopes or terraces. Gradients are between 2 - 4% with slightly sinuous to relatively straight single or braided channels. Streams tend to be large or medium size and may contain bedrock steps or cascades which could limit fish migration. Substrate is large gravel, small boulders and bedrock. There is potential steelhead spawning and rearing habitat and resident fish spawning, rearing, and overwintering areas.

Moderate Gradient, constrained (MC)

MC has gently to narrow v-shaped valley with a minimal floodplain and moderate gradient from 2-4%. Large, medium or small streams are contained in this channel type and tend to be a single channel that conforms to hillslopes. Sediment is transported through these channel types. Mass wasting may be a potential sediment source. Streambanks are generally bedrock controlled and stable. There is potential for both anadromous and resident fish spawning and rearing.

Steep Narrow Valley Channel (SV):

SV is constrained, narrow and v-shaped and has a gradient of 8-16%. Stream sizes are small. Lower gradient areas may provide limited anadromous rearing areas if accessible. Resident fish may have limited rearing and spawning habitat depending on gradient. These channel types tend to be sediment sources.

This channel type is present in the highest parts of the watershed and may also have no fish usage due to gradient, potentially high water velocities, intermittent or low flows, and small stream size. The importance of these streams is to manage them to limit potential sediment transport and high water temperature conditions due to degraded riparian conditions.

Ecoregions

Ecoregions are areas of similar type, quality, and quantity of environmental resources. These regions were identified through the analysis of patterns and composition of biotic and abiotic criteria. The criteria used to define ecoregions are: geology, physiography, vegetation, climate, soils, land use, wildlife, and hydrology. Ecoregions provide distinct partitioning of areas with common features and are useful for evaluating the condition of biological communities. See **Fig. 3-1** for ecoregions and elevation.

The U.S. Environmental Protection Agency (EPA) has developed an ecoregion map of Western Oregon and Western Washington at a scale of 1:250,000. This map was

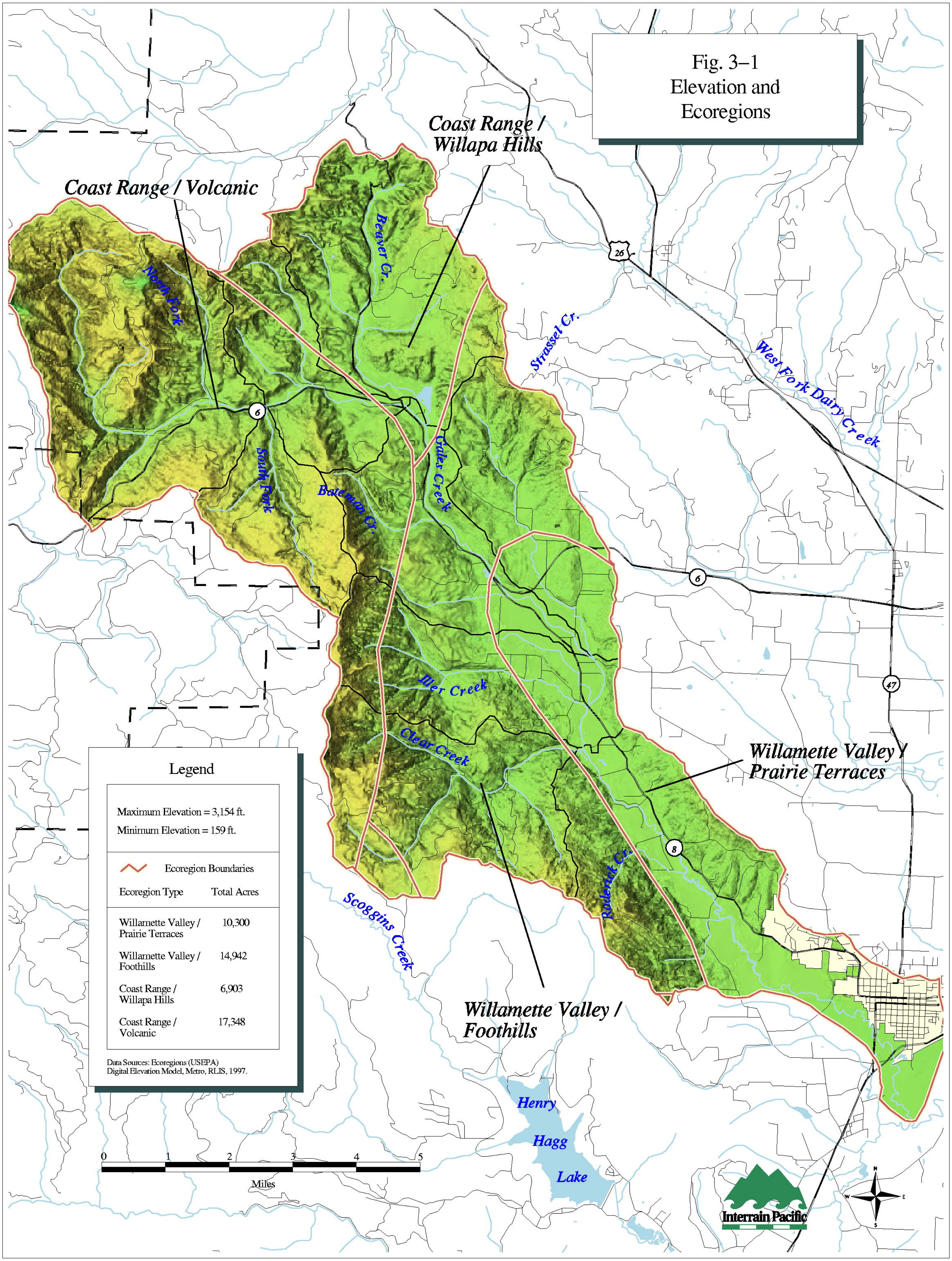

Fig. 3–1
Elevation and Ecoregions

developed to provide a common conceptual ecosystem framework to aid federal and state management agencies in research, assessment, and monitoring of ecosystems.

The GWEB Technical Review team working on the assessment manual determined that ecoregions will be incorporated into the channel habitat typing section of the final version of the manual. Although ecoregions were not discussed in the draft manual they are included in this report.

There are four ecoregions in the Gales Creek watershed:

1) Coast Range / Volcanics
The Coast Range/ Volcanics are characterized by low to high mountains with high gradient streams with relatively stable flows, spruce/cedar/hemlock Douglas-fir vegetation. Soil orders include Andisols and Ultisols with udic (wet) moisture regimes.

2) Coast Range / Willapa Hills
This ecoregion is characterized by low, rolling hills and mountains with medium gradient sinuous streams, western hemlock, Western red cedar and Douglas-fir vegetation. Soil orders are Andisols, Alfisols and Inceptisols with udic moisture regimes.

3) Willamette Valley / Prairie Terraces
This ecoregion has nearly level to undulating fluvial terraces with sluggish streams. Historically wetlands and ponds were common. Soil orders are Alfisols, Mollisols and Inceptisols; soils tend to be mesic with xeric (dry summer) moisture regimes.

4) Willamette Valley / Valley Foothills
This ecoregion has rolling hillsides with medium gradient sinuous streams, vegetation of Oregon white oak and madrone on drier sites and Douglas-fir and some western red cedar in moister areas. Soil orders are Alfisols, Ultisols, Mollisols and Inceptisols with xeric moisture regime.

Stream profiles of the mainstem Gales Creek and its major tributaries are included in **Fig. 3-1a, 3-1b, 3-1c** to show the general elevation changes in streams.

A state stream database, using channel habitat type and ecoregion, is under development by several state agencies. This section may need to be updated when that database becomes available to watershed councils.

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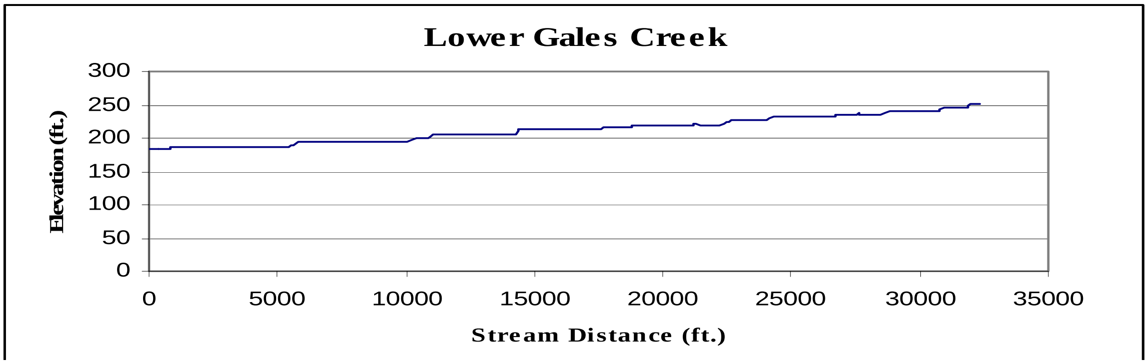
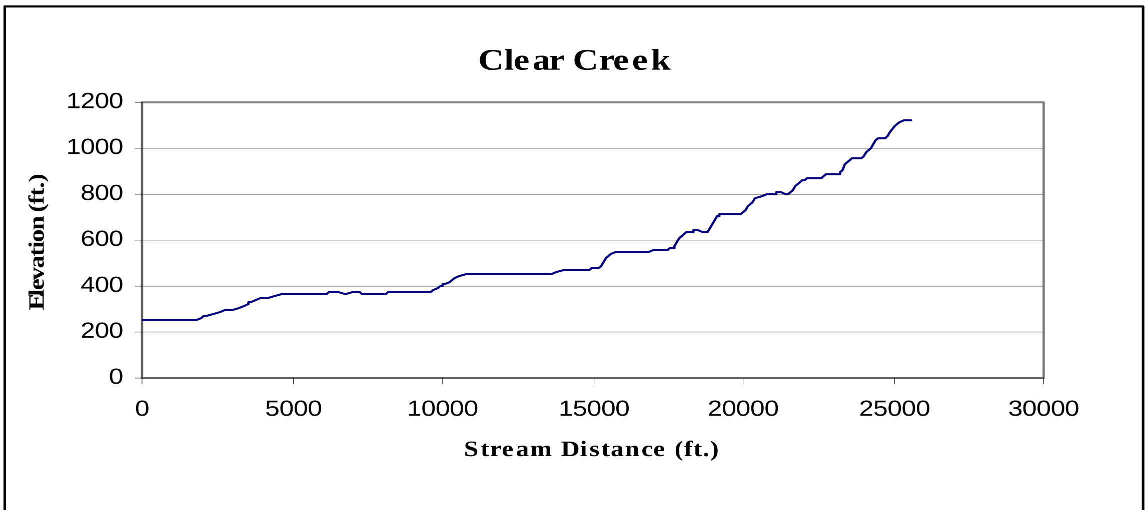
Fig 3-1a. Stream Profiles for Lower Gales Creek Watershed Major Streams





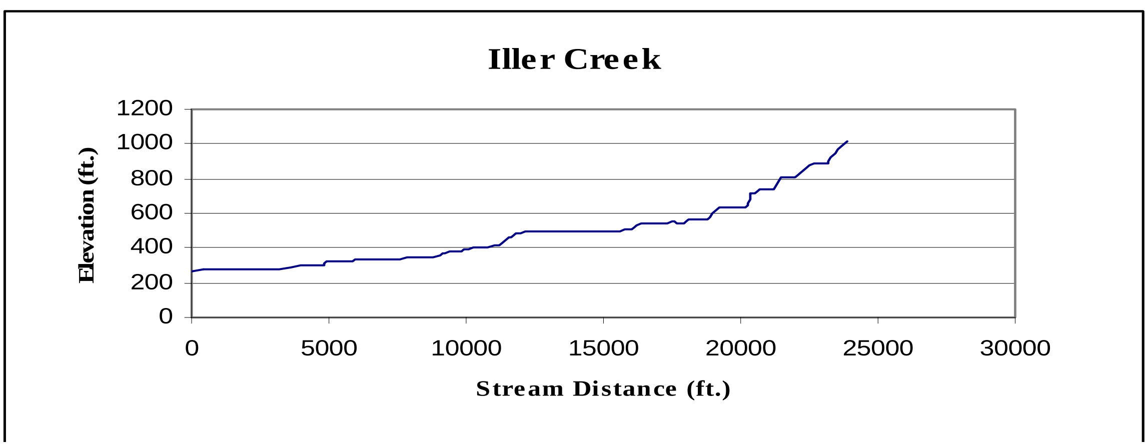
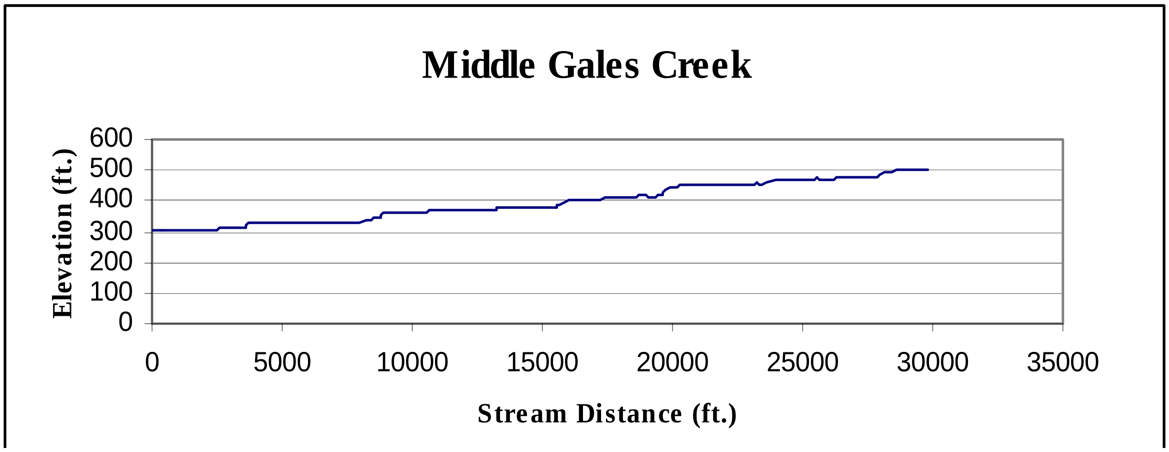
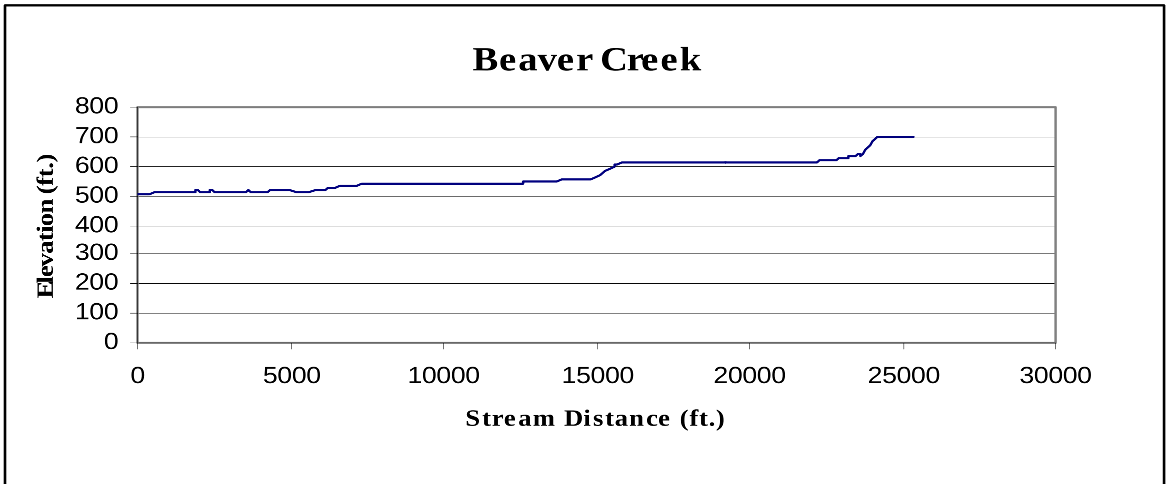


