Seven Basins Watershed Assessment

Prepared for:
Seven Basins Watershed Council

Prepared by:
Environmental Management Services, Inc.
1150 Knutson Road, Suite 4
Medford, Oregon 97504-4157

February 27, 2004

PREFACE

The purpose of this watershed assessment is threefold. First, it provides a compilation of basic information regarding the environmental characteristics of the Seven Basins Watershed. Secondly, it identifies data gaps and makes recommendations for the development of action plans that will address the data gaps. These two goals are typically developed and presented in most watershed assessments. However, the Seven Basins Watershed Council envisioned an assessment that was more than just a compilation of facts; they wanted a document that could be used to educate themselves and other stakeholders in the watershed. Thus, the third purpose of this assessment is that it provides an introduction to some of the basic physical, chemical, and biological processes that control factors, such as:

- Slope stability;
- Sediment Production and Transport;
- Water Quality;
- Water Quantity;
- Stream Flow;
- Groundwater Flow; and
- Surface Water/Groundwater Interaction.

While the first two items are necessary to develop an appreciation of the information that exists for the watershed, we feel the background and educational information presented is equally if not more important. This material provides a basis for understanding the processes that control and shape a watershed. This material is important for those who will be involved in

the development of specific action plans. However, it is even more critical to those who will be involved in designing monitoring programs and/or interpreting the results from such programs. A basic understanding of the processes one is attempting to evaluate is imperative. Without this knowledge it is difficult to develop sampling and testing programs that will generate meaningful results.

Longer chapters in the assessment such as Chapter 4–Hydrology and Water Uses, Chapter 5–Riparian/Wetland Assessment, Chapter 7–Sediment Sources, Chapter 9–Water Quality, and Chapter 10–Fish Assessment provide background and educational discussions related to the basic processes that control the various topics to be discussed. This information sets the stage for the discussion of how these fundamental processes influence the conditions observed in the watershed. For those readers who may not be interested in these educational sections, you are invited to move directly to sections specifically related to the watershed.

Throughout the document, attempts have been made to incorporate examples from the watershed of the different phenomena being discussed. It is intended that such an approach will interject a sense of realism, ownership, and personalization to the assessment and its readers. Through this approach it is hoped that stakeholders will be motivated to participate by volunteering and take a proactive role in improving the wellness of their watershed.

This assessment represents the information available at the time this document was prepared. The intention of the Seven Basins Watershed Council was to create an organic document that would be easily updated as new and additional information and data become available, growing in content as the community's knowledge for their watershed expands. This document was intended to inspire, motivate, and enable the community for which it was created.

ACKNOWLEDGEMENTS

The Seven Basins Watershed Council would like to thank the many people involved in preparing the assessment. Our special thanks is extended to Environmental Management Services, Inc. (EMS) for their efforts to produce a quality assessment document. We would also like to thank those individuals from various federal and state agencies who volunteered their time to review specific chapters of the assessment. Specifically, Jay Doino and Jerry Voit, ODFW; Bill Meyers and Wayne Kauzlarich, DEQ; Ivan Gall, ODWR; Jane LaFores, and Leanne Mruzik, BLM; Tim Stevens, ODA; and Dennis Turco, ODF. In addition, we would like to thank Mr. Eric Dittmer (student advisor), Laura Michelon, Amanda Pelletier, Tiffiny Manger, Alyss Brodrick, and Yoshi Takekubo from Southern Oregon University, Environmental Studies Program for their work on the assessment related to geology, riparian habitat, channel modifications, and dam removal. We would also like to thank Mr. Mark Grenbemer, OWEB for providing timely and informative reviews of the assessment document. In addition, we would like to thank the Southern Oregon Historical Society, Rogue Valley Genealogical Society, the Woodville Museum, Jackson County Libraries, Jackson County Water Master, and the owners of private historical collections which contributed to the compilation of Chapter 2: A Brief History of the Seven Basins Watershed and Appendix A: History of SBW. A special dept of gratitude is extended to those members of the Assessment Committee, Paul Howell, John Nalley, Gail Periotti, Max Bennett, and Linda Davis who gave many hours of their time to work with EMS in preparing this assessment.

CONTRIBUTORS TO THE SEVEN BASINS WATERSHED ASSESSMENT

Chapter 1
Introduction

Prepared by:
David Graham, EMS
Alyss Brodrick, SOU

Reviewed by:
Monty Bruner, EMS
Paul Howell, SBWC
John Nalley, SBWC
Gail Periotti, SBWC
Mark Grenbemer, OWEB

Chapter 2
A Brief History of the Seven Basins Watershed

Prepared by:
Linda Davis, SBWC
Max Bennett, OSU
David Graham, EMS

Reviewed by:
Katie Mosser, EMS
Paul Howell, SBWC
John Nalley, SBWC
Gail Periotti, SBWC
Mark Grenbemer, OWEB

Chapter 3
Channel Habitat Type Classification

Prepared by:
Katie Mosser, EMS
Gene Kurz, EMS

Reviewed by:
David Graham, EMS
Paul Howell, SBWC
John Nalley, SBWC
Gail Periotti, SBWC
Jane LeFores, BLM
Mark Grenbemer, OWEB

Chapter 4
Hydrology and Water Uses

Prepared by:
David Graham, EMS

Reviewed by:
Steve Strickler, EMS
Katie Mosser, EMS
Paul Howell, SBWC
John Nalley, SBWC
Gail Periotti, SBWC
Ivan Gall, OWRD
Wayne Kauzlarich, DEQ
Mark Grenbemer, OWEB

Chapter 5
Riparian/Wetlands Assessment

Prepared by:
Katie Mosser, EMS
Laura Michelon, SOU
Amanda Pelletier, SOU

Reviewed by:
Monty Bruner, EMS
Paul Howell, SBWC
John Nalley, SBWC
Gail Periotti, SBWC
Jay Doino, ODFW
Mark Grenbemer, OWEB

Chapter 6
Impact of Wildfire

Prepared by:
Katie Mosser, EMS
David Graham, EMS

Reviewed by:
Paul Howell, SBWC
John Nalley, SBWC
Gail Periotti, SBWC
Leanne Mruzik, BLM
Dennis Turco, ODF
Mark Grenbemer, OWEB

Chapter 7
Sediment Sources

Prepared by:
David Graham, EMS
Tiffiny Manger, SOU

Reviewed by:
Katie Mosser, EMS
Paul Howell, SBWC
John Nalley, SBWC
Gail Periotti, SBWC
Bill Meyers, DEQ
Jane LaFores, BLM
Mark Grenbemer, OWEB

Chapter 8
Channel Modification Assessment

Prepared by:
Katie Mosser, EMS
David Graham, EMS
Yoshi Takekubo, SOU

Reviewed by:
Monty Bruner, EMS
Paul Howell, SBWC
John Nalley, SBWC
Gail Periotti, SBWC
Jane LeFores, BLM
Mark Grenbemer, OWEB

Chapter 9
Water Quality

Prepared by:
David Graham, EMS
Katie Mosser, EMS

Reviewed by:
Monty Bruner, EMS
Paul Howell, SBWC
John Nalley, SBWC
Gail Periotti, SBWC
Bill Meyers, DEQ
Tim Stevens, ODA
Mark Grenbemer, OWEB

Chapter 10
Fish Assessment

Prepared by:
Katie Mosser, EMS

Reviewed by:
Monty Bruner, EMS
Paul Howell, SBWC
John Nalley, SBWC
Gail Periotti, SBWC
Jay Doino, ODFW
Jerry Voit, ODFW
Mark Grenbemer, OWEB

Chapter 11
Summary of Watershed Conditions

Prepared by:
Katie Mosser, EMS
David Graham, EMS

GIS Assessment Maps

Maps Created by:
Gene Kurz, EMS

Word Processing, Editing, and Document Layout

Carolyn Burrill, EMS
David Graham, EMS

TABLE OF CONTENTS

Preface ii

Acknowledgements iv

Contributors to the Seven Basins Watershed Assessment v

List of Tables ix

List of Figures xii

Chapter 1 Introduction 1-1

Chapter 2 A Brief History of the Seven Basins Watershed 2-1

Chapter 3 Channel Habitat Type Classification 3-1

Chapter 4 Hydrology and Water Uses 4-1

- 4.1 Hydrology 4-1
- 4.2 Surface Water/Ground Water Interaction 4-20
- 4.3 Water Use 4-29
- 4.4 Hydrology Issues in the SBW 4-40

Chapter 5 Riparian/Wetlands Assessment 5-1

- 5.1 Riparian Areas 5-1
- 5.2 Wetland Characterization and Functional Assessment ... 5-20

Chapter 6 Impact of Wildfire 6-1

Chapter 7 Sediment Sources 7-1

- 7.1 Erosional Processes 7-2
- 7.2 Sediment Transport 7-10
- 7.3 Impacts of Mining 7-32

Chapter 8 Channel Modification Assessment 8-1

Chapter 9 Water Quality 9-1

- 9.1 Why Do We Monitor Water Quality? 9-1
- 9.2 Biogeochemical Cycles 9-6
- 9.3 Water Quality Parameters 9-13
- 9.4 Analysis of Available Data In The SBW 9-30

Chapter 10 Fish Assessment 10-1

Chapter 11 Summary of Watershed Conditions 11-1

TABLE OF CONTENTS (Continued)

Appendix A: History of SBW A-1
Appendix B: Vegetation of the SBW B-1
Appendix C: Channel Habitat Type C-1
Appendix D: Water Rights-Total Certificates D-1
Appendix E: Water Rights-Total Permits E-1
Appendix F: Water Rights-Applications F-1
Appendix G: Wells in the SBW G-1
Appendix H: Riparian Condition Units H-1
Appendix I: Fish Barriers I-1
Appendix J: Fish Distribution J-1

Watershed Acronyms WA-1
Watershed Glossary WG-1

LIST OF TABLES

1-1 Elevation and Precipitation Breakdown for the Subwatersheds in the Seven Basins Watershed 1-6

1-2 List of Native Vegetation Types Present in the Evans Creek Subwatershed 1-24

1-3 Threatened and Endangered Species in the Seven Basins Watershed 1-25

1-4 Distribution of Land Use Within Subwatersheds in the Seven Basins Watershed 1-28

1-5 Distribution of Land Ownership in Four Subwatersheds in the Seven Basins Watershed Based on BLM Reports 1-33

1-6 Distribution of Land Ownership for All Subwatersheds in the Seven Basins Watershed 1-34

2-1 Estimated Number of Salmon and Steelhead Migrating Over Gold Ray Dam; 1942-2002 2-35

3-1 Channel Habitat Types (CHT) 3-6

3-2 Channel Sensitivity 3-7

3-3 Channel Habitat Type Sensitivity Rating 3-8

3-4 Greatest CHT Lengths in Sub Watersheds 3-14

3-5 Total Miles and Percent of Highly Sensitive CHTs Occurring in Each Sub Watershed 3-15

3-6 Total Miles and Percent of Moderately Sensitive CHTs Occurring in Each Sub Watershed 3-17

3-7 Total Miles and Percent of Low Sensitivity CHTs Occurring in Each Sub Watershed 3-18

4-1 Recurrence Intervals 4-9

LIST OF TABLES (Continued)

4-2 Years that Major Flooding Occurred 4-12

4-3 Water Rights and Beneficial Uses of Water in the Seven Basins Watershed 4-36

4-4 Number of Wells Based on Well Logs on File with the OWRD 4-39

4-5 Peak Discharges for Gage 14359500, Evans Creek Near Bybee Springs Near Rogue River, Oregon 4-42

4-6 Selected Watershed Characteristics 4-42

4-7 Historic Diversion Ditches Used in the SBW 4-50

5-1 Buffer Strip Requirements by State 5-6

5-2 Livestock Impacts on Stream Corridors 5-9

5-3 Generalized Relationships Between Grazing Systems, Stream System Characteristics, and Riparian Vegetation Response 5-10

5-4 303(d) Listed Streams in the Seven Basins Watershed 5-17

5-5 Rogue Basin Riparian Condition Assessment; Weighted Stream Shade and Recovery Time 5-18

5-6 USFWS Classification System for Wetlands 5-23

5-7 Description of Classes and Subclasses of Wetlands 5-25

5-8 Water Regime Modifiers of Wetlands 5-26

5-9 Wetland Classification Types Found in Seven Basins Watershed 5-30

5-10 Total Number and Percent of Wetland Type Identification Codes Mapped Within Seven Basins Watershed 5-35

LIST OF TABLES (Continued)

7-1 Erosion Agents and the Types of Erosion Processes that they Generate 7-5

7-2 Erosion Types and Associated Physical Processes 7-6

7-3 Types and Miles of Roads in BLM Watershed Analysis Units (WAUs) 7-17

7-4 Percent Debris Flow Hazards for Each Subwatershed 7-31

8-1 Number of Mines and Percentage of Channel Habitat Types in Each Sub Watershed 8-9

8-2 Number of Barriers and percentage of Channel Habitat Types in Each Sub Watershed 8-10

9-1 Summary of Dissolved Oxygen Concentrations Associated with Effects on Fish in Salmonid and Non-Salmonid Waters 9-22

9-2 Water Quality Standards for Selected Parameters 9-27

9-3 303(d) Listed Streams in Seven Basins Watershed 9-31

10-1 Chinook Salmon Freshwater Habitat Requirements 10-14

10-2 Coho Salmon Freshwater Habitat Requirements 10-15

10-3 Steelhead Trout Freshwater Habitat Requirements 10-16

10-4 ODFW Habitat Benchmarks 10-17

10-5 Species Presence/Distribution and Barrier Information for Seven Basins Watersheds 10-21

10-6 Top 20 Barriers to be Modified or Removed from Seven Basins Watershed as Prioritized by RBFAT/ODFW 10-23

LIST OF FIGURES

1-1 Seven Basins Watershed Boundaries 1-2

1-2 Seven Basins Watershed Precipitation Map 1-5

1-3 Seven Basins Watershed Ecoregion Map 1-8

1-4 Upper and Lower Table Rock with the Gold Ray Dam in the Foreground 1-14

1-5 Upper Table Rock with a Portion of Sams Valley in Foreground 1-15

1-6 Seven Basins Watershed Soil Classification Map 1-18

1-7 Seven Basins Watershed Vegetation Map 1-22

1-8 Map of *Fritillaria Gentneri* 1-27

1-9 Seven Basins Watershed Land Use Map 1-29

1-10 Seven Basins Watershed Land Ownership Map 1-32

2-1 Small Placer Operation in the SBW During late 1800s 2-13

2-2 Placer Mining along Pleasant Creek, circa 1899 2-15

2-3 Dredge Operating on Pleasant Creek During the Early 1900s 2-16

2-4 Grain Harvest in Evans Valley, circa 1900 2-20

2-5 Harvesting Grain on the Neathamer Farm in Evans Valley, circa 1899 2-21

2-6 Fruit Harvest in an Orchard Located Along the Rogue River Near Table Rock 2-23

2-7 Del Rio Vineyard West of Gold Hill 2-24

2-8 Typical Small Sawmill in the SBW 2-26

LIST OF FIGURES (Continued)

2-9 Falling Timber in Upper Evans Creek Using a Springboard, Axe, and Crosscut Saw 2-27

2-10 Early Hard Tire Log Truck Used in the SBW, circa 1930s 2-28

2-11 Estimated Number of Spring Chinook Migrating Over Gold Ray Dam; 1942-2002 2-37

2-12 Estimated Number of Fall Chinook Migrating Over Gold Ray Dam; 1942-2001 2-38

2-13 Estimated Number of Coho Migrating Over the Gold Ray Dam; 1942-2001 2-39

2-14 Estimated Number of Summer Steelhead Migrating Over Gold Ray Dam; 1942-2001 2-40

2-15 Estimated Number of Winter Steelhead Migrating Over Gold Ray Dam; 1942-2002 2-41

3-1 Seven Basins Watershed Channel Habitat Type Classification Map 3-5

4-1 Schematic Representation of the Components of the Hydrologic Cycle 4-2

4-2 Channel Discharge is the Product of Channel Area Times Discharge Rate 4-6

4-3 Stream Hydrograph Used to Show Response of a Stream to Precipitation Events 4-7

4-4 Floodplain Components 4-8

4-5 Terraces in Nonincised and Incised Streams 4-11

4-6 Palmer Drought Index as Calculated by NOAA for the Period Shown 4-14

LIST OF FIGURES (Continued)

4-7 Precipitation Data Illustrating Cool/Wet and Warm/Dry Cycles Along the Oregon Coast 4-15

4-8 Climate Effects on Columbia River Chinook Salmon 4-17

4-9 Components of a Ground Water Flow System 4-18

4-10 Illustration of Ground Water Flow Paths and Aquifer Types 4-19

4-11 Gaining Streams Receive Water from the Ground Water System; Losing Streams Lose Water to the Ground Water System; and Disconnected Streams are Separated from the Ground Water System by an Unsaturated Zone 4-22

4-12 If Stream Levels Rise Higher than Adjacent Ground Water Levels, Stream Water Moves into the Streambanks as Bank Storage 4-23

4-13 Affect of Pumping a Well Along a Stream Channel 4-26

4-14 Schematic Illustration of a Hyporheic Zone 4-28

4-15 Seven Basins Watershed Water Rights – Points of Diversion 4-37

4-16 Seven Basins Watershed Water Rights – Places of Use 4-38

4-17 Hydrograph for Well Located Near Wimer, Oregon 4-44

4-18 Hydrograph for Well Located Along Evans Creek Between Rogue River and Wimer 4-45

4-19 Hydrograph for Well Located at the Town of Rogue River, Oregon 4-46

4-20 Hydrograph for a Well Located Along the Eastern Margin of Sams Valley 4-47

4-21 Hydrograph for a Well Located Along Kane Creek 4-48

LIST OF FIGURES (Continued)

4-22 Seven Basins Watershed Instream Water Rights 4-52

4-23 Dead Trees Between Evans Creek and Abandon Williams Whalen Irrigation Ditch, June 2003 4-53

4-24 Dead Trees Below Williams Whalen Irrigation Ditch Evans Creek, June 2003 4-54

5-1 Vertical Complexity 5-4

5-2 Edge and Interior Habitat 5-5

5-3 Edges: Abrupt or Gradual 5-8

5-4 Relationship Between Impervious and Surface Runoff 5-11

5-5 Canopy Vegetation 5-12

5-6 Seven Basins Watershed Wetlands Map 5-29

5-7 Percentage of Wetland Habitat Classification Within Kane Creek Sub Watershed 5-31

5-8 Percentage of Wetland Habitat Classifications Within Sams Creek Sub Watershed 5-32

5-9 Percentage of Wetland Habitat Classifications Within Snider Creek Sub Watershed 5-33

5-10 Percentage of Wetland Habitat Classifications Within Upper Evans Creek Sub Watershed 5-34

5-11 Percentage of Wetland and Deepwater Habitat Classification Greater than 1%, Found in Seven Basins Watershed 5-36

6-1 Seven Basins Fire History 6-14

6-2 Upland Area of Hull Mountain Fire, 1994. 6-15

LIST OF FIGURES (Continued)

6-3 Ramsey Creek Burn, Part of Hull Mountain Fire in 1994 6-16

6-4 Slope Failure Along Ramsey Creek from Hull Mountain Fire 6-17

6-5 Impact to Vegetation at Hull Mountain Fire 6-18

6-6 Impact on Vegetation Due to Hull Mountain Fire 6-19

6-7 Portion of Sykes Creek Burn that Occurred in the Late 1980s 6-20

6-8 Spignet Butte Burn Area 6-21

6-9 Water Chance on May Creek 6-25

6-10 Water Chance on May Creek 6-26

6-11 Possible Water Chance Location 6-27

7-1 Typical Pathways of Forest Rainfall 7-9

7-2 Movement of Sediments Along a Stream Channel 7-11

7-3 Rilling Caused by Sheet Flow Along a Spur Road Along West Evans Creek 7-14

7-4 Decomposed Granite Sediments in West Fork of Evans Creek 7-15

7-5 Seven Basins Watershed Mapped Sediment Sources and Mine Locations 7-16

7-6 Unmapped Roads in a Portion of the Seven Basins Watershed 7-19

7-7 Erosion of Granitic Soils on an Unimproved Road on the West Fork of Evans Creek 7-20

LIST OF FIGURES (Continued)

7-8 Erosion of Granitic Soils on an Unimproved Road in the West Fork of Evans Creek Drainage 7-21

7-9 Undercutting of Streambank along Evans Creek 7-25

7-10 Streambank Erosion Processes have Exposed Tree Roots 7-26

7-11 Seven Basins Watershed Debris Flow Potential Map 7-28

7-12 Slide Repair on Rock Creek 7-32

7-13 Hydraulic Mining along a Stretch of Sykes Creek 7-35

7-14 Schematic Diagram of Mercury Cycling Pathways in Aquatic Environments 7-40

7-15 Entrance to the Blue Ledge Mine on Murphy Gulch 7-44

7-16 Wimer Dam Located at River Mile 10 on Evans Creek 7-46

7-17 The Wimer Dam is Located at Right of the Photograph. The Pool Holding is Located to the Left of the Dam 7-47

7-18 Sediments in Evans Creek Up Stream of the Wimer Dam 7-48

8-1 Impact of Hydraulic ZMining on Stream Channel and Riparian Zone Above the Town of Rogue River Along Evans Creek 8-3

8-2 Bucket Dredge Used on Several Streams in the SBW 8-4

8-3 Seven Basins Watershed Channel Habitat Type and Barriers Map 8-6

8-4 Pool Downstream of Box Culvert Along West Fork Evans Creek Prior to Removal 8-12

8-5 Discharge Scour Pool Immediately Downgradient of the Box Culvert Prior to Replacement 8-13

LIST OF FIGURES (Continued)

8-6 West Fork of Evans Creek Box Culvert Replacement Project. Water from Stream was Routed through Construction in Black Pipe Shown in Photo..... 8-14

8-7 West Fork Evans Creek New Bridge Discharge Pool, Approximately Two Thirds Full of Rip Rap. Material Placed in Stream to Minimize Erosion. 8-15

8-8 Photograph of Maple Gulch Dam Prior to Removal. The Dam is in the Center of the Photograph. The Stream Channel can be seen in the Lower Third of the Photo 8-16

8-9 Maple Gulch Site After Dam Removal, June 18, 2003..... 8-17

8-10 Maple Gulch Dam Post Removal, December 31, 2002..... 8-18

8-11 Conditions at Maple gulch Dam Site in May 2003 8-19

8-12 Cross-Sectional Representation of Downstream Sediment Deposition 8-20

8-13 Ramsey Canyon Creek Culvert 8-22

8-14 Large Woody Debris (LWD) Placement 8-23

9-1 Schematic Representation of the Carbon Cycle..... 9-9

9-2 Schematic Representation of the Nitrogen Cycle 9-12

9-3 Schematic Diagram of the Phosphate Cycle 9-13

9-4 Effects of pH on Various Species Typically Present in a Watershed Ecosystem 9-23

9-5 Seven Basins Watershed DEQ 303(d) Streams..... 9-32

9-6 Seven Basins Watershed Location of Water Quality Monitoring 9-34

LIST OF FIGURES (Continued)

9-7 Temperature Profile Along Evans Creek Based on DEQ Data Collected in 1978 and 1979 9-35

9-8 Temperature Profile Along Ward Creek Based on DEQ Data Collected in 1978 and 1979 9-36

9-9 Profile of Total Coliform Along Ward Creek Based on DEQ Data Collected in 1978 and 1979 9-37

9-10 7-Day Average Maximum Temperature Values for Selected Streams 9-39

9-11 Number of Times the 7-Day Average Maximum Temperature Exceeded the DEQ Temperature Standard for Selected Streams 9-40

9-12 Diurnal Fluctuation of Temperature Over a 24-Hour Measurement Period on West Fork of Evans Creek 9-42

9-13 Inverse Relationship of Temperature and DO Over a 24-Hour Measurement Period on West Fork of Evans Creek 9-43

9-14 Relationship of pH and DO Over a 24-Hour Measurement Period in West Fork of Evans Creek 9-44

10-1 Life Cycle of Chinook Salmon 10-6

10-2 Coho Life Cycle 10-8

10-3 Steelhead Trout Life Cycle 10-10

10-4 Seven Basins Watershed Fish Distribution Map 10-20

10-5 Peak Counts of Coho/Mile in 2001 ODFW Random Spawning Survey 10-24

10-6 Estimated Size Run for Coho in 2001 ODFW Random Spawning Survey 10-25

LIST OF FIGURES (Continued)

10-7 Peak Counts of Coho/Mile in 2002 ODFW Random Spawning Survey 10-26

10-8 Estimated Run Size of Coho in 2002 ODFW Random Spawning Survey 10-27

10-9 Number of Coho Smolt Captured and Recaptured 1999-2002 in West Fork Evans Creek 10-29

10-10 Number of Steelhead Smolt Captured and Recaptured in 1999-2002 in West Fork Evans Creek 10-30

10-11 Summer Steelhead Redds/Mile in Seven Basins Watershed from 1990-1994..... 10-32

10-12 Steelhead Redds/Mile in Kane Creek and Foots Creek..... 10-33

CHAPTER 1
INTRODUCTION

Prepared by:
David L. Graham, EMS
Alyss Brodrick, SOU
Reviewed by:
Monty Bruner, PhD, EMS

DESCRIPTION OF THE SEVENS BASIN WATERSHED

Physiography

The Seven Basins Watershed (SBW) lies in southwestern Oregon and encompasses some 258,615 acres or about 405 square miles. The SBW is located in an east-west trending mountain range that connects the Cascade and Klamath Mountains. The watershed is semi-mountainous and comprises several wide valleys, such as the Evans Creek valley which cuts through the central portion of the watershed in roughly a northeast southwest direction and Sams Valley on the eastern margin of the watershed. The Rogue River flows through the southern portion of the watershed. Main tributary valleys include Kane Creek, Galls Creek, and Foots Creek south of the Rogue River and Sams, Sardine, Wards, and Evans Creeks north of the Rogue River. Elevations range from approximately 1,000 to 4,000 feet above mean sea level (amsl) with steep mountain slopes that have a heavy cover of vegetation. Figure 1-1 shows the boundaries and major features of the SBW.

Climate

The southwestern interior of Oregon is situated in the Climatic Zone 3 which is one of the more rugged portions of the state. Mountains and ridges are

INSERT FIGURE 1-1

Seven Basins Watershed Boundaries

separated by deeply incised river valleys, with most of the rivers flowing westward towards the Pacific Ocean. Much of the area lies in the rain shadow of the Coast Range to the west. However, many of the higher elevation sites receive abundant precipitation with some locations receiving in excess of 120 inches per year (Oregon State Climatological Service [OSCS], 2003). The climate in the SBW is characterized by mild, damp winters and hot, dry summers.

In southwestern Oregon, most precipitation falls during the months of November through March. As much as 75 percent of average annual precipitation falls during this five month period. Occasional summer thunderstorms cause precipitation during the warmer months, but average monthly totals during summer are quite low.

Temperature

Due to its separation from the coast, Zone 3 has greater temperature extremes than the remainder of western Oregon. During summer, it is generally the warmest part of the state. Winter temperatures can be quite cold. The average extreme low temperature in Medford during December and January is about 18°F, and an average of twenty days in January has low temperatures of 32°F or below. Medford's monthly mean temperature ranges from 72.5°F in July to 37.7°F in December, a range greater than most other stations west of the Cascades. Valley locations typically have longer growing seasons than those located at higher elevation. Most of valley locations have at least 140 days between spring and fall 32°F temperatures. The length of time between 28°F temperatures is generally more than 200 days (OSCS, 2003).

Cloud cover is greatest during the winter months, averaging more than 80 percent of total potential cloud cover during December and January. Mid-latitude storms generally produce extensive middle and high clouds, while fair

weather periods between storms often produce extensive valley fog, sometimes lasting for many days. Summers are mostly cloud-free, averaging only about 20 percent mean sky cover (OSCS, 2003).

Precipitation

Total precipitation in a given area is strongly influenced by elevation. In general, the driest areas are those at the lowest valley locations, while precipitation increases steadily at higher elevations. The driest areas in Zone 3 all receive less than 20 inches of precipitation per year. Low elevation mountains and higher peaks within the SBW average 35 to 50 inches of precipitation annually. Figure 1-2 illustrates the distribution of total precipitation across the SBW. The greatest precipitation amounts are observed in the upland areas in the northern portion of the watershed with lesser amounts measured in the valley bottoms. Table 1-1 lists mean annual precipitation for the subwatersheds within the SBW.

Snow falls nearly every winter in southwestern Oregon. In the valleys, the annual total is about 20 to 30 inches per year, although snow on the ground seldom lasts more than a few days at a time. At higher elevations, a great deal more snow is reported. At Sexton Summit (3,836 feet), for example, the average annual snowfall is about 100 inches. The frequency of snowstorms also varies widely with elevation differences. Medford, for example, has an average of three days per year with at least one inch of snow while Sexton Summit averages 30 inches (OSCS, 2003).

Temperatures in the winter months occasionally fall below freezing, and snow is common in the higher elevations. The upland portions of many of the subwatersheds are situated at elevations greater than 3,900 feet amsl (Table 1-1) indicating that they have the potential to receive a large portion of their precipitation in the form of snow.

INSERT FIGURE 1-2 (11x17)

Seven Basins Watershed Precipitation Map

Table 1-1
Elevation and Precipitation Breakdown for the Subwatersheds in the Seven Basins Watershed

Subwatershed Name	Min. Elevation (ft)	Max. Elevation (ft)	Mean Precipitation (in)
Foots Creek	986	4411	28.7
Rogue/Galls Creek	1022	4123	25.1
Rogue/Ward Creek	982	4007	28.6
Rogue/Sardine Creek	986	3370	27.9
Lower Evans Creek	985	3995	31.3
Rogue/Sams Creek	1016	3486	26.6
Rogue/Snider Creek	1105	2790	24.6
Evans Creek/Sykes Creek	1157	3694	31.6
Pleasant Creek	1108	4432	39.5
Lower West Fork Evans Creek	1452	4649	42.7
Upper West Fork Evans Creek	1837	5095	48.5
Upper Evans Creek	1452	4777	41.2

ECOREGIONS

The state of Oregon has been divided into ecoregions that have been identified based on climate, geology, physiography, vegetation, soils, land use, wildlife, and hydrology. Each ecoregion has characteristic disturbance regimes that shape the form and function of the watersheds in the region. Ecoregion boundaries have been delineated by both the U.S. Environmental Protection Agency (USEPA) and the Oregon Natural Heritage Program (ONHP). The Oregon Watershed Enhancement Board (OWEB) has generated an appendix to their *Watershed Assessment Manual* that describes the ecoregions in the state. The appendix uses USEPA Level III and Level IV ecoregion descriptions to characterize patterns within a watershed. The purpose of the descriptions is to assist watershed councils in interpreting watershed conditions.

Four ecoregions occur within the SBW. They are:

- Inland Siskiyous (78e);
- Rogue/Illinois Valleys (78a);
- Siskiyou Foothill (78b); and
- Southern Cascades (4g).

The primary ecoregion is the Inland Siskiyous. It encompasses the majority of the SBW with the exception of the eastern margin. Along the eastern margin of the watershed, the northern portion lies in the Southern Cascades Ecoregion, the central portion is in the Siskiyou Foothills Ecoregion, and the southern portion is in the Rogue/Illinois Valley Ecoregion. The delineation of the ecoregions is illustrated on Figure 1-3.

GEOLOGY

Regional Geology

The Evans Creek area is in the northwestern part of Jackson County. The study area lies on the eastern edge of the Klamath Mountains Geologic Province where it contacts with the Payne Cliffs Formation and the Cascade Mountains Geologic Province.

The Klamath Mountain Province

The Klamath Mountains Province covers 30,500 km^2 of Northern California and Southwestern Oregon, approximately between Interstate 5 and Highway 101. Ranges in the Klamath Mountains include the Trinity, South Fork, Salmon, Trinity Alps, Scott, Scott Bar, and the Marble Mountains. Peaks range between 1,500 meters (m) and 2,100 m (5,000-7,000 feet) with some peaks up to 2,740 m (9,000 feet). The province is arranged in four belts with linear bodies

INSERT FIGURE 1-3 (11x17)

Seven Basins Watershed Ecoregion Map

of ultramafic rocks between the belts. The province is interpreted to be accreted terranes, foreign bodies of rock that were plastered to the North American continent in a subduction zone (Orr & Orr, 1999). The area has been intruded by plutonic rock, ranging from necks to batholiths (Hotz, 1971).

The Payne Cliffs Formation

On the eastern edge of the Klamath Mountains Province lays the Payne Cliffs Formation, a Tertiary age group of non-marine sandstones, siltstones, and conglomerates. This formation records both the riverine system that drained the Klamath Mountains at this time and also the earliest volcanic activity of the Cascade Mountains (Orr and Orr, 1999).

The Cascade Province

The Cascade Range is a north-south trending chain of volcanoes that stretches from Mt. Garibaldi in British Columbia to Mt. Lassen south of the study area. The Province is divided into two groups, the Western Cascades (50 million years to 5 million years in age) and the High Cascades (less than 5 million years to less than 500 years in age) (Chesterman and Saucedo, 1984). Rocks of the Western Cascades are found in the study area.

Descriptive Geology

May Creek Formation

The May Creek Formation is composed of a variety of highly metamorphosed amphibolite facies metasedimentary rocks such as mica slate and mica schist. Scarcity of exposures and complex structural relationship require grouping of diverse rocks into this formation (Bartley, 1955). Rock types include mica slate, biotite quartz schist, and garnet-biotite-quartz schist as well as quartzite

and gneiss (Bartley, 1955; Page and others, 1977; Wiley and Hladky, 1990). Outcrops are usually resistant and blocky and consist of a dense, hard, greenish gray to medium gray, medium grained schist. The schistocity is not always apparent in outcrops (Bartley, 1955). As determined in thin section analysis, the rock contains 43% quartz, 21% andesine, 14% biotite, 12% clinoziosite, 6% epidote, and 4% accessory minerals (Bartley, 1955). The formation has a thickness of approximately 1,900 m (Wiley and Hladky, 1990). A minimum age for metamorphism was determined at 145 million years ago (Ma). The age of the protolith is unknown (Wiley and Hladky, 1990; Wiley, 1993).

Amphibolite

A number of authors, including Diller and Bartley, treat the amphibolite as a phase within the May Creek Formation. Wiley's scheme divides them into two formations.

The amphibolite consists of a dense, fine grained greenish black to greenish gray rock with a silky sheen on the surface (Bartley, 1955). The rock consists mainly of alternating layers of granoblastic plagioclase and amphibole (Bartley, 1955; Wiley and Hladky, 1990; Wiley, 1993). The amphibole is almost always hornblende, but sometime actinolite is found. From thin section analysis, the rock is approximately 59% hornblende, 35% plagioclase feldspar, 2% clinozoisite, and 1% quartz with trace amounts of accessory minerals such as sphene, ilmenite, magnetite, pyrite, and phyrrotite (Bartley, 1955). The rock is often folded isoclinaly and small fault drags and pytgmatic folding are also found (Bartley, 1955; Page and others, 1977).

The protolith has been described on the basis of preserved textures and bulk geochemistry as metavolcanic (Wiley, 1993). The parent rock is probably andesitic to basaltic rock interlayered with fine grained sedimentary rocks (Page and others, 1977). Donato recognized mafics sills or dikes with relict

porphyritic textures, chilled margins as well as coarse grained amphibolite and felsic gneiss with relict intrusive textures. Age dates of 145 Ma on the hornblende give a date of metamorphism (Wiley and Hladky, 1990; Wiley, 1993).

Serpentinite

These rocks are partially to completely serpentinized periodtite to dunnite that outcrop as jointed and blocky black to olive gray to dusky yellow green rocks (Page and others, 1977; Wiley and Hladky, 1990). The soil is brownish red and supports a distinctive vegetation of mountains mahogany and pine timber (Bartley, 1955). Metamorphic olivine, amphibole, pyroxene, talc, and chlorite are common minerals. The age of metamorphism is 145 Ma based on associated amphibolite (Wiley and Hladky, 1990).

Jurassic Metavolcanic Rocks

These rocks are found along the western edge of the map area in conjunction with the serpentinite and schist. They consist of metavolcanics, diabase dikes, and massive gabbro and metagabbro. The metavolcanics are basalt flows and volcanic breccias while the gabbros are layered and massive. The rocks contain plagioclase and amphibole and are locally amphibolitized (Page and others, 1977).

Galice Formation

The Galice Formation is early Mesozoic metavolcanic rocks and shales. It is mapped as the upper Triassic Applegate group, Jurassic metavolcanics, and Jurassic Shales by Page and others (1977). The Applegate group consists of greenish to gray medium to fine grained andesites and basalts. Porphyritic texture is common as are agglomerates and flow breccias. The sedimentary member of the Galice Formation is slaty shale with some coarser grained

material that may be tuffaceous. The Galice Formation also has a metavolcanic member that is made up of andesite and basalt flows with porphyritic texture, vesicles, and pillow structures. Tuffs and dacites compose the uppermost part of this member (Bayne, 1950; Page and others, 1977).

Mesozoic Intrusive Rocks

This formation consists of a two-mica quartz diorite and a hornblende gabbro (Wiley, 1993). The quartz diorite is equigranular to inequigranular fine to medium grained rock with a light gray fresh surface that weathers to a yellowish brown (Bartley, 1955). Quartz, plagioclase feldspar, biotite, and muscovite are the main minerals but magnetite, pyrite, apatite, sphene, and zircon are common accessory minerals (Bartley, 1955; Page and others, 1977). The hornblende diorite is mostly intruded into the amphibolite (Page and others, 1977). Potassium-argon (K-Ar) dates on micas give dates of 141 Ma and 138 Ma giving the rock a lower Cretaceous age (Page and others, 1977; Wiley, 1993).

Payne Cliffs Formation

In the western portion of the mapped area there is a large areal extent of Tertiary aged non-marine sandstones, shales, coal, and conglomerates of the Payne Cliffs Formation (Page and others, 1977; Wiley and Hladky, 1990; Wiley, 1993). Mudstones are gray to grayish green and may contain concretions and leaves. Coal, lignite, and calcified wood are found in rare occurrences (Wiley and Hladky, 1990). The sandstone beds are gray, green, tan, or white and are lithic to arkosic wacke. They locally cross bedded, laminated, or massive and can be tuffaceous (Bartley, 1955; Wiley and Hladky, 1990). Pebble conglomerates are clast supported, locally imbricate, or cross bedded with beds up to 5 m thick. The clasts are subrounded to well rounded with an average of diameter of 2 centimeters (cm) and a maximum

diameter of 10 cm. Wood fragments up to 50 cm in diameter are found. The clasts are mainly andesite and quartzite, with mafic volcanic, silt and mudstone, silicic volcanic, and chert clasts are also found (Wiley and Hladky, 1990). Conglomerate beds occur in many horizons but are limited in extent. Lateral gradations are very pronounced throughout the formation (Bartley, 1955). Petrified wood and leaf impressions are abundant and thin layers of platy, low-grade coal are found locally. Tuff is interbedded with the sandstones in upper part of formation. The formation has an estimated thickness of 950 feet in the southern part of area but thins to the north (Bartley, 1955).

The sediments of the Payne Cliffs Formation is interpreted have been deposited in shallow fresh or brackish water and the streams that fed these waters. Some areas were swamps as is evidenced by coal deposits (Bartley, 1955). The Payne Cliffs Formation overlies the metamorphic rocks with an angular unconformity. Basaltic intrusions cut through the formation and it is overlain by basalts and rhyolites. Fossil floras date the formation as Eocene and a K-Ar date on a dike that intrudes the formation is given as 36.9 ± 0.8 Ma (Bartley, 1955; Wiley and Hladky, 1990).

Upper and Lower Table Rock are two prominent local landmarks located near the Rogue River between the towns of Sams Valley and Central Point, Oregon. Local residents commonly refer to the buttes as the Table Rocks. These buttes stand more than 800 feet above the valley floor and owe their distinctive morphology to a cliff-forming cap of upper Miocene lava that overlies sandstone, conglomerate, and mudstone of the Payne Cliffs Formation (Hladky, 1998). The buttes have vertical faces in their upper portions that change abruptly to flat tops at their summits. This morphology is distinctive and unlike the surrounding rounded hills of the area. Figure 1-4 shows the Upper and Lower Table Rocks with the Gold Ray Dam in the foreground. Figure 1-5 is Upper Table Rock taken from Sams Valley.

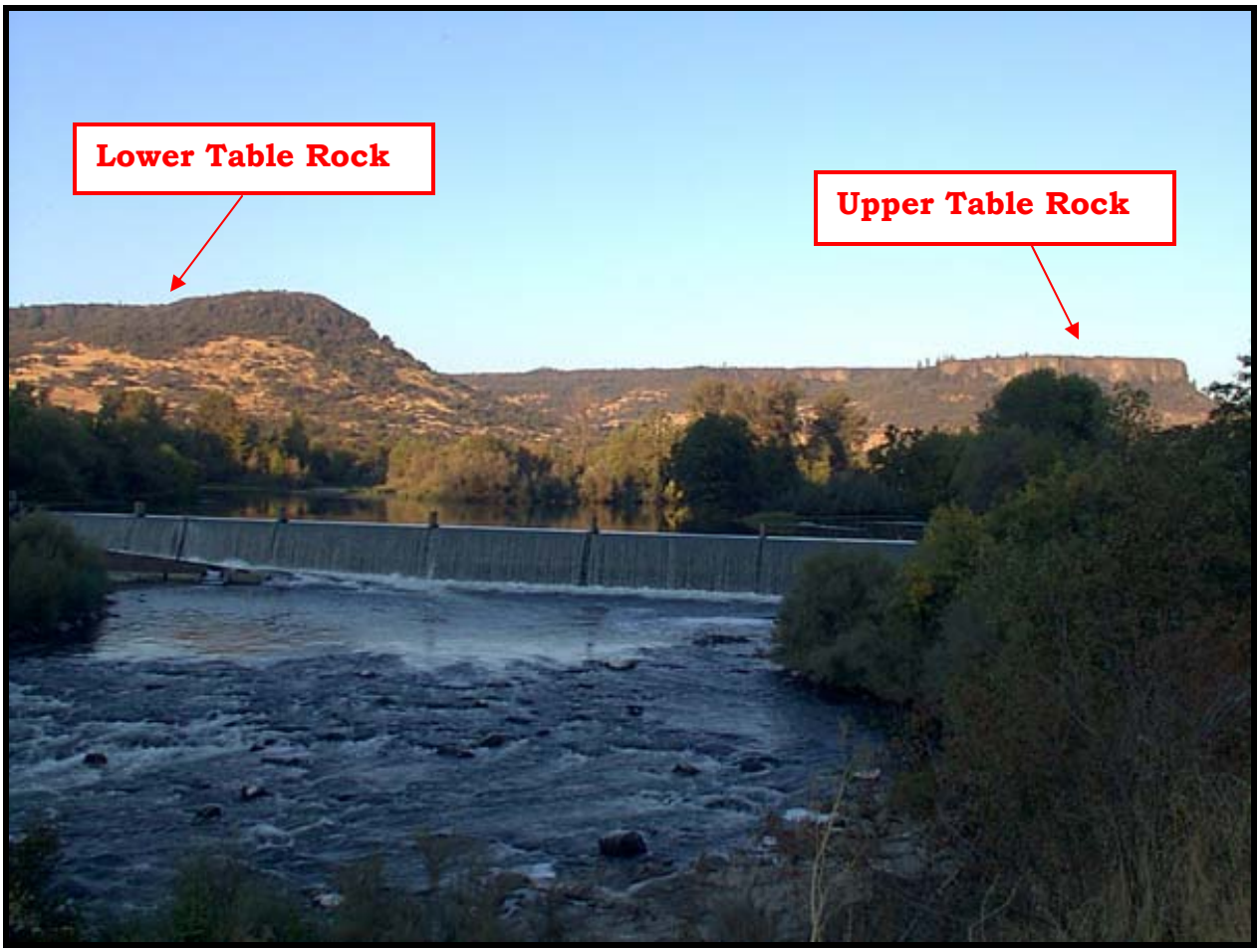


Figure 1-4
Upper and Lower Table Rock with the Gold Ray Dam in the Foreground
(Photo provided by the Linda Davis Collection)

Tertiary Volcanic Rocks

The far eastern edge of the map area is covered by upper Eocene to Lower Oligocene aged andesites, basalts, rhyolites, and volcanogenic agglomerates and breccias. The Oligocene aged rocks may be associated with the Roxy Formation of Hladky (1998) and other lithologies may be associated with the Colestin Formation (Wiley, 1993).

Figure 1-5
Upper Table Rock with a Portion of Sams Valley in Foreground
(Photo provided from the Linda Davis Collection)

The basalts are lower Oligocene to upper Eocene in age. They are fine to medium grained, olive gray to olive black with phenocrysts of plagioclase and augite in a groundmass of plagioclase. Olivine was found in some samples and sometimes has altered to chlorite (Bartley, 1955; Wiley, 1993). The outcrops are blocky with poorly developed columns. Flow breccias and vesicular zones are apparent (Bartley, 1955). The rhyolite outcrops as brown and gray rock that includes biotite and quartz phenocrysts with a total of approximately 33% phenocrysts (Bartley, 1955).

Tertiary Volcanic Tuffs

At the top of the sequence of volcanic rocks lay two thick layers of volcanic tuff mapped together. The Mosser Mountain Tuff of Hladky (1998) is lower Oligocene in age and above that is the Bond Creek Tuff. The Mosser Mountain Tuff is tan to brown plagioclase feldspar-orthoclase vitric ash flow tuff. There are very few lithic fragments and the maximum thickness is measured as 36.5 m. The Bond Creek tuff is buff to tan colored and rhyolitic to rhyodacite in composition. It is a biotite-orthoclase-quartz vitric ash flow tuff with a K-Ar date of 34.9 Ma. The thickness is approximately 210 m (Wiley, 1993).

Geologic History

The serpentinite, amphibolite, schist, and quartzite are the oldest rocks in the area. The protoliths of these formations were emplaced in the subduction trench off the coast of what would become Oregon during Mesozoic time (Orr and Orr, 1999). The schist and quartzite protoliths, which are interpreted to be fine to medium grained clastic rocks, were thrust over mafic and ultramafic volcanic rocks and metamorphism by high temperature and pressure occurred (Wiley and Hladky, 1990). During the latest Jurassic to early Cretaceous, the two-mica quartz diorite seen in the area intruded into the schists and amphibolites (Wiley, 1993).

An angular unconformity separates metamorphic rocks from Eocene age non-marine sedimentary rocks. This indicates that erosion was occurring in this area during the Cretaceous (Wiley and Hladky, 1990). Near the base of the Payne Cliffs Formation, amphibolite and schist pebbles are found showing that the two rock types were adjacent (Wiley, 1993). The Payne Cliffs Formation represents non-marine fluvial environments and swamps that were present in the area during the Eocene. The contact with younger volcanic and volcanogenic rocks is transitional. The volcanic rocks exhibit lateral variations

in lithology and texture interpreted to be from lava flows, hot and cold debris flows, autoclastic breccia, and conglomerate. In the early Oligocene, tuffs blanketed the area and gabbro dikes intruded the area. A date of 21.9 ± 0.3 Ma was taken on a sill exposed on Chicago Creek while an age of 36.9 ± 8 Ma was taken on dikes that define high angle faults along Evans Creek (Wiley, 1993).

SOILS

Figure 1-6 is a soils map for the SBW. As can be ascertained from the figure, the distribution of soils across the 405 square mile watershed is very complex. There are literally hundreds of soil types that have been mapped throughout the watershed and they are too numerous to list in this assessment. A brief generic discussion of soils for specific areas of the watershed will be presented here. For a more detailed description of the specific soils units and types please refer to Johnson (1993). Specific soils types are derived from the host rock present in the watershed. The rock types in the SBW include metamorphic schists, gneisses, quartzites, and amphibolites found in conjunction with serpentinite, granitic intrusions and volcanic flows, breccias, and tuffs. The metamorphic rock types are mapped as the May Creek Schist, an amphibolite and the Galice Formation. The May Creek Schist includes mica schists, garnet-biotite-quartz schists, gneisses, and quartzites. The amphibolite consists of alternating layers of hornblende and feldspar. The Galice formation includes a metavolcanic member with an andesite or basalt protolith and a sedimentary member of shales and mudstones. The granitic rocks are a two-mica quartz diorite and a hornblende gabbro.

INSERT FIGURE 1-6 (11x17)

Seven Basins Watershed Soil Classification Map

As discussed in the geology section, only the northern portion of the SBW has been geologically mapped. There is no coverage for the southern portion. However, the southern section of the watershed is presumed to be composed of the many of the same types of rocks observed in the northern portion.

The Bureau of Land Management (BLM) described the rock formations and soils in the Rogue-Gold Hill Subwatershed as being primarily metamorphic rocks composed of metasediments and metavolcanics (78%) with the remainder being composed of granitic rocks. The soils that have developed from the metamorphic rocks are described as being shallow, composed of silts and clays with variable amounts of rock fragments. Generally, the upper fractured bedrock has only a thin weathering rind (BLM, 2001).

The soils derived from granitic rocks are generally described as being moderately deep over decomposed bedrock and are highly erosive because of low cohesive coarse textured particles. Throughout the subwatershed, granite is found in discontinuous outcrops (less than two square miles) in the headwaters of Kane Creek, midslope along Galls Creek, the headwaters to the Left and Middle Forks of Foots Creek, midslope of Right Fork of Foots Creek, and the headwaters of Birdseye Creek (BLM, 2001).

The Evans Creek drainage cuts through several major rock types from the headwaters to its confluence with the Rogue River. The West Fork of Evans Creek heads in intrusive granitic rocks. As it moves downslope, it enters a zone of metamorphic rocks mapped as amphibole. Near the confluence with the East Fork of Evans Creek, it crosses into another metamorphic zone dominated by schist. Just east of the town of Wimer, Evans Creek crosses into another intrusive body dominated by granitic type rock. As it continues south toward the Rogue River, it meanders across bedrock composed of granitic rock and rocks associated with the Galice Formation. This formation is composed of shales and metavolcanics. Thus, soils along Evans Creek can be quite varied

and can be expected to change as the streams move across the various bedrock units along it length.

For example, the BLM described the soils in the West Fork Evens Creek subwatershed as 65% derived from granitic rocks, 25% from schists (metamorphic), and 10% from metavolcanic/metasedimentary rocks. In the watershed analysis conducted for the East Fork of Evans Creek, the geology was described as being dominated by metamorphosed volcanic rocks composed of amphibole and schists. The dominate soils types in this subwatershed were described as being formed from decomposed schists. The most extensive soils in the watershed are the Musty and Goolaway soil series. Both are described as being silty loams, moderately deep (20-40 inches), well drained, and have water erosion hazard. The Musty soils are skeletal (>35%) rock fragments in the subsoil over fractured bedrock. The Goolaway soil has a silt loam subsoil and underlain by weathered bedrock. These soils are prone to slumping and sliding, particularly on steeper slopes (>60%), and under saturated conditions (Johnson, 1993). Near the bottom of the watershed the soils are characteristically deep alluvial silt deposits.

Soils along the eastern margin of the SBW in the vicinity of Sams Valley vary also depending on the location within the valley. Soils along the western margin and to the north of Sams Valley are typically derived from metamorphic parent rock. Those soils in the central and eastern portion are composed primarily of sedimentary rock such as sandstones most likely from the Payne Cliffs Formation. Those located furthest to the east are derived from volcanic tuffs and breccias associated with Tertiary Volcanic deposits located to the east of Sams Valley area.

The soils in the immediate vicinity of the Table Rock area are derived from volcanic tuffs and breccias. The soils in the Table Rock out crop complex are derived from andesite and sandstone. Soils to the north of the Table Rock area

are from the metamorphic and granitic rocks located to the north of the Table Rocks.

A complete description of the soils in the SBW can be reviewed in Johnson (1993).

VEGETATION

The dominant vegetation zones have been mapped across the SBW. Within the watershed, 11 vegetation zones have been identified. Figure 1-7 illustrates the boundaries of the mapped zones. A brief description of dominant species present, the general ecological conditions, and upper and lower range of elevation for each zone is provided. The descriptions of the zones are from the Manual of Oregon Actual Vegetation that was prepared for the Oregon Gap Analysis Program.

Vegetation patterns within the lower elevation of the SBW are very distinct. However, agriculture has dramatically altered native vegetation patterns in many locations across the watershed. The Soil conservation Service described native vegetation within the interior valleys of Evans Creek as composed of areas of open grassland or slowly growing Oregon white oak-ponderosa pine savanna. In areas where soils are deep and well drained they may support rapidly growing ponderosa pine, mixed oak, and Pacific madrone. Tress typically found in the watershed include Oregon white oak, ponderosa pine, sugar pine, California black oak, Pacific madrone, Oregon ash, willow, and underbrush of common snowberry, Himalyan blackberry, poison oak, Pacific serviceberry, mountain brome, and Idaho fescue (Atwood and Lang, 1995).

INSERT FIGURE 1-7 (11-x17)

Seven Basins Watershed Vegetation Map

The mid-elevation portion of the watershed characterized by Douglas fir-mixed Pine-Fescue Forest, contain Douglas Fir, sugar pine, and California black oak. The understory vegetation and grasses are composed of common snowberry, Tall Oregon grape, whiteleaf manzanita, deerbrush, Idaho fescue, mountain brome, and baldhip rose.

At higher elevations within the watershed, vegetation is predominately Douglas fir, along with lesser amounts of California black oak, pacific madrone, canyon live oak, and sugar pine. In the highest portions of the watershed, vegetation is dominated by Douglas fir and includes Pacific rhododendron, salal, red huckleberry, and western hemlock (Atwood and Lang, 1995). Table 1-2 is a compilation of native species in the Evans Creek drainage.

Many noxious weeds are present throughout Southern Oregon as well as within the SBW. Noxious weeds are described by the Oregon State Weed Board as "exotic, non-indigenous, species that are injurious to public health, agriculture, recreation, wildlife, or any public or private property" (Oregon Department of Agriculture [ODA], 2003). Noxious weeds are commonly referred to as invasive or non native species. These plants are usually prevalent in areas of disturbance such as fires, construction, and the removal of riparian areas. The Oregon noxious weed list is updated annually. The ODA has a weed staff which sets statewide priorities for the funding of the control of noxious weeds and appropriate projects to achieve this.

WILDLIFE

The SBW is located within the convergence of the Cascade Mountains and the Klamath Mountains, placing it in an area of unique biodiversity and ecological transition. Many species reside within this transitional area which are endemic to this part of the state. Wildlife in the SBW includes black bear,

Table 1-2
List of Native Vegetation Types Present in the Evans Creek Subwatershed
(Atwood and Lang, 1995)

Vegetation Type	Botanical Name	Common Name
Trees	Alnus rhombifolia Nutt.	White alder
	Franxinus latifolia Benth.	Oregon ash
	Populus balsaminifera L. var. trichocarpa (T&G) Brayshaw	Black cottonwood
	Quercus kelloggii Newb.	California black oak
	Calocedrus decurrens (Torrey) Florin	Incense cedar
	Chrysolepis chrysophylla (Hook.) HJelmq.	Giant chinquapin
	Pseudotsuga menziesii (Mirbel) Frano	Douglas fir, red fir
	Abies concolor (Gord. & Glend) Lindl.	White fir
	Arbutus menziesii Pursh.	Madrone, Pacific madrone, madrono
	Quercus chyroslepis Liebm.	Canyon live oak
	Acer macrpphyllum Pursh	Big-leaf maple. Oregon maple
	Pinus lambertiana Dougl.	Sugar pine, redwood
	Quercus garryana Hook.	Garry oak, Oregon white oak
	Taxus brevifolia Nutt.	Pacific yew
Undergrowth	Ceanothus velutinus Dougl.	Mountain balm, Sticky laurel
	Ceanothus cuneatus Nutt.	Buckbrush
	Chryolepis semprivirens (Kellog)	Bush chinquapin
	Cornus nuttallii Pursh	Western flowering dogwood
	Adentostoma fasciculatum Holodiscus discolor (Hook. & Arnold) Maxim.	Chamise Oceanspray
	Corylus cornuta Marsh var. Californica (A. CC) W. Sharp	California hazelnut
	Ceanothus interrgerrimus Hook. & Arnold	Deerbrush, wild lilac
	Arctostaphylos Columbiana Piper A. patula Greene A. viscida Parry	Bristly manznaita, Green-leaved manzanita, White-leaved manzanita
	Rhus diversiloba T. & G.	Poison oak
	Quercus garryana Hook, var. breweri (Engelm.) Jepson	Brewer oak, or any low growing oak
	Symphoricarpos albu (L.) Blake S. mollis Nutt.	Snowberry, Creeping Snowberry
	Acer circinatum Pursh	Vine maple

black-tailed deer, ring-necked pheasants, blue and ruffed grouse, band-tailed pigeons, western gray squirrels, rabbit, beaver, mink, and river otter.

Many of the streams in the watershed are spawning and rearing areas for anadromous salmonids. These species include spring and fall chinook salmon, coho salmon, and winter and summer steelhead trout (Atwood and Lang, 1995). Other fish species present throughout the watershed also include resident rainbow trout, cutthroat trout, carp, redside shiner, klamath small-scale sucker, mosquitofish, speckled dace, reticulate sculpin, and anadromous Pacific lamprey.

THREATENED AND ENDANGERED SPECIES

The SBW contains various plant and animal species that are considered threatened or endangered both on the federal and state level. A list of these species has been provided by the Medford District BLM Office and can be seen in Table 1-3.

Table 1-3
Threatened and Endangered Species in the Seven Basins Watershed

Common Name	Scientific Name	Status
Bald eagle	*Haliaeetus leucocephalus*	Threatened
Northern spotted owl	*Strix occidentalis caurina*	Threatened
Coho salmon	*Oncorhynchus kisutch*	Threatened
Vernal pool fairy shrimp	*Branchinecta lynchi*	Threatened
Gentner's fritilary	*Fritillaria gentneri*	Endangered
Large-flowered wooly meadowfoam	*Limnanthese floccosa grandiflora*	Endangered
Cook's lomatium	*Lomatium cookii*	Endangered

Fritillaria gentneri is one of the endangered species found within the SBW. The BLM has mapped the population distribution of this plant on BLM owned lands within the SBW in order to gain understanding of its current locations as well as how to better protect it from further disruption. A map has been provided by the Medford District BLM Office to depict the general locations of *Fritillaria gentneri* populations within the SBW (Figure 1-8). The exact location of threatened or endangered species is rarely made public in order to better protect the population.

LAND USE

Private land is primarily used for residence, ranching, and timber. Public lands are used for grazing and timber harvest in addition to recreation. Recreation activities which are a significant land use activity on much of the public lands throughout the watershed. Table 1-4 is a breakdown of major land uses and Figure 1-9 illustrates the land use designations in the SBW.

Much of the land in the watershed has been used for timber production. Trees have been commercially harvested from the SBW since the late 1800s. Logging has occurred on public and privately owned timber lands across the watershed. Logging activity increased during the 1960s and peaked in the 1970s. Logging began to decrease in the1980s and has continued to decline through the present. During this time, extensive road building was conducted opening the upper portions of the watershed for timber extraction and other human activities.

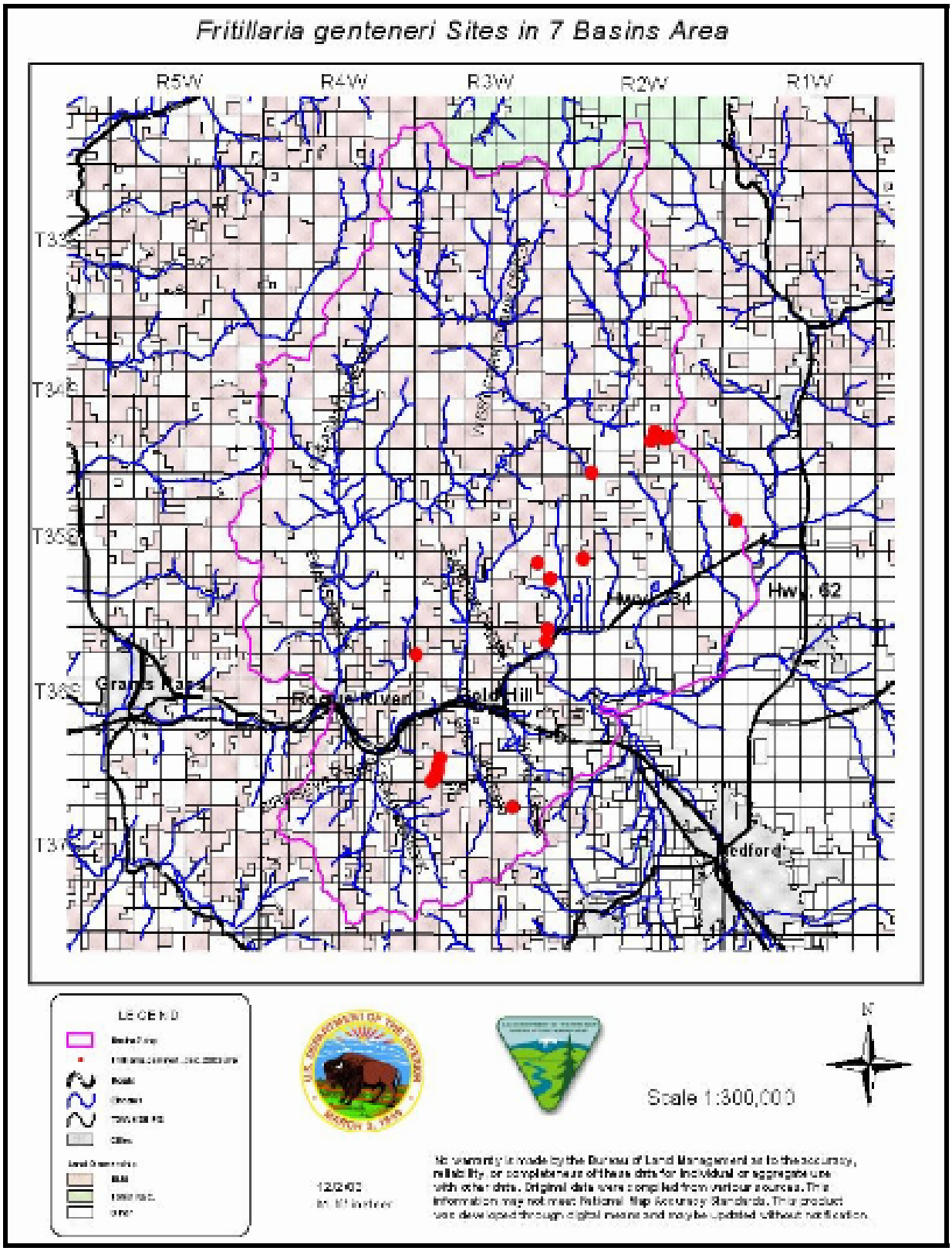


Figure 1-8
Map of *Fritillaria Gentneri*

Table 1-4
Distribution of Land Use Within Subwatersheds in the Seven Basins Watershed

Subwatershed	% Forest Land	% Ag and Range Land	% Urban	% No Data
Foots Creek	91.9	6.1	2.0	0.0
Rogue/Galls Creek	69.3	22.1	8.6	0.0
Rogue/Ward Creek	85.0	6.9	8.1	0.0
Rogue/Sardine Creek	80.2	16.3	3.5	0.0
Lower Evans Creek	71.1	15.1	9.0	4.8
Rogue/Sams Creek	57.5	38.1	4.4	0.0
Rogue/Snider Creek	36.7	57.1	6.2	0.0
Evans Creek/Sykes Creek	92.2	7.3	0.5	0.0
Pleasant Creek	80.5	8.8	3.8	3.8
Lower West Fork Evans Creek	99.8	0.2	0.0	0.0
Upper West Fork Evans Creek	96.5	0.0	0.0	3.5
Upper Evans Creek	92.0	8.0	0.0	0.0

In addition to forestry, agricultural and ranching have been of important land uses across the watershed. These activities include the production of hay, grain, and seed crops as well as the raising beef cattle, poultry, sheep, and the dairy industry. The majority of the agriculture occurs in the Sams Valley on the eastern margin of the watershed and in lower Evans Creek valley in the central portion of the watershed in the general vicinity of Wimer, Oregon.

Farming, ranching, and logging have declined in recent years across the watershed following a regional trend.

Cattle operations are the number one agricultural commodity in Oregon. Within the Rogue-Gold Hill subwatershed, cattle operations are the largest non-forestry agricultural venture. In this subwatershed, 96% of the BLM-managed lands are allocated to six grazing allotments covering 28,844 acres (BLM, 2001).

INSERT FIGURE 1-9 (11x17)

Seven Basins Watershed Land Use Map

There are no active allotments in the West Evans Creek Watershed. However, historically grazing has occurred in on several allotments from 1977 to 1990. The amount of acres was not provided (BLM, 1995).

In the Mid Evans Creek subwatershed, grazing has occurred historically. The total acreage of all allotment was 77,678 acres. However, the allotment acreage in the subwatershed was 4,358. The total allotment acreage after 1993 was 799 (BLM, 1994).

Portions of two allotments exist within the East Evans Creek subwatershed. The total acreage in the subwatershed was 14,348 acres. At the time the watershed analysis was conducted for this subwatershed no grazing was occurring on BLM lands within the subwatershed.

Mining has been an important part of the economy in southern Oregon and specifically the SBW. In the mid 18th century, hydraulic mining began for gold placer deposits in the streams of the area. By the early 20th century, lode mining was common for both gold and cinnabar, a sulfide of mercury. Historically, mining has been a major land use activity throughout a significant portion of the watershed. Placer mining has accounted for the most of the gold produced in the area. The earliest mining activity began in the 1850s at the beginning of the southern Oregon gold rush.

Early operations consisted on hand work using sluice boxes and the rocker or cradle. Where sufficient water was available, hydraulic mining commonly referred to as “hydraulicking” was a much more efficient way to work the gravels. Later, in the early 1900s, dredging became an important mining technique. Winchell reported that an electric dredge was constructed on Kane Creek. The dredge had a capacity 500 cubic yards per 10-hour shift. Power for the dredge was supplied by Gold Ray Dam (Brooks and Ramp, 1968).

Lode mining was also conducted at various locations throughout the SBW. This type of mining ranged from “pocket mining” to relatively good sized

underground mining operations. In 1941-1942 there were 11 active gold mines and prospects working in watershed.

Quicksilver (mercury) operations occurred in the northeastern portion of the watershed. In the early 1940s, mercury prices were $192 per 76 pound flask.

Several limestone quarries for cement manufacture and lime products are located in the vicinity of Gold Hill, Oregon.

Tremolite asbestos was mined near the town of Asbestos, Oregon in the northeastern portion of the watershed. The location of many of the mines in the watershed is illustrated on Figure 1-1.

Gold mining stopped during World War II and never recovered. The highest output in the area was in 1940 and has dropped steadily to a negligible amount after 1965. Today, most mines are lode mines for gold with some for copper, manganese, cinnabar, and chrome. Additionally, gravel and quarrying operations are found in the area (Atwood and Lang, 1995).

LAND OWNERSHIP

The SBW includes a mix of public and private lands. The ownership is split between public and private lands (Figure 1-10). There is very little state or Forest Service Land in the SBW. The northern portion of the watershed is predominately BLM land while the areas around Wimer, Oregon and Sams Valley are mostly private land. Table 1-5 lists the ownership of lands in the Mid Evans Creek, West Evans Creek, East Evans Creek, and Rogue-Gold Hill subwatersheds based on BLM data. Table 1-6 lists the distribution of ownership for the entire SBW.

INSERT FIGURE 1-10 (11x17)
Seven Basins Watershed Land Ownership Map

Table 1-5
Distribution of Land Ownership in Four Subwatersheds in the Seven Basins Watershed Based on BLM Reports

Subwatershed	Acres	BLM	U.S. Forest Service	Boise Cascade	Medite	KOGAP	Oregon State Forest	Woodlot	Other Private	Farm
Mid Evans Creek	33,980	14,520 (42%)	0	2,400 (7%)	4,080 (12%)	160 (<1%)	0	8,450 (25%)	0	4,370 (13%)
West Evans Creek	38,170	21,310 (56%)	160 (<1%)	0	15,900 (42%)	0	640 (2%)	0	160 (<1%)	0
East Evans Creek	21,136	7,863 (37%)	896 (4%)	2,757 (13%)	8,143 (39%)	0	41 (<1%)	0	1,199 (7%)	237 (1%)
Rogue-Gold Hill	41,029	15,494 (38%)	0	0	0	0	0	0	25,534 (62%)	0
Total Acres	134,315	59,178 (44%)	1,056 (<1%)	5,157 (4%)	28,123 (21%)	160 (<1%)	681 (<1%)	8,450 (6%)	26,893 (20%)	4,697 (4%)

From BLM 1994, 1995, 1996, and 2001.

Table 1-6
Distribution of Land Ownership for All Subwatersheds in the Seven Basins Watershed

Subwatershed	Total Acres	BLM	Private	State	USFS
Foots Creek	16,497	5,899 (36%)	10,599 (64%)	0.0	0.0
Rogue/Galls Creek	18,572	5,227 (28%)	13,346 72%	0.0	0.0
Rogue/Ward Creek	14,547	6,297 (43%)	8,250 (57%)	0.0	0.0
Rogue/Sardine Creek	19,099	8,286 (43%)	10,814 (57%)	0.0	0.0
Lower Evans Creek	21,750	5,540 (25%)	16,211 (75%)	0.0	0.0
Rogue/Sams Creek	18,076	4,617 (26%)	13,459 (74%)	0.0	0.0
Rogue/Snider Creek	28,541	3,414 (12%)	25,126 (88%)	0.0	0.0
Evans Creek/Sykes Creek	23,823	11,541 (48%)	12,283 (52%)	0.0	0.0
Pleasant Creek	27,437	10,320 (38%)	17,118 (62%)	0.0	0.0
Lower West Fk Evans Creek	23,146	11,746 (51%)	11,220 (48%)	0.0	91
Upper West Fk Evans Creek	16,012	9,606 (60%)	6,266 (39%)	0.0	140 (0.87%)
Upper Evans Creek	31,112	11,178 (32%)	19,247 (62%)	38.3 (0.12%)	649 (2.1%)

REFERENCES

Atwood, Katherine C. and Lang, Frank A., *As Long as the World Goes On: Environmental History of the Evans Creek Watershed*, Medford District BLM, 1995.

Bartley, Ronald Clark, *Geology of East Evans Creek Trail Quadrangle, Oregon*, Oregon State College, 1955.

Brooks, H.C. and L. Ramp, Gold and Silver in Oregon, DOGAMI, Bulletin 61, 337 pgs., 1968.

Bureau of Land Management, *Landscape Analysis of Mid Evans Creek*, Medford District BLM, Butte Falls Resource Area, May 1994.

Bureau of Land Management, *Watershed Analysis of West Evans of Creek*, Medford District BLM, Butte Falls Resource Area, April 1995.

Bureau of Land Management, *South Rogue-Gold Hill Watershed Analysis*, Medford District BLM, Ashland Resource Area, August 2001.

Cenozoic Volcanic Stratigraphy of Shasta Valley, Siskiyou County

Chesterman, C. W. and Saucedo, G. J., *California Geology*, v. 37, 1984.

Hladky, Frank R., *Age, Chemistry, and Origin of Capping Lava at Upper Table Rock and Lower Table Rock, Jackson County, Oregon*, Oregon Geology, Vol. 60, No. 4, July/August, 1998.

Johnson, et al., *Jackson County Soil Survey*, 1993.

Oregon Department of Agriculture (ODA), Noxious Weed List, <http://oda/state.or.us/Plant/weed_control/weedlistcommon.html>, (Accessed November 10, 2003).

Oregon State Climatological Service (OSCS), *Oregon Climate Zone Summary, Zone 3-Southwestern Interior*, 2003.

Orr, Elizabeth L. and Orr, William N., *Geology of Oregon*, Kendall/Hunt Publishing, Dubuque IA, 1999.

Page, Norman J.; Blair, Will N.; Gray, Floyd; Cannon, Jerome K.; Grimes, David J.; and Leinz, Reinhard W., *Preliminary Reconnaissance Geologic Map of the Wimer Quadrangle, Oregon*, United States Geological Survey, 1977.

Wiley, Thomas J. and Hladky, Frank. R., *Geology and Mineral Resources Map of the Boswell Mountain Quadrangle, Jackson County, Oregon*, State of Oregon Department of Geology and Mineral Industries, 1990.

Wiley, Thomas J., *Geology and Mineral Resources Map of the Cleaveland Ridge Quadrangle Jackson County, Oregon*, Oregon Department of Geology and Mineral Industries, 1993.

CHAPTER 2
A BRIEF HISTORY OF THE SEVEN BASINS WATERSHED

Prepared by:
Linda Davis, SBWC
Max Bennett, OSU Extension Service
David L. Graham, EMS
Reviewed by:
Katie M. Mosser, EMS

INTRODUCTION

This chapter provides a brief history of the SBW and discusses major land use activities that have had an impact on the watershed. This chapter is a summary of two larger documents that were prepared as part of the watershed assessment. The portion of the chapter dealing with indigenous peoples, mining, and agriculture were taken from a document prepared by Linda Davis of the Seven Basins Watershed Council. The entire document entitled, "Seven Basins Watershed Historic Conditions" is provided in Appendix A. The portion of this chapter related to logging activities is excerpted from a more lengthy document prepared by Max Bennett, OSU Extension Service entitled: "Vegetation of the Seven Basins Watershed: A Brief Environmental History." This document is also provided in its entirety in Appendix B.

INDIGENOUS PEOPLE/NATIVE POPULATIONS

It is estimated that humans have been present in southwest Oregon for at least 10,000-12,000 years, and possibly earlier (LaLande, 1982). Beckham estimated

the total Native population living in southwestern Oregon at the time of Euro-American contact at about 10,000 people (Beckman and Dow, 1971).

Though, there is little definite information as to where they came from, archaeological research seems to indicate that the natives of the Rogue Valley may have migrated into the area from the Plateau. Radiocarbon dating of archaeological sites including Cascadia Cave in the western Cascades, the Marial Site in the Rogue River Valley, and several localities along the Long Tom River west of Eugene is between 6,000-10,000 years old. A long-standing way of life focused on hunting and root crops is indicated by the stone tools and charred plant remains at the sites (Buan and Lewis, 1991).

According to various authorities, the "Rogue Rivers," called themselves Lo-to-ten, Tutatamy, Totutime, Tootouni, Tootooton, Tutoten, Tototin, Tututna, and Too-too-na; all of which may be regarded as the same word, uttered variously by individuals of different tribes, and reproduced in writing in varying ways as well. Tribes of restricted numbers frequently called themselves by the name of their chief (Wailing, 1884). They lived in small, independent villages in semi-subterranean plank houses.

Much has been lost of the primitive history, culture, and arts of the native people of the Rogue Valley. There are a few official government reports dealing with their language and a limited account of their life and customs to tell us of this now vanished people. It is a limited history that has been maintained, for the most part, by incidental segments of the accounts of their extended and bitter struggles with Euro-American's. In the early 1900s, linguists and ethnographers began interviewing the last of the Takelma. From these interviews comes much of our information on the life and customs of this vanished people.

It is believed that they were a relatively friendly and peaceful people; until their homes were threatened and their lands and women taken from them by Euro-

Americans. According to Genaw (1988), the Indians that lived around the valley could be very aggressive. If a neighboring tribe blocked a stream and prevented salmon from reaching another tribe, it could be a cause for war. There is also information that suggests that there was occasional warring with the Shastas located to the south.

The land use of the hunters and gatherers was closely related to their subsistence economy. They followed the food sources and the settlements moved with the seasons, except where staple resources were available most of the year. Meadows and wetlands that provided abundant wildlife were preferred to steeply inclined canyons. Winter settlements were mainly located along the river. Summer encampments tended to be in the upper elevations for hunting and gathering seasonal crops. Villages were usually dispersed to maximize the food sources. The native groups had similar economies, though their environment provided food specialties. Presence of grinding tools indicates subsistence partially based on wild roots, seeds, and vegetables (Follansbee and Pollock, 1978).

Before Euro-American contact, horses were evidently unknown to the people west of the Cascade Range of Southern Oregon. From Ogden's 1827 trek along the Rogue River, he deduced that from their awe-struck reaction to his brigade's mounts the natives had never before seen such animals. The native people were quick to see their usefulness and soon took advantage of the increased mobility offered by the beast. The native people of southwestern Oregon soon acquired a reputation among Euro-American trappers as accomplished horse thieves (LaLande, 1991).

The Takelma, whose name (Da-agelma-an) means "those living alongside the river," lacked a written language which limits any record of their history. Much of the information we have today is the result of linguists, ethnographers, and anthropologists. Sapir, Harrington, and Drucker were the primary ethnographers who researched the Takelma language (Jackson County, 1980).

Edward Sapir's research took place around 1906. His knowledge was based on interviews with Mrs. Frances Johnson who was one of his primary sources of information. By that time, the Takelma language was spoken by only three or four older women in the region. Frances was one of the last surviving Takelma Indians living on the Siletz Reservation (Gray, 1987).

John Peabody Harrington interviewed Mrs. Frances Johnson about twenty-five years after Sapir. She was his primary source of information on the Lowland Takelma. Molly Orton or Orcutt who spoke the Upland or "Table Rock" dialect, was his primary source of information for that group (Gray, 1987).

Philip Drucker's source of information was also Molly Orton for the areas around Table Rock and eastward in the Bear Creek Valley. According to Drucker, Molly was the last member of her people to have any recollection of the old culture (Gray, 1987).

The Tribes and Their Territories

Upland Takelma or Lat-ga-wa

In describing the territory of the Upland Takelma, Edward Sapir in his 1907 article on the Takelma noted: "they dwelt further to the east of the Lowland Takelma, occupying the poorer land of the Upper Rogue, east say of Table Rock towards the Cascades and also in the neighborhood of the present town of Jacksonville" (Gray, 1987).

The hunting and gathering of the Upland Takelma relied less on fish than the Lowland Takelma. They would fish for salmon when the water was low near Table Rock. The women split, dried, or pulverized the fish to be put up for later use. Vegetable foods in their diet were acorns, pine nuts, grass seeds, and camas. Deer, rabbits, and other game were hunted or snared. Protein

supplementation in the diet included caterpillars, yellow jacket larvae, grasshoppers, and snails (Follansbee and Pollock, 1978).

Lowland Takelma

The Lowland Tekelma's territory extended westward from Gold Hill and Jacksonville along the northern bank of the Rogue River to Galice Creek (Gray, 1987). Their diet consisted of fish, meat, berries, acorns, and roots. The men often used snares for elk, deer, and antelope. Important foods derived from the water were salmon and trout species, crawfish, and freshwater mussels. They built fish weirs and dams of interwoven *Ceanothus* or "buckbrush" that helped them trap and harvest the river's abundant salmon and steelhead and to contain the fish for easy spearing. They also speared salmon by torchlight. Trout were caught using branches to beat the water driving them into pools where they were scooped out. Clubbing was also a method often used to kill animals or fish, after driving them into a fenced or netted area. The club was also the main weapon used on an enemy (Follansbee and Pollock, 1978).

Carbohydrates were supplied by acorns, bulbs, and roots, while seeds and nuts provided source of fat. Fruits such as berries were used as a sweetener and condiment to improve palatability. In the Rogue Valley, the acorn of the California Black Oak (*Quercus kelloggii*) was much preferred to that of Oregon white oak (*Quercus garryana*) (LaLande, 1991). A staple of the Takelma vegetable diet, the camas bulb, was dug with a sharpened and fire hardened stick of Mountain Mahogany or deer antlers. Manzanita berries were pounded into flour and mixed with pine nuts (Follansbee and Pollock, 1978).

Fire was the main tool used by the Takelma for agricultural practices; it kept meadows clear, and fostered seed and root growth. Journals of early travelers through the Rogue Valley reported a valley often filled with smoke

(LaLande, 1987). Controlled burns were usually conducted by women who apparently specialized in this activity.

Twice a year, south facing slopes were burned to maintain grassy areas, and replenish meadows for wildlife and hunting, to clear trails, and maintain open areas under the forest canopy, and to fertilize new growth of plants and shrubs. The fires were of low intensity and rarely burned more than a few acres. A large fire may have burned a few hundred acres at the most. The fire reduced overall fuel load of the forests, by removing the combustible underbrush (Boyd, 1986). The only plant cultivated by both of the Takelma groups was tobacco, which was grown on land cleared by burning.

The Lowland Takelma had five basic shelter types: a semi-subterranean winter dwelling, the bark structures of the poor people, the man's sweathouse, the women's sweathouse, and the summer brush shelter. The rectangular winter dwelling was excavated to about one and a half to two feet and had a smooth stamped floor. There were four corner posts with connecting crossbeams. The walls were split sugar pine boards placed vertically between the crossbeams on the floor. Above the cross beams was a ridge post supported by two forked posts. The rectangular door, made of several pieces of lumber, was above the surface of the ground and had a dirt ramp for access. Inside a ladder stretched from the door to the center of the lodge, where the fire was located. Brush fences were planted and used as windbreaks around villages (Follansbee and Pollock, 1978).

The Rogue Bands

According to the best evidence, about 600 native people lived along the Rogue River between Table Rock and Evans Creek in the early 1850s. They were broken into tribal communities based on importance and all owed a quasi-allegiance to Joe and Sam (brothers), co-chiefs of the Table Rock band (Wailing, 1884). They were the most dominant, largest. and wealthiest of the

seven bands of Rogues living around the Rogue Valley. Sam's winter residence was about where the town of Gold Hill now stands (Genaw).

Wailing (1884) described the setting of the Table Rock bands being "in the midst of a pleasant country fruitful in game, roots, seeds, and acorns, while in the river, at the proper season, salmon swarmed by the thousand." They derived an easy and abundant living from their advantageous surroundings and were the dominate band of the tribe. Their number probably reached 500 at one time. In addition, there were quite a number of Indians of other tribes settled within the valley and through some consideration of Indian polity, gave their adhesion to the Table Rock chiefs and were in effect a part of their people. This band was ever regarded with jealousy by the whites until their removal to a distant reservation in 1856 (Wailing, 1884).

The "Contact Period"

"Southwestern Oregon's Contact Period," lasted from the mid-1770s to the mid-1850s" (LaLande, 1991). Hudson Bay Company employee, Peter Skene Ogden led a trapping expedition into the Rogue Valley and southern Oregon in 1827. In February of that year his party camped along the Rogue River and he recorded some of his observations of the native people. Ogden's journal reports that over 1,500 pelts were taken from the Applegate area. As trapping continued over the next decades, the decline of beaver began to alter the stream side and aquatic environment. This produced stream channelization, less channel complexity, and reduced the quality of habitat for fish (LaLande, 1987).

With the opening of the Emigrant Road through the Southern Oregon region in 1846 and the California gold rush of 1849, the Rogue River Valley became a thoroughfare of ever increasing travel. Many of the travelers going south

rushing to the gold fields of California, didn't want to waste time by stopping to deal with any difficulty with the natives.

Circa 1830-1856 Exploration, Gold Rush and Indian Wars

A land giveaway of 2,500,000 acres, referred to as the Land Act of 1850, brought thousands of settlers to Oregon and the Rogue Valley. Gold was discovered in 1850 on Josephine Creek (a tributary of the Illinois River) and in 1851 on Rich Gulch near Jacksonville. By March, word had leaked out of the large strike and miners flocked in from every direction increasing the population by mid-summer to around a thousand persons. The completion of the Yreka to Umpqua Road connecting the county with California to the south and Douglas County to the north led to an influx of settlers. The flood of outsiders coming to the region, was to lead to the beginning of prolonged period of "Indian troubles," that would continue from 1851-1856.

Robison (1943) points out that "One factor often overlooked in explaining the Indians' adjustment to white neighbors is that though they had seen white people pass through their region for twenty years, occupation of the region occurred, figuratively speaking, overnight." There was little time for the native people to make gradual adjustment to the new relationship with the whites they were faced with for the first time.

Jackson County government began with the appointment of the first county officials in March, 1853. These officers included three county commissioners, a county clerk, a sheriff, a prosecuting attorney, and a treasurer. An assessor and surveyor were added later.

The miners or settlers who flocked to southern Oregon gave little consideration to securing title to the land from the native people. As the farmers cultivated the land, it caused destruction to native people's sources of plant foods. The miners had operations along every stream of the region and it began to affect

the supply of fish. After the treaty of 1853, the discontent of the Indians was found to be largely among those hill tribes. This discontent was mainly toward the miner in the mountains who regarded his time there as being of a temporary nature, as compared to the farmer in the valleys who expected to make a permanent home in the area (Robinson, 1943).

Euro-American Foray

The hostilities of 1853 lead to the signing of a Treaty near the "Table Rocks" in September of that year. The event was described "As the Indian and volunteer forces moved down into the valley, each keeping strict watch on the other." The ground chosen for the council was on the south side of Rogue River. The Indians make their encampment on an elevation directly opposite the cliffs of Table Rock and General Joseph Lane in the valley one mile distant. The camp was selected by Lane and was near the location of present day Bybee Bridge, at the time called Hailey's Ferry.

The majority of the area in which the SBW encompasses was the area that would be a temporary reservation. A Fort was built across the river from the reservation. It was named for General Joseph Lane. Fort Lane was built and used by the U.S. military from 1853-1856. The fort served mainly as a protection for the native people from the Euro-American settlers. Chief Sam's tribe sought protection there several times (Wailing, 1884). Its location was in the southern part of the north eastern quadrant of Section 19, Township 36 South, Range 2 West, across the river from Lower Table Rock.

MINING

The first gold boom in Oregon ended about 1870, but it had been strong enough to attract people with diversified talents so that other industries such as farming and raising cattle cushioned the shock. In addition, the gold rush

was responsible for the early entry of railroads into the State, and this hastened the growth of cities and provided a more stable economy.

The Klamath Mountains of western Oregon were broken into valleys, mountain ranges, and hills that were densely wooded in the 1850s and 1860s, with numerous streams of varying sizes, all or most all of which flowed into the Rogue River. The Gold Hill mining district was located in the Klamath mountains between latitude 42˚23' north and 42˚43' north and longitude 122˚47' west and 123˚15' west, in northwestern Jackson County. Placers were worked in the district as early as 1853, but the big strike occurred in 1859 when lode gold was discovered. The Oregon Department of Geology and Mineral Industries officially recorded the amount gold taken from the Gold Hill pocket as $700,000 of which $400,000 was taken out in the first year. At 1990 prices, that same amount of gold would be worth $15,312,500 (Department of Geology and Mineral Industries [DOGAMI], 1943).

The impact of mining can be found across the SBW. Placer mining, dredging, and hard rock mining took place along nearly all the creeks, surrounding hillsides from Sams Creek west. Mine shafts, tailings, residence sites, and water ditches are remnants of past mining activity in the SBW.

Geological Resources

In the stories of their travels, early explorers hinted that experienced miners might find precious metals in the "northwest country." The writings of Bonneville, Father De Smet, Fremont, and Lewis and Clark describe geological formations favorable to the discovery of precious metals. Reverend Samuel Parker devoted an entire chapter of his journal to describing the geological formations of the Oregon country, including a list of minerals already discovered and he expressed his belief that gold and silver would probably be discovered at a future date (Spreen, 1939).

Aggregate

Construction materials such as sand and gravel, quarry stone, and clay have been mined within the watershed. Like other minerals, these materials can be mined only where they occur naturally. Limitations on production include hauling distance, weathering, thickness of overburden, and necessary specifications of the intended use. Other conflicts and constraints include noise, dust, increased turbidity, and preservation of fish spawning areas (Mason, 1977). Most of the current aggregate mining in the SBW is near the railroad and the Rogue River and not far off Interstate 5. Aggregate activities are in operation at sites near the Rogue River, off Table Rock Road, Modoc Road, at Tolo, on Kirkland Road, and west of Gold Hill past Rock Point on North River Road.

Metallic and Nonmetallic Minerals

The history of mining activity for most of the metallic and nonmetallic minerals shows a piece-meal production under a variety of economic and technological conditions. The experience of miners has shown that the gold veins of Jackson County are "spotted." Gold and silver have had a history of ongoing mining and there are probably quantities and grades still present and able to be mined. Minerals with moderate potential of future development based on past production include clay, chromite, copper, lead, zinc, and tungsten. However, known deposits are not large enough to compete with outside sources (Mason, 1977). According to Mason (1977) mercury with molybdenum, nickel, platinum, manganese, and cobalt have a low probability of future development due to outside completion and poor record of discovery. However, mercury has a history of being mined in the SBW on Evans Creek, at Spikenard, on Cinnabar Mountain, and in Ramsey Canyon.

The History of Gold Mining in Seven Basins Watershed

Spreen (1939) described how the gold was carried and deposited in the streams. "The streams having the Rogue River as the parent stream, with their generally rapid current were responsible for the presence of gold at the spots where the prospectors and packers found it. The currents, with their eroding action, wore away the parent rock, broke it up and carried the fragments down their courses until compelled by a change to a less steep gradient to drop this material. In the passage of years it was often covered by sedimentary deposits brought down by floods, perhaps to be uncovered again by a later flood. The gold deposits in southwestern Oregon were the results of ages of weathering of rock, floods, and sedimentary deposit which often reached a considerable thickness."

During the fall of 1852, gold was discovered on Foots Creek, fifteen miles west of Jacksonville; at Willow Springs, five miles north of Jacksonville; and at Pleasant Creek in the northern part of the county. However, hostility from the native people resulted in curtailment of mining activities in these areas until after 1856.

The first gold was found in streams and the early miners of southern Oregon operated small placer mines using the simple mining devices (Figure 2-1). A placer is an alluvial deposit of sand and gravel containing gold in particles large enough to be obtained through washing. Placer mining requires the use of water to extract the gold from the gravel. This method is based on the fact that gold is heavier than the accompanying rock debris and will work downward with agitation. Running water is needed to wash away the debris. One person operating with a pick, shovel, and pan could do well in a rich area. This type of small operation was much less detrimental to the environment than what was to follow.

Figure 2-1
Small Placer Operation in the SBW During late 1800s
(Photo #14973 provided by the Southern Oregon Historical Society)

When rockers and long-toms were used, the streams were often diverted for a short distance. The rocker or cradle took two people to operate. It was a box like device mounted on rockers with one open end. It could handle from three to five cubic yards of earth in ten hours. A lot of fine-grained gold was lost with this method (Spreen, 1939).

Between October 1856 to June 1880, 5,438 mining locations were operating in Jackson County. Of these, 16 were copper, one tin, 124 were cinnabar, and the rest gold and silver. There were 1,221 conveyances of mining claims and 133 transfers of water ditches and rights during this same time. Claims in the SBW were as follows: Willow Springs, 785; Gold Hill, 361; Gall's Creek, 95; Foot's Creek, 288; Evans Creek, 115; and Sardine Creek, 132 (Wailing, 1884). By the 1860s, hydraulic mining had been introduced in southern Oregon. This

form of mining greatly increased the amount of gravel that could be worked at any given time. Up to 1,500 cubic yards of tailings were dumped into the watercourse daily. This type of mining also required a great deal of water, capital, skill, and labor. Long flumes to span deep gulches had to be built; many miles of ditches had to be constructed, reservoirs were erected, thousands of feet of piping lain, and giants and other machinery set.

In the 1870s companies were organized and they hired groups of Chinese labors to build the long ditches and flumes necessary to operate the large hydraulic placer mines. This method allowed larger volumes of lower valued gravels to be worked at a profit. Pressurized water from a pipe or hose was used to expose gold deposits by scouring away hundreds of cubic yards of earth per day (Figure 2-2). The water washed the sediments into sluice boxes where the gold amalgamates were collected with the use of Quicksilver (mercury). The miners were able to remove the soil and uncover the gold faster with these methods. However, they had a more drastic effect on the land, waterways, and water quality than the small placer mines of the earlier decade. By 1865, all the placer deposits known today had been discovered. The cost of freight and supplies determined if a placer was worked. At least one half ounce of gold per day was needed from a placer to cover expenses; only the coarse gold was removed leaving the finely powered gold (McKinley and Frank, 1996).

As the richer placers were being exhausted, some miners began to search for other sources of the gold. Many rich deposits of gold ore were discovered. Prospecting for the lode began as early as 1859 on the Gold Hill. Five quartz claims were filed at 3 p.m. on 13 January 1860, called the “Emigrant Lead” situated on the North side of the divide running towards Big Bar on Rogue River Southwest one-quarter of the Northeast one-quarter of Section 14, Township 36 South, Range 3 West. It was situated at the 2,000 foot elevation. As described by Libbey (1943), “the outcropping rock was so full of gold that it could scarcely be broken by sledging.” People began to file clams until 10 p.m.

Figure 2-2
Placer Mining along Pleasant Creek, circa 1899
(Note Impacts to Stream Channel and Riparian Areas)
(Photo provided by the Woodville Museum)

that night. Soon there were about 150 claims taking up the whole side of the mountain (Genaw, 1988).

The process to recover gold from its ore depends primarily on the mineralogical character of the ore. Initially, the ore needs to be crushed and finely ground. Water or horse/mule powered arrastras were built in the early days to grind the ores. The initial step in the extraction of free gold and/or gold-bearing sulfide minerals from the finely ground ore was by amalgamation, flotation, cyanidation, jigging, table concentration, or a combination of these processes. Free gold recovered by amalgamation or cyanidation was sold as bullion and

sulfide concentrates were usually shipped to a smelter (Brooks and Ramp, 1968).

The Rogue River and its tributaries have produced a large amount of placer gold. However, after a time the gold mining industry in southwest Oregon saw a decrease in production. Placer mining activity in the early 1900s began to increase when bucket line dredges were developed and came into use replacing small hand-operated equipment (Figure 2-3). The dredges worked the deeper stream gravels and were able to open large areas of very rich ground as well as make a profit working the lower grade deep stream placers. Foots Creek was dredged in 1903 and Kane Creek was dredged in 1908. Dredges also operated on parts of Sardine, Sykes, and Pleasant Creeks. Dredging operations continued to some extent in southern Oregon until the 1940s (Mayo, 1994).

Figure 2-3
Dredge Operating on Pleasant Creek During the Early 1900s
(Photo #18585 provided by the Southern Oregon Historical Society)

Oregon's gold mining and production declined sharply in the 1920s. Southwest Oregon saw a steady decline in gold production between the years 1906 to 1934 except for a small increase after World War I. The Great Depression brought renewed interest in mining activity to southern Oregon when labor and material costs were back in line with gold prices (Mayo, 1994). Job opportunities in the 1930s were few and far between and many took to the streams in search of gold. The small scale mining became a means of economic survival for many. Federal money was used by the Jackson County court to provide a three-day class in "gold mining techniques" for indigent families in hopes of easing the pressure on the county relief funds (LaLande, 1980).

More efficient dredges and improved methods in quartz mining plus an increase in the price of gold from $29 per fine ounce to $35 in 1934 were factors that lead to a steady increase in the regions gold production. In 1940, the gold yield in dollars was $1,053,395 for a single year. It was during this era that the Oregon Department of Geology required miners to construct settling ponds, which greatly reduced downstream sedimentation (Rivers, 1963).

Placer and lode mining have both seen rise and fall patterns. As mining and milling methods improved the production of lode gold increased until 1942. With World War II, the U. S. government put a stop to all gold mining as non-essential to the war effort. Some mining equipment was even shipped to the Soviet Union (Mayo, 1994). The cost of running a mine increased after the war. Material and labor cost prohibited many mines from reopening. Many operating plants had deteriorated because of the length of time the mines were left abandoned and neglected. Mining in Oregon continued to decrease from 1942 to practically nothing by 1965, except for a peak in 1947, which was comparable to 1907-08 production (Brooks and Ramp, 1968).

During the period of lean years, a few miners eked out a living working both lode and placer mines. An interest in gold mining was revived as mining laws changed. Private ownership of gold bullion was allowed and the price of gold was allowed to follow market demands as it rose and fell.

Technology opened up a new form of gold mining. Skin and scuba diving was combined with a suction type gold dredge and sand, gravel, and gold were suctioned up from the steam bottom. Some of these dredges have a suction hose up to twenty-four inches in diameter and are capable of working many feet under the water surface. A floating sluice box is used to process the sand and gravel (Mayo, 1994).

Cinnabar was found in the "Meadows" area of the Gold Hill district in 1878. Local production was sold locally to the placer-gold miners in the vicinity. Limited records are available regarding the production of quicksilver from the area. Based on data presented in Schuete (1981), 65 flasks were produced in 1887, 32 flasks were produced in 1888, and 20 flasks were produced in 1889. The largest cinnabar mines in the SBW were the War Eagle, Chisholm, and Dave Force mines.

Other minerals that were mined were copper at the Cartinell Mine. It was discovered in 1902 in Section 9, Township 34 South, Range 4 West. Chrome was mined on a tributary of Pleasant Creek, Boulder Creek, Section 3, Township 34 South, Range 3 West. Manganese was found in Section 6, Township 35 South, Range 3 West. Foster & Grunnells Mining Maps show several coal deposits northwest of Asbestos, in Township 33 South, Range 2 West (DOGAMI, 1943).

AGRICULTURE

The native people of the watershed used fire for agricultural purposes to keep meadows clear and to foster seed and root growth. It was also used in the

harvest process of tarweed seed. After the area where the plant grew was burned it was harvested by walking through and hitting the seed heads, with a stick, and gathered into baskets. Tobacco was the only plant grown by the native people of the area. Land was also burned before cultivation and planting of tobacco (Follansbee and Pollock, 1978).

Alonzo A. Skinner, government Indian agent, was among the first to select a donation land claim in the Rogue Valley. His claim was southeast of Table Rock, where he constructed a log home. James Kennedy and Nathaniel Dean settled at Willow Springs. Enoch Pelton and James Bruce selected donation land claims along Snider Creek and began cultivating grain and raising hogs. Others selected the fertile land close to the river near Table Rock to farm. Further west on the south bank of the Rogue, the Birdseye and Savage families began farming on the fertile river bottom soil. The basic food supply was provided by dairy cattle, and newly planted potatoes, corn, cabbage, and other vegetables grown in the gardens. Wheat, oats, and barley were planted as soon as possible and would feed people as well as livestock.

The family farm was usually diverse and fairly self sufficient. They raised their own chickens which supplied them with eggs and meat and a family cow furnished their milk and butter. Corn, wheat, rye, oats, barley, potatoes, and hay were their best income crops (Figure 2-4). Nearly everyone raised a garden. Family orchards were planted and made up of many varieties of apples, pears, peaches, plums, cherries, grapes, and berries.

Water posed a problem to the farmer in the SBW and vicinity, not only if there was too much but, also if there was too little. The Democrat News reported on the dry weather: “Dry weather-This summer has proven the driest of the many dry summers we have ever witnessed in Southern Oregon. Streams that were never know to dry up before have quite failed this season, and as a consequence, farms and gardeners complain of a deficiency of water for irrigation. All kinds of vegetation are burning up for want of water, and even

Figure 2-4
Grain Harvest in Evans Valley, circa 1900
(Photo provided by the Woodville Museum)

the fruit crop is destined to suffer greatly from the same cause. We understand that the plum crop is 'gone up' in some parts of the valley." (Democrat News, 1869).

Willow Springs, the Sams Valley area, including Beagle and Table Rock, became noted farming communities. The farmers were becoming fairly prosperous, commanding a good price for their grain. Farming was often a cooperative effort among neighbors and harvest often became a community project. What one farmer didn't raise another did. Barter and trade of a skill or product was often exchanged in lieu of cash.

By the 1860s there were eight large flour mills in the Rogue Valley, and the processed grain was even transported out by pack animals and wagons (Follansbee and Pollock, 1978). In northwest Jackson County there was the Daily's mill in Eagle Point (Butte Creek Mill), the Houck mill at Gold Hill, or the Welch Mill in Central Point where farmers took grain to have it ground into flour. The farmer usually ran the grain through a fanning mill to remove the chaff before taking it to the flour mill (Figure 2-5).

Figure 2-5
Harvesting Grain on the Neathamer Farm in Evans Valley, circa 1899
Steam Powered Thrasher being used to Harvest Grain
(Photo provided by the Woodville Museum)

The early agricultural effort of the Rogue valley farmers was very important. Thousands of miners depended on the wheat raised locally. Local farming was very lucrative during this period. Transportation of produce and commodities into the area was costly, being brought in via packers and freight wagons. This

gave the local growers an edge over wheat imported from other areas. Wheat was grown as a favorite crop along with barley, rye, and oats. In the 1880s two factors effected local agriculture, the coming of the railroad and the decrease in mining.

Many prospectors moved on to the gold strikes in Alaska and other areas. Those who stayed continued to mine the south bank tributaries of the Rogue, Sardine Creek, and Evans and Pleasant Valleys where they often combined mining and farming. The same ditches that were used in the winter for placer mining were sometimes used in the summer for irrigation.

In 1887 the railroad was completed. Within the SBW area there were depots at Tolo, Gold Hill, Ray Gold, and Woodville, to handle passage and freight going both north and south. With the railroad came the opportunity to export agricultural products. However, the railroad also brought competition from the outside as crops were shipped in at a lower price.

In Jackson County a period of economic expansion began by 1910. The development of the pear orchard industry in the Bear Creek Valley had much to do with the boom. Donation Land Claims were subdivided into tracts of newly planted orchards and many new homes were built. This posed a need for additional water for both domestic and agricultural purposes (LaLande, 1991).

The new orchards were being planted, some with irrigation, others without. Fruit such as pears, apples, cherries, and peaches were planted at Rogue River, Rock Point, Table Rock, Sams Valley, and of course other areas of the Rogue River Valley (Figure 2-6). Mrs. Amelia Frierson left a diary that made mention of an irrigation ditch, indicating that they probably had water at Table Rock, as early as 1896. The project that brought irrigation water from the Rogue River is credited to Mr. R. E. Drum for having promoted it (Leavitt).

Figure 2-6
Fruit Harvest in an Orchard Located Along the Rogue River Near Table Rock
(Photo provided from the Fredenburg Collection)

Post World War II, there was a shift from the farm to the timber industry. The 1960s and 1970s experienced the Back-To-The-Land movement. More roads were improved because of the logging industry. With more dependable transportation, people found the valleys and gulches to their liking. These people were not farmers to making their living from the land. They worked off the land, some raising their own meat and fruit and garden, others were hobbyists, enjoying the county lifestyle.

Traditionally, timber production and grazing were the primary natural resource industries within the upper reaches of the watershed. The valleys had deeper soils and were able to support a wider diversity of agricultural. Orchards in the valley were close to irrigation and to transportation routes. Livestock

production is currently the predominant form of agriculture. Commercial crops include wheat, barley, hay, oats, and corn. During the last decade, however, vineyards (Figure 2-7) have been established while specialty crops such as cut-flowers, herbs, and organic fruits and vegetables are also being produced.

Figure 2-7
Del Rio Vineyard West of Gold Hill
(Photo provided from the Linda Davis Collection)

LOGGING

Logging and Milling (1900-1945)

Improvements in lumber markets, logging technology, and the road network accelerated the pace of timber harvesting after the turn of the century. As eastern and mid-western forests were tapped out, lumber manufacturers moved west to take advantage of the region's vast and seemingly inexhaustible timber resources. A few private companies acquired land in the SBW and local loggers sold to Timber Products Co. in Medford and other firms. In addition,

much forest land reverted to the U. S. Government through the O & C Act of 1916, and through subsequent forfeitures of tax delinquent private land. This resulted in a distinctive land ownership pattern in the watershed. Most lowland areas were privately owned as small farms or woodlots. Higher slopes and upstream reaches in the watershed had a checkerboard pattern, with alternate sections of privately held land and ownership by BLM. Ultimately, BLM came to control over 40% of the land in the watershed.

Technological developments in the logging industry included the steam donkey in the early 1900s, the crawler tractor in the 1930s, and the chainsaw around World War II. These developments facilitated more efficient harvest of the timber resource. In addition, the road network continued to expand, giving access to previously distant areas of the watershed. Small sawmills sprang up throughout the watershed, in fact, "...up every little creek there was a sawmill. They were little mills. There would always be a big pile of sawdust where they would mill their lumber right there and then haul it out." (Dale Hatch quoted in Atwood and Lang, p. 89, 1995). Despite this increased level of activity, much of the watershed was too remote and remained untouched by logging activity until after World War II (Figure 2-8).

Jackson County timber harvests increased greatly after World War II to accommodate the growing demand for lumber. In 1946, there were 76 sawmills operating in Jackson County, including larger facilities operating two shifts a day (Atwood and Lang, 1995). Total harvest levels exceeded 800 million board feet annually through most of the 1950s and 1960s. There was a dramatic drop during the recession of the early 1980s, and again after about 1990 when harvest levels on federal lands declined sharply due to legal challenges and policy changes.

Figure 2-8
Typical Small Sawmill in the SBW
This Particular Mill was Located along Queens Branch, circa 1898
(Note Water Line Bringing Water to Run Saws)
(Photo provided by the Woodville Museum)

In the SBW, while lowland areas had largely been harvested, upper slopes and higher reaches of the watershed still had extensive stands of valuable mature timber (Figure 2-9). Following the war, these areas were roaded and logged (Figure 2-10). Clearcutting was the main harvest method, though some partial and shelterwood cutting was used, the latter on BLM land. Ultimately, all or nearly all of the private timber holdings in the watershed were harvested, and much of the BLM lands as well.

Figure 2-9
Falling Timber in Upper Evans Creek Using a Springboard, Axe, and Crosscut Saw. Tree was Typical of Many in the Watershed in the Early 1900s.
(Photo provided by the Woodville Museum)

Wilber Milton, a logger, recalled this era:

> "We just went further out in the Evans Creek area....I started my own outfit in 1953. We logged on Pleasant Creek. Worked up there for years. Logged everything -- Red fir, cedar, and pine. We cut on both private and public land. Timber companies bought up all the private timber they could." (Atwood and Lang, p. 120, 1995).

Figure 2-10
Early Hard Tire Log Truck Used in the SBW, circa 1930s
(Photo provided by the Woodville Museum)

Another logger, Dale Hatch, talked about logging for Timber Products on many BLM sales:

> "I logged in there in the 60's when they first started putting the BLM roads up in there. There really hadn't been that much logging going on. It was kind of a new area. They've hit it pretty hard since the big roads went in. It was real big timber -- Doug fir. Up on the ridges you'd hit sugar pine and yellow pine, most was heavy in Douglas fir. Railroad Gap, Round Top, still big timber up in that area, but not much. You started getting into heavy timber in Angel Camp area. Red Mountain. That was the big timber area. I logged about every other section up in the West Evans Creek area and over into East Evans Creek...logged a lot

> of cut-over area later on because I could re-log some of the areas that had been selectively cut" (Atwood and Lang, p. 121, 1995).

Milton (quoted in Atwood and Lang, p. 130, 1995) made the following observation about the logging:

> "When I first started working for Timber Products, they told you to take the timber down to eighteen inches breast high. In certain area there was a lot of good stands of reproduction. You kept out of that. You didn't put a cat in that. They stayed with that until the old company sold. When the next guy bought it…he no more got set in here with his upper foreman, than he had us go back and take what we had already. When we got through it was a clearcut. Nothing left. That ruined the whole thing. You cannot have water without trees. Trees hold your water and give shade."

Another logger, Dick Skevington, had this to say:

> "Years and years ago, everything was forested. We got nobody to blame but ourselves. Years ago they cut only the best timber and left the scrubby stuff and so your grade of timber run down. They were doing pretty fair up until after World War II. Then they got big motorized equipment and went in and did all the clear cutting.…Well, we went for forty years and nobody planted anything…" (Atwood and Lang, p. 131, 1995.).

Yet another logger made this comment:

> "The Evans Creek area has very little old growth left up there…there are some little pockets where they've left some old growth, but not much. It's been logged pretty heavy most anywhere you go. You drive up there and see some big timber and remember when it all used to be like that. It is kind of sad. The way we logged it there was no restrictions. You had to

> fall snags. You don't get into our streams anymore like we used to. Used to be we'd cat log it and come down into the bottom of the stream and go right down the middle of creek. It pushed mud in the creeks.
>
> It looks different because we've got more brush now and more young trees than we used to have. Used to be big timber and young trees wasn't under a canopy. Now that they've cut everything off or its been burnt off the brush is coming back heavy. Years ago when you went hunting it was all big timber and things smelled so woodsy. You don't have that kind of smell now." (Dale Hatch, quoted in Atwood and Lang, p. 129, 1995).

It is important to note that while extensive areas have been logged, most of these areas are forested today. A combination of natural regeneration and planting has ensured the return of tree cover to most harvested areas, whether on private or public land. The major changes in forest vegetation have been a shift from predominantly larger, older timber, with more open understories, to younger, smaller timber. The species composition has probably shifted to a lower proportion of pine (both ponderosa and sugar) and a higher proportion of Douglas-fir and hardwoods.

There is little direct evidence of historical conditions in riparian areas. Many lowland streams were cleared of large conifers shortly after settlement. Trees typically were logged to the water's edge in upland streams as logging moved higher up in the watershed. Many of the logged streamside areas were quickly colonized by hardwoods such as alder, but conifers have been slower to return.

Adoption of a state forest practices act in 1972 and numerous revisions to the act since then have increased the level of protection to riparian zones on private forest land. Riparian zones also receive much greater protection on federal land today than a few decades ago.

FISH

Several studies have been completed by the Oregon State Game Commission regarding fish and fish habitat as related to the Rogue River and its tributaries. These reports provide historical perspectives on the factors that have affected fish populations in the SBW over the past forty years. Rivers (1946) reported that there were many limiting factors to fish migration in the Rogue. Many barriers have been found that are impassible in some water stages but passable at others. These barriers make for fluctuations in the number of fish that reach given areas from year to year.

According to Rivers (1957) the factors that have lead to the decline in salmon and steelhead populations include:

- Mining;
- Unscreened irrigation diversions;
- Construction of dams; and
- Commercial fishing.

Extensive mining occurred in the SBW throughout from 1880 to 1942. Heavy loads of silt from hydraulic mining operations created flows of "red ooze" from the first rains in the fall to early summer. The potential hatch of steelhead eggs in the gravel in all waters affected was limited by the smothering slit loads (Rivers, 1957). Fishing decreased on area streams due to intensive mining, logging, sediment accumulation, low water, and warm stream temperatures. According to Roy Milton, "When we were little kids, Evans Creek was full of fish. The water is not coming now, period. The fish ladder worked for years. Now we are just not getting the water." (Atwood and Lang, 1995).

Unscreened irrigation diversions were more directly responsible for the decline of Rogue steelhead than any other cause. Since 1945, the enormous loss of

migratory fish to unscreened ditches was significantly reduced by the Game Commission's screening program. There were ranchers who admitted that they did not have to use fertilizer until the screening program stopped the supply of fish to their irrigated fields (Rivers, 1957).

Newcomb (1943) reported on the numerous dams and obstructions that limited fish passage on the Rogue River and its tributaries. Dams were constructed on the Rogue River that had a dramatic affect on the steelhead populations. The dams included Grants Pass Power Supply Company (GPPSC) Dam at Grants Pass, the Ament Dam of the Gold Drift Mining Company, the Grants Pass Irrigation Districts' Dam at Savage Rapids, and the power generating dams of the California Oregon Power Company (Gold Ray Dam) and the Ideal Cement Company dam at Gold Hill. The GPPSC Dam blocked runs of salmon and steelhead from 1890 to 1905. Only fish that could jump the 12 foot high dam could reach sections of the river above the dam. The Ament dam seriously blocked the runs of fish from 1905 to 1923. The Savage Rapids Dam, Gold Ray Dam, and the Ideal Cement Company dam at Gold Hill were completed in 1923, 1904, and 1942 respectively. It was not until several years after the completion of these structures that consideration was given to the passage of fish (Newcomb, 1943).

Rivers (1946) listed barriers that made fish passage impossible during normal flows. Included in this list was Evans Creek to the Fielder Creek Dam above the town of Rogue River, but when passable, the Wimer Dam located above the town of Wimer. The Wimer Dam was originally built of logs and constructed about 1900. In 1934 it was replaced by a concrete structure. Newcomb (1943) reported that a very inefficient fish ladder was present and, except for a few periods under favorable water conditions, fish were unable to pass this dam. The fish ladder was originally built for use as a fish trap for egg taking activities. He reported that a new fish way should be designed and kept in proper operating condition.

The earliest miners and settlers in the Evans Creek area noted that streams and even tributaries held ample fish. Following heavy rains, Evans Creek settlers reported frequent appearance of trout and salmon in Evans Creek. Twice in 1879 the Jacksonville newspaper reported on Evans Creek salmon: "Salmon are running up to Steckel's Mill dam. This is the first time they ran up Evans Creek in five years. A few have been caught." "Salmon have again made their appearance. The late rains raised the creek." (Atwood and Lang, 1995).

Reporting on the flood of the winter of 1890, Stephen Beers of Pleasant Creek area reported that, "the dam near George Meagerle's place has gone out and fish are running plentifully in Evans Creek for the first time in years." One month later, residents of The Meadows were "rejoicing over the prospect of plenty of fish, now that there are no dams to obstruct their passage up Evans Creek…" (Atwood and Lang, 1995).

Rivers (1957) discussed steelhead in the Rogue River system. Old-time residents recall that in the late 1800s sizeable runs of steelhead were in the main Rogue River at nearly all times of the year. The heaviest runs of salmon were in the summer and fall of the year and the steelhead were regarded by many to be a nuisance fish by those interested in catching salmon. Decline in the steelhead populations was not noticeable until the sport fishery became popular in the 1920s. Heavy mining silt loads, unscreened irrigation and mining diversions, open and unladdered power dams, and commercial fishing caused an early encroachment on the fishery resource (Rivers, 1957).

Dick Skevington noted changes to the creek and in fishing, "We swam all summer in Evans Creek. Now in places up there you can't find any water. There is not water running under the bridge there at Wimer. The creek bed is dry. Pleasant Creek is dry. It's pretty sad…There was a lot of water in the creeks, steelhead used to come up Queen's Branch." (Atwood and Lang, 1995).

From 1901 to 1931, the Bureau of Fisheries took from 5 to 6 million steelhead eggs a year, most of which were shipped to many parts of the world to establish runs of steelhead in other North American streams and rivers on other continents. Egg taking operations stripped the Applegate River, Little Butte Creek, Evans Creek, and Bear Creek of much of their steelhead populations. Over zealous development of irrigation and other intensive water uses since then have provided little opportunity for these runs to recover (Rivers, 1957).

The Rogue River was fished commercially from 1877 to 1935. During the 1935 legislative session the Rogue was closed to commercial fishing. Nets were still being used frequently through 1939 and there was evidence that they were being used as late as 1941. Commercial fishing records indicated that the take of steelhead was insignificant but anecdotal reports from cannery workers said that the nets claimed many steelhead and that they were packed as salmon. One old-timer stated that "salmon were getting scarce before the commercial fishing closure and that steelhead were the only fish that kept him in business" (Rivers, 1957).

Management of the fishery resource from 1927 to 1940 consisted mainly of ladder construction supervision and enforcement of angling laws. Since 1941, most attention has been directed toward stream improvements, stream protection, watershed management, life history studies, and public relations and community education work (Rivers, 1957).

Records have been kept on fish migrating over the Gold Ray Dam on the Rogue River. The estimates are provided in Table 2-1. Figures 2-11 to 2-15 are graphs that illustrate the number of salmon and steelhead that have been counted at the dam from 1942 to 2002.

Table 2-1
Estimated Number of Salmon and Steelhead Migrating Over Gold Ray Dam; 1942-2002

Return Year	Spring Chinook	Fall Chinook	Coho	Summer Steelhead	Winter Steelhead
1942	41,779	1,670	4,608	7,387	
1943	36,136	1,611	3,290	5,648	16,314
1944	30,632	1,223	3,230	5,530	13,380
1945	31,996	1,641	1,907	7,302	16,038
1946	28,374	1,691	3,840	4,448	8,729
1947	33,637	1,176	5,340	3,221	9,653
1948	26,979	757	1,764	2,133	8,605
1949	18,810	1,233	9,440	3,618	8,052
1950	15,530	1,204	2,007	4,583	8,684
1951	19,443	1,489	2,738	3,262	5,744
1952	15,888	2,558	320	4,200	10,648
1953	31,465	2,083	1,453	3,831	10,945
1954	24,704	955	2,138	2,222	7,228
1955	15,714	836	480	1,703	5,239
1956	28,068	1,884	421	2,753	8,775
1957	17,710	1,060	1,075	1,323	4,508
1958	15,016	700	732	1,293	3,855
1959	13,972	735	371	865	4,550
1960	24,374	1,843	1,851	2,034	6,901
1961	31,775	1,260	232	2,408	8,965
1962	31,395	1,265	457	3,603	9,901
1963	40,567	960	3,831	1,508	9,024
1964	37,327	1,137	168	778	6,431
1965	47,644	1,776	482	2,144	7,310
1966	31,422	1,166	178	2,092	12,463
1967	14,693	1,800	89	1,637	5,150
1968	19,469	912	149	693	7,235
1969	59,043	2,190	530	7,768	6,559
1970	45,101	3,068	160	6,088	13,789
1972	30,788	2,756	185	3,559	16,826
1973	35,276	3,816	193	5,236	9,566
1974	17,006	2,309	146	7,858	7,108

Table 2-1 (cont.)

Return Year	Spring Chinook	Fall Chinook	Coho	Summer Steelhead	Winter Steelhead
1975	21,483	2,312	154	8,338	10,367
1976	21,570	2,648	44	3,529	6,048
1977	16,403	5,181	522	11,352	4,724
1978	47,221	5,878	756	4,977	7,867
1979	38,207	3,093	1,744	14,867	12,767
1980	36,932	2,906	5,617	7,773	13,371
1981	17,213	4,767	6,725	11,929	8,197
1982	29,942	4,595	670	13,654	6,337
1983	12,511	3,829	1,493	7,581	9,728
1984	12,690	3,184	3,236	7,397	8,486
1985	40,545	8,455	1,170	7,511	10,462
1986	89,522	14,239	4,072	14,598	16,664
1987	81,581	10,699	5,395	24,955	17,587
1988	82,591	11,497	6,882	19,283	15,019
1989	60,332	6,903	1,401	12,411	14,595
1990	24,589	3,650	697	5,959	10,487
1991	12,350	3,205	2,562	4,975	4,547
1992	5,801	6,797	4,006	3,507	4,134
1993	26,103	6,711	3,486	10,595	6,479
1994	14,076	11,530	10,669	11,085	6,581
1995	81,051	14,336	13,518	13,894	12,434
1996	36,621	11,385	13,599	11,680	9,168
1997	41,794	4,857	15,750	7,538	14,957
1998	15,957	5,332	6,044	6,056	5,029
1999	20,981	3,540	6,305	4,785	9,497
2000	30,265	9,892	28,791	6,734	6,807
2001*	33,273	13,203	32,962	16,064	8,994
2002*	48,132				21,941
10 Yr. Ave.	32,262	7,762	10,476	8,085	9,638
Ave. All Yrs.	31,833	3,807	3,378	6,349	9,516

* Preliminary
Count Period:

Spring Chinook	March 1-August 15
Fall Chinook	August 1-December 15
Coho	September 15-January 30
Summer Steelhead	May 15-December 30
Winter Steelhead	January 1-May 15

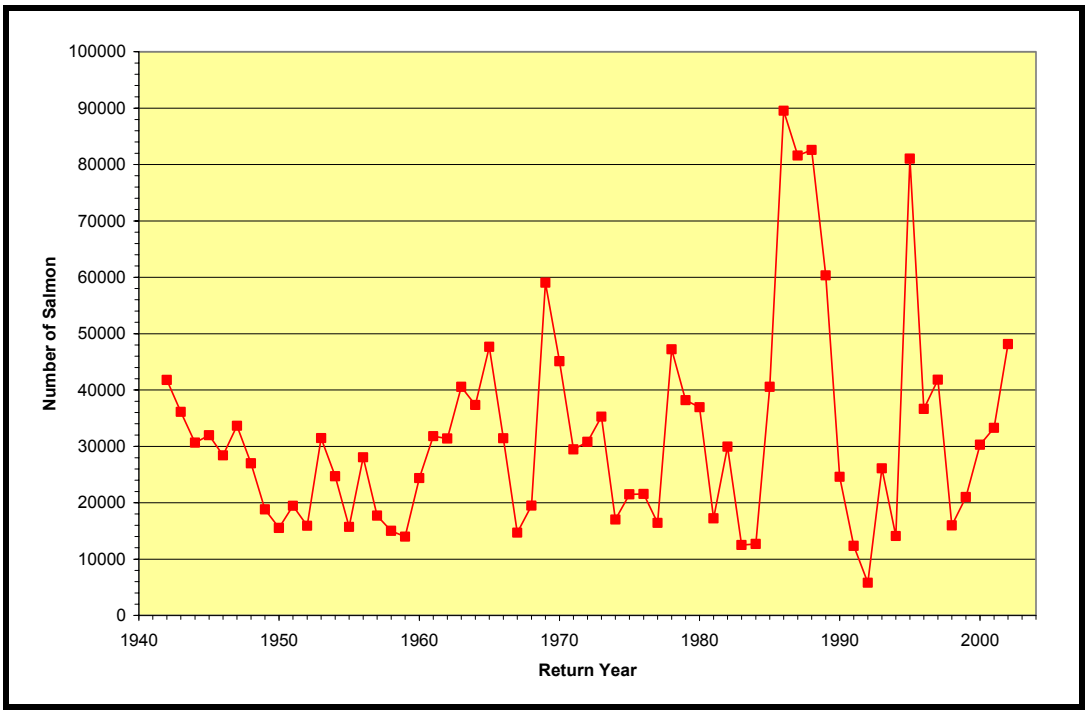


Figure 2-11
Estimated Number of Spring Chinook Migrating Over Gold Ray Dam; 1942-2002

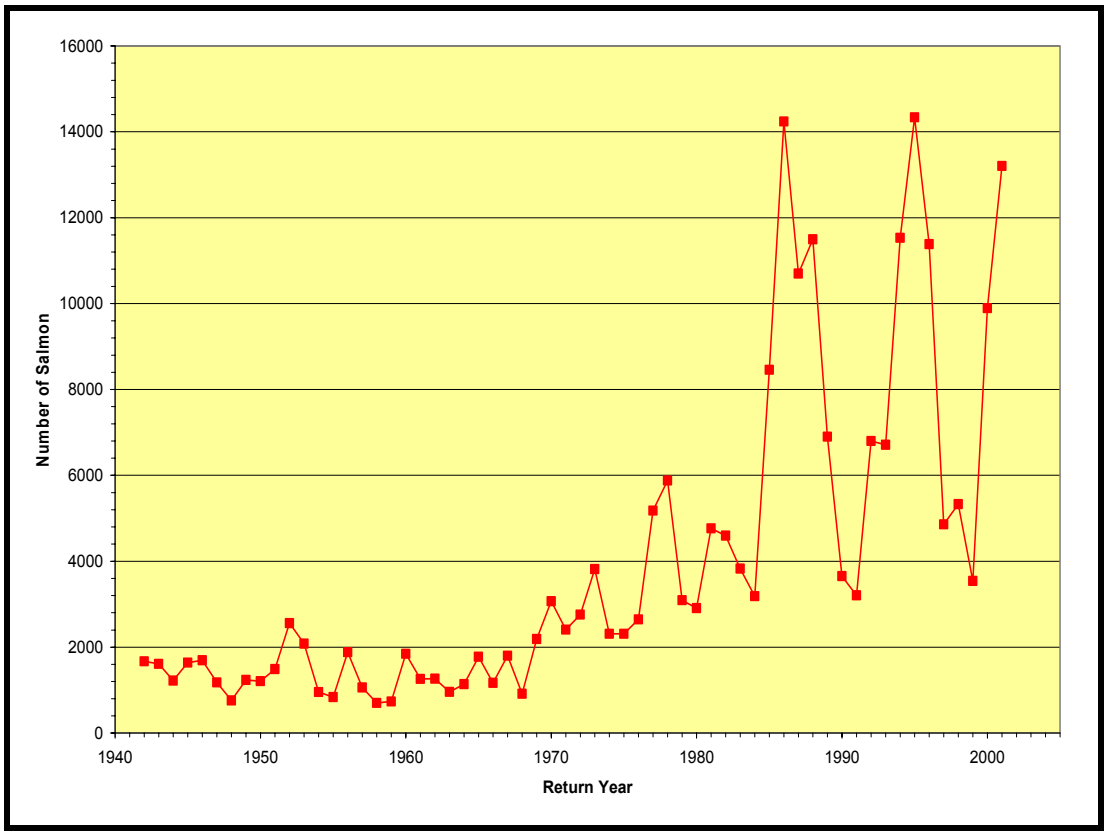


Figure 2-12
Estimated Number of Fall Chinook Migrating Over Gold Ray Dam; 1942-2001

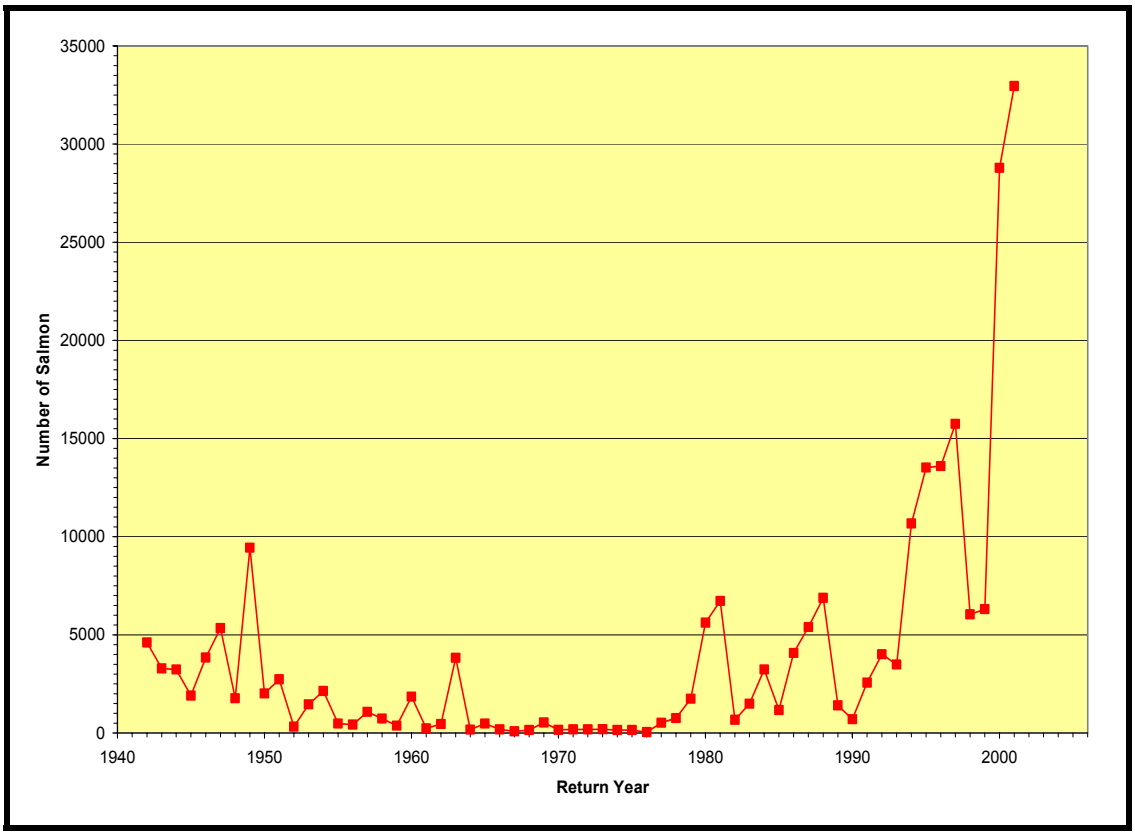


Figure 2-13
Estimated Number of Coho Migrating Over the Gold Ray Dam; 1942-2001

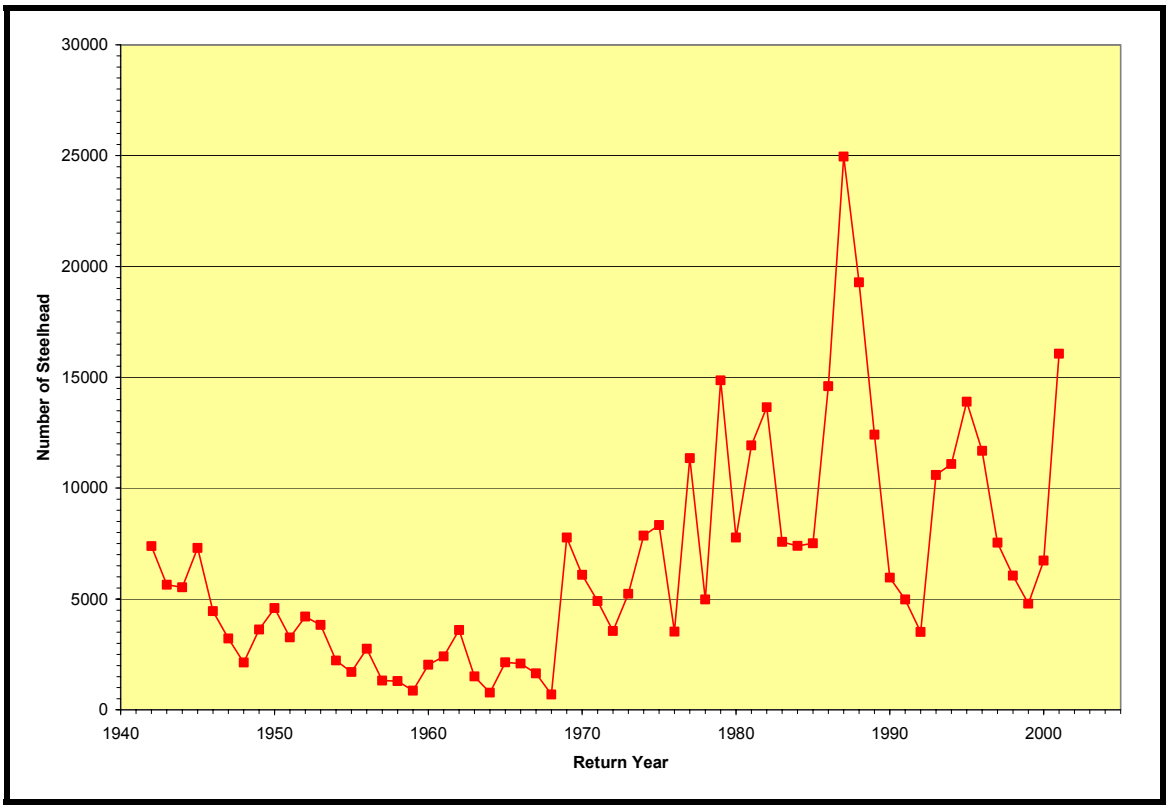


Figure 2-14
Estimated Number of Summer Steelhead Migrating Over Gold Ray Dam; 1942-2001

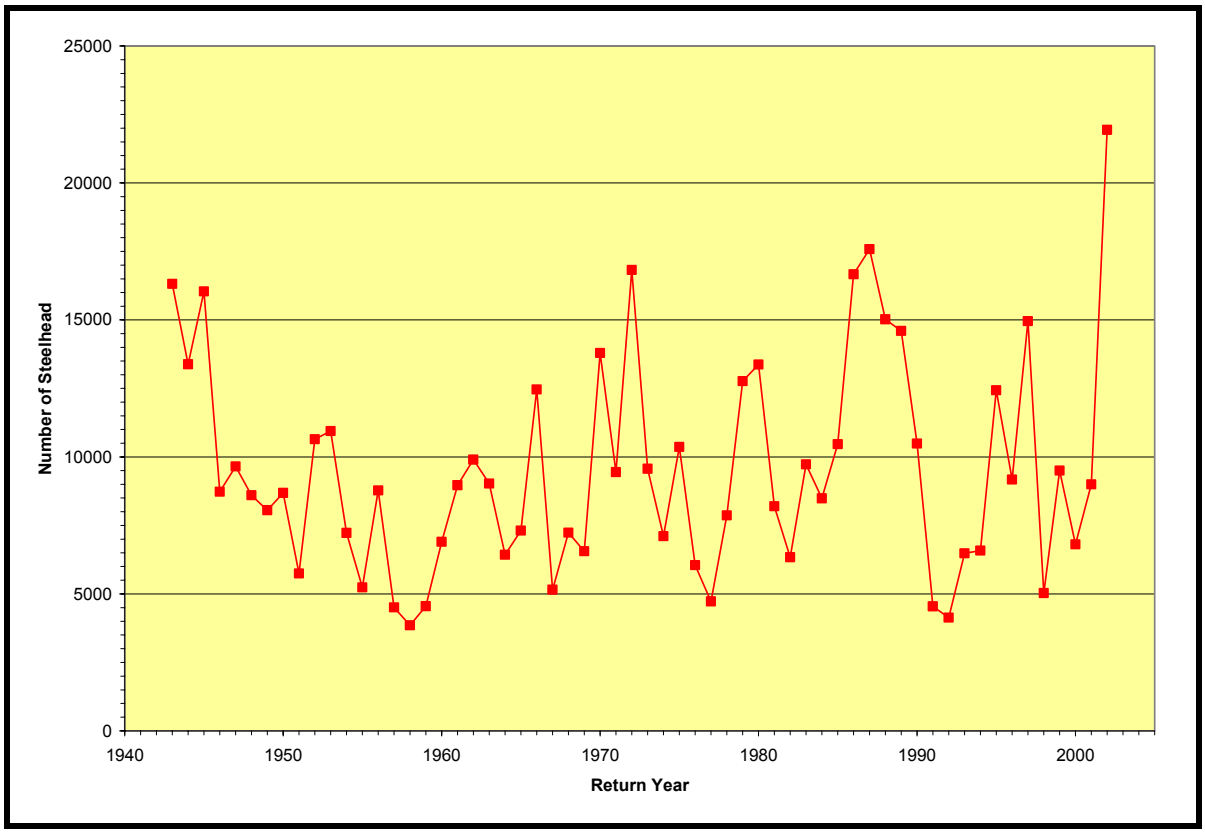


Figure 2-15
Estimated Number of Winter Steelhead Migrating Over Gold Ray Dam; 1942-2002

CONCLUSIONS

The environmental history of the SBW has been dictated by several factors that include:

- Land uses practiced by indigenous peoples of the area;
- Historic mining activity;
- Agricultural practices; and
- Logging.

Indigenous peoples used fire to clear land for agriculture and disrupted natural riparian habitats. Mining operations destroyed riparian areas, severely altered

stream courses, polluted streams with natural and anthropogenic chemicals, and diverted streams into diversion ditches and flumes for the purposes of mining and mineral extraction. Agricultural activities used some of the same diversions that were used for mining to move water from the streams for irrigation. Many of the flood plain areas were cleared of native vegetation and used to grow crops. Logging also adversely affected the health of the watershed. As road building proficiency improved, more and more of the watershed was opened to logging. These activities resulted in increased sediment transport, timing of peak flows, reduction of riparian habitat, and a change in the mix flora in the forests.

All of these activities adversely affected water quality in streams throughout the watershed. Parameters that were affected included:

- Temperature;
- Sediment load (suspended and dissolved solids);
- Dissolved oxygen;
- pH;
- Bacteria;
- Nutrients; and
- Agricultural chemicals.

Chemical changes coupled many physical changes to the streams adversely impacted the fish and fish habitat in and around the SBW. The major factors that affected the fish populations were:

- Increases in temperature due to a reduction in riparian habitat as result of mining, agriculture and logging;
- Increased sediment loads due to mining, agriculture, and logging; and

- Increase in the number of barriers constructed on streams that restricted fish passage (dams, diversion ditches, culverts, etc.).

REFERENCES

Atwood, Katherine C. and Lang, Frank A., *As Long as the World Goes On: Environmental History of the Evans Creek Watershed*, Medford District, BLM, 1995.

Beckham and Stephen Dow, *Requiem For A People: The Rogue Indians and the Frontiersmen,* Norman, Oklahoma: University of Oklahoma Press, 1971.

Boyd, Robert T., *Strategies of Indian Burning in the Willammette Valley*, Canadian Journal of Anthropology, 5:1(Fall), pp.65-86, 1986.

Brooks, Howard and Ramp, Len, *Gold and Silver in Oregon,* Bulletin 61, State of Oregon, DOGAMI, pg., 33 pg., 1968.

Buan, Carolyn M. and Lewis, Richard (eds.), *The First Oregonians*, Oregon Council for Humanities, 1991.

Democrat News, 1869

DOGAMI, *Oregon Metal Mines Handbook*, Bulletin No. 14-C, State of Oregon, DOGAMI Vol. II, Section 2, (Jackson County), 97 pg., 1943.

Follansbee, Julia and Pollock, Nancy L., *Prehistory and History of the Jackson-Klamath Planning Unit. A Cultural Resources Overview,* 251 pg., 1978.

Genaw-Morehouse, Linda, *Gleanings from the Gold Hill Echo.*

Genaw-Morehouse, Linda. *Gold Hill and Its Neighbors along the River*, pg. 24, April 1988.

Gray, Dennis J., *The Takelma and Their Athapascan Neighbors. A New Ethnographic Syntheses for the Upper Rogue River Area of Southern Oregon,* University of Oregon Anthropological Papers, No. 37, pg. 10, 13, 1987.

Jackson County, *Indians of the Rogue Valley,* Medford, OR, Jackson County Extension Office of Oregon State University, pg. 1, 1980.

LaLande, Jeffrey M., *Prehistory and History of the Rogue River national Forest: A Cultural Resource Overview,* Rogue River National Forest, Medford, OR, 93 pg., 1980.

LaLande, Jeff, *Rogue River Time-Line: A Chronology of the Rogue River National Forest and the Surrounding Area*, Medford, OR. Rogue River National Forest, p-5., 1982.

LaLande, J., *First Over the Siskiyous: Peter Skene Ogden's 1826-1827 Journey Through the Oregon-California Borderlands*, Oregon Historical Society, Portland, OR., 1987.

LaLande, Jeff, *The Indians of Southwestern Oregon: An Ethnohistorical Review,* Anthropology Northwest Number 6, Department of Anthropology, Oregon State University, Corvallis, Oregon, 41 pg., 1991.

Leavitt, Katherine Nealon, *History of Table Rock*.

Libbey, F. W., Oregon Department of Geology, *Least We Forget, The Ore Bin*, XXXVIII, No. 12, 1943.

Mason, Ralph S., *Bulletin 94: Land Use Geology of Central Jackson County*, State of Oregon, DOGAMI, State Geologist, pg. 42, 43., 1977.

Mayo, Roy F., *Gold Mines of Southern Oregon_*, Nugget Enterprises P.O. Box 184, Enumclaw, WA 98022, 4 pg., 1994.

McKinley G. and Frank, D., *Stories on the Land: An Environmental History of the Applegate and Upper Illinois Valleys*, Medford, OR, 1996.

Portland, Oregon 1991.

Newcomb, Hugh Ross, *A Second Preliminary Report of Investigations Made On Rogue River and Its Tributaries*, Oregon State Game Commission, 1943.

Rivers, Cole M., *Third Progress Report of Fishery Investigation of the Rogue River and its Tributaries, Oregon State Game Commission*, 1946.

Rivers, Cole M., *Steelhead of the Rogue River System with Reference to the Management Program and Related Studies from 1941 to 1956*, Oregon State Game Commission, 1957.

Rivers, Cole, *History and Development of the Rogue River Basin as Related to Its Fishery Prior to 1941* (typescript: Rogue River Fisheries, Vol.1) Salem: Oregon State Game Commission, 1963.

Robison, Huston T., *The Rogue River Indians and Their Relations with the Whites*, A Thesis presented to the Department of History and the Graduate Division of the University of Oregon in partial fulfillment of the requirements for the degree of Master of Science, Chapter VIII: Conclusion, June 1943.

Schuete, C. N., *Quicksilver in Oregon* , DOGAMI, State of Oregon, Bulletin No. 4., Portland, OR, pg. 81, 1981.

Spreen, Christian August, *A History of Placer Gold Mining in Oregon 1850-1870; A Thesis*, University of Oregon Dept. of History, pg. 4, 5, June 1939.

Wailing , A.G., *History of Southern Oregon* , 1884, pg. 325.

CHAPTER 3
CHANNEL HABITAT TYPE CLASSIFICATION

Prepared By:
Gene Kurz, EMS
Katie M. Mosser, EMS
Reviewed By:
David L. Graham, EMS

INTRODUCTION

Stream channels are shaped by multiple factors. These include geologic conditions, climate, local weather, and biologic inputs into the stream. Streams have variable sensitivities to physical change depending upon the combination of stream channel conditions. These changes are most specific to the addition or removal of large woody debris (LWD), riparian condition, fine sediment, coarse sediment, and peak flow.

By determining Channel Habitat Types (CHTs), an evaluation of watershed stream channel conditions is possible. Stream sensitivities to physical changes are readily determined once CHTs have been classified. CHT classifications provide an understanding of the impact of watershed land use practices and management of streams. The receptiveness of a stretch of stream to restoration activities is also determined by classifying CHTs.

METHODS

CHT classification for streams within the SBW are based on three criteria:

- Stream Gradient Class;

- Channel Confinement; and
- Stream Size.