Fig 3-1b. Stream Profiles for Middle Gales Creek Watershed Major Streams





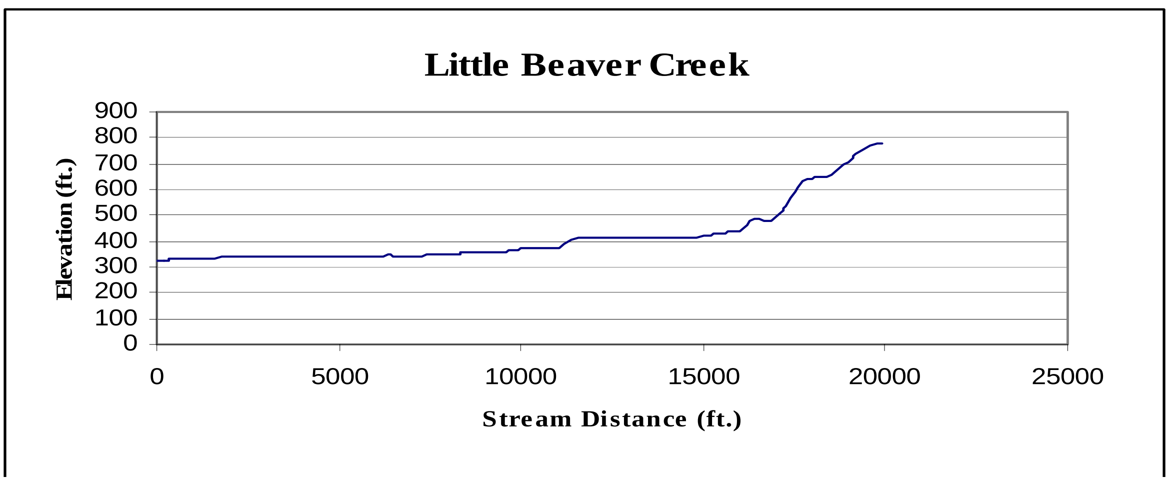
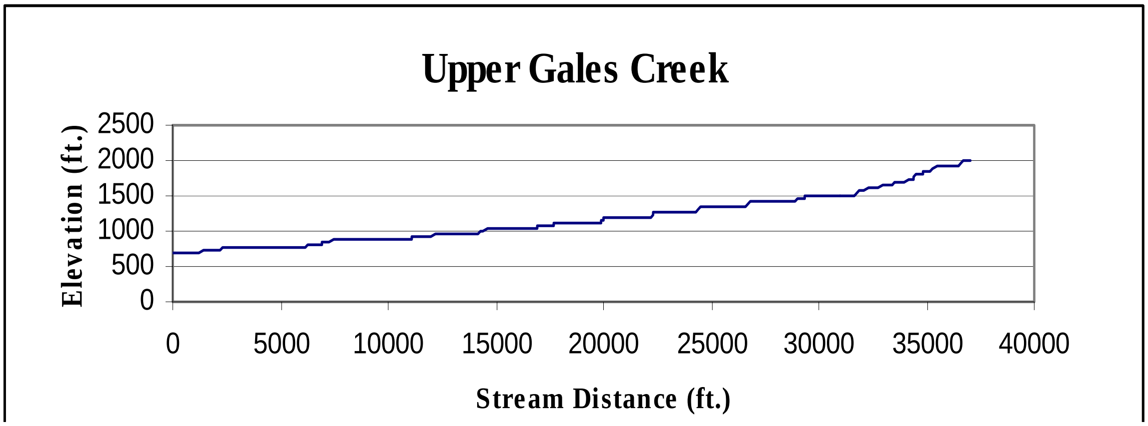
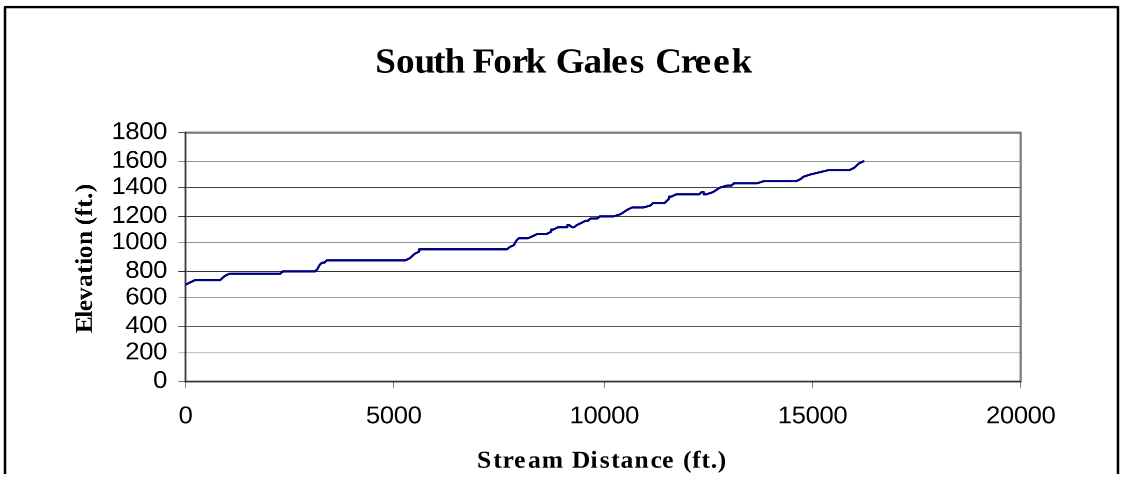
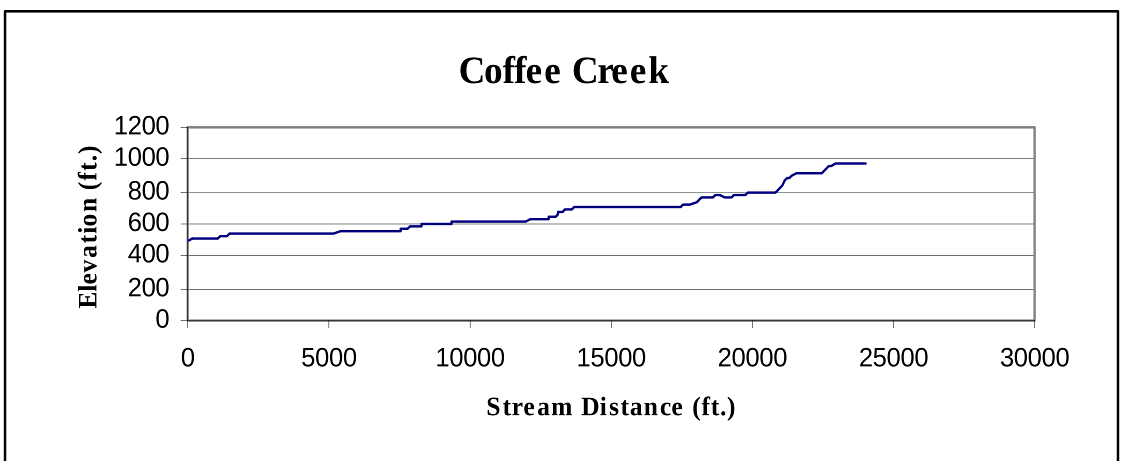


Fig 3-1c. Stream Profiles for Upper Gales Creek Watershed Major Streams







3.3 Fish Distribution

Cutthroat trout, steelhead trout, and coho salmon are important fish species found in the watershed. They depend on clear, cool water, vegetated riparian zones, and unobstructed passageways to rearing, spawning, and overwintering habitat. The tributaries and channel of Gales Creek provide the only non-fragmented natural connection between the upland forests of the Coast Range and the wetlands and flood plain of the Tualatin River. Anadromous fish migrate to and from the watershed via the Tualatin, the Willamette, and the Columbia rivers on their way to and from the Pacific Ocean.

The National Marine Fisheries Service (NMFS) is reviewing existing information to decide whether to list winter steelhead in the watershed as a threatened species under the federal Endangered Species Act. This decision involves the Upper Willamette River Evolutionarily Significant Unit (ESU) which includes the entire Tualatin River Basin. Genetic testing is occurring to determine if Tualatin Basin steelhead trout are hatchery or wild and how much hatchery releases have influenced the wild stock. If the stock is determined to be hatchery they may not be listed. This decision is expected in March of 1999.

Coastal cutthroat trout are another candidate species under consideration by NMFS. The status of resident and sea-run cutthroat populations west of the Cascade Crest are being reviewed. The decision to list or not is due in December 1998.

Salmonid fish are dwindling statewide, and appropriate restoration or management activity that protects or provides more fish habitat is justified. Fish use in the Gales Creek Watershed appears to be widespread, but several factors limiting the quality of fish habitat have been identified. The purpose of this section is to identify limiting factors and to suggest means of improving conditions for fish use.

Coho salmon, steelhead trout, cutthroat trout and other fish species use a significant portion of the mainstem and tributaries in the watershed. **Fig. 3-2** shows anadromous and resident fish presence in the watershed. This information comes from ODF fish presence stream maps coordinated with ODFW information. The following shows the extent of stream miles used by fish in the watershed:

Species:	Total Linear Miles:
Coho Salmon	38.4 miles
Steelhead Trout	37.1 miles
Resident fish	71.1 miles

Natural and human-caused impediments to fish use are also mapped in Fig. 3-2. These may be the result of naturally high gradients, cascades or known diversions, dams or culverts. Much of this information needs to be verified in the field.

The following is a list of documented fish species present in the watershed. This information is from biotic surveys conducted by Pacific University. See **Appendix C**.

Anadromous:

Steelhead Trout (*Oncorhynchus mykiss*)
Coho Salmon (*Oncorhynchus kisutch*)
Cutthroat Trout (*Oncorhynchus clarki)*
Pacific Lamprey (*Entosphenus tridentatus*)
Western brook Lamprey (*Lametra richardsoni*)

Resident:

White Crappie (*Pomoxis annularis*)	- introduced
Longnose Dace (*Rhinicthys cataractae*)	- native
Rainbow Trout (*Oncorhychus mykiss*)	- native
Prickly Sculpin (*Cottus asper*)	- native
Reticulate Sculpin (*Cottus perplexus*)	- native
Riffle Sculpin (*Cottus gulosus*)	- native
Torrent Sculpin (*Cottus rhotheus*)	- native
Redside Shiner (*Richardsonius balteatus*)	- native
Sucker (Catostomus sp.)	- native

Historic Information

There is very little documented or even anecdotal information about historic fish distribution in the Gales Creek Watershed. There is some debate about the status of steelhead trout as native species in the watershed. A May 30, 1998 letter written to the Tualatin River Watershed Council by Louis Bateman, from the Bateman family who homesteaded in the watershed in 1884, refutes the presence of steelhead and coho salmon and suggests that both salmonids were introduced in the 1930s. One 1893 settler's journal described steelhead as present in Gales Creek. The ODFW Steelhead Management Plan 1986-1992 and the 1992 Tualatin Basin Fish Management Plan described steelhead trout as being native to the Tualatin River. Fisheries biologists generally agree that steelhead trout are native to the Gales Creek Watershed.

Coho salmon were not present in the Tualatin Basin until a fish ladder was constructed on Willamette Falls in the late 1800s. Since steelhead trout and chinook salmon can jump up to approximately 15 vertical feet, they are the only native anadromous salmonids which occurred above Willamette Falls before the fish ladder was built.

Oregon Fish Commission records show that 20,000 silver (coho) fingerlings were released into Gales Creek in 1936 and releases continued until 1987. Spring chinook salmon may have used the upper reaches of Gales Creek prior to 1940 but were probably not abundant. There may presently be some small use near the mouth of the Tualatin River but the last siting of spring chinook salmon near Gales Creek was in the late 1980s, in Scoggins Creek.

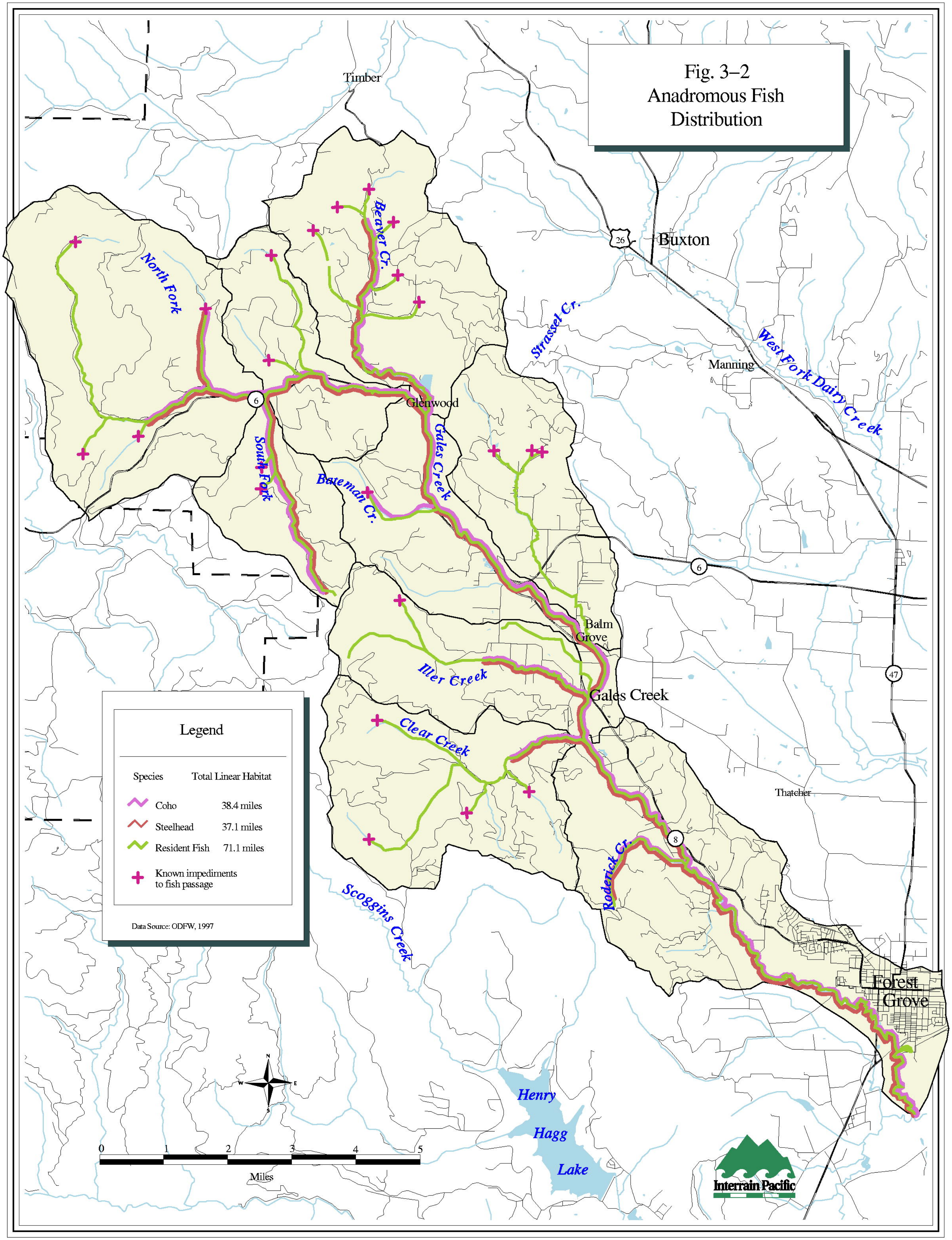


Fig. 3–2
Anadromous Fish
Distribution
Timber
Buxton
26
Manning
Strassel Cr.
West Fork Dairy Creek
North Fork
Beaver Cr.
6
Glenwood
Gales Creek
South Fork
Bateman Cr.
Balm
Grove
Iller Creek
Gales Creek
Clear Creek
47
Thatcher
8
Roderick Cr.
Scoggins Creek
Forest
Grove
Henry
Hagg
Lake
Legend
Species
Total Linear Habitat
Coho 38.4 miles
Steelhead 37.1 miles
Resident Fish 71.1 miles
Known impediments
to fish passage
Data Source: ODFW, 1997
N
W
E
S
0
1
2
3
4
5
Miles
Interrain Pacific

Current Information

Basic information regarding species composition, distribution, population sizes, and fish habitat conditions in the Gales Creek Watershed is very limited. A thorough search of the Clackamas ODFW field office library revealed only two reports with information about Gales Creek Watershed fisheries. One 1960 report described coho salmon spawning ground surveys on Iller and Beaver Creeks from 1952 to 1958. The other report, written in 1966, described coho salmon and steelhead trout stocking, minimum stream flows, and economic values of sport fishing. There may be 1993-1994 ODFW stream habitat surveys on the North and South Forks of Gales Creek but these surveys could not be located in the Clackamas field office.

The U.S. Geological Survey conducted an intensive biotic survey of one site in the ODF Gales Creek Campground in 1993. Results of this survey were just published in the U.S. Geological Survey Water Resources Investigations Report. Unfortunately this site was altered in the 1996 flooding, and current stream conditions cannot be compared to this study.

The Oregon Department of Forestry (working with ODFW) conducts fish presence surveys in streams where timber harvests on state and private lands are planned and where fish information is lacking. These surveys occur during late spring and summer field season, using ODFW and ODF staff who electro-fish stream segments. The surveys verify the presence and absence of fish, and basic species identification is made in the field. ODF then transfers the survey results onto USGS quad maps with stream designations of small, medium, and large. While these stream maps are valuable in knowing where fish are, they do not provide quantitative information on numbers of fish or fish habitat conditions. Results of 1998 field surveys have not been tabulated.

The following list needs to be updated as more information becomes available. An asterix (*) denotes those streams which have not been surveyed.

Mainstem of Gales Creek	- Fish Use (from mouth to most of upper headwaters)
*Prickett Creek	- no fish surveys done as of 1997
Roderick Creek	- surveys done but results not received
*Godfrey Creek	- no fish surveys done as of 1997
Clear Creek	- Fish Use
Roaring Creek	- Fish Use
Thomas Creek	- Fish Use
Deep Creek	- Fish Use
Iler Creek	- Fish Use
*Fir Creek	- no fish surveys done as of 1997
*White Creek	- surveyed but results not received
*Lyda Creek	- unknown
Bateman Creek	- Fish Use
Little Beaver Creek	- Fish Use
Beaver Creek	- Fish Use

Coffee Creek	- Fish Use
Finger Creek	- Fish Use
Low Divide Creek	- Fish Use
South Fork Gales	- Fish Use
North Fork Gales	- Fish Use

The Tualatin River Biotic Survey Team (Dr. Rob Stockhouse, Dr. Pam Lopez and a trained crew of Pacific University students) has conducted detailed biological surveys at two sites in the Gales Creek watershed for a number of years. Seine and D-nets were used to collect specimens (macroinvertebrates, fish, and other aquatic life) which were dislodged by agitating the substrate upstream. Collected specimens were then placed in an alcohol solution and identified in a lab using dissecting microscopes and dichotomous keys. The results of sampling done in 1996 are in Appendix C. Sampling was also conducted during the 1998 field season, but results were not tabulated in time for this report. Sample sites included: Gales Creek Campground, Beaver Creek at Wildcat Mountain Rd, Pacific Arboretum, Rippling Waters, and USA property just above the confluence of the Tualatin River.

Two electro-fishing sessions were conducted by an ODFW fisheries biologist in June, 1998. These sites were located at the Pacific Arboretum and on Gales Creek at the confluence of Bateman Creek. Surveyed fish species included: coho salmon (at the Bateman site), steelhead trout, cutthroat trout, Pacific lamprey, reticulate and torrent sculpin. Crayfish and a Pacific Giant salamander (at the arboretum) were also captured. Due to the types of species and observations of stream and riparian conditions, the ODFW biologist determined that these sites were of very high quality (personal communication, T. Friesen, ODFW, 6/10/98).

The various surveys show that, in general, salmonids and other cold water species appear to use the mid to higher reaches of the watershed for rearing because these areas have better physical habitat and water quality. In general, coho salmon are found in streams with less than 4% gradient and steelhead trout use streams with less than 10% gradient. Steelhead trout rearing will occur in steeper faster water especially in streams that support several salmonid species. Cutthroat trout also use much of the Gales Creek Watershed.

Fish surveys have not been conducted on the lowest reaches of Gales Creek or at the confluence with the Tualatin River. Introduced warm water species which are more tolerant of degraded habitat seen in the flood plain areas may be present.

As a part of a cooperative study with Unified Sewerage Agency, ODFW biologists conducted intensive fish and habitat surveys at 38 sites on fifteen streams in the Tualatin Basin in 1994 and 1995. Measurements of available habitat were made. A stream ranking was developed to determine the highest priority for protection and enhancement. These surveys unfortunately did not include streams in the Gales Creek watershed. The results of this study are important to show which species could be introduced into Gales Creek from the Tualatin River. Since the Tualatin River serves as the migration route between Gales Creek and the Willamette River for anadromous fish, it is important to understand the potential impacts of non-native species, fish passage barriers, poor water quality, and other factors that salmonids may encounter during migration.

The Oregon Department of Fish and Wildlife (ODFW) has been managing fish in the Gales Creek watershed since the 1920s, with local fish hatcheries and juvenile fish releases. Rainbow trout and cutthroat trout smolt were released in the mainstem of Gales Creek until 1986 when native cutthroat runs were promoted. From 1975 to 1995 winter steelhead trout hatchery fish were released into Gales Creek. Coho salmon were introduced into Gales Creek through stocking efforts in 1936. To promote native fish runs, all stocking in Gales Creek has been stopped since 1995. However, Dorman Pond, an off-channel pond located just northwest of the intersection of Highway 6 and Gales Creek Road, is still stocked with hatchery trout for recreational fishing purposes.

ODFW has identified several fish habitat constraints in their 1992 Tualatin River Basin Fisheries report: 1) turbidity and siltation; 2) limited spawning and rearing areas; 3) Balm Grove Dam, Clear Creek Dam, Roaring Creek Dam; and 4) potential predation by introduced warm water species. Other factors which limit salmonid usage are low water levels and high water temperatures during the summer and degraded water quality. The Balm Grove dam is a cement structure on the mainstem of Gales Creek. Flashboards are dropped into place to back up water during the summer months to create a swimming pool for a private campground. Clear Creek Dam and Roaring Creek Dam are two water diversions in the City of Forest Grove Watershed.

Potential migration barriers to both juvenile and adult fish passage were studied at various sites throughout the watershed. After a GIS analysis (see **Fig. 3-3**) was run to locate all road and stream crossing points, volunteers drove to 43 publicly accessible bridges and culverts. Culverts were surveyed using the GWEB manual protocols. On visual inspection, no bridges proved to be barriers. At each culvert, the culvert gradient, culvert construction and size, and water flow characteristics were measured. Any culvert blockages (i.e. woody debris, gravels) were identified and removed if possible. Two culverts appear to be potential juvenile fish barriers due to high gradient and culvert height above the downstream pool. Woody debris blocked the upstream end of one culvert. One culvert is located at a spur road just east of Washington Bridge #1387 at Parsons Road and Little Beaver Creek. The other culvert is Washington County Culvert #1661 located on Timber Road, crossing Beaver Creek.

Section 4 contains a list of data gaps, further surveys and summarizes fisheries in the watershed.

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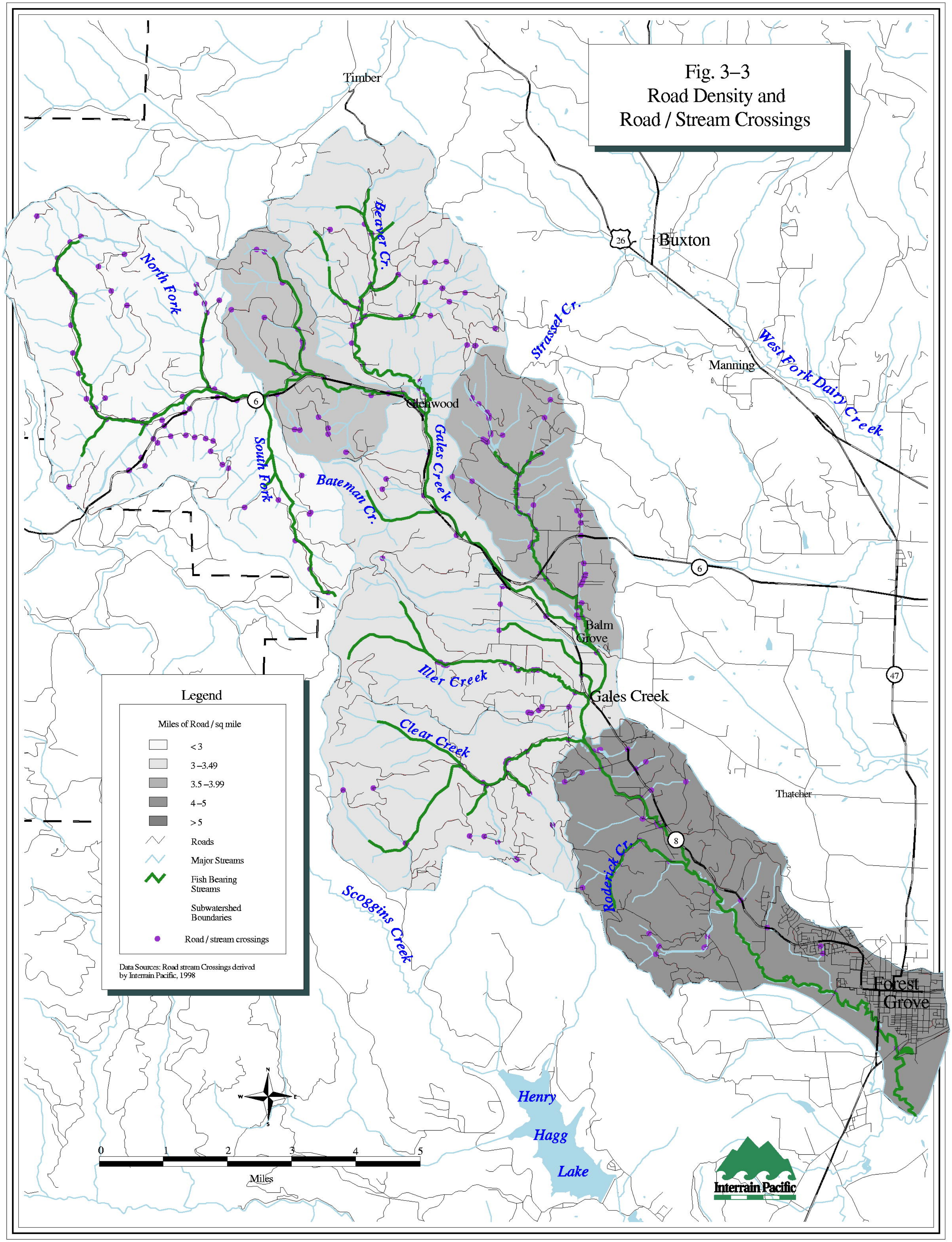

Fig. 3–3
Road Density and
Road / Stream Crossings
Timber
Buxton
26
Manning
West Fork Dairy Creek
Strassel Cr.
North Fork
Beaver Cr.
South Fork
Glenwood
Gales Creek
Bateman Cr.
6
Balm
Grove
47
Iller Creek
Gales Creek
Clear Creek
Thatcher
8
Roderick Cr.
Scoggins Creek
Forest
Grove
Henry
Hagg
Lake
Legend
Miles of Road / sq mile
< 3
3 – 3.49
3.5 – 3.99
4 – 5
> 5
Roads
Major Streams
Fish Bearing
Streams
Subwatershed
Boundaries
Road / stream crossings
Data Sources: Road stream Crossings derived
by Interrain Pacific, 1998
0
1
2
3
4
5
Miles
Interrain Pacific

3.4 Riparian / Wetland Assessment

Riparian

Riparian vegetation functions to stabilize banks, shade streams to lower water temperature, provide habitat for wildlife, influences fish habitat, provide a food source for macroinvertebrates in the form of decomposing leaf litter, filters water and sediment and serve as a natural barrier between adjacent land uses and the stream itself. **Appendix D** has a list of riparian plant species found in the watershed.

Riparian width is an important component of the assessment process for both restoration and land management activities. Local land managers (ODF, ODA, SWCD, NRCS, USA, Metro, and Washington County) suggest different management practices using varying riparian widths (usually in 25 ft. or 50 ft. increments) according to adjacent land uses and individual management strategies.

A DEQ/ODA riparian habitat improvement study in the Tualatin River Basin was undertaken in 1993 by an Oregon State University intern. The purpose of this study was to determine the benefits and costs of improving riparian habitat at two agricultural sites, on Gales Creek and Dairy Creek. Aerial photos of the mainstem of Gales Creek were measured from the confluence to Trolley Park. The area along the stream covered by the tree canopy was used for the existing riparian zone. For example, length of canopy adjoining cropland that had a tree canopy width of 0-25 ft. Irrigation diversions, roads, ditches and adjacent land uses (i.e. pasture) were identified. Canopy width was categorized and the percentage calculated:

- length of stream adjoining pasture - 9.5 %
- length of streambank with less than 25% canopy - 14.6 %
- length of streambank adjoining cropland 0-25 ft. - 0.5 %,
- length of streambank adjoining cropland 25-50 ft. - 9.7 %,
- length of streambank adjoining cropland 50-75 ft. - 7.6 %.
- areas with canopy > 75 ft. or not suitable for restoration - 58.1 %

Land with a canopy greater than 75 ft. and areas not subject to restoration (i.e. bridges, roads and residences) were lumped together.

It was not possible from these results to determine how much of the mainstem had extensive riparian canopy. Ground truthing for this study showed that streambanks were fairly steep, the streambed was fairly wide (20-50 feet); and the stream was usually shallow. This study suggested many management practices to protect or restore riparian vegetation including: fencing, tree planting, blackberry removal, off-channel livestock watering, reducing irrigation pipe and ditch sizes, decommissioning field drains, retiring land from crop production, timber harvest or grazing uses, and limiting road construction near streams. This study is a good reference for potential restoration activities as well as costs in 1993 dollars.

For the Gales Creek Watershed assessment project, riparian width was assessed in the following manner:

- Studying 1997 aerial color slides of Gales Creek mainstem
- Developing a working map by tracing the slides onto paper and identifying significant land marks
- Tracing Gales Creek riparian vegetation of both banks onto paper
- Highlighting areas of no vegetation and measuring varying riparian widths
- Verifying riparian width in the field at nine publicly accessible road crossings

Twenty 1997 Washington County Farm Services Agency color aerial slides were studied. These aerials (flown at an elevation of 8,500 ft. with a 28mm camera lens) only cover agricultural lands in the watershed, not the forested uplands. Estimates of riparian conditions were completed for the mainstem of Gales Creek, from the confluence to RM 15.

Tracing paper was laid over each slide and the riparian areas on both banks were drawn. Major roads were also traced and identified. Each tracing overlapped the next so that, when all were taped together, a continuous map of the mainstem was completed. This map is available for review at the Council's office.

The next step was to determine the approximate scale of these tracings. Known fixed points were measured on USGS topographic 7.5 minute quadrangle maps and transferred to the tracings. Finer-scale riparian widths were measured in the field at nine road crossings and these were transferred to the tracings. The field verification at nine publicly accessible locations was conducted by an NRCS staff member and a student intern. Photos and measurements were taken of channel width and right and left upstream bank vegetation.

The GWEB assessment manual suggests using riparian width categories of: 0, less than 30 ft., greater than 30 ft., and forested riparian zone. A different set of width categories has been used to be more consistent with local management plans. These categories are:

Absent riparian vegetation	=	0
Limited riparian vegetation	=	< 25 ft.
Narrow riparian buffer	=	25 to 49 ft.
Wide riparian buffer	=	50 to 100 ft.
Extensive riparian buffer	=	> 100 ft.

Measurements are not precise. A map wheel and engineer's ruler were used to measure riparian lengths on the tracings. Field measurements were taken using measuring tapes.

The riparian area of each river mile was measured and categorized. **Table 3-4a** shows the results of these measurements. Five river miles with the poorest riparian conditions are shaded gray. For example, from Rm10 to RM11, 12% of the measured stream bank had no riparian vegetation, limited vegetation was 29%, and narrow vegetation was 29.4%. Therefore roughly 72% of the stream length had less than 50 ft. of riparian vegetation. The river miles with the least amount of vegetation should be field checked to determine the causes of the poor conditions. Riparian vegetation planting efforts could then focus on these river miles, as resources allow.