Stream Channel Gradient Class

Channel gradient is defined as the change in elevation divided by the length of any given stream segment (Elevation/Stream Length). A combination of two analytical methods to characterize channel gradient classes for streams within the SBW was used. The ArcGIS Spatial Analyst Extension was employed to generate "Percent Slope" coverage for the entire watershed area utilizing 10-Meter Digital Elevation Models (DEMs). The percent slope coverage was then reclassified and symbolized using the six channel gradient classes described in OWEB (1999). Symbolized gradient classes of the percent slope coverage provided an initial tool for distinguishing variations in channel gradient along streams of interest. In addition, Spatial Analyst was used to generate contour lines at twenty-foot intervals for the entire watershed area. These were then used as a complimentary method for determining channel gradient classes utilizing methods described in the OWEB (1999), i.e., the distances between contour lines and the number of contour lines per 1,000 feet of stream channel.

In order to prevent an unmanageable number of stream segments and simplify the process for stream segmentation based on channel gradient, OWEB guidelines were followed. General guidelines included:

- Stream segments were a minimum of 1,000 feet in length and spanned a minimum of three contour lines;
- Stream segment breaks were located at the confluences of tributaries; and
- Major waterfalls were segregated regardless of their length.

Exceptions to these guidelines existed where frequent variations in gradient were observed over short distances and were segmented accordingly.

Stream Channel Confinement

Channel confinement is defined as the ratio of the bank full width to the width of the modern flood plain. Utilizing available desktop references such as topographic maps (which do not provide adequate resolution), channel confinement is difficult to determine, especially for lower-gradient streams.

EMS utilized a combination of visual analytical methods for determining/estimating channel confinement for streams within the SBW. Specific methods include:

- Observing topography and stream geometries on both the percent slope Geographic Information Systems (GIS) coverage and United States Geological Survey (USGS) 7.5-minute quadrangles; and
- Analyzing contour line geometries utilizing methods described in the OWEB manual (Step 3; OWEB, 1999).

Stream Size

Oregon Department of Forestry (ODF) Stream Classification maps were used to determine stream size. The information from these maps was combined with the GIS data regarding stream gradient class and channel confinement to determine the channel habitat type classifications.

Channel Habitat Type Assignment

Channel Habitat Types were assigned based on stream channel gradient classes and channel confinement. Stream segments were selected based on CHT criteria described in OWEB, 1999 and classified accordingly. Stream segments were then symbolized based on their CHT designation and displayed on the CHT map (Figure 3-1).

CHANNEL HABITAT TYPES

All possible CHTs, as defined by the OWEB, are listed in Table 3-1. Those CHTs which are present in the SBW are described later in this chapter.

Channel habitat type sensitivity is based on the responsiveness of a channel to the addition or removal of LWD, riparian condition, fine sediment, coarse sediment, and peak flows (Table 3-2). Each channel habitat type occurring in the SBW has had a sensitivity determined for each of the above listed criteria as well as overall sensitivity. Table 3-3 shows the sensitivity rating for the channel habitat types occurring in the SBW.

Insert Figure 3-1 (11x17)

Table 3-1
Channel Habitat Types (CHT)

Code	CHT Name	Gradient	Channel Confinement	Size
ES	Small Estuary	<1%	Unconfined to moderately confined	Small to medium
EL	Large Estuary	<1%	Unconfined to moderately confined	Large
FP1	Low Gradient Large Floodplain	<1%	Unconfined	Large
FP2	Low Gradient Medium Floodplain	<2%	Unconfined	Medium to Large
FP3	Low Gradient Small Floodplain	<2%	Unconfined	Small to medium
AF	Alluvial Fan	1-5%	Variable	Small to medium
LM	Low Gradient Moderately Confined	<2%	Moderately Confined	Variable
LC	Low Gradient Confined	<2%	Confined	Variable
MM	Moderate Gradient Moderately Confined	2-4%	Moderately Confined	Variable
MC	Moderate Gradient Confined	2-4%	Confined	Variable
MH	Moderate Gradient Headwater	1-6%	Confined	Small
MV	Moderately Steep Narrow Valley	3-10%	Confined	Small to medium
BC	Bedrock Canyon	1->20%	Confined	Variable
SV	Steep narrow Valley	8-16%	Confined	Small
VH	Very Steep Headwater	>16%	Confined	Small

Source: Oregon Watershed Assessment Manual (GWEB, 1999)

Table 3-2
Channel Sensitivity

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

Source: Oregon Watershed Assessment Manual (GWEB, 1999)

Table 3-3
Channel Habitat Type Sensitivity Rating

CHT	LWD	Fine Sediment	Coarse Sediment	Peak Flow
FP1	Moderate to High	Moderate	High	Low to Moderate
FP2	High	Moderate	High	Low to Moderate
FP3	High	Moderate to High	High	Low
LM	Moderate to High	Moderate to High	Moderate to High	Moderate
LC	Low to Moderate	Low	Moderate	Low to Moderate
MM	High	Moderate	Moderate to High	Moderate
MC	Low	Low	Moderate	Moderate
MH	Moderate	Moderate	Moderate to High	Moderate
MV	Moderate	Low	Moderate	Moderate
SV	Moderate	Low	Low to Moderate	Low
VH	Moderate	Low	Low to Moderate	Low

Source: Oregon Watershed Assessment Manual, GWEB 1999

Description of Channel Habitat Types and Sensitivities in the Seven Basins Watershed

The following CHT descriptions are taken from the OWEB (1999).

FP1: Low Gradient Large Floodplain Channel

FP1 channels have less than or equal to 1% stream gradient. They are located in the lowlands and valley bottoms of large watersheds. The channel tends to be sinuous and unconstrained. Sloughs, oxbows, wetlands, and abandoned channels are common in these stream systems. Systems of this size have the capability of moving large amounts of sediment during high water events. This

results in channel migration and the formation of new channels. LWD sensitivity is moderate to high. This system is moderately sensitive to the addition of fine sediments and highly sensitive to coarse sediments. FP1 channels have low to moderate sensitivity to peak flows. The overall channel habitat sensitivity is high in these systems. FP1 channels are important for coho, steelhead, rainbow, and cutthroat spawning and rearing.

FP2: Low Gradient Medium Floodplain Channel

FP2 channels have less than or equal to 2% stream gradient. They are located in broad, flat valley bottoms with single to multiple channels and can be sinuous. Alluvial fans and dissected foot slopes are likely to be found in direct proximity to FP2 channels. Extensive gravel bars, terraces, and riparian areas are commonly associated with these channels. FP2 channels are unconfined and considered large to medium size streams within Oregon. These channels are located in the middle to lower end of the drainage basin and are dominated by sand to cobble substrate. Channel sensitivity to LWD presence is high. Moderate sensitivity to fine sediments and high sensitivity to coarse sediments are exhibited in these systems. Peak flow sensitivity is low to moderate in FP2 channels. Overall channel habitat sensitivity is high in these systems. FP2 channels are important for coho, steelhead, rainbow, and cutthroat spawning and rearing.

FP3: Low Gradient Small Floodplain Channel

FP3 channels are located in broad valley bottoms and flat lowlands. They are associated with the toes of foot slopes or hill slopes within valley bottoms of larger channel systems. FP3 channels are typically fed by high gradient streams. Many times they are found downstream of alluvial fans and contain wetlands. The stream gradient in these channels is less than or equal to 2%. The channel confinement is moderate to unconfined and the channel pattern

consists of single to multiple channels. Dominant substrates in FP3 channels range from sand to small cobble. These channels are considered small to medium in Oregon. The sensitivity to LWD presence is high. Moderate to high sensitivity to fine sediments and high sensitivity to coarse sediments are exhibited in these systems. Peak flow sensitivity is low in FP3 channels. Overall channel habitat sensitivity is high in these systems. FP2 channels are important for coho, steelhead, rainbow, and cutthroat spawning and rearing.

LM: Low Gradient Moderately Confined Channel

LM channels have low gradient reaches and are confined within low terraces and/or hill slopes. Narrow floodplains which are approximately two to four times the width of the active channel are often present. The stream gradient in these channels is less than 2%. The channel confinement is variable. Dominant substrates in LM channels range from fine gravel to bedrock. These channels are considered medium to large in Oregon. The sensitivity to LWD presence is moderate to high. Moderate to high sensitivity to fine sediments and coarse sediments are exhibited in these systems. Peak flow sensitivity is also moderate to high in LM channels. Overall channel habitat sensitivity is moderate in these systems. LM channels are potential habitat for coho, steelhead, rainbow, and cutthroat spawning and rearing.

LC: Low Gradient Confined Channel

LC channels are incised or contained within gentle landforms such as hill slopes on one side of the channel and lowlands on the other. Stream bank terraces are often present and found above current floodplains. The stream gradient in these channels is less than 2%. Channel confinement by hill slopes or high terraces is typical. Dominant substrates in LC channels include boulder, cobble, bedrock with pockets of sand, gravel, and cobble. These channels are considered medium to large in Oregon. The sensitivity to LWD

presence is low to moderate. Low sensitivity to fine sediments and moderate sensitivity to coarse sediments are exhibited in these systems. Peak flow sensitivity is low to moderate in LC channels. Overall channel habitat sensitivity is moderate in these systems. LC channels are potential habitat for coho, steelhead, rainbow, and cutthroat spawning and rearing.

MM: Moderate Gradient Moderately Confined Channel

MM channels have alternating valley terraces and/or mountain-slopes which are adjacent. Foot-slopes and hill slopes are also common. All of these land forms limit channel migration and floodplain development. Narrow floodplains may be present. These usually alternate from bank to bank. The stream gradient in these channels is generally 2-4%. The channel confinement is variable. Dominant substrates in MM channels range from fine gravel to small boulders. These channels are considered medium to large in Oregon. The sensitivity to LWD presence is moderate to high. Moderate sensitivity to fine sediments and moderate to high sensitivity to coarse sediments are exhibited in these systems. Peak flow sensitivity is moderate in MM channels. Overall channel habitat sensitivity is high in these systems. MM channels produce limited habitat for coho spawning and rearing. These channels also provide potential steelhead spawning and rearing habitat.

MC: Moderate Gradient Confined Channel

MC channels are located in narrow valleys and have developed minimal river terraces. Hill slopes and mountain slopes provide the valley walls. The stream gradient in these channels is generally 2-4%, but may vary from 2-6%. Dominant substrates in MC channels range from coarse gravel to bedrock. These channels vary in size. The sensitivity to LWD presence is low. Low sensitivity to fine sediments and moderate sensitivity to coarse sediments are exhibited in these systems. Peak flow sensitivity is moderate in MC channels.

Overall channel habitat sensitivity is moderate in these systems. MC channels provide potential steelhead, rainbow, and cutthroat spawning and rearing.

MH: Moderate Gradient Headwater Channel

MH channels have moderate gradients and are exclusively located in headwater areas. These channels are potentially located above the natural occurrence of anadromous fish. The stream gradient in these channels is generally 1-6%. Dominant substrates in MH channels consist of sand to cobble, bedrock. These channels are considered small in Oregon. The sensitivity to LWD presence is moderate. Moderate sensitivity to fine sediments and moderate to high sensitivity to coarse sediments are exhibited in these systems. Peak flow sensitivity is moderate in MH channels. Overall channel habitat sensitivity is moderate in these systems. MH channels provide potential steelhead, rainbow, and cutthroat spawning and rearing habitat, if they are accessible.

MV: Moderately Steep Narrow Valley Channel

MV channels are moderately steep. Adjacent moderate to steep hill slopes account for the channel confinement. The stream gradient in these channels is generally 4-8%. Dominant substrates in MV channels range from small cobble to bedrock. These channels are considered small to medium in Oregon. The sensitivity to LWD presence is moderate. Low sensitivity to fine sediments and moderate sensitivity to coarse sediments are exhibited in these systems. Peak flow sensitivity is moderate in MV channels. Overall channel habitat sensitivity is moderate in these systems. MV channels have potential steelhead, rainbow, and cutthroat spawning and rearing habitat.

SV/VH: Steep Narrow Valley/Very Steep Headwater Channel

SV and VH channels are very similar and are described together in the Oregon Watershed Assessment Manual of 1999. VH channels are steeper than SV channels. SV channels are located in steep valley bottoms and have steep mountain or hill slopes on both sides of the stream. Vertical steps, cascades, and falls are very common is these systems. VH channels are located in the headwaters of a watershed and extend to ridge tops and summits. The stream gradient in SV channels is 8-16%, VH channels are less than 16%. Dominant substrates in SV/VH channels range from large cobble to bedrock. These channels are considered small to medium in Oregon. The sensitivity to LWD presence is moderate. Low sensitivity to fine sediments and low to moderate sensitivity to coarse sediments are exhibited in these systems. Peak flow sensitivity is low in SV/VH channels. Overall channel habitat sensitivity is low in these systems. SV channels provide limited habitat for anadromous fish rearing and limited spawning and rearing habitat for resident fish. VH channels have very limited resident fish rearing habitat.

ANALYSIS OF CHANNEL HABITAT TYPE DATA

Appendix C contains the complete list of channel habitat type stream miles occurring in each sub watershed. CHTs FP1, FP2, FP3, and MM are considered the most highly sensitive as described in OWEB (1999). CHTs which include LC, LM, MV, MH, and MC, are moderately sensitive. SH and VH CHTs have low sensitivity. Table 3-4 shows the longest CHT lengths present in each sub watershed.

Table 3-5 lists the total stream miles of highly sensitive CHTs occurring in each sub watershed. The percentage of highly sensitive habitat types within each sub watershed is also included in Table 3-5. Rogue River/Snider Creek contains the greatest total stream miles and greatest percent of highly sensitive

Table 3-4
Greatest CHT Lengths in Sub Watersheds

Channel Habitat Type	Sensitivity	Sub Watershed	Stream	Stream Miles
FP1, FP2, FP3	**High**	**Rogue/Snider Creek**	**Snider Creek**	**8.51**
FP1, FP2, FP3	**High**	**Upper West Fork Evans Creek**	**West Fork Evans Creek**	**3.1**
MM	**High**	**Evans Creek/Sykes Creek**	**Sykes Creek**	**3.42**
MM	**High**	**Lower West Fork Evans Creek**	**Rock Creek**	**1.47**
LC	Moderate	Lower West Fork Evans Creek	West Fork Evans Creek	3.62
LM	Moderate	Evans Creek/Sykes Creek	Evans Creek	8.92
LM	Moderate	Lower Evans Creek	Evans Creek	8.51
LM	Moderate	Upper Evans Creek	Evans Creek	7.46
LM	Moderate	Pleasant Creek	Pleasant Creek	6.15
MV, MH, MC	Moderate	Upper Evans Creek	Evans Creek	7.41
MV, MH, MC	Moderate	Sardine Creek	Right Fork Sardine Creek	6.69
MV, MH, MC	Moderate	Lower West Fork Evans Creek	Salt Creek	5.93
MV, MH, MC	Moderate	Upper Evans Creek	Morrison Creek	5.06
SV	Low	Foots Creek	Middle Fork Foots Creek	2.15
SV	Low	Foots Creek	Right Fork Foots Creek	1.93
SV	Low	Upper Evans Creek	Canon Creek	1.9
SV	Low	Evans Creek/Sykes Creek	Neathammer Gulch	1.86
VH	Low	Rogue/Galls Creek	East Branch Galls Creek	1.87
VH	Low	Foots Creek	Right Fork Foots Creek	1.21

Bold = Sub Watersheds show highest CHT sensitivity

Table 3-5
Total Miles and Percent of Highly Sensitive CHTs Occurring in Each Sub Watershed

Sub Watershed	Total Stream Miles of FP1, FP2, FP3, and MM	Percent of Sub Watershed FP1, FP2, FP3, and MM
Upper West Fork Evans Creek	3.1	10.69
Upper Evans Creek	0.74	1.71
Rogue River/Ward Creek	0.65	2.65
Rogue River/Snider Creek	8.73	47.16
Rogue River/Sams Creek	5.259	15.35
Rogue River/Sardine Creek	0	0
Rogue River/Galls Creek	1.16	4.63
Pleasant Creek	1.98	4.49
Lower West Fork Evans Creek	1.99	5.89
Lower Evans Creek	3.11	10.8
Foots Creek	0	0
Evans Creek/Sykes Creek	4.2	8.67

channel habitat in the SBW. Rogue River/Sams Creek contains the second greatest total stream miles and percent of high sensitivity channel habitat. Rogue River/Sardine Creek and Foots Creek do not contain any high sensitivity CHTs. Figure 3-1 shows the distribution of CHTs throughout the entire watershed. Highly sensitive streams generally have gradients which range from <2% to 4%. Such stream gradients are preferred by coho salmon, rainbow trout, steelhead, and chinook salmon. These streams should be a high priority for conservation and restoration efforts within the watershed, as they provide critical habitat for the salmonids of the watershed. FP1, FP2, and FP3 channels have questionable success with regard to riparian enhancement efforts. This is due to the tendency of the stream to move laterally. Side channel improvements to riparian vegetation and increasing shade may

indirectly improve bank stability and stream habitat and be a more efficient means of channel enhancement. MM channels, however, are receptive to enhancement efforts. The addition of LWD and boulders may help to increase habitat diversity in forested areas. Bank stabilization and riparian planting efforts are beneficial to these channels in non forested areas.

Moderately sensitive CHTs are located throughout the SBW. Table 3-6 lists the total stream miles of moderately sensitive CHTs occurring in each sub watershed. All sub watersheds within the SBW contain moderately sensitive CHTs. Many of these sub watersheds are comprised of approximately fifty percent or greater of moderately sensitive CHTs. Lower West Fork Evans Creek has the greatest percentage of moderately sensitive CHTs, but the second greatest total stream miles. Upper Evans Creek has the greatest total stream miles and second greatest percentage of moderately sensitive channel habitat. Sams Creek has the smallest total stream miles and greatest percentage of moderately sensitive CHTs. Moderately sensitive streams generally have gradients which range from <2% to 6%. Such stream gradients are preferred by rainbow trout, steelhead, and chinook salmon. These streams should be a priority for conservation and restoration efforts within the watershed, as they provide critical habitat for many salmonids in the watershed. Riparian enhancement success is variable in these channels. In many instances, livestock access control and riparian plantings create beneficial improvements to the channel.

Table 3-6
Total Miles and Percent of Moderately Sensitive CHTs Occurring in Each Sub Watershed

Sub Watershed	Total Stream Miles of LC, LM, MV, MH, and MC	Percent of Sub Watershed LC, LM, MV, MH, and MC
Upper West Fork Evans Creek	13.53	46.67
Upper Evans Creek	26.97	62.54
Rogue River/Ward Creek	14.27	58.26
Rogue River/Snider Creek	7.93	42.84
Rogue River/Sams Creek	7.58	22.11
Rogue River/Sardine Creek	15.04	69.69
Rogue River/Galls Creek	13.63	54.45
Pleasant Creek	21.72	49.3
Lower West Fork Evans Creek	23.78	70.41
Lower Evans Creek	17.07	59.29
Foots Creek	11.35	32.69
Evans Creek/Sykes Creek	21.08	43.53

Low sensitivity CHTs are present in all sub watersheds of the SBW. Table 3-7 is a listing of the total stream miles and percentage of low sensitivity CHTs present in each sub watershed. Pleasant Creek has the greatest total stream miles and greatest percentage of low sensitivity CHTs. Upper West Fork Evans Creek has the second greatest percentage and third greatest total stream miles of low sensitivity CHTs. Rogue River/Snider Creek has the lowest total stream miles and percent of low sensitivity CHTs. Low sensitivity streams generally have gradients which range from 8% to >16%. These channels provide limited spawning and rearing habitat for steelhead, rainbow trout, and cutthroat trout. Enhancement efforts may not be readily responsive to improvements. However, the establishment and maintenance of riparian areas will add to woody debris within the watershed and improve overall conditions along the channel.

Table 3-7
Total Miles and Percent of Low Sensitivity CHTs Occurring in Each Sub Watershed

Sub Watershed	Total Stream Miles of SV and VH	Percent of Sub Watershed SV and VH
Upper West Fork Evans Creek	7.52	25.94
Upper Evans Creek	5.07	11.75
Rogue River/Ward Creek	4.55	18.57
Rogue River/Snider Creek	0.82	4.43
Rogue River/Sams Creek	2.25	6.56
Rogue River/Sardine Creek	1.56	7.22
Rogue River/Galls Creek	5.24	20.93
Pleasant Creek	13.65	30.98
Lower West Fork Evans Creek	3.98	11.78
Lower Evans Creek	4.88	16.95
Foots Creek	9.13	26.29
Evans Creek/Sykes Creek	10.34	21.35

CONCLUSIONS

CHT classifications provides baseline data that allows for prioritization of monitoring and restoration projects. By understanding the relationship between stream gradient class, channel confinement, and stream size in relation to stream channel sensitivity, the watershed council will be able to make educated decisions regarding riparian enhancement activities.

The data derived from this assessment have not been field verified. Other methods of CHT classification such as those described in Rosgen (1996), require more field oriented procedures and may produce more in depth results

in relation to channel restoration needs. These methods were not used in this assessment due to the length of time needed to conduct such field intensive analysis. However, it may be beneficial for further analysis of the SBW channels to utilize classification methods such as those described by Rosgen (1996) in future efforts at channel classification in the SBW.

Highly sensitive and moderately sensitive CHTs should be a priority for monitoring with regards to LWD, fine sediments, coarse sediments, and peak flows. However, field verification of those stretches of streams identified as being highly or moderately sensitive should be conducted to verify that the classifications are accurate.

DATA GAPS

A variety of data gaps exist for CHT classifications within the SBW. They are as follows:

- Channel confinement designations have not been determined;
- Field verification has not been conducted for any channel habitat type classifications; and
- Channel habitat type classifications should be compared to the Riparian Assessment of the entire watershed upon its completion.

ACTION PLAN RECOMMENDATIONS

An action plan should be developed to prioritize projects for the Seven Basins Watershed Council. The following is a list of recommendations to be incorporated in the action plan with regard to CHT classifications.

- Channel confinement designations should be determined;

- Field verification should be conducted for the channel confinement designations once completed;
- Highly sensitive and moderately sensitive CHTs should be prioritized for monitoring efforts with regards to LWD, fine sediments, coarse sediments, and peak flows;
- Field verification should be conducted for all CHT classifications;
- Conduct stream surveys to identify CHTs in unsurveyed areas; and
- A database should be assembled to efficiently manage future data. A GIS component should be used with this database in order to make it fully functional, accessible, and current.

REFERENCES CITED

Oregon Watershed Enhancement Board (OWEB), *Oregon Watershed Assessment Manual*, 1999.

Rosgen, D.L., *Applied River Morphology, Wildland Hydrology*, Colorado, 1996.

CHAPTER 4
HYDROLOGY AND WATER USES

Prepared By:
David L. Graham, EMS
Reviewed By:
Steve Strickler, R.G., EMS

INTRODUCTION

This chapter presents basic information regarding hydrology, hydrogeology, and water use in a watershed. The chapter has been divided into three main sections. Section 4.1 addresses basic aspects of hydrology and hydrogeology that are responsible for the spatial and temporal distribution of water throughout the watershed. Section 4.2 addresses the interrelationship between surface water and ground water and why they should be viewed as a single resource. Section 4.3 speaks to the issue of water use providing a brief discussion of water rights and their affect on how water is obtained and used by individuals, industry, and municipalities. Section 4.4 presents a discussion of hydrologic issues as they pertain to the SBW based on a limited set of data available for the watershed.

4.1 HYDROLOGY

The hydrologic cycle (Figure 4-1) is a group of links that represent different pathways through which water in nature circulates and is transformed. The pathways encompass three parts of the total earth system: atmosphere, hydrosphere, and lithosphere. The cycle has no beginning or end since water evaporates from the oceans and the land and becomes part of the atmosphere.

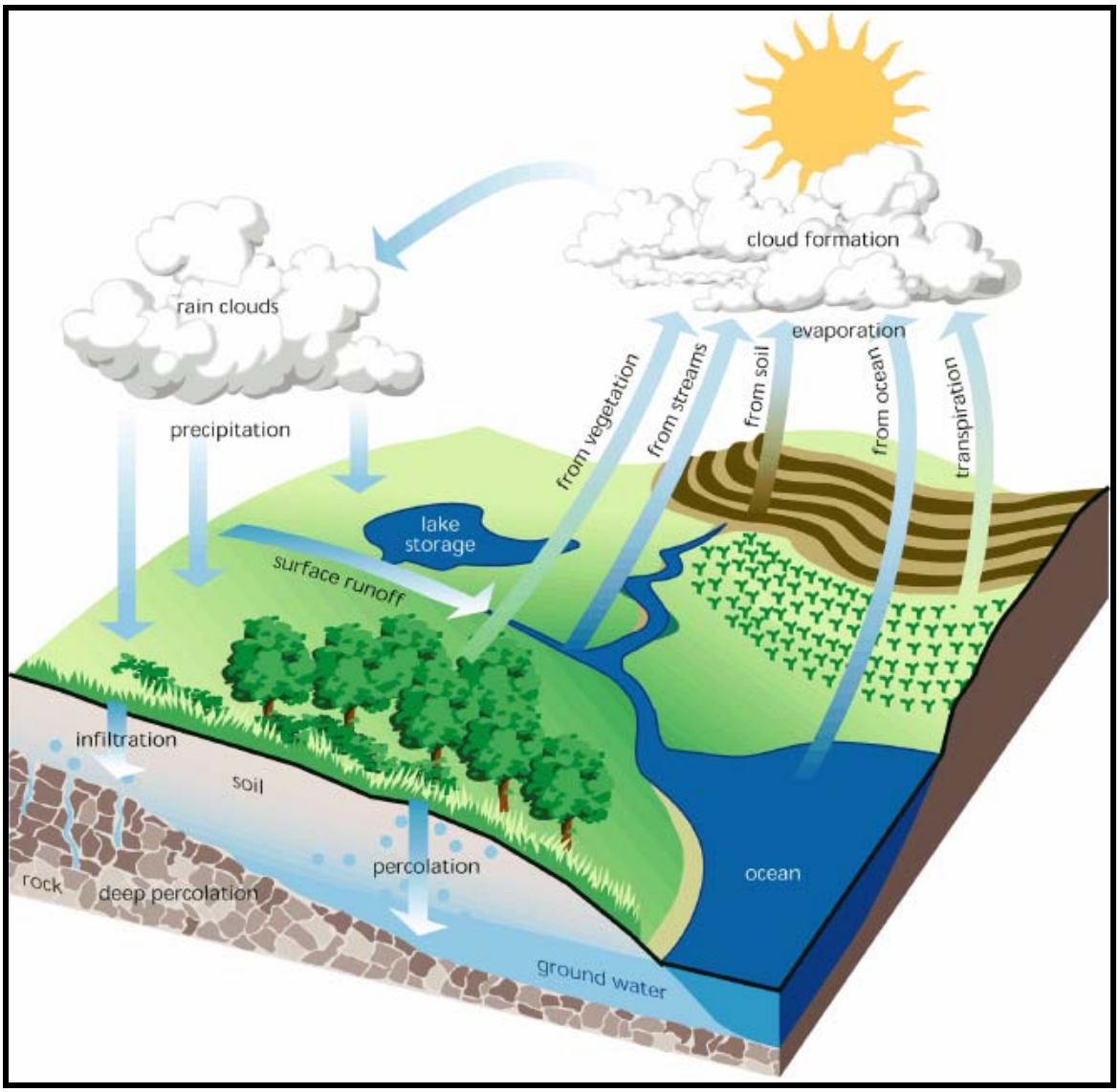


Figure 4-1
Schematic Representation of the Components of the Hydrologic Cycle
(From FISRWG, 1998)

The evaporated moisture is lifted and carried in the atmosphere until it falls as precipitation to the earth to start the cycle again (Chow 1964).

Precipitated water may be intercepted by plants, run over the ground surface and into streams, or infiltrate into the ground. Much of the intercepted and transpired water and/or surface runoff return to the air via evaporation. The infiltrated water may percolate to deeper zones to be stored as ground water.

This water may later flow out as springs or seep into streams, finally evaporating into the atmosphere to complete the hydrologic cycle.

Inflow to the hydrologic cycle arrives as precipitation in the form of rainfall or snowmelt. Outflow takes place as streamflow (runoff) and as evapotranspiration (a combination of evaporation from open bodies of water, evaporation from soil surfaces, and transpiration from soils by plants). Precipitation is delivered to streams on the land surface and overland flow to tributary channels as well as by subsurface flow routes as interflow and baseflow following infiltration into the soil. A watershed must be envisioned as a combination of both surface drainage and the parcel of subsurface soils and geologic formations that underlie it. The subsurface hydrologic processes are just as important as the surface processes. In fact, it could be argued that they are more important, for it is the nature of the subsurface materials that controls infiltration rates, and the infiltration rates influence the time and spatial distribution of surface runoff.

Considerable attention has been given to the concept of the global water balance (Nace, 1971; Lvovitch, 1970; and Sutcliffe, 1970). If we remove from consideration the 94% of the earth's water that resides in the oceans and seas at high levels of salinity, ground water accounts for two-thirds of the freshwater resources in the world. If consideration is limited to only the utilizable freshwater resources (minus icecaps and glaciers), ground water accounts for almost all the total volume. If consideration is further limited to only the most "active" ground water flow regimes the freshwater breakdown comes to ground water (95%), rivers, lakes, and swamps (3.5%) and soil moisture (1.5%). The volumetric superiority is tempered however, by the average residence times for each component. River water has a turn over time on the order of two weeks while ground water moves slowly with residence times of 10's, 100's or even 1,000's of years. Even considering the concept of residence time, it is clear that both ground water and surface water must be taken into account when

attempting to evaluate the hydrologic conditions within a watershed (Freeze and Cherry, 1979).

Understanding the interaction of ground water and surface water is essential to management of water resources at all scales. Management of one portion of the hydrologic system is common, but only partly effective because each hydrologic component is in continual interaction with others.

STREAM CORRIDORS

Most stream corridors have three major components:

- Stream Channel;
- Floodplain; and
- Transitional Upland Fringe.

The stream channel is that portion of the corridor with flowing water at least part of the year. The floodplain is a highly variable area on one or both sides of the stream channel that in inundated by flood waters at some interval. The transitional upland fringe is a portion of the upland on one or both sides of the floodplain that serves as a transitional zone or edge between the floodplain and the surrounding landscape (Federal Interagency Stream Restoration Working Group (FISRWG], 1998).

Stream Channel

Nearly all channels are formed, maintained, and altered by water and sediment they carry. Usually they are gently rounded in shape and roughly parabolic, but form can vary greatly. The deepest part of the channel is referred to as the thalweg. The dimensions of a channel cross section define the amount of water that can flow along without spilling over the banks.

A distinguishing feature of the channel is streamflow. As part of the water cycle, the ultimate source of all flow is precipitation. The pathways precipitation takes after it falls affect many aspects of streamflow including quantity, quality, and timing. The two basic components the stream channel are streamflow and baseflow. Stream flow is precipitation that reaches the channel over a short time frame through overland and underground routes. Baseflow is precipitation that percolates to ground water and moves slowly through an aquifer before reaching the channel. It sustains streamflow during periods of little or no precipitation (FIRSWG, 1998).

Stream Discharge

Discharge is the term used to describe the volume of water moving down a stream channel per unit time. The basic unit of flow used to describe discharge is cubic feet per second (cfs). Discharge is related to the cross sectional area of the stream channel through which the water flows and the average velocity of the water. Discharge can be estimated in the following manner:

$$Q = AV$$

Where:

Q = Discharge (cfs);

A = Area through which the water flows (ft^2); and

V = Average velocity in feet per second (ft/sec).

The various components of flow are illustrated in Figure 4-2.

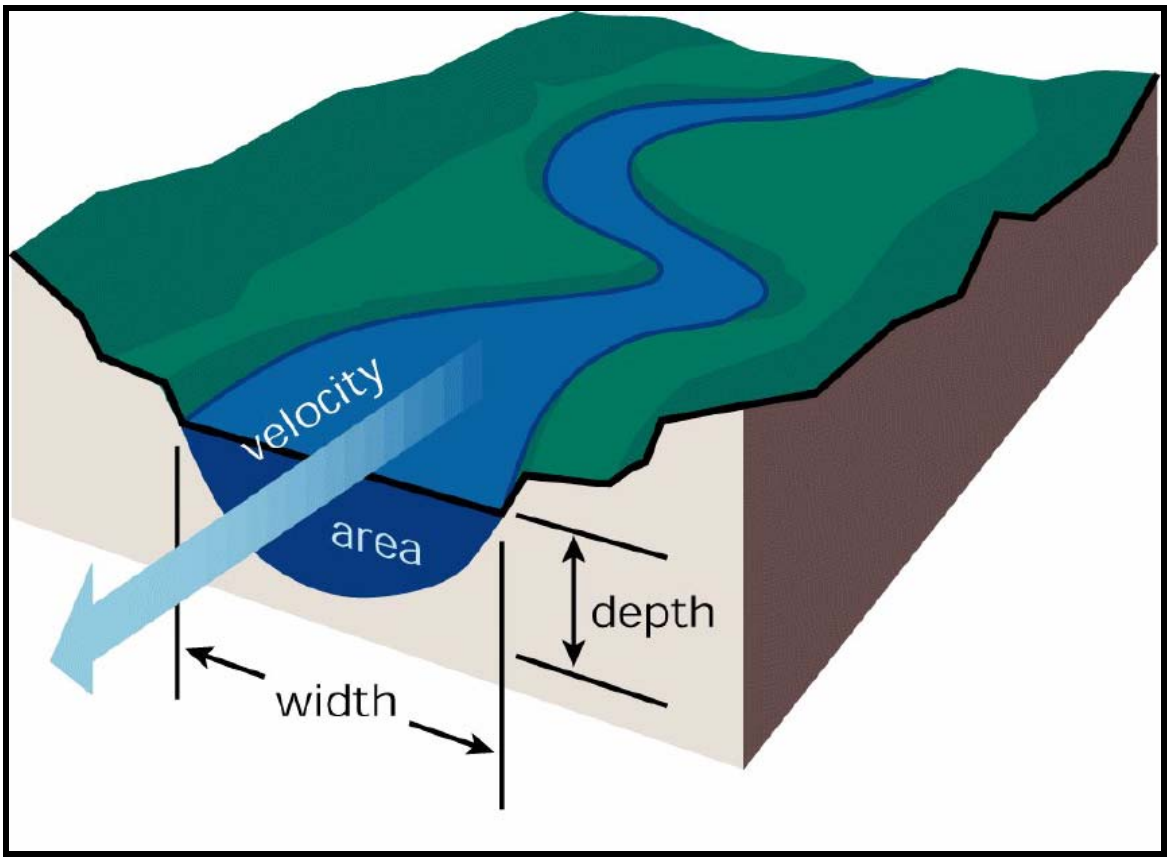


Figure 4-2
Channel Discharge is the Product of Channel Area Times Discharge Rate
(From: FISRWG, 1998)

Peak Discharge

A storm hydrograph is a tool used by hydrologists to determine how stream discharge changes with time (Figure 4-3). The portion of the hydrograph that lies to the left of the peak is called the rising limb and it provides information regarding how long it takes the stream to peak following a particular precipitation event. The portion of the curve to the right of the peak is referred to as the recession limb and provides an estimate of how long it takes a stream to return to normal flow conditions after a peak. The time between the middle of the rainfall event and the occurrence of peak runoff is called the lag time. These features of a storm hydrograph are illustrated in Figure 4-3.

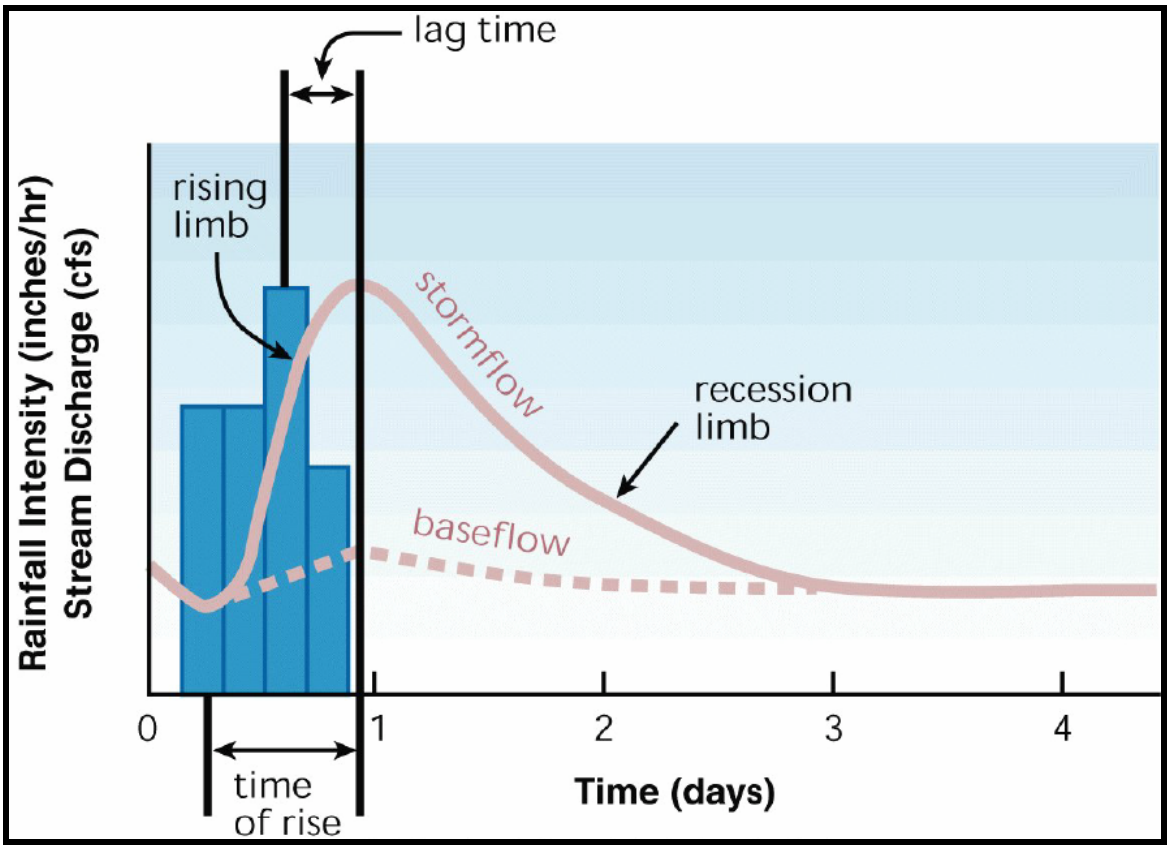


Figure 4-3
Stream Hydrograph Used to Show Response of a Stream to Precipitation Events
(From: FIRSWG, 1998)

Floodplain

The floor of most stream valleys is relatively flat. This is because over time the stream moves back and forth across the valley floor in a process called lateral migration. In addition, periodic flooding causes sediments to move down gradient and to be deposited on the valley floor near the channel. There are two basic types of floodplains; the hydrologic floodplain and the topographic floodplain. These two types of floodplains are illustrated in Figure 4-4. The hydrologic flood plain is defined as the land found adjacent to the baseflow channel below the bankfull elevation. It is typically inundated. However, not all stream corridors have a hydrologic floodplain. The topographic floodplain is

defined as the land adjacent to the channel that includes the hydrologic floodplain and other land up to an elevation reached by a flood peak of a given frequency (e.g., the 100-year floodplain)(FIRSWG, 1998).

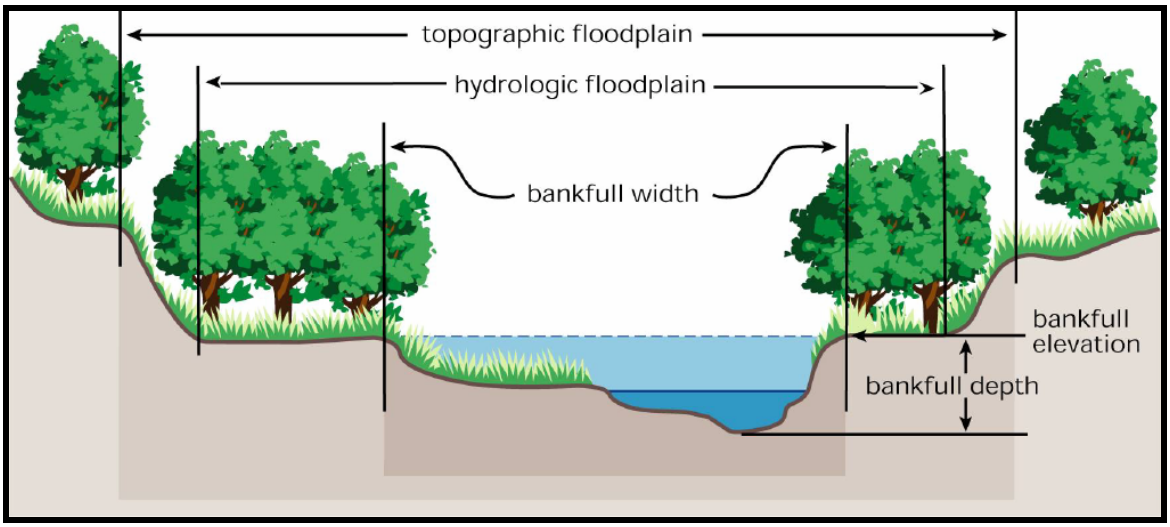


Figure 4-4
Floodplain Components
(From: FIRSWG, 1998)

The term "100-year flood," is used to describe the recurrence interval of floods (Table 4-1). As shown in Table 4-1, the 100-year recurrence interval means that a flood of that magnitude has a one percent chance of occurring in any given year. In other words, the chance that a river will flow as high as the 100-year flood stage in any year is 1 in 100. Statistically, each year begins with the same 1% chance that a 100-year event will occur. However, it should be realized that just because a 100-year flood happened last year does not mean that it will not happen this year, too. In other words, future rainfall and floods do not depend on the rainfall and floods that happened in the past. Past records are mainly used to show what kind of river flows can be expected. Thus, the term 100-year flood provides a general idea that such a flood was a significant event.

Table 4-1
Recurrence Intervals

Recurrence Interval (in yrs)	Probability of Occurrence in any Given Year	% Chance of Occurrence in any Given Year
100	1 in 100	1
50	1 in 50	2
25	1 in 25	4
10	1 in 10	10
5	1 in 5	20
2	1 in 2	50

The floodplain provides temporary storage space for floodwaters and sediment produced by the watershed. This attribute serves to add to the lag time of a flood. If the streams capacity for moving water and/or sediment is diminished, or if the sediment load produced from the watershed become too great for the stream to transport, flooding will occur more frequently and the valley floor will begin to fill. Valley filling results in the temporary storage of sediment produced by the watershed (FIRSWG, 1998).

It should be recognized that most of the streams in the SBW are considered to be in mountainous terrain or are small in size and typically do not have well developed floodplains. With the exception of the Rogue River, the lower reach of Evans Creek, primarily between the towns of Wimer and Rogue River, is the best example of a floodplain in the SBW.

Transitional Upland Fringe

The transitional upland fringe (TUF) serves as a transitional zone between the floodplain and the surrounding landscape. Thus, its outside boundary is also

the outside boundary of the stream corridor itself. Stream related hydrologic and geomorphic processes may be responsible for forming some portion of the TUF over geologic time; they typically are not responsible for maintaining or altering its present form. Land use activities have the greatest potential impact on this component of the stream corridor (FISRWG 1990).

There is no typical cross section for this component of the stream corridor. TUFs can be flat, sloping, or in some cases nearly vertical. All TUFs have one common attribute; they are distinguishable from the surrounding landscape by their greater connection to the floodplain and stream.

The floodplain side of the TUF often reveals one or more benches. These benches are terraces formed in response to new patterns of streamflow, changes in sediment size or load, or changes in watershed baselevel (i.e., the elevation at the watershed outlet). Figure 4-5 illustrates terrace formation by channel incision. Figure 4-5 represents a nonincised channel. Changes in streamflow or sediment delivery can disrupt stream equilibrium and the channel degrades and widens. The original floodplain is abandoned and becomes a terrace (B). The widening phase is completed when a floodplain evolves within the widened channel (C) (FIRSWG, 1998).

IMPACTS OF WEATHER ON WATERSHED HYDROLOGY AND ECOSYSTEMS

Flooding

Floods have been recorded in the northwest since Euro-American settlement. Records show fifteen high water events have occurred in the vicinity of the SBW in the past one hundred fifty years. The years that have experienced major flooding are listed in Table 4-2.

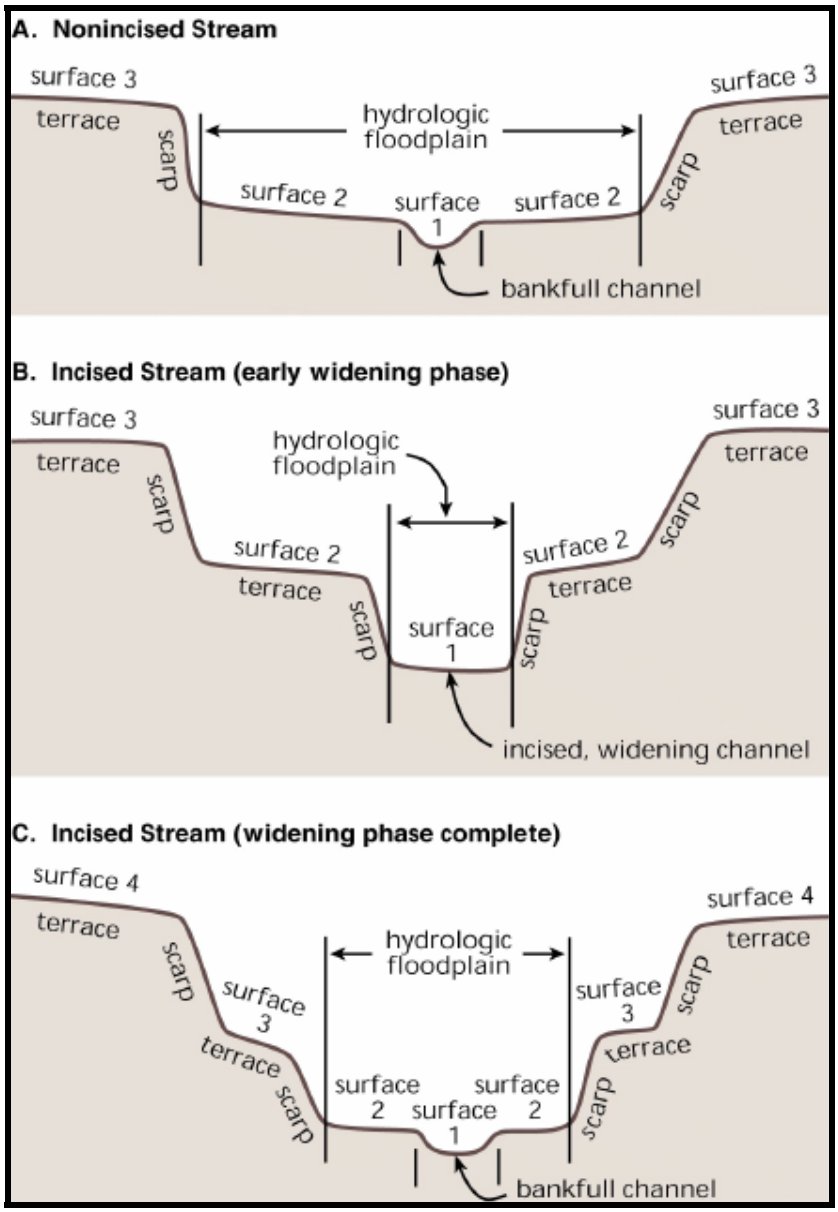


Figure 4-5
Terraces in (A) Nonincised and (B) and (C) Incised Streams
(From: FIRSWG, 1998)

Major floods are typically caused by a combination of a heavy snow pack in the mountains and warm torrential rain that quickly melts the snow. The SBW has experienced periodic flooding which has resulted in significant changes to the landscape, channels, and ecosystems. Flood waters have changed the course of rivers and streams, damaged or destroyed homes, bridges, ferries,

and crop lands in the SBW. When flooding occurs in areas inhabited by man, it can spread pollutants and invasive organisms by disrupting normal drainage systems in cities and overwhelming sewer and septic systems.

Table 4-2
Years that Major Flooding Occurred

1853	1945
1858	1948
1861	1953
1866	1955
1867	1962
1880	1964
1890	1974
1927	1997

Flooding is a natural phenomenon that cycles water, nutrients, and sediment through river systems. Flood waters scour away organic materials that accumulate on river bottoms and deposit sediment onto stream banks, encouraging growth of riparian vegetation. Flooding is beneficial to streams because it creates both local and regional environmental balance, affecting water quality and aquatic life. Many species of fish and macroinvertebrates require high water events to complete there life cycle. Flood waters carry heavy sediment loads from areas where accelerated erosion and scour occur. These sediments are redistributed over vast areas. In areas where the sediment is deposited, replenishment of valuable topsoil can occur. Shallow water table aquifers can be physically affected by flooding when water levels rise in response to rapid recharge from flood waters. Ground water can also be affected chemically by flooding if pollutants are transported by flood waters and recharged to shallow aquifers. Silt ladened flood waters can reduce infiltration rates to shallow aquifers by reducing the hydraulic conductivity of the surface soils where recharge normally takes place.

Drought Cycles

A drought is a period of drier-than-normal conditions that results in water-related problems. Precipitation (rain or snow) falls in uneven patterns across the country. The amount of precipitation at a particular location varies from year to year, but over a period of years, the average amount is fairly constant.

The amount of rain and snow also varies with the seasons. In some areas, most of the yearly precipitation falls in the early spring. Even if the total amount of rainfall for a year is about average, rainfall shortages can occur during critical periods when moisture is needed for plant growth (Moreland, 1993).

When little or no rain falls, soils can dry out and plants can die. When rainfall is less than normal for several weeks, months, or years, several changes in water resources occur:

- The flow of streams and rivers decline;
- Water levels in lakes and reservoirs fall; and
- The depth to water in wells increases.

If dry weather persists and water-supply problems develop, the dry period can become a drought (Moreland, 1993).

The beginning of a drought is difficult to determine. Several weeks, months, or even years may pass before it is recognized that a drought is occurring. The first evidence of drought usually is seen in precipitation records. Within a short period of time, the amount of moisture in soils can begin to decrease. The effects of a drought on flow in streams and reservoirs may not be noticed for several weeks or months. Declining water levels in wells may not reflect a shortage of rainfall for a year or more after a drought begins because of the lag between the time when precipitation falls and the actual time that it enters the aquifer as recharge.

The Palmer Drought Severity Index was developed in the 1960's and uses temperature and rainfall information in a formula to determine dryness. The index is most effective in determining long term drought that extends over several months and is not as good for short-term forecasts (a matter of weeks). It uses a 0 for normal, and drought is shown in terms of negative numbers; for

example, negative 2 is moderate drought, negative 3 is severe drought, and negative 4 is extreme drought (National Oceanic and Atmospheric Administration [NOAA], 2003). The advantage of the Palmer Index is that it is standardized to local climate, so it can be applied to any part of the country to demonstrate relative drought or rainfall conditions.

Figure 4-6 illustrates the Palmer Index for the continental United States. The figure shows that the SBW is currently in a period of moderate drought. The drought index is updated weekly on the NOAA website.

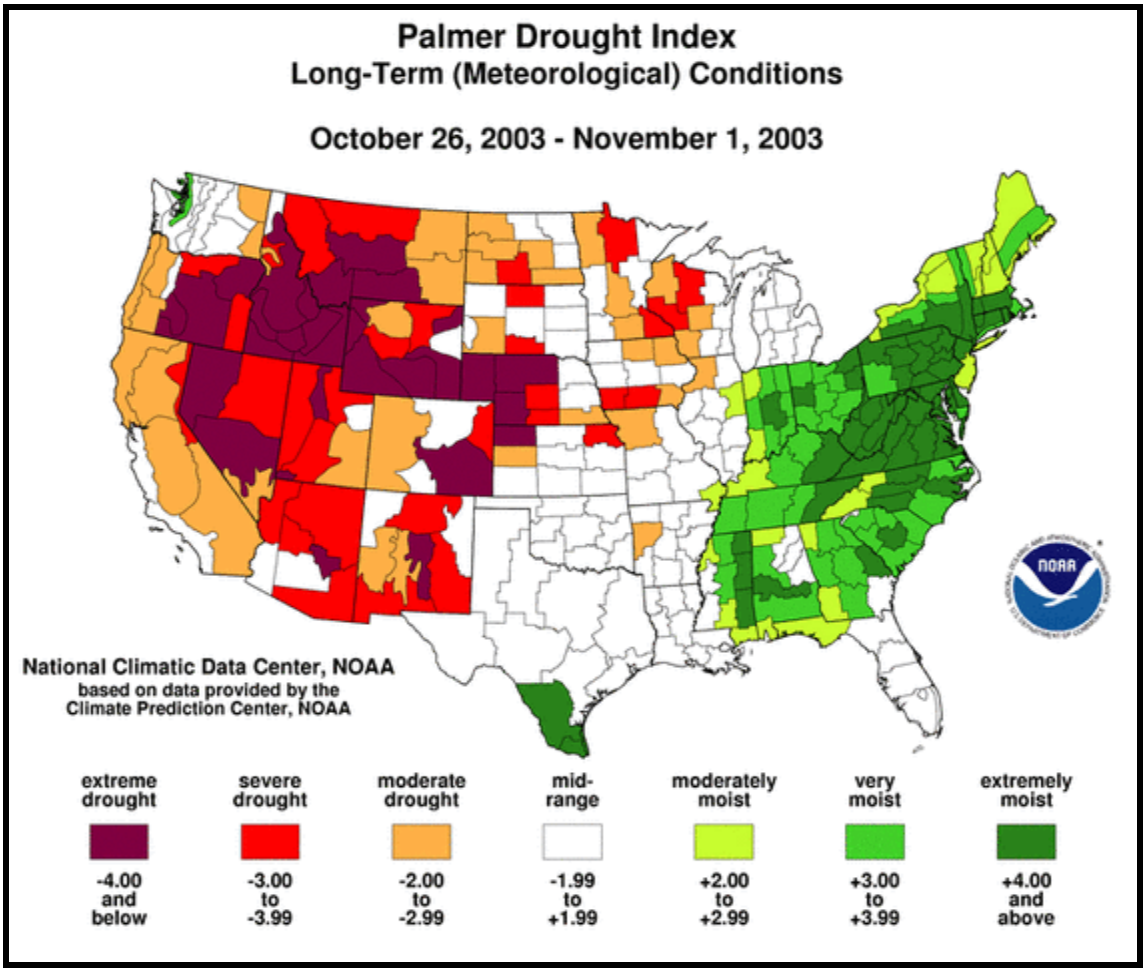


Figure 4-6
Palmer Drought Index as Calculated by NOAA for the Period Shown

Recurrent drought cycles have been shown to be influenced by repeated *El nino* and *La nina* cycles. In the Northwest, temperature and precipitation data are available for about the past 100 years. During that time, there have been four relatively distinct climatic periods (Taylor and Southards, 1997):

- 1896-1914 Generally wet/cool
- 1915-1946 Generally dry/warm
- 1947-1975 Generally wet/cool
- 1976-1994 Generally dry/warm

These periods are illustrated graphically in Figure 4-7 which shows annual precipitation (departures from the long-term average) for the Oregon Coast. All stations west of the crest of the Coast Range were averaged together to arrive at a single value each year and the yearly values were compared with the long-term average. The Water Year (October through September) was used so that all months from a single winter remained in the same data set.

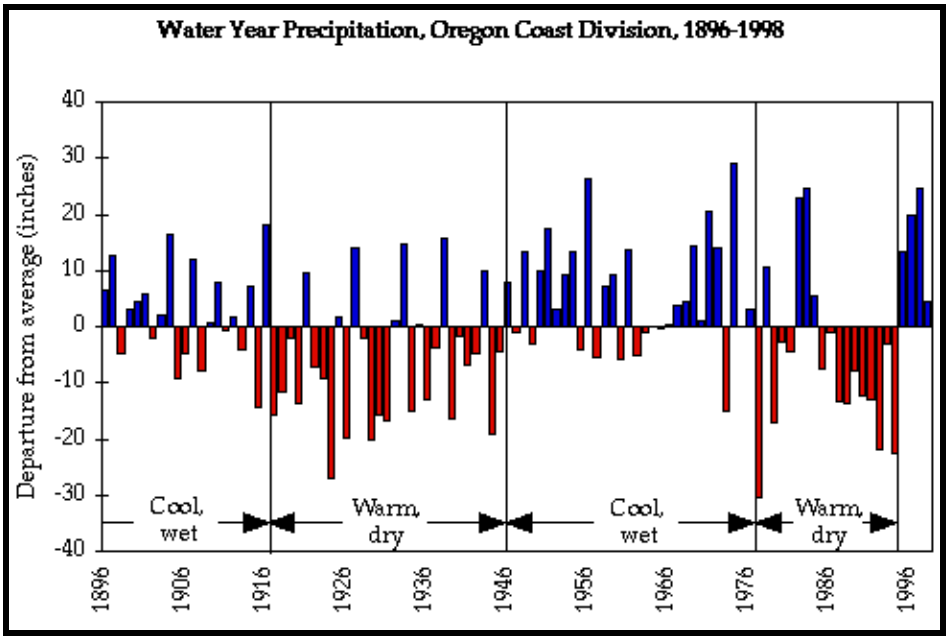


Figure 4-7
Precipitation Data Illustrating Cool/Wet and Warm/Dry Cycles Along the Oregon Coast
(From: Taylor and Southards, 1997)

Taylor and Southards (1997) note that for any given period, not all the years are dry or wet, but that a high percentage follows that pattern. For example, in the 1915-1946 period, there were 22 dry years and only 10 wet ones. Consecutive dry years were common (indicating drought periods). The wet period immediately following had 21 wet years versus seven dry years, and consecutive dry years never occurred. Droughts were nonexistent during the latter period, although there were several major floods. The most severe drought years recorded were the years of 1929–1931. The entire Pacific Northwest experienced an extended drought from 1976 to 1995. 2001 was the driest year since recording began.

Potential Impact of Climate on Salmon Populations

According to Taylor and Southards (1997); there is increasing evidence that salmon populations in the northwest are significantly influenced by long-term climate changes. Scientists have found that salmon returns in the Northwest show long-term correlation with climate cycles. Figure 4-8 (Anderson, 1995) presents a comparison of the "Pacific Northwest Index" (PNI) to distinguish cool, wet periods from warm, dry periods. This data correlates well with the data presented in Figure 4-7 for the Oregon Coast.

Anderson (1996) also compared the PNI with Columbia River spring Chinook salmon returns using data collected since 1940 (earlier data are not available). The correlation between spring Chinook and PNI is very strong, and indicates that salmon returns increase during cool, wet periods and decline during warm, dry ones. As pointed out by Taylor and Southards (1997), while there are undoubtedly human-induced effects on the fish (including dam construction, habitat destruction, etc.), Figure 4-8 provides compelling evidence that natural climate variability may be a very significant influence as well, and should be considered in any salmon restoration plan.

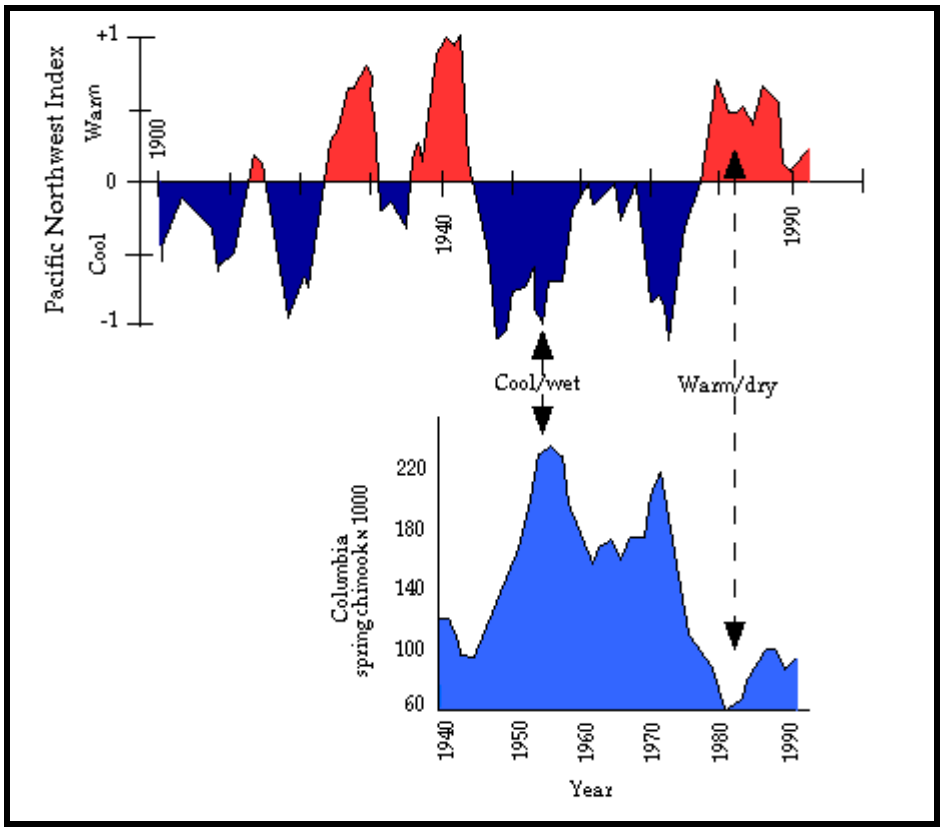


Figure 4-8
Climate Effects on Columbia River Chinook Salmon
(From: A testimony before the U.S. House of Representatives by Anderson, 1995)

GROUND WATER

Water beneath the land surface occurs in two principal zones, the vadose or unsaturated zone and the saturated zone. In the unsaturated zone, the spaces between grains of gravel, sand, silt, clay, and cracks within rocks--contain both air and water. Although a considerable amount of water can be present in the unsaturated zone, this water cannot be pumped by wells because it is held too tightly by capillary forces (Winter et al., 1998). The upper part of the unsaturated zone is typically referred to as the soil-water zone. The soil zone is crisscrossed by roots, voids left by decayed roots and animal and worm burrows, which enhance the infiltration of precipitation into the soil zone. Soil water is used by plants for basic life functions and transpiration, and can also

evaporate directly to the atmosphere. Figure 4-9 graphically illustrates the location of the unsaturated zone, the capillary fringe, and the saturated zone.

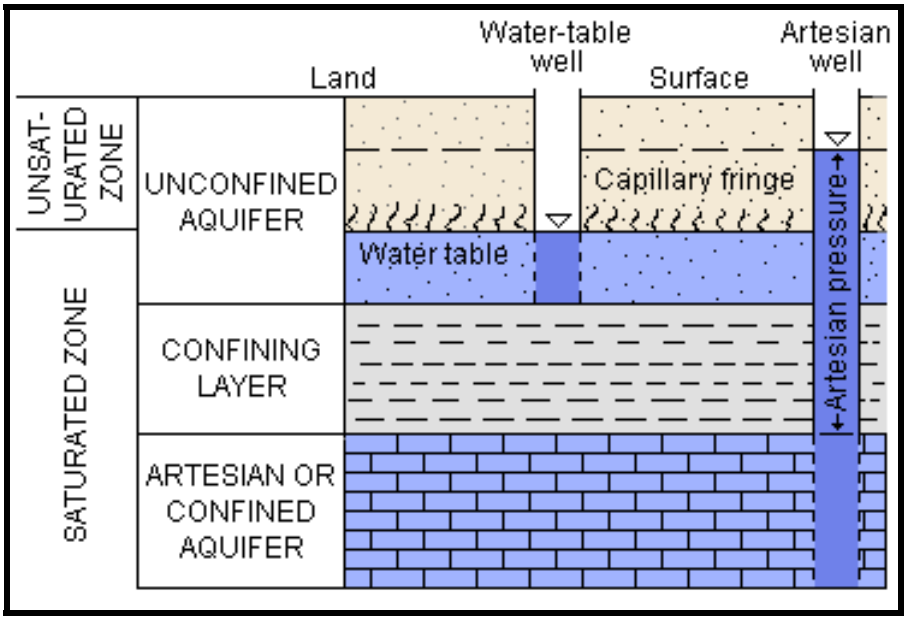


Figure 4-9
Components of a Ground Water Flow System
(From: Purdue Research Foundation, 1996)

Unlike the unsaturated zone, the voids in the saturated zone are filled with water. This water is referred to as ground water. The upper surface of the saturated zone is called the water table. Below the water table, the water pressure is great enough that water enters wells, thus permitting ground water to be withdrawn for beneficial use. Figure 4-9 illustrates the location of wells in various portions of an aquifer(s) (Winter et al., 1998).

The depth to the water table can be highly variable and can range from zero, when it is at land surface, to hundreds or even thousands of feet in some types of landscapes. Usually, the depth to the water table is small near permanent bodies of surface water such as streams, lakes, and wetlands. An important characteristic of the water table is that its location or configuration varies seasonally and from year to year. This variability is because ground water

recharge is related to variation in quantity, distribution, and timing of precipitation (Winter et al., 1998).

As illustrated in Figure 4-10, ground water moves along flow paths of varying lengths from areas of recharge (i.e., locations within a ground water flow system where precipitation enters the saturated zone) to areas of discharge (i.e., locations within a ground water flow system where ground water leaves an aquifer). The source of water to the water table (ground water recharge) is infiltration of precipitation. Ground water discharge points can be the result of springs exiting at ground surface, discharge to surface water bodies (rivers, lakes, wetlands, ocean, etc.), or discharge to wells as result of pumping.

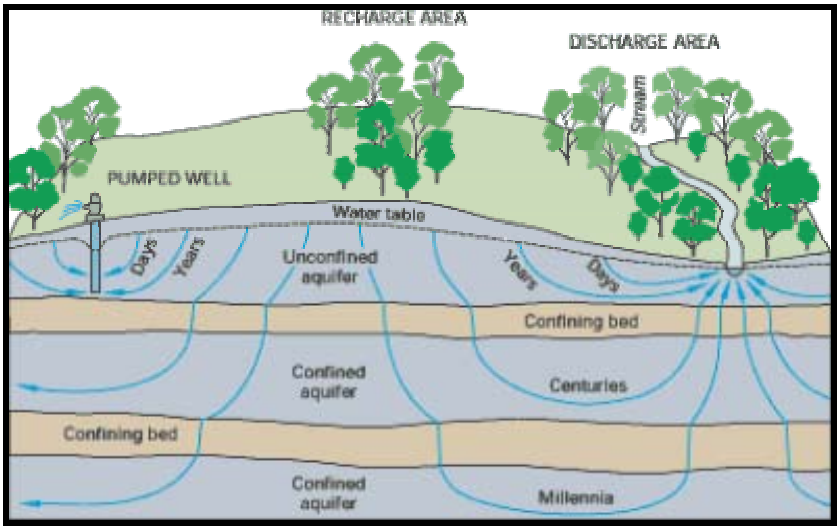


Figure 4-10
Illustration of Ground Water Flow Paths and Aquifer Types
(From: Winter et al., 1998)

The generalized flow paths in Figure 4-10 start at the water table, continue through the ground water system, and terminate at a stream and a pumped well. In general, the surface of the water table tends to mimic the surface topography. In the uppermost, unconfined aquifer (water table aquifer), flow paths near the stream can be 10's to 100's of feet in length and have corresponding traveltimes of days to a few years. The longest and deepest flow

paths are associated with deep confined aquifers. Flow path length may be 1,000's of feet to 10's of miles and traveltimes may range from decades to millennia in these deeper aquifers (Winter et al., 1998).

4.2 SURFACE WATER/GROUND WATER INTERACTION

The hydrologic system is complex, from the climate system that drives it, to the earth materials that the water flows across and through, to the modifications of the system by human activities. Much research and engineering has been devoted to the development of water resources for water supply. However, most past work has concentrated on either surface water or ground water without much concern about their interrelations. The need to understand better how development of one water resource affects the other is universal, and will surely increase as development intensifies.

The path by which water reaches a stream depends on such factors as climate, geology, topography, soils, vegetation, and land use. In various parts of the same watershed different processes may generate streamflow or the relative importance of each process may differ. Nevertheless, it is recognized that there are essentially three processes that feed streams. They are:

- Overland flow;
- Subsurface stormflow (or interflow); and
- Ground water flow (baseflow).

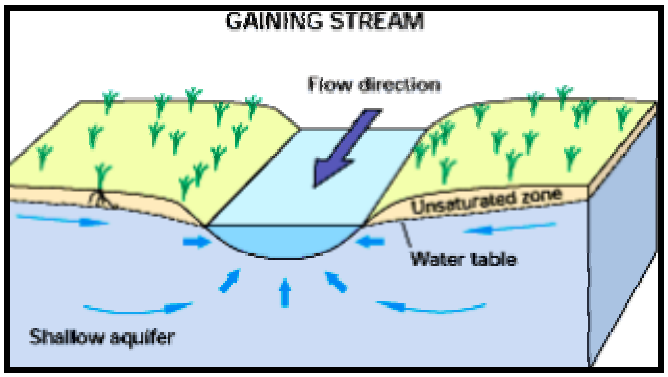
While regional ground water flow may sometimes contribute to runoff during storms, its primary importance is in sustaining streams during low-flow periods between rainfall and snowmelt events. Streamflow hydrographs reflect two very different types of contributions from the watershed. The peak flows are delivered to a stream by overland flow, subsurface stormflow, and to a much lesser extent by ground water flow. The peaks are the result of a fast

response to short-term changes in the subsurface flow systems in hillslopes adjacent to channels. Baseflow, which is delivered to the stream by deeper ground water flow, is the result of a slow response to long-term changes in the regional ground water flow systems.

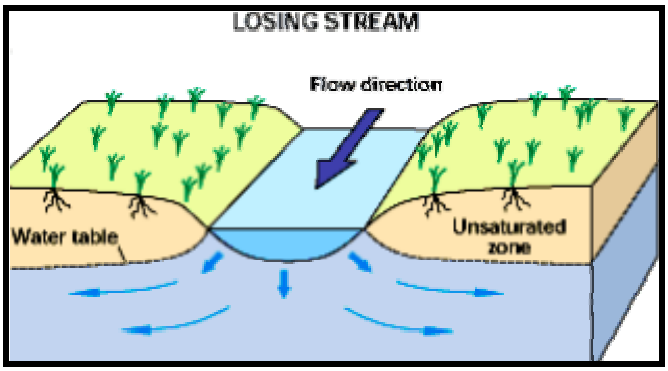
Ground water contributes to stream flow in most physiographic and climatic settings. Even in settings where streams are primarily losing water to ground water, certain reaches may receive ground water inflow during some seasons. The proportion of stream water that is derived from ground water inflow varies across physiographic and climatic settings. The amount of water that ground water contributes to streams can be estimated by analyzing streamflow hydrographs to determine the ground water component, which is termed base flow. Several different methods of analyzing hydrographs have been used by hydrologists to determine the base-flow component of streamflow (Winter et al., 1998). However, a discussion of these analytical tools is beyond the scope of this document.