Table 3-4a. Gales Creek Mainstem Riparian Conditions

River Mile	Absent Vegetation		Limited (<25 ft)		Narrow (25-49 ft)		Wide (50-100 ft)		Extensive (>100 ft)	
	ft.	%	ft.	%	ft.	%	ft.	%	ft.	%
RM 0 - 1	469	9	436	8	369	7	603	12	3350	64
RM 1 - 2	134	5	134	5	764	26	536	18	1340	46
RM 2 - 3	335	4	804	10	1139	14	5360	67	335	4
RM 3 - 4	0	0	0	0	201	4	2071	37	3350	60
RM 4 - 5	0	0	0	0	0	0	1407	40	2111	60
RM 5 - 6	0	0	0	0	536	24	1005	44	737	32
RM 6 - 7	0	0	201	3	737	12	938	16	4087	69
RM 7 - 8	436	10	134	3	134	3	436	10	3350	74
RM 8 - 9	168	4	0	0	503	11	201	4	3685	81
RM 9 - 10	101	2	201	4	469	8	1072	19	3953	68
RM 10 - 11	503	12	1240	29	1273	29	402	9	905	21
RM 11 - 12	536	7	302	4	1005	14	2278	31	3250	44
RM 12 - 13	0	0	1072	27	2513	63	402	10	0	0
RM 13 - 14	436	10	101	2	235	5	804	18	2881	65
RM 14 - 15	0	0	0	0	0	0	1039	19	4422	81
Totals:	3118	4	4625	6	9878	13	18554	25	37756	51

In July, 1998, Ecotrust and Interrain Pacific took aerial photos (flown at 6,200 feet) of the entire watershed. The photos (and an accompanying aerial video) need to be rectified. As time and funds allow, these photos should be studied in detail to determine riparian conditions throughout the watershed. This material would be valuable to agencies or industries managing lands in the Gales Creek Watershed.

Wetlands

Most of the agricultural lands in the lower, flatter valley floor of the watershed were historically wetlands. Clay tiles and open ditches were used to drain these areas which were turned into cropland by the turn of the century. Sporadic patches of wetlands exist, mainly along the lower reaches of Gales Creek, Roderick, Clear Creek, Fir Creek, Iller Creek and Little Beaver Creek. See **Fig. 3-4** for wetlands in the watershed.

As Gales Creek flows into the Tualatin River just south of Forest Grove, it becomes part of the Tualatin River flood plain and the Fernhill Wetland system. Fernhill

Wetlands, a 160 acre wetland complex managed by USA, is located just outside the watershed boundary, at its southeastern tip. The complex currently provides habitat and forage for a variety of migratory and wintering waterfowl, as well as anadromous and resident fish and other wildlife.

USA is developing a wetlands mitigation bank instrument located near Fernhills Wetlands on 362 acres at the confluence of Gales Creek and the Tualatin River. This instrument will address the future mitigation needs for USA, its member cities, TVID and the Joint Water Commission of Washington County and is required to compensate for future necessary permitted wetland impacts. This mitigation plan will hopefully benefit the Gales Creek Watershed by improving wildlife corridors which connect the Fernhill Wetlands project, Gales Creek, and the Tualatin River. It will protect, enhance, and restore wildlife and fisheries habitat, provide additional flood plain storage, and improve water quality. This document describes in detail the types of wetland soils, plants, and animals present in the area and is an excellent reference.

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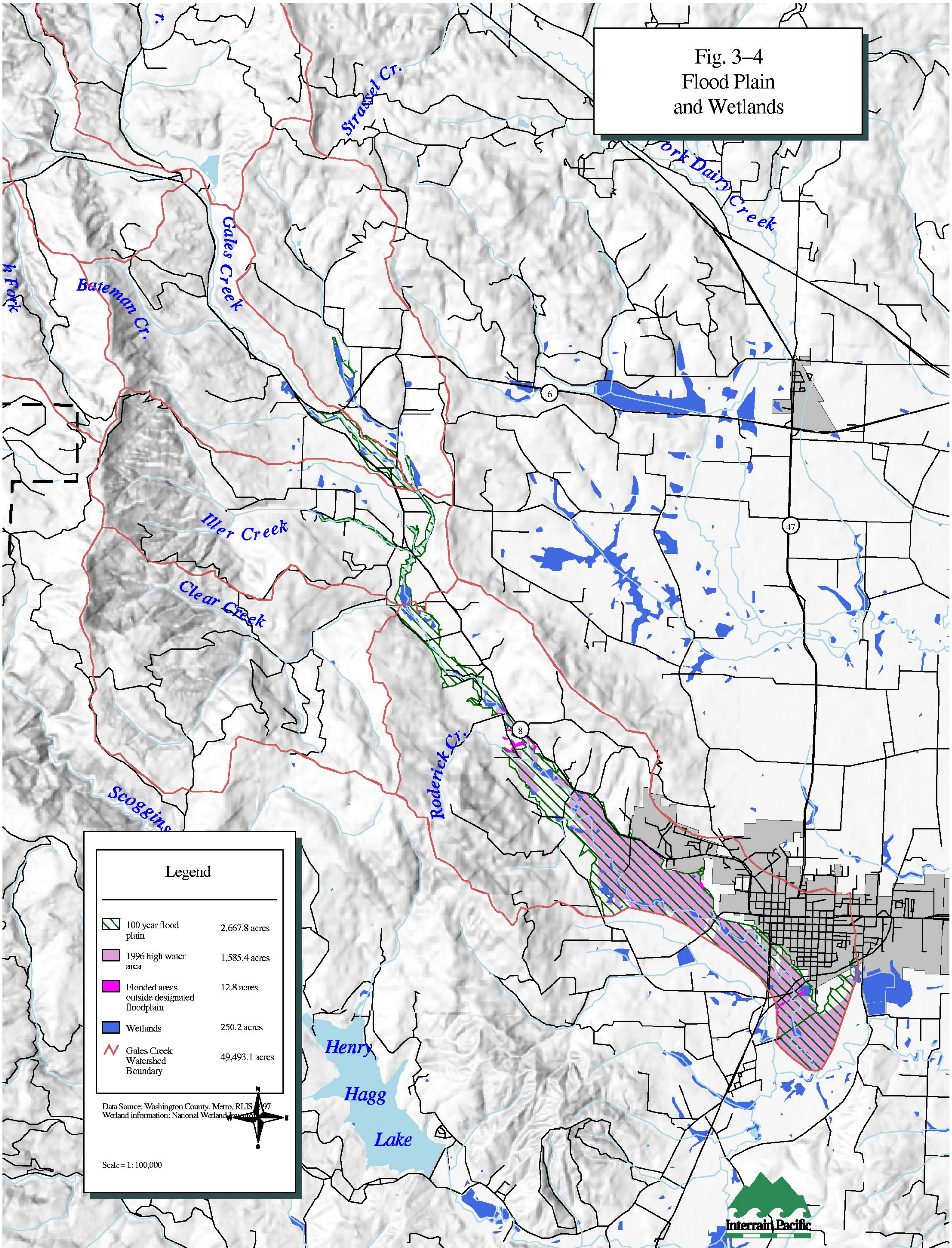
3.5 Channel Modification

For the purposes of this assessment, channel modification is any human-caused physical alteration or activity that influences the channel morphology (shape) and changes the stream from its natural state. Channel modifications can move a stream from its natural channel and flood plain, can affect water velocities causing erosion and can severely impact aquatic and riparian habitat.

Modifications include dams, water diversions, cement channels, roads, bridges, culverts, ditches, riprap, dredging, and in-stream mining. Dams reduce stream flows which store sediment, potentially increase stream temperatures, and can be barriers to fish. Channelization tends to increase stream velocity. High streamflows increase stream bank erosion, move materials (gravel, leaf and woody material) out of the system, and limit aquatic habitat and movement. During high water events (floods), channelized streams will typically attempt to return to their natural channels and flood plain. This may cause significant bank erosion which can result in damage to stream-side areas and structures.

Fig. 3–4
Flood Plain and Wetlands



Understanding how modifications affect stream morphology and knowing where these modifications occur are important in protecting wildlife habitat, in minimizing economic loss, and in prioritizing and planning restoration activities in areas where they will have the most positive impact.

Historically, channel modification activities in the watershed included:

- draining wetlands for agriculture
- using splash dams to form ponds to float logs down streams during high water events (two sites have been documented)
- building log dams for hydropower
- dynamiting naturally-formed log jams to clear a path for log driving
- mining in-stream gravel for road construction
- constructing roads and a railroad line mainly for log transport
- constructing culverts and bridges where roads cross streams
- fish hatcheries and fish ladders
- water diversions and ditches for various uses and
- removal of large woody debris and riparian vegetation

Current channel modifications consist of:

- culverts and bridges
- Balm Grove concrete structure and flashboards
- water diversions in City of Forest Grove watershed
- water diversions for irrigation
- ditches to control surface water runoff
- riprap for road maintenance
- emergency repairs of stream banks impacted by the 1996 flood events
- and other land uses impacting the riparian zone and streams

Culverts and bridges are scattered throughout the watershed. Culverts within the Tillamook State Forest and the City of Forest Grove Watershed are routinely checked to determine if they are functioning properly. ODF holds training sessions to promote culvert assessments for private woodlands owners in the watershed.

A private dam exists at RM 13 in Balm Grove along Highway 6. This structure consists of concrete sides and flash boards dropped into place in the summer months to form a swimming pool for visitors at the private streamside campground. The dam has been identified by ODFW as a fish barrier.

As previously discussed in the Fisheries section, a survey of 43 bridges and culverts was conducted by volunteers using the culvert assessment protocol provided in the GWEB assessment manual. Oregon Department of Transportation (ODOT) and Washington County maintain the bridges and culverts of most paved roads throughout the watershed. ODF and the City of Forest Grove survey and maintain culverts on their lands.

Highway 6, intersecting Gales Creek at several points, was built in 1942 to provide a rapid route to Tillamook which was feared to be a potential invasion site by the Japanese during World War II. Construction of the road required re-channelization of Gales Creek using riprap at several bends in the mainstem. Engineer's drawings and blueprints made in 1940 were provided from ODOT and illustrate the location of these channel modifications.

Riprap has also been used to stabilize banks at bridges and at emergency flood repair sites. As part of the NRCS EQIP program, technical assistance and funding was provided to stream-side residents with severe flood damage during the 1996 floods. Stream banks were stabilized with riprap and then planted with riparian vegetation.

Concrete diversion structures on Clear, Roaring, Deep and Thomas Creeks, within the City of Forest Grove watershed, have modified the stream channels by obstructing water flow and impounding water and may have resulted in barriers to fish.

In-stream gravel mining, begun around the turn of the century and still continuing sporadically, has severely impacted the mainstem of Gales Creek. This activity has resulted in channel widening, riparian vegetation removal, streambank erosion and loss of gravel habitat for fish and macroinvertebrates. Gravels are important in providing habitat for spawning, food production and hydrologic diversity. In-stream mining is an activity regulated through the Department of State Lands. If steelhead trout are listed under the ESA, such activity will likely be severely curtailed, not only in the Gales Creek Watershed but throughout the Tualatin River Basin.

References:

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3.6 Hydrology and Water Use

Hydrology

The Gales Creek Watershed contains about 49,500 acres (77.9 square miles). Streams are fed mainly by precipitation. Annual rainfall ranges from 110 inches in the higher, western parts of the watershed to about 45 inches in the lowest areas, near Forest Grove. Many streams exhibit "flashy" characteristics in which high rainfall quickly elevates water levels that drop just as quickly when storms pass. December, January and February are the wettest months. The driest months in the watershed are July, August and September. Daily discharges for Gales Creek are recorded at the USGS gage #14204530 at RM 2.4 at Old Hwy 47. The daily discharge in cubic feet per second (cfs) for 1997 is shown in **Appendix E**. For comparison, the maximum daily discharge was 2,720 cfs on November 20, and the minimum daily discharge was 8.4 cfs on August 12, 1997.

Rain-on-snow events are infrequent but can result in flood events such as in 1996. NRCS maintains a SNOTEL measuring station on Saddle Mountain, elevation 3,250 ft, which is southwest of the watershed and monitors the drainage area into Hagg Lake. Measurements taken at this site can be used to give a rough approximation of snow levels at the highest elevations in the Gales Creek Watershed.

Elevations in the watershed range from a minimum of 159 ft at the confluence with the Tualatin River to a maximum of 3,154 ft on the eastern slopes of the Coast Range. The mainstem of Gales Creek has a low gradient and is slow moving for its first 10 miles; then, above the community of Gales Creek, it rises fairly steeply. The average stream slope from the confluence to Balm Grove is 12 feet per mile. The higher mountain slopes in the watershed tend to be steep with high gradient streams, over 15%. The hillsides then transition into low rolling hills with medium gradient, sinuous streams. The landscape gradually levels off to form fluvial terraces and flat, sluggish and meandering streams which historically flowed through wetlands and ponds. Refer again to individual stream profiles, Fig 3-1a and 3-1b, in the Channel Habitat Typing section of this report.

Flood Activity

The 100-year flood plain ranges from 500 feet wide near the community of Gales Creek to 5,000 feet near Forest Grove. See Fig. 3-4 for a map of the flood plain. There are no existing flood control storage projects in the watershed. Flood events have been recorded at a USGS gaging station (#14204500) near Forest Grove from 1941-1955, then again from 1970-1980. The average peak flow measured during these years was 3,842 cfs. The five highest recorded floods are listed below:

Date of flood	Gage height	Estimated peak discharge (cfs)
02-17-49	10.90	6,410
12-21-55	11.86	6,300
01-21-72	12.95	6,260
12-13-77	12.02	6,070
01-15-74	11.90	5,740

Data for 1996 and 1997, from USA gage (#14204530, at Old Hwy 47) showed peak flows of 4,780 and 2,660 cfs respectively.

The Gales Creek mainstem is 23.5 miles long. Its tributaries range in length from 0.5 miles to 5.5 miles. **Table 3-6a** lists the seventeen tributaries of Gales Creek and their drainage areas.

Table 3-6a. Tributaries of Gales Creek
(Modified from OWRD Tualatin Basin Watermaster, 1995)

Stream Name	River Mile (RM)	Length of Stream (miles)	Drainage Area (acres)
Prickett Creek	6.53	1.5	841
Roderick Creek	7.70	2.25	664
Godfrey Creek	8.94	1.5	343
Kelly Creek	9.22	0.5	*not considered a subwatershed
Clear Creek	10.68	5.0	6109
Iller Creek	11.44	3.75	3089
Fir Creek	11.47	3.0	932
Little Beaver Creek	12.40	5.5	4393
White Creek	14.44	2.5	566
Lyda Creek	15.74	0.75	*not considered a subwatershed
Bateman Creek	16.26	2.25	892
Beaver Creek	18.00	5.0	6560
Coffee Creek	19.88	3.0	1238
Finger Creek	20.07	1.5	588
South Fork Gales Creek	20.70	3.25	2631
North Fork Gales Creek	21.60	2.25	8969 *includes Low Divide Creek
Low Divide Creek	22.76	0.75	

Land Uses

The GWEB manual describes the potential impacts of various land uses on the hydrology of a watershed. These land uses include forest land, grazed land, cropped land, and urban land. The manual directs users to divide the watershed into subwatersheds then to analyze each watershed according to the percent of lands within the land use categories.

For this assessment project, more specific land use categories were developed by Interrain Pacific from existing GIS land use data. These land uses are: evergreen forest, mixed forest land, cropland/pasture, orchards/nurseries and urban. Urban includes residential, industrial, and commercial services. The percent of each land use was determined for each major subwatershed. **Table 3-6b** shows these results. However, these percentages are approximations since some areas of the watershed have mixed use, a combination of forestry and agriculture or agriculture and rural residential. Refer also to Fig. 1-2, 1-3, 3-3 and the Sedimentation Potential Analysis in the Sediment Sources section.

By far the largest land uses in the watershed are timber harvest and associated timber road density. These activities may impact streams by potentially supplying large amounts of sediment, reducing riparian vegetation in headwaters and high elevation streams, and limiting large woody debris recruitment and shade-bearing trees. These impacts may result in increasing water temperatures, increasing the risk of mass wasting from building roads on steep slopes, and blocking fish passage at road culverts.

The GWEB assessment manual instructs users to determine the percentage of each subwatershed that have been clearcut, using aerial photos. Due to time constraints, this was not completed for this report. Color aerial photos of the watershed taken during Interrain Pacific/Ecotrust flights in July of 1998 could be used to determine acres of clearcuts.

The next largest land use, agriculture, can impact streams by channelization and removing riparian vegetation to maximize farmable lands. There is the potential for increased bank erosion, reduced stream shading because of a lack of large trees, as a sediment source if soil runs off lands and as a source of chemical pollution. Agricultural roads can also be sediment sources as well as fish barriers at culverts.

Mining is another land use that has greatly impacted stream conditions. Rock quarries and in-stream gravel removal have added to sedimentation, aquatic habitat destruction, and decreased water quality.

Urban impacts usually consist of impervious surface (concrete-covered landscapes), stormwater run-off, as a source of chemical pollution, and as sediment sources during construction activities. The urban areas of the watershed are extremely small and occur at Forest Grove, Gales Creek, Balm Grove, Glenwood, and other rural residential enclaves. Potential impacts include limited treated stormwater runoff, leaky septic systems, and chemical pollution from stream-side homes. However, as the population of Forest Grove increases, more growth-related impacts will likely be noticed.

Table 3-6b. Percent of Land Use in each Subwatershed

Sub-watershed (total acres)	Evergeen Forest	Mixed Forest Land	Cropland / Pasture	Orchards / Nurseries	Urban
Lower Gales Creek (9,250 ac)	39 %	7 %	40 %	3 %	11 %
Clear Creek (5,948 ac)	86 %	14 %	-	-	-
Iller Creek (4,597 ac)	42 %	27 %	27 %	4 %	-
Middle Gales Creek (4,134 ac)	80 %	-	14 %	-	6 %
Little Beaver Creek (4,425 ac)	48 %	8 %	19 %	25 %	-
Beaver Creek (6,440 ac)	49 %	51 %	-	-	-
Coffee Creek (3,236 ac)	64 %	33 %	-	-	3 %
South Fork Gales (2,572 ac)	100 %	-	-	-	-
Upper Gales Creek (8,879 ac)	79 %	21 %	-	-	-

Water Use

Water right holders draw their water from the streams and wells in the watershed according to the amounts and seasons stipulated on their water rights certificates. Each water right has a maximum rate at which water can be withdrawn, an annual water restriction, and a designated beneficial use. The earliest water rights in the watershed date back to 1875, on Prickett Creek. There are 305 maximum seasonal water rights with a total amount of potential diversion of 67.54 cfs.   See **Appendix E** for a summary of water rights.

Oregon Water Resources Department (OWRD) water rights for the Gales Creek Watershed list 26 beneficial use codes. See Appendix E. These uses range from irrigation, storage, domestic and municipal water supply to fish, aesthetics, sawmills, and cemeteries. Gales Creek and all of its tributaries have allocated water rights of some kind. An Oregon Graduate Institute intern organized the uses for each stream and then charted the percentage of each use. The percentage of water uses for the entire watershed is shown in Appendix E. All of these charts are available at the Council office.

The main uses for water in the watershed are: irrigation (71%), domestic water supply (6%), storage (6%), nursery (3%), municipal (3%), fish (2%), supplemental irrigation (2%), instream use (2%), livestock (1%) and an ‘other’ category (4%) (swimming, fire protection, campground, log pond, railroad, spraying, boiler, reservoir maintenance, commercial power development and sawmill).

There are no large-scale storage reservoirs (like Hagg Lake) in the watershed. There are many small reservoirs and off-channel ponds such as Dorman Pond scattered throughout the watershed. Off-channel ponds are most commonly used for supplemental irrigation, aesthetics, or fisheries. Another storage facility is irrigation tailwater recycling ponds used by container nurseries to manage their runoff. Permitted irrigation recycling ponds eliminate irrigation discharge into streams during the summer months.

There are approximately 75 diversion points in Gales Creek, mostly for irrigation purposes.

The City of Forest Grove municipal water supply comes from a 4,500 acre subwatershed which includes most of the Clear Creek drainage and its tributaries (Roaring Creek, Deep Creek, and Thomas Creek). The first water right dates back to 1917 with supplemental rights added in 1947. The City has water rights of approximately 9 cfs. There is potential for exporting this water and selling it to users outside the watershed. The watershed is also managed for potential timber harvest as a future funding source for the city.

Oregon water rights are managed by OWRD to maintain water flows to the earliest (most senior) water rights holders and to prevent over-allocation. Instream water rights designate a certain amount of water to be retained in streams at certain times of the year. Instream water rights are for fish and aquatic habitat. OWRD administers instream water rights for the state. These date back to 1966. These rights include parts of Gales Creek and Little Beaver Creek, and all of Beaver Creek, North and South Forks of Gales Creek. These instream water rights are shown in Appendix E. Some rights are used concurrently and amounts vary according to season.

Out-of-stream water withdrawals reduce stream flows that may have an adverse effect on aquatic species. Low flows during the summer months are more likely to have higher temperatures and may prevent fish passage to spawning areas. Individual or combined water rights may substantially reduce flows during the low flow season of July through October. If enough senior water rights holders used their full entitlement, some streams could be completely dewatered. The instream water rights in Gales Creek have a much newer (junior) priority date than most of the significant out-of-stream users so there is a high potential for dewatering.

Estimates of water availability at the 80% exceedance level (the amount of water available in 4 out of 5 years) was used to determine streams with potential low flow problems. OWRD has developed a computer model (WARS) to calculate water availability based on natural streamflow minus existing instream and out of stream uses. Not all the streams in the watershed have 80% exceedance estimates. The following water deficits were identified by month, in cubic feet per second (cfs):

Stream Name:	July	August	September	October
Gales Creek	-34.6	-15.1	-13.7	-6.62
Little Beaver			-.12	
Beaver Creek	-.32			
North Fork	-2.38	-1.13	-1.20	-1.05
South Fork	-.63	-.62	-.28	

References:

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3.8 Water Quality

The Department of Environmental Quality has set parameters for the quality of Oregon's waters. Water quality is influenced by a number of human activities which will have direct and indirect impacts on these parameters. Point and nonpoint sources of pollution, land use activities in riparian areas, channel disturbances that affect stream flows, substrate particle size, channel shape (i.e. instream gravel mining), and water withdrawals or diversions will have great effects on water quality.

Natural conditions such as low gradient, low summer flows and high summer temperatures make the lower mainstem of Gales Creek prone to poor water quality conditions. Lack of contiguous riparian vegetation on the mainstem and many tributaries also exacerbates water temperature problems.

The following is a summary of 1998 Department of Environmental Quality water quality information:

Water Quality limited?	Yes
DEQ Segment Identifiers:	22M-GALE0 and 22M-GALE11 (Gales Cr. and Clear Cr.)
Parameters of Concern:	Bacteria, temperature, dissolved oxygen, pH
Uses Affected:	Public and private domestic water supply, anadromous fish passage, salmonid fish rearing and spawning, resident fish and aquatic life, aesthetics, water contact recreation
Known sources:	Urban, Agriculture, Forestry

DEQ designates beneficial uses for the waters of the state under Oregon Administrative Rules Chapter 340 Div. 41. The beneficial uses listed for water in the Gales Creek Watershed are:

Public Domestic Water Supply	Private Domestic Water Supply
Industrial Water Supply	Irrigation
Livestock Watering	Anadromous Fish Passage
Salmonid Fish Rearing	Salmonid Fish Spawning
Resident Fish and Aquatic Life	Wildlife and Hunting
Fishing	Boating
Water Contact Recreation	Aesthetic Quality
Hydro Power	

Some water bodies in the state have been identified as high quality waters and are carefully managed to maintain these conditions. It is unlikely that there are high quality waters in the Gales Creek Watershed but no documents were found to substantiate this.

There are several agencies and groups that monitor water quality in the watershed. These include DEQ, EPA,USGS, USA, OWRD, SWRP and OGI. Most sampling is done to meet agency data gathering requirements while other activities serve an educational function. Water quality monitoring sites in the watershed are shown in **Fig. 3-5**.

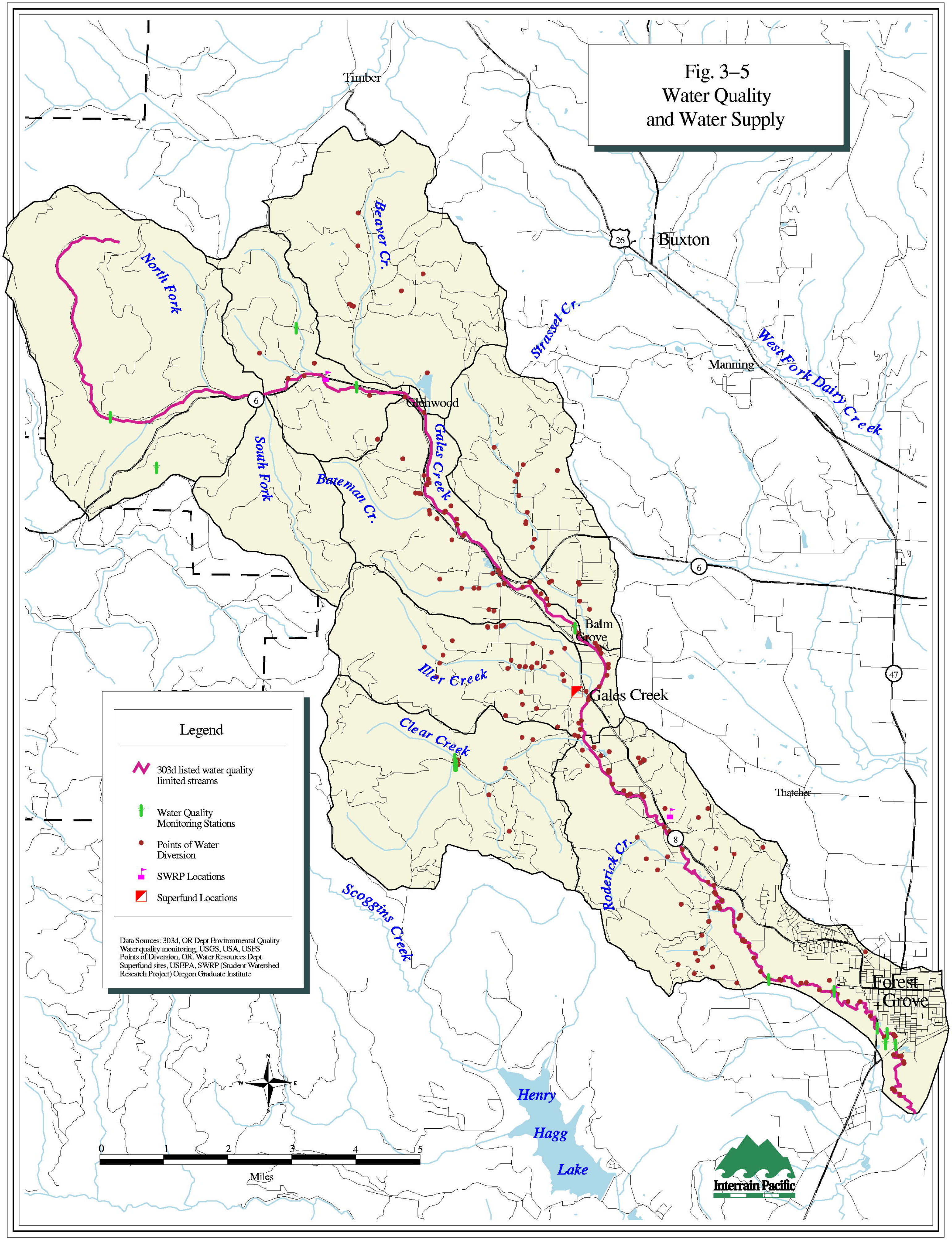

Fig. 3–5
Water Quality
and Water Supply
Timber
Buxton
26
Manning
Strassel Cr.
West Fork Dairy Creek
Beaver Cr.
North Fork
South Fork
Glenwood
6
Gales Creek
Bateman Cr.
Balm
Grove
Iller Creek
Gales Creek
47
Clear Creek
Thatcher
8
Roderick Cr.
Scoggins Creek
Forest
Grove
Henry
Hagg
Lake
Legend
303d listed water quality limited streams
Water Quality Monitoring Stations
Points of Water Diversion
SWRP Locations
Superfund Locations
Data Sources: 303d, OR Dept Environmental Quality
Water quality monitoring, USGS, USA, USFS
Points of Diversion, OR. Water Resources Dept.
Superfund sites, USEPA, SWRP (Student Watershed Research Project) Oregon Graduate Institute
0
1
2
3
4
5
Miles
N
W
E
S
Interrain Pacific

The following fourteen parameters have been tested at various monitoring sites in the watershed:

From Mouth of Gales Creek to Clear Creek: Bacteria (Summer) and Bacteria (Fall-Winter-Spring), Chlorophyll a (Summer), Dissolved Oxygen (November 1-April 30) Dissolved Oxygen (May 1-October 31), Nutrients (May 1 to October 31), pH (Summer) and pH (Fall-Winter-Spring), Sedimentation, Temperature (Summer) and Toxics (May 1-November 30).

From Clear Creek to the Headwaters of Gales Creek: pH (Fall-Winter-Spring), pH (Summer) and Temperature (Summer)

DEQ's data sources are from monitoring sites at USA locations (Site 3810012 RM 1.2, 1.7, Site 3810190 RM 19.0 and Site 3810260 RM 24.3), a USGS site near Glenwood, and DEQ Site 404175 RM 2.3. This information is downloaded from the Environmental Protection Agency (EPA)'s STORET national database. The STORET code number for Gales Creek is 3810012.

Of all of the water quality parameters tested in the Gales Creek watershed, four met the necessary criteria for 303(d) listing in 1998. **Table 3-7a** lists these parameters.

Table 3-7a. Water Quality Limited stream segments in Gales Creek Watershed
(source: DEQ 1998 Draft 303(d) list)

Location Description	Listed Parameter (Season)	Parameters of Concern
Mouth of Gales Creek to Clear Creek	Bacteria (summer) Temperature (summer) Dissolved Oxygen (May 1-Oct.31)	Water Contact Recreation (fecal coliform), Fresh water Fish Rearing 64°F (17.8C) Cool-water aquatic resources (DO<6.5mg/l)
Clear Creek to Headwaters of Gales	pH (Fall-Winter-Spring)	

Bacteria (Escherichia coli) or Water Contact Recreation (Fecal Coliform)

Microbiological contamination in a water body is measured by the presence and quantity of coliform bacteria, which serve as indicators for potential disease-causing organisms. A common source of these organisms is from domestic animal waste such as dairy and beef cattle, raw sewage from stormwater runoff or treatment overflow, and leaking septic systems. The potential for fecal coliform contamination appears high in the watershed especially during the summer months when stream flows are at their lowest.

Temperature

Elevated water temperature is detrimental to cold water fish species and other aquatic life. According to Oregon Administrative Rule(OAR) 340 41 285 (2) (b) (A) (i), the maximum temperature to protect salmon and trout is a seven-day average of the daily maximum temperature of 64°F (17.8° C).

Water temperatures on the mainstem of Gales Creek were measured by the Tualatin Basin watermaster at the USGS gauge #14204530, near Old Highway 47. Measurements were taken from May 15 to October 15, 1997. These measurements are listed in Appendix E. The mainstem of Gales Creek, at this gage, had elevated water temperatures from July to mid September. The maximum temperature recorded was 24.2°C or 75.6°F on August 6, 1997.

In the summer of 1998, the watermaster placed three temperature gages in the headwaters of Gales Creek, at Clapshaw Road, and on the lower mainstem. These measurements were taken for the 1998 summer season only. The results will be compiled by the watermaster in October, 1998.

Dissolved Oxygen (DO)

High concentrations of dissolved oxygen in the water column are essential to support aquatic life. Salmon and trout, especially in their early life stages as eggs and alevins, are very susceptible to low dissolved oxygen concentrations. Dissolved oxygen concentrations naturally vary over the course of a day due to photosynthetic processes. Daily minimum values are the best indication of instream oxygen concentrations.

pH

The pH of water is a measurement of cations and anions expressed as the negative log of the concentration of free hydrogen ions. Low pH waters (pH less than 7.0) is considered acidic while high pH waters (pH greater than 7.0) are considered basic. Persistent pH values in the range of 9.0 to 9.5 are harmful to salmon. The pH of water also affects the availability and toxicity of metals, ammonia, and other substances.

In 1994 a total maximum daily load (TMDL) was established for phosphorus (P) in Gales Creek, with a goal of 0.045mg/L total P.

Unified Sewerage Agency and the Student Watershed Research Project (SWRP) are the only entities that regularly monitor water quality in the watershed. USGS, OWRD and Pacific University have collected water quality samples sporadically.