The interaction of surface water and ground water takes place in three basic ways: streams gain water from inflow of ground water through the streambed (gaining stream; Figure 4-11 A), they lose water to ground water by outflow through the streambed (losing stream, Figure 4-11 B); or they do both, gaining in some reaches and losing in other reaches.

A.



B.



C.

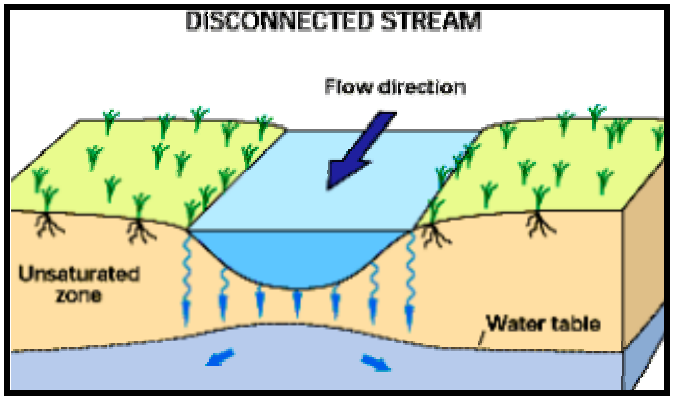


Figure 4-11
(A) Gaining Streams Receive Water from the Ground Water System;
(B) Losing Streams Lose Water to the Ground Water System; and
(C) Disconnected Streams are Separated from the Ground Water System by an Unsaturated Zone
(Modified from Winter et al., 1998)

Gaining Stream

A stream can receive water as a result of ground water discharge. For ground water to discharge into a stream channel, the altitude of the water table in the vicinity of the stream must be higher than the altitude of the stream-water surface. Under these conditions the water table slopes toward the stream so that the hydraulic gradient of the aquifer is in the direction of the stream channel (Figure 4-11 A). A stream that is normally a gaining stream during baseflow conditions may temporarily become a losing stream during flood events. If the flood crest depth in the channel is greater than the local water table elevation, the hydraulic gradient in the aquifer next to the stream can be reversed as a result of bank storage (Figure 4-12).

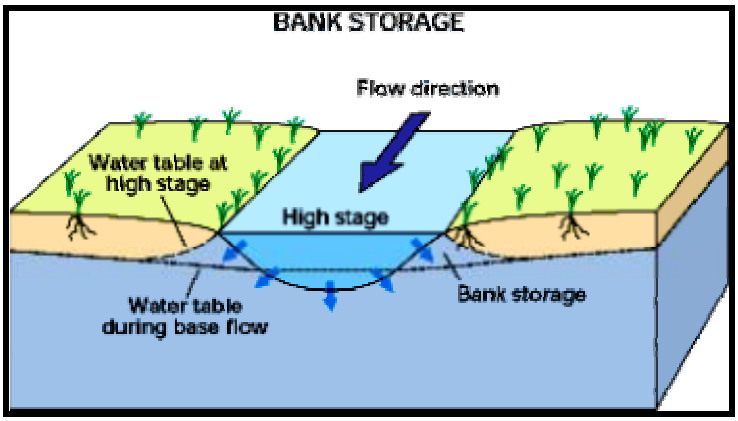


Figure 4-12
If Stream Levels Rise Higher than Adjacent Ground Water Levels, Stream Water Moves into the Streambanks as Bank Storage
(Modified from Winter et al., 1998)

Losing Stream

Typically, streams are fed by overland flow, interflow, and baseflow at higher elevations. As they move to lower elevations the local precipitation amounts decrease, consequently there is less infiltration and a lower water table. As one goes downstream, less and less water will be found in the stream channel. The

rate of water loss is a function of the depth to ground water and the hydraulic conductivity (ability of a material to transmit water) of the underlying materials. For surface water to seep to ground water, the altitude of the water table in the vicinity of the stream must be lower than the altitude of the stream-water surface.

Losing streams can be connected to a ground water system by a continuous saturated zone (Figure 4-11 B) or can be disconnected from the ground water system by an unsaturated zone (Figure 4-11 C). An important feature of streams that are disconnected from ground water is that pumping of shallow ground water near the stream does not affect the flow of the stream near the pumped wells (Winter et al., 1998).

Ground water use near a stream can have a significant effect on the relationship between surface water and ground water. Heavy ground water pumping from wells located near a stream can lower the water table to an elevation below the bottom of the stream channel. The reach of stream affected by the lowering water table can become a losing stream, while the upstream and downstream reaches can still be gaining.

Effects of Pumping Near a Stream

Ground water use near a stream can have a significant effect on the relationship between surface water and ground water. Heavy ground water pumping from wells located near a stream can lower the water table to an elevation below the bottom of the stream channel. The reach of stream affected by the lowering water table can become a losing stream, while the upstream and downstream reaches can still be gaining.

Withdrawing water from shallow aquifers near surface water bodies can diminish the available surface water supply by:

- Capturing some of the ground water flow that would normally discharge to the surface water body; or
- By inducing flow from the surface water source into the surrounding aquifer (Winter et al., 1998).

The magnitude of this affect depends on the distribution of the wells and how they are pumped. A limited amount of wells located sporadically along a stream will produce local changes in the surface water regime. However, numerous wells spaced relatively closely over a large area can cause regional impacts to stream flow.

Figure 4-13 is an illustration presented by Winter et al. (1998). In this example, a river system and a shallow water table aquifer are hydraulically connected. The situation illustrated in Figure 4-13 A, represents a case where ground water in the shallow aquifer discharges to the stream under natural flow conditions. Figure 4-13 B illustrates how the ground water flow regime is altered when a production well is placed near the stream. In this situation, ground water flow that would typically discharge to the stream is "short circuited" and moves to the well. Only a limited amount of the ground water moves to the stream under these conditions. If the well is pumped at a higher rate; additional drawdown can occur and more water is removed from the aquifer (Figure 4-13 C). Under these conditions, the well intercepts more water than would typically discharge to the stream under natural conditions. Under these conditions, water can be induced to flow from the stream to the well reducing the amount of water flowing in the stream.

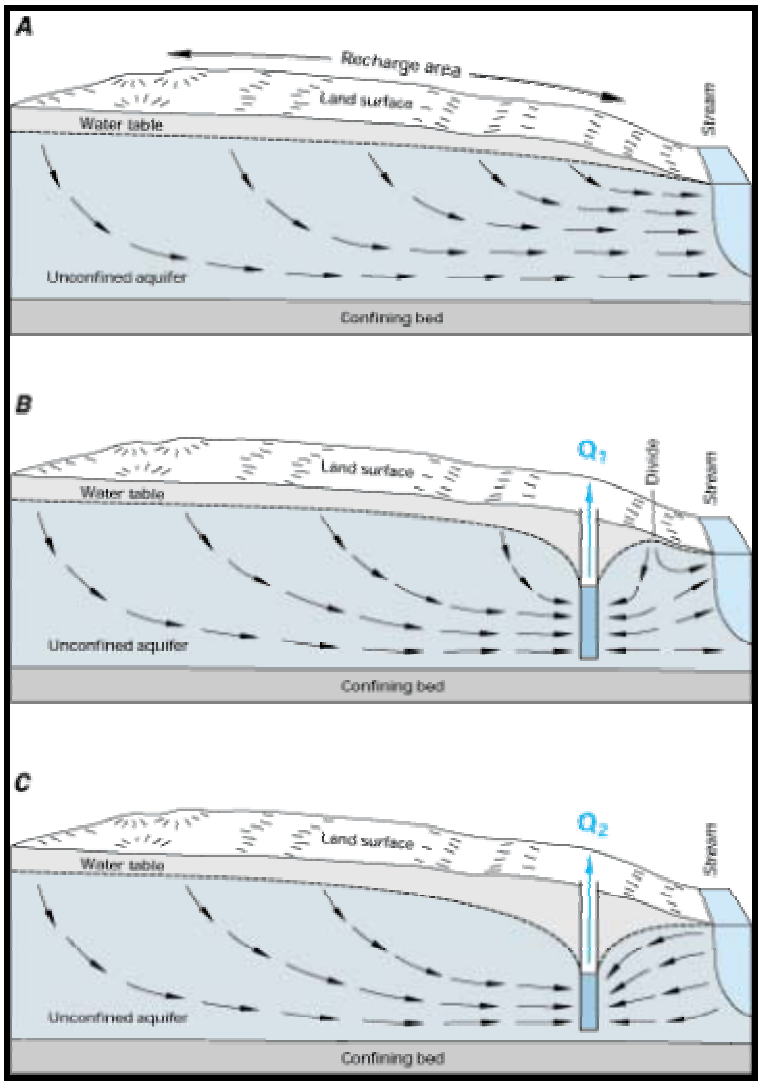


Figure 4-13
Affect of Pumping a Well Along a Stream Channel
(From: Winter et al., 1998)

This simplification of the interaction between shallow ground water and a stream is a compelling illustration of why more and more emphasis is being given to the concept that ground water and surface water should be treated as one resource. In the situation illustrated in this example, over the long term, the quantity of ground water withdrawn will be approximately equal to the reduction in streamflow that is potentially available to downstream users (Winter et al., 1998).

Interactions with Wetlands

Wetlands are present in climates and landscapes that cause ground water to discharge to land surface or that prevent rapid drainage of water from the land surface. Similar to streams, wetlands can receive ground water inflow or provide recharge to underlying ground water flow systems, or both (Winter et al., 1998).

Wetlands that occupy depressions in the land surface interact with ground water in a similar manner as streams. However, unlike streams, wetlands do not always occupy low points and depressions in the landscape. They can also be present on slopes (such as fens) or found along drainage divides (such as some types of bogs). Fens are wetlands that commonly receive ground water discharge; therefore, they receive a continuous supply of ground water. Bogs are wetlands that occupy uplands or extensive flat areas, and they receive much of their water from precipitation (Winter et al., 1998).

The source of water to wetlands can be from ground water discharge where the land surface is underlain by an aquifer, from ground water discharge at seepage faces and at breaks in slope of the water table, from streams, and from precipitation. Wetlands in riverine areas have especially complex hydrological interactions because they are subject to periodic water-level changes. The combined effects of precipitation, evapotranspiration, and interaction with surface water and ground water result in a pattern of water depths in wetlands that is distinctive (Winter et al., 1998).

In regions where intense runoff occurs in a relatively short period of time, closed topographic depressions are filled by runoff water to form ephemeral ponds and wetlands. As the water level in a pond occupying a depression rises, it flows from the pond to the water table where the hydraulic head is lower than the pond. The duration of standing water in the depression is referred to as the hydroperiod. Hydroperiod is an important parameter that

affects the species richness of aquatic invertebrates, amphibians, and their predators (Haysahi and Rosenberry, 2002). Hydroperiod affects all wetland characteristics, including the type of vegetation, nutrient cycling, and the types of invertebrates, fish, and bird species present. The hydroperiod of ephemeral water bodies is determined by climatic factors, amount of surface runoff input, and ground water exchange. Trees and shrubs that grow in riparian areas can transpire large amounts of surface and ground water and significantly affect the hydroperiod of ephemeral ponds (Haysahi et al., 1998).

The Hyporheic Zone

Streambeds and banks are unique environments because they are where ground water that drains much of the subsurface of landscapes interacts with surface water that drains much of the surface of landscapes. The hyporheic zone is located directly beneath the streambed and it is a zone where surface water and ground water are mixed (Figure 4-14). The zone is underlain by unmodified ground water that has physical and chemical characteristics considerably different from stream water (Williams, 1993). The hyporheic zone is an ecotone between the surface environment characterized by light, high dissolved oxygen, and temperature fluctuation, and the ground water environment characterized by darkness, low dissolved oxygen, and stable temperature (Gibert et al., 1994).

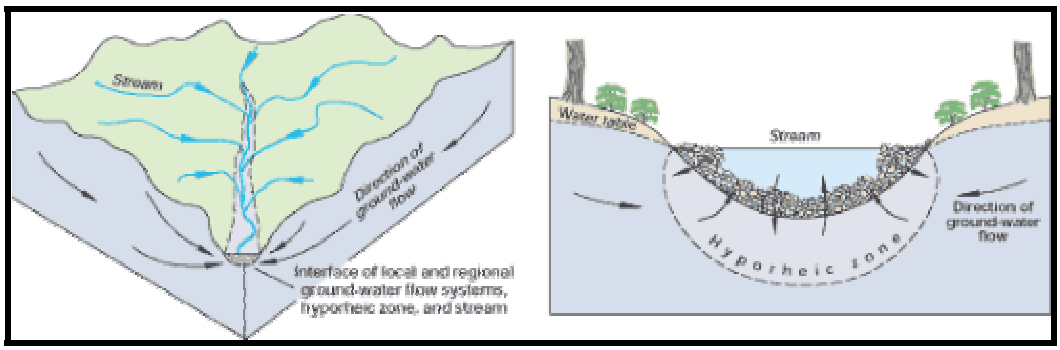


Figure 4-14
Schematic Illustration of a Hyporheic Zone
(From:Winter et al., 1998)

The hyporheic zone is an essential component of the lotic ecosystem. Ground water exchange in this zone affects the ecology of surface water by sustaining stream base flow. It also provides stable-temperature habitats and supplies nutrients and inorganic ions. Localized areas of high ground water discharge in streams provide thermal refugia for fish (Hayashi and Rosenberry, 2002). The chemical and biological character of the hyporheic zone may differ markedly from adjacent surface water and ground water due to mixing between ground water and surface water in the zone.

4.3 WATER USE

Under Oregon law, all water is publicly owned. With some exceptions, cities, farmers, factory owners, and other users must obtain a permit or water right from the Oregon Water Resources Department (OWRD) to use water from any source (i.e., underground, or from lakes or streams). Landowners with water flowing past, through, or under their property do not automatically have the right to use that water without a permit from OWRD (OWRD, 2002).

In order to appreciate how water is used in the SBW, it is necessary to understand the concept of water rights and how they effect how water is obtained and used by individuals, industry, and municipalities.

Water Rights and the Oregon Code

In Oregon and the other 16 western states, water rights are primarily determined under the appropriation doctrine. The two major concepts of this system are:

- A water right is a right to use the water; the right is acquired by appropriation; and

- An appropriation is the act of diverting water from its source and applying it to a beneficial use.

This system is often referred to as the Doctrine of Prior Appropriation (i.e., first in time, first in right). Water is not owned by individuals, but held in trust by the state for the beneficial use of its people. Water rights in Oregon are established through a permit process. The basic concept of the appropriations doctrine is that the earliest water users have priority over later appropriators at times of water shortage. Generally, Oregon law does not provide a preference of one kind of use over another. If there is a conflict, the date of priority determines who may use the available water (OWRD, 2002).

Initially, the appropriation doctrine was considered applicable only to flowing streams because surface water was the first to be exploited and this is where the first conflicts between users occurred. By contrast, there was very little use of ground water resulting in a general lack of regard for legal rules to address its allocation. Only in recent years have State courts and legislatures been forced to address the problems of allocating ground water resources as ground water use is increasing.

There are laws in effect that require special attention be given to the relationship between surface water and ground water. It is now being recognized that all water sources are basically hydraulically connected. OWRD's administrative rules (Oregon Administrative Rules [OAR] 690-09-040 [2]) assume a hydraulic connection exists whenever the ground water point of diversion (from an unconfined aquifer) is located within one quarter mile of a surface water source. The issue of hydraulic connection and its effect on permit decisions is critical. The basic issue with respect to a water right is one of availability. Due to the concept of hydraulic connection, the issue of water availability in nearby streams comes up even with ground water rights for wells.

This rule can be particularly troublesome for ground water users who drill their well, then apply for a permit. This approach is allowed by the OWRD, but caution must be taken to ensure that the well is not being drilled in a critical or limited ground water basin and that there is no connection to an already over-appropriated stream. Proceeding in this manner could result in one owning an extremely expensive well that cannot be used.

Water Dedicated to Instream Uses

OWRD also approves instream water rights for fish protection, minimizing the effects of pollution or maintaining recreational uses. Instream water rights establish flow levels to remain in a stream on a month-by-month basis and are usually set for a certain stream reach and measured at a specific point on the stream. Instream water rights have a priority date and are regulated in the same way as other water rights (OWRD, 2002).

Instream water rights were established by the 1987 Legislature. This law allows the Departments of Fish and Wildlife, Environmental Quality and Parks and Recreation to apply for instream water rights. The law gives instream water rights the same status as other water rights. In a Governor-declared drought, Oregon law allows OWRD to give preference to human consumption and livestock watering over other uses including instream uses (OWRD, 2002). Based on OWRD records, instream water rights have been established for:

- Anadromous and resident fish habitat;
- Anadromous and resident fish rearing;
- Supporting aquatic life and minimizing pollution;
- Instream uses; and
- Undetermined uses.

Instream water rights are not guarantees that a certain quantity of water will be present in the stream. When the quantity of water in a stream is less than the instream water right, OWRD will require junior water right holders to stop diverting water. However, under Oregon law, an instream water right cannot affect a use of water with a senior priority date (OWRD, 2002).

Exempt Uses of Water

Some uses of water do not require water rights. These are referred to as "exempt uses." While these water uses are exempt from the requirement to obtain a water right, the use is only allowed to the extent that water is used for a beneficial purpose without waste. Exempt uses of water in a watershed can have a significant impact on surface water and ground water availability due to their cumulative impact.

Exempt Uses of Surface Water

The following are exempt uses of water as listed in OWRD (2002):

- **Natural springs**: a landowner[1]s use of a spring which, under natural conditions, does not form a natural channel and flow off the property where it originates at any time of the year.
- **Stock watering**: where stock drink directly from a surface source and there is no diversion or other modification to the water source. Also, use of water for stock watering from a permitted reservoir to a tank or trough, and, under certain conditions, use of water piped from a surface source to an off-stream livestock watering tank or trough.
- **Salmon**: egg incubation projects under the Salmon and Trout Enhancement Program (STEP) and water used for fish screens, fishways, and bypass structures are also exempt.

- **Fire control**: the withdrawal of water for use in emergency fire fighting.
- **Forest management**: certain activities such as slash burning and mixing pesticides. To be eligible, a user must notify the Department and the Oregon Department of Fish and Wildlife (ODFW) and must comply with any restrictions imposed by the Department relating to the source of water that may be used.
- **Land management practices**: where water use is not the primary intended activity.
- **Rainwater**: collection and use of rainwater from an impervious surface (i.e., a parking lot or a building's roof).

Exempt Uses of Ground Water

- **Stock watering**.
- **Lawn or non-commercial garden watering**: of not more than one-half acre in area.
- **Single or group domestic purposes**: for no more than 15,000 gallons per day.
- **Single industrial or commercial purposes**: not exceeding 5,000 gallons per day.
- **Down-hole heat exchange** uses.
- **Watering**: the grounds, ten acres or less, of schools located within a critical ground water area.

Abandoning Wells

Unused wells that are not properly abandoned can cause ground water contamination, waste, or loss of artesian pressure. Oregon's well abandonment

standards are designed to prevent contamination of the well or aquifer by surface and subsurface leakage which may carry harmful chemicals or bacteria. Ultimately, landowners can be held responsible for harm to the ground water resource resulting from old or unused wells (OWRD, 2002).

OWRD has minimum standards that describe the acceptable methods for two types of well abandonment.

- Temporary Abandonment
- Permanent Abandonment

A well is considered temporarily abandoned when it is taken out of service for a short time. Wells are temporarily abandoned when it is envisioned that they are to be brought back into service at a future date. In accordance with OWRD standards, a temporarily abandoned well must be covered by a watertight cap or seal to prevent materials from entering the well from the surface.

According to OWRD standards, a well is considered permanently abandoned when it is completely filled so that movement of water within the well is permanently stopped. Permanent abandonment must be performed by a licensed water well constructor, or the landowner under a Landowner's Water Well Permit.

In the case of the abandonment of a dug well, OWRD must be contacted and the proposed method must be approved. Typically, a hand-dug well free of debris may be abandoned by filling the well with cement or concrete to above the water producing zone and then clean fill (not gravel) to land surface. In some cases, hand-dug wells containing debris may be subject to other abandonment methods (OWRD, 2002).

Water Uses in the SBW

Water within the SBW is used for many beneficial uses. The OWRD has a list of beneficial uses of water for classification of water rights. The list includes:

- Mining (0)
- Agriculture (1)
- Domestic (2)
- Irrigation (3)
- Commercial (4)
- Recreation (5)
- Power (6)
- Fish (7)
- Livestock (8)
- Municipal (9)
- Instream (I)
- Miscellaneous (M)
- Wildlife (W)

Of the codes listed, all but power, fish, and wildlife are represented in the SBW. Table 4-3 lists the beneficial uses for the water rights obtained from the OWRD files for the SBW. The primary beneficial use of water in the SBW is for irrigation followed by domestic use and mining. There are 866 surface water rights and 126 ground water rights. Figure 4-15 illustrates the points of diversion where water is removed and Figure 4-16 illustrates the place of use for water rights in SBW. A listing of water right certificates, permits, and applications in the SBW based on file with OWRD is provided in Appendices D, E, and F.

Table 4-3
Water Rights and Beneficial Uses of Water in the Seven Basins Watershed

Sub Watershed	Beneficial Use Code																					
	Undetermined		0		1		2		3		4		5		8		9		M		Total	
	S	G	S	G	S	G	S	G	S	G	S	G	S	G	S	G	S	G	S	G	S	G
Upper West Fork Evans Creek																					0	0
Upper Evans Creek							8	2	41						4				1		54	2
Rogue/Ward Creek			5				15	1	24	3				1			1	2			45	7
Rogue/Snider Creek	1				5	2	5		75	55			3		11				5		105	57
Rogue/Sams Creek	1				1		5		92	8	10		3		8		1		1		122	8
Rogue/Sardine Creek	2		1		4		18		66	1	1		1						1		94	1
Rogue/Galls Creek	3		1				15	3	52	15	1				4				1		77	18
Pleasant Creek			17				8		74	9			1		3				1		104	9
Lower West Fork Evans Creek							1		1												2	0
Lower Evans Creek			3				5		111	14					2			1			121	15
Foots Creek			18				6		27	4									1		52	4
Evans Creek/Sykes Creek	4						17	5	65				1		3						90	5
Total	11	0	45	0	10	2	103	11	628	109	12	0	9	1	35	0	2	3	11	0	866	126

S = Surface Water
G = Ground Water
0 = Mining
1 = Agriculture
2 = Domestic
3 = Irrigation
4 = Commercial
5 = Recreation
8 = Livestock
9 = Municipal
M = Miscellaneous

Insert Figure 4-15

Seven Basins Watershed Water Rights – Points of Diversion

Insert Figure 4-16

Seven Basins Watershed Water Rights – Places of Use

Surface Water Use in the SBW

Based on OWRD files, most surface water rights are for irrigation followed by domestic and municipal uses. The majority of the irrigation occurs in the Upper and Lower Evans Creek, Rogue/Snider, Rogue/Sams, Rogue/Sardine, Evans Creek/Sykes, and Rogue/Galls subwatersheds with lesser amounts used in Rogue River/Ward and Foots Creek subasins. Of the 866 surface water rights in the watershed, irrigation use represents 73% of the surface water rights in the SBW while domestic use represents approximately 12%, mining 5%, and municipal uses 4%. These values represent the percentage of each use by number of water rights in the SBW not by volume of water used.

Ground Water Use in the SBW

OWRD files indicate that there are 4,512 wells in the SBW. This number is based on well logs filed with OWRD (Appendix G). Well logs have been recorded with OWRD since approximately 1955. Thus, those wells identified in Table 4-4 reflect only those wells that have been drilled since 1955. It is highly likely that numerous additional wells exist in the SBW for which well drilling records have not been recorded with the state. The data provided in Table 4-4 indicate that there are 126 ground water rights in the SBW.

Table 4-4
Number of Wells Based on Well Logs on File with the OWRD

Sub Watershed	Total No. of Wells
Rogue-Birdseye/Ward	515
Foots Creek	298
Rogue-Galls/Kane	553
Rogue-Sardine	239
Rogue-Table Rock	982
Lower Evans Creek	659
Pleasant Creek	508
Evans-May/Sykes	498
West Fork Evans Creek-Lower	2
West Fork Evans Creek-Upper	4
Evans-Rock/Salt	0
Evans Creek Upper	254
Total	**4,512**

This represents about 13%, by number, of the total water rights in the watershed. The primary beneficial use for the majority of the 126 ground water rights is irrigation. The greatest concentrations of wells are focused in Rogue/Snider Creek (55), Rogue/Galls Creek (15), and Lower Evans Creek (14) subwatersheds. The distribution of wells that have a water right is shown on Figures 4-15 and 4-16. These figures illustrate the points of diversion and places of use for ground water rights in the SBW.

The majority of the remaining 4,386 wells are presumed to be exempt wells used for single or group domestic purposes and for stock watering and/or lawn or non-commercial garden watering. Lawn or non-commercial watering of gardens could represent the greatest use of exempt groundwater, particularly during the dry season.

4.4 HYDROLOGY ISSUES IN THE SBW

The following discussion is related to hydrology issues specific to the SBW. Topics addressed in the previous sections will be addressed in the context of how they affect the hydrology and water use in the SBW. The discussion is based on the limited amount of hydrologic data that is available for the watershed.

Estimation of Peak Stream Discharge for Evans Creek

A study of the magnitude and frequency of the peak discharges of rural unregulated streams in Oregon west of the Cascade crest has been completed by OWRD (Cooper, 2002). The results of the study include (1) the magnitude of annual peak discharges for selected frequencies at 445 gauging stations, (2) a map of generalized logarithmic skew coefficients for western Oregon, and (3) sets of equations relating the magnitude of floods at selected frequencies to physical watershed characteristics such as drainage area or mean January

precipitation. There is a set of frequency specific prediction equations for each of three hydrologically similar regions within western Oregon. The selected flood frequencies are described by the interval at which the flood is likely to recur.

Return intervals of 2, 5, 10, 20, 25, 50, 100, and 500 years were used in the evaluation. As discussed in Section 4.1, a return interval is the number of years expected to pass, on average, between peak discharges for a given magnitude. The selected peak discharge frequencies are described by the interval at which the peak is likely to recur.

Peak discharges were calculated for Evans Creek at Bybee Springs as discussed in Cooper (2002). Data presented in Table 4-5 under the heading "Station" represents systematic and historically measured values taken at the gauging station. The column labeled "Predicted" represents the values generated using regional regressions equations that relate peak discharges to watershed characteristics. Table 4-6 lists the watershed characteristics used to calculate the peak flows for this gauging station. The values listed in the column labeled "Weighted" represent the peak discharges weighted using (1) the actual number of peaks and (2) an equivalent number of peaks as specified in Cooper (2002).

Table 4-5
Peak Discharges For Gage 14359500, Evans Creek Near Bybee Springs Near Rogue River, Oregon
(From: Cooper, 2000)

Return Period	Station			Prediction			Weighted		
	Peak Flow	95% confidence		Peak Flow	95% confidence		Peak Flow	95% confidence	
		Lower	Upper		Lower	Upper		Lower	Upper
2	4260	3160	5800	4600	2120	9960	4340	2880	6580
5	7070	5260	10900	7150	3190	16000	7090	4550	12200
10	9070	6560	15300	8830	3880	20100	8990	5480	16800
20	11100	7760	20200	10400	4470	24300	10800	6260	21700
25	11700	8130	21900	10900	4650	25700	11400	6500	23300
50	13700	9250	27500	12400	5150	30100	13100	7170	28600
100	15700	10300	33600	13900	5590	34700	14900	7790	34100
500	20600	12800	49700	17200	6410	46400	18900	9070	48000

*Flow is measured in cubic feet per second (cfs)

The regionalized prediction equations were developed to be used to estimate peak flows at ungauged watersheds for the described recurrence intervals. The equations relate peak discharge to physical and climatological characteristics of the watershed such as precipitation intensity and drainage area.

Table 4-6
Selected Watershed Characteristics
(From: Cooper, 2000)

Drainage Area	115	Square Miles
Mean Watershed Elevation	2730	Feet amsl
Mean Watershed Slope	21.8	Percent
Precipitation Intensity	2.19	Inches/hour
January Precipitation	5.6	Inches
Minimum January Temperature	32.7	Degrees F
Maximum January Temperature	44.4	Degrees F
Depth to Bedrock	34.8	Inches

Historical Diversions of Water in the SBW

OWRD has established a suite of wells around the state that are routinely monitored to evaluate long-term trends in water levels. Many are wells that private land owners have agreed to allow monitoring to occur. There is a suite of wells scattered throughout the SBW where limited water level data have been collected. The period of record for most wells in the SBW is from the late 1970s or early 1980s until 1995 when monitoring was terminated. The data for the wells is located on the OWRD web page. The hydrographs illustrates several factors regarding the behavior of the aquifer (s) that these wells penetrate. These include:

- The water levels in most wells show seasonal fluctuations;
- Most wells show water level declines that are most likely the result of drought;
- Some wells appear to be showing long-term water level declines; and
- Selected wells illustrate the influence of surface water bodies on measured water levels.

Figure 4-17 is a hydrograph for a well located along Evans Creek near the town of Wimer, Oregon. Water levels in this well show a well defined seasonal trend with higher water levels observed in the winter and spring, and lower levels observed during late summer and fall. As discussed in Section 4.1 related to drought, the period from 1976 to 1996 was characterized by warm dry weather (see Figure 4-7). This weather pattern is depicted in Figure 4-17. A water level drop of approximately 25 feet occurred in the well in late 1992. After 1992, water levels appear to have returned to normal levels based on the period of record for the well. It is probable, however, that water levels in this well were higher prior to 1976 than those observed in hydrograph. Water levels most likely increased over the last data shown on the hydrograph in response to cooler and wetter conditions that occurred in the late 1990s to present.

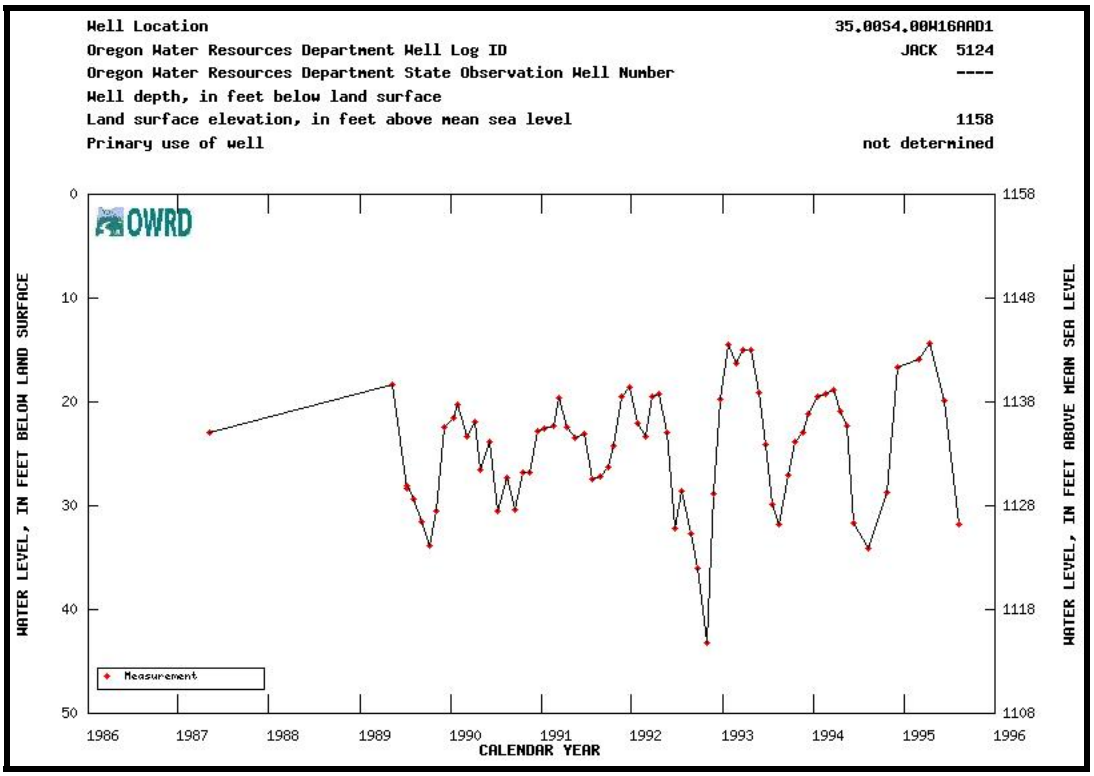


Figure 4-17
Hydrograph for Well Located Near Wimer, Oregon

Figure 4-18 is a hydrograph for a well located south of the well in Figure 4-17. It is located along Evans Creek and has a period of record similar to the well in Wimer. The water levels in this well show a well defined seasonal trend was observed in the Wimer well. However, the water levels in this well demonstrate a somewhat different trend than the previous well with respect to its response to drought conditions. Substantial water level declines occurred from about 1989, with the greatest decline observed in 1991 (~10 feet). Water levels began to recover in 1992 and continued to show recovery through the period of record in mid-1994. The water level in this well was at its lowest, about one year earlier than those observed in the well near Wimer (Figure 4-17).

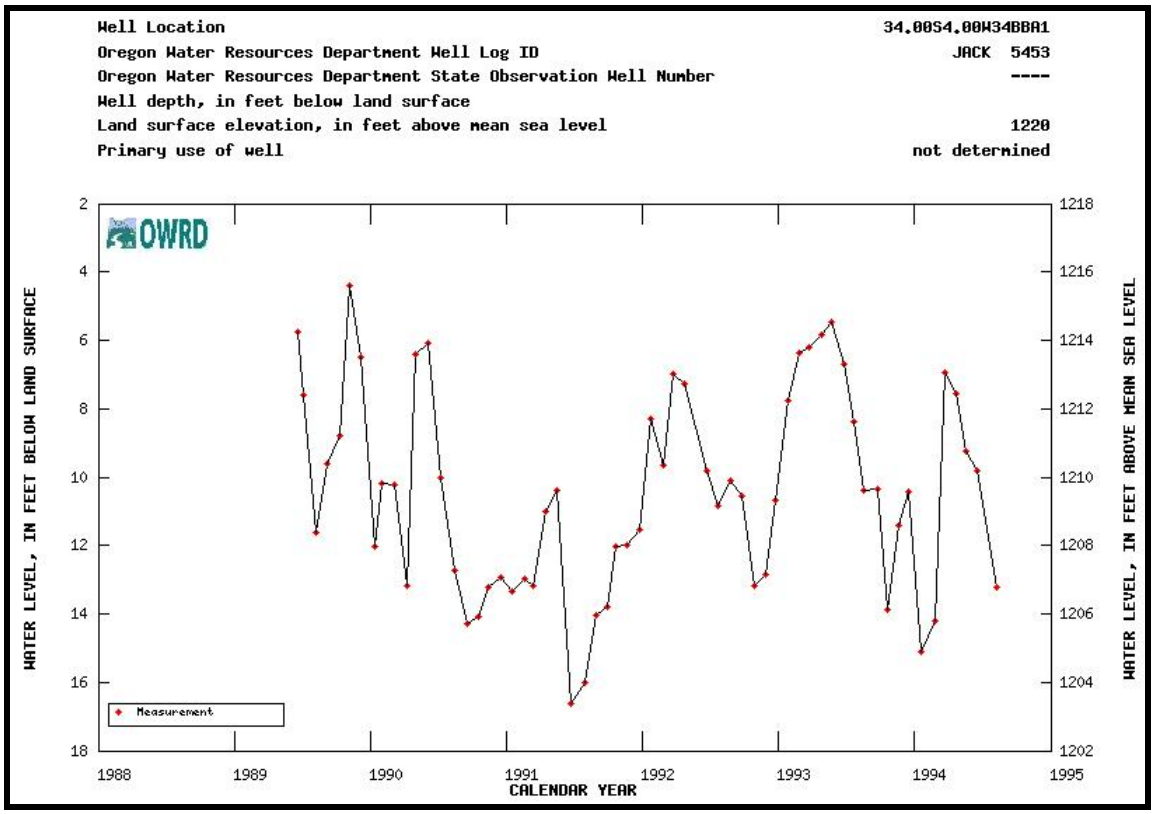


Figure 4-18
Hydrograph for Well Located Along Evans Creek Between Rogue River and Wimer

Figure 4-19 is a hydrograph for a third well located along Evans Creek. This well is located near the town of Rogue River which is adjacent to the Rogue River. The hydrograph for this well is substantially different than the two previous wells located along Evans Creek. Substantial water level declines were observed in this well in late 1989 (~65 feet), late 1990 (~55 feet), and 1991 (~40 feet). It is not known if the measurements reflect static water levels or if they were collected when the well was pumping or recovering. Superimposed over these seasonal water level declines is a slight increase in water level from approximately 1983 to late 1995. This increase is most likely the effect of changes in the stage of the Rogue River on the local water table. Also of note is the fact that water level declines were not as prevalent after 1992, indicating

that the impacts of the drought may have been lessening at this location in the aquifer.

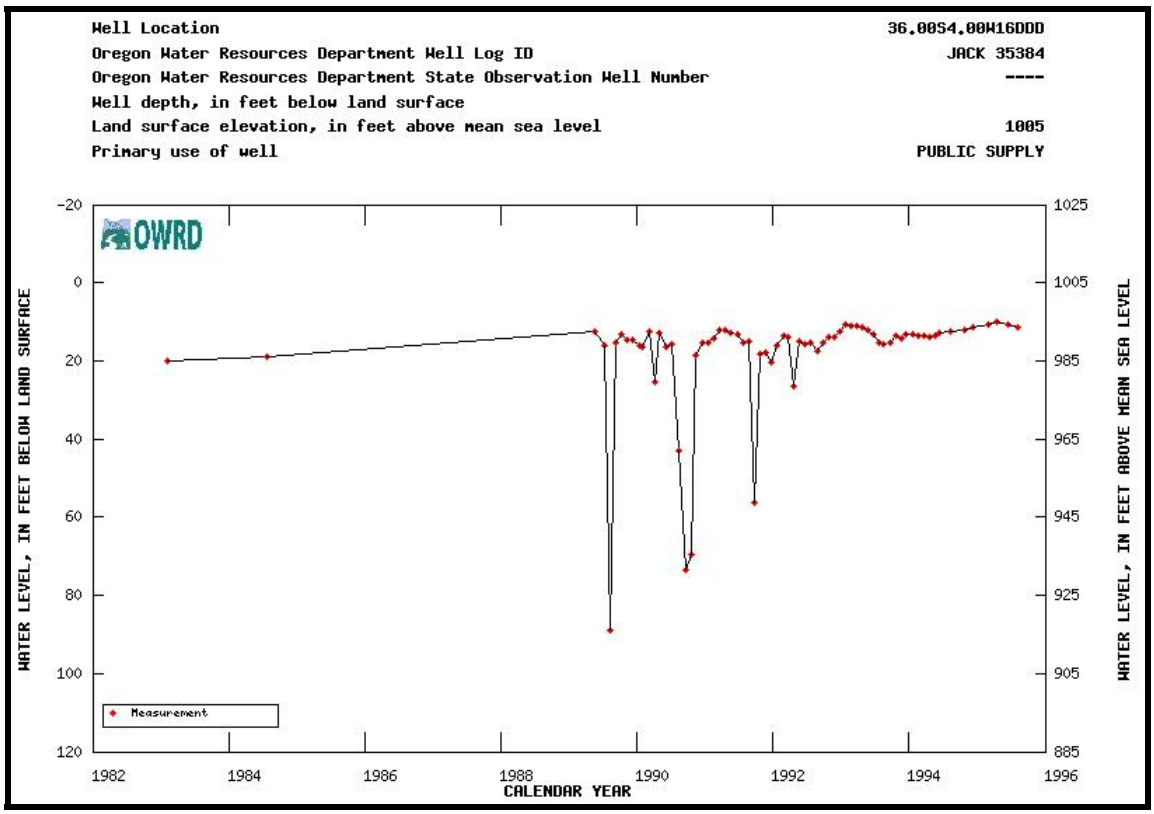


Figure 4-19
Hydrograph for Well Located at the Town of Rogue River, Oregon

Water levels demonstrated a somewhat different trend in a well located along the eastern margin of Sams Valley. The hydrograph for this well is illustrated in Figure 4-20. At this location, water levels were declining from the beginning of the period of record and continued to decline through the end of 1992. Water levels rebounded somewhat in 1993 but declined significantly again in 1994 (~70 feet). The data presented in the hydrograph indicates that as of mid 1995, the water levels in the Sams Valley area had not returned to pre-drought conditions.

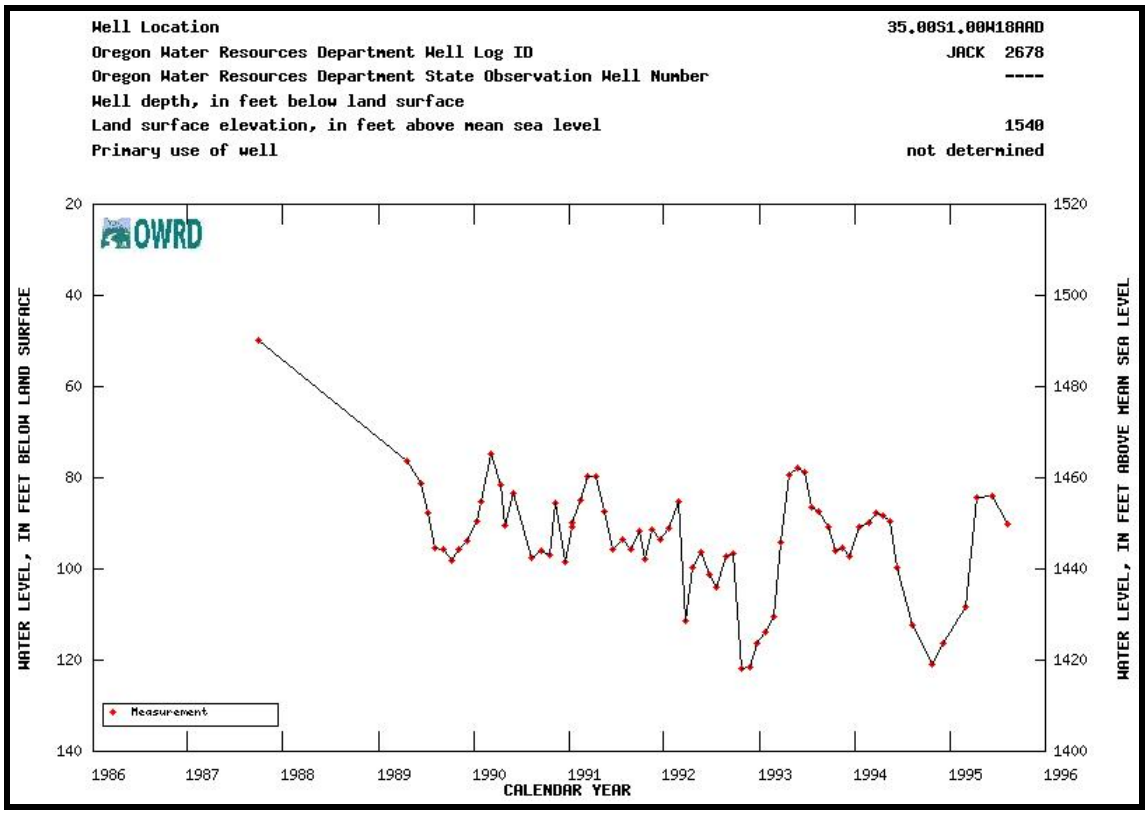


Figure 4-20
Hydrograph for a Well Located along the Eastern Margin of Sams Valley

Figure 4-21 is a hydrograph for a well located along Kane Creek. Once again, seasonal variations of water level were observed in this well. However, this well showed a much different response to the drought than other wells in the SBW. From 1989 through the first part of 1994, this well did not show effects of the drought. It was not until the end of 1994 that water levels began to drop in this well (~35 feet). This drop could have been the result of drought and/or and increase in ground water development in the area.

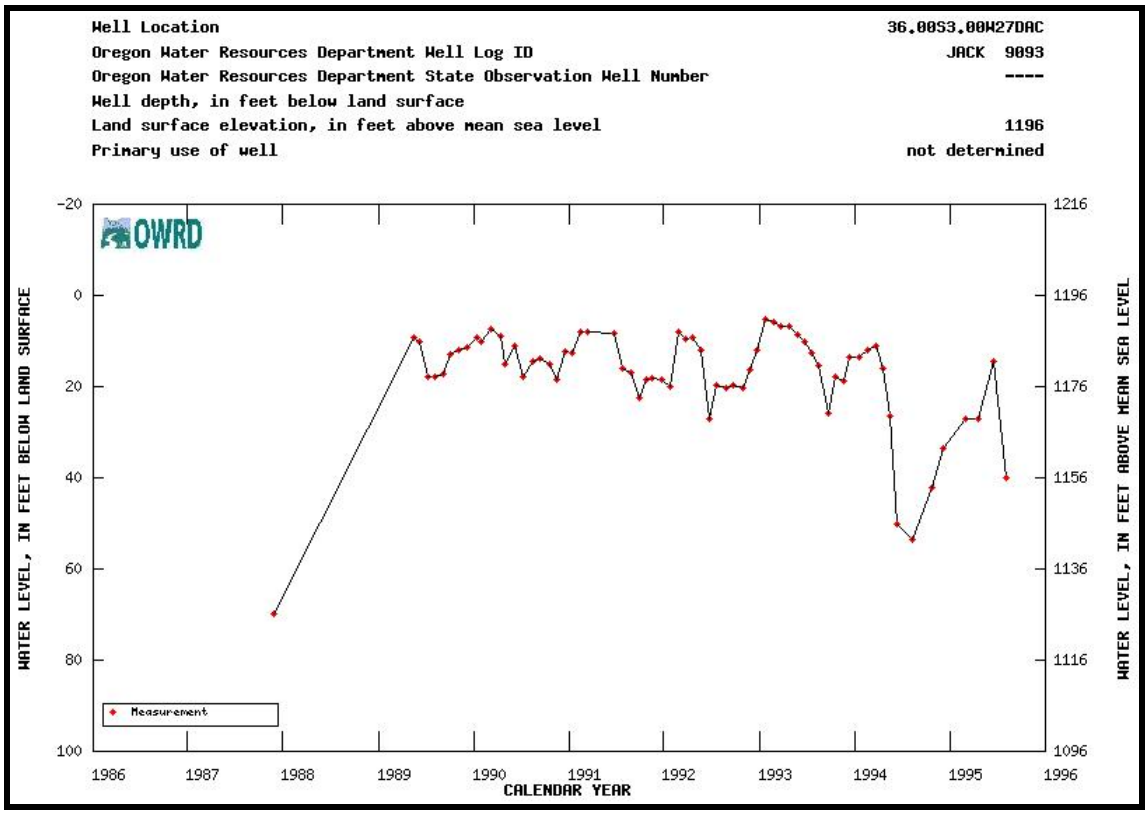


Figure 4-21
Hydrograph for a Well Located along Kane Creek

Historical Diversions of Water in the SBW

Historically, most of the water uses in the SBW were related to mining and irrigation for agriculture. Neither mining nor farming was sufficient to support the early settlers in the watershed so most farmed during the early spring through fall and mined during the wetter portions of the year when flows in the streams were higher. As a result, most of the early water rights filed were joined to mining interests. Later, some water rights were filed to co-mingle farming/mining uses. Most of the mines in the watershed used ditches to move water from streams to their point of use. As agriculture evolved in the watershed many of the ditches initially used for mining were extended to allow irrigation of land further from the main branch of streams. The construction of many of the ditches began in the mid to late 1800s. All major ditch

construction projects were complete and operating by World War II. Table 4-7 lists the major ditches that were constructed for mining and irrigation purposes in the SBW. As mining activity declined and irrigation changed from flood to sprinkler application, the diversion ditches were slowly taken out of service. All of these ditches are now out of service and are no longer being used to divert water throughout the watershed (Atwood and Lang, 1995).

After World War II, reservoirs were built for irrigation in the SBW. Some smaller projects were built in the former Beagle area. In 1956, the Sams Valley Irrigation Association constructed a large reservoir referred to as Ramsey Lake or "Big Five." This project was constructed with some government assistance to provide water to five farms in Sams Valley. The structure is an earth dam that is 330 feet long, 60 feet high and is capable of producing a maximum discharge of 500 cfs. The surface area of the reservoir is 50 acres and normal storage capacity is 890 acre feet (ac/ft). The drainage area supplying water to the reservoir is 62 square miles. A ditch from Ramsey Lake, serves five large farms or ranches along Ramsey Road and fields on Old Sams Valley Road.

Instream Rights in the SBW

In early 1996, two major landowners that were using the Williams-Whalen Ditch converted from flood to sprinkler irrigation. They became the first water right holders in Oregon to create an in-stream water right by using an innovative law passed in 1987, referred to as the Conserved Water Statute. The remaining landowners on the Williams-Whalen ditch worked with Oregon Water Trust (OWT) and the Evans Creek Watershed Council to develop a conservation project that would allow each landowner to switch from flood to sprinkler irrigation. The landowners now divert water directly from Evans Creek, thereby eliminating the need for the ditch system. The conservation project involved conversion of gravity flood irrigation to sprinklers with individual pumps located downstream of the old ditch diversion. An allocation

Table 4-7
Historic Diversion Ditches Used in the SBW

Ditch Name	Established	Stream	Use
Bybee ditch		Evans Creek	Irrigation
Carter	1893	Evans Creek	Irrigation
Williams and Whalen ditch	1896	Evans Creek	Mining/Irrigation
Fielder or Hillis ditch		Evans Creek	Irrigation
Sivers ditch		Evans Creek	Irrigation
Hull ditch		Evans Creek	Irrigation
Mayfield ditch	1888	EF Evans Creek	Irrigation
Jesse Neathammer ditch	1889	Evans Creek	Irrigation
Dan Neathammer ditch	1874	Queens Branch	Irrigation
Bennett ditch	1882	Evans Creek	Irrigation
Carner ditch	ca 1880	Evans Creek	Irrigation
Joel Miton ditch	ca 1880	Evans Creek	Irrigation
Oden ditch	ca. 1889	Fry's Gulch	Mining
Vroman and Seeley ditch	1902	Evans Creek	Irrigation
Dinkens ditch	1907	Evans Creek	Irrigation
Spignet ditch	1871	EF Evans Creek	Irrigation
John Sizemore ditch	1887	Evans Creek	Irrigation
Table Rock irrigation ditch	late 1800's	Rogue River	Irrigation
Birdseye ditch	1855	Birdseye	Irrigation
Shory ditch	1855	Birdseye	Mining
West and East ditch		Sardine Creek	Mining/Irrigation
Gold Hill ditch		Sardine Creek	Mining
Smith ditches		Dixie Gulch	Mining
Newton ditch		Spring Gulch	Stock/Dom
Ring ditch		Sardine Creek	Mining
Young ditch		RF Sardine Creek	Mining
Beeman ditch		LF Sardine Creek	Mining
Hardman ditches		LF Sardine Creek	Mining
Hull ditch		Sykes Creek	Irrigation
Manning ditch	1888	Brown Gulch	Mining
Bennett ditch	1882	Evans Creek	Irrigation
Lower Wakeman ditch	1865	Pleasant Creek	Mining/Irrigation
Upper Wakeman ditch		Pleasant Creek	
Williams ditch	ca 1860	Pleasant Creek	Mining
Owens ditch	1891	Ditch Creek	Mining
Calvin ditch		Queens Branch	Mining
Ingladue ditch		Queens Branch	Mining
Collins ditches		Pleasant Creek	Mining
Highline ditch		Pleasant Creek	Mining
Leason ditch		Pleasant Creek	Mining
Moore ditch		RF Pleasant Creek	Mining

of conserved water was approved for the project to establish an instream water right in Evans Creek with an 1896 priority date. Figure 4-22 illustrates the location of stream reaches where instream water rights have been established in the SBW.

Effects on Local Ecosystems and Hydrologic Regimes as a Result of Diversion Ditches.

The many ditches used throughout the SBW had an impact on local ecosystems and hydrologic regimes. Many of the ditches were in operation since the late 1800s and as a result, the local environment in the vicinity of the ditches developed unique ecosystems and hydrologic conditions. The ditches were unlined and significant amount of leakage occurred from them when in use. Due to leakage localized shallow ground water flow systems developed in the downgradient direction of the ditches. These flow systems were created in the alluvial terrace deposits along stream channels. The shallow bedrock in the vicinity of the ditches most likely acted as a confining layer limiting the vertical extent of the shallow flow system to the alluvial materials. Leakage created springs along sections of the ditches and as a result, local wetland ecosystems developed. The wetlands supported diverse populations of plants and animals. Dense stands of trees including alder, pine, cedar, and Douglas fir were established between the ditch and the stream which created a thick riparian area.

Numerous changes occurred in the watershed after the closing of the ditches. The shallow ground water flow systems that were created due to leakage from the ditches no longer existed. This in turn affected the local wetlands causing them to dry up and disappear. According to local residents in the SBW, trees in the riparian corridor died because they were dependent on shallow ground water and were not able to develop a deep root system which could utilize deeper sources of water. As a result, the riparian zones along many of the

Insert Figure 4-22

ditches were impacted once the ditches were no loner in use. Examples of stands of dead tress along Evans Creek are shown in Figures 4-23 and 4-24. Similar behavior has been demonstrated in other studies that have shown that riparian vegetation is highly dependent on ground water. Dawson and Ehleringer (1991) showed that riparian trees (oak and maple) on a mountain stream selectively used ground water even when stream water was readily available.

Figure 4-23
Dead Trees Between Evans Creek and Abandoned Williams Whalen Irrigation Ditch, June 2003

Figure 4-24
Dead Trees Below Williams Whalen Irrigation Ditch Evans Creek, June 2003

An Evaluation of the Amount of Ground Water Consumed by Exempt Uses in the SBW

As discussed previously, exempt uses of water can have an impact to the over all water budget of a watershed depending on the number and spatial distribution of the exempt users. To develop a perspective on the amount of ground water consumed in the SBW by exempt uses, a simple calculation was conducted to estimate volume of water used in the watershed by exempt ground water users. The volume of water used for domestic purposes can be estimated by assuming that the average household in the SBW is comprised of four people. It is estimated that each person uses approximately 100 gallons of

water per day (gpd). Thus, each household would use 400 gpd. This equates to a pumping rate of ~0.3 gallons per minute (gpm) if the well was pumped continually over a 24-hour period. Multiplying this value by 4,385 wells, results in an estimated water withdrawal of approximately 1.8 million gallons of ground water each day. This is a small number when compared to the amount of water used by a large city or by agricultural practices. However, if the calculation is extended over a year, then it can be seen that approximately 660 million gallons of ground water are removed from aquifers within the watershed each year for domestic purposes. If every household were using the maximum volume of water allowed by the OWRD for a single or group domestic purpose (15,000 gpd or ~10 gpm), then approximately 60 million gpd or 22 billion gallons per year of ground water would be used. These examples represent upper and lower bounds for the amount of ground water used within the watershed as a result of exempt uses.

The purpose for conducting such an exercise is to illustrate that it is not possible to evaluate the water balance of a watershed without taking into account all aspects of water use. The withdrawal of ground water can have a significant impact on stream flows based on the location, volume, and the time of year in which they occur.

Abandonment of Unused Wells

As mentioned previously in Section 4.3, there are over 4,500 wells in the SBW for which there are well logs on record with OWRD. Well log records have been maintained by the state since about 1955. Given the history of the watershed, it is highly likely that there are many wells throughout the watershed that are not recorded with the state. Those wells that are no longer in use should be abandoned to eliminate potential water quality and quantity problems. Efforts should be made to inventory these wells and determine accurate locations.

Landowners should be made aware of the regulations related to well abandonment and the potential impacts to aquifers that open wells can cause.

DATA GAPS

- Stream gage information is not available for all streams in the SBW. Historical data exists only for Evans Creek.
- There are no accurate records of the actual number of wells located in the SBW. A detailed well inventory documenting locations is not available.
- There are limited historical data related to ground water levels in the watershed.

ACTION PLAN RECOMMENDATIONS IDEAS

- Use prediction equations developed by OWRD to estimate peak flows for primary streams in each subwatershed. Develop a data base of subwatershed characteristics needed for calculations.
- Design a stream gauging program and establish gauging stations in each subwatershed. Data can be used to evaluate the peak flow estimates based on prediction equations.
- Develop a plan to establish several weather stations within the SBW. Stations should be located at various locations throughout the watershed to represent different weather conditions (i.e., upland areas, Sams Valley, etc.). Data could be collected by volunteers.
- Work with OWRD to develop a data base of wells with emphasis given to location and well yield.

- Develop an interactive environmental data base coupled with Geographic Information Systems (GIS) to document information collected and map spatial data.
- Provide educational information regarding surface water and ground water resources in the SBW.

REFERENCES

Anderson, J.J., *Decline and Recovery of Snake River Salmon*, Information based on the CRiSP Research Project, Testimony Before the U.S. House of Representatitives Subcommittee on Power and Water, June 3, 1995.

Anderson, J.J., *Decadal Climate Cycles and Declining Columbia River Salmon,* in: Proceedings of the Sustainable Fisheries Conference, Victoria B.C. Canada, Eric Knutson Ed., Special Publication of the American Fisheries Society, 1996.

Atwood, Katherine C. and Lang, Frank A., *As Long as the World Goes On: Environmental History of the Evans Creek Watershed*, Prepared for Medford District BLM, Butte Falls Resource Area, 1995.

Chow, Ven Te, *Handbook of Applied Hydrology*, McGraw-Hill Book Company, New York, 1964.

Cooper, Richard M., *Estimation of Peak Discharges for Rural Unregulated Streams in Western Oregon*, OWRD, Open File Report SW 02-00, 2002.

Dawson, T.E. and Ehleringer, J.R., *Streamside Trees That Do Not Use Stream Water*, Nature, Vol. 350, pp.335-337, 1991.

Federal Interagency Stream Restoration Working Group (FISRWG), *Stream Corridor Restoration: Principals, Processes, and Practices*, Federal Interagency Stream Restoration Working Group, GPO Item No. 0120-A, 1998.

Freeze, R. Allan and Cherry, John A., *Groundwater,* Prentice-Hall, Inc., Englewood Cliffs, New Jersey, 1979.

Gibert, J., Stanford, J.A., Dole-Oliver, M.J., and J.V. Ward, *Basic Attributes of Groundwater Ecosystems and Prospects for Research, In: Groundwater Ecology*, ed. J. Gibert, D.L. Danielopol, and J.A. Stanford, San Diego, CA, Academic Press, pp. 7-40, 1994.

Haysahi, M., van der Kamp, G., and Rudolf, D.L., *Water and Solute Transfer Between a Prairie and Adjacent Uplands,* I. Water Balance, Journal of Hydrology, Vol. 207, pp. 42-55, 1998.

Haysahi, Masaki and Rosenberry, Donald O., *Effects of Ground Water Exchange on the Hydrology and Ecology of Surface Water*, Ground Water, Vol. 40, pp. 309-316, 2002.

Lvovitch, M.I., *World Water Balance: General Report,* Proc. Symp. World Water Balance, Intern. Assoc. Sci. Hydrol., Vol. 2, pp 401-415, 1970.

Moreland, J.A., *Drought: U.S. Geological Survey Water Fact Sheet*, Open-File Report 93-642, 1993.

Nace, R.L., ed., *Scientific Framework of World Water Balance,* UNESCO Tech. Papers Hydrol., No. 7, 27 pg, 1971.

NOAA, 2003, <http://www.drought.noaa.gov/palmer.html>.

Oregon Water Resources Department (OWRD), *Water Rights in Oregon, An Introduction to Oregon's Water Laws and Water Rights System*, OWRD, Salem, OR, 52 pg., 2002.

Purdue Research Foundation, *Ground Water Primer*, EPA Region 5 and Agriculture & Biological Engineering, Purdue University, 1996.

Sutcliffe, R.C., World *Water Balance: A Geophysical Problem,* Proc. Symp. World Water Balance, Intern. Assoc. Sci. Hydrol., Vol. 2, pp. 19-24, 1970.

Taylor, George H. and Southards, Chad, *Long-Term Climate Trends and Salmon Population*, Oregon Climatological Service, Corvallis, Oregon, 1997.

Williams, D. D., *Nutrient and Flow Vector Dynamics at the Hyporheic/Groundwater Interface and Their Effects on the Interstitial Fauna, Hydrobiologia*, Vol. 251, pp. 185-198, 1993.

Winter, Thomas C.; Harvey, Judson W.; Franke, O. Lehn; and Alley, William M., *Ground Water and Surface Water A Single Resource*, U.S. Geological Survey Circular 1139, 79 pg., 1998.

CHAPTER 5
RIPARIAN/WETLANDS ASSESSMENT

Prepared By:
Katie M. Mosser, EMS
Laura Michelon, SOU Capstone Student
Amanda Pelletier, SOU Capstone Student
Reviewed By: Monty Bruner, PhD, EMS

5.1 RIPARIAN AREAS

INTRODUCTION

The Environmental Protection Agency (EPA) is the federal agency responsible for carrying out the goals of the Federal Clean Water Act (CWA). These goals call for the restoration and maintenance of the chemical, physical and biological integrity of the United State's waters (Arbuckle et al., 1993). Riparian areas are considered to be part of the nation's waters and fall under the goals of the CWA. The Department of Environmental Quality (DEQ) is responsible for maintaining federal goals at the state level.

In addition to the federal CWA, the state of Oregon provides guidance for the protection of riparian areas. One method of guidance is in the form of The Oregon Plan for Salmon and Watersheds. The Oregon Plan recognizes the importance of riparian areas to watershed and salmonid health and calls for their protection and management through the Statewide Riparian Management Policy. The goals of this policy are to protect and restore riparian functions throughout Oregon as well as to achieve clean water and productive riparian and aquatic habitats to support self-sustaining native fish species (Oregon Plan for Salmon and Watersheds, 2002). This policy calls for state agencies to:

- Promote the protection of healthy and functioning riparian areas.
- Promote the restoration of degraded riparian areas.
- Utilize all possible resources to ensure protection and restoration of riparian areas.
- Recognize, accommodate, and mitigate to the extent possible existing legal uses of private and public property that prevent the restoration of riparian areas.
- Work with the implementation of agency programs that will affect riparian areas, and establish regional riparian management priorities.
- Develop a landscape approach for management of streams and their associated riparian features.
- Understand the public value of riparian areas and the benefit to private property values by protecting riparian functions.

What is a Riparian Area?

The word riparian refers to anything which is connected with or adjacent to the banks of a stream or other body of water. Riparian areas (zones) act as vegetated buffers along streams and rivers and provide habitat during varying stages of many species life cycles (Tjaden and Weber, 1998 [a], and American Rivers, 2003). These areas are complex ecosystems and their natural function is crucial for the health and protection of the streams of the SBW.

Riparian areas are the culmination of hydrology, topography, and vegetation, and are critical to both the upland and aquatic ecosystems, providing a transitional zone, or ecotone, that helps maintain the biodiversity of both adjoining ecosystems (American Rivers, 2003 and USGS, 2003). Western Oregon riparian vegetation usually consists of conifers, deciduous trees, shrubs, grasses, sedges, and rushes (Godwin, 2000). This combination of

vegetation works together to regulate stream flow in response to high or low water levels. Through water storage, the riparian ecosystem helps to maintain stream flow during summer months. In healthy riparian areas, groundwater storage can be greater than in areas of degraded riparian health (USGS, 2003). Riparian zones also retain water by slowly releasing water back to the stream, reducing stream velocities during flood events (BLM, 1996, 1994). By acting as a filter, riparian vegetation can absorb possible stream pollutants, such as nutrient rich agricultural and urban run off (Morrow and Fischenich, 2000). Riparian vegetation allows the ecosystem some ability to respond to environmental changes such as drought or flood events. Streamside vegetation also provides stabilization to stream banks. This stabilization reduces erosion and prevents stream channels from down cutting. "A properly functioning riparian area increases the filtration function of the stream and aids in stability" (BLM, 1995).

The riparian canopy works as a buffer to diffuse direct solar radiation and moderate diurnal temperature changes, helping to minimize stream temperature increases. Canopies also supply litter to the stream, providing nutrients during decomposition (USGS, 2003). Riparian ecosystems also provide a buffer from environmental extremes found in the uplands or upstream. In healthy, functioning riparian areas, vegetation should be diverse and exhibit vertical complexity as well as a multi-layered canopy (Figure 5-1).

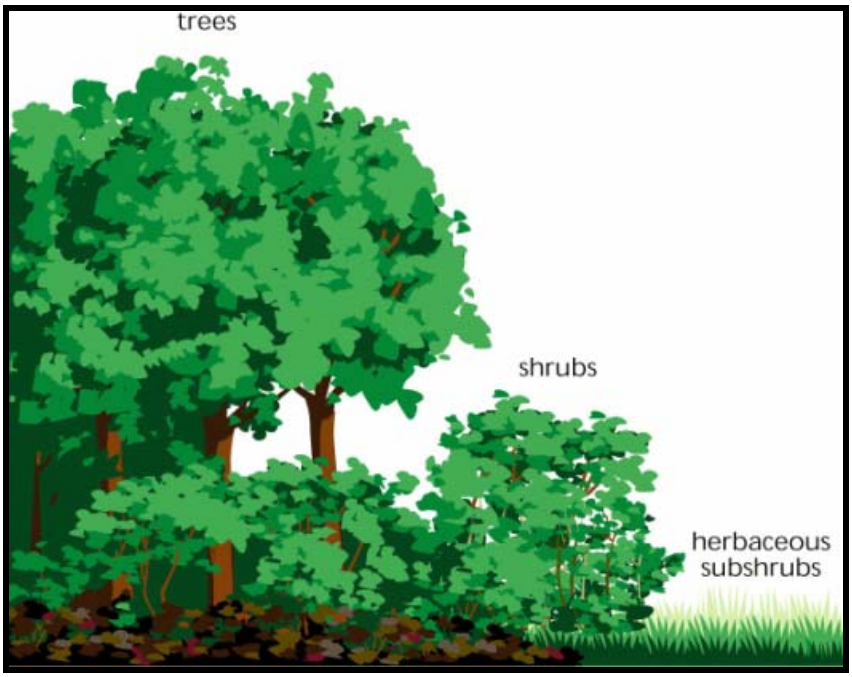


Figure 5-1
Vertical Complexity
(Source: FIRSWG, 1998)

Horizontal complexity is needed as well. This complexity is crucial to ensure a functional buffer between the stream and upland practices. In general, this horizontal complexity can be divided into zones, and moves from the interior stream bed to the exterior edge, as depicted in Figure 5-2. Zone 1 is adjacent to the stream bed and consists of undisturbed forest, providing shade and maintaining low stream temperatures. Zone 2 is upland of the stream bed and adjacent to Zone 1. This zone consists of managed forest, allowing for timber harvest, outdoor recreation, wildlife habitat, or alternative forestry products. Zone 2 allows for absorption of waterborne nutrients and pollutants before they enter the stream ecosystem. Large trees dominate this zone along with smaller trees and shrubs in the understory. Zone 3 is upland from, and adjacent to, Zone 2 and provides a transitional area between Zones 1 and 2 and the adjacent upland. This zone consists of grasslands and/or forbs, which encourage infiltration of surface runoff, provide water storage, and absorb

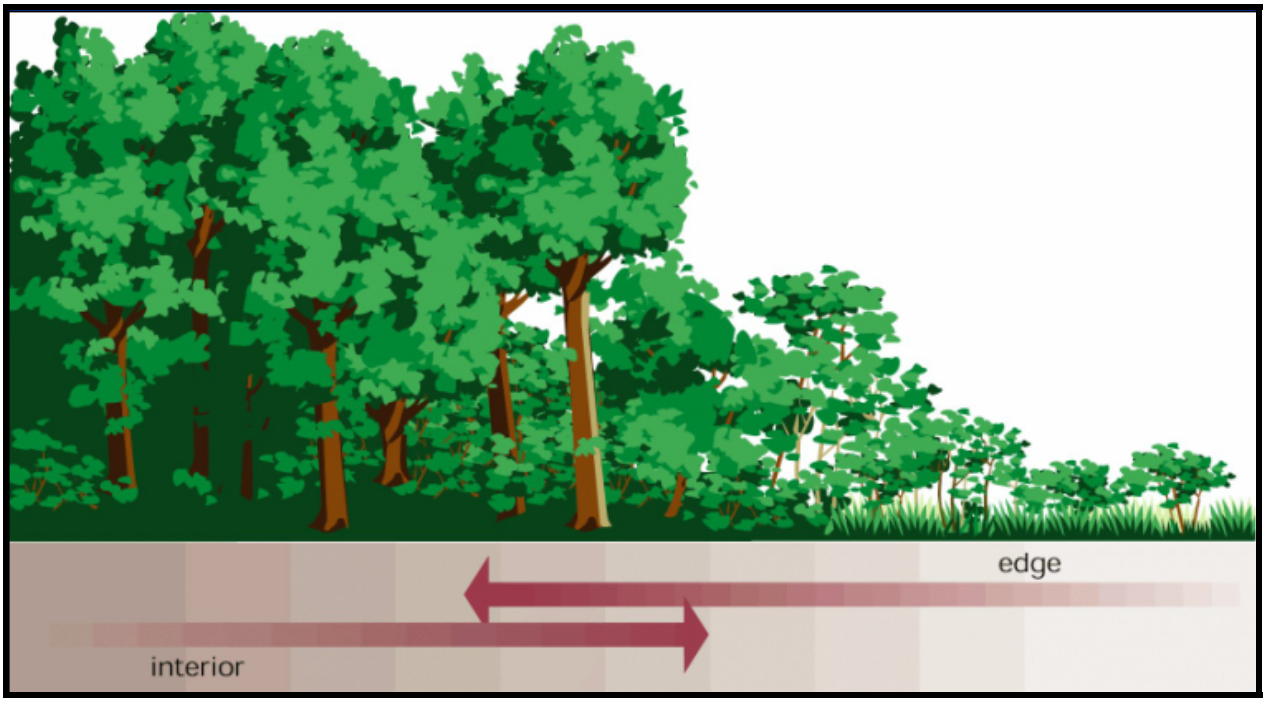


Figure 5-2
Edge and Interior Habitat
(Source: FIRSWG, 1998)

nutrients. Upland from Zone 3 is the Urban/Suburban Developed area, or Rural Cropland area (Tjaden and Weber, 1998 [a, b]). The combination of these zones provides a healthy transition from urban areas to stream beds, filtering potential pollutants and acting as a buffer to ensure the preservation of the aquatic ecosystem.

The zones described above are a conceptual method of evaluating riparian buffers. Many states have established specific riparian buffer criteria (Table 5-1). These can be seen for Idaho, Washington, California, and Oregon. Buffer strip requirements are specified by width, shade or canopy, and leave trees.

Table 5-1
Buffer Strip Requirements by State
(Source: FISRWG 1998)

State	Stream Class	Buffer Strip Requirements		
		Width	Shade or Canopy	Leave Trees
Idaho	Class I*	Fixed minimum (75 feet)	75% current shade[a]	Yes, number per 1,000 feet, dependent on stream width[b]
	Class II * *	Fixed minimum (5 feet)	None	None
Washington	Type 1, 2, and 3 *	Variable by stream width (5 to 100 feet)	50%, 75% if temperature >60ºF	Yes, number per 1,000 feet, dependent on stream width and bed material
	Type 4 * *	None	None	25 per 1,000 feet, 6 inches diameter
California	Class I and Class II *	Variable by slope and stream class (50 to 200 feet)	50% overstory and/or understory; dependent on slope and stream class	Yes; number to be determined by canopy density
	Class III * *	None[b]	5% understory[e]	None[e]
Oregon	Class I * *	Variable, 3 times stream width (25 to 100 feet)	50% existing canopy, 75% existing shade	Yes; number per 1,000 feet and basal area per 1,000 feet by stream width
	Class II special protection * *	None[f]	75% existing shade	None

* Human water supply or fisheries use.
* * Streams capable of sediment transport (CA) or other influences (ID and WA) or significant impact (OR) on downstream waters.
a In ID, the shade requirement is designed to maintain stream temperatures.
b In ID, the leave tree requirement is designed to provide for recruitment of large woody debris.
c May range as high as 300 feet for some types of timber harvest.
d To be determined by field inspection.
e Residual vegetation must be sufficient to prevent degradation of downstream beneficial uses.
f In eastern OR, operators are required to "leave stabilization strips of undergrowth… sufficient to prevent washing of sediment into Class I streams below."

Unhealthy riparian areas may have some or all of the following characteristics (Malheur Experiment Station, 2003):

- Low water table and decreased storage capacity;
- Low forage production;
- Little shade and warm water;
- Poor fish habitat and poor water quality;

- Low wildlife diversity;
- Few large trees for LWD recruitment;
- Little vegetation and roots to help protect and stabilize banks; and
- Reduced late summer stream flows.

Healthy riparian areas may have some or all of the following characteristics (Malheur Experiment Station, 2003):

- High water table and increased storage capacity;
- High forage production;
- Good shade and cool water;
- Good fish habitat and good water quality;
- High wildlife habitat diversity;
- Vegetation and roots present to protect and stabilize banks;
- Higher late summer stream flows; and
- Source of LWD.

Human Impacts on Riparian Areas

Humans have had a large impact on riparian areas throughout the SBW. Through development and urbanization in many areas of the watershed, riparian areas have been greatly damaged or completely destroyed. Many land use practices can easily degrade healthy, functional riparian areas. Livestock grazing, timber harvest, and construction within the riparian area can have devastating effects on the riparian area (Extension and Experiment Station Communications [EESC], 2003). The loss of riparian areas eliminates the transitional zone and the ability to filter between the uplands and aquatic ecosystems, ultimately creating an edge effect.

Edge effects can be abrupt or gradual (Figure 5-3) and are unhealthy compared to a riparian transitional zone. Fish and wildlife populations decline after prolonged riparian area absence due to degraded water quality and spawning habitat. The lack of riparian vegetation to filter sediments may increase erosion downstream as well as choke out potential spawning gravels for fish populations. Steams are more susceptible to flooding without a healthy riparian area due to the loss of filtering and flow control provided by riparian vegetation and their roots. Only healthy, intact riparian ecosystems can provide a buffer to such extreme environmental change.

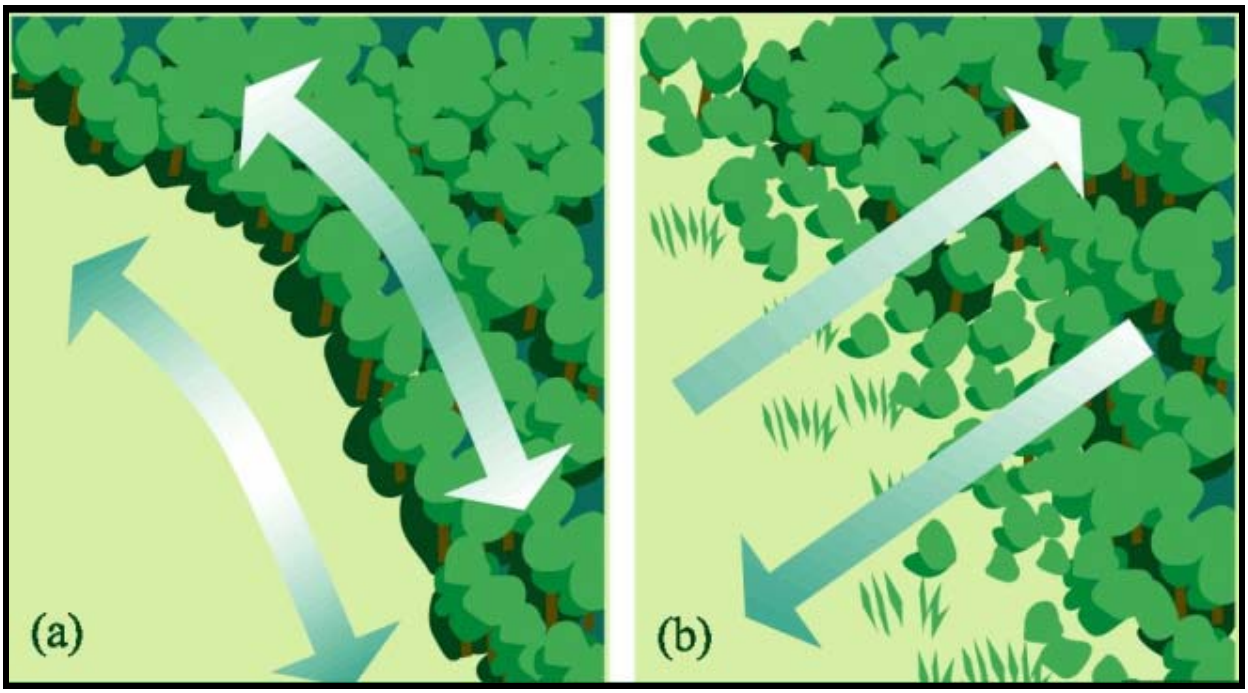


Figure 5-3
Edges: Abrupt or Gradual
(Source: FIRSWG, 1998)

Livestock grazing can have very serious effects on riparian areas when it occurs within the riparian area (Table 5-2). Grazing in this area can decrease plant vigor, density and biomass. Species composition and diversity can be altered. This creates the possibility for invasive, nonnative species to establish. Decreased ground cover leads to increased surface runoff, erosion, and

sediment delivery. Shade is decreased due to the lack of re-growth of vegetation in these areas. Increased surface runoff produces degraded water quality and ultimately a decline in aquatic species due to inappropriate or insufficient habitat. The relationship between methods of grazing, stream system characteristics, and riparian vegetation response can be seen in Table 5-3.

Table 5-2
Livestock Impacts on Stream Corridors

Impact
Decreased plant vigor
Decreased biomass
Alteration of species composition and diversity
Reduction or elimination of woody species
Elevated surface runoff
Erosion and sediment delivery to streams
Sreambank erosion and failure
Channel instability
Increased width to depth ratios
Degradation of aquatic species
Water quality degradation

References: Ames (1977); Knopf and Cannon (1982); Hansel et al. (1995); Kauffman and Kreuger (1984); Brooks et al. (1991); Platts (1979) MacDonald et al. (1991).

Timber harvesting can damage riparian areas as well. The removal of timber near or adjacent to the stream bank has similar effects as grazing. Timber provides a buffer to solar radiation with its canopy. Sediments and upland surface runoff are filtered by ground cover. Larger vegetation help to reduce the energy of rainfall, provide shade, LWD, and bank stability. Stream stabilization provided by the roots of large trees and small understory

vegetation prevents erosion and helps prevent down cutting of the bank, reducing stream energy during high flows.

Table 5-3
Generalized Relationships Between Grazing Systems, Stream System Characteristics, and Riparian Vegetation Response
(Source: FIRSWG, 1998)

Grazing System	Steep, Low Sediment Load	Steep, High Sediment Load	Moderate, Low Sediment Load	Moderate, High Sediment Load	Flat, Low Sediment Load	Flat, High Sediment Load
No grazing	Shrubs + Herbs + Banks 0	Shrubs + Herbs + Banks 0 to +	Shrubs + Herbs + Banks 0	Shrubs + Herbs + Banks +	Shrubs + Herbs + Banks +	Shrubs + Herbs + Banks +
Winter or dormant season	Shrubs + Herbs + Banks 0	Shrubs + Herbs + Banks 0 to +	Shrubs + Herbs + Banks +	Shrubs + Herbs + Banks +	Shrubs + Herbs + Banks +	Shrubs + Herbs + Banks +
Early growing season	Shrubs + Herbs + Banks 0	Shrubs + Herbs + Banks 0 to +	Shrubs + Herbs + Banks +	Shrubs + Herbs + Banks +	Shrubs + Herbs + Banks +	Shrubs + Herbs + Banks +
Deferred or late season	Shrubs - Herbs + Banks 0 to -	Shrubs - Herbs + Banks 0 to -	Shrubs - Herbs + Banks 0 to +	Shrubs - Herbs + Banks +	Shrubs - Herbs + Banks +	Shrubs - Herbs + Banks +
Three-pasture rest rotation	Shrubs - Herbs + Banks 0 to -	Shrubs - Herbs + Banks 0 to -	Shrubs - Herbs + Banks 0 to +	Shrubs - Herbs + Banks +	Shrubs - Herbs + Banks +	Shrubs - Herbs + Banks +
Deferred rotation	Shrubs - Herbs + Banks 0 to -	Shrubs - Herbs + Banks 0 to -	Shrubs - Herbs + Banks + to 0	Shrubs - Herbs + Banks +	Shrubs - Herbs + Banks +	Shrubs + Herbs + Banks +
Early rotation	Shrubs + Herbs + Banks 0 to -	Shrubs + Herbs + Banks 0 to +	Shrubs + Herbs + Banks + to 0	Shrubs + Herbs + Banks +	Shrubs + Herbs + Banks +	Shrubs + Herbs + Banks +
Rotation	Shrubs - Herbs + Banks 0 to -	Shrubs - Herbs + Banks 0 to -	Shrubs - Herbs + Banks 0 to +	Shrubs - Herbs + Banks +	Shrubs - Herbs + Banks +	Shrubs - Herbs + Banks +
Season-long	Shrubs - Herbs - Banks 0 to -	Shrubs - Herbs - Banks 0 to -	Shrubs - Herbs - Banks -	Shrubs - Herbs - Banks -	Shrubs - Herbs - Banks -	Shrubs - Herbs - Banks -
Spring and fall	Shrubs - Herbs - Banks 0 to -	Shrubs - Herbs - Banks 0 to -	Shrubs - Herbs - Banks -	Shrubs - Herbs - Banks -	Shrubs - Herbs - Banks - to 0	Shrubs - Herbs - Banks 0 to +
Spring and summer	Shrubs - Herbs - Banks 0 to -	Shrubs - Herbs - Banks 0 to -	Shrubs - Herbs - Banks -	Shrubs - Herbs - Banks -	Shrubs - Herbs - Banks - to 0	Shrubs - Herbs - Banks 0 to +

Note: - = decrease; + = increase; 0 = no change. Stream gradient: 0 to 2% = flat; 2 to 4% = moderate; >4% = steep. Banks refers to bank stability.

Construction along the stream often eliminates native vegetation and creates an impervious surface. Paved walkways, driveways, parking lots, roofs, and roads increase surface runoff by redirecting water from its natural path of

infiltration (EESC, 2003). These impervious surfaces cause spikes in stream flows and reduce the stream storage capacity. This removes the ability of the riparian area to filter sediments or pollutants before they enter the stream. Figure 5-4 demonstrates the increase in surface runoff in response to construction and the increase in impervious structure. The desire for a clear view of the stream often prompts the removal of much of the riparian vegetation. This makes the property susceptible to invasive species, erosion, surface runoff, and degraded aquatic habitat.

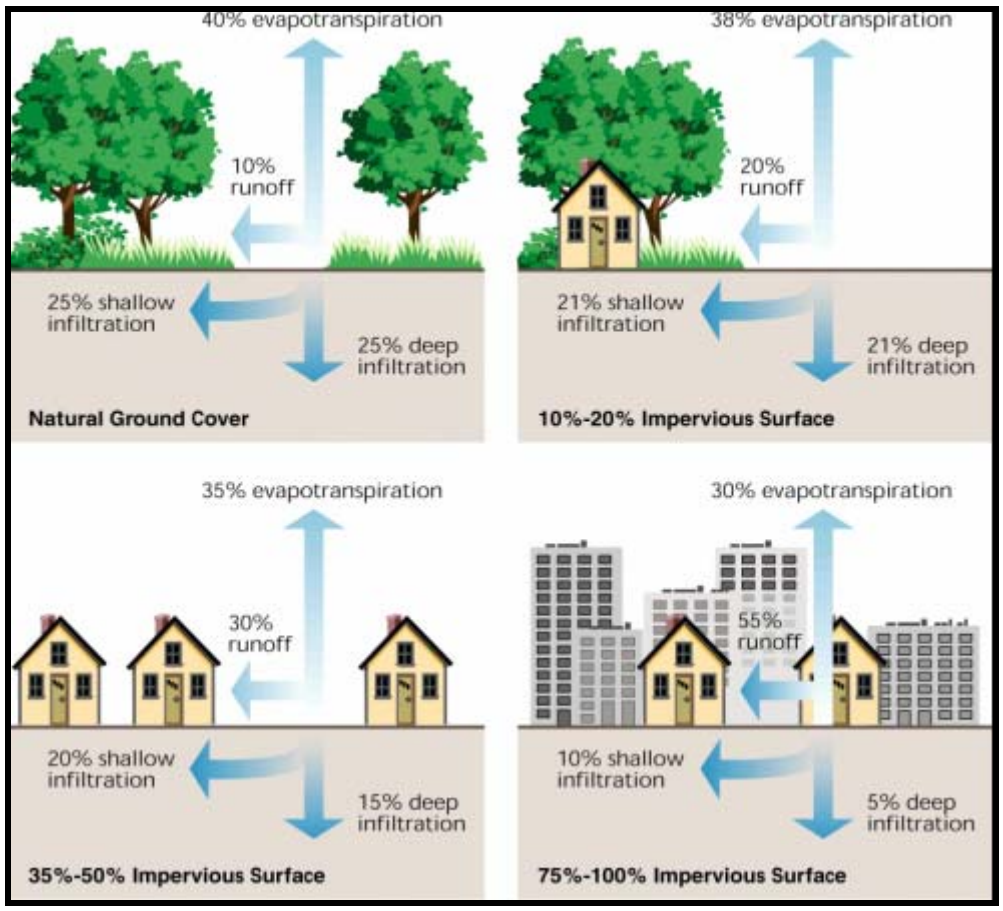


Figure 5-4
Relationship Between Impervious and Surface Runoff
(Source: FIRSWG, 1998)

How Do Riparian Areas Help Fish?

Healthy riparian areas are an essential component to fish habitat and survival. Salmonids prefer complex instream structure that consists of LWD, shaded streams, and banks lined with trees for rearing habitat (ODFW, 2003). Riparian vegetation provides habitat for insects on which fish feed. The leaf litter that enters the stream provides nutrients and energy that are needed to support the aquatic organisms on which fish feed. Many times, this leaf litter is an imperative contributor of stream nutrients, particularly in smaller tributary streams (Morrow and Fischenich, 2000). Low order streams comprise the majority of streams in the SBW. Tree canopies shade the stream from solar radiation and moderate stream temperature during hot summer months. The canopy also provides fish with increased protection from predatory birds (Figure 5-5).

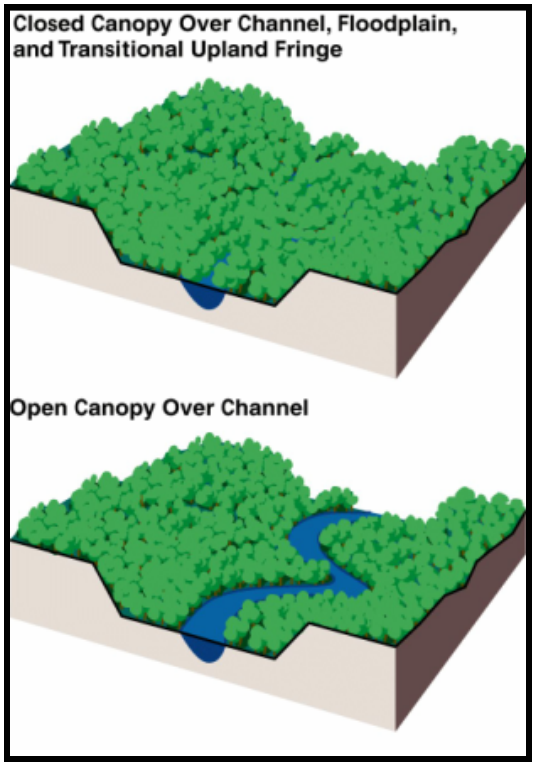


Figure 5-5
Canopy Vegetation
(Source: FIRSWG, 1998)

Native salmonids are more abundant and diverse in streams that contain LWD (Water and Rivers Commission, 2000 [a]). Riparian areas are important sources of this critical component to the aquatic ecosystem. LWD provides a link between the riparian area and the stream and has a great effect on stream function (Cooperative Forest Ecosystem Research [CFER], 2003). The geomorphology and ecology of a stream are affected by the presence of LWD (Water and Rivers Commission, 2000 [b]). The addition of LWD to streams increases channel complexity by creating areas of pools and riffles. These areas provide refuge for aquatic organisms during high stream flows, cover from predators, and rearing ponds for fish. LWD retains sediment, providing spawning gravels for salmonids (OWEB, 1999). Macroinvertebrate species tend to be more diverse and productive around LWD than elsewhere in the stream (Water and Rivers Commission, 2000 [a]). The presence of LWD increases the stable habitat available for macroinvertebrates, providing a greater food source for salmonids. The presence of LWD in an aquatic ecosystem increases its stability and resilience to disturbance (Lemly and Hilderbrand, 2000).

METHODS USED TO EVALUATE RIPARIAN AREAS IN THE SBW

Data were collected from various public agencies including the DEQ and the ODFW. Southern Oregon University (SOU) Capstone students generated a baseline riparian condition assessment and conducted a search of available riparian data from various agencies.

SOU Capstone students analyzed color aerial photographs of approximately eight and a half miles of Evans Creek. The area of analysis encompassed the area from the confluence of Evans Creek and the Rogue River to upstream of Wimer. Medford BLM color aerial photos from the year 2001 were analyzed using the methodologies described for the Riparian/Wetlands Assessment in

the OWEB Watershed Assessment Manual. The analysis area included Township 35 South, Range 4 West, Sections 10, 11, 12, 16, 21, 28, and 33 and Township 36 South, Range 4 West, Sections 4, 9, 10, and 16. These sections can be found on the Wimer and Rogue River USGS 7.5 minute quadrangles.

The width of the riparian zone, continuity of riparian vegetation, and density of riparian vegetation were determined by dividing the stream into 1,000 foot Riparian Condition Units (RCUs). Each side of the stream had its own set of RCUs. Each RCU was further divided into four 250 foot segments that are classified for width, continuity, and density.

Each segment was given a riparian area **width** according to the following guidelines:

- Absent
- Narrow (< 30 feet wide)
- Wide (> 30 feet wide)

Each segment was classified by the **continuity** of the riparian area vegetation:

- Mostly Continuous
- Some Interruptions (<1 interruption per 1,000 feet)
- Discontinuous (>1 interruption per 1,000 feet)

Each segment was classified by the **density** of the riparian vegetation:

- Dense (<1/3 of the ground is visible)
- Sparse (>1/3 of the ground is visible)

Aerial Photo Analysis

The aerial photo assessment, determined that 48% of the riparian zone along the 8.5 mile section of Evans Creek could be classified as "wide." This means that 52% was either "absent" or "narrow." Approximately 43% of the riparian area was classified as "dense" with the remaining 57% of the area considered "sparse" in nature. Lastly, almost 80% of the stream vegetation was considered to be "discontinuous." The information from each RCU was consolidated into four 10,000 foot sections and one 5,000 foot section for each side of the stream. The results of this analysis can be seen in Appendix H.

This method of assessment is useful for very general base-line data gathering. However, upon ground truthing, often what was classified as "wide" from the aerial photos, ended up being dense tracts of Himalayan blackberry, an invasive species. A major limitation when assessing color aerial photos is that species composition is impossible to determine with this method. Stereoscopic photos are more efficient in determining vegetation height, which would provide a clearer understanding of the riparian condition.

Riparian Data Search

A riparian data search was also conducted to gather riparian information for the SBW from various agencies. The ODFW provided Habitat Surveys which generally described the riparian habitat and LWD found in stream reaches of various SBW streams.

A total of 89 stream reaches were surveyed by ODFW from August 1994 to September 2000. The riparian habitat of the stream reaches consists of various deciduous, hardwood, and conifer tree species or mixtures of these groups. The riparian understory consists of various shrubs, grasses, and/or young deciduous tree species.

Of the 89 stream reaches, 66 (74.15%) were classified by ODFW as having low amounts of LWD. Five (5.61%) were classified as having moderate amounts of LWD and three (3.37%) were classified as having high amounts of LWD. The remaining 15 stream reaches did not have adequate descriptions to determine their classifications.

The SOU data search for ODFW habitat surveys provided baseline data that were insufficient to create a riparian conditions assessment. SOU student contributions also provided baseline calculations of RCUs. Due to the methods and materials used in the SOU student calculations of RCUs, Riparian Vegetation Characteristics were unable to be determined. The SOU data search and baseline calculations of RCUs were beneficial in creating an example of a final riparian conditions assessment as well as demonstrating the need for ground truthing in this process.

ANALYSIS OF AVAILABLE SBW RIPARIAN DATA

DEQ 303(d) Riparian Condition Assessment

Oregon DEQ conducted a Riparian Condition Assessment of 303(d) listed streams in the Rogue Basin. This assessment area encompassed 303 (d) listed streams in the SBW. The assessment documented shade parameters, riparian vegetation, and channel conditions along these streams. Interpretations were made using 1996 BLM stereoscopic aerial photos and 1994 BLM Ortho-photo quads (7.5 min). Table 5-4 lists the streams which are 303(d) listed. All of these streams are temperature non-compliant. This assessment specifically dealt with 303(d) listed streams affected by riparian vegetation and channel conditions in relation to temperature.

Table 5-4
303(d) Listed Streams in the Seven Basins Watershed

Waterbody Name	Stream Segment	Listed Parameter	Miles Assessed
Foots Cr.	Mouth to headwater	Temperature	3.7
Kane Cr.	Mouth to headwater	Temperature	5.5
Sams Cr.	Mouth to headwater	Temperature	7.5
Sardine Cr.	Mouth to headwater	Temperature	3.4
Galls Cr.	Mouth to headwater	Temperature	5.2
Birdseye Cr.	Mouth to headwater	Temperature	4.1
Evans Cr.	Mouth to headwater	Temperature	35.2
WF Evans	Mouth to headwater	Temperature	15
Battle Cr.	Mouth to headwater	Temperature	3.9
Cold Cr.	Mouth to headwater	Temperature	4.3
Pleasant Cr.	Mouth to headwater	Temperature	13.4
Ramsey Cr.	Mouth to headwater	Temperature	3.4
Rock Cr.	Mouth to headwater	Temperature	7.8
Salt Cr.	Mouth to headwater	Temperature	6.4
R.F. Salt	Mouth to headwater	Temperature	2.6

The results of this assessment can be seen in Table 5-5, which represents the weighted stream shade and recovery time of streams within the SBW. The existing potential of percent shade is the optimum shade that would be expected to be at a given site based on site specific characteristics, such as stream width and riparian vegetation. In this assessment, the site potential was projected only in areas where human activities had altered riparian vegetation. This calculation does not include areas of poor riparian vegetation due to natural site conditions, such as serpentine soils or sites of natural disturbance. Percent shade was determined using the shade model *Shadow* (Oregon DEQ, 2003). Years to recovery were calculated based on growth models for specific species and were delineated by a site index value that related to growing conditions. These values were applied to the difference

between the date of aerial photos used in the assessment and the date of the assessment (Oregon DEQ, 2003).

Table 5-5
Rogue Basin Riparian Condition Assessment;
Weighted Stream Shade and Recovery Time
(From: Oregon DEQ, 2003)

Stream	Existing Potential			Existing Potential			Existing Potential	
	Stream Miles	% Shade BLM	Years to Recovery	Stream Miles	% Shade Private	Years to Recovery	% Shade BLM	% Shade Private
Foots Cr	0			3.7	81	25		
Kane Cr	0.6	93	93	4.9	86		87	87
Sams Cr	1.3	88	88	6.2	84	15	85	88
Sardine Cr	0			3.4	76	45		
Galls Cr	0			5.2	89			
Birdseye Cr	0.2	95	95	3.9	88	5	92	93
Evans Cr Below W.F.				19.3	29	80		
Evans Cr. Above W.F.	3.2	88	90	12.7	85	35	85	88
WF Evans	7	75	81	8	63	55	69	79
Battle Cr	2.5	94	94	1.4	90		93	93
Cold Cr	1.5	84	85	2.8	67	25	73	83
Pleasant Cr	2.3			11.1				
Ramsey Cr.	1.5	84	90	1.9	85	8	84	90
Rock Cr.	3.7	90	90	4.1	84	55	87	87
Salt Cr.	2	92	92	4.4	82	5	85	86
R.F.Salt	2.6	93	93	0				

Prepared for BLM by Oregon DEQ, 2003 DRAFT

Of the area assessed within the SBW, 93 stream miles are privately owned and 28.4 stream miles are owned by the BLM. Evans Creek below the West Fork Evans Creek has the greatest years to recovery on privately owned land. On BLM owned land, the majority of streams have 81-95 years to recovery. Birdseye Creek has the greatest years to recovery on BLM land. Portions of the

Rogue Basin were ground-truthed in this assessment. However, none of those locations were within the SBW.

This compilation of data provides a necessary baseline for understanding riparian conditions and their effect on 303(d) listed streams in the SBW. Continued monitoring throughout the coming years should provide an excellent demonstration of the importance of riparian areas in the SBW with regard to 303(d) compliance.

DEQ Forward Looking Infra-Red Flight

DEQ conducted a forward-looking infra-red (FLIR) flight in portions of the SBW in the summer of 2003. The purpose of this flight was to collect baseline surface temperature data for 303(d) listed streams within the watershed. This infra-red technology provides a thermal picture of the streams and distinctly shows "hot spots" along the stream as well as areas of thermal mixing, and groundwater upwelling. This baseline data is useful to distinguish locations along streams which may be contributing to stream warming. This data also provides an understanding of areas within the stream which are remaining cool and may be critical areas for salmonids.

At the time of this printing, the final FLIR flight data was not available to be incorporated into this document. As this information becomes available, it will be incorporated into this assessment.

5.2 WETLAND CHARACTERIZATION AND FUNCTIONAL ASSESSMENT

INTRODUCTION

The EPA is responsible for carrying out the goals of the Federal CWA as they pertain to wetlands as well. Wetlands are considered to be part of the nation's waters and therefore fall under the goals of the CWA. DEQ is responsible for maintaining federal goals at the state level.

The state of Oregon provides guidance for the protection of wetlands in the form of The Oregon Plan for Salmon and Watersheds. The Oregon Plan is one of many programs that state agencies have developed to recognize the importance of wetlands to watershed function and salmonid health. Natural resource agencies throughout the state are called upon by the Oregon Plan to set priorities for wetland protection and management.

Loss of Wetlands

Oregon has lost approximately 38% of its original wetlands. Freshwater wetlands in urbanized and agricultural areas have experienced the greatest loss and degradation (Morlan, 2000). The Rogue Valley is prioritized for wetland restoration and acquisition by the state of Oregon due to the large historical loss of wetlands and compromised water quality as a result of rapidly urbanizing areas (Oregon Parks and Recreation Department, 2003). Statistics such as these have become more prevalent in the state of Oregon, prompting a surge of awareness and interest in wetland issues. Increased research into wetlands will promote better understand of the distribution, functions, and values of wetland ecosystems. Watershed assessments provide a means of

gathering valuable data for local wetlands as well as contribute to statewide goals of wetlands preservation, restoration, and management.

What is a Wetland?

The term wetland encompasses a wide range of possible ecosystems. A wetland can be an area that is never flooded, but has groundwater at or near the ground surface. An area that is flooded year round can also be considered a wetland. There are many variations of wetlands between these two extreme scenarios as well. Wetlands encompass marshes and wet meadows dominated by herbaceous plants, swamps dominated by shrubs, and wooded swamps dominated by trees (USEPA, 2003 [a]). The most consistent characteristic of a wetland is the persistent presence of water during some time frame within an average annual period.

Wetlands have water saturated soils. Flooded soils diffuse oxygen nearly 10,000 times slower than aerobic soils (Kalec and Knight, 1996). The extremely low levels of oxygen in wetland soils result in anaerobic conditions. This means that very low levels of oxygen are present within the soil, allowing only bacteria and plant species which are adapted to the low oxygen wetland environment to persist (Dennison and Berry, 1993). These anaerobic soils are commonly referred to as hydric soils. Plant species which flourish in wetland ecosystems are referred to as hydrophytic vegetation.

Wetlands absorb and control flood waters, contributing significantly to the prevention of property damage during high water events. Wetlands also absorb excess nutrients, sediment, and other pollutants as they move through the ecosystem. This helps prevent excess loading of substances such as fertilizers, manure, nutrients from leaking septic tanks, and/or municipal sewage into streams, lakes, and rivers (USEPA, 2002 [a]). The ability to absorb excess water enables wetlands to slow the momentum and erosive potential of high

velocity waters and reduce flood heights. Ground water recharge is possible as well, contributing to base flows during low water periods (USEPA, 2002 [b]).

Wetlands are some of the most biologically productive and species rich habitats in Oregon. They are an intricate part of many ecological processes within a watershed and provide an essential component to salmonid life cycles.

Types of Wetlands

The transitional zone between the terrestrial and aquatic ecosystems creates a variety of possible wetland types. The location of a wetland dictates its specific characteristics. These are dependant on soils, topography, climate, hydrology, water chemistry, vegetation, and human disturbance (USEPA, 2003 [b]).

The variation in wetlands has been addressed by the United States Fish and Wildlife Service (USFWS) through the use of their wetlands classification. This is one of the most widely recognized methods of wetland classification in the United States. It systematically distinguishes the specific system, subsystem, class, subclass, dominance type, and modifiers to which a specific wetland belongs. This classification scheme will be used to describe the wetlands currently mapped in the SBW.

The most broad distinction of wetlands is the determination of physical characteristics between freshwater versus saltwater wetlands. The focus of this discussion will only be on freshwater wetlands due to the absence of saltwater wetlands in the SBW. The physical characterization of the wetland is further described by the system. A system is a complex of wetland ecosystems that share similar hydrologic, geomorphologic, chemical, or biological features (Tiner, 2003). The system can be marine, estuarine, riverine, lacustrine, or palustrine (Table 5-6).

Table 5-6
USFWS Classification System for Wetlands

System	Subsystem	
Marine- open oceanfront	Subtidal- continuously submerged	Rock bottom; unconsolidated bottom; aquatic bed; reef
	Intertidal- exposed at low tide	Aquatic bed; reef; rocky shore; unconsolidated shore
Estuarine-tidal embayments; variable salinity	Subtidal- continuously submerged	Rock bottom; unconsolidated bottom, aquatic bed; reef
	Intertidal- exposed at low tide	Aquatic bed; reef; stream bed; rocky shore;
		unconsolidated shore; emergent wetland; scrub-shrub
		wetland; forested wetland
Riverine- associated with river channels	Tidal- fluctuating flows	Rock bottom; unconsolidated bottom; aquatic bed;
		rocky shore; unconsolidated shore; emergent wetland
	Perennial- continuously inundated	Rock bottom; unconsolidated bottom; aquatic bed;
		rocky shore; unconsolidated shore; emergent wetland
Lacustrine- associated with lakes	Intermittent- seasonally exposed	Stream bed
	Limnetic- deep water	Rock bottom; unconsolidated bottom; aquatic bed
	Littoral- shoreline, shallow water	Rock bottom; unconsolidated bottom; aquatic bed:
		rocky shore; unconsolidated shore; emergent wetland
Palustrine- nontidal, emergent vegetation	None	Rock bottom; unconsolidated bottom; aquatic bed;
		unconsolidated shore; moss-lichen wetland; emergent
		wetland; scrub-shrub wetland; forested wetland

Kadlec and Knight, 1996

Marine systems are in the open ocean and/or associated with the coastline. Estuarine systems are found in tidal waters of coastal rivers, salty tidal marshes, mangrove swamps, and tidal flats. Riverine systems are associated with rivers and streams. Lacustrine systems are associated with lakes. Palustrine systems are nontidal and have emergent vegetation. Lacustrine and palustrine systems are found in the SBW.

Each system, other than the palustrine system, has associated subsystems which describe water levels within the wetland (Table 5-6). Associated with each subsystem are classes which describe the general appearance of the wetland with regard to dominant vegetation or substrate (Table 5-6 and 5-7). The subclass defines the dominant vegetation in vegetated wetlands or the substrate when no vegetation is present (Table 5-7).

The USFWS allows for more specific wetland classification by distinguishing any special modifiers associated with the wetland. Water regimes are considered a special modifier and within the SBW are described as permanently flooded, semipermanently flooded, temporarily flooded, saturated, seasonally flooded, intermittently flooded, or artificially flooded (Table 5-8). Other special modifiers in the SBW specify if the wetland has been diked, impounded, or excavated. These classifications are found after the class of the wetland.

Table 5-7
Description of Classes and Subclasses of Wetlands

Class	Brief Description	Subclass
Rock Bottom	Generally permanently flooded areas with bottom substrates consisting of at least 75% stones and boulders and less than 30% vegetative cover.	Bedrock; rubble
Unconsolidated Bottom	Generally permanently flooded areas with bottom substrates consisting of at least 25% particles smaller than stones and less than 30% vegetative cover.	Cobble-gravel; sand; mud; organic
Aquatic Bed	Generally permanently flooded areas that are vegetated by plants growing principally on or below the water surface.	Algal; aquatic; rooted vascular; floating vascule
Reef	Characterized by elevations above the surrounding substrate and interference with normal wave flow; they are primarily tidal.	Coral; mollusk; worm
Streambed	Channel whose bottom is completely dewatered at low water periods.	Bedrock; rubble; cobble-grave; sand; mud; organic; vegetated
Rocky Shore	Wetlands characterized by bedrock stones or boulders with areal coverage of 75% or more and with less than 30% coverage by vegetation.	Bedrock; rubble
Unconsolidated Shore	Wetlands having unconsolidated substrates with less than 75% coverage by stones, boulders, and bedrock and less than 30% native vegetative cover.	Cobble-gravel; sand; mud; organic; vegetated
Moss-lichen wetland	Wetlands dominated by mosses or lichens where other plants have less than 30% coverage	Moss; lichen
Emergent wetland	Wetlands dominated by woody vegetation less than 20 feet (6 meters) tall.	Persistent; nonpersistant
Scru-shrub wetland	Wetlands dominated by woody vegetation less than 20	Deciduous;

Defined by Cowardin et al. (1979)

Table 5-8
Water Regime Modifiers of Wetlands

Tidal	Salt and Brackish Water Areas	**Subtidal** Permanently flooded tidal waters
		Irregularly Exposed Exposed less often than daily by tides
		Regularly Flooded Daily tidal flooding and exposure to air
		Irregularly Flooded Flooded less often than daily and typically exposed to air
	Freshwater	**Permanently Flooded** Permanently flooded by tides and river overflow but with tidal fluctuation in water levels
		Semipermanently Flooded Flooded most of the growing season by river overflow but with tidal fluctuation in water levels
		Regularly Flooded Daily tidal flooding and exposure to air
		Seasonally Flooded Flooded irregularly by tides and river overflow
		Permanently Flooded Flooded throughout the year in all years
Nontidal	Inland freshwater and saline areas	**Intermittently Flooded** Flooded year-round except during extreme droughts
		Semipermanently Flooded Flooded throughout the growing season in most years
		Seasonally Flooded Flooded for extended periods in the growing season, but surface water is usually absent by the end of the growing season
		Saturated Surface water is seldom present, but the substrate is saturated to the surface for most of the growing season
		Temporarily Flooded Flooded for only brief periods during the growing season, with the water table usually well below the soil surface for most of the season
		Intermittently Flooded The substrate is usually exposed and only flooded for variable periods without detectable seasonal periodicity(may be upland in some situations)
		Artificially Flooded Duration and amount of flooding is controlled by pumps or siphons in combination with dikes or dams
		Permanently Flooded Flooded throughout the year in all years

Types of Wetlands Found Within the SBW

Lacustrine systems have a range of subsystems which can be intermittent (seasonally exposed), limnetic (deep water), or littoral (shoreline, shallow water). Of the wetlands currently mapped in the SBW, the lacustrine systems have limnetic subsystems. These subsystems have associated classes, which include rock bottoms, unconsolidated bottoms, or aquatic beds. The lacustrine, limnetic wetlands currently mapped in the SBW have unconsolidated bottoms (Kadlec and Knight, 1996).

Palustrine systems do not have associated subsystems. The classes associated with palustrine systems include rock bottoms, unconsolidated bottoms, aquatic beds, unconsolidated shores, moss-lichen wetland, emergent wetland, scrub-shrub wetland, and forested wetland. The palustrine wetlands currently mapped in the SBW have unconsolidated bottoms, aquatic beds, forested wetlands, emergent wetlands, and scrub-shrub wetlands (Kadlec and Knight, 1996).

Importance of Wetlands to Fish

Salmonid populations are dependent on the filtering abilities of riparian wetlands. It is crucial that sediments and excess nutrients settle in wetlands before entering the stream. This protects salmonids from potentially harmful chemical and physical water quality issues typically found in surface runoff. Stream flow moderation is also critical to salmonid survival. Wetlands help regulate stream flow during high water events, and also replenish streams with groundwater during low flow periods (USEPA, 2003 [c]). This function helps to ensure streamflow as well as recharge of cold water to streams during warmer periods of the year.

METHODS

Data were gathered from National Wetlands Inventory Maps available for the SBW.

DISCUSSION OF AVAILABLE DATA

Location of Wetlands in the SBW

Currently, only Kane Creek sub watershed, Sam's Creek sub watershed, Snider Creek sub watershed, May/Sykes Creek sub watershed, and Upper Evans Creek sub watershed have been mapped by the National Wetlands Inventory. Wetlands are present in all of these sub watersheds (Figure 5-6), however, at the time of this assessment, mapping by the National Wetlands Inventory has not been completed. As a result, these data provide only a very general summary of wetlands within the SBW. No wetland data describing the remaining portion of the SBW are available.

National Wetlands Inventory classifies wetlands based on which wetland system it falls under, limits of this system, the class of the system, and any special modifiers found within the specific wetland. Every wetland mapped in the SBW has a National Wetlands Inventory identification code based on the previously described classifications. These codes are described in Table 5-9.

INSERT FIGURE 5-6
11x17
Seven Basins Watershed Wetlands Map

Table 5-9
Wetland Classification Types Found in Seven Basins Watershed

Wetland Type Identification Code	Wetland Type Description
L1UBHh	(L) Lacustrine, (1) Limnetic, (UB) Unconsolidated Bottom, (H) Permanently Flooded, (h) Diked/Impounded
L1UBHx	(L) Lacustrine, (1) Limnetic, (UB) Unconsolidated Bottom, (H) Permanently Flooded, (x) Excavated
PABF	(P) Palustrine, (AB) Aquatic Bed, (F) Semipermanently Flooded
PABFh	(P) Palustrine, (AB) Aquatic Bed, (F) Semipermanently Flooded, (h) Diked/Impounded
PABFx	(P) Palustrine, (AB) Aquatic Bed, (F) Semipermanently Flooded, (x) Excavated
PABH	(P) Palustrine, (AB) Aquatic Bed, (H) Permanently Flooded
PABHh	(P) Palustrine, (AB) Aquatic Bed, (H) Permanently Flooded (h) Diked/Impounded
PABHx	(P) Palustrine, (AB) Aquatic Bed, (H) Permanently Flooded (x) Excavated
PEMA	(P) Palustrine, (EM) Emergent, (A) Temporarily Flooded
PEMB	(P) Palustrine, (EM) Emergent, (B) Saturated
PEMC	(P) Palustrine, (EM) Emergent, (C) Seasonally Flooded
PEMCh	(P) Palustrine, (EM) Emergent, (C) Seasonally Flooded, (h) Diked/Impounded
PEMCx	(P) Palustrine, (EM) Emergent, (C) Seasonally Flooded, (x) Excavated
PEMF	(P) Palustrine, (EM) Emergent, (F) Semipermanently Flooded
PEMFb	(P) Palustrine, (EM) Emergent, (F) Semipermanently Flooded (b) Beaver
PEMFh	(P) Palustrine, (EM) Emergent, (F) Semipermanently Flooded (h) Diked/Impounded
PEMFx	(P) Palustrine, (EM) Emergent, (F) Semipermanently Flooded (x) Excavated
PFOA	(P) Palustrine, (FO) Forested, (A) Temporarily Flooded
PFOC	(P) Palustrine, (FO) Forested, (C) Seasonally Flooded
PFOJ	(P) Palustrine, (FO) Forested, (J) Intermittently Flooded
PSSAh	(P) Palustrine, (SS) Scrub-Shrub, (A) Temporarily Flooded, (h) Diked/Impounded
PSSB	(P) Palustrine, (SS) Scrub-Shrub, (B) Saturated
PSSC	(P) Palustrine, (SS) Scrub-Shrub, (C) Seasonally Flooded
PSSCh	(P) Palustrine, (SS) Scrub-Shrub, (C) Seasonally Flooded, (h) Diked/Impounded
PSSCx	(P) Palustrine, (SS) Scrub-Shrub, (C) Seasonally Flooded, (x) Excavated
PUBF	(P) Palustrine, (UB) Unconsolidated Bottom, (F) Semipermanently Flooded
PUBFh	(P) Palustrine, (UB) Unconsolidated Bottom, (F) Semipermanently Flooded, (h) Diked/Impounded
PUBFx	(P) Palustrine, (UB) Unconsolidated Bottom, (F) Semipermanently Flooded, (x) Excavated
PUBH	(P) Palustrine, (UB) Unconsolidated Bottom, (H) Permanently Flooded
PUBHh	(P) Palustrine, (UB) Unconsolidated Bottom, (H) Permanently Flooded, (h) Diked/Impounded
PUBHx	(P) Palustrine, (UB) Unconsolidated Bottom, (H) Permanently Flooded, (x) Excavated
PUBKx	(P) Palustrine, (UB) Unconsolidated Bottom, (K) Artificially Flooded, (x) Excavated
PUSCx	(P) Palustrine, (US) Unconsolidated Shore, (C) Seasonally Flooded, (x) Excavated
U/PEMA	Unknown/ (P) Palustrine, (EM) Emergent, (A) Temporarily Flooded

Within the Kane Creek sub watershed, the majority of mapped wetlands are classified as PABHh, followed by PUBHx, and PEMC (Figure 5-7). Sam's Creek sub watershed is dominated by PUBFx, followed by PUBHh and PUBFh (Figure 5-8). Snider Creek is also dominated by PUBFx, followed by PEMC and PUBHx (Figure 5-9). National Wetlands Inventory has mapped only four wetlands within May/Sykes sub watershed. All four wetlands are classified PABHh. PUBFx is the dominant wetland classification found in Upper Evans Creek. PEMC and PUBH are the second and third most dominant wetland classifications in Upper Evans Creek (Figure 5-10).

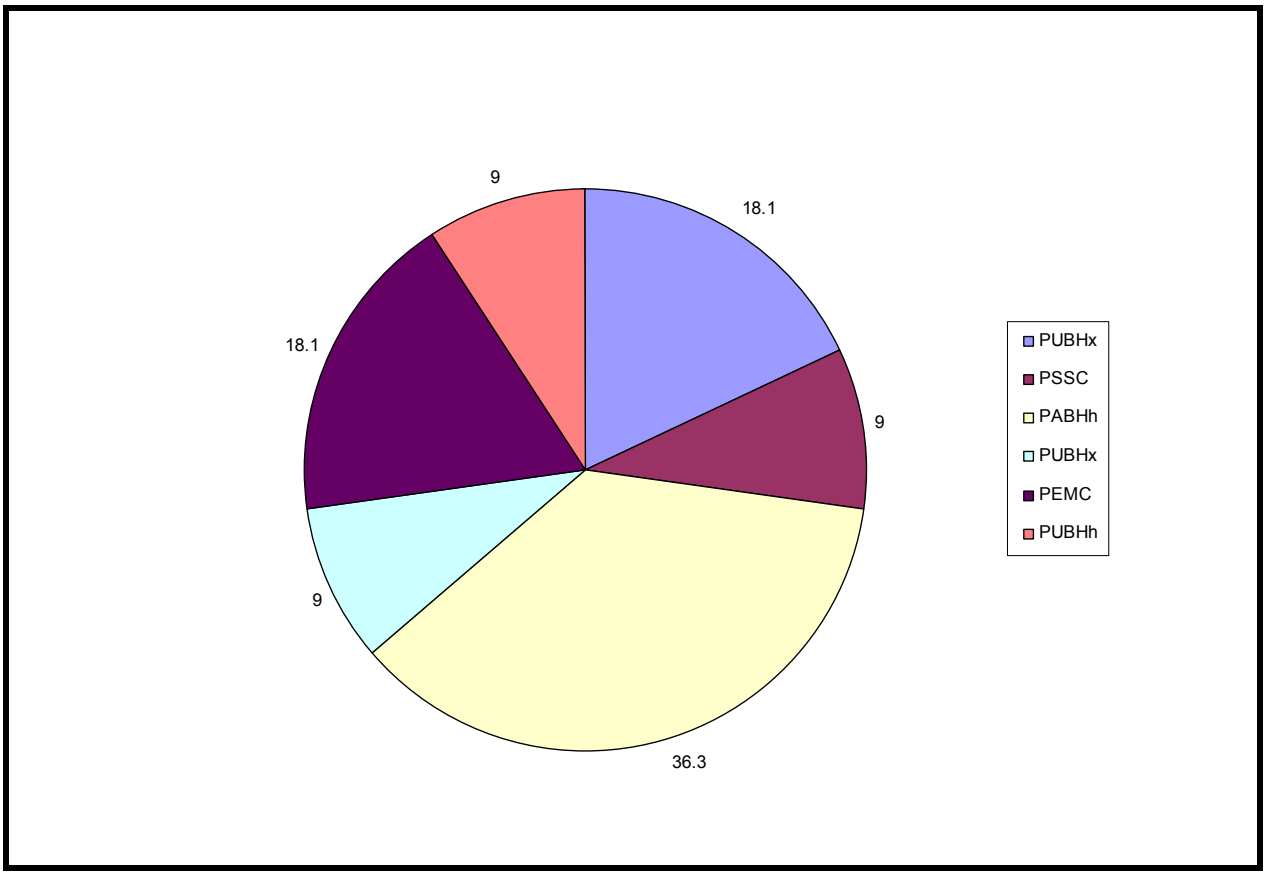


Figure 5-7
Percentage of Wetland Habitat Classification Within Kane Creek Sub Watershed

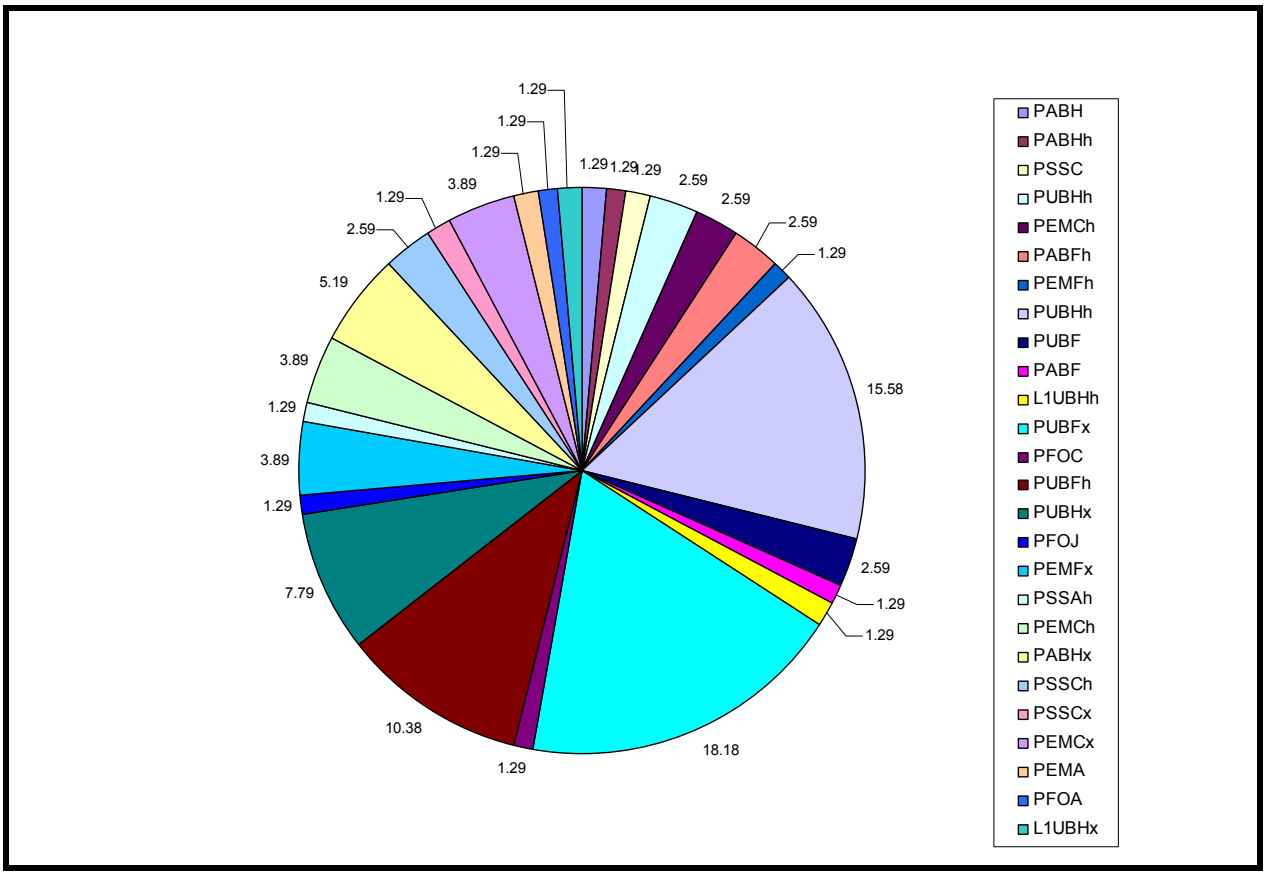


Figure 5-8
Percentage of Wetland Habitat Classifications Within Sams Creek Sub Watershed

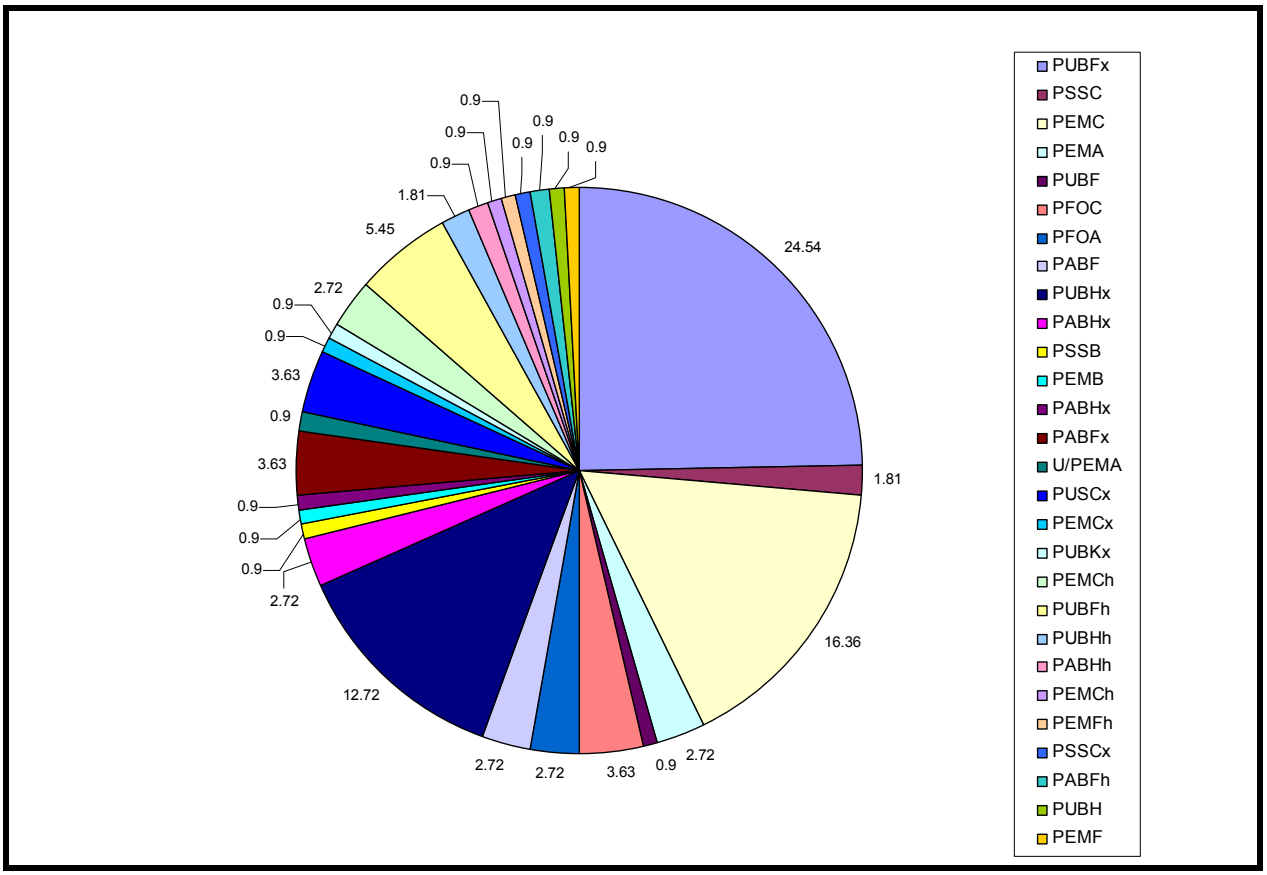


Figure 5-9
Percentage of Wetland Habitat Classifications Within Snider Creek Sub Watershed

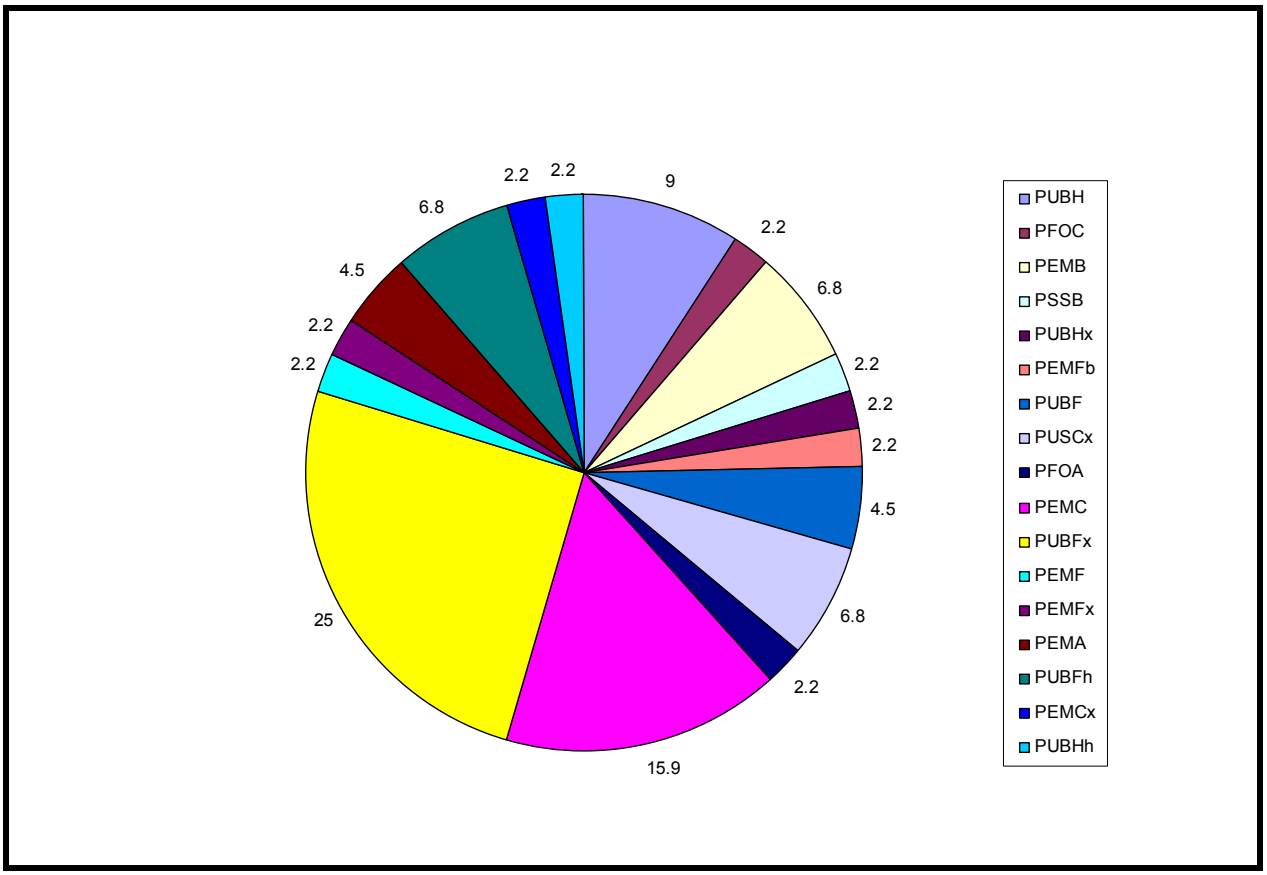


Figure 5-10
Percentage of Wetland Habitat Classifications Within Upper Evans Creek Sub Watershed

General Characteristics of Wetlands Within the SBW

Wetlands within the SBW, which have been mapped by the National Wetlands Inventory, fall into 34 separate habitat classifications (Table 5-9). The most prevalent of these wetlands are classified as PUBFx, PEMC, and PUBHh. PUBFx accounts for 20.8% of the currently mapped wetlands. PEMC makes up 12.8% and PUBHh makes up 10.8% (Table 5-10, Figure 5-11). These are all palustrine wetlands with systems described as being emergent or having an unconsolidated bottom. The water regimes are permanently flooded,

Table 5-10
Total Number and Percent of Wetland Type Identification Codes Mapped Within Seven Basins Watershed

Wetland Type Identification Code	Percent Found in SBW	Total Number of Wetlands In Wetland Type ID Code
PUBFx	20.8	52
PEMC	12.8	32
PUBHh	10.8	27
PUBHx	7.6	19
PUBFh	7.2	18
PABHx	3.2	8
PABHh	2.8	7
PEMA	2.4	6
PUBF	2.4	6
PEMCh	2	5
PEMCx	2	5
PFOA	2	5
PUBH	2	5
PUSCx	2	5
PABF	1.6	4
PABFx	1.6	4
PEMB	1.6	4
PEMFx	1.6	4
PFOC	1.6	4
PSSC	1.6	4
PSSCx	1.6	4
PEMF	1.2	3
PEMFh	1.2	3
PABFh	0.8	2
PABH	0.8	2
PSSB	0.8	2
PSSCh	0.8	2
L1UBHh	0.4	1
L1UBHx	0.4	1
PEMFb	0.4	1
PFOJ	0.4	1
PSSAh	0.4	1
PUBKx	0.4	1
U/PEMA	0.4	1
PUBFx	20.8	52

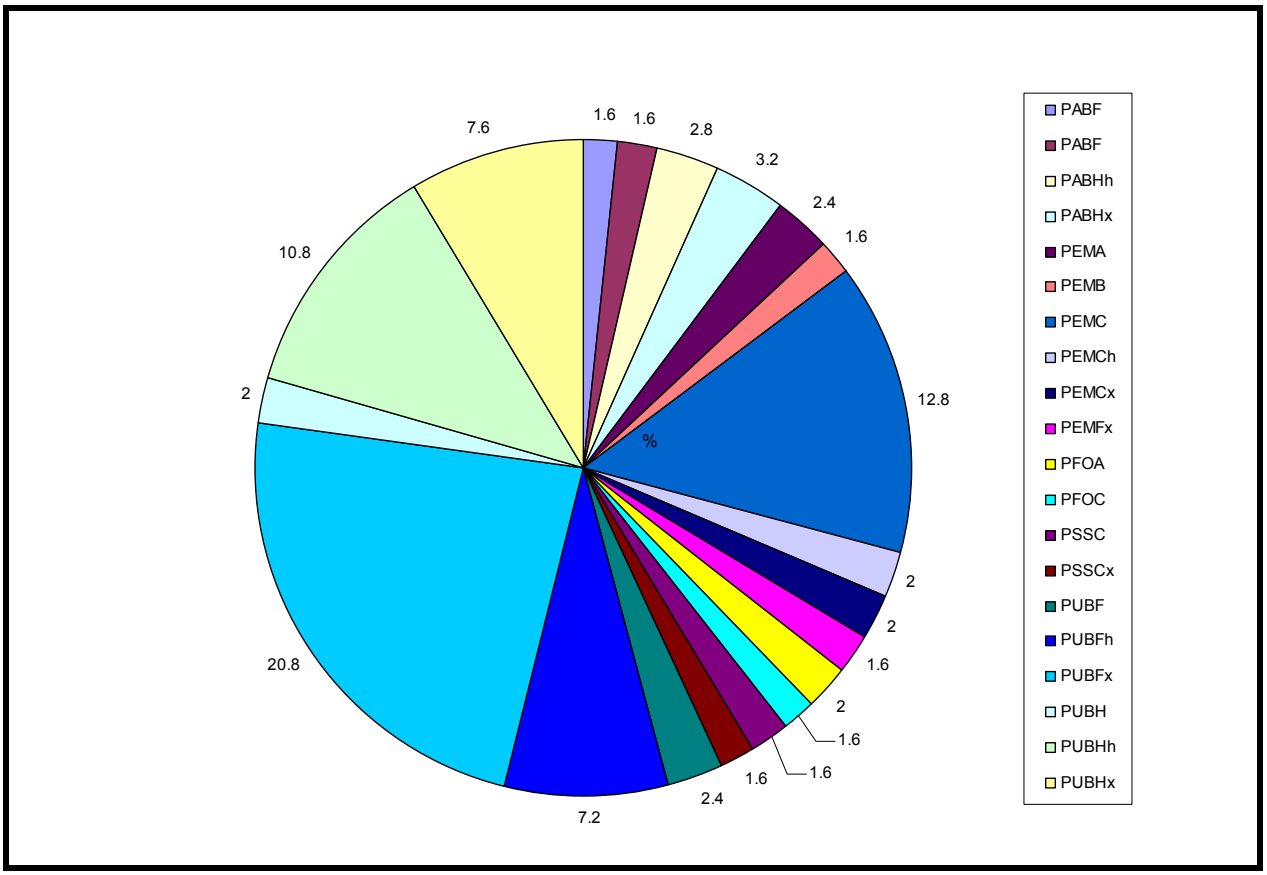


Figure 5-11
Percentage of Wetland and Deepwater Habitat Classification Greater Than 1%, Found in Seven Basins Watershed

semipermanently flooded, or seasonally flooded. These wetlands are diked, impounded, or excavated.

Two wetlands are classified as lacustrine in the SBW (Table 5-9). The wetland classifications for these are L1UBHh and L1UBHx and each are 0.4% of the total mapped wetlands in the SBW (Table 5-9). These wetlands are classified as limnetic and have unconsolidated bottoms. Both wetlands are permanently flooded and have either been diked, impounded, or excavated.

CONCLUSIONS

Due to the size of the SBW and the time frame of this assessment, a full riparian conditions assessment was not possible. Therefore, riparian conditions within the SBW are quantitatively unknown. Data generation by SOU capstone students, ODFW, and DEQ has provided a valuable beginning to a riparian condition assessment for the SBW.

Data gathered by the recent FLIR Sensor flight in the summer of 2003 within the SBW was not available for inclusion in this draft of the assessment. Inclusion of this data will enhance the baseline data for riparian conditions within the SBW.

Wetlands in the SBW have not been completely mapped. As a result, these data provide only a partial understanding of wetland ecosystems in the watershed. Once the watershed has been sufficiently mapped by National Wetlands Inventory, a greater understanding of wetlands issues will be realized.

DATA GAPS

A variety of data gaps exist for riparian and wetland conditions within the SBW. They are as follows:

- Riparian Conditions Assessment has not been completed for the entire SBW;
- Riparian Conditions Assessment has not been mapped;
- Riparian Conditions Assessment has not been ground truthed;
- Habitat surveys have only been located for six years (1994-2000). Recent riparian conditions need to be evaluated;

- All streams throughout the watershed need evaluation as conducted by DEQ in the Riparian Condition Assessment of 303(d) listed streams;
- 303(d) streams have not been mapped in relation to riparian condition;
- Riparian condition of 303(d) streams has not been ground truthed;
- FLIR flight data has not been applied;
- Broad community education of importance of riparian areas and effects of land use practices on riparian areas is needed;
- National Wetlands Inventory Map is not complete; and
- Baseline wetland water quality data is not available.

ACTION PLAN RECOMMENDATIONS

An action plan should be written to prioritize projects for the Seven Basins Watershed Council. The following is a list of recommendations to be incorporated in the action plan with regard to riparian areas and wetlands. These recommendations are not in order of priority.

- Riparian Conditions Assessment should be completed for the entire SBW.
- Riparian Conditions Assessment should be mapped for the entire SBW. By mapping this data in GIS, this component will become fully accessible, functional, and easily updated.
- Riparian Conditions Assessment should be ground truthed. SBW Council members and community volunteers should conduct ground truthing to increase understanding of riparian processes and effects of land use practices.
- Current riparian conditions need to be evaluated through continued ODFW habitat surveys. The contribution of SBW volunteers will aid in

the continuation, regular occurrence, and community understanding of these surveys.

- All streams throughout the watershed need evaluation as conducted by DEQ in the Riparian Condition Assessment of 303(d) listed streams. 303(d) streams should be mapped in relation to riparian condition. The use of GIS will make this data fully functional and accessible.
- Riparian condition of 303(d) streams should be ground truthed. SBW volunteers will provide DEQ with extra labor, and provide the Council with an enhanced understanding of agency processes and assessment goals.
- Baseline riparian data should be generated regarding plant and animal species within the SBW that are dependent on riparian areas during specific life cycle stages. SBW volunteers should produce a database and GIS component to make this data functional, accessible, and easy to update.
- Broad community education of the importance of riparian areas and the effects of land use practices on riparian areas is needed. The Seven Basins Watershed Council should provide community education and outreach with regard to basic riparian processes, effects of land use practices, and proactive land use practices which should be used by landowners.
- Seven Basins Watershed Council volunteers should work with agencies to create a database for baseline wetland water quality. This should be coupled with a GIS mapping component to make this database easy to update and readily accessible.
- Ground truthing of wetland locations should be conducted by Seven Basins Watershed Council volunteers to enhance understanding of location of wetlands, characteristics of wetlands, and effects of local land use practices.

- Community education regarding wetland functions, processes, characteristics, and effects of land use practices should be provided by the Seven Basins Watershed Council.

REFERENCES CITED

American Rivers, "River Ecology 101," <http://www.amrivers.org/aboutrivers/riparian.htm> (Accessed July 25, 2003)

Arbuckle, Brownell, Case, Halbleib, Jensen, Landfair, Lee, Miller, Nardi, Olney, Sarvadi, Spensley, Steinway, Sullivan, *Environmental Law Handbook; Twelfth Edition*, 1993.

Bureau of Land Management (BLM), Medford District, Butte Falls Resource Area, *Landscape Analysis of Mid Evans Creek*, May 1994.

Bureau of Land Management (BLM), Medford District, Butte Falls Resource Area, *Watershed Analysis of West Fork Evans Creek*, April 1995.

Bureau of Land Management (BLM), Medford District, Butte Falls Resource Area, *Watershed Analysis of East Evans Creek*, March 1996.

Cooperative Forest Ecosystem Research (CFER), "Research Projects: Large Woody Debris in the Terrestrial and Aquatic Riparian Zone: Production, Recruitment, Retention, and Function," <http://www.fsl.orst.edu/cfer/research/resproj/lrgwd/lrgwd.html> (Accessed August 25, 2003)

Dennison, M. S.; Berry; J. F., *Wetlands: Guide to Science, Law, and Technology,* Noyes Publications, 1993.

Extension and Experiment Station Communications (EESC), Oregon State University, "Taking Care of Streams in Western Washington, Western Oregon, and Coastal Alaska: A Landowner's Guide to Riparian Areas," <http://eesc.orst.edu/agcomwebfile/garden/enews/aug_03.html> (Accessed August 26, 2003)

Federal Interagency Stream Restoration Working Group (FISRWG), *Stream Corridor Restoration: Principles, Processes, and Practices*, 1998.

Godwin, D., Oregon State University Extension Service, "Life on the Edge: Improving the Riparian Function," Reprinted April 2000, <http://eesc.orst.edu/agcomwebfile/EdMat/EM8738.pdf>

Kadlec, R. H., Knight; R.L., *Treatment Wetlands*, CRC Press, 1996.

Lemly, A. D., Hilderbrand, R. H., "Influence of Large Woody Debris on Stream Insect Communities and Benthic Detritus, Hydrobiologia," 421:179-185, 2000, <http://www.srs.fs.usda.gov/pubs/viewpub.jsp?index+1610>

Malheur Experiment Station: Oregon State University, "Riparian Areas," <http://ww.cropinfo.net/riparian.htm> (Accessed August 26, 2003)

Morlan, Janet C., Oregon State of the Environment Report 2000, "Summary of Current Status and Health of Oregon's Freshwater Wetlands, 2000," <http://statelands.dsl.state.or.us/soer_ch34.pdf>

Morrow, Dr. J. V., Jr.; Fischenich, Dr. C.; U.S. Army Corps of Engineers Ecosystem Management and Restoration Research Program, "Habitat Requirements for Freshwater Fishes," May 2000, <http://www.wes.army.mil/wl/emrrp/pdf/sr06.pdf>

Oregon Department of Environmental Quality (DEQ); *Rogue Basin Riparian Condition Assessment: Draft*, 2003.