USA Water Quality Monitoring Sites:

Unified Sewerage Agency has three monitoring sites in the Gales Creek watershed which have been used since 1980. These are:

#3810015, located at New Highway 47,
#3810038, Ritchey Rd.,
#3810190, Highway 6, Girl Scout Camp

SWRP Monitoring Sites:

Student Watershed Research Project (SWRP), Saturday Academy, Oregon Graduate Institute, has been collecting chemistry and biological data at several sites in the watershed since 1992. Sites include Dorman Pond, VanAken Rock Crusher, Trolley Park (near the Pacific University Arboretum), Ritchey Road, and Isaac Walton Park.

These data include: pH, temperature, dissolved oxygen, biochemical oxygen demand (BOD), alkalinity, phosphorus, chloride, nitrates, stream flow habitat information, and macroinvertebrate sampling.

The mainstem of Gales Creek has water quality problems due to its natural morphology, significant riparian vegetation removal, and inputs from adjacent land uses. There is no comprehensive water quality monitoring program for Gales Creek and its tributaries.

References:

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Boyd, M and D. Sturdevant, 1997. *The Scientific Basis for Oregon's Stream Temperature Standard: Common Questions and Straight Answers.* Oregon Department of Environmental Quality, Portland, OR

Doyle, M.C. and J.M. Caldwell. 1996. *Water-Quality, Streamflow, and Meteorological Data for the Tualatin River Basin, Oregon, 1991-93, Open File Report 96-173*. United States Geological Survey (USGS). Portland, OR

Kelly, V. J. 1996. *Dissolved Oxygen in the Tualatin River, Oregon, during Winter Flow Conditions, 1991 and 1992, Open File Report 95-451*. United States Geological Survey (USGS) with Unified Sewerage Agency, Portland, OR

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Unified Sewerage Agency (USA). 1997b. *Unified Sewerage Agency 1996 Annual Report to the Oregon Department of Environmental Quality – Nonpoint Source Program for Total Maximum Daily Load Requirements*. Hillsboro, OR

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3.8 Sediment Sources

Assessing sediment sources using the procedures in the draft assessment manual proved to be difficult. This section is incomplete due to little existing data and a lack of time and staffing necessary to gather information.

The draft assessment manual divided the sediment source assessment into three types of erosion processes: mass wasting (landslides), streambank erosion, and surface erosion. The manual focused on identifying and mapping the following: mass wasting, bank erosion, surface erosion, forest harvest, agriculture, grazing, mining and urban areas exist in the watershed. Various land uses were assigned adjustment factors as a means of calculating erosion potential.

The calculations and adjustment factors suggested in the draft manual did not work for agricultural lands. Agricultural areas can have a variety of crops and cropping patterns can change on a seasonal basis.

Analysis of potential sediment sources in the Gales Creek Watershed was conducted by Interrain Pacific, using GIS information. The analysis is based on how much potential sediment is contributed from mass wasting and soil erosion from various types of roads. The sediment source analysis determined the following parameters:

- number of road crossings/mile of watershed (index of riparian disturbance)
- miles of streamside roads
- sediment from surfaces of non-city roads
- sediment from surfaces of city roads
- sediment from landslides not related to roads
- sediment from cropped land

Results of the analysis are shown in **Fig. 3-6**. The darkest shaded Upper Gales Creek subwatershed appears to have the highest potential to contribute sediment to Gales Creek.

Interns from Northwest Service Academy studied the soil survey of Washington County to determine where hazardous slopes were located. These areas were tranferred onto ODF stream maps. These hand-drawn maps are available in the Council office.

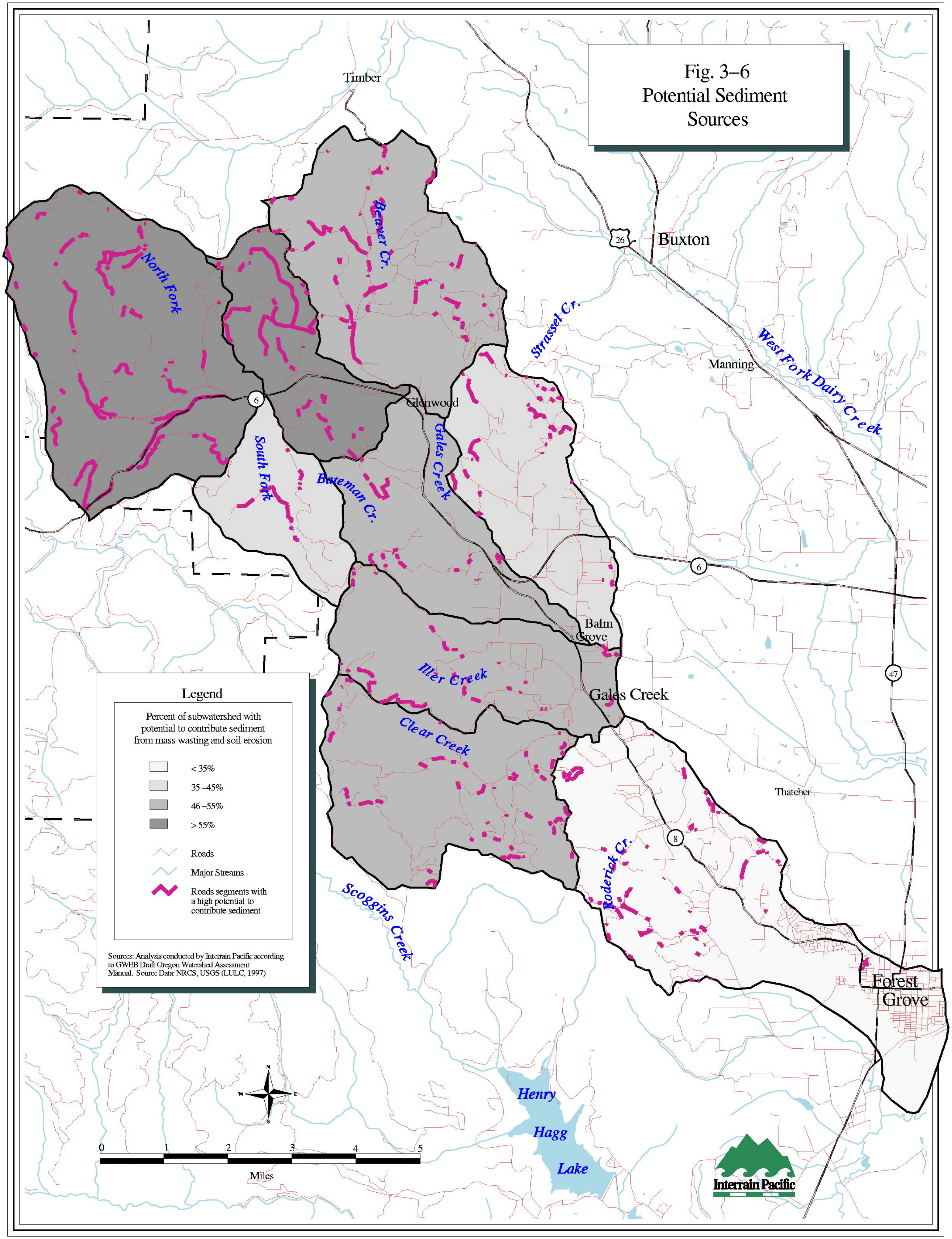

Fig. 3–6
Potential Sediment
Sources

Road failures, road related landslide risk and inaccessible or legacy roads have been identified as potential sediment sources. Legacy roads are defined as old haul roads, skid roads or railroad grades. Failures of associated side cast and/or log puncheon culverts may cause fish passage problems. ODF has developed protocols to inventory forest roads and to restore road/stream crossings. Technical assistance is available from ODFW and ODF to help willing landowners improve or protect upslope (away from streams) watershed functions.

In 1994, a slope stability and landslide hazard analysis was performed for the City of Forest Grove Watershed to determine the potential impacts of proposed timber harvest activities. A landslide hazard map was developed from the results. This information was used by the City of Forest Grove to develop its watershed management plan.

References:

Natural Resources Conservation Service. 1982. *Soil Survey of Washington County.* United States Department of Agriculture

Blackwood, T.W. 1994. *Slope stability and landslide hazard evaluation of the Forest Grove Watershed, Washington County, Oregon*. Forest Grove, OR

4.0 Watershed Condition Summary

This section identifies missing or unavailable information and suggests additional analyses and data gathering for the Gales Creek Watershed. Condition summaries for each component are also included. Finally, recommendations for improving current management activities are discussed.

Channel Habitat Types

Data Needs:
- Field verification of habitat types

Summary:

Six channel habitat types were identified in this assessment. These are:
- Low-Gradient Floodplain Channel (FP2) - large to medium stream size
- Low-Gradient Floodplain Channel (FP3) – small
- Low Gradient Constrained Channel (LC) – large or medium
- Moderate gradient, moderately constrained (MM) – large and medium
- Moderate Gradient, constrained (MC) – small, medium and large
- Steep Narrow Valley Channel (SV) - small

Enhancement strategies for low to moderate gradient habitat types differ from the steep narrow valley channel type.

Recommendations:

Restoration projects in low gradient floodplain channels and in moderate gradient channels should focus on maintaining or improving perennial riparian vegetation including trees along the mainstem and tributaries to increase bank stability. Improving riparian vegetation would recruit large woody debris, retain sediment, reduce erosion, and shade streams.

Management and enhancement in steep narrow valley channels should focus on eliminating fish barriers and improving or maintaining fish habitat. Management on steep slopes should consider mass wasting potential, sediment retention and impacts of logging roads.

Fish Distribution

Data Needs:
- Historic distribution of anadromous fish
- ODFW electro-fishing sessions or other sampling methods to determine fish presence and fish assemblages
- Intensive watershed-wide fish habitat surveys using the same methodology as the 1995 ODFW/USA Tualatin Basin study

- Redd (salmonid egg nests) counts and spawning surveys, conducted by ODFW, NW Steelheaders, and Trout Unlimited, to determine salmonid use
- Macroinvertebrate sampling throughout the watershed
- Inspection of Balm Grove Dam and water diversions in City of Forest Grove watershed (Clear Creek and tributaries) to determine if these are potential fish barriers
- A comprehensive and coordinated survey of culverts, bridges and water diversions, on both public and private lands

Summary:

The upper reaches of Gales Creek Watershed appear to be used most by anadromous and resident fish. However, the extent of this use is unknown.

The lower, flatter reaches in the watershed seem to have less fish habitat due to poor riparian conditions, high water temperatures, and high sedimentation. Part of this is from the natural hydrology of the mainstem of Gales Creek, but much of this is also due to upstream human activities that cause increased sedimentation and to significant removal of riparian vegetation.

ODFW has acknowledged in its 1992 Tualatin Basin fish management plan that stream surveys need to be conducted for: Gales Creek and Iller, Clear, Roderick, Coffee and South Fork Gales creeks. Spawning surveys, fish sampling or presence/absence surveys, macroinvertebrate surveys, and riparian assessments are crucial to understanding where and how fish actually use the watershed.

Recommendations:

Few ODFW fish habitat surveys have been conducted in the Gales Creek watershed. In 1995, ODFW and USA completed a cooperative study to describe the status and characteristics of fish populations and aquatic habitat in the urban areas of the Tualatin Basin. The purpose of this study was to identify stream reaches that would most likely benefit from habitat enhancement. The same survey procedures should be applied to the Gales Creek watershed. Not only would this survey provide valuable information, it would also provide a comparison of rural stream conditions to urban conditions.

Results of surveys should be compared to ODFW and NMFS regional benchmarks (when these are available), to determine the range of good to poor habitat quality in the watershed. Potential ESA listing of steelhead and cutthroat trout as threatened in the Tualatin River Basin may provide new habitat benchmarks. The Council can use these benchmarks to determine where restoration efforts should be targeted and what types of restoration activities can help meet fish recovery goals. Future NMFS fish recovery plans and current plans such as the Oregon Plan for Salmon and Watersheds, ODFW basin plans and ODF management plans will direct restoration activities.

Once stream surveys have been completed, streams or stream reaches should be rated according to high quality, middle condition or poor quality. Discrepancies between existing conditions and benchmarks should drive protection and enhancement efforts.

Bank stability, shading and LWD recruitment potential need to be verified on the ground, especially in agricultural areas. Riparian conditions in upland areas, especially near recent timber harvests need to be studied to determine potential adverse effects on water quality and stream shading.

A comprehensive and coordinated survey of culverts, bridges, and water diversions needs to be developed throughout the watershed, on both public and private lands. This information is needed to determine how much fish habitat is not available due to barriers. ODF currently trains private landowners on culvert maintenance and fish-friendly culvert construction practices. Potential upstream habitat needs to be surveyed above the culverts to determine if reconstruction of culverts is cost-effective and will provide passage to a significant amount of fish habitat.

Water diversions in the City of Forest Grove watershed need to be assessed for potential fish barriers. The Balm Grove dam also needs to be inspected for potential fish passage problems.

Riparian

Data Needs:

- ODFW stream surveys with riparian data
- Watershed-wide map of riparian areas with no or limited shading
- Locations of areas where streams exceed temperature standards
- Due to time constraints and lack of trained staff, estimates of canopy cover and density of riparian stands was not done. These estimates, using a densiometer and measuring tapes in the field, would be very valuable in determining the composition of riparian stands (indigenous vs. non-native plant species). Other valuable information includes the amount of stream shading, the potential of LWD material falling into the stream, also known as LWD recruitment and the potential for detrital material entering the stream system.
- Use low elevation aerial slides from Interrain Pacific for finer detail of riparian areas in both lower and upper reaches of the watershed.
- Field surveys of riparian areas in forested lands and near recent clear cuts should be conducted.
- A continuation of riparian width field measurement from agriculture to forest lands would be useful on the mainstem and tributaries.

Summary:

A study of 1993 aerial photos and 1997 aerial slides shows that riparian conditions are poorest in the lower reaches of the watershed. The width of trees and shrubs in the riparian area is minimal in the flat agricultural lands of the watershed. However, some riparian areas near steep clearcuts appear to be minimal as well. The lack of significant riparian width in many reaches of the watershed contributes to rising water temperatures, potential sedimentation, lack of LWD recruitment, and poor aquatic habitat.

Based on aerial photos, measurements and field verification, five reaches along the mainstem Gales Creek were identified as having poor riparian quality. See Table 3-4a in the Riparian Conditions section. The highest priority areas are at RM 0-3 and RM 7-14.

There is a broad range of best management practices (BMPs), depending on adjacent land uses, which could be undertaken to maintain riparian sites and improve poor areas. These include fencing, tree planting, blackberry removal, off-channel livestock watering, improve irrigation efficiency, decommissioning tile and surface drains, retiring cropland, retiring timber harvest or grazing uses, and limiting road construction near streams. However, there are many economic and social factors to consider before applying these practices. Voluntary programs which provide incentives for landowners to implement BMPs should be promoted.

Recommendations:

USA recently mapped stream shade conditions on several urban streams. This information has been scanned and is now available on GIS maps compiled by Interrain Pacific. Similar shade mapping should be done in the Gales Creek Watershed. Mapping should focus on the mainstem of Gales Creek and Clear Creek since these streams do not meet DEQ water temperature criteria.

Improving riparian areas by promoting the planting of native tree and shrub species should be a high priority of the Council. The Council, Washington County SWCD and NRCS can work with willing landowners to investigate and implement riparian vegetation plantings which are economically feasible.

Based on aerial photos, measurements and field verification, five reaches along the mainstem Gales Creek were identified as having poor riparian quality. The highest priority areas, at RM 0-3 and RM 7-14, should be investigated for tree and shrub plantings, if landowners are willing and if economically feasible.

Wetlands

Data Needs:

- Map of historic wetlands in the watershed
- Current wetlands delineation for entire watershed
- Priority wetlands and degraded wetlands have not been identified

Summary:

Historic wetlands in the watershed have been extensively drained. Except for the USA wetland mitigation bank site, potential restoration opportunities have not been extensively explored. Restoring wetlands may only be feasible near the Fernhill Wetlands mitigation site due to existing adjacent land uses.

Recommendations:

Potential wetland restoration strategies need to be developed.

Channel Modifications

Data Needs:

- Need to develop a map of channel modification locations such as Balm Grove dam, water diversion points, bank repair riprap sites, current restoration sites
- Need a comprehensive survey of culverts throughout the watershed by trained staff, during high and low streamflows, to determine potential fish passage problems.
- Need to inspect existing structures to determine impacts on streams, fish, and water quality

Summary:

Channel modifications in the Gales Creek Watershed have mainly been the result of road and bridge building, agricultural and forestry activities, water diversion structures and ditches, and in-stream gravel mining. It is unlikely that these activities will be discontinued in the near future.