Oregon Department of Fish and Wildlife (ODFW), "Coho Salmon Life History," <http://www.dfw.state.or.us/ODFWhtml/InfoCntrFish/LifeHist/Coho.html> (Accessed August 20, 20003)

Oregon Department of Fish and Wildlife (ODFW), *ODFW Aquatic Inventory Project Stream Reports*, 1994-2000

Oregon Parks and Recreation Department; "2003-2007 Oregon, Statewide Comprehensive Outdoor Recreation Plan: Appendix L: Oregon Wetlands Priority Plan," January 2003, <http://www.prd.state.or.us/images/pdf/scorp_21_appl.pdf>

Oregon Plan for Salmon and Watersheds, "Statewide Riparian Management Policy," May 2002, <http://www.oregon-plan.org/Riparian/index.html>.

Oregon Watershed Enhancement Board (OWEB), *Oregon Watershed Assessment Manual*, July 1999.

State of Oregon, "Statewide Riparian Protection and Restoration Policy: Draft," September 2001, <http://www.oregon-plan.org/Riparian/Sept01RipDraftRvw.pdf>

Tiner, R. W., United States Geologic Survey (USGS), "Technical Aspects of Wetlands: Wetland Definitions and Classifications in the United States," <http://water.usgs.gov/nwsum/WSP2425/definitions.html> (Accessed September 25, 2003)

Tjaden, B., Weber, G. M., "An Introduction to the Riparian Forest Buffer," 1998 (a), <http://www.riparianbuffers.umd.edu/fact/FS724.html>

Tjaden, B., Weber, G. M., "Riparian Forest Buffer Design, Establishment, and Maintenance," 1998 (b), <http://www.riparianbuffers.umd.edu/fact/FS725.html>

United States Environmental Protection Agency (USEPA), "Wetlands Overview," March 2002 (a), <http://www.epa.gov/owow/wetlands/what/orverview.pdf>

United States Environmental Protection Agency (USEPA); "Functions and Values of Wetlands," March 2002 (b), <http://www.epa.gov/owow/wetlands/fun_val.pdf>

United States Environmental Protection Agency (USEPA), "What are Wetlands?," <http://www.epa.gov/owow/wetlands/vital/what.html> (Accessed August 26 2003 [a])

United States Environmental Protection Agency (USEPA), "Wetland Definitions," <http://www.epa.gov/owow/wetlands/what/definitions.html> (Accessed August 26, 2003 [b])

United States Environmental Protection Agency (USEPA), "Water Quality and Hydrology," <http://www.epa.gov/owow/wqhydrology/fish.html> (Accessed August 26, 2003 [c])

United State Geological Survey (USGS), "Riprarian Ecosystem Creation and Restoration: A Literature Summary," <http://www.npwrc.usgs.gov/resource/literatr/ripareco/function.htm> (Accessed August 25, 2003)

Water and Rivers Commission, "Water Notes: The Value of Large Woody Debris (Snags)," January 2000 (a), <http://www.wrc.wa.gov.au/public/waternotes/pdf/9.pdf>

Water and Rivers Commission, "The Management and Replacement of Large Woody Debris in Waterways," January 2000 (b), <http://www.wrc.wa.gov.au/public/waternotes/pdf/13.pdf>

CHAPTER 6
IMPACT OF WILDFIRE

Prepared By:
David L. Graham, EMS
Reviewed By:
Katie M. Mosser, EMS

INTRODUCTION

Fire has been an important factor in the Pacific Northwest forests for thousands of yeas. Climate and cultural changes have affected distribution of forest types, fire ignition and behavior patterns, and subsequent ecological effects. A comparison of historical and current fires in the northwest has revealed that modern fire control policies have been effective at reducing the total acreage burned by fires. However, this success has allowed more uniform and larger fuel loads across the landscape, resulting in more severe fire effects (Agee, 1990).

Wild fire is a prevalent issue in southern Oregon watersheds, including the SBW. Fire season usually begins around May and ends around November. The average length of a fire season in southwestern Oregon since 1967 is 142 days. The longest fire season in southwestern Oregon since 1967 occurred in 1988, and lasted for 199 days. The shortest fire season in southwestern Oregon occurred in 1997, and lasted for 100 days (Southwest Oregon District, 2003 a).

Wildfire can have beneficial or devastating impacts on an ecosystem and community. Naturally occurring fires that occurred prior to fire exclusion efforts were normally not devastating, but rather an important component of an ecosystem. As we have moved away from natural historic conditions,

especially in the Ponderosa pine and mixed conifer forests, devastating fires are more likely to occur. These impacts are partially determined by the pre-fire conditions of the watershed. Pre-fire conditions are dictated by the land management practices of the land owner. Multiple land owners exist within the SBW, resulting in various methods of fire prevention and management.

Historically, fire has been a beneficial disturbance for successional processes within ecosystems. Native Americans routinely burned the understory of the watershed to encourage regeneration of vegetation and enrich the soil for their crops. By the early 1900s, European Americans were prevalent within the SBW and fires were viewed to be detrimental to forests. This view took hold following the 1910 fires, which began an era of fire suppression within the natural resource agencies. As a result, fire suppression became a major goal of many land management agencies. From the 1950s to present day, fire suppression techniques increased in efficiency throughout the watershed. This created unnatural amounts of fuel to accumulate throughout the SBW (BLM, 2001). The presence of surface fuels and ladder fuels creates the threat of crown fires. These catastrophic fires were historically rare, but now occur in great frequency during fire season throughout southwest Oregon.

Catastrophic fires damage thousands of acres, reach incredible temperatures, and create high speed winds and pressure within the fire. These types of fires take long periods of time to control and suppress. Many times these fires burn so hot, they kill all nutrients within the soil, leaving it unproductive and difficult for regeneration to occur. Due to the lack of vegetation in many of these burn sites, slope stability becomes an issue. Slopes erode and slide easier when there is unsubstantial vegetation holding it in place. Once slope stability becomes an issue within a watershed, sedimentation follows. Sedimentation from slides chokes out critical salmonid spawning habitat. Riparian areas can also be lost during these catastrophic fire events. A lack of riparian area leads to increased water temperatures in streams, loss of

sediment filtering, and ultimately a loss of salmonid habitat. These ecological impacts are only a few on a long list of possible detrimental results from catastrophic fire. Such catastrophic fire events are unnatural and a product of decades of fire suppression and exclusion as well as unmanaged fuels throughout the SBW.

When a watershed is managed for fire fuels, the risk as a result of catastrophic fires can be greatly reduced. However, it needs to be understood that after years of neglect, it will take many years of fuels management to reduce the fire intensities throughout the SBW.

The probability of catastrophic wildfires in the western United States has increased the need to understand the flooding risk and the erosional and depositional responses of burned watersheds. In addition, surface water flowing from burned areas can carry increased levels of sediment, organic debris, and chemicals that may contribute to significant degradation of municipal water supplies and aquatic habitats.

Risk from wildfire is no longer limited to the physical and/or biological impacts to a forest or watershed. Risks associated with loss of real property or human life, have become critical issues with respect to fire management. In response to these concerns much effort is currently being given to the wildland/urban interface (WUI). This boundary is of particular concern because wildfires that encroach upon this boundary can cause significant damage to property, structures, and communities. Efforts are currently being undertaken by land management agencies, watershed councils, and others to reduce the risks associated with wildfire along this boundary.

CAUSES OF FIRES

Natural Causes of Fire

The presence of fire in the landscape has been one of the major evolutionary factors determining the composition of flora throughout the state and around the world. Natural causes of fire range from lightning, sparks from falling rocks, volcanic activity, and the spontaneous combustion of plant materials and other organic matter (Barbour, Burk, & Pitts 1980). However, of these, lightning is the most influential factor in almost all regions of the world as lightning strikes the earth an average of 100 times a second totaling over three billion strikes a year (Barbour, Burk, & Pitts 1980). Generated by summer thunder storms, lightning is responsible for much of the wildland fires that occur throughout the western United States each year. Lightning was the cause of the Sykes Creek fires in 1956 and again in the late 1980s, the Tin Pan Peak Fire in August 1993, and the East Evans Creek fire which burned in August 1994.

Man and Fire

Man has also played a role in the pattern of fires in the landscape, dating back possibly as far as 300 years ago with the arrival of the first Americans. Early Spanish explorers and missionaries documented the use of fire by Native Americans who used fire to clear areas for the germination of oaks, for the production of acorns, and to create and maintain grasslands for hunting. Many Native American stories speak of the use of fire, and these stories indicate that wildfire was also a concern of Native Americans and that fire was used in a careful and respectful manner (Burcham, 1987). Later, European settlers used fire to clear brush so land could be used for agricultural purposes. Through the use of fire, patterns or burn mosaics may have been

created, which, to a certain extent, may have operated as a fuel break due to the reduction of dead fuels. These inadvertent fuel breaks would have been very important to early Americans due a limited ability to control blazes of any substantial size.

In present day, the majority of fires within the SBW are caused by humans. Most man made fires begin on private lands or along road corridors. Approximately 75% of fires in the SBW are started by humans (Mruzik, 2004).

TYPES OF WILDFIRES

The four main classes of wildfire intensities are *ground, surface*, *passive, and crown* fires. The type of fire behavior and intensity depends upon location, fuels, aspect, slope, species composition, and weather. The following types of wildfire intensities may be seen in any combination, one leading to another, depending on weather conditions and available fuels.

Ground Fires

Ground fires, although occurring less frequent than other forms of fire, typically smolder and remove vegetation and organic matter down to bare soil. This smoldering burns organic matter until it flares up into a flaming surface fire (Mruzik, 2004). The heat and intensity of such fires can destroy roots, tubers, and rhizomes, located beneath the soil surface and may devastate entire plant communities (Barbour, Burk, and Pitts, 1980).

Surface Fires

Surface fires are typically low intensity, rapid fires that seldom reach high temperatures, burning only in the surface fuel bed. These fires consume light fuels and present little danger to basal portions, root stocks, and tubers, in the soil (Barbour, Burk, and Pitts, 1980).

Passive Fires (Torching Fires)

Passive fires are small scale and generally consume single trees or small groups of trees. These fires generally occur prior to the active crown fire.

Crown Fires

Crown fires occur in the upper sections of trees and are typically the result of a surface fire. These fires spread throughout the canopy of the forest. During such fires, surface materials and trees alike are burned. Ignited branches and embers fall, further spreading the fire.

Post-Fire Vegetation Patterns

The pattern of vegetation in a watershed is influenced by exposure, geology, and fire. Soils and exposure create different growing conditions on southern and western facing slopes, than exist on northern and east facing slopes. Although a combination of soil, geology, exposure and climate may be the chief factors controlling vegetation type, fire plays an important role in the life cycle of these plant communities (Ainworth and Doss, 1995).

Formation of Hydrophobic Soils

During a fire, temperatures at ground level may reach six to seven hundred degrees centigrade. Oils, resins, and waxy fats stored in plants and their litter are released as they vaporize due to the intense heat (McPhee, 1989). Soil is an excellent insulator, and temperatures just several centimeters below the surface remain much cooler. This allows the vaporized substances to recondense forming what is referred to as a hydrophobic layer, a condition also known as nonwettability. This layer is impermeable and prevents water from reaching all but the first few inches of soil, but at the same time slows the process of evaporation in the root zone. The extent, depth, and persistence of a hydrophobic layer depends on the type of soil, soil moisture, soil texture, severity of the fire, and quantity and composition of litter (DeBano, 1981). Water repellency is more common in coarse-grained soils because the soil temperature gradients that affect volatilization and condensation during burning are often greater and the soil has less surface area on which volatilized compounds may condense (McNabb and Swanson, 1990). In the case of clay soils, which are fairly dense, they tend to resists this condition; however, sandy and sandy loam soils appear to be far more susceptible to hydrophobic conditions (DeBano, 1987). Course-textured soils include soils derived from granite, pumice and other volcanic ash, and glacial till (McNabb and Swanson, 1990).

If a drop of water is placed on a pre-burn sample of sandy loam soil, the water will quickly soak into the soil. Yet, if a drop of water is placed upon a post-burn sample, the drop will ball up and may remain for hours. The depth at which these layers form is dependent on factors such as fire intensity and soil moisture content (DeBano, 1987). Fires typically occur in the drier summer months prior to winter rains. Water quickly saturates the thin layer of permeable soil above the hydrophobic zone due to the absence of a vegetative

canopy. Slower infiltration rates result in an increased intensity of surface runoff and erosion (Ainworth and Doss, 1995).

Water repellency at the soil surface is most likely to occur when fire intensity and duration cause moderate increases in soil temperature (DeBano, 1987). Severe fires producing high soil temperatures force the hydrophobic layer to form deeper in the soil (McNabb and Swanson, 1990). Hydrophobic layers last for short periods of time following fires of low-to-moderate temperatures. However, hydrophobic soils have been shown to persist for about six years after a late summer wildfire in the Oregon Cascades (Dryness, 1976).

Post-Fire Erosion Processes

One thread that links many different components in the ecosystem's response to wildfire is sediment. Sediment erosion and deposition are affected by geological, biological, and physical processes and have significant feedbacks on these processes. The threshold of the erosion response is changed when extreme fire temperatures alter soil properties (chemical and physical) and disturb mycorrhizal communities which may have soil binding properties. Knowing the spatial distribution of soil properties after a fire leads to better precipitation-runoff models, better predictions of peak flood discharge, and better prediction of areas with risks from hillslope erosion. Identification of erosion risks could be used to prioritize fuel treatments at the watershed, regional, and national scales (Moody and Martin, 2003).

Post-fire hillslope erosion of soil is often associated with nutrient losses that affect ecosystem health and increases in chemical and sediment loadings that can affect water quality at downstream locations. Channel erosion spans the spectrum of sediment concentration, from debris flows which threaten infrastructures to increases in suspended-sediment which affect the total maximum daily loads (Moody and Martin, 2003).

Deposition of fire-related sediment and its associated nutrients and chemicals can be either detrimental or beneficial. Fire-related sediment sometimes damages aquatic communities, such as smothering aquatic invertebrates, filling beaver ponds, and altering key fish habitat. It also damages public and private property such as water-supply reservoirs, homes, and recreational facilities. However, eroded fire-related sediment can also supply nutrients that are beneficial to fish and other aquatic populations within the ecosystem as well as new deposits of coarse sand and gravel necessary for fish spawning. This and many other effects of sediment are not completely understood and would require an integrated effort to better understand the various interrelationships (Moody and Martin, 2003).

Erosion is a prevalent process on slopes ranging from 25 to 70 degrees in steepness. Portions of watersheds can exceed the angle of repose (Radtke, 1983). These slopes are shaped by gravity as materials not firmly attached to the slope slide and fall unless held in place by plant materials or other anchors. Gravity, more than water or wind, may be the most important cause of erosion in such environments. On slopes steeper than the angle of repose a process known as dry creep or dry ravel occurs, which is generally described as the down slope movement of materials due to gravity. During dry years this process can exceed erosion rates that occur during the wettest season of the year (Radtke, 1983).

The occurrence of dry ravel is probably unknown to most people, because the process occurs on steep slopes away from structures, or is unobserved under a canopy of vegetation. However, the presence of dry ravel becomes apparent following a fire as the formation of rills formed by dry ravel and dry creep appear on the barren slopes of post-fire watersheds. Dry ravel and, to a lesser extent, the formation of extensive rill networks can account for most of the increased sediment production following a fire (Wells, 1987). This process may

even be more prominent in the post-fire environment due to creation of hydrophobic soil layers.

Debris Flows

Post fire erosion rates may be more than 50 - 100 times greater than on a well vegetated watershed (Radtke, 1983). The process by which debris flows develop in the post fire environment are the acceleration of dry ravel and formation of rill networks. The rill networks develop rapidly and deliver runoff water to the stream channels where large amounts of debris, delivered by both processes, are stored (Wells, 1987). The result is a rapid mobilization of channel deposits into debris flows (Wells, 1987). These debris flows usually occur in small watersheds in response to unusually small amounts of rainfall. However, large debris flow events can occur when an extreme storm event occurs after a severe fire.

The post fire landscape is subject to significantly increased erosion rates capable of producing large destructive debris flows. Increased post fire erosion rates can be expected for a period of 8-10 years. During the recovery period, erosion rates may be 9 to 10 times greater than those that occurred before the burn (Ainsworth and Doss, 1995).

Post Fire Landslides

On vegetated slopes anchored by deep rooted plants, the angles of repose can be much steeper than in areas where plants are shallowly rooted. Landslide occurrences are strongly related to the angle of repose for different soils, taking into account cover, root depth, and root strength. Soil slips and landslides can account for as much as 50% of the total erosion in a watershed (Radtke, 1983). Unlike dry creep, these soil movements normally occur when the soil is saturated. Although hydrophobic soils, dry ravel, and formation of rills and the

debris flows associated with these processes account for the majority of post fire erosion. Landslide activity may also increase as a result of fire.

Another possible contributing factor to increased landslides in the post fire environment is stream channel scour and erosion. This process may remove or over steepen the channel banks contributing to landsliding of over steepened slopes along the creek channel. It is also possible to reactivate previous landslides by removing the toe of the slide (Ainsworth and Doss, 1995).

Impacts on Water Quality

The water quality consequences of both wildfire and prescribed fire may produce significant and immediate impacts on fish and other aquatic organisms and on downstream drinking water supplies. These impacts are the cumulative result of chemicals mobilized by the fire itself (such as manganese), the use of fire-fighting chemicals, and sediment from post-fire erosion.

Fire affects water quality in a watershed through:

- Alteration of litter and duff;
- Alteration of soil organic matter;
- Precipitation of volatile organic gasses on soil particles;
- Alteration of soil mineralogy;
- Increase of readily available material for rock weathering;
- Alteration of detachment characteristics;
- Modification of hydrology pathways;
- Increases in base flow and peak flow characteristics;
- Mobilization of existing deposits;
- Effects on soil microbiota;

- Input of fire retardant and suppression chemicals; and
- Effects on instream oxygen regime.

Fire is responsible for the export of materials out of the watershed. These include floatable organic materials such as ash, charcoal and coarse woody debris, dissolved phase parameters, and particulate phase materials such as suspended sediment and bedload materials (Martin, 2000).

Post-Wild Fire Water Quality

Increases of sediment over differing time scales (short-term and long-term) can affect water quality. Fire has been shown to cause changes in:

- BOD;
- Cyanide;
- Hydrocarbons;
- Manganese;
- Nitrate;
- pH; and
- Phosphorous.

Existing Regulations Related to Wildfire or Prescribed Fire

There are no explicit EPA regulations related to water quality issues with respect to wildfire. In addition, there are few states including Oregon that have water quality regulations addressing water quality impacts as a result of wildfire. Idaho's regulations specifically exclude regulation of fire related impacts to water quality "…does not include naturally occurring events such as

floods, landslides, and wildfires including prescribed natural fire." (Idaho code 39-3602).

The Oregon DEQ enforces air quality standards within the state. The agency addresses wildfire smoke management through its Wildfire Natural Events Action Plan in an attempt to protect public health during natural wildfire events. They are also responsible for assessing when prescribed burns can be conducted based on air quality conditions.

Impacts to SBW from Historic Fires

The BLM, in cooperation with the ODF, has created a historical fires map (Figure 6-1) for the SBW. Large forest fires are color coded for the decade in which they occurred. Small fire start locations are also shown on the map and are color coded by decade. Those fires which started by lightning strike have been labeled as well. The Hull Mountain Fire (7,990 acres) and East Evans Creek Fire (10,135 acres) and Sykes Creek Fire (10,313 acres) appear to be the largest fires which have occurred in the SBW. The Hull Mountain Fire burned in 1994 and East Evans Creek Fire burned in 1992. The Sykes Fire burned in 1987.

The Hull Mountain Fire burned in 1994, incinerating land throughout the SBW. This fire produced multiple natural resource issues due to its size, intensity, the weather conditions, and the pre fire condition of the land. Slope failures throughout the burn site as seen in Figures 6-2 and 6-3 are common, nearly ten years following the fire. These slope failures are due to increased runoff and cutting of the slope to construct roads. Figure 6-4 depicts slope failure due to increased erosion from the fire. Cutting of the bank at the base of slopes to construct roads also increased erosion and slope failure seen throughout the Hull Mountain Fire. Vegetation was drastically altered from this fire. Soils were possibly stripped of a large amount of nutrients and duff.

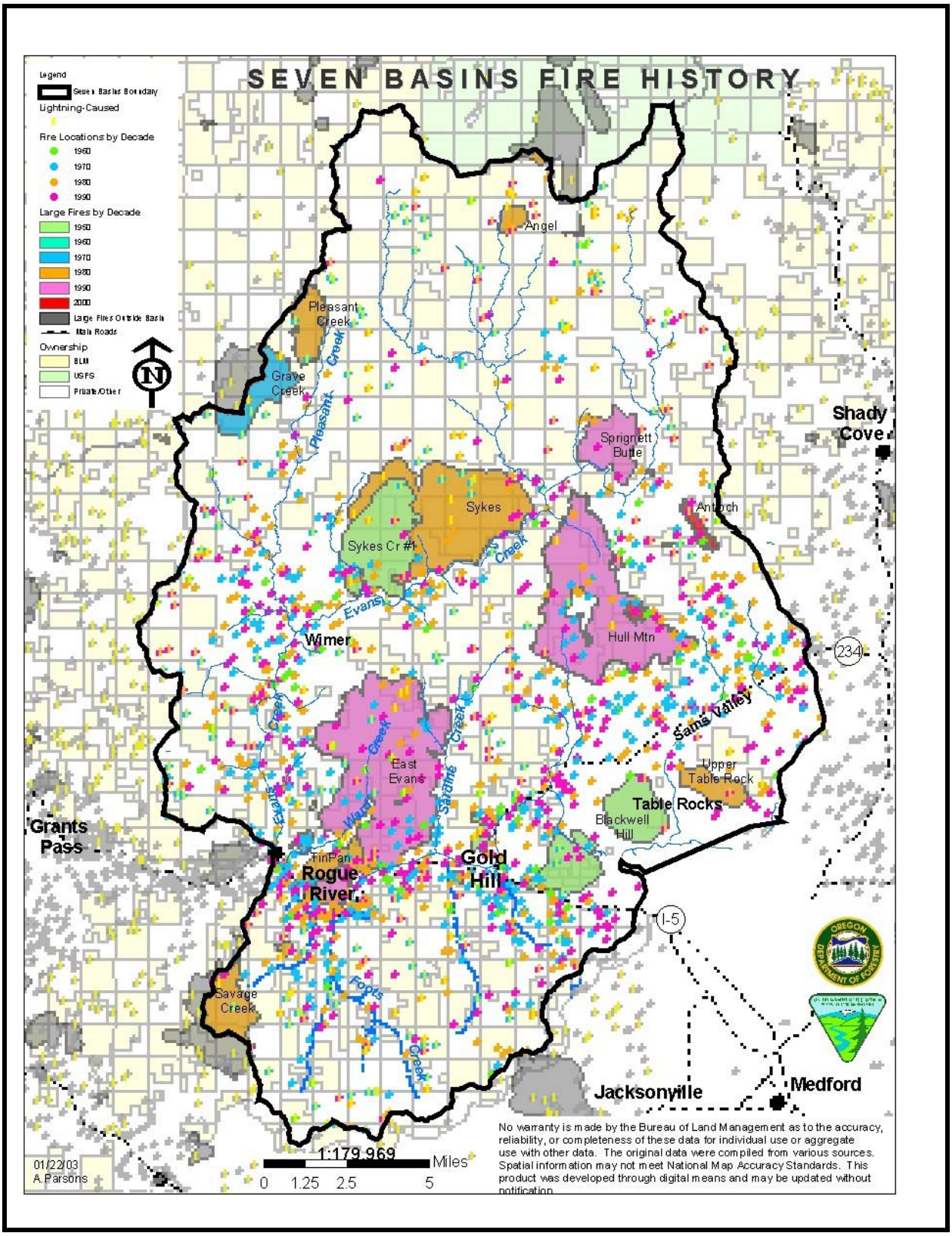


Figure 6-1
Seven Basins Fire History

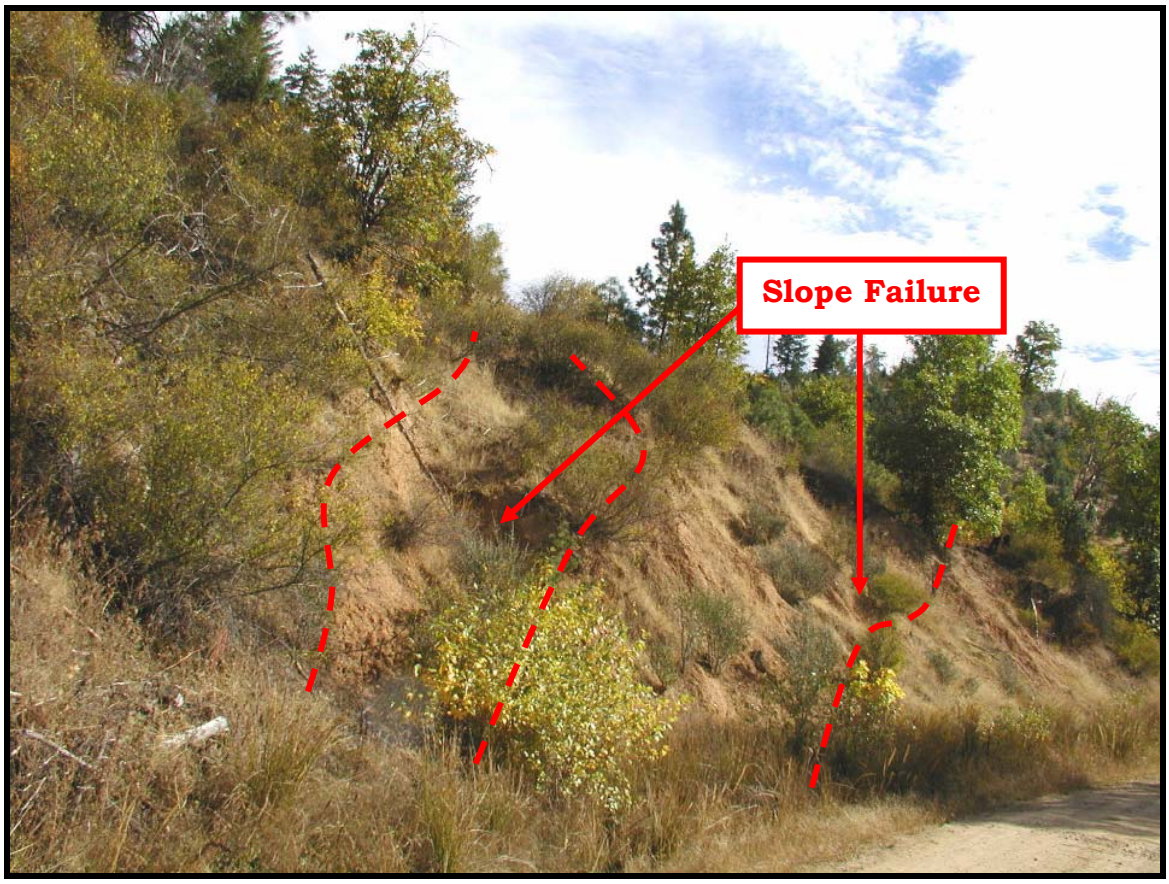


Figure 6-2
Upland Area of Hull Mountain Fire, 1994
(Slope failure above road in center of photograph)

Figure 6-3
Ramsey Creek Burn, Part of Hull Mountain Fire in 1994
(Area of slope failure is evident at the center of photo, just above the road)

Figure 6-4
Slope Failure Along Ramsey Creek from Hull Mountain Fire

This has a great influence on the rate of regeneration of vegetation throughout the burn area. Examples of the impacts of fire on vegetation can be seen in Figures 6-5 and 6-6.

Less recent burns are still having an effect on portions of the SBW. Figure 6-7 depicts a portion of the Sykes Creek Burn that occurred in the late 1980s. Slope failure and erosion are still an issue in this area, due to slow growth of stabilizing vegetation on slopes as well as the condition of soils in the burn area.

Figure 6-5
Impact to Vegetation at Hull Mountain Fire

Figure 6-6
Impact on Vegetation Due to Hull Mountain Fire

Figure 6-7
Portion of Sykes Creek Burn that Occurred in the Late 1980s
(Slope failure in center of photo)

The Spignet Butte Burn area in Figure 6-8 shows the slow regeneration of vegetation following a fire. The main branch of Evans Creek can be seen in the bottom of the canyon in the photo. Fire on these slopes has increased the erosion potential of the soils and in turn, affecting the timing of runoff to Evans Creek. Erosion of soils can increase the flooding potential of a drainage following a fire.

Figure 6-8
Sprignett Butte Burn Area

FEDERAL AND STATE MANAGEMENT

The National Fire Plan is a federal plan developed by Governors, Congressmen, Senators, and multiple Presidents to address fire fighting preparedness, rehabilitation of burned areas, as well as the underlying issues of wildfire that affect communities and the environment. This plan is unique because it focuses on the growing threat of wildfire due to excess hazardous fuels within forests. It calls for the cooperation of all federal fire management agencies, states, communities, and tribes in addressing this growing issue within the country (Northwest Fire Plan, 2002).

Specifically in the Pacific Northwest, federal and state fire management and environmental agencies have agreed to collaborate in order to implement the National Fire Plan. In the Pacific Northwest, this collaboration of agencies is called the Pacific Northwest Coordinating Group and includes agencies such as:

- Washington Department of Natural Resources
- ODF
- National Park Service
- USFWS
- Bureau of Indian Affairs
- BLM
- U.S. Forest Service
- National Marine Fisheries Service
- EPA
- The State Fire Marshals of Oregon and Washington
- The Oregon Governors Office
- Community and Tribal Representatives

The Interagency National Fire Plan Strategy Team is found under the umbrella of the Pacific Northwest Wildfire Coordinating Group. This Strategy Team consists of representatives from each of the above named agencies and is responsible for coordinating interagency implementation of the National Fire Plan (Northwest Fire Plan, 2002).

The Southwest Oregon District of the ODF is responsible for protecting public and private lands throughout Jackson and Josephine Counties from wildfire. This includes, but is not limited to lands owned by BLM, municipalities, Corps of Engineers, and State Parks (Southwest Oregon District, 2003 b). The ODF

works to control wildfires, while other agencies work to protect structures within the watershed. This partnership has proven to be operationally beneficial.

LOCAL MANAGEMENT

Private land owners account for 63% of land ownership and the Medford District BLM owns 36% of the land in the SBW. Local management of fuels is in the hands of private land owners, private industry, and the BLM. Private timber companies within the SBW manage lands according to their own business practices and goals. As a result, differing methods of fuels management are present in a mosaic across the landscape of the watershed. Two BLM Resource Areas manage lands within the SBW. They are the Ashland Resource Area and the Butte Falls Resource Area.

Within the SBW, the Ashland Resource Area is responsible for lands south of the Rogue River. This includes Birdseye Creek, Foots Creek, Kane Creek, and Galls Creek sub watersheds. The Butte Falls Resource Area is responsible for the lands north of the Rogue River. In the SBW, this includes Pleasant Creek, Upper West Fork Evans Creek, Lower West Fork Evans Creek, Evans-May/Sykes, Upper Evans Creek, Lower Evans Creek, Rogue-Ward, Rogue-Sardine, Rogue-Sams, and Rogue-Snider sub watersheds. Both Resource Areas employ similar fuels reduction methods that include thinning by use of a "slash buster" and/or hand cutting, hand pile burning, and understory burning. However, prescribed burning of the understory occurs less often in the Butte Falls Resource Area due to smoke management restrictions imposed by the DEQ.

Local Ability to Respond to Wildfire

Throughout the SBW, water chances are located to provide response personnel access to water. The availability of this water is crucial during times of intense, highland wildfires. These sites provide emergency water to begin the initial attack on wildfires within the watershed. However, it should be understood that if the fire continues for an extended period, these features will not provide sufficient water to suppress such fires.

These structures also provide a possible benefit to wildlife aquatic life as well as providing water for emergency needs. The pond depicted in Figures 6-9 and 6-10 is located very near the top of May Creek. And this area has a history of lightening strikes and wildfire. May Creek Road is the fastest available route to the head of Pleasant Creek, Rasberry Creek, Sykes Creek, Maple Gulch, Neathammer Gulch, and Bald Mountain, making the location of the water chance ideal.

These sites are a valuable resource to both the community and ecosystems within the watershed. An inventory of the water chances currently available within the SBW would be beneficial for future fire seasons. The development of other possible water chance sites, as seen in Figure 6-11, would also be a valuable addition to the fire response personnel within the SBW. However, if fuel issues are not addressed within the watershed, such water chance locations will be insufficient to fight large, catastrophic fires.

Figure 6-9
Water Chance on May Creek

Figure 6-10
Water Chance on May Creek

Figure 6-11
Possible Water Chance Location

SEVEN BASINS WATERSHED COUNCIL

The Oregon State University (OSU) Extension has been involved in leading a cooperative program, partnering with the ODF, BLM, and the Seven Basins Watershed Council to develop the Seven Basins Neighborhood Fire Planning Project (SBNFPP). The Job Council, three local Fire Districts, Jackson County Sheriff's Department, and Jackson County Emergency Management have also been included in this project. This group has worked to create neighborhood fire plans, emergency phone lists, inventories of neighborhood resources, and the implementation of fuel load reductions.

The SBCFPP was formed in December 2002. The steering committee members included representation from OSU Extension, ODF, BLM, and the Seven Basins Watershed Council. This committee meets monthly to continue guiding the project.

A mass mailing to 6,400 households was the first undertaking by the committee. This mailing was intended to introduce the Fire Planning Project to watershed residents as well as invite them to educational workshops. This mailing was well received within the community and resulted in three workshops which were held in Wimer, Gold Hill, and Sams Valley in February 2003. These workshops were led by community volunteers and were attended by more than 90 residents. Residents signed up for ODF homesite consultations and neighborhood interest in fire planning was expressed to workshop leaders. This community interest lead to 12 initial neighborhood fire planning meetings. Others have followed due to word of mouth and publicity for the project. As of September 2003, 57 neighborhood meetings have taken place and more than 100 property owners have agreed to have ODF homesite consultations. At this time, due to the participation in the program, there is a waiting list for consultations.

Fuels reduction projects have taken place on numerous private properties without agency involvement. Other cooperative fuels reduction projects between neighbors have been successful as well.

The SBNFPP has been instrumental in creating a bridge between private land owners and public agencies within the watershed. Large acreage fuels reduction projects are planned by ODF and BLM Ashland Resource Area to take place on both BLM and private lands in the Foots Creek and Galls Creek sub watersheds. This project will take place in Fall/Winter 2003 on 1,500 acres of BLM land and a minimum of 100 acres of private land including both Foots and Galls Creek sub watersheds. Future plans include fuels treatments

to take place on 2,400 acres of BLM land in Foots Creek sub watershed. However, this project has not yet been scheduled.

BLM Butte Falls Resource Area is currently planning to conduct fuels reductions on their lands which are adjacent to private lands taking part in the SBNFPP. This project will treat a total of 400 acres of fuels. The specific sites where this project will take place are still being determined at this time.

Other public involvement in the SBNFPP has included the Jackson County Road Department. They will be conducting a pilot project within one of the participating neighborhoods of the watershed to address the fuel load concerns in the county-right-of-way. This project was developed by ODF and the local fire district. The Job Council is also conducting fuels reduction with private property owners in the watershed as a result of the SBNFPP. This reduction had already occurred on two private access roads and is scheduled to be conducted on three more.

In addition to the SBNFPP, the Seven Basins Watershed Council is planning on developing a Mobile Information Center (MIC). This will be a trailer to be put in place during any emergency event and used to relay the latest emergency information to the public. This additional step towards preparedness will aid the residents of the SBW in withstanding future fire seasons.

CONCLUSIONS

Fire is an important and prevalent issue for the watersheds of southern Oregon. Fire has been demonstrated to affect soils, erosion, runoff, slope stability, and water quality. Impacts can be severe and the cumulative effects can be detrimental to ecosystems within the SBW. To address the impacts and risks associated with wildfire, it is critical that fuel hazards be evaluated and fuels reduced. In addition, issues such as tree mortality due to drought and/or

insects are critical to evaluating overall fire risk. Population increases in the WUI have increased risks with respect to human life and property damage. Air quality issues with respect to smoke management are also need to be addressed.

DATA GAPS

Based on available information for the SBW, the following data gaps have been identified:

- Fuels research pertaining to reduction of hazards, plant associations, and/or fuel regimes;
- Comparison of efficiency of fuels reductions methods within the watershed;
- Community education of the benefits of fuels reductions;
- Affects of fire on soils, erosion potential, and slope stability;
- Inventory of current water chance locations within the SBW;
- Impacts of fire on water quality; and
- Understanding of cumulative effect of fire on salmonid habitat.

ACTION PLAN RECOMMENDATIONS

Programs could be developed to:

- Investigate the relation between rainfall intensity and peak water discharge from burned watersheds, a relation that depends on the size of the rainstorm, the size of the burned area and burn severity, and the changes in infiltration capacity of the soil;

- Investigate hillslope and channel erosion and deposition processes after wildfire;
- Evaluate water quality impacts of wildfire and develop post-fire water-quality sampling protocols;
- Develop program to locate and construct additional water chance sites;
- Conduct fuels research pertaining to reduction of hazards, plant associations, and/or fuel regimes in association with state and/or federal agencies;
- Develop a plan to protect high hazard areas throughout the WUI in order to protect private lands and structures;
- Treat fuels around high value "zero" risk areas such as historical sites, etc.; and
- Develop an interactive environmental data base of fire information coupled with GIS to allow mapping and tracking of changes in the watershed as a result of fire activity.

REFERENCES

Agee, James K., *The Historical Role of Fire in Pacific Northwest Forests, In: Natural and Prescribed Fire in the Pacific Northwest*, Ed. John D. Walsted, Steven R. Radosevich and David V. Sandberg, Oregon State Univ. Press, pp. 25-38, 1990.

Ainsworth, Jack and Doss, Troy Alan, *Natural History of Fire and Flood Cycles, Post-Fire Hazard Assessment Planning and Mitigation Workshop*, University of California, Santa Barbara, August 18, 1995.

Barbour, M.G., Burk, J.H., and Pitts, W.D., *Terrestrial Plant Ecology*, The Benjamin/Cummings Publishing Company, Menlo Park, California, 1980.

Burcham, L.T., *Fire and Chaparral Before European Settlement*, California Division of Forestry, 1987.

Bureau of Land Management (BLM), Medford District, *South Rogue-Gold Hill Watershed Analysis*, Ashland Resource Area, August 2001.

DeBano, L.F., *Water Repellent Soils: A State-of-the-Art,* USDA For. Serv., Pac. Southwest For. Rge. Exp. Sta., Berkeley, CA., Gen. Tech. Rpt. PSW-46, 21p., 1981.

DeBano, L.F., *Chaparral Soils,* Pacific Southwest Forest and Range Experimental Station, 1987.

Dryness, C.T., *Effects of Wildfire on Soil Wettability in the High Cascades of Oregon,* USDA For. Serv. Pac. NW For. Rge. Exp. Sta., Portland, OR, Res. Pap. PNW-202, 18 p., 1976.

Martin, Debra A., *A comprehensive Approach to Post-Fire Water Quality Monitoring and Decision Making, Second USGS Wildfire Workshop*, Los Alamos, New Mexico, October 31-November 3, 2000.

McNabb, David H. and Frederick J. Swanson, *Effects of Fire on Soil Erosion, In: Natural and Prescribed Fire in the Pacific Northwest*, Ed. John D. Walsted, Steven R. Radosevich and David V. Sandberg, Oregon State Univ. Press, pp. 159-176, 1990.

Moody, John A. and Martin, Deborah A., *Possible Fire-Science Program: Ecosystem Response to Wildfire--the Sediment Story*, USGS, Fort Collins, Colorado, 2003.

McPhee, J., *The Control of Nature*, The Noonday Press, Farrar, Straus and Giroux, New York, 1989.

Mruzik, Leanne, Fuels Management Specialist, Butte Falls Resource Area, U.S. Department of Interior Bureau of Land Management Medford District Office, Personal Communication, 2004.

Northwest Fire Plan, "Summary of the National Fire Plan Strategy for the Pacific Northwest," April 8, 2002, <http://www.nwfireplan.gov/>.

Radtke, K.W.H., *Living More Safely in the Chaparral-Urban Interface*, United States Department of Agriculture, Pacific Southwest Forest and Range Experimental Station, 1983.

Southwest Oregon District, Oregon Department of Forestry (ODF), "Southwest Oregon District Fire Season History," November 11, 2003 (a) <http://159.121.125.11/swo/firehist.htm>.

Southwest Oregon District- Oregon Department of Forestry (ODF), "Protection from Fire- Southwest Oregon," <http://159.121.125.11/swo/protfire.html> (Accessed 10/21/03 [b]).

Wells, W.G., *The Effects of Fire on the Generation of Debris Flows in Southern California*, Geologic Society of America Reviews in Engineering, 1987.

CHAPTER 7
SEDIMENT SOURCES

Prepared by:
David L. Graham, EMS
Tiffany Manger, SOU Capstone Student
Reviewed by:
Katie M. Mosser, EMS

INTRODUCTION

This chapter focuses on sediments that contribute to instream sediment loading. As rocks are weathered, they produce soils that are composed of the primary minerals present in the host rock as well as alteration products of these minerals such as clays. The primary weathering agent in watersheds in temperate climates is water. Water acts as the primary transportation agent moving soils from one area to another within the watershed. In many instances, this process results in increased turbidity which can be detrimental to ecosystems within the watershed.

This chapter has been organized into three sections. Section 7.1 addresses erosional processes at the watershed level. Section 7.2 addresses sediment transportation within the watershed. The historical presence of mining has been great in the SBW, and thus has had a substantial influence on sedimentation issues within portions of the watershed. Section 7.3 of this chapter has been devoted to the explanation of the mining processes and their potential effects on the SBW.

7.1 EROSIONAL PROCESSES

Erosion, the detachment of particles of soil and surficial sediments and rocks, occurs by hydrological (fluvial) processes of sheet erosion, rilling and gully erosion, and through mass wasting and the action of wind. Surface erosion is caused by numerous mechanisms that are responsible for the movement of individual soil particles or small aggregates from the land surface (Satterlund and Adams, 1992). Where land use causes soil disturbance, erosion may increase greatly above natural rates. In uplands, the rate of soil and sediment erosion approaches that of denudation (the lowering of the Earth's surface by erosional processes).

Soil erosion is an important social and economic problem and an essential factor in assessing ecosystem health and function. Erosion is a fundamental and complex natural process that is strongly modified (generally increased) by human activities, such as land clearance, agriculture (plowing, irrigation, grazing), forestry, road building, construction, surface mining, and urbanization. Estimates of erosion are essential to issues of land and water management, including sediment transport and storage in lowlands, reservoirs, and irrigation systems. In the United States, soil is being eroded about 17 times greater than the rate at which it forms. About 90% of U.S. cropland is currently losing soil above the sustainable rate.

Geomorphology is the study of surface landforms and the processes that are responsible for their formation. The geomorphic processes that shape the earth's surface are the primary mechanisms that form drainage patterns, drainage basins, channels, floodplains, terraces, and other watershed and stream corridor features. The primary geomorphic processes involved with flowing water are:

- Erosion, the detachment of soil particles;

- Sediment transport, the movement of eroded soil particles in flowing water; and
- Sediment deposition, the settling of eroded soil particles to the bottom of a water body or left behind as water leaves.

Deposition can be transitory as in a stream channel from one storm to another, or more or less permanent as in a reservoir (FISRWG, 1998).

The occurrence, magnitude, and distribution of erosion processes in watersheds affect the yield of sediment and associated water quality contaminants to the stream corridor. Soil erosion can occur gradually over a long period of time or it can be cyclic or episodic, accelerating during specific seasons or certain magnitude rainstorms. Soil erosion can be caused by anthropogenic activities or natural processes. Erosion is not a simple process because soil conditions are continually changing with temperature, moisture content, growth stage of vegetation and amount of biomass, and the degree of human manipulation to the soil for development or crop production.

Erosion Mechanisms

Erosion occurring as the result of water can be classified into overland erosion and stream and channel erosion.

Overland Erosion

Overland erosion occurs on denuded slopes as a result of raindrop splash and runoff. It includes sheet, rill, and gully erosion; and is the largest source of sediment during construction activities.

Raindrop Erosion

Erosion resulting from the impacts of raindrops which dislodges soil particles and splashes them into the air, is referred to as raindrop erosion or splash erosion. These dislodged particles are then vulnerable to other types of erosion.

Sheet Erosion

Sheet erosion is caused by shallow sheets of water flowing off the land. These broad moving sheets of water are seldom the detaching agent, but the flow transports soil particles detached by raindrop impact and splash. The shallow surface flow rarely moves as a uniform sheet for more than a few feet before concentrating in land surface irregularities.

Rill Erosion

Rill erosion develops as the shallow surface flow begins to concentrate in low spots. The concentrated flow increases in velocity and turbulence, which in turn causes the detachment and transport of more soil particles. This action cuts tiny well-defined channels called rills, which are usually only a few inches deep.

Gully Erosion

Gully erosion occurs as the flow in rills comes together in larger and larger channels. The major difference between this and rill erosion is size.

Stream Channel Erosion

Stream channel erosion occurs as the volume and velocity of flow increase sufficiently to cause movement of the streambed and bank materials.

Tables 7-1 and 7-2 list the basic processes that influence erosion and the different types of erosion found within a watershed.

Table 7-1
Erosion Agents and the Types of Erosion Processes that they Generate
(FISRWG, 1998)

Agent	Process
Raindrop impact	Sheet, interill
Surface water runoff	Sheet, interill, rill, ephemeral gully, classic gully
Channelized flow	Rill, ephemeral gully, classic gully, wind, streambank
Gravity	Classic gully, streambank, landslide, mass wasting
Wind	Wind
Ice	Streambank, lake shore
Chemical reactions	Solution, dispersion

Table 7-2
Erosion Types and Associated Physical Processes
(FISRWG, 1998)

Erosion Type	Erosion/Physical Process			
	Sheet	Concentrated Flow	Mass Wasting	Combination
Sheet and rill	X	X		
Interill	X			
Rill	X	X		
Wind	X	X		
Ephemeral gully		X		
Classic gully		X	X	
Floodplain scour		X		
Roadside				X
Streambank		X	X	
Streambed		X		
Landslide			X	
Wave/shoreline				X
Urban, construction				X
Surface mine				X
Ice gouging				X

Factors Influencing Erosion

The inherent erosion potential of an area is determined by four principal factors:

- Soil characteristics;
- Vegetative cover;

- Topography; and
- Climate (rainfall).

Although each of these factors is discussed separately, they are interrelated.

Soil Characteristics

Soil properties which influence erosion by rainfall and runoff are those which affect the infiltration capacity of a soil and those which affect the resistance of the soil to detachment and transport by flowing or falling water. The four factors of primary importance are:

- Soil texture (average particle size and gradation);
- Percentage of organic content;
- Soil structure; and
- Soil permeability.

Soils that contain high percentages of silt and very fine sand are generally the most erodible. As the clay and organic matter content of these soils increase, the erodibility decreases. Clays act as a binder of soil particles and reduce erodibility. However, while clays have a tendency to resist erosion, once detached from the soil they are easily transported by water and settle out very slowly.

Organic matter is plant and animal residue in various stages of decomposition. Soils high in organic matter have a more stable structure which improves their permeability. Such soils resist raindrop detachment and absorb more rainwater, thus minimizing erosion. Well-drained and well-graded gravels and gravel-sand mixtures are the least erodible soils. Coarse gravel soils are highly permeable and have a good absorption capacity which either prevents or delays, and thereby reduces, the amount of surface runoff.

Vegetative Cover

Vegetative cover plays an extremely important role in controlling erosion. The following are several ways that vegetative cover controls erosion:

- It shields the soil surface from the impact of falling rain.
- It holds soil particles in place.
- It maintains the soil's capacity to absorb water.
- It slows the velocity of runoff.
- It removes subsurface water through evapotranspiration.

Figure 7-1 illustrates pathways for forest rainfall. As can be seen in this illustration, a portion of the rainfall never reaches the ground because it is intercepted by vegetation and other surfaces. By sequentially scheduling (staging) and limiting the removal of vegetation, and by decreasing the area and duration of exposure, soil erosion and sedimentation can be significantly reduced. Special consideration should be given to the maintenance of vegetative cover on areas of high erosion potential such as erodible soils, steep or long slopes, stormwater conveyances, and the banks of streams.

Topography

The size, shape, and slope characteristics of a watershed influence the amount and rate of runoff. Slope length and gradient are key elements in determining the volume and velocity of runoff and the erosion risks. As both slope length and gradient increase, the velocity and volume of runoff increases and the erosion potential is magnified. Slope orientation can also be a factor in determining erosion potential.

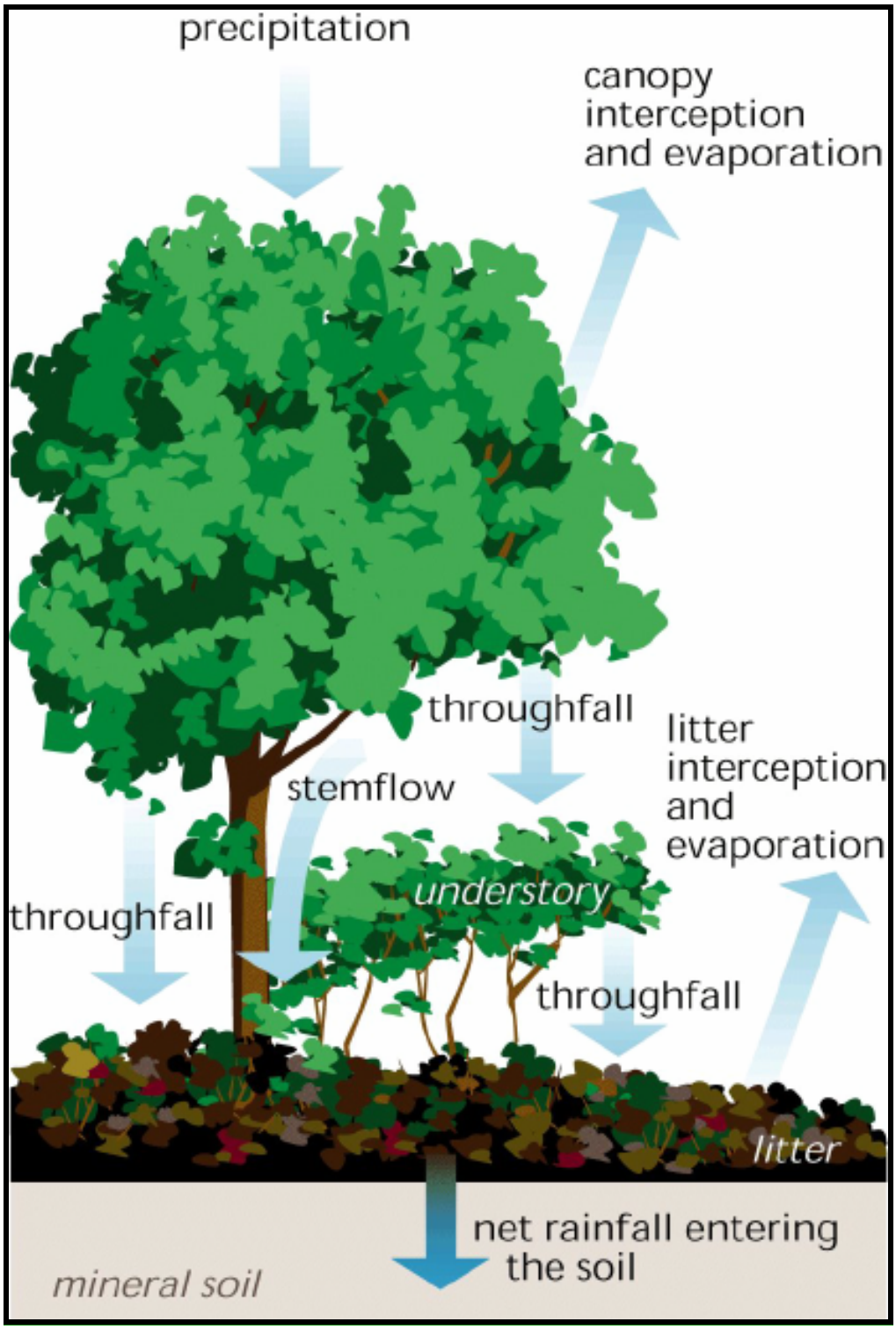


Figure 7-1
Typical Pathways of Forest Rainfall
(FISRWG, 1998)

Climate (Rainfall)

The frequency, intensity, and duration of rainfall are fundamental factors in determining the amount of runoff. As both the volume and the velocity of runoff increases, the capacity of runoff to detach and transport soil particles also increases. When storms are frequent, intense, or of long duration, erosion risks are high. Seasonal changes in rainfall and temperature define the high erosion risk period of the year. Land disturbing activities should be scheduled to take place during periods of low precipitation and low runoff. Exposed areas should be stabilized before the period of high erosion risk.

7.2 SEDIMENT TRANSPORT

Sediment is defined as unconsolidated solid material that is derived from weathering of rock and carried by, suspended in, or deposited by water or wind. The sediment load carried by a stream is a natural attribute of the stream system. The processes controlling sediment transport is necessary for maintenance of the relative stability among streambed and stream banks, erosion, and deposition (Allan, 1995 and Dunne and Leopold, 1978). Sediment is often classified by particle size: clays (<0.005 millimeter [mm]), silts (0.005 to 0.075 mm), sands (0.075 to 4.75 mm), gravels (4.75 to 75 mm), cobbles (75 to 300 mm), and boulders (>30 mm). All rivers and streams transport sediments. The amount of sediment transported is dependent on the amount of sediment derived from the upstream watershed and the velocity and turbulence of the flowing water. The ultimate source of sediments to a stream is from hillslope erosion with lesser contributions being supplied from the streambed and stream banks. Hillslope erosion can be in the form of surface erosion of fine sediments or more dramatically as slope failures leading to debris flows (Alan, 1995, and Dunne and Leopold, 1978).

Fine grained sediments, such as clays and silts, are typically transported as suspended particles and do not comprise a significant portion of the stream bed or "wash load." Riverbed sediments typically consist of coarse-grained particles such as sand, gravel, and cobble. Sand-sized particles can be transported by rivers in suspension if river velocities and turbulence are great enough, or rolled and bounced along the river bed as "bedload." Gravel and courser-grained sediment particles are typically transported as bedload. Figure 7-2 illustrates the various components of sediment transport along a stream channel (FISRWG, 1998).

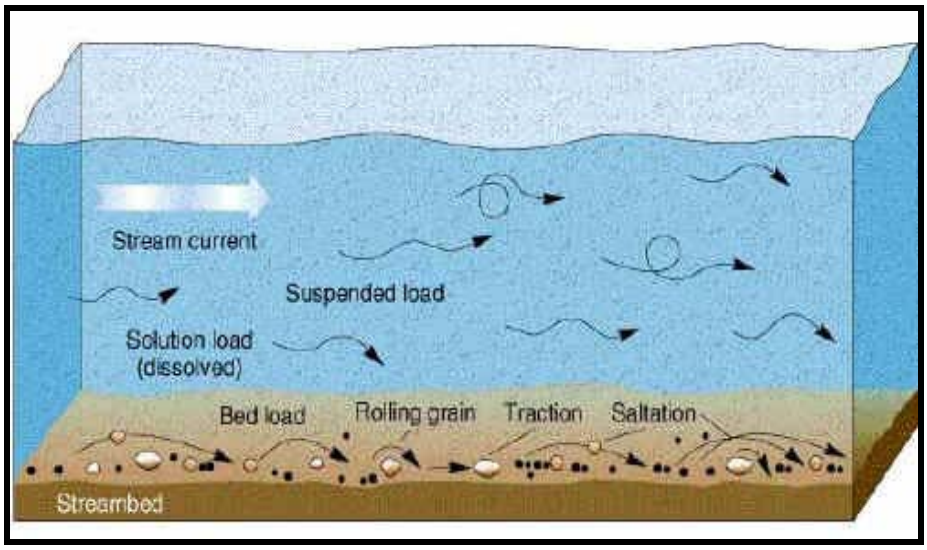


Figure 7-2
Movement of Sediments Along a Stream Channel

The load of sediment (in suspension and as bedload of sand and gravel) through stream channels reflects upland erosion within the drainage basin and change in storage of sediment in alluvial bottomlands. In turn, this is influenced by climate, vegetation, soil and rock type, relief and slope, and human activities such as timber harvesting, agriculture, and urbanization. Much of the sediment eroded from upland areas is deposited (stored) on lower hillslopes, in bottomlands, and in lakes and reservoirs. In terms of sediment budget, net erosion can be described by the following relationship:

Net Erosion = Total Denudation - Sediment Storage + Channel Erosion

Where: denudation is a measure of regional upland erosion.

Sediment load determines channel shape and pattern. Changes in sediment yield reflect changes in basin conditions, including climate, soils, erosion rates, vegetation, topography, and land use. Fluctuations in sediment discharge affect a great many terrestrial processes, including ecosystem responses, because nutrients are transported together with the sediment load. For example, to reproduce effectively, salmon and trout need gravel stream beds for spawning; silt and clay deposits formed by flooding or excessive erosion can destroy these spawning beds. Stream deposits also represent huge potential sinks for, and sources of, contaminants.

Stream sediment storage and load affects virtually all environmental issues in drainage basins. Stream sediments may affect, for example, the health of aquatic organisms or may result in the silting-up of reservoirs. They may also store chemical contaminants that can be subsequently released into the environment by flood events or other disturbances such as mining, construction, or dam removal.

Streams are dynamic landforms subject to rapid change in channel shape and flow pattern. Water and sediment discharges determine the dimensions of a stream channel (width, depth, and meander wavelength). Dimensionless characteristics of stream channels, types of pattern (braided, meandering, straight) and sinuosity are significantly affected by changes in flow rate, sediment discharge, and by the type of sediment load in terms of the ratio of suspended load to bed load.

Anthropogenic activities within a watershed typically result in increased erosion of hillslopes. Rural road systems, urban surfaces, and agricultural activities are all sources of fine sediments in a watershed. Fine sediments present the greatest adverse impact on fish and insects. Fine sediments

decrease the suitability of streambeds for spawning by silting in gravel beds typically used for spawning (Meehan, W.R. and T.C. Bjornn, 1991). High turbidity levels caused by fine sediment during the incubation period of embryos and alevins of salmon and trout will reduce the percentage of young fish that survive and emerge from the redd (Meehan, W.R. and T.C. Bjornn, 1991).

Sediment Sources in the SBW

Soils derived from granitic rocks in the SBW tend to be highly erodible and prone to gully erosion and debris slides (Figure 7-3). These soils typically have a low clay content and a coarse single grain structure that contributes to a lack of cohesion. In turn, such characteristics make stabilizing these soils very difficult after they have been disturbed. This is particularly true along the many roads present in the watershed where cutbank erosion and channel erosion are common. Roads and skid trails are the major contributors of sediments in much of the watershed (BLM, 1994; 1995; 1996; 2001).

Soils derived from metamorphic rocks seem to be more stable than those associated with granitic environments. However, some of the metamorphic areas are prone to instability because of the tendency for these rocks and their corresponding soils to undergo mass wasting when they become wet or saturated.

The impacts on soils in much of the SBW are cumulative in nature. They result from the compaction of road building, skid trails, and landings constructed for logging. Once compacted, these soils are prone to rapid runoff, channelization of flow, and increased erosion. All of which result in increased sedimentation of stream channels (Figure 7-4).

Figure 7-3
Rilling Caused by Sheet Flow Along a Spur Road Along West Evans Creek

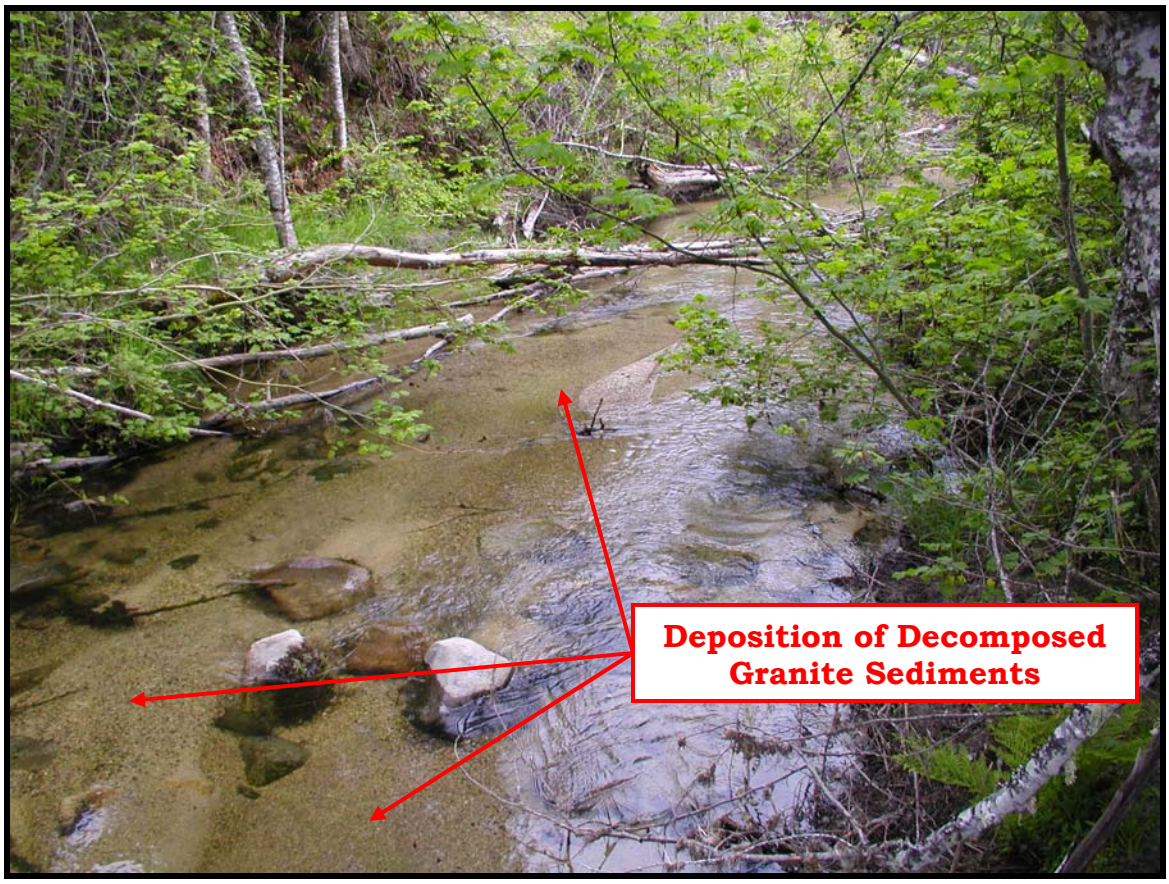


Figure 7-4
Decomposed Granite Sediments in West Fork of Evans Creek
(Note, high amount of granite sand and lack of visible gravel or cobbles)

In the upland areas of the SBW, logging has contributed to a greater potential for rain on snow pack that can lead to flooding and peak flow conditions. Such conditions can result in destabilization of stream banks and reorientation of stream channels. In addition, logging on slopes in these drainages has contributed to an increase in mass wasting, particularly in areas dominated by decomposed metamorphic parent rock. Figure 7-5 illustrates mapped sediment source areas in a small portion of the SBW. This work was conducted as part of the assessment but represents only a small fraction of sites present in the SBW. Mapping and documenting of source areas is a significant data gap for the watershed.

Insert Figure 7-5 (11x17)

Mapped Sediment Sources and Mine Locations

Roads

BLM and other private land owners have constructed hundreds of miles of road throughout the watershed. The roads were constructed primarily for log hauling and administrative purposes. In the BLM Watershed Analysis Units (WAUs), roads range from primitive four wheel drive roads to paved highways. Table 7-3 lists the type and miles of road the BLM controls in each subwatershed.

Table 7-3
Types and Miles of Roads in BLM Watershed Analysis Units (WAUs)

WAU	Rocked	Natural Surface	Unknown	BST	Total Miles
West Fork Evans Creek	182	39		23	244
East Fork Evans Creek	22*	6.3*		2.2*	31*
Mid Evans Creek	--	--		--	187
Rogue-Gold Hill	56	24.7	132	30.5	244
Total Miles	258	64	132	25	535

WAU-Watershed Analysis Unit
BST-Bituminous Surface Treatment
* Miles of Road in the Riparian Reserve within the WAU
-- Information not in BLM Assessment Report

The data presented in Table 7-3 represents only a small portion of the actual roads present in the watershed. There are many miles of unmaintained and abandoned roads on both BLM and private lands that are a major source of sediment to the watershed. Figure 7-6 is an example of road density in the area between Swamp Creek and Cedar Creek on the West Fork of Evans Creek. This area is on the west side of the West Fork near the site of a new bridge that replaced a box culvert. The property is owned by Lone Rock Timber Company and is located in T35S R4W Section 12. Few, if any, of these roads are shown on topographic maps. The roads were located by overlaying topographic maps on aerial photos and transferring the roads on the photos onto the map. The

area of the map in Figure 7-6 covers approximately 1.5 square miles (970 acres) of the watershed. The total mileage of roads shown is 217 miles. There are many areas in the watershed similar to that illustrated in Figure 7-6. The mapping and inventory of these roads represent a data gap that needs to be addressed in order to obtain a better perspective on the magnitude of the sediment issues in the watershed.

Many of these roads have been used for recreational purposes such as motorcycling and most recently by all terrain vehicles (ATVs). These activities greatly increase the potential for erosion. Figures 7-7 and 7-8 are examples of roads have been used by off road vehicles (ORV). ORV use is creating a major problem in many parts of the SBW, especially along reaches of the West Fork of Evans Creek. There are numerous minor sediment areas along the entire stretch of the West Fork of Evans Creek primarily between Rock Creek and Elderberry Flats. The waterbars in many locations have been worn down and runoff flows over the waterbars causing erosion of the roads.

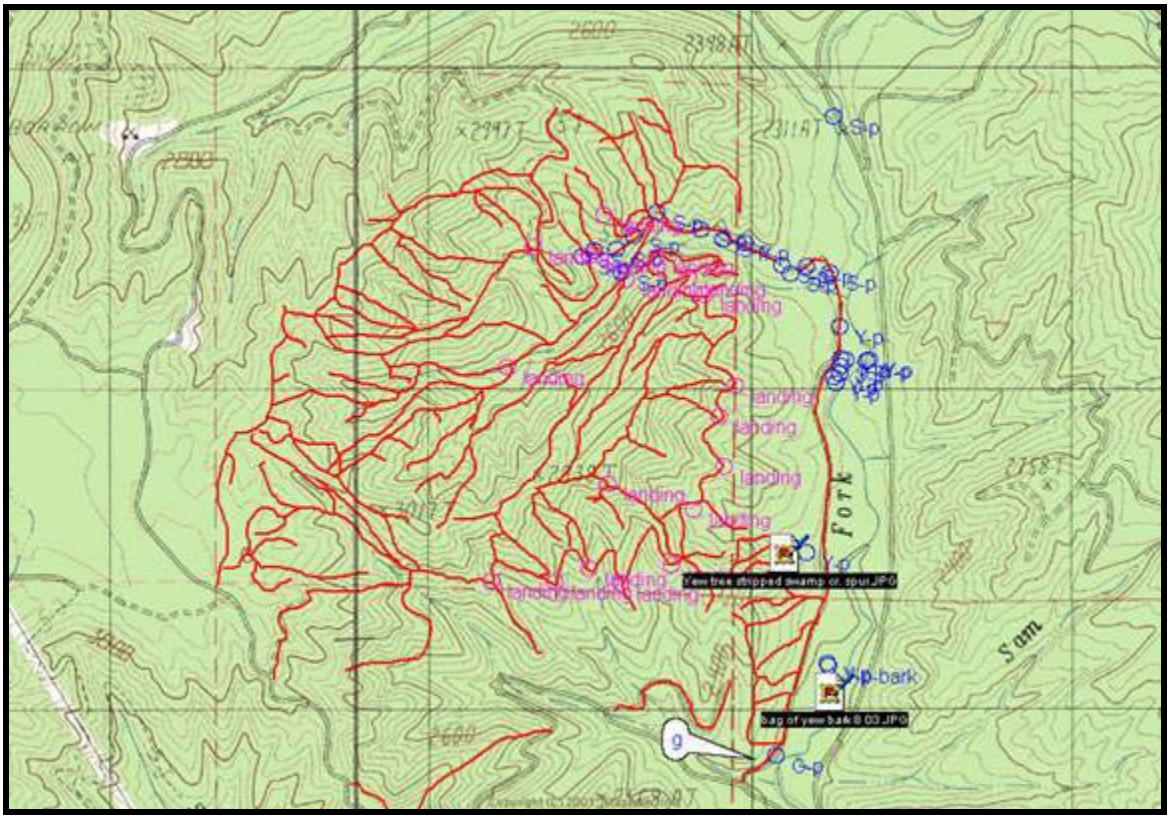


Figure 7-6
Unmapped Roads in a Portion of the Seven Basins Watershed

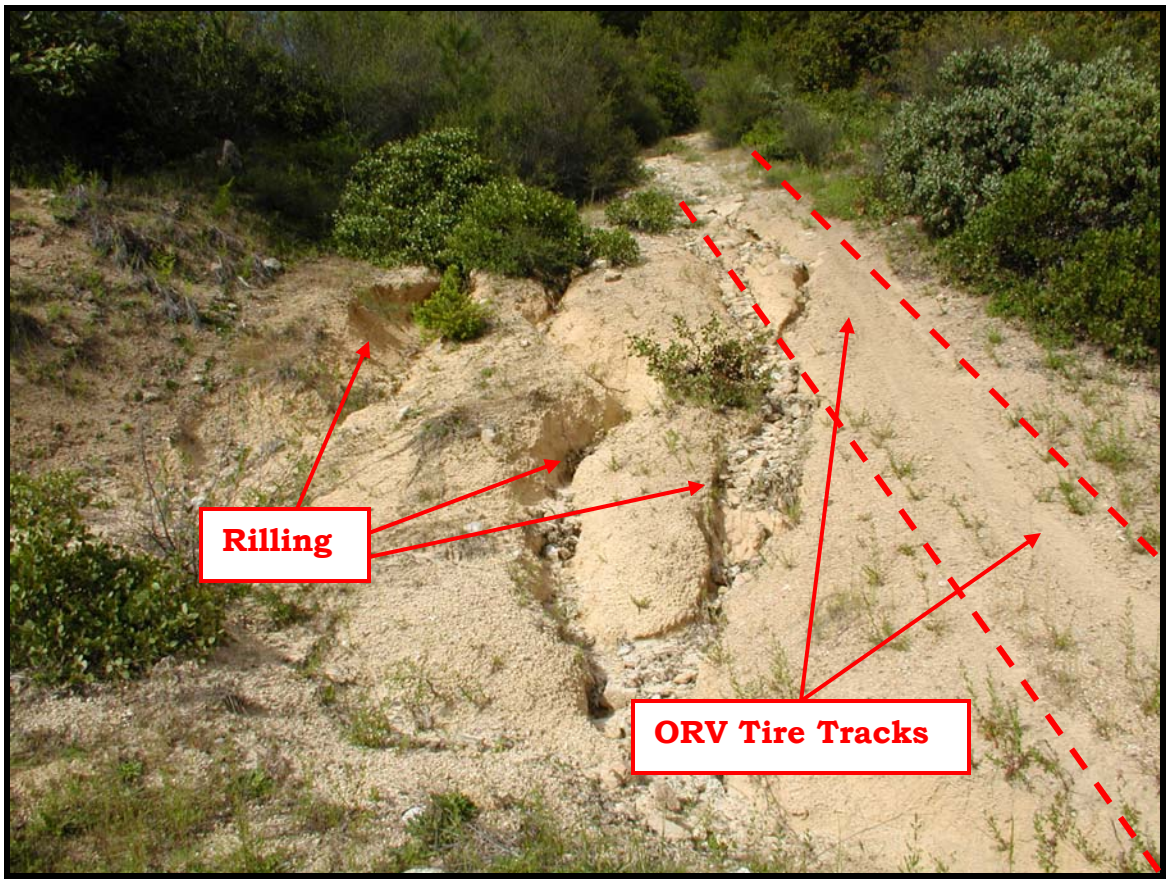


Figure 7-7
Erosion of Granitic Soils on an Unimproved Road on the West Fork of Evans Creek
(At other locations on this road there are washes that are estimated to be four feet deep)

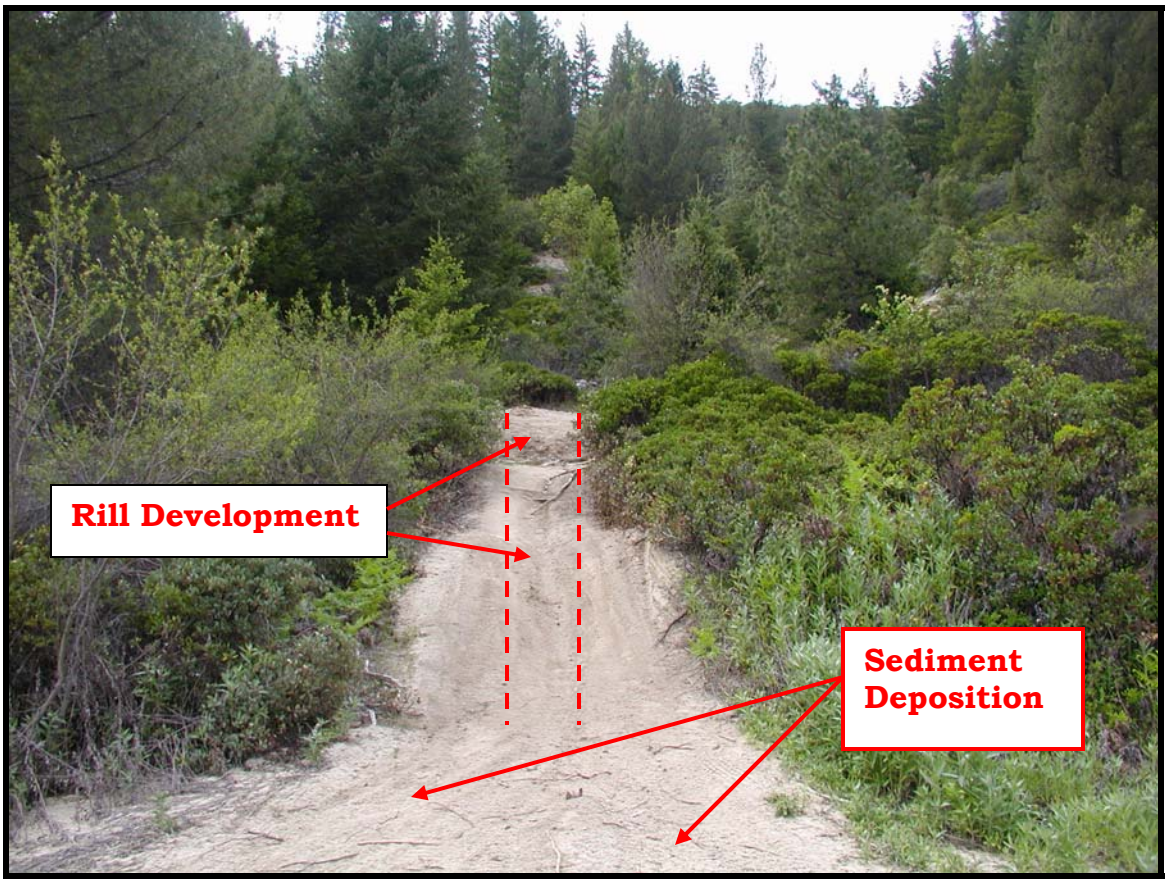


Figure 7-8
Erosion of Granitic Soils on an Unimproved Road in the West Fork of Evans Creek Drainage
(Increased erosion is caused by extensive ORV use)

Streambank Erosion

Bank erosion occurs as stream channels move. Since factors both at the site and upstream in the watershed influence the movement of rivers and streams, it is important to look at the big picture as well as the immediate site. Bank erosion and bank failure are two distinct processes, although they often occur in combination. Streambank failure occurs when a large mass of bank material collapses and slips into the stream. Streambank erosion occurs when individual soil particles at the bank's surface are carried away by the force of moving water.

A streambank is stable when its shear strength is equal to or greater than the shear stress acting upon it. A bank can fail either when its shear strength is decreased or when the shear stress exerted upon it increases.

Swelling of clays from absorption of water, increased groundwater pressure within the bank, and soil creep all weaken the bank. While swelling clays or excessive groundwater pressure are difficult to observe, cracks developing in the bank parallel to the stream are evidence of soil creep. Absence of bank vegetation to help bind the soil together reduces its shear strength. Large trees leaning over the water may lead to failure of steep banks if the trees fall and dislodge soil as they are uprooted. Surface runoff may turn animal burrows and trails near the bank into gullies.

Shear stress increases with changes in channel shape, increase in the load on the top of the bank, or rapid drawdown force of water against the bank face. The faster and deeper the flow of moving water, the stronger the shear force it can exert upon the bank. The speed of water flow depends on slope, roughness of the streambed, depth of the water, and cover of upstream banks. The duration of a flood can have a greater impact on bank stability than the volume of flow. More energy is required to overcome initial bank resistance than to maintain the erosion process, and once erosion begins, it can proceed quickly.

Sand and silt particles erode most readily. Cobbles and other large particles are heavier and harder to move. Clay particles stick together and so are also difficult to dislodge.

Absence of Bank Vegetation

Water that does not filter into the soil becomes surface runoff that can detach more soil particles and cut narrow rills and then wider gullies as it gains in speed and force on its way to the stream. Trees, shrubs, herbaceous plants, and grasses on the bank slow water running off the land. Grasses and other low plants along streams can bend to protect the bank during high flow

without obstructing the passage of water. The loss of streambank and buffer vegetation is often the single greatest contributing factor to increased erosion on small and medium-sized streams.

Obstacles in the Stream

Obstacles in the stream, either natural or man-made, can alter the natural flow of water, resulting in erosion and/or deposition. This situation can occur as a result of placement of LWD if it is not placed in an appropriate location within the stream channel. Condition of the bank itself is often a very small part of the problem.

Watershed Factors that Affect Bank Erosion and Failure

There may be larger forces at work that affect bank stability. Any change in land use that causes water to reach the stream more quickly and with more energy can cause a previously stable bank to erode. Examples of such changes include:

- Wetlands act as natural sponges to hold water during storms and release it slowly. Filling wetlands or removing their vegetation increases the chance of flooding and erosion.
- Vegetation holds soil, slows runoff, and helps water sink into the soil. Trees store more water than smaller plants. Removal of protective plant cover, especially through large-scale deforestation, sends more surface water at greater velocities into streams and adds to their sediment load.
- Water that cannot sink into the soil will reach the stream faster and with more force than if it met the stream as groundwater. Construction of impervious surfaces such as paved parking areas and shopping

centers can cause a stream to suddenly flood and erode its banks, even if the development occurs far upstream in the watershed.

- At high flow, the energy of a stream must be dissipated. Upstream channelization or bank stabilization projects which prevent a stream from using its floodplain, or deflect the stream's energy rather than absorbing it, can focus the stream's force on a site downstream that otherwise would remain stable.

Streambank erosion is occurring at many locations throughout the SBW. Figures 7-9 and 7-10 are examples of undercutting that is occurring along Evans Creek. Undercutting has been shown to provide improved habitat for fish by providing cover and refuge. However, if it is not stabilized in problem areas, high water will continue to wash soil away from tree roots and the tree will fall. Once this occurs, the roots of the tree will no longer be available to stabilize the bank and further erosion will occur.

Slope Stability

Mass movement processes can move large quantities of sediment down slope and deposit it in streams. Sediments can be transported rapidly by catastrophic events, such as landslides or debris flows, or can occur slowly by processes such as earthflows or creep. These events can alter stream channel flow and have adverse impacts on fish and other organisms present in the stream.

Figure 7-9
Undercutting of Streambank along Evans Creek
(Streambank erosion has exposed tree roots and tree will eventually fall into stream)

Figure 7-10
Streambank Erosion Processes have Exposed Tree Roots
(Loss of trees along stream will result in additional bank erosion)

Slope failures have the greatest potential to introduce large amounts of sediment into stream channels over relatively short (hours to days) periods of time. Dirt roads in close proximity to stream channels have a high potential to deliver sediments into channels. Proper road maintenance, drainage (culvert spacing and sizing), revegetation of fillslopes and cutbanks, and minimizing future road construction in riparian areas and on slopes >60% have been recognized as being important to reducing the risk of slope failure resulting in sedimentation of local streams (BLM, 1996).

Slope failures occur naturally throughout the Pacific Northwest and the SBW is no exception. The greatest frequency and volume of slope failures occur in

areas associated with forest roads, rural roads, and clearcuts (Amaranthus, et al., 1985; Rice and Lewis, 1991; and Sullivan, 1985).

Steep slopes are also at risk for failure in areas where large conifers have been removed by logging. The decomposed schist and soil types are particularly prone to mass wasting under wet or saturated conditions. Typically, landslides and road related erosion are triggered by intense rainstorms and/or saturated conditions. There are still remnants of slope failures that resulted from the floods of 1964 and 1974 which were classified as 100 year storm events in the SBW. Maintaining adequate numbers of large conifers within the riparian zones is critical to minimizing risks associated with slope failures (BLM, 1996).

In the upper portions of the SBW, there is a high risk for rain-on-snow occurrence. This is because there are numerous areas that are considered to be non-recovered openings. Non-recovered openings are areas where the overstory canopy of trees has been harvested and the remaining stand of vegetation is inadequate to intercept snow and prevent the accumulation of snow pack. These areas of collected snow pack can produce flood conditions if a rainstorm were to occur. This tendency towards flooding conditions can also occur as a result of loss of vegetation due to fire. Within the SBW this set of conditions is most likely to occur in the elevation zone of 3,500-4,500 feet amsl (BLM, 1996).

Figure 7-11 is a map illustrating the potential for debris flows throughout the SBW. This map was developed by the ODF to provide a preliminary indication of debris flow (rapidly moving landslide) hazard for western Oregon. The map is intended to include locations subject to naturally occurring debris flows and include the initiation sites and locations along the paths of potential debris flows (confined stream channels and locations below steep slopes). The map did not consider the effects of management-related slope alterations (drainage and excavations) which can increase the hazard, nor does the map consider

Insert Figure 7-11 (11x17)

Debris Flow Potential Map

very large landslides that may be triggered by volcanic or earthquake activity (ODF, 1999).

Debris flows are typically initiated by landslides on steep slopes that quickly transform into semi-fluid masses of soil, rock, and other debris. Usually they scour materials for a portion of their travel distance and move rapidly down steep hillslopes and confined channels. Very small landslides can become large debris flows, so there is no minimum size indicated by these maps. Velocities of debris flows may exceed 35 miles per hour (ODF, 1999).

The map is intended to show areas where further on-the-ground investigation is prudent prior to land management and development activities. Specific sites with higher and lower hazards exist in any of the hazard rating categories. The map is intended as a screening tool and should not be used to determine the actual hazard at any specific location. On-the-ground geotechnical inspections or investigations are required to determine true hazards at any specific site. The map includes areas at risk of debris flows after landslide occurrence.

Some areas mapped as high hazard have very steep slopes but infrequent landslide occurrence. Steeply sloped areas with low landslide occurrence are often associated with unaltered igneous and certain metamorphic rock units that are common in parts of the Siskiyou Mountains in southwest Oregon, and in portions of the Cascade Mountains. Unfortunately, existing geologic mapping is of insufficient precision to accurately identify the boundaries of these rock units in many cases. Therefore, on-the-ground geotechnical investigation is usually necessary to identify these steeply sloped areas where debris flows are uncommon (ODF, 1999).

The maps generated by ODF may provide some indication of other rapidly moving landslides; however they provide no information on slumps and other landslides that may damage property but are generally not life threatening.

Therefore, on-the-ground geotechnical investigation is usually necessary to identify these areas.

The following information was used by ODF to develop Figure 7-11:

- DEM, at 30-meter resolution based on USGS data, were used to derive slope steepness and then to develop polygons for assigned hazards.
- Actual slopes are steeper than these DEM slopes.
- Stream channel confinement near steep hillslopes based on USGS Digital Raster.
- Graphics (DRG).
- ODF "*Storm Impacts and Landslides of 1996*" study; debris flow initiation, and path location data.
- Historical information on debris flow occurrence in western Oregon (from ODF, United States Forestry Service, DOGAMI, BLM, and Oregon Department of Transportation sources).
- Fan-shaped land formations below long, steep slopes.
- Areas of highest intensity precipitation do not appear to be correlated with known areas of high and extreme debris flow hazard, so precipitation intensity was not used to develop risk (hazard) ratings.

Table 7-4 lists the percent debris flow hazard by subwatershed. The areas having the highest (>10%) high hazards are those located in areas dominated by granitic bedrock and soil types. The areas having the greatest potential are those areas south of the Rouge River along Foots Creek, Galls Creek, and Ward Creek and an area in the central portion of the SBW in the general area of Sardine and Sykes Creeks. With the exception of Sams and Snider subasins, most others are dominated by greater than 50% moderate hazards.

Table 7-4
Percent Debris Flow Hazards for Each Subwatershed

Subwatershed	% Low Potential	% Medium Potential	% High Potential
Foots Creek	26.3	61.5	12.6
Rogue River/Galls Creek	41.6	47.8	10.6
Rogue River/Ward Creek	27.4	59.3	13.3
Rogue River/Sardine Creek	29.4	58.2	12.6
Lower Evans Creek	49.6	39.5	10.9
Rogue River/Sams Creek	60.3	34.2	5.5
Rogue River/Snider Creek	86.2	12.9	0.8
Evans Creek/Sykes Creek	22.6	60.3	17.2
Pleasant Creek	38.8	53.0	8.1
Lower West Fork Evans Creek	21.6	70.9	7.5
Upper West Fork Evans Creek	44.2	50.4	5.5
Upper Evans Creek	42.6	53.1	4.4

Figure 7-12 is an example of mass wasting that is occurring along Rock Creek. The area where this slide is occurring is composed of decomposed granite material found throughout the watershed. The bank in the far right of the photo has been sloped to reduce movement. However, the bank where debris and small trees have moved was not sloped. The roots of the larger trees located near the top of the slide are holding the bank in place at the time this photo was taken. Rain, and at times snowmelt, accelerates the movement of this slide and it will most likely continue to plague this particular area in the future. This slide moved across the road and down the slope toward Rock Creek requiring repair of the road and stabilization of the down slope side of the bank.

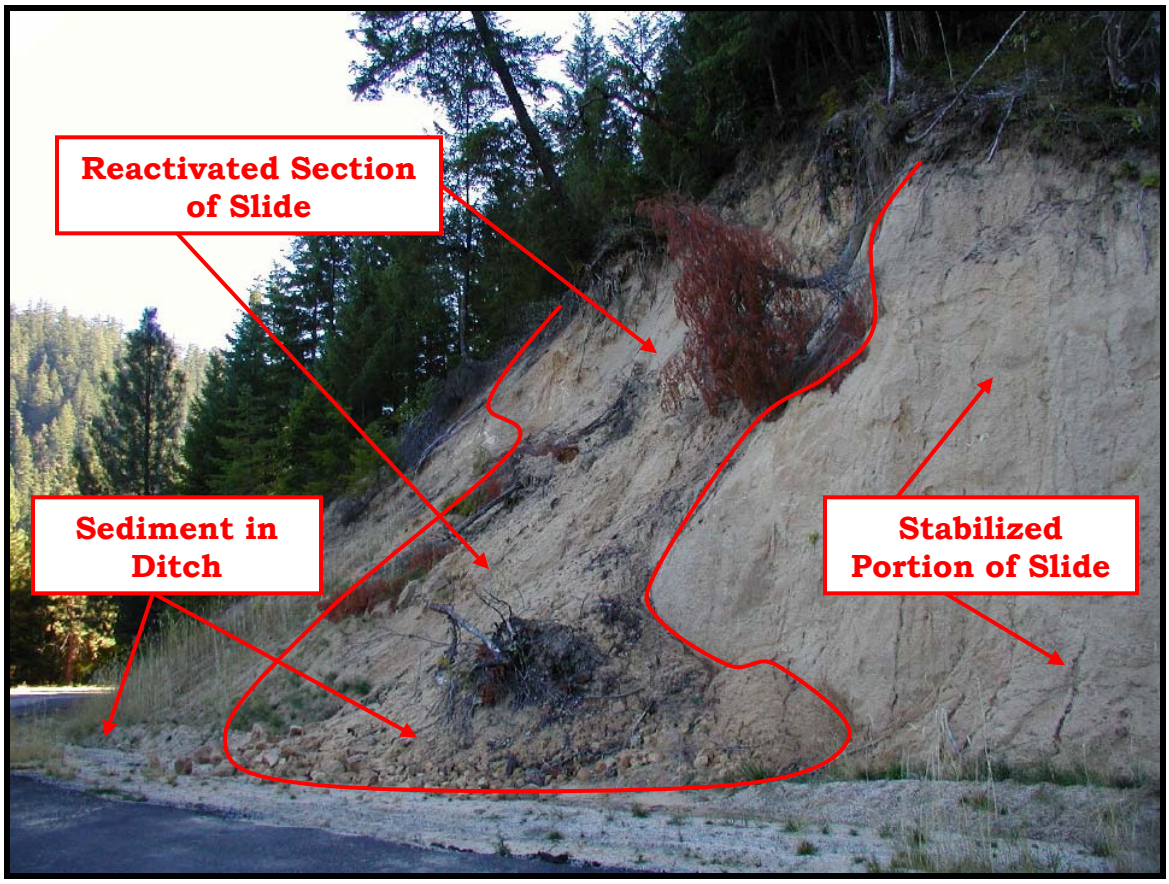


Figure 7-12
Slide Repair on Rock Creek
(The slide began to move early in the winter 2003 during the first rains)

At various times, the ditch along the road is filled with debris and water backs up onto the pavement and runs down the road. The sediment ladened water flows across the road, over the bank and eventually discharges into Rock Creek. Mapping the location of existing slides and determining areas that have a high potential for future movement is a data gap that should be addressed by the Seven Basins Watershed Council.

7.3 IMPACTS OF MINING

The major mineral hazards in the SBW are derived from ore minerals that naturally occur and from the mine tailings that were created as these ores were

extracted over the last century and a half. The minerals of most economic importance in the area were gold and cinnabar (a sulfide of mercury).

Hydraulic mining for gold was the major method of mining in SBW from the mid the late 19th century. Such operations occurred in Sykes Creek, May Creek, Murphy Gulch, McConville Gulch, Pleasant Creek, Dixie Gulch, Harris Gulch, Jamison Gulch, Bear Branch, and Queens Branch. While this type of mining severely impacted stream bed and riparian habitat, it did not introduce as many toxins into streams as lode mining (Atwood and Lang, 1995). Lode mine prospects for gold and quicksilver were started in the first half of the 20th century and by the 1940s there was a significant amount of lode mining occurring in the watershed. The Homestake mine, one mile from Woodville, employed a five-stamp McFarland mill and covered 80 acres at its peak. A three foot shaft and 300 foot deep open cut were constructed on the property. The Lone Star Mine, on Pleasant Creek approximately six miles above the confluence with Evans Creek, had a five mile long mine ditch on 305 acres. The Cameron Mine downstream from the Lone Star Mine occupied 1,100 acres (Atwood and Lang, 1995). Lode mining could be very harmful to the environment because of the many chemicals used to extract the metal from the ore.

Cinnabar was of economic importance in various locations throughout the SBW and prospects were opened as long ago as 1878. In the early 20th century, the demand for mercury to be used in gold processing prompted opening of a number of mines. The War Eagle, Dave Force, and Chisholm mines were particularly successful mines in the area (Atwood and Lang, 1995). The mineral was found in epithermal deposits along fault zones in Payne Cliffs and May Creek formations (Bartley, 1955; Wiley, 1993). At War Eagle Mine, cinnabar was associated with pyrite, marcasite, and arsenopyrite (Bartley, 1955). Mining in the Meadows area was mostly mercury (Wiley and Hladky, 1990). The War Eagle mine produced significant amounts of mercury

(657 flasks) from a fault zone within amphibolite and biotite schist (Wiley and Hladky, 1990). This mine had a total output of $69,000 before it closed in 1937 (Atwood and Lang, 1995).

In addition to mercury and gold, the rocks in this area contain many other minerals of economic importance. The May Creek Schist hosts nickel, copper, manganese, cobalt, platinum, carbon, and arsenic mineralization (Wiley and Hladky, 1990). U.S. Bureau of Mines Electrodevelopment Laboratory at Albany, Oregon determined that the May Creek Schist contained 1.1% copper, 1.3% nickel, and 0.003 ounce platinum per ton of this rock (Bartley, 1955). Copper-nickel sulfides are found in the Shamrock mine area. Underground deposits 100 feet in length and 1-25 feet wide, were discovered. Pyrrhotite, pentlandite, and chalcopyrite are principle minerals and minor amounts of cobalt are present as well. Manganese ore in the form of pyrolusite and rhodonite is found near the Shamrock mine (Bartley, 1955).

Quicksilver mines, such as War Eagle and Chisholm claims, were shown to affect irrigation and horticulture downstream during the first part of the 20th century. The minerals washing down from the mine tailings deteriorated the mining flumes and also had detrimental effects on downstream harvests. Aquatic food chains may also have been affected. Mercury and cyanide contamination may still be present at selected mine sites (Atwood and Lang, 1995).

As discussed previously, extensive mining activity has occurred throughout portions of the SBW since the mid 1800s. At the time the mining was being conducted, it had a large impact on the health of the watershed. It destroyed large sections of riparian habitat, was responsible for altering many of the streams where mining occurred, adversely affected water quality by the introduction of toxins and increasing sediment loads, and physically destroying salmonid spawning habitat. These effects were devastating to many reaches of streams resulting in stream channels becoming incised and permanently

removed from their floodplains (Figure 7-13). The physical effects of mining can still be recognized in areas such as Foots Creek and Pleasant Creek where large mechanical dredges were used to remove huge volumes of sediments from the stream channels. These sediments were redistributed along stream banks as tailings that significantly altered the stream channels and burying riparian vegetation. Those areas where large scale hydraulic mining was conducted still bear the scars of this activity.

Figure 7-13
Hydraulic Mining along a Stretch of Sykes Creek
(Note erosion of stream bank and destruction of riparian area)
(Photo provided by the Woodville Museum)

Other remnants of the mining history within the SBW watershed are still lingering and may pose adverse impacts on the local ecosystems. These impacts are not as easy to discern as the physical scars. Typically, the majority of the mining that occurred within SBW was for the extraction and processing of gold and to a lesser degree, cinnabar. The chemical processing of gold bearing ores was potentially extremely harmful to the environment. The

degree to which the ore processing steps impacted the ecosystem was based primarily on how careful the miners were that conducted the processing. Unfortunately, in the past, miners as a group were not as concerned about the environment as much as they were with the extraction and processing of the commodities they were mining.

The extraction of gold typically utilized several chemicals that are known toxins. Most notably the chemicals of concern were cyanide and mercury. Sodium cyanide is a lethal poison. Low levels of mercury have been demonstrated to have chronic effects on a wide variety of organisms. The following is a brief discussion of the gold extraction process typically used by miners during the gold rush in southern Oregon.

Gold Extraction Processes

Gold can be recovered from its ore by several processes. The actual process utilized depends on the mineralogical characteristics of the ore being mined. Each process requires that the ore bearing rocks be crushed and ground into a fine powder. Free gold and gold bearing sulfides can be extracted from the finely ground ore by amalgamation, flotation, cyanidation, jigging, table concentration, or a combination of several of these processes (Brooks and Ramp, 1968).

Early miners used a series of crushing and grinding techniques to extract as much gold and sulfides as possible. However, it was quickly realized that crushing alone was not an efficient method of extracting the gold. Gold-bearing sulfides were separated from waste materials by using concentration devices such as the vanner or concentrating tables. While better than simple crushing, these techniques still resulted in the loss of approximately 25% of the gold present in the ore (Brooks and Ramp, 1968). Eventually, flotation and

cyanidation began to replace gravity concentration in the extraction of sulfide ores.

The flotation process used finely ground ore mixed with water, and this mixture was agitated and aerated with small amounts of certain compounds. These compounds would adhere to the desirable minerals and float them to the surface where they could be extracted as a concentrate. Waste materials remained submerged and were discarded. In the cyanidation process, finely crushed ores or concentrates are placed in vats containing a dilute solution of sodium cyanide. The gold dissolves to form sodium gold cyanide. The solution is then brought into contact with zinc or aluminum that causes the gold to precipitate (Beard, 1987).

The traditional use of amalgamation involved the stamp mill and amalgamation plates. The plates were made of pure annealed copper at least 1/8 inch thick to prevent buckling. They were scoured with sand and lye to remove any coating or oxidation. The resulting bright metallic copper was then rinsed with clean water and washed with a 2 to 3% solution of cyanide, if available. Next, a mixture of sal ammoniac and fine sand in equal proportions containing mercury was scrubbed onto the plate and as much mercury as the plate could adsorb was added. After coating the plate, it was washed again with clean water and rinsed with the cyanide solution. Keeping the mercury clean was a problem until the plate built up a good gold amalgam coating. To alleviate this problem, the plates were typically silvered by applying silver amalgam to the prepared plate (Beard, 1987).

The physical and/or chemical characteristics that make amalgamation work are not clearly understood to this day. However, it is known that if clean mercury is brought into contact with clean gold, the gold is wetted and “drawn into” the mercury. This results in a solution of gold in mercury or an alloy of gold and mercury called amalgam.

The amalgamation process generally worked best on relatively coarse gold that could be liberated from the gangue and abraded clean without too much difficulty. Since mercury will not penetrate into minute crevasses or pores, the ore must be ground fine enough to expose the gold at the surface. If the gold is very fine, cyanidation is more effective and, typically, a combination of amalgamation and cyanidation was usually employed. Gravity and flotation were also frequently used in conjunction with amalgamation (Beard, 1987).

After the gold was taken up by the mercury, the amalgam was collected. The gold on the plates was scraped off as previously described. The amalgam left in the slurry would be brought together into larger globules and separated from the slurry. Gravity separation was usually employed. Sluices, jigs, tables, wheels, pans, or any other gravity device was used.

After the mercury gathered in the gold, it could be removed by dissolving it in nitric acid or by driving it off as a vapor by heat, and the gold remained behind. In many instances, the excess mercury was removed by squeezing it though damp chamois or canvas leaving a hard lump of amalgam. The remaining mercury was then removed by retorting or by dissolving it in dilute nitric acid. Because mercury vaporizes at a much lower temperature than gold it can be driven off by heat leaving the gold behind. In the retort, mercury vapors can be captured and condensed so that the mercury could be reused. If heated too rapidly, the amalgam could splatter and clog the outlet which could result in the explosion of the retort (Beard, 1987).

If a retort was not available, the mercury and silver were removed by placing the amalgam in hot dilute nitric acid. The mercury and silver are dissolved leaving the gold. This solution could then be used to “silver” copper plates or pans, or it was simply discarded as waste.

The Potential Impacts of Mercury on a Watershed Ecosystem

Although all rocks, sediments, water, and soils naturally contain small but varying amounts of mercury, mining of gold and mercury contribute greatly to mercury concentrations on a local basis.

Mercury is a highly toxic element that is found both naturally and as an introduced contaminant in the environment. Recent research has shown that mercury can be a threat to the health of people and wildlife in many environments that are not obviously polluted. The risk is determined by the likelihood of exposure, the form of mercury present (some forms are more toxic than others), and the geochemical and ecological factors that influence how mercury moves and changes form in the environment.

Mercury is a heavy metal that has no known metabolic purpose and is toxic to living organisms. The toxic effects of mercury depend on its chemical form and the route of exposure. Methylmercury [CH_3Hg] is the most toxic form. Elemental mercury, Hg(O), the form used in gold mining can be converted from inorganic compounds to organic forms such as methylmercury that is easily absorbed by organisms. Thus, mercury deposits and mines, and residual mercury from past mining operations could pose in a potential hazard to residents and wildlife because drainage from these sources can enter streams and rivers that are part of local ecosystems.

Figure 7-14 is a simplistic representation of the mercury cycles that can exist in a watershed. Mercury cycling pathways in aquatic environments are very complex. Once in surface water, the various forms of mercury can be converted from one to another; most important of which is the conversion to methylmercury (CH_3Hg+), the most toxic form. Mercury can be brought to sediments by particle settling and then later released by diffusion or resuspension. It can enter the food chain, or it can be released back to the atmosphere by volatilization. The concentration of dissolved organic carbon

(DOC) and pH have a strong effect on the ultimate fate of mercury in an ecosystem. Current thinking suggests that higher acidity (decrease in pH) and DOC levels enhance the mobility of mercury in the environment, thus making it more likely to enter the food chain.

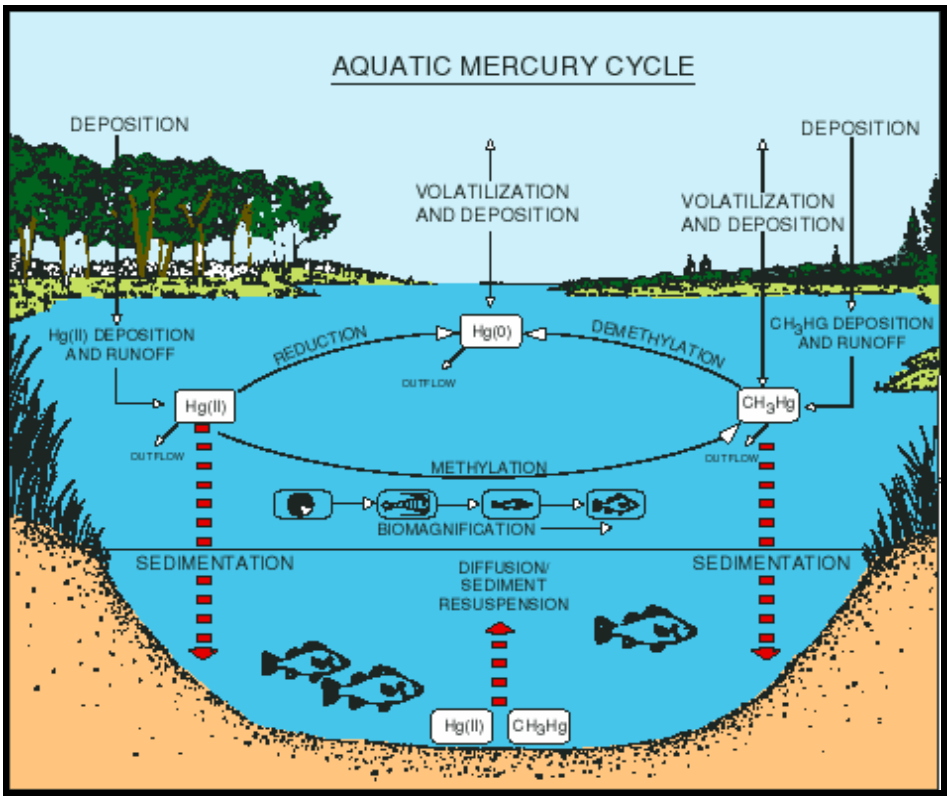


Figure 7-14
Schematic Diagram of Mercury Cycling Pathways in Aquatic Environments
(Source: Watras and Huckabee, 1994)

The EPA has set an instream concentration a limit of 0.012 parts per billion (ppb) for mercury because concentrations above this level may result in chronic effects to aquatic life. When stream water exceeds 0.012 ppb, edible portions of fish should be analyzed to determine if mercury concentrations exceed the 1.0 parts per million (ppm) (wet weight) action level established by the Food and Drug Administration (FDA). At this concentration, sale of fish is restricted by the FDA.

Residual mercury in stream sediments as a result of past mining activities and cinnabar deposits in upland areas can be a dominant source of mercury in a stream ecosystem. Most organic mercury resides in the stream sediments and is then transferred to stream water and food sources of fish, such as larvae, insects, and other small fish that live in and around the mercury-rich sediment. When mercury enters the food chain, it can be hazardous because mercury tends to concentrate in the highest predators through a process called biomagnification. Mercury concentrations in fish are useful for studying the levels of mercury in the food chain that can eventually affect humans. Elevated mercury concentrations measured in fish are a strong indicator that mercury is being converted from inorganic mercury in the sediment to organic mercury that is more biologically available.

The Potential Impacts of Cyanide on a Watershed Ecosystem

Cyanide in water rapidly breaks down in the presence of sunlight into largely harmless substances, such as carbon dioxide and nitrate or ammonia. However, cyanide also tends to react readily with many other chemical elements, and is known to form, at a minimum, hundreds of different compounds (Flynn and Haslem, 1995). Many of these breakdown compounds, while generally less toxic than the original cyanide, are known to be toxic to aquatic organisms. In addition, they may persist in the environment for long periods of time, and there is evidence that some forms of these compounds can be accumulated in plant (Eisler, 1991) and fish tissues (Heming and Thurston, 1985; Heming and Blumhagen, 1989).

The general term “cyanide” refers to various compounds having the chemical group CN, that is, one single atom of carbon (C) and one single atom of nitrogen (N). Several plants, some soil bacteria, and several species of invertebrate organisms produce natural cyanide and related compounds.

Nevertheless, cyanide compounds are seldom present in uncontaminated waters in measurable concentrations.

Cyanide readily combines with most major and trace metals. It is this property that makes it useful in extracting metals from ores. Cyanide also tends to react readily with many other chemical elements, producing a wide variety of toxic, cyanide-related compounds. Cyanide is a carbon based organic compound, and it reacts readily with other carbon-based matter, including living organisms.

When metal-cyanide complexes are formed and released into the near-surface environment, they begin to decompose at varying rates, some quickly, others quite slowly. This breakdown releases cyanide into the soil or water, generally at relatively low concentrations. Those complexes that most readily decompose are referred to as weak complexes, those most resistant to decomposition are called strong complexes. Examples of weak cyanide complexes include zinc and cadmium cyanides. Moderately strong complexes include copper, nickel, and silver cyanides. And strong complexes include iron, cobalt, and gold cyanides. Some of the strong complexes do not break down in the presence of strong acids, but will decompose when exposed to various wavelengths of light, releasing cyanide ions. This is especially true of the iron cyanides, which are often the most common forms of these complexes found in mining wastes (Moran, 1998).

The decomposition rates of these complexes also are affected by the water temperature, pH, total dissolved solids, and complex concentration. Some metal-cyanide complexes degrade more rapidly when exposed to sunlight, atmospheric carbon dioxide, and air. And some complexes degrade more rapidly when they percolate through soils, are agitated and mixed by wind or streams, or are metabolized by bacteria. Cyanide complexes degrade more rapidly in neutral or low pH environments, but some may be stable for decades.

While much of the cyanide present in mining-related waters breaks down into largely harmless compounds, significant concentrations of other potentially toxic cyanide breakdown compounds may persist. No regulatory standards exist for most of these potentially toxic constituents, with the exception of ammonia and nitrate. Most state and federal agencies require mining-related water samples to be analyzed using either the weak acid dissociable (WAD) or total cyanide methods only. Neither method detects the majority of the cyanide-related compounds likely to be present at a mine site. A tailings or heap leach pad water sample can easily have a WAD cyanide concentration of less than 0.05 milligrams per liter (mg/L), and still contain concentrations of cyanate or thiocyanate that are potentially toxic to fish (Moran, 1998).

Cyanide used in past mining operations does not pose as high a risk as other toxics substances, such as mercury. However, because of the lack of information regarding the various species of cyanide compounds, it is warranted to evaluate sediments and tailings wastes associated with past mining activities.

Potential Chemical Impacts to the SBW from Past Mining Activities

Figure 7-15 is a photograph of the adit at the Blue Ledge Mine, the largest mine site in Murphy Gulch. This tunnel is approximately ten feet high by ten feet wide and extends into the mountain for an undetermined distance. Anecdotal information from local residents suggests there is a vertical shaft part way back in the mine filled with water.

Figure 7-15
Entrance to the Blue Ledge Mine on Murphy Gulch
(Adit is approximately ten feet by ten feet)

Remnants of the mill site are still evident. Portions of the cyanide solution agitator that stirred zinc plates through the cyanide solution and ground up ore to electroplate gold to the zinc plates. Once the plates were sufficiently covered, the cyanide solution and ground ore were dumped into Murphy Gulch. New plates were attached to the agitator and the used plate sent to a smelter to separate the zinc from the gold. Steel bands used to hold wooden cyanide tanks together can still be seen at the site of the Murphy Gulch mill. The tanks were approximately twelve feet in diameter. However, the height of the tanks could not be determined. If it is assumed that the tank was eight feet tall it would have a capacity of approximately 6,800 gallons of cyanide solution. Local residents familiar with the operation of the mine indicated that the

contents of these tanks were routinely emptied into Murphy Gulch and replaced with new solutions.

Mining operations such as those on Murphy Gulch were prevalent throughout the SBW until the mid 1940s when mining was stopped because of World War II. The remnants of these operations may pose a threat to various segments of the stream ecosystem because of residual levels of contaminants that may remain in sediments derived from the mining areas. One area of concern is the sediments that have been deposited behind dams in the watershed. This is not a concern for all dams, only those located down gradient and in close proximity to areas that underwent extensive mining and processing of ores. These sites should be evaluated to determine if residual contaminants are present. Figure 7-5 illustrates the location of mines located immediately upgradient of the Wimer Dam. This does not, however, represent all of the mines located in the SBW.

One such dam is the Wimer Dam (Figure 7-16) located immediately down stream from the mining areas on Murphy Gulch, Sykes Creek, Magerly Gulch, and Stein Gulch as well as several mines located along Evans Creek. All of these sites contributed sediments to Evans Creek up gradient of the Wimer Dam. The dam was originally constructed on logs in 1903 for irrigation purposes. The current structure was built of concrete in 1930. It has a span of approximately 100 feet and is 11 feet high. It is three feet thick. A fish ladder is located on the north side of the dam. The pool created by the dam is about 300 to 400 feet long with an average width of 120 feet. The depth of the pool is two to five feet deep at low flows (Figure 7-17). Both stream and pool substrate is composed of bedrock, boulders, cobbles, gravels, sand, and silt (National Marine Fisheries Service, [NMFS] 2001). The depth of sediment behind the dam varies from nearly 12 feet immediately behind the dam to seven feet further up stream (Howell, 2003). Figure 7-18 shows the sediment in the pool upgradient of the Wimer Dam. Using an average sediment depth of

eight feet it is estimated that approximately 15,000 cubic yards of sediment is present behind the dam.

Figure 7-16
Wimer Dam Located at River Mile 10 on Evans Creek
(The fish ladder can be seen in the foreground)

Figure 7-17
The Wimer Dam is Located at Right of the Photograph
The Pool Holding Sediments is Located to the Left of the Dam

Figure 7-18
Sediments in Evans Creek Up Stream of the Wimer Dam

A local miner in the Wimer area has conducted suction dredging in the sediments behind the dam and has found gold and elemental mercury in the sediments. These metals have been transported down stream from the above mentioned mining areas and have been deposited in the sediments behind the dam. The presence of the mercury in the sediments is problematic based on the factors discussed above with respect to mercury partitioning in the aquatic environment. This is also a potential issue with respect to removal of this and other similar dams (Fielder Dam) in the SBW.

Studies in other watersheds and river systems (Johnson et al., in press) that have been contaminated by past mining activities have demonstrated that once ecosystems are disturbed or subjected to chronic contamination, recovery is a

slow process. Many contaminants have been shown to have an affinity for particulates and accumulate at the sediment/water interface. Biota living in, or at, the interface can be exposed to surprisingly high concentrations of contaminants by either direct contact or sediment ingestion (Johnson, 1999). As an example, Cox et al. (1994) reported average lead concentrations of 0.002 micrograms per milliliter (µg/ml) (total or soluble plus particulate) in upper Columbia River water and 500 micrograms per gram (µg/g) in suspended sediment collected by centrifugation of the same water. Thus the concentration in suspended sediment (on a µg/g basis) was 250,000 times greater than the total concentration (µg/ml or µg/g) in the water. Similar observations have been reported for heavy metals and selected organic contaminants in other ecosystems (Olsen, et al., 1982). Johnson et al., (in press) demonstrated that concentrations in metals in river sediments whose origin was from mining areas decline at a slower rate than expected. They attributed the decline to resuspension of riverbed sediment behind upper river dams and runoff/erosion from old mining and/or mill sites during periods of high precipitation.

Should the Wimer dam or other similar structures be breached, sediments would move down stream and mercury and other potential contaminants could be resuspended and redistributed throughout the ecosystem. Prior to removal of any dam or other structure that could allow sediments to accumulate, a comprehensive evaluation of the chemical character of the sediments should be conducted. The characterization effort should follow procedures described in McDonald and Ingersoll, (2002 a, b, c) or other similar guidance documents. The characterization process would provide valuable information regarding the distribution of contaminants, the concentration level of contaminants, and their chemical form. The results of the characterization will allow informed management decisions to be made as to disposition of the sediments.

Many of the options for the disposition of the sediments will require the involvement of several agencies and the acquisition of appropriate permits. Agencies that will need to be involved in such decisions include, but are not limited to, DEQ (sediment quality), Division of State Lands (removal/fill permits), OWRD, ODFW, State Historic Preservation Office, U.S. Army Corps of Engineers, etc.

Projects that require grading, trenching or other types of construction in waterways, riparian areas, and wetlands may require specific permits from local, state, or federal agencies. Activities in wetlands and waterways are regulated by:

- The Division of State Lands (DSL) under the state Removal-Fill Law (503) 378-3805;
- The U.S. Army Corps of Engineers under the federal CWA and Rivers and Harbors Act (503) 808-4373;
- The ODF under the Forest Practices Act (503) 945-7470;
- The U.S. Natural Resource Conservation Service under the Food, Agriculture, Conservation, and Trade Act—check government listings; and/or
- Some city and county land use ordinances.

Regulations apply to all lands, public or private. A wetland does not have to be mapped by the state or otherwise "designated" to fall under the regulations.

The following activities are regulated under the above referenced regulations:

- Placement of fill material;
- Alteration of stream bank or stream course;
- Ditching and draining;
- Plowing/disking non-farmed wetlands;

- Excavation or dredging of material; and
- In-water construction (may also require a DSL lease).

The following activities are exempt from regulation:

- Some routine maintenance activities; and
- Some minor projects involving small amounts of fill or removal.

Established, ongoing agricultural activities and grazing are regulated by the Department of Agriculture under Senate Bill 1010 that requires the development of Water Quality Management Plans.

DATA GAPS

- No comprehensive field inventory or mapping of recent and historical landslides and severely eroded terrain is available.
- Quantification of landslide and erosion rates for both anthropogenic and natural areas has not been conducted.
- Inventory of roads by type, road density, and distance from riparian areas has not been completed.
- Mapping and evaluation of mine properties located upstream from major barrier structures is insufficient to evaluate impacts on stream sediments and aquatic habitat.
- Geochemical characterization of sediments behind dams that may be impacted by mine tailings has not been conducted.
- Inventory and mapping of streambank erosion has not been completed.

ACTION PLAN RECOMMENDATIONS

- Work with federal and state agencies to develop a program for characterization of sediments behind dams that have a high potential for contamination based on historic mining activity.
- Develop a program to map areas that have a high potential for slope instability. This should include field checking of areas mapped by ODF as having high to moderate potential for debris flows.
- Devise a strategy for mapping roads throughout the watershed and continue to map sediment sources associated with roads. This should include mapping distances from streams and determining widths of buffer zones along stream reaches.
- Develop an approach for quantifying the amount of sediment transport potential and impact to steams from both natural and anthropogenic sources. This should be coupled with sediment evaluations related to wildfire.
- Develop an interactive environmental data base coupled with GIS to document inventory information and map spatial data.
- Provide community education related to the importance of sediment issues. Education should be related to erosion reduction/soil stabilization methods and practices. In addition, the Seven Basins Watershed Council should coordinate education efforts with the BLM regarding the impact of ORVs with respect to erosion and sensitive areas. This program should include ways that stakeholders can get involved in the characterization effort.

REFERENCES

Alan, J.D., Stream *Ecology: Structure and Function of Running Waters*, Kluwer Academic Publishers, Dordrecht, The Netherlands, 1995.

Amaranthus, M.P.; Rice, R.M.; Farr, N.R.; and Ziemer, R.R., *Logging and Forest Roads Related to Increased Debris Slides in Southwestern Oregon*. Journal of Forestry, Vol. 84, No.4, pp. 229-233, 1985.

Atwood, Katherine C., and Lang, Frank A., *As Long as the World Goes On: Environmental History of the Evans Creek Watershed*, Prepared for Butte Falls Resource Area, Medford District, BLM, 180 p., 1995.

Bartley, Ronald Clark, *Geology of East Evans Creek Trail Quadrangle, Oregon*, Eugene Oregon; Oregon State College, 1955.

Beard, Richard R., Treating Gold Ores by Amalgamation, Arizona Department of Mines and Mineral Resources, Circular No. 27, 1987.

Brooks, H.C. and L. Ramp, Gold and Silver in Oregon, DOGAMI, Bulletin 61, 337 pgs., 1968.

Bureau of Land Management (BLM), *Landscape Analysis of Mid Evans Creek*, Medford District BLM, Butte Falls Resource Area, May 1994.

Bureau of Land Management (BLM), *Watershed Analysis of West Evans of Creek*, Medford District BLM, Butte Falls Resource Area, April 1995.

Bureau of Land Management (BLM), *East Evans Watershed Analysis*, Medford District BLM, Butte Falls Resource Area, 1996.

Bureau of Land Management (BLM), *South Rogue-Gold Hill Watershed Analysis*, Medford District BLM, Ashland Resource Area, August 2001.

Cox, S.E., Foreman, W.T., Bortelson, G.C., and Green, K.A., *Distribution of Selected Trace Elements and Chlorinated Dioxins in Water and Suspended Sediment of the Columbia River at Northpoint, Washington*, Proceedings Of the Canada/United States Technical Workshop on the Upper Columbia River Basin: An International Dialogue, November 15-16, Spokane, Washington Water Resources Center, Publ. No. 89 of the State of Washington Water Research Center, Pullman, Washington, 1994.

Dunne, T. and Leopold, L.B., *Water in Environmental Planning*, W. H. Freeman and Company, New York, 1978.

Eisler, R., *Cyanide Hazards to Fish, Wildlife, and Invertebrate: A Synoptic Review: Contaminant Hazard Review Report 23*, U. S. Dept. Interior, Fish and Wildlife Service, 55pg., 1991.

Federal Interagency Stream Restoration Working Group (FISRWG), *Stream Corridor Restoration: Principles, Processes, and Practices*, 1998.

Flynn, C. M. and Haslem, S. M., *Cyanide Chemistry-Precious Metals Processing and Waste Treatment,* U. S. Bureau of Mines Information Circular 9429, 282 pg., 1995,

Heming, T. A. and Blumhagen, K. A., *Factors Influencing Thiocyanate Toxicity in Rainbow Trout Salmo gairdneri*, Bull. Environ. Contam. Toxicol. V. 43, p. 363-369, 1989.

Heming, T. and Thurston, R.V., *Physiological and Toxic Effects of Cyanides to Fishes: a Review and Recent Advances, in Cyanide and the Environment*, Proc. of a Conf., D. Van Zyl (ed.), Dec. 1984, Colo. State Univ., Ft. Collins, Colorado, Geotechn. Engineering Program, Dept. Civil Engineering, v. 1, p 85-104, 1985.

Howell, P., 2003, Personal Communication.

Johnson, Vernon G., *Contaminant Loading Limits for a Major North Temperate River System: A Benthic Ecorisk Assessment Approach*, Advances in Env. Res., 3 (1), pp. 28-48, 1999.

Johnson, V., Peterson, R., and Olsen, K., *Heavy Metal Concentrations in River Sediment Cores as an Indicator of Upstream Mining and Smelter Operations*, J. Envi. Mon. and Assess., in press.

MacDonald, Donald D. and Ingersoll, Christipher G., *A Guidance Manual to Support the Assessment of Contaminated Sediments in Freshwater Ecosystems, Volume I – An Ecosystem-Based Framework for Assessing and Managing Contaminated Sediments,* USEPA, EPA-905-B02-001-A, 149 pg., 2002a.

MacDonald, Donald D. and Ingersoll, Christipher G., *A Guidance Manual to Support the Assessment of Contaminated Sediments in Freshwater Ecosystems, Volume II – Design and Implementation of Sediment Quality Investigations,* USEPA, EPA-905-B02-001-B, 136 pg, 2002b.

MacDonald, Donald D. and Ingersoll, Christipher G., *A Guidance Manual to Support the Assessment of Contaminated Sediments in Freshwater Ecosystems, Volume III – Interpretation of the Results of Sediment Quality Investigations,* USEPA, EPA-905-B02-001-C, 232 pg., 2002c.

Meehan, W.R. and Bjornn, T.C., *Salmonid Distributions and Life Histories, in: Influences of Forest and Rangeland Management on Salmonid Fishes and Their Habitats,* W.R. Meehan, ed., American Fisheries Society Special Publication 19, 1991.

Moran, Robert, *Observations on the Chemistry, Toxicity, and Analysis of Cyanide in Mining-Related Waters*, MPC Issue Paper No. 1, Mineral Policy Center, Washington DC, 1998.

National Marine Fisheries Service (NMFS), United States Department of Commerce, National Oceanic and Atmospheric Administration, *Biological Opinion: Formal Section 7 Consultation on Wimer Dam, Maple Gulch Dam, Farmer's Ditch Dam, Beaver Creek Dam, and Buck and Jones Dam Removal Projects in the Rogue Basin*, Jackson County, Oregon, July 2001.

Olsen, C.R., Cutshall, N.H., and Larsen, I.L., *Pollutant-Particle Associations and Dynamics in Coastal Marine Environments: A Review*, Marine Chemistry, 11, pp. 501-533, 1982.

Oregon Department of Forestry (ODF), *Western Oregon Debris Flow Hazard Map*, Methodology and Guidance for Map Use, January 1999.

Rice, R.M., and Lewis, J., *Estimating Erosion Risks Associated with Logging and Forest Roads in Northwestern California*, Water Resources Bulletin, Vol. 27, No. 5, pp. 809-817, 1991.

Satterlund, D. and Adams, P., *Wildland Watershed Management*, 2nd Ed., John Wiley and Sons, Inc., New York, 1992.

Sullivan, K., *Long-Term Patterns of Water Quality in a Managed Watershed in Oregon: 1. Suspended Sediment*, Water Resources Bulletin, Vol. 21, No. 6, pp. 977-987, 1985.

Watras, Carl J. and Huckabee, John W. (ed.), *Mercury Pollution Integration and Synthesis*, Lewis Publishers, Boca Raton, Florida, 1994.

Wiley, Thomas J., *Geology and Mineral Resources Map of the Cleaveland Ridge Quadrangle Jackson County, Oregon*, Oregon Department of Geology and Mineral Industries, 1993.

Wiley, Thomas J. and Hladky, Frank. R., *Geology and Mineral Resources Map of the Boswell Mountain Quadrangle, Jackson County Oregon*, State of Oregon Department of Geology and Mineral Industries, 1990.

CHAPTER 8
CHANNEL MODIFICATION ASSESSMENT

Prepared By:
Katie M. Mosser, EMS
Monty Bruner, PhD, EMS
Yoshi Takekubo, SOU Capstone Student
Reviewed By:
Dave Graham, EMS

INTRODUCTION

A channel modification is an anthropogenic alteration that influences channel geomorphology and often disrupts biotic function of a stream. Modifications can be of various sizes and types, and include channelization, dams, roads, bridges, rip rap, ditches, culverts, in-stream mining, dredging, levee building, and other bank stabilizing structures. Channel modifications can move a stream from its natural channel, affect water velocities and temperature, and reduce available habitat for aquatic organisms. For example, channelization activities such as the narrowing, straightening, or moving of a stream can cause change in substrate distribution by creating unnatural areas of sediment loss or deposition and can reduce habitat for aquatic organisms (Oregon Water Resources Research Institute, 1995).

In the Pacific Northwest, channel modifications have significantly altered salmonid habitat. Dams are often barriers of salmonid migration to spawning beds. Roads often create conditions that prevent the free movement of fish species. Dikes and streambank protection measures (such as rip rap) can simplify stream habitat and increase peak flows, which can be detrimental to many aquatic species (Governor's Watershed Enhancement Board, 1999).

Historical Channel Modifications

Areas within the SBW have experienced urbanization and population increases, particularly along the Rogue River in the vicinity of Gold Hill and the City of Rogue River. The portion of the watershed that includes Evans Creek and its tributaries has maintained a primarily rural character, which usually tends to have fewer channel modifications. However, mining and logging activities in this area have led to the construction of many roads with bridge and culvert crossings over streams. Additionally, several irrigation and flood control dams are located on the main stem and tributaries of Evans Creek.

Mining has had a major impact in certain areas within the SBW over the last century and a half. The minerals of most economic importance in the area were gold and cinnabar, a sulfide of mercury. The primary impacts to the environment have occurred as a consequence of mining and milling and extraction operations that took place either in the stream channel (hydraulic mining) or along the banks of streams (milling and extraction).

Hydraulic mining for gold was the major method of mining in this area from the mid to the late 19th century. Such operations occurred in Skyes Creek, Mays Creek, Murphy Gulch, McConville Gulch, Pleasant Creek, Dixie Gulch, Ditch Creek, Harris Gulch, Jamison Gulch, Bear Branch and Queens Branch of Lower Evans Creek, Foots Creek, and Galls Creek.

Extensive mining activity has occurred throughout portions of the SBW since the mid 1800s. At the time the mining was being conducted, it had a large impact on the health of the watershed. It destroyed large sections of riparian habitat, was responsible for altering many of the streams where mining occurred, adversely affected water quality by the introduction of toxins and increasing sediment loads, and physically destroying spawning habitat. These effects were devastating to many reaches of streams at the time they were occurring. These activities altered stream morphology and affected stream

Figure 8-1
Impact of Hydraulic Mining on Stream Channel and Riparian Zone Above the Town of Rogue River Along Evans Creek
(Photo provided by the Woodville Museum)

functions in numerous ways. The physical effects of mining can still be recognized in areas such as Foots Creek and Pleasant Creek, where large mechanical dredges were used to remove huge volumes of sediments from the stream channels and redistribute tailings along streambanks significantly altering the stream channels. Many of the channels are now incised and are permanently disconnected from surrounding floodplains.

Figure 8-2
Bucket Dredge Used on Several Streams in the SBW
(Note size of operators for scale)
(Photo #16746 provided by the Southern Oregon Historical Society)

Logging has also had a significant impact on streams in the headwater reaches of the SBW. Much of the land in the watershed has been used for timber production. Trees have been commercially harvested from the SBW since the late 1800s. Logging has occurred on public and privately owned timber lands across the watershed. Logging activity increased during the 1960s and peaked in the 1970s. Logging began to decrease in the 1980s and has continued to decline through the present. During this time, extensive road building was conducted, opening the upper portions of the watershed for timber extraction and other human activities. Logging activity also results in soil compaction and reduction of canopy which in turn contribute to increased peak flows. The

roads crossed numerous streams and culverts were placed in the streams to facilitate flow. Many of these structures have proven to be barriers to fish migration over time. Road ditches increase the drainage network and also capture and concentrate flows resulting in increased peak flows and erosion.

As early as the 19th century, irrigation ditches were constructed in many portions of the SBW. These structures diverted water from streams and transported it to areas where crops were grown. Most of the early ditches in the Evans Valley were constructed between 1860 and 1895. Because farm tracts were generally small, the ditches were relatively short, mostly being only a mile to two miles long. Irrigation ditches continued to be an important part of agriculture development in the watershed, and by World War II, all important irrigation ditches developed within the watershed were functioning. Increased rural development since World War II has reduced the amount of agricultural land devoted to raising crops. Livestock grazing and hay production constitute most agricultural activity. Pumping from ditches and wells brought water to portions of the watershed previously without irrigation. Irrigation has indirectly increased stream temperature because of reduced instream flow and heating of return flow as it moves across irrigated surfaces and back to the stream (Atwood and Lang, 1995). Many of the ditches were associated with dams that raised stream water levels, allowing water to enter and flow through the ditches. Some of these structures are considered to be barriers to fish migration and are being considered for removal.

The purpose of the channel modification assessment is to identify the location, type, and significance of modifications on the natural environment and create a channel modification map. This provides a comparison of channel habitat type classifications to channel modifications, and determining the location of channel modifications within stretches of stream classified as sensitive channel habitat types (Figure 8-3).

INSERT FIGURE 8-3 (11x17)

Seven Basins Watershed Channel Habitat Type Map

EVALUATION OF EXISTING INFORMATION

Data on channel modifications were acquired from the Rogue Basin Barrier Database compiled by the Rogue Basin Fish Access Team (RBFAT). The database was developed by RBFAT in conjunction with the Southwest Oregon Salmon Restoration Initiative, Southwest Oregon Province Resource Information GIS data CD set, American Fisheries Society, and the Rogue Watershed Office of ODFW (Restore the Rogue, 2003). The database prioritizes over 800 fish passage barriers throughout the Rogue Basin. The database included information for approximately 150 channel modifications located within the Evans Creek drainage.

To prioritize each barrier, a scoring system was developed, with points given based on criteria which included: the location of the barrier within the watershed; the percentage of total Rogue Basin salmonids found above the barrier; the presence of coho, summer steelhead, spring chinook, fall chinook; and the severity of the barrier. Points for each barrier were tallied and listed from highest to lowest. The higher the ranking, the greater the need for removal with respect to fish passage (ODFW, 2003). This database and associated barriers for the entire SBW is discussed in greater detail in Chapter 10 – *Fish Assessment* and is provided in Appendix I.

Barriers within the watershed were plotted on the channel modification map (Figure 8-3). These barriers include concrete dams, culverts, concrete culvert lined pipes, and corrugated metal pipes. Figure 8-3 also includes the location of mines within the watershed.

DISCUSSION OF SBW CHANNEL MODIFICATIONS

Figure 8-3 depicts the location of channel modifications in relation to CHTs throughout the SBW. CHTs FP1, FP2, FP3, and MM are considered the most highly sensitive as described in Governor's Watershed Enhancement Board (1999). CHTs which include LC, LM, MV, MH, and MC, are moderately sensitive. SH and VH CHTs have low sensitivity. A detailed breakdown of CHTs in the SBW is discussed in greater detail in Chapter 3 - *Channel Habitat Type Classification* and is provided in Appendix C.

Table 8-1 contains the number of mines within each sub watershed as well as the percentage of each CHT within the subwatershed of the SBW. Foots Creek and Evans Creek/Sykes Creek subwatersheds both contain the greatest number of mines. Foots Creek does not contain any percentage of sensitive CHTs. Evans Creek/Sykes Creek is 8.67% highly sensitive CHT.

Rogue River/Snider Creek and Rogue River/Sams Creek contain the two greatest percentages of highly sensitive CHTs in the SBW and each contains 16 mines. These subwatersheds are the most sensitive to channel modifications and should be priority for restoration and monitoring within the SBW. Attention should be paid when instream channel modification projects are underway within these subwatersheds due to their sensitive nature.

All subwatersheds within the SBW contain moderately sensitive CHTs. Many of these subwatersheds are comprised of approximately fifty percent or greater of moderately sensitive CHTs. Subwatersheds containing moderately sensitive CHTs are also priority for restoration and monitoring. Channel modifications such as mining activities should be monitored for potential instream impacts.

Table 8-1
Number of Mines and Percentage of Channel Habitat Types in Each Sub Watershed

Sub Watershed	Number of Mines	Percent of Sub Watershed FP1, FP2, FP3, and MM: HIGH SENSITIVITY	Percent of Sub Watershed LC, LM, MV, MH, and MC: MODERATE SENSITIVITY	Percent of Sub Watershed SV and VH: LOW SENSITIVITY
Foots Creek	32	0	32.69	26.29
Evans Creek/Sykes Creek	32	8.67	43.53	21.35
Rogue River/Galls Creek	30	4.63	54.45	20.93
Rogue River/Sardine Creek	21	0	69.69	7.22
Rogue River/Ward Creek	20	2.65	58.26	18.57
Rogue River/Snider Creek	16	47.16	42.84	4.43
Rogue River/Sams Creek	16	15.35	22.11	6.56
Pleasant Creek	14	4.49	49.3	30.98
Lower Evans Creek	14	10.8	59.29	16.95
Upper Evans Creek	13	1.71	62.54	11.75
Lower W. Fork Evans Cr.	5	5.89	70.41	11.78
Upper W. Fork Evans Cr.	3	10.69	46.67	25.94

Low sensitivity CHTs are also present in all subwatersheds of the SBW. These CHTs are most prevalent in Pleasant Creek, Foots Creek, Evans Creek/Sykes, and Rogue River/Galls subwatersheds. Mining has been prevalent in all of these subwatersheds.

Table 8-2 contains the number of barriers as well as the percentage of CHTs found within each subwatershed of the SBW. Evans Creek/Sykes Creek and Foots Creek subwatersheds have the greatest number of barriers. Evans Creek/Sykes Creek contains 8.67% sensitive channel habitat and has 14 barriers. Foots Creek contains no sensitive channel habitat and has 12 barriers. Rogue River/Snider Creek has the greatest percentage of sensitive channel habitat. This subwatershed contains five barriers. Sams Creek has

the second greatest percentage of sensitive channel habitat and contains eight barriers. Subwatersheds which are the most sensitive to channel modifications should be priority for restoration and monitoring within the SBW. Attention should be paid to instream channel modification projects as they are underway within these subwatersheds due to the sensitive nature of the channels and the possible impacts to the stream channel.

Table 8-2
Number of Barriers and Percentage of Channel Habitat Types in Each Sub Watershed

Sub Watershed	Number of Barriers	Percent of Sub Watershed FP1, FP2, FP3, and MM: HIGH SENSITIVITY	Percent of Sub Watershed LC, LM, MV, MH, and MC: MODERATE SENSITIVITY	Percent of Sub Watershed SV and VH: LOW SENSITIVITY
Evans Creek/Sykes Creek	14	8.67	43.53	21.35
Foots Creek	12	0	32.69	26.29
Pleasant Creek	9	4.49	49.3	30.98
Rogue River/Galls Creek	8	4.63	54.45	20.93
Rogue River/Sams Creek	8	15.35	22.11	6.56
Lower Evans Creek	7	10.8	59.29	16.95
Upper Evans Creek	7	1.71	62.54	11.75
Rogue River/Snider Creek	5	47.16	42.84	4.43
Rogue River/Sardine Creek	4	0	69.69	7.22
Rogue River/Ward Creek	2	2.65	58.26	18.57
Lower W. Fork Evans Cr.	0	5.89	70.41	11.78
Upper W. Fork Evans Cr.	0	10.69	46.67	25.94

All subwatersheds within the SBW contain moderately sensitive CHTs. Many of these subwatersheds are comprised of approximately fifty percent or greater of moderately sensitive CHTs. Subwatersheds containing moderately sensitive CHTs are also priority for restoration and monitoring. Channel modifications such as barriers should continue to be monitored for potential instream impacts.

Low sensitivity CHTs are also present in all subwatersheds of the SBW. These CHTs are most prevalent in Pleasant Creek, Foots Creek, Evans Creek/Sykes, and Rogue River/Galls sub watersheds. Barriers are prevalent in all of these subwatersheds.

Recent Channel Modifications in the SBW

Multiple channel modifications occur each season within the SBW. These are both natural and anthropogenic processes. Recent man made channel modifications within the SBW will be discussed in this section to provide an understanding of the potential impacts these projects can have on the channel. Four particular channel modifications will be discussed: West Fork Evans Creek box culvert replacement, Maple Gulch dam removal, Ramsey Canyon Creek culvert maintenance, and LWD placement in the watershed.

West Fork Evans Creek Box Culvert Replacement

West Fork Evans Creek box culvert replacement took place in the summer of 2003. This project was conducted by the BLM in an effort to increase salmonid migration and spawning habitat in West Fork Evans Creek. The culvert was undersized and blocking coho salmon migration as well as causing erosion downstream of the culvert in the form of a scour pool.

Figure 8-4 depicts the box culvert prior to its replacement. The pool below the box culvert was approximately ten feet deep with many juvenile steelhead, coho, and trout present. This picture was taken prior to the removal of the box culvert. Figure 8-5 is the pool below the box culvert, prior to removal. Water to the right in frame is coming out of the confluence of Cedar Creek with West Evans Creek.

Figure 8-4
Pool Downstream of Box Culvert Along West Fork Evans Creek
Prior to Removal

Figure 8-5
Discharge Scour Pool Immediately Downgradient of the Box Culvert Prior to Replacement

Figure 8-6 depicts the modification of the stream channel during the construction of the bridge. The bridge pier and the end of the piping through the work area for the replacement of the box culvert are shown in Figure 8-6. The stream was diverted from upstream of the bridge construction through plastic piping, to downstream of the construction site. Figure 8-7 shows the pool on the discharge end of the new bridge. It has been filled approximately two thirds of the way with large rip rap boulders approximately two to three feet in diameter. The purpose of this rip rap is to prevent the stream from headcutting upstream and causing erosion. The floating white piping at the upper left-hand portion of the photograph is a boom to collect any oil from the construction from traveling downstream. This photo was taken June 30, 2003.

The difference in the pool downstream from the channel modification can be seen when comparing Figure 8-5 (prior to box culvert removal) and Figure 8-7 (after the new bridge is in place). The scour pool has now filled in with gravels and provides additional spawning habitat.

Figure 8-6
West Fork of Evans Creek Box Culvert Replacement Project. Water from Stream was Routed through Construction in Black Pipe Shown in Photo.
(Looking upstream from work area)

Figure 8-7
West Fork Evans Creek New Bridge Discharge Pool, Approximately Two Thirds Full of Rip Rap. Material Placed in Stream to Minimize Erosion.

Maple Gulch Dam Removal

Maple Gulch dam was located on Maple Gulch, a small tributary to Evans Creek upstream of the town of Wimer. It was a 100 year old concrete dam that was approximately nine feet tall. The dam is shown in Figure 8-8, prior to its removal. This dam was mechanically removed by BLM to improve fish passage up Maple Gulch in the summer of 2002. Figure 8-9 depicts the remnants of the dam and the current condition of the dam site since its removal. At the base of the dam is a natural three foot vertical rise in the streambed where the axis of the dam once set. It was estimated that approximately 750 cubic meters

Figure 8-8
Photograph of Maple Gulch Dam Prior to Removal.
The Dam is in the Center of the Photograph.
The Stream Channel can be seen in the Lower Third of the Photo.
(Source: Stewart, 2003)

of sediment were stored behind Maple Gulch dam prior to its removal (Stewart, 2003). The sediments behind the dam were left in place to be conveyed downstream by high stream flows. During the winter of 2002/2003, the reservoir sediments began to quickly erode a channel. Figure 8-10 depicts the change in the channel as of December 31, 2002 due to high winter precipitation. Current conditions at the Maple Gulch dam removal site can be seen in Figure 8-11.