Recommendations:

Developing a coordinated and comprehensive training program of fish-friendly culvert construction and maintenance throughout the watershed would improve fish passage, reduce potential sediment sources and keep roads from washing out. When new construction or repairs are necessary, fish-friendly designs should be explored and installed if economically feasible.

A more natural means of stream stabilization than rip rap should be used. For example, large woody debris could be placed along stream banks with the root wads in the stream to provide habitat. Tree trunks can also be used for habitat, food production, shelter and hydrologic diversity. Planting perennial vegetation will decrease bank erosion and eventually provide shade, wildlife habitat, and influence instream habitat by increasing future detritus accumulation and potential aquatic food production. Since stream systems are dynamic, materials will likely move downstream. Monitoring of any material placed in a stream is important.

Hydrology and Water Use

Data Needs:

- Permanently maintained water gaging stations in the headwaters and tributaries providing constant flow measurements
- Understanding the impacts of various land uses on hydrology and water quantities

- Determining the extent of illegal water diversions
- Determining the potential for over-allocation of water

Summary:

Stream flows have been measured inconsistently at a limited number of gaging stations in the watershed. Maintenance and operation of stations is subject to funding shortfalls. The gaging station at Old Highway 47, near the confluence with the Tualatin River, has provided the most stream flow data.

Recommendations:

Securing minimum stream flows for fish use should be a high priority and will probably be required if steelhead trout or other fish species are listed by NMFS. Purchasing or leasing senior water rights and dedicating them to instream use is becoming a common strategy. Water rights holders who conserve water should be rewarded and incentives should be provided to those who wish to keep water instream. The Council could promote conservation practices and support the leasing or buying of water rights for instream use.

If off-channel ponds are stocked, outlets should be screened to prevent non-native fish from being introduced into streams.

Water Quality

Data Needs:

- Understanding of water quality conditions on mainstem and tributaries
- Consistent water quality measurements on mainstem and tributaries
- In the summer of 1998, OWRD placed three temperature gages in the headwaters, at Clapshaw Road, and on the lower mainstem. These measurements were taken for the 1998 summer season only and need to be studied when available.

Summary:

Water quality is best in the highest reaches of the watershed but little is known about the tributaries. Temperature, pH, fecal coliform and DO exceed DEQ standards on the mainstem of Gales Creek. Water temperatures of tributaries within the City of Forest Grove watershed also exceed DEQ standards.

Recommendations:

Water quality monitoring efforts by local agencies and organizations (i.e. SWRP) should be supported and expanded if possible.

Presence of pesticides (including herbicides) in streams should also be studied.

Sediment Sources

Data Needs:

- Timber harvest summaries for each subwatershed
- Numbers of clearcut acres in each subwatershed
- Contribution to sediment load by rock quarry and mining activities
- Agricultural practices are so varied in the watershed that overall sediment sources were not determined. Modeling would be valuable.
- Impacts of forestry activities near streams
- Location and timing of construction projects near streams
- Impacts of abandoned (legacy) logging roads and costs to obliterate them
- Identifying slide (mass wasting) potential, determining highly erodible lands
- Field verifying eroding streambanks

Summary:

Sediment source potential from various types of roads has been analyzed by Interrain Pacific. The Upper Gales Creek subwatershed appears to have the highest potential for mass wasting and sediment contribution. Sediment contribution from other sources (i.e. agriculture, urban, bank erosion) has not been identified.

ODF has developed protocols to inventory forest roads and to restore road/stream crossings. Technical assistance is available from ODFW and ODF to help willing landowners improve or protect upslope (away from streams) watershed functions.

Recommendations:

Conduct an in-depth characterization of sediment source types (i.e. mass wasting, bank erosion, surface erosion, forest harvest, agriculture, grazing, mining and urban areas). Sediment transport should be identified, with particular focus on agricultural and floodplain areas of the watershed and the steep, logged areas crossed by dirt roads. When final GWEB sediment source procedures are available, these should be applied to conditions in the watershed. ODF is developing a state-wide mass wasting GIS data layer which may provide locations within the watershed.

Timber harvest summaries for each subwatershed were not completed for this report. Numbers of clearcut acres in each subwatershed need to be determined by looking at color aerial photos. (Use Interrain Pacific/Ecotrust 1998 low elevation aerial photos if possible)

Inaccessible or legacy roads may be a potential sediment source. Review old aerial photography to determine where inaccessible or legacy roads are located. Compare with current aerial photography. Sample sites on the ground to determine the extent of sediment source potential and to determine if improvement is feasible.

5.0 Monitoring and Evaluation

Many federal, state, local entities and private organizations have had or currently maintain monitoring sites in the watershed. For the most part these monitoring activities measure water quality and water quantity. Biological parameters are studied as well as macroinvertebrates, algal growth, and fecal coliform.

DEQ is developing monitoring protocols specifically for watershed councils. The following parameters should be monitored:

- Stream temperature
- Sediment
- Dissolved oxygen
- Specific conductivity
- Surface water toxics
- Surface water pH
- Fecal coliform bacteria
- Macroinvertebrate populations

ODFW has already developed protocols for watershed council use:

- Stream surveys
- Fish sampling

ODF also has protocols available for:

- Road assessment
- Culvert and fish passage assessment
- Placement of large woody debris

SWRP has developed a training manual for high school teachers to do both laboratory and field assessments. This manual follows guidelines set forth by DEQ, GWEB and ODFW. The manual provides a tool for sound science curriculum by giving middle through high school age students the opportunity to do basic research in local environments under quality controlled conditions. The manual tests the following:

- water quality testing
- chemistry
- vegetation
- habitat assessment
- macroinvertebrate sampling
- and other parameters

Pacific University, Oregon Graduate Institute and Portland State University have also conducted field sampling and are valuable sources of information. Internship opportunities should be explored.

Comprehensive, scientifically-valid monitoring protocols need to be developed for the Gales Creek Watershed. GWEB will be developing monitoring guidelines for watershed councils.

Appendix A: List of Contributors

Bob App, Natural Resources Conservation Service
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Tom Wolf, Trout Unlimited
David Whitaker, CH2MHill
Greg White, Fisheries Biologist, CH2MHill
Jim Young, Oregon Department of Forestry

Landowners:
The Bateman Family
Mr. Walter Parkin
Mr. Paul Sansone

Pacific University Biology Field Crew, June, 1998
Oregon Graduate Institute, Ecosystem Ecology Class, Winter Quarter, 1998

Appendix B:

Channel Habitat Typing Tables CHT-1 and CHT-2
(from the Draft 1997 GWEB Assessment Manual)

This information can be found in Appendix 5 of the Dairy-McKay Watershed Analysis, March 1999

Appendix C: Fish and Macroinvertebrate Sampling

Fish Presence List
Gales Creek
Site: Pacific University Arboretum
Sampled during Summer, 1996

Methodology: This data was compiled by members of the Tualatin River Biotic Survey team sponsored by Pacific University during the summer of 1996. Seines and D-nets were used to collect specimens dislodged by agitating the substrate upstream. Collected specimens were then placed in an alcohol solution and identified in a lab using dissecting microscopes and dichotomous keys.

<u>Taxa Present:</u>
White Crappie (*Pomoxis annularis*) - non-native
Trout smolt (*Salmonidae spp*.) - native
Torrent Sculpin (*Cottus rhotheus*) - native
Reticulate Sculpin (*Cottus perplexus*) – non-native

Macroinvertebrate Presence List
Gales Creek
Site: Pacific University Arboretum
Sampled during Summer of 1996

Methodology: This data was compiled by members of the Tualatin River Biotic Survey team sponsored by Pacific University during the summer of 1996. Seines and D-nets were used to collect specimens dislodged by agitating the substrate upstream. Collected specimens were then placed in an alcohol solution and identified in a lab using dissecting microscopes and dichotomous keys.

<u>Taxa Present:</u>
Gastropoda (snails)
Coleoptera (beetles)
Diptera (flies)
- mosquito
- midge

Ephemeroptera (mayflies)
- crawler
- clinger
- swimmer
- burrower

Plecoptera (stone flies)
- giant
- golden
- little yellow
- little green

Tricoptera (caddisflies)
- tube case
- net spinning
- free living
- micro caddis

Decapoda (rayfish)
Arachnida (spiders)

Fish Presence List
Gales Creek
Site: Rippling Waters
Sampled during Summer of 1996

Methodology: This data was compiled by members of the Tualatin River Biotic Survey team sponsored by Pacific University during the summer of 1996. Seines and D-nets were used to collect specimens dislodged by agitating the substrate upstream. Collected specimens were then placed in an alcohol solution and identified in a lab using dissecting microscopes and dichotomous keys.

Taxa Present:
Sucker (*Catostomus sp.*) - native
Prickly Sculpin (*Cottus asper*) - native
Riffle Sculpin (*Cottus gulosus*) - native
Trout smolt (*Salmonidae spp.*)
Redside Shiner (*Richardsonius balteatus*) - native
Longnose Dace (*Rhinicthys cataractae*) - native

Macro-invertebrate Presence List
Gales Creek
Site: Rippling Waters
Sampled during Summer of 1996

Taxa Present:
Bivalvia (clams, mussels)
Gastropoda
Coleoptera
Hemiptera
Diptera
- mosquito

Ephemeroptera
- crawler
- clinger
- swimmer
- burrower

Tricoptera
- tube case

Hirudinae
Oligochaeta (worms)
Amphipoda
Decapoda
Plecoptera
- giant
- golden
- net spinning
- free living

Lepidoptera (butterflies)
Odonata (dragonflies)

Appendix D: Riparian Plant Species List

Species Name	Common Name
Abies grandis	grand fir
Acer circinatum	vine maple
Acer macrophyllum	large-leaved maple
Achlys triphlla	vanilla leaf
Amelanchier alnifolia	service berry
Alnus rubra	red alder
Athyrium filix-femina	lady fem
Berberis aquifolium	Oregon grape
Clematis ligusticifolia	wild clematus
Cornus stolonifera	creek dogwood
Corylus cornuta	Western hazel
Crataegus douglassi	Western hawthome
Dentaria tenella	spring beauty
Dicentra formosa	bleeding heart
Epilobium angustifolium	fireweed
Epilobium adenocaulon	
Epilobium halleanum	
Equisetum arvense	common horsetail
Fragaria vesca	strawberry
Fraxinus latifolia	Oregon ash
Galium aparine	bedstraw
Galium trifidum	swamp bedstraw
Holodiscus discolor	ocean spray
Impatiens capensis	touch me not
Lonicera ciliosa	climbing honeysuckle
Lycopus uniflorus	
Mentha arvensis	wild mint
Mentha piperita	peppermint
Mentha puleghim	pennyroyal
Mimulus dentasus	Woods monkey flower
Mimulus moschatus	musk
Montia siberica	candy flower
Myosotis laxa	small forget me not
Oemleria cerasiformis	Indian peach
Philadelphus lewisii	mock orange
Physocarpus capitatus	nine-bark
Polypodium spp.	licorice fern
Polystichum mumitum	sword fern
Prunus emarginata	wild cherry

Riparian Plant Species

Species Name	Common Name
Pseudotsuga menziesii	Douglas-fir
Pteridium aquilinum	Western brake fern
Ranunculus orthorhynchus	bird-foot buttercup
Ranunculus repens	creeping buttercup
Ranunculus scleratus	biting buttercup
Rhamnus purshiana	cascara
Rhus diversiloba	poison oak
Rorippa curvisiliqua	yellow cress
Rorippa islandica	marsh cress
Rosa nutkana	common wild rose
Rubus parviflorus	thimbleberry
Rubus procerus	Himalaya blackberry
Rubus spectabilis	salmon-berry
Salix spp.	willow
Scutellaria lateriflora	common skull cap
Smilacina racemosa	large false Solomon's seal
Smilacina stellata	small false Solomon's seal
Solanum dulcamara	bittersweet nightshade
Spiraea douglasii	hardhack
Stachys cooleyae	giant hedge nettle
Stachys polustris	hedge nettle
Symphoricarpos albus	snow berry
Tellima grandiflora	fringe cups
Thuja plicata	Western red cedar
Tolmiea menziesii	youth-on-age
Trillium ovatum	wood lilly
Urtica lyalli	nettle
Vancouveria hexandra	inside-out flower
Veronica americana	common speedwell
Veronica scutellata	narrow-leaved speedwell
Viola glabella	wood violet
Viola langsdorfii	

Appendix E: Water Rights and Water Use

Stream Mile Index for GALES CREEK

(211400300560)

(source: OWRD, Web site, 4/98)

Mile	Description
0.00	Confluence with Tualatin River (0211400300)
	ISWR C-59523 5/25/66
1.63	Southern Pacific Railroad Bridge
1.75	Forest Grove Bypass Bridge- State Highway 47 to State Highway 8
2.36	State Highway 47 Bridge
	Gales Creek Recording Stream Gauge
3.66	Ritchey Road Bridge (CR 461)
6.53	Prickett Creek (RB-02114003000560090)
6.98	Stringtown Road Bridge (CR A-176)
7.70	Roderick Creek (RB-02114003000560110)
8.56	Roderick Road Bridge (CR 395)
	Former USGS Gage #14204500: Gales Creek near Forest Grove, Oregon (10/40 to 9/56 & 10/70 to 9/81)
8.94	Godfrey Creek (RB-02114003000560130)
9.22	Kelly Creek (LB- 02114003000560120)
10.68	Clear Creek (RB- 02114003000560150)
11.44	Iller Creek (RB-02114003000560170)
11.46	NW Gales Creek Road (CR 1312)
	Community of Gales Creek
11.47	Fir Creek (RB- 02114003000560190)
12.00	ISWR C-59509 5/25/66 above this point
12.36	Clapshaw Hill Road Bridge (CR 2037)
	Rated Staff Gage for Stream Flow
12.40	Little Beaver Creek (LB- 02114003000560200)
	ISWR C-59512 5/25/66
12.92	Parson Road Bridge

14.44	White Creek (RB-02114003000560210)
14.68	NW Wilson River Highway Bridge (State Highway 6)
15.74	Lyda Creek (RB- 02114003000560230)
16.26	Bateman Creek (RB- 02114003000560250)
17.50	Former USGS Gage #1420400: Gales Creek near Gales Creek, Oregon (10/35 to 9/45 & 10/63 to 9/70)
18.00	Beaver Creek (LB- 02114003000560280)
	Community of Glenwood
	ISWR C-59524 5/25/66
18.45	NW Timber Road Bridge (CR 374)
18.65	Wilson River Highway Bridge (State Highway 8)
19.70	Wilson River Highway Bridge (State Highway 8)
19.88	Coffee Creek (LB-02114003000560300)
20.07	Finger Creek (LB- 02114003000560305)
20.70	South Fork Gales Creek (RB- 02114003000560310)
	ISWR C-59514 5/2566
21.60	North Fork Gales Creek (LB- 02114003000560320)
	ISWR C-59513 5/25/66
22.76	Low Divide Creek (RB- 02114003000560330)
	Gales Creek Forest Park
23.20	USGS Gage #14203750: Gales Creek near Glenwood, Oregon (7/94 to present)

Beneficial Use Codes

IR	-	Irrigation
IS	-	Supplemental Irrigation
IL	-	Irrigation / Livestock
ST	-	Storage
CM	-	Commercial
DO	-	Domestic
D2	-	Two Domestics
DS	-	Domestic/Stock
DI	-	Domestic / Irrigation
MU	-	Municipal
FI	-	Fish
FP	-	Fire Protection
LV	-	Livestock
NU	-	Nursery
RC	-	Recreation
PD	-	Power Development
LP	-	Log Pond
RR	-	Railroad
SW	-	Swimming
CS	-	Campground
CE	-	Cemetery
SP	-	Spraying (to fill tank for chemical applications)
BO	-	Boiler
RM	-	Reservoir Maintenance
AS	-	Aesthetics (pond)
SM	-	Sawmill

OREGON WATER RESOURCES DEPARTMENT
14204530 Gales Creek @ Old Highway 47 near Forest Grove, OR

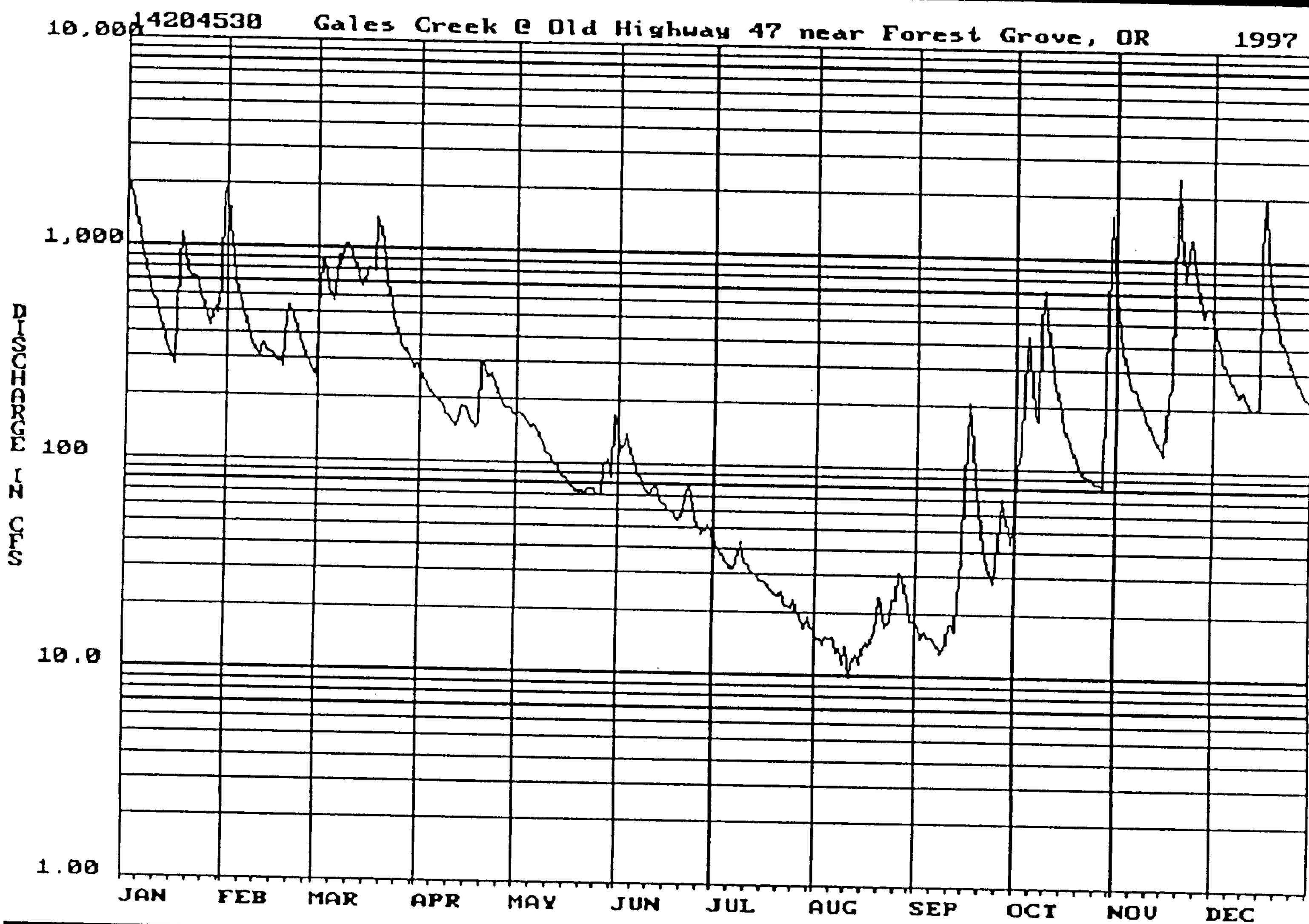
Latitude: 453039 Longitude: 1230652 Stream Mile 2.36
Drainage Area: Gage Datum: 154.73
USGS #: 14204530

DAILY DISCHARGE IN CUBIC FEET PER SECOND FOR 1997

Day	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1	2,160	1,930	505	272	178	152	44	17	19	59	696	528
2	1,880	1,270	890	252	177	115	41	15	17	100	477	461
3	1,670	899	807	237	166	127	39	15	15	122	372	401
4	1,390	698	663	221	163	143	36	14	17	260	312	352
5	1,190	576	573	211	153	117	34	16	16	437	265	314
6	959	495	623	206	154	101	33	15	16	274	249	285
7	812	449	916	199	147	93	33	15	15	188	247	266
8	698	391	887	189	135	86	35	13	14	175	217	249
9	605	351	1,060	175	125	79	43	13	13	529	197	233
10	538	319	1,050	166	117	74	36	11	14	714	184	249
11	477	303	938	158	110	72	34	14	17	508	168	231
12	416	360	821	150	102	76	32	10	18	363	157	216
13	364	333	752	160	98	79	31	11	17	280	146	205
14	328	325	677	189	93	68	31	13	24	226	136	203
15	298	311	725	186	88	64	29	11	39	190	127	211
16	282	298	825	169	86	62	29	14	84	163	122	1,120
17	516	293	827	156	80	60	28	14	213	146	233	1,950
18	1,150	277	780	148	77	58	27	14	132	135	256	1,100
19	937	476	1,430	156	74	55	25	16	91	122	810	729
20	777	534	1,230	305	74	53	25	16	64	110	2,470	608
21	726	486	879	280	74	59	25	25	49	102	1,470	522
22	733	429	694	258	71	71	25	21	38	97	847	444
23	672	380	570	269	75	78	22	17	34	95	895	404
24	601	340	481	236	76	63	22	19	31	93	1,270	365
25	535	311	417	217	75	55	22	24	28	89	1,050	330
26	476	291	370	201	71	49	23	23	44	86	791	302
27	429	270	346	192	71	47	20	32	73	87	612	282
28	520	250	345	186	97	49	18	30	62	82	549	261
29	489	------	305	186	106	52	17	26	50	269	609	245
30	645	------	282	175	86	46	19	22	44	1,040	612	232
31	1,820	------	290	------	173	------	18	19	------	1,630	------	219
TOTAL	25,093	13,645	21,958	6,105	3,372	2,303	896	535	1,308	8,771	16,546	13,517
MEAN	809	487	708	204	109	76.8	28.9	17.3	43.6	283	552	436
MAX	2,160	1,930	1,430	305	178	152	44	32	213	1,630	2,470	1,950
MIN	282	250	282	148	71	46	17	10	13	59	122	203
AC-FT	49,770	27,060	43,550	12,110	6,690	4,570	1,780	1,060	2,590	17,400	32,820	26,810

YEAR 1997 TOTAL 114,049 MEAN 312 MAX 2,470 MIN 10 AC-FT 226,200

* Incomplete Record
Max on 11/20 @ 1100: GH 16.64 = 2720 cfs
Min on 08/12 @ 1015: GH 0.70 = 8.4 cfs
Source Agency: Tualatin Basin Watermaster


14204530
Gales Creek @ Old Highway 47 near Forest Grove, OR
1997
10,000
1,000
100
10.0
1.00
DISCHARGE IN CFS
JAN
FEB
MAR
APR
MAY
JUN
JUL
AUG
SEP
OCT
NOV
DEC

Period of Record: 5/15 through 10/15
MAX. 24.2 Aug 6 MIN. 9.6 Oct. 11

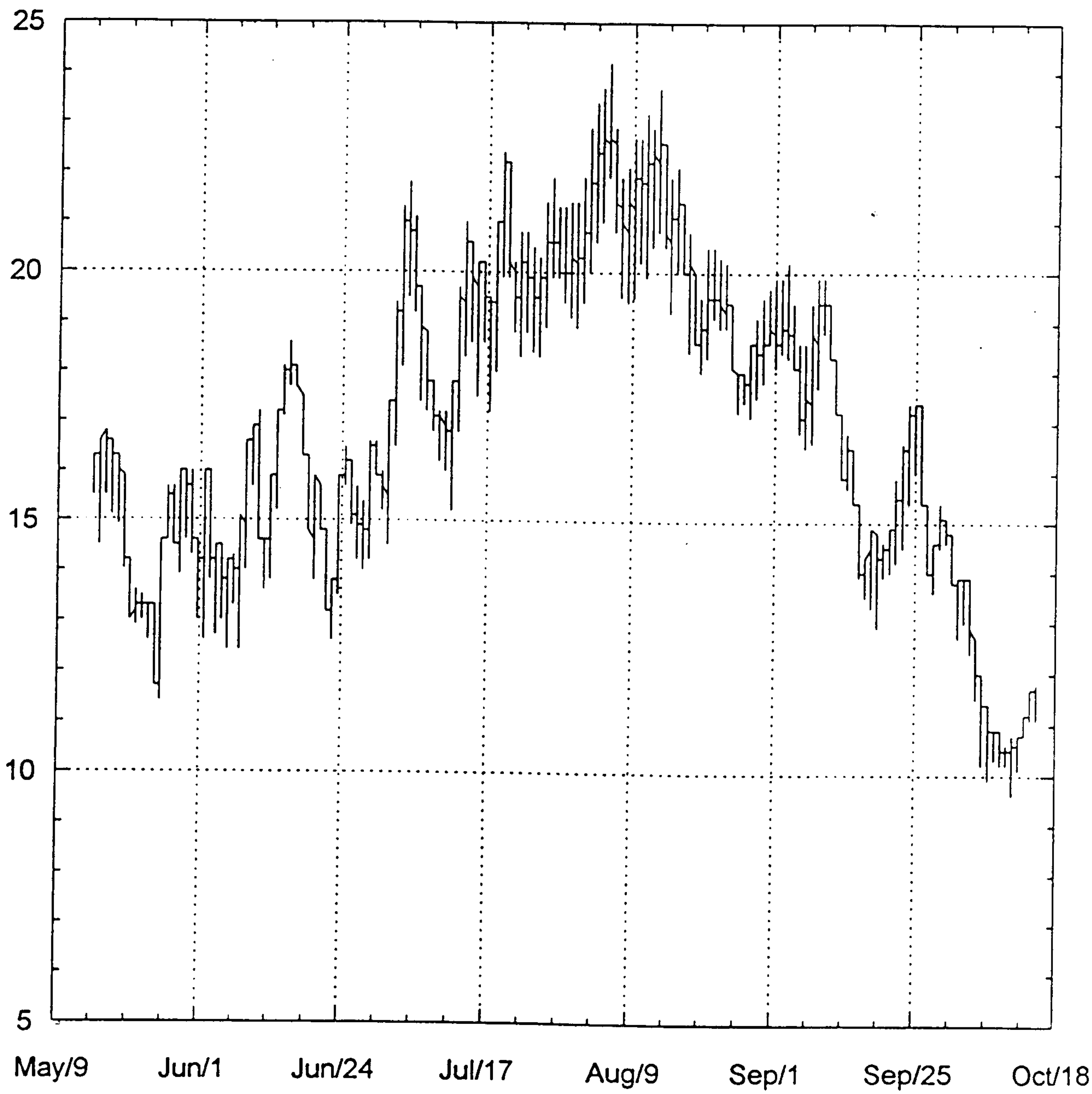
Source Agency: Tualatin Basin Watermaster
* = Partial Record

TEMPERATURE, WATER (DEG. C), MAY TO OCTOBER 1997

Day	May Max	May Min	May Mean	June Max	June Min	June Mean	July Max	July Min	July Mean
1				14.6	13.0	13.7	16.0	15.2	15.6
2				16.0	12.6	13.8	17.4	14.5	15.8
3				16.0	13.8	14.6	19.4	16.5	17.8
4				14.5	12.7	13.5	21.3	18.1	19.7
5				14.5	13.0	13.7	21.8	19.5	20.6
6				14.2	12.4	13.3	21.1	19.2	20.2
7				14.3	13.3	13.8	19.7	17.4	18.7
8				15.1	12.4	13.6	18.8	17.2	17.9
9				16.6	14.0	15.1	17.8	16.8	17.2
10				16.9	15.7	16.4	17.2	16.2	16.7
11				17.2	14.6	16.0	17.2	16.0	16.7
12				14.6	13.6	14.2	17.8	15.2	16.6
13				15.9	13.8	14.7	19.7	16.8	18.2
14				17.2	15.2	16.0	21.0	18.3	19.6
15	*16.3	*15.5	*16.0	18.1	17.1	17.6	20.6	18.6	19.6
16	16.6	14.5	15.6	18.6	17.7	18.1	20.2	17.5	19.1
17	16.8	15.5	16.3	18.1	17.7	17.9	20.2	18.6	19.4
18	16.6	15.1	15.9	17.5	16.3	16.9	19.5	17.2	18.6
19	16.3	14.9	15.7	16.3	14.8	15.4	21.0	18.0	19.4
20	15.9	14.0	14.8	15.9	13.8	14.8	22.4	19.9	21.1
21	14.2	13.0	13.5	15.7	14.8	15.1	22.2	19.9	20.7
22	13.6	12.9	13.2	14.8	13.2	13.8	20.2	18.8	19.5
23	13.5	13.0	13.3	13.8	12.6	13.1	20.8	18.3	19.5
24	13.3	12.6	13.1	15.9	13.5	14.5	20.8	18.8	19.8
25	13.3	11.7	12.4	16.5	15.7	16.0	20.5	18.4	19.5
26	14.6	11.4	12.5	16.2	14.9	15.3	20.3	18.3	19.3
27	15.7	14.6	15.3	15.7	14.2	15.0	21.4	18.9	20.1
28	15.7	14.5	15.0	15.4	14.0	14.8	21.9	19.9	20.8
29	16.0	13.9	14.6	16.6	14.2	15.2	21.3	19.9	20.5
30	16.0	14.6	15.2	16.6	15.9	16.2	21.3	19.4	20.1
31	16.0	14.3	15.1				21.4	19.1	20.1
Month	*16.8	*11.4	*14.5	18.6	12.4	15.1	22.4	14.5	19.1

Day	August Max	August Min	August Mean	September Max	September Min	September Mean	October Max	October Min	October Mean
1	21.4	18.9	20.1	19.7	18.6	19.1	14.8	13.9	14.5
2	21.9	19.4	20.4	19.9	18.1	18.9	13.9	12.7	13.3
3	22.9	20.0	21.2	19.9	18.4	19.0	13.9	13.0	13.5
4	23.4	20.6	21.8	20.2	18.3	19.1	13.9	12.4	13.0
5	23.7	21.0	22.1	19.4	18.3	18.8	12.9	11.5	12.0
6	24.2	21.9	22.8	18.6	16.8	17.6	12.0	10.2	10.9
7	22.9	20.8	21.8	18.6	16.5	17.4	11.4	9.9	10.5
8	21.9	19.5	20.6	19.4	16.6	17.8	10.9	10.3	10.6
9	22.1	19.4	20.5	19.9	17.7	18.7	10.9	10.2	10.5
10	22.7	19.5	21.0	19.9	18.8	19.3	10.6	10.2	10.4
11	22.7	20.2	21.3	19.4	18.4	19.0	10.8	9.6	10.2
12	23.2	19.9	21.4	18.3	17.4	17.8	10.8	10.1	10.3
13	22.9	20.5	21.6	17.2	15.9	16.5	11.1	10.8	10.9
14	23.7	20.8	22.1	16.8	15.7	16.2	11.7	11.1	11.2
15	22.6	20.5	21.2	16.5	15.4	15.7	*11.8	*11.1	*11.5
16	21.9	19.2	20.4	15.4	13.9	14.2			
17	22.1	20.0	21.0	14.3	13.5	13.9			
18	21.4	20.0	20.6	14.8	13.3	14.0			
19	20.8	18.4	19.6	14.9	12.9	13.8			
20	20.2	18.6	19.2	14.6	13.9	14.2			
21	19.5	18.0	18.7	14.9	14.0	14.5			
22	20.5	18.3	19.3	15.9	14.2	15.0			
23	20.5	19.1	19.6	16.6	14.5	15.6			
24	20.3	18.9	19.4	17.4	15.4	16.4			
25	20.2	18.9	19.4	17.4	16.0	16.9			
26	19.4	18.1	18.9	17.4	15.4	16.2			
27	18.1	17.2	17.8	15.4	14.0	14.4			
28	18.0	17.4	17.7	14.6	13.6	14.0			
29	18.6	17.1	17.9	15.4	14.5	14.9			
30	19.1	17.5	18.3	15.1	14.6	14.9			
31	19.5	17.8	18.6						

Gales Creek at Hwy 47 near Forest Grove, OR
Stream Mile 2.4
1997



Temperature - Degrees Celsius
Source Agency - Tualatin Basin Watermaster

Percentage of Water Allocations in Gales Creek Watershed during Summer
(T. Breinlinger, from OWRD 1998 water rights of record)