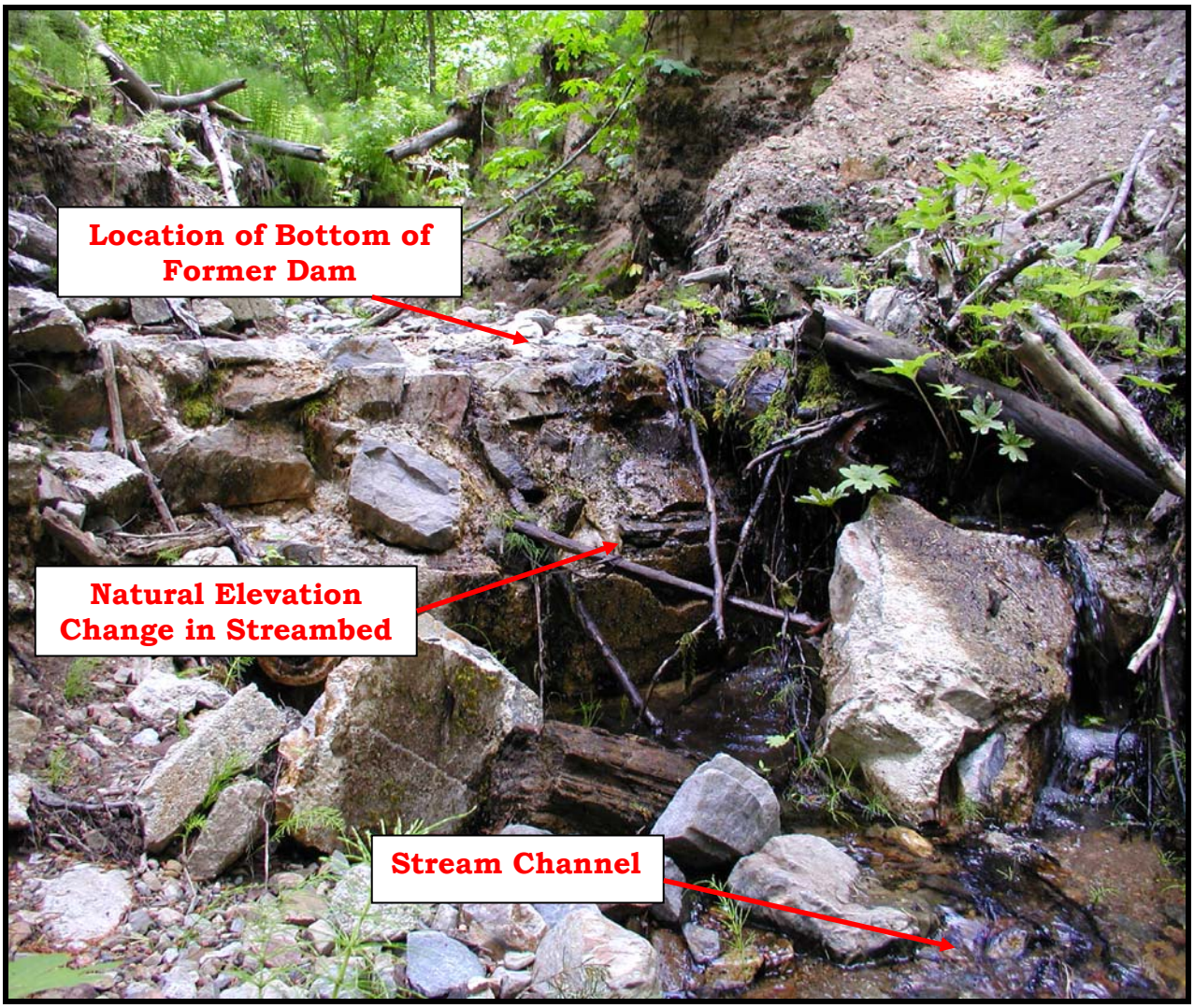


Figure 8-9
Maple Gulch Site After Dam Removal, June 18, 2003

Figure 8-10
Maple Gulch Dam Post Removal, December 31, 2002
(Source: Stewart, 2003)

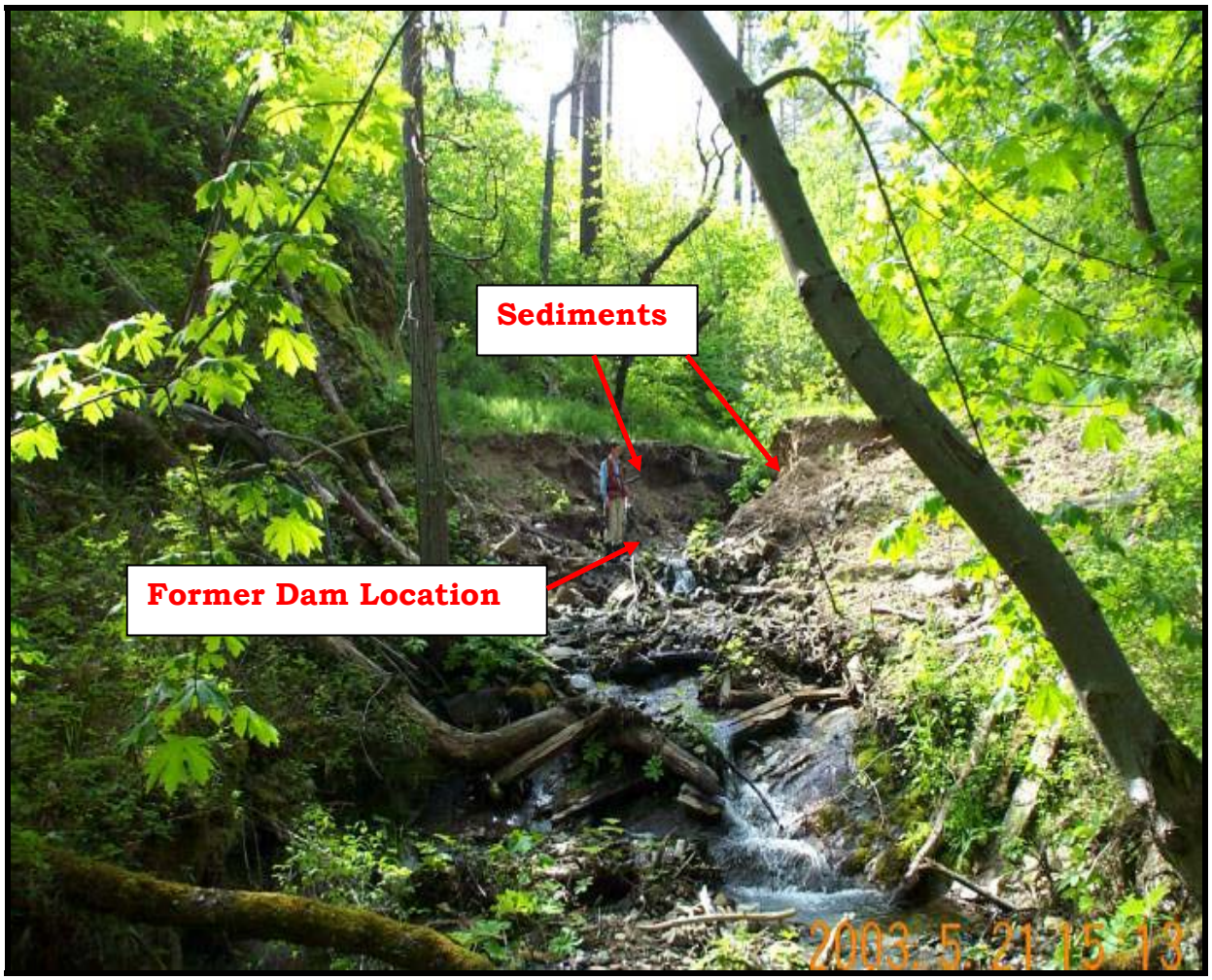


Figure 8-11
Conditions at Maple Gulch Dam Site in May 2003
(Source: Stewart, 2003)

Greg Stewart, a Ph.D. student in the Watershed Processes Group, the Department of Geosciences at Oregon State University, has been conducting repeated surveys and estimating the volume and timing of sediment export from behind the Maple Gulch dam. Mr. Stewart shared his findings with BLM staff as well as the Seven Basins Watershed Council during the course of his ongoing research. His data provides insight into the complex interactions of water, erosion, and sediment transport. A cross sectional profile of Maple Gulch downstream from the dam after its removal can be seen in Figure 8-12.

This graph illustrates the amount of sediment deposition that occurred in the Maple Gulch channel in the first six months following the dam removal.

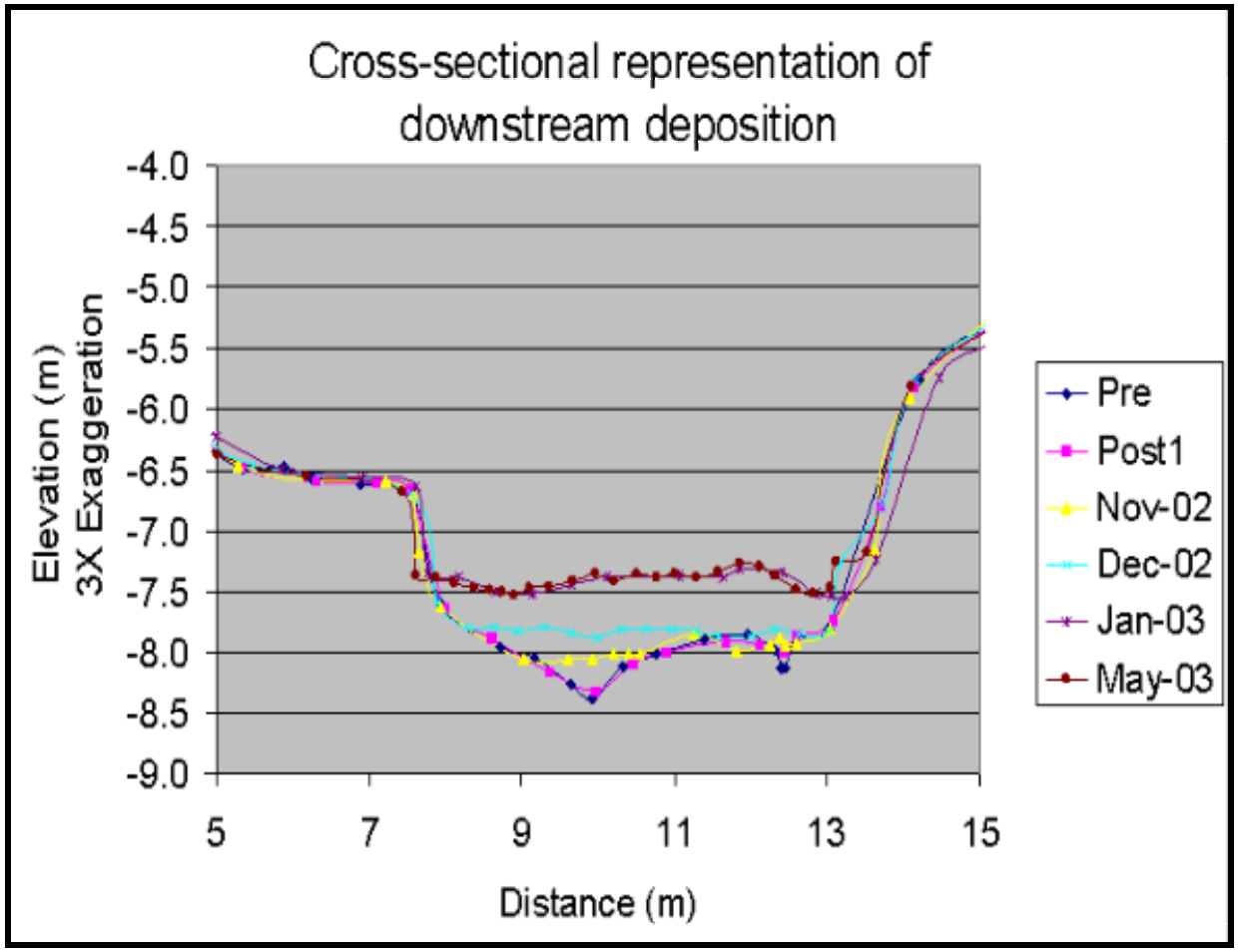


Figure 8-12
Cross-Sectional Representation of Downstream Sediment Deposition
(Source: Stewart, 2003)

Ramsey Canyon Culvert Maintenance

Ramsey Canyon Creek flows under East Evans Creek Road via the Ramsey Canyon culvert. This culvert is typical for a great number of the channel modifications that occur in the SBW. Many culverts were originally designed with the intent to divert water around an obstacle and return it back into the original streambed. While not specifically designed to be fish ladders, many of

these structures enable fish to continue their migration up to headwaters and spawning grounds, which may have been impossible to reach had the culvert not been put in place. However, many culverts have been made out of materials or placed in such a manner that presents impossible conditions for fish to maneuver.

In the case of the Ramsey Canyon culvert, gravel and rock washing through the culvert had worn out the bottom of the culvert, as seen in Figure 8-13. Ramsey Canyon Creek supports runs of summer steelhead and trout. This culvert became an issue for their migration when the hole was eroded in the bottom of the culvert. This culvert was in the condition seen in Figure 8-13 for approximately four years prior to its correction. In September 2003, the Jackson County Roads department temporarily fixed the hole in the culvert. This was accomplished by digging out approximately 10-12 feet of the old culvert and replacing it with a new section of culvert. The long term plan for this culvert is to eventually have a bridge designed and installed in place of the culvert to better ensure fish passage along Ramsey Canyon Creek.

Figure 8-13
Ramsey Canyon Creek Culvert

LWD Placement

LWD placement is a common restoration effort in watersheds to increase stream complexity and increase spawning habitat for salmonids. The placement of LWD is a channel modification which can be extremely beneficial to streams, when designed and applied appropriately. LWD placement can be done by state agencies such as ODFW or ODF, as well as by private

landowners. Private landowners can lower their leave-tree requirements in riparian management areas by placing LWD in streams as described in the 1994 Oregon Forest Practices Rules. The placement gives landowners a basal area credit. Landowners should contact the ODF if they are interested in LWD placement programs. The LWD seen in Figure 8-14 was placed by ODFW within the last year with the intentions of trapping spawning gravels and pool habitat. The successful placement of these channel modifications is achieved when stream width, slope, velocity, and seasonal timing are taken into consideration.

Figure 8-14
Large Woody Debris (LWD) Placement

Channel modifications such as dam or culvert removal, culvert placement or maintenance, and woody debris placement all cause some level of stream

channel disturbance over the short term. Sedimentation, erosion, water quality, and riparian habitat disturbance are all issues which accompany such projects. The long-term benefit to fish passage many times outweighs the short term impacts to the stream channel that can occur as a result of the modifications. In many instances most of the impacts are naturally mitigated over the long term.

CONCLUSIONS

A large number of channel modifications were found within the Evans Creek drainage. The channel modifications most critical to fish passage are primarily dams and culverts. Barriers associated with past mining practices and road stream crossings are also prevalent throughout the SBW.

Many channel modifications are present within sensitive and moderately sensitive channel habitats. These areas will require on-going monitoring and restoration efforts to ensure healthy stream channels.

DATA GAPS

Because of the size of the watershed and the scope of work involved in identifying and prioritizing channel modifications, much of the information available from agencies has focused on barriers to fish passage. This information is reviewed in much greater detail in Chapter 10 – *Fish Assessment*. A list of data gaps regarding channel modifications includes the following:

- Topographical map inspections for channel modifications are lacking for the entire watershed.

- Information concerning channel modifications other than stream crossings and barriers to fish passage is lacking.
- Analysis of aerial photographs and field verification of identified channel modifications has not been conducted.

ACTION PLAN RECOMMENDATIONS

To put this assessment to use, an action plan will need to be written to prioritize projects for the Seven Basins Watershed Council. The following is a list of recommendations to be incorporated in the action plan with regard to channel modifications.

- Topographical map inspection should be completed for the entire watershed. This should be conducted in conjunction with aerial photographic analysis and field verification.
- The types and significance of modifications detected from topographical map inspection should be studied and identified using aerial photographic analysis and field verification.
- Information concerning channel modifications other than stream crossings and barriers to fish passage should be obtained using analysis of aerial photographs and field verification.
- Research should be conducted to determine priorities with respect to channel modification mitigation. These issues should be addressed with the cooperation of watershed council volunteers, RBFAT and ODFW.
- All information thus obtained should be assembled into one useful and accessible database. A GIS component should be used with this database to make it fully functional.

REFERENCES

Atwood, Katherine C., and Lang, Frank A., *As Long as the World Goes On: Environmental History of the Evans Creek Watershed*, Prepared for Butte Falls Resource Area, Medford District, BLM, 180 p., 1995.

Governor's Watershed Enhancement Board, *Oregon Watershed Assessment Manual. Channel Modification*, pp. 13-18, Enhancement Board. pp. 31-34 and VII – VII -11, 1999.

Oregon Department of Fish and Wildlife (ODFW), <http://oregonstate.edu/dept/nrimp/information/fishcounts.htm> (Accessed April 15, 2003).

Oregon Department of Fish and Wildlife (ODFW), "Fish Barrier Information," <http://www.dfw.state.or.us/ODFWhtml/Resource&ReportsRBFAT.Strategic_Plan.htm>

Oregon Water Resources Research Institute, "Gravel Disturbance Impacts on Salmon Habitat and Stream Health," Vol. 1. Summary Report, 1995, <http://www.cwest.oregonstate.edu/cwest_library/gravel.htm>

Oregon Water Resources Research Institute, "Gravel Disturbance Impacts on Salmon Habitat and Stream Health," Vol. 2. Technical Background Report, 172-173, 1995, <http://www.cwest.oregonstate.edu/cwest_library/gravel.htm>

Restore the Rogue, The Rogue Basin Fish Access Team, "The Strategic Plan," <http://restoretherogue.org/rbfat/index.html> (Accessed July 25, 2003).

Stewart, Greg, <http://www.collbett.org/greg/> (Accessed November 2003)

United States. Bureau of Land Management, *Environmental History Of The Evans Creek Watershed, As Long As The World Goes On: Environmental History Of The Evans Creek Watershed*, 1995.

CHAPTER 9
WATER QUALITY

Prepared By:
Katie M. Mosser, EMS
David L. Graham, EMS
Reviewed By:
Monty Bruner, PhD; EMS

INTRODUCTION

Monitoring, sampling, and analysis of water quality within a watershed provide quantitative information regarding the conditions of the stream(s) that comprise the watershed. This chapter is organized to provide a broad look at water quality as it relates to the SBW. Section 9.1 explains the federal and state laws related to water quality. Section 9.2 describes the processes that are responsible for controlling the water quality observed in a watershed. The concept of biogeochemical cycles is presented and how they affect water quality. This section is somewhat technical but provides important information for those who will be involved in designing water quality monitoring programs and/or interpreting the results from such programs. Section 9.3 explains water quality parameters that are commonly monitored and their relationship to salmonids. Section 9.4 provides an evaluation of available water quality data for the SBW.

9.1 WHY DO WE MONITOR WATER QUALITY?

The Federal CWA sets forth national goals to "restore and maintain the chemical, physical and biological integrity of the nation's waters" (Arbuckle, et al., 1993). To achieve these goals, the EPA has determined

federal effluent standards for specific industries and/or specific chemicals, and requires these standards to be monitored in each state (Arbuckle et al., 1993). The DEQ is responsible for maintaining these federal effluent standards at the state level. DEQ monitors the watersheds of Oregon to determine the chemical, physical, and biological integrity of the streams.

There are numerous factors that can affect water quality in a watershed both spatially and temporally. These factors need to be well known in order to develop a thorough understanding of the "wellness" of a stream ecosystem.

A stream is a dynamic system in which the water is always moving and mixing. Pollutants that enter the stream travel some distance before they are thoroughly mixed throughout the cross section of the stream. For example, water upstream of a wastewater discharge point may be clean. However, at the discharge point, and immediately downstream of it, the water maybe extremely degraded. Further downstream, in the recovery zone, overall quality may improve as pollutants are diluted with more water. Far downstream from the point of discharge the stream as a whole may be relatively clean again. Pollution can be broadly divided into two classes according to its source. Point source pollution comes from a clearly identifiable point such as a pipe which discharges directly into a water body. Examples of point sources include factories, wastewater treatment plants, and illegal straight pipes from homes and boats (USEPA 1997 [a]).

Non-point source pollution comes primarily from surface water runoff. It originates from a broad area and thus can be difficult to identify and characterize. Examples of non-point sources include agricultural runoff, mine drainage, construction site runoff, and runoff from city streets and parking lots (Oregon DEQ, 2003 [a]).

On a national scale, the pollutants most often detected in stream environments are typically not toxic substances, such as lead, mercury, or oil and grease.

More impacts are caused by sediments and silt from eroded land and nutrients such as the nitrogen and phosphorus found in fertilizers, detergents, and sewage treatment plant discharges. Other pollutants include pathogens such as bacteria, pesticides, and organic enrichment that lead to low levels of dissolved oxygen (eutrophication). Common sources of pollution to streams include:

- Agricultural activities such as crop production, cattle grazing, and maintaining livestock in holding areas or feedlots. These contribute pollutants such as sediments, nutrients, pesticides, herbicides, pathogens, and organic enrichment.
- Municipal dischargers such as sewage treatment plants, which contribute nutrients, pathogens, organic enrichment, and toxicants.
- Urban runoff from city streets, parking lots, sidewalks, storm sewers, lawns, golf courses, and building sites. Common pollutants include sediments, nutrients, oxygen demanding substances, road salts, heavy metals, petroleum products, and pathogens (USEPA, 1997 [b]).

Other commonly reported sources of pollutants are mining, industrial discharges, forestry activities, and modifications to stream habitat and hydrology.

Water quality monitoring is defined here as the sampling and analysis of water constituents and conditions. These may include:

- Introduced pollutants, such as pesticides, metals, and oil.
- Constituents found naturally in water that can be affected by anthropogenic sources, such as dissolved oxygen (DO), bacteria, and nutrients.

The magnitude of their effects can be influenced by water properties such as pH and temperature. For example, temperature influences the quantity of DO that water is able to contain, and pH affects the toxicity of ammonia (USEPA, 1997[b]).

Historically, water quality monitoring has generally considered the primary way of identifying water pollution problems. Today, investigations at the watershed scale are moving toward approaches that combine chemical, physical, and biological monitoring methods to achieve the best understanding of water quality conditions (USEPA, 1997[b]).

Water quality monitoring can be used for many purposes that include:

- Identifying whether waters are meeting designated water quality criteria;
- To identify specific pollutants and sources of pollution;
- To evaluate trends; and
- To determine if adverse impacts have occurred.

All states have established specific criteria (limits on pollutants) identifying what concentrations of chemicals are allowable in various waters. When chemicals exceed maximum or minimum allowable concentrations, waters may no longer be able to support the beneficial use(s) for which they have been designated. Designated uses and the specific water quality criteria that protect them together form the basis for water quality standards. State agencies assess water quality by comparing the concentrations of chemicals found in streams to the criteria in the state's standards, and determine whether streams are meeting their designated uses (USEPA, 1997[b]).

Water quality monitoring alone, however, may be not be sufficient to determine whether aquatic habitats are stable in a stream. While some constituents (such as DO and temperature) are important to maintaining healthy fish and aquatic insect populations, other factors, such as the physical structure of the stream and the condition of the habitat, play an equal or greater role. In many instances, biological monitoring methods are better suited to determining the condition of aquatic life within the stream environment (USEPA, 1997[b]).

Water quality monitoring helps link sources of pollution to a stream quality problem because it identifies specific problem pollutants and their concentrations. Since certain activities tend to generate certain pollutants (e.g., bacteria and nutrients are more likely to come from an animal feedlot than a mining operation), a tentative link might be made that would warrant further investigation or monitoring (USEPA, 1997[b]).

Chemical constituents that are properly monitored (i.e., consistent time of day and on a regular basis, using consistent methods) can be analyzed for trends that may occur spatially and temporally. Finding excessive levels of one or more chemical constituents can serve as an early warning "screen" of potential pollution problems (USEPA, 1997[b]).

The following discussion presents information regarding basic concepts that are important with respect to understanding the factors that control water quality in a watershed. The initial section presents information regarding important cycles that occur with respect to nutrients, water, carbon, and oxygen. Specific water quality parameters are discussed and information regarding why they are important is presented. Water quality data specific to the SBW is also presented and trends discussed.

9.2 BIOGEOCHEMICAL CYCLES

Inorganic nutrients cycle through more than organisms; they also enter into the atmosphere, the oceans, and even rocks. Since these chemicals cycle through both the biological and the geological environments, the processes are referred to as biogeochemical cycles. While each chemical has its own unique cycle, it should be recognized that all of the cycles do have certain things in common. Reservoirs are those parts of the cycle where a chemical is held in large quantities for long periods of time. On the other hand, a chemical is held for only a short time in exchange pools. The length of time a chemical is held in an exchange pool or a reservoir is termed its residence time. As an example, the oceans would be considered a reservoir for water, while a cloud would be an exchange pool. Water may reside in an ocean for thousands of years, but in a cloud for only a few days (McSchaffrey, 2004).

The biotic community includes all living organisms. This community may serve as an exchange pool and also serve to move chemicals from one stage of the cycle to another. All inorganic nutrients move through cycles and it is important to understand these cycles in order to visualize how they affect the overall wellness of a watershed. These cycles are critical to all plants and animals in a watershed. The following is a discussion of four of the most important cycles that occur in nature – water (hydrologic cycle), carbon (and oxygen), nitrogen, and phosphorous.

The Hydrologic Cycle

The hydrologic cycle is one of the most important cycles in nature. A detailed description of the hydrologic cycle is presented in Chapter 4 – *Hydrology and Water Uses*. With respect to biologic activity within a watershed, water is the primary medium that moves chemicals and nutrients to locations within the

watershed where they can be utilized by organisms. Lakes, ponds, and wetlands are exchange pools where water is temporarily stored. Groundwater is stored in aquifers that can be considered as reservoirs where water can be stored for long periods of time. Organisms play an important role in the water cycle. Most organisms contain a significant amount of water (up to 90% of their body weight). This water is not held for any length of time and moves out of the organism rather quickly. Animals and plants lose water through evaporation from the surface of their body, and through evaporation from the gas exchange structures (such as lungs). In plants, water is drawn in at the roots and moves to gas exchange organs (leaves) where it is quickly transferred to the atmosphere via the process of transpiration. In both plants and animals, the breakdown of carbohydrates (sugars) to produce energy (respiration) produces both carbon dioxide and water as waste products. Photosynthesis reverses this reaction, and water and carbon dioxide are combined to form carbohydrates. The term carbohydrate refers to the combination of carbon and water in the sugars referred to as carbohydrates (McSchaffrey, 2004).

The Carbon Cycle

From a biological perspective, the key elements of this cycle are the complementary reactions of respiration and photosynthesis. The process of respiration uses carbohydrates and oxygen (O_2) and combines them to produce carbon dioxide (CO_2), water (H_2O), and energy. Photosynthesis uses carbon dioxide and water and produces carbohydrates and oxygen. These two processes are inextricably linked because the outputs of respiration are the inputs of photosynthesis, and the outputs of photosynthesis are the inputs of respiration (McShaffrey, 2004).

These reactions are also complementary in the way they deal with energy. Photosynthesis takes energy from the sun and stores it in the carbon-carbon bonds of carbohydrates; respiration releases that energy. Both plants and animals carry on respiration, but only plants (and other producers) can carry on photosynthesis. The chief reservoirs for carbon dioxide are the oceans and rocks. Carbon dioxide dissolves readily in water and once there, it may precipitate (drop out of solution) as a solid known as calcium carbonate (limestone). Plants use carbon dioxide and convert it into carbohydrates through photosynthesis. Once carbon is in plants there are three possible fates:

- It can be transferred to the atmosphere by the plant through respiration;
- It can be eaten by animals; or
- It can be present in the plant when the plant dies.

Animals obtain all carbon from their food. Thus, all carbon in biological systems ultimately comes from plants. Carbon from plants or animals that is released to the atmosphere through respiration will either:

- Be taken up by a plant through photosynthesis; or
- Dissolved in aqueous environments.

When an animal or plant dies, two things can happen to carbon:

- It can either be respired by decomposers and released to the atmosphere; or
- It can be buried and ultimately form fossil fuels such as coal, oil, or natural gas.

The fossil fuels can be mined and burned in the future; releasing carbon dioxide to the atmosphere. Humans have a great impact on the carbon cycle because when they burn fossil fuels, it releases excess carbon dioxide into the atmosphere. As a result, more carbon dioxide goes into the oceans, and more is present in the atmosphere. The latter condition has been linked to the process of global warming. In this process, carbon dioxide in the atmosphere allows more energy to reach the Earth from the sun than it allows to escape from the Earth (McShaffrey, 2004). Figure 9-1 illustrates various components of the carbon cycle.

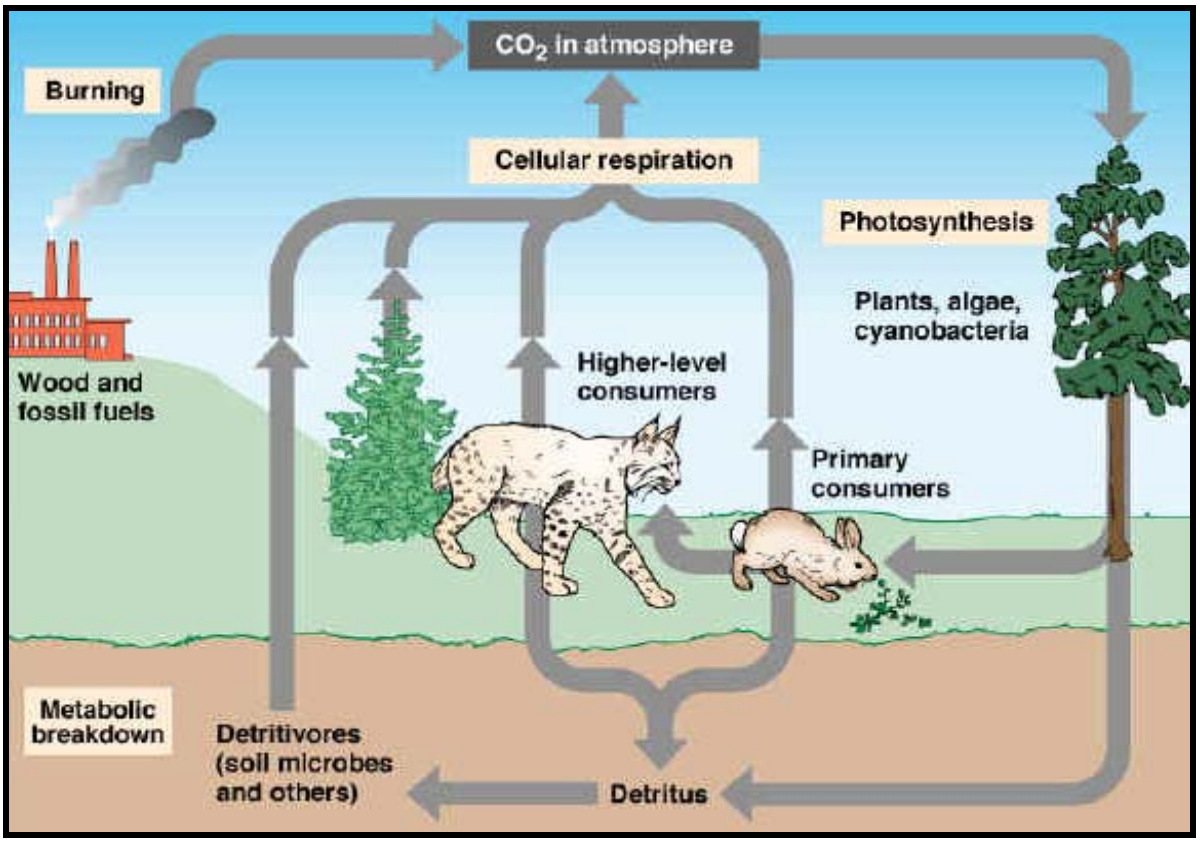


Figure 9-1
Schematic Representation of the Carbon Cycle
(Source: Coordinated Sciences 2, University High School)

Oxygen Cycle

The carbon cycle also describes the oxygen cycle, since these atoms often are combined. Oxygen is present in carbon dioxide, in the carbohydrates, in water, and as a molecule of two oxygen atoms. Oxygen is released to the atmosphere by autotrophs (producers) during photosynthesis and taken up by both autotrophs and heterotrophs (consumers) during respiration. In fact, all of the oxygen in the atmosphere is biogenic; that is, it was released from water through photosynthesis by autotrophs (McScheffrey, 2004).

The Nitrogen Cycle

Nitrogen gas in the atmosphere is composed of two nitrogen atoms bound to each other (N_2). It is a relatively non-reactive gas. As a result, it takes a great deal of energy to get nitrogen gas to break down so it can combine with other atoms such as carbon or oxygen. Nitrogen gas can be taken from the atmosphere in two basic ways. First, lightning provides enough energy to break down the nitrogen and fix it in the form of nitrate, which is a nitrogen atom with three oxygen atoms attached (NO_3). This basic process is duplicated in fertilizer factories to produce nitrogen fertilizers. The other form of nitrogen fixation is generated by nitrogen fixing bacteria. These organisms use enzymes to fix nitrogen. There are three basic forms of nitrogen-fixing bacteria. They include those that are free-living in the soil; those that form symbiotic associations with the roots of bean plants and other legumes (rhizobial bacteria); and the third are photosynthetic blue-green algae (cyanobacteria) that are found most commonly in water. All three of these types of bacteria fix nitrogen, either in the form of nitrate or in the form of ammonia (NH_3) (McShaffrey, 2004).

Plants take up nitrate and convert it to amino acids and animals acquire all of their amino acids from eating plants (or other animals). When plants or

animals die (or release waste) nitrogen is returned to the soil. The usual form of nitrogen returned to the soil in animal wastes is ammonia. Elevated levels of ammonia can be toxic. However, there are nitrite bacteria in soil and water that can assimilate ammonia and convert it to nitrite (NO_2). Nitrite can also be toxic to plants and animals. Fortunately, another type of bacteria (nitrate bacteria), convert nitrite it to nitrate, which can be readily used by plants to continue the cycle (McShaffrey, 2004). Nitrogen is returned to the atmosphere through the process of denitrification. Bacteria within the soil carry out this process and convert the nitrate back to nitrogen gas (Ophardt, 2003). Figure 9-2 is a graphical representation of the various components of the nitrogen cycle.

The Phosphorous Cycle

The various components of the phosphorous cycle are illustrated in Figure 9-3. The phosphorous cycle is the simplest of the cycles discussed. For the purposes of the watershed evaluation, phosphorous has only one form, phosphate, which is a phosphorous atom with four oxygen atoms (PO_4). This heavy molecule never partitions into the atmosphere, it is always found in organisms, dissolved in water, or in the form of a mineral. When rock with phosphate is exposed to water (especially water with a little acid in it), the rock is weathered and goes into solution (McShaffrey, 2004).

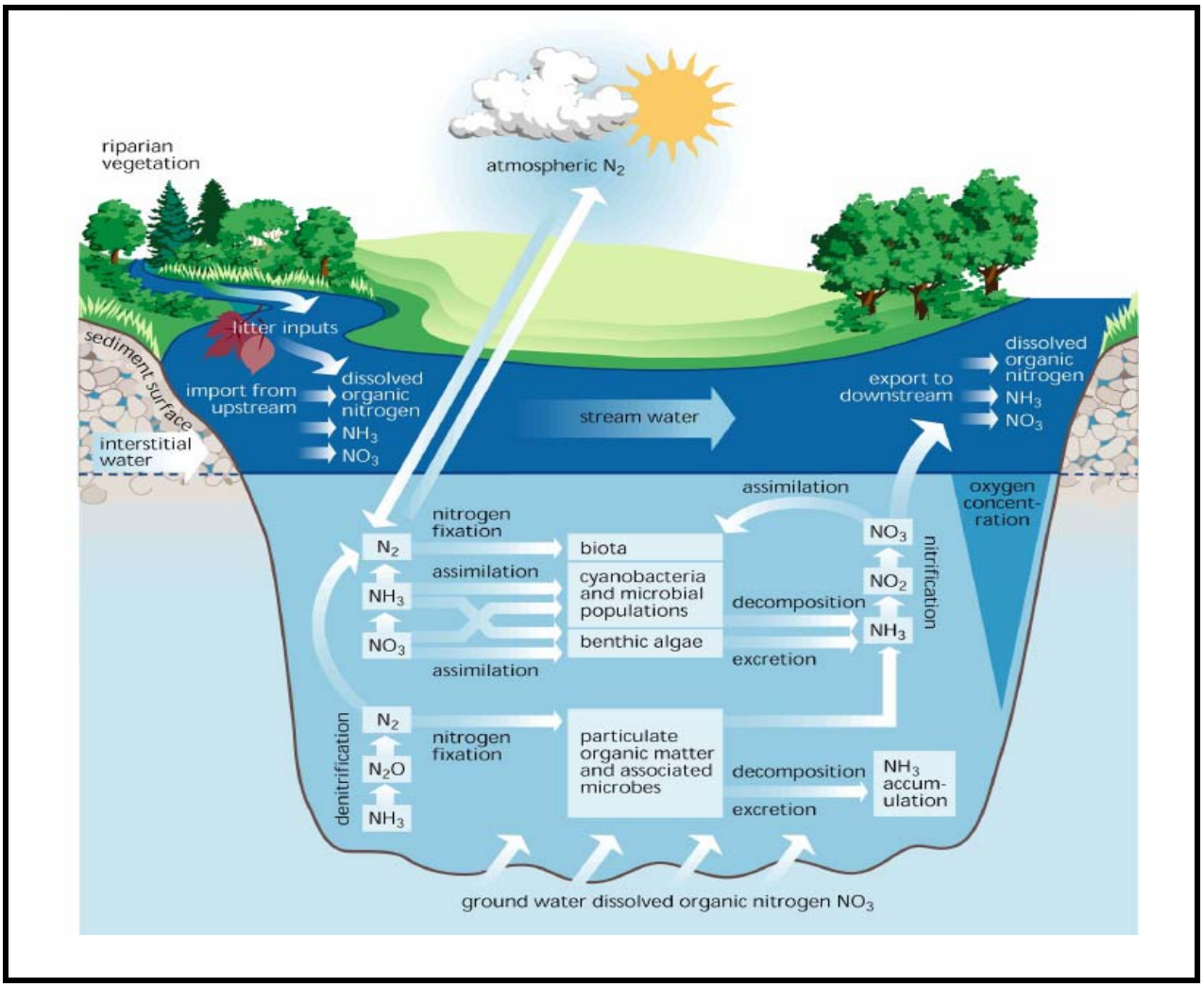


Figure 9-2
Schematic Representation of the Nitrogen Cycle
(From: FISRWG, 1998)

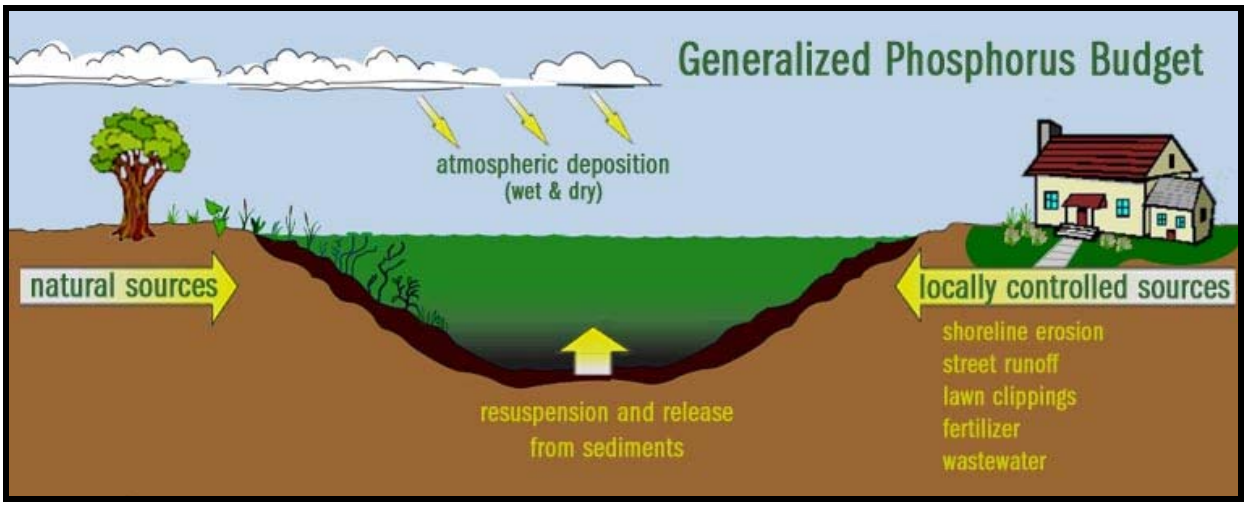


Figure 9-3
Schematic Diagram of the Phosphate Cycle
(Source: Lake Access and Empact Metro Project)

Autotrophic organisms use phosphorous in a variety of ways. It is an important constituent of cell membranes, DNA, RNA, and ATP (adenosine triphosphate). Animals obtain their phosphorous from the plants they eat. One specific type, the fungi, take up phosphorous and may form mutualistic symbiotic relationships with plant roots. Many animals may also use phosphorous as a component of bones, teeth, and shells. When animals or plants die (or when animals defecate), phosphate is returned to the soil or water by the decomposers where it can be taken up by other plants and used again. Taken to its finality, this cycle will occur over and over until at last the phosphorous is transported to the bottom of the oceans, where it will become part of the sedimentary rocks and start the cycle over again (McShaffrey, 2004).

9.3 WATER QUALITY PARAMETERS

The ability of a body of water to produce living material is known as its productivity. Productivity results from a combination of chemical and physical factors. A body of water with low productivity is desirable for a water supply of

activities such as swimming. Relatively high productivity is required to support healthy fish populations. Excessive productivity can result in choking by weeds and in odor problems. The growth of algae may become quite high in very productive waters, with the result that the decomposing dead algae reduce oxygen levels in the water to very low values. This set of conditions is commonly referred to eutrophication.

To assess the quality of water within the watershed, a range of standard physical and chemical factors should be monitored and evaluated, both temporally (over time) and spatially. Physical parameters typically include temperature, turbidity, and turbulence while chemical parameters include DO, pH, conductivity, and nutrient levels. Evaluating these and other factors allows the health of a stream to be determined and provides insight into those processes that are critical to maintaining and/or improving water quality within the watershed.

Water quality parameters can naturally vary dependant on the time and location of measurement. The headwaters of a stream are generally colder than downstream reaches. This is due to the change in elevation and channel morphology as the stream runs through the watershed. Solar radiation will cause a fluctuation in stream temperature throughout the day. Riparian cover can diffuse solar radiation effects on the stream if a sufficient canopy exists. Therefore, water quality between segments of a stream can differ due to the condition of the riparian cover.

Geology contributes to water quality within the watershed as well. The geologic composition of soils within a watershed will affect sedimentation, presence of naturally occurring minerals, leaching of minerals into the stream, etc. Natural occurrences such as flood or drought will also impact water quality by changing the temperature or turbidity of the stream.

Stream pollution sources can come from point and non-point sources. Point sources are specific locations where pollution is being introduced to the stream ecosystem. An example of this is a discharge pipe that empties directly into the stream. Non-point pollution comes from surface water runoff and is the most prevalent source of pollution in Oregon (Oregon DEQ, 2000). Human activities within the watershed can alter the quality of water through non-point sources. These can include urbanization, clear cutting, pesticide/herbicide use, grazing livestock to the bank of a stream, road erosion, etc. (USEPA, 2003[a]). Urbanization can increase water temperature and contribute to surface runoff of sediments and urban toxins. Clear cutting increases solar radiation which, in turn, increases water temperature, decreases riparian cover, and increases sedimentation and turbidity. Irresponsible pesticide/herbicide use can result in elevated levels of these poisons found within the stream. These can bioaccumulate to toxic levels within stream organisms, and ultimately the food chain. Grazing livestock to the bank of a stream will increase erosion, sedimentation, turbidity, and bacteria within the stream. Road erosion contributes to sedimentation and turbidity issues. The amount of stream pollution created by these non-point sources is greater than pollution from industry (Oregon DEQ, 2000). Hence, the need for monitoring our streams for pollution from non-point sources in the watershed is great.

Water quality determines stream health and productivity. It is also a reflection of overall watershed health. Through monitoring and analysis, water quality data will allow educated decisions to be made regarding land uses within the watershed.

Water quality is strongly influenced by the physical, chemical, and biologic properties of a body of water. Temperature, turbidity (transparency), and turbulence are three main physical properties affecting aquatic life.

Temperature

Stream temperature is imperative to fish survival. Very low temperatures result in very slow biological processes due to the reduction in metabolic rates, whereas very high water temperatures are fatal to most organisms. A difference of only a few degrees of temperature can produce large differences in the kinds of organisms present. Thermal discharges to streams can kill temperature-sensitive macroinvertebrates and fish while increasing the growth of other species adapted to warmer temperatures (USEPA, 2003[b]).

External water temperatures dictate salmonid survival because they are ectothermic (cold-blooded). Cold waters breed healthy, productive fish populations. Optimal growth for salmonids will range at 40-66 degrees Fahrenheit (Oregon Plan for Salmon and Watersheds, 2003). Salmon and trout populations begin to compete for a limited food supply when temperatures are not within this optimal range. Salmonids can also experience adverse and potentially lethal health effects (Oregon DEQ, 2003 [b]). With an increase in temperature comes a decrease in DO. This decrease in DO can become a stress on the metabolism of aquatic organisms, causing them to eat less and making them susceptible to disease (Oregon Plan for Salmon and Watersheds, 2003).

In order to preserve fish populations within Oregon, the Oregon DEQ has determined temperature standards for all bodies of water. These standards set forth maximum temperatures to be found within streams on a Seven-Day Moving Mean of Daily Maximum. This "smoothes out some of the daily fluctuations in the temperature profile and also provides a picture of the average temperature affecting fish over a longer period of time than daily maximum" (Oregon Plan for Salmon and Watersheds, 2003).

Temperature standards are determined by the most sensitive beneficial use found within each watershed. The beneficial uses, as determined by the Oregon DEQ, within the SBW are:

- Private Domestic Water Supply
- Irrigation
- Livestock Watering
- Anadromous Fish Passage
- Salmonid Fish Spawning
- Resident Fish and Aquatic Life
- Wildlife and Hunting
- Fishing
- Water Contact Recreation
- Aesthetic Quality

Anadromous fish passage and salmonid fish spawning are considered the most sensitive beneficial use within the SBW. Therefore, DEQ temperature standards are set to maintain salmonid populations throughout all life cycle stages (Oregon DEQ, 2003 [c]). Oregon DEQ has set both narrative and numerical temperature criteria to protect salmonids. They are as follows:

- Human (point and non-point source) activities that cause a "measurable increase" in ambient stream temperature are prohibited in waters identified by DEQ as cold water refugia for temperature-sensitive fish.
- Proposed new or increased discharges from point sources, and discharges from dams that may warm waters that meet or are colder than the numeric triggers, can only be authorized if DEQ (or in the case of agriculture and forestry, the ODA and the ODF respectively), through

an antidegradation analysis, determines that the benefits of this warming outweigh the adverse water quality consequences of warming the waters.

- All dischargers to all State waters must use the highest and best practicable treatment or controls to minimize their heat load to the river.
- Human (point and non-point source) activities are prohibited from causing a "measurable increase" in ambient temperatures in a natural lake.
- Human (point and non-point source) activities that cause a "measurable increase" above background stream temperatures are prohibited if any federal threatened or endangered species (including listed salmonids) are present in the stream unless the source can demonstrate that the temperature increase will not impair the biological integrity of the threatened or endangered species' stream population.
- Human (point and non-point source) activities are prohibited from causing a "measurable increase" in stream temperature if ANY ONE of the following numeric triggers is exceeded.

Turbidity

Turbidity is a measure of the clarity of water. The turbidity of water is important factor in determining the growth of organisms. Turbid water may not be very productive of biomass even though it has the nutrients, optimum temperature, and other conditions required.

Sediments are related to turbidity and comprise an intricate part of the stream ecosystem. They are essential to stream organisms, particularly salmonid habitat. Gravels provide ideal spawning and rearing conditions for salmonids.

Sediment becomes a problem when excessive fine sediment enters the stream. When this occurs, salmonid survival is stressed due to the change in their food source, habitat, and stream channel. Fine sediment can alter macroinvertebrate survival, reducing salmonid food sources. In-filling of deep pools and gravel spawning areas makes salmonids more vulnerable to predators and less reproductively successful. Fine sediment also alters the morphology of the stream channel, affecting salmonid habitat.

Sediment enters the stream through erosional processes. Natural erosion occurs within the watershed due to factors such as geology, slope, climate, and vegetation. This natural erosion can be altered by land use practices within the watershed as well. By accelerating the erosional process, fine sediment is delivered to streams in excessive amounts, directly affecting salmonid populations.

Turbidity is a surrogate measurement of suspended fine sediment within the water column. Monitoring turbidity is an inexpensive field method of determining water quality in comparison to a costly laboratory analysis of actual suspended sediment within the stream. This form of monitoring depicts baseline trends within the stream and can be useful in determining the effects of a specific land use practice on sedimentation within the stream (Oregon Plan for Salmon and Watersheds, 2003). DEQ has turbidity standards for streams related to human activities. This standard states that the activity cannot cause more than a "ten percent cumulative increase in natural stream turbidity as it is measured relative to a control point immediately upstream of the turbidity causing activities" (BLM, 2001).

Turbulence

Turbulence is an important factor with respect to mixing and transport processes in water. Small organisms (plankton) depend on water currents for

their mobility. Water turbulence is largely responsible for the transport of nutrients to living organisms and of wastes products away from them. It plays a role in the transport of oxygen, carbon dioxide, and other gases through a body of water and in the exchange of these gases at the water-atmosphere interface. Moderate turbulence is generally beneficial to aquatic life.

In addition to physical parameters, there are numerous chemical and biological parameters that provide information regarding the health of a watershed. The following is a discussion of several of the key parameters that are important indicators of water quality. They include DO, pH, nutrients, conductivity, and bacteria.

Dissolved Oxygen (DO)

Oxygen is frequently the key component in determining the extent of and kinds of life present in a stream. Oxygen deficiency is fatal to many aquatic animals such as fish. The concentration of DO is always one of the first parameters to be measured when attempting to assess the biological characteristics of a stream.

DO, is a measure of the amount of oxygen dissolved in water. The numeric value of this parameter is dependent upon water temperature, atmospheric pressure, level of biological activity at a given time, and salt concentration of the water. DO is critical to aquatic organisms because it is the means by which they breathe. Without DO at an appreciable level, many kinds of aquatic organisms cannot exist in water. DO is a critical parameter that affects aquatic life, thus making it one of the key water quality indicators parameters used to evaluate the health of a body of water.

DO saturation will vary depending on water temperature, source, and demands. Oxygen comprises 20.95% by volume of clean, dry air and most

elemental oxygen in water is derived from the atmosphere. Therefore, the ability of a body of water to re-oxygenate itself by contact with the atmosphere is an important characteristic. The maximum concentration of DO in water at 25°C in equilibrium with air at atmospheric pressure is 8.32 mg/L. There is no "chemical sink" for oxygen in water. There are no chemical reactions that replenish DO and, except for oxygen provided by photosynthesis, it must come from the atmosphere (Manahan, 1975).

Stream temperature ultimately determines the saturation level of DO within a stream ecosystem. Lower temperatures will allow water to hold more DO. This combination of high DO and low temperatures creates an ideal balance for salmonid habitat. The concentration of DO in water will range from 14.74 to 7.03 mg/L over the temperature range of 0 to 35°C (32 to 95°F). The temperature effect on the solubility of gases in water is particularly important with respect to oxygen (Manahan, 1975).

DO can be supplied to a stream through photosynthesis by aquatic plants. For example, oxygen is produced by the photosynthetic action of algae. However, oxygen production by algae is not an efficient mechanism for oxygenating a water body because some of the oxygen formed by photosynthesis during the daylight hours must be "paid back" at night when the algae consume oxygen as part of their metabolic processes. Thus the net transfer of DO to the water body may be low over a 24-hour period.

DO is consumed through respiration from aquatic plants as well as decomposition of organic matter within the stream. If oxygen-consuming processes are occurring in water, the DO level may rapidly approach zero unless some efficient mechanism for the reaeration of water is occurring, such as turbulent flow in a shallow stream. This is particularly problematic when water temperature increases because there is a corresponding decrease in the solubility of oxygen. This, combined with increased respiration rate of aquatic organisms, can frequently cause a condition in which an increased demand for

oxygen is accompanied by decreased solubility of the gas in water that can drive DO levels to zero.

DO is also consumed by the degradation of organic matter in water. For example, when algae die, the degradation of their biomass consumes oxygen, thus lowering the DO levels in the water. Many fish kills have resulted not from the direct toxicity of pollutants, but from an oxygen deficiency as a result of its consumption during the biodegradation of the pollutants.

The USEPA (1986) and DEQ have developed DO stream requirements specifically for the most sensitive beneficial use within the stream. Anadromous fish passage and salmonid fish spawning are considered the most vulnerable beneficial use within the SBW. Therefore, DO requirements are centered on the needs of salmonids and their life cycle stages. Table 9-1 presents effects in fish with respect to DO concentrations.

Table 9-1
Summary of Dissolved Oxygen Concentrations Associated with Effects on Fish in Salmonid and Non-Salmonid Waters
(FISRWG, 1998)

Level of Effect	Salmonid[a]	Nonsalmonid
Early life stages (eggs and fry)		
No production impairment	11 (8)	6.5
Slight production impairment	9 (6)	5.5
Moderate production impairment	8 (5)	5.0
Severe production impairment	7 (4)	4.5
Limit to avoid acute mortality	6 (3)	4.0
Other life stages		
No production impairment	8 (0)	6.0
Slight production impairment	6 (0)	5.0
Moderate production impairment	5 (0)	4.0
Severe production impairment	4 (0)	3.5
Limit to avoid acute mortality	3 (0)	3.0

[a] Values for salmonid early life stages are water column concentrations recommended to achieve the required concentration of dissolved oxygen in the gravel spawning substrate (shown in parentheses).

pH

pH is another key component to the overall water quality of a stream. pH is a measurement of how acidic or basic water is. The level of pH directly affects the types of organisms that can

survive and reproduce within a stream. Figure 9-4 illustrates the effect of pH in several species typically present in a watershed ecosystem.

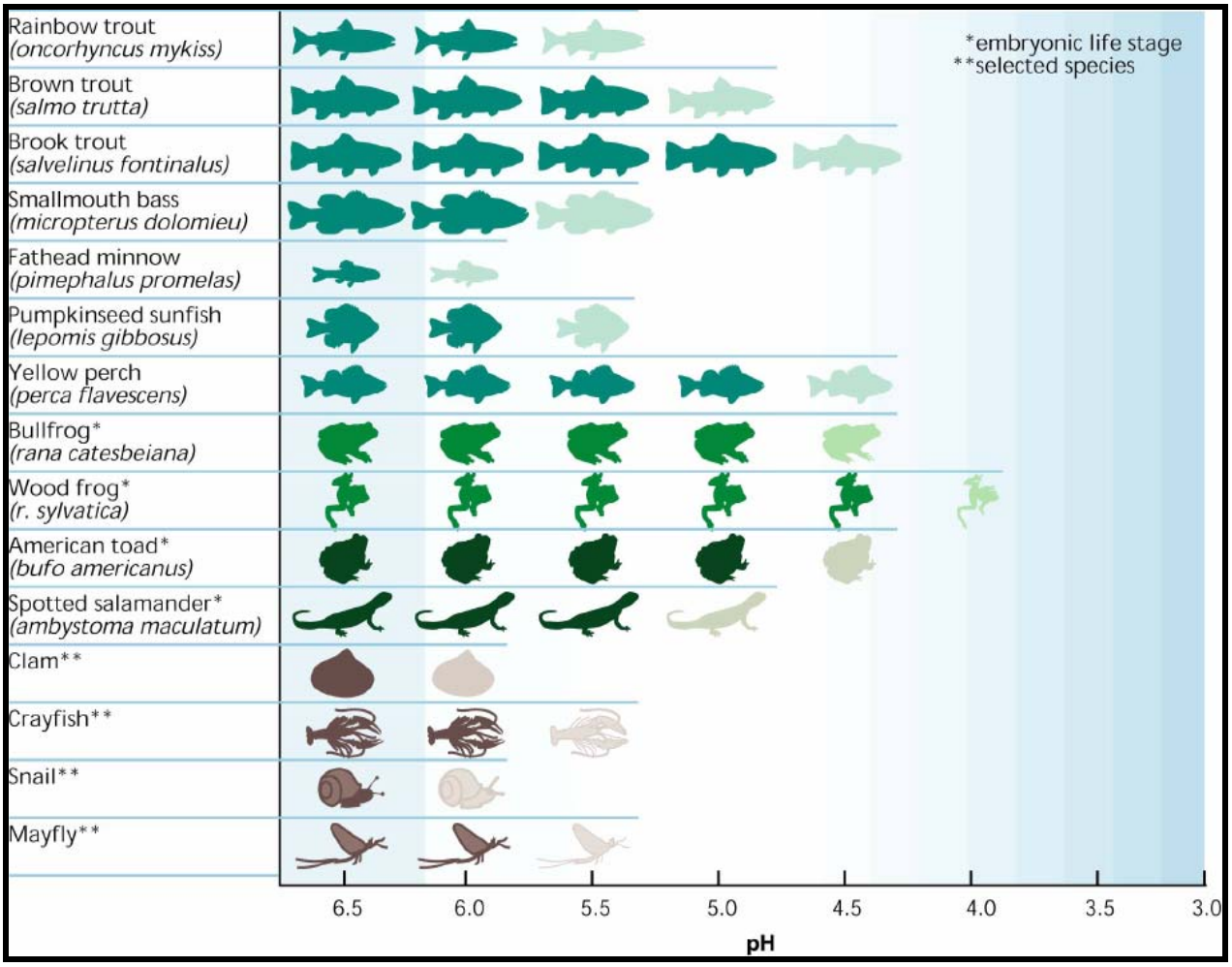


Figure 9-4
Effects of pH on Various Species
Typically Present in a Watershed Ecosystem
(Source: FIRSWG, 1998)

Typically, water is neutral and has a pH of approximately 7 (6.5-7.5). If water is found to be below 7, it is considered to be acidic while water with a pH greater than 7 is considered basic. Numerous factors that occur within a watershed can affect the natural levels of pH, such as the occurrence of acid mine drainage, acid rain, and/or chemical spills. The pH of a stream can be altered due to the addition of fertilizers from sewage, industrial discharge,

septic tanks that have failed, or runoff from agricultural or urban areas. If the concentration of fertilizer or other nutrients is high enough, in addition to high water temperatures, it can cause a bloom of excess aquatic vegetation (eutrophication), which can alter the natural pH of the stream to higher values during the day and lower values at night.

pH levels in an aquatic system have been shown to vary diurnally due to the link between pH and aquatic photosynthesis. Photosynthesis utilizes carbon dioxide and generates oxygen through out the day. This shifts the chemical equlibria to a higher pH. During nighttime hours, photosynthesis does not occur and respiration dominates producing carbon dioxide and consuming oxygen. This process shifts the equlibria of the system back to a more acidic condition and the pH deceases. Therefore, due to the phenomena of photosynthesis, streams are naturally the most basic in the mid afternoon and most acidic just before sunrise. This behavior occurs most commonly in areas dominated by open water. Areas having dense emergent vegetation do not demonstrate diurnal fluctuations in pH largely due to the cooler temperatures and lower nutrient concentrations.

Nutrients

Nutrients such as nitrogen and phosphorus are essential for plant growth. Nitrogen is found in all organisms and is present as a major component in the atmosphere (78% by volume). Aquatic vegetation is most dependent on nitrate as an essential component for growth. The nitrogen cycle is a natural and essential component of the aquatic ecosystem, providing nutrients to aquatic vegetation. Nitrogen is present in most ecosystem in one or more of the following forms; N_2, NO_2, NH_4, and NO_3.

Phosphorous is also an important component of natural water systems. It is one of several key elements essential for the growth of aquatic plants.

Phosphorus is typically bound in sediments and is utilized by all aquatic plants. This nutrient stimulates plant growth as well as increasing biomass. As a result, more detritus is created, returning the phosphorus to the sediments when the plant decomposes (Kadlec and Knight, 1996). Phosphorous is generally the limiting nutrient for growth by most aquatic plants. Since phosphorous reacts with a number of species to form insoluble salts and is absorbed readily by vegetation, the concentration of dissolved phosphate in water is typically low.

Under certain conditions, these nutrients can to be detrimental within the stream ecosystem. Excessive amounts of either of these nutrients can result in problems that include annoying tastes and odors in water. Toxic levels of nitrates and nitrites can be found in surface water and become fatal to stream organisms and humans if ingested (Kadlec and Knight, 1996). Elevated levels of nitrogen and/or phosphorus are usually found in association with sewage treatment dumped directly into the stream, runoff from heavily applied nitrogen fertilizers, and/or animal waste introduced into the stream.

Eutrophication is a specific condition that is the result of excessive levels of nitrogen and/or phosphorus. This creates a bloom of aquatic vegetation (usually algae) that is triggered when excessive levels of nutrients such as nitrogen and/or phosphorus are loaded into a stream. An increase in aquatic plants will shift the balance of DO and pH, causing multiple negative impacts to water quality. Attempts have been made to limit such occurrences by limiting one or more of the essential nutrients in a stream. Generally, it has been believed that phosphorous is the algal nutrient most responsive to reduction below limiting nutrient levels. This is due to the fact that many of the sources of phosphorous are anthropogenic in origin. Such impacts to water quality have been shown to have direct affects on aquatic and salmonid habitats.

Conductivity

Conductivity measures the water's ability to conduct an electrical current. Water becomes more conductive when there is an increase in temperature and an increase in the concentration of dissolved salts. Conductance usually increases when wastewater from industrial or domestic origin is released into the stream. Storm water and irrigation water also may have a higher conductance than healthy stream water (Oregon Plan for Salmon and Watersheds, 2003). There are no water quality standards in Oregon for conductivity. Typically, fresh surface water ranges from a low of approximately 20 to 500 micromhos/centimeter (µmhos/cm). Monitoring conductivity allows for the evaluation of possible multiple water quality issues within the stream.

Bacteria

Water contains microbes such as bacteria, algae, and protozoans that are too small to see without a microscope. Pathogenic microbes, such as some forms of bacteria, viruses, and parasites can cause diseases in humans. In order for waters to be safe for drinking and swimming, they must be checked for the presence of harmful microbes. These pathogens are difficult to detect in water because they are typically few in number, they are difficult to grow, and they cannot survive long outside a human or animal body. The presence of these organisms are indicated when high levels of total coliform or fecal coliform bacteria are found in water samples.

Some types of coliform bacteria naturally coexist with pathogens inside the intestines of both warm and cold blooded animals. These bacteria are beneficial to both humans and other animals in that they aid in digestive process. A test for total coliform bacteria includes all coliform bacteria that come from the gut of vertebrates as well as from soil dwelling bacteria. Fecal coliform bacteria are only present in the intestines of warm blooded animals.

E. coli is a type of fecal coliform that is commonly monitored as an indicator of water quality. Fecal coliform bacteria can create intestinal problems. However, they are not, themselves, usually considered pathogenic. Their importance with respect to water quality is that their presence indicates that excrement from humans or other warm blooded animals has contaminated a water source. Unprocessed toilet wastes, farm animal wastes, and pet waste can contaminate a body of water. Untreated wastes from wastewater treatment plants or sewer systems can be source of fecal coliform to water. In rural areas, faulty septic tanks also allow harmful bacteria to pass untreated into surface and/or groundwater. Diseases such as hepatitis, dysentery, typhoid fever, and ear infections can be contracted in water with high fecal coliform counts (Manahan, 1975).

Most of these water quality parameters have numerical standards that have been established by either federal and/or state agencies. Table 9-2 lists the standards for the parameters discussed above. Where naturally occurring quality parameters of water of the Rogue Basin are outside the numerical limits of the standards listed in the table, the naturally occurring water quality shall be the standard (Oregon DEQ, 2003 [a]).

Table 9-2
Water Quality Standards for Selected Parameters
(DEQ, 2003 [a])

Parameter	Standard
Temperature	Spawning, egg incubation, or fry emergence 55°F (12.8°C) Salmonid juvenile rearing 64°F (17.8°C)
Dissolved Oxygen	Minimum of 8.0 mg/L
pH	5-9
Nitrogen	Nitrate (as N) 1mg/L; Nitrite (as N) 10 mg/L
Bacteria	30-day log mean of 126 E coli organisms per 100 mL, based on 5 samples; No single sample shall exceed 406 e. coli organisms per 100 mL
Turbidity	No greater than 10% increase in natural stream turbidity (standard related to human activities within a stream)

Other Water Quality Parameters

Bioindicators are organisms whose presence, absence, or condition provides information about environmental quality. Every organism has particular environmental requirements for it to be healthy and reproduce successfully. The presence or absence of healthy populations of organisms within their habitats provides valuable information regarding the environmental conditions in a water body. The advantage of using bioindicators over chemical and physical tests to evaluate water quality is that the presence of living organisms inherently provides an integrated indication of water quality. In contrast, chemical and physical tests typically provide information related to the conditions that exist at the time the sample was taken. The presence of a mixed population of healthy aquatic insects, mussels, or fish usually indicates that the water quality has been good for some time. The absence of bioindicators in water that appears to be of good quality, according to chemical and physical sampling, should indicate that further investigation as to the cause for the lack of bioindicators.

Macroinvertebrate stream populations are sensitive to anthropogenic disturbance, making them good indicators of stream health. Salmonids feed on these populations, providing a direct link between salmonid health and macroinvertebrate health. Changes in macroinvertebrate populations indicate non-point source pollution, sporadic events, or low levels of pollution that can accumulate within the stream (Oregon Plan for Salmon and Watersheds, 2003). Surveys to monitor these populations can be cost effective and provide great insight into the water quality of the stream.

Benthic macroinvertebraes include aquatic insects, worms, shellfish, crustaceans, and other animals that are large enough to see without a microscope and live at the bottom of a water body. Many species of mayfly nymphs, casddisfly larvae, water pennies, and stonefly larvae can survive only in swift, cool, well oxygenated water. Healthy, thriving populations of these

organisms in a stream is generally a sign that the water quality in the stream in good. In contrast, black fly larvae, midges, leeches, and various species of aquatic worms are quite tolerant of pollution. Thus, they can be found in waters of both good and poor quality. If they are the only types of macroinvertebrates found in a stream it can indicate that the waters are silty and have low levels of dissolved oxygen.

The presence or absence of certain indicator species provides information regarding water quality. Additional understanding can be obtained from gathering data related to both the number of different species present and the EPT richness. The three most pollution intolerant orders of aquatic insects are the Ephemeroptera (mayflies), Plecoptera (stoneflies), and Trichoptera (caddisflies). An index referred to as the EPT richness index can be used to provide an indication of stream health. The first letter of each order gives the index its name - EPT. The index provides an indication of water quality based on the percentage of pollution intolerant species in relation to the percentage of tolerant species.

Pesticides and toxins are also water quality parameters which can be monitored. Pesticides are herbicides, insecticides, rodenticides, and any other chemicals that are used to kill off vegetation and pests. These enter the stream by directly applying them to the water, aerial drift, transportation through groundwater, or by overland flow. Toxins can include a range of materials that usually appear in streams due to urban or agricultural runoff. Examples of toxins are chlorinated hydrocarbons, phenols, polychlorinated biphenyls (PCBs), metals, and oils and grease. Sources of these contaminants can be spills, leaking underground storage tanks, mining activities, manufacturing and agricultural industries. High concentrations or prolonged exposure to pesticides or toxins can be extremely harmful to fish populations.

The choice of pesticides or toxins which are utilized vary for each land use practice depending on whether it is intended for forestry, agriculture, or urban

use. Due to the large range of possible chemicals that could be present within the stream at any given time, watershed councils are cautioned when deciding how and when to test for certain pesticides or toxins. This is due to the greater cost associated with this kind of testing, as well as the characteristics associated with each possible chemical when suspended in the water column.

9.4 ANALYSIS OF AVAILABLE DATA IN THE SBW

Data was gathered from various public agencies, including the BLM, Oregon DEQ, and USGS. Private stakeholders within the watershed also provided data independently gathered for personal use.

303(d) Stream Listings

Section 303(d) of the CWA sets forth water quality goals for all U.S. waters to make them "fishable and swimmable" (Oregon DEQ, 2000). The CWA requires states to define instream water quality standards. When these standards are not consistently met, the stream is considered to be water quality limited. It is then placed on the 303(d) Stream List indicating that the standard that is not being met (USEPA, 2003 [a] and Oregon DEQ, 2003[a])). As a result, the state must develop a recovery and implementation plan for the stream and/or sub basin. Total Maximum Daily Loads (TMDLs) are determined for each sub basin and used to gage water quality recovery (USEPA, 2003 [c, d]). Implementation is devised through use of Water Quality Management Plans (USEPA, 2003 [b]). The Oregon DEQ is responsible for developing TMDLs for each sub basin which contain 303(d) listed streams within Oregon (Oregon DEQ, 2002). TMDLs for the Middle Rogue, which includes the SBW, are targeted to be completed in 2004 (Oregon DEQ, 2003 [e]).

There are ten 303(d) stream listings within the SBW (Oregon DEQ, 2002). They are all listed for temperature (Table 9-3). Figure 9-5 illustrates the locations of the 303(d) listed streams in the SBW.

Table 9-3
303(d) Listed Streams in Seven Basins Watershed

Waterbody Name	Stream Segment	Listed Parameter
Foots Creek	Mouth to headwater	Temperature
Kane Creek	Mouth to headwater	Temperature
Sams Creek	Mouth to headwater	Temperature
Sardine Creek	Mouth to headwater	Temperature
Galls Creek	Mouth to headwater	Temperature
Birdseye Creek	Mouth to headwater	Temperature
Evans Creek	Mouth to headwater	Temperature
WF Evans	Mouth to headwater	Temperature
Battle Creek	Mouth to headwater	Temperature
Cold Creek	Mouth to headwater	Temperature
Pleasant Creek	Mouth to headwater	Temperature
Ramsey Creek	Mouth to headwater	Temperature
Rock Creek	Mouth to headwater	Temperature
Salt Creek	Mouth to headwater	Temperature
R.F.Salt	Mouth to headwater	Temperature

Water Quality Monitoring

Water quality has been monitored in the SBW for the past decades by three agencies: DEQ, BLM, and USGS. Monitoring methods varied between agencies as well as the parameters and stream segments chosen for monitoring. The data sets generated by these agencies provide a modest amount of baseline

INSERT FIGURE 9-5 (11 x 17)

Seven Basins Watershed DEQ 303d Streams

information regarding the overall water quality in the SBW. The locations of where water quality was monitored by DEQ, BLM, and the USGS are illustrated on Figure 9-6.

DEQ Water Quality Data

DEQ monitored various points along Evans Creek in 1978 and 1979. Parameters monitored included temperature, DO, pH, conductivity, total coliform most probable number (MPN), and turbidity (DEQ, 2003 [g]. The data were collected on a monthly basis at locations from the upper portions of the watershed to near its confluence with the Rogue River (Figure 9-6). Figure 9-7 is a graph of temperature versus time along Evans Creek based on the 1978 and 1979 DEQ data. The data provide a "snap shot" of the changes in temperature along the stream during winter and summer conditions. In general, water temperatures increase from the upper reaches of the watershed to the confluence with the Rogue River. There was approximately a 20°C (68°F) difference between winter and summer water temperatures. Water temperatures at all sampling stations in July/August were above the current DEQ temperature standard of 17.8°C (64°F) based on the 1978-1979 data set. There was relatively little variation in temperature during each sampling event.

Maximum temperature was observed near the town of Wimer and the lowest was observed at river mile 5 (Evans Creek at Foot Bridge).

DEQ also collected water quality data along Ward Creek in 1978 and 1979. Parameters monitored included temperature, total coliform MPN, conductivity, and pH. Figures 9-8 and 9-9 are graphs of temperature and total coliform versus distance along the stream channel measured at various times throughout 1978 and 1979.

INSERT FIGURE 9-6 (11 x 17)

Locations of Water Quality Monitoring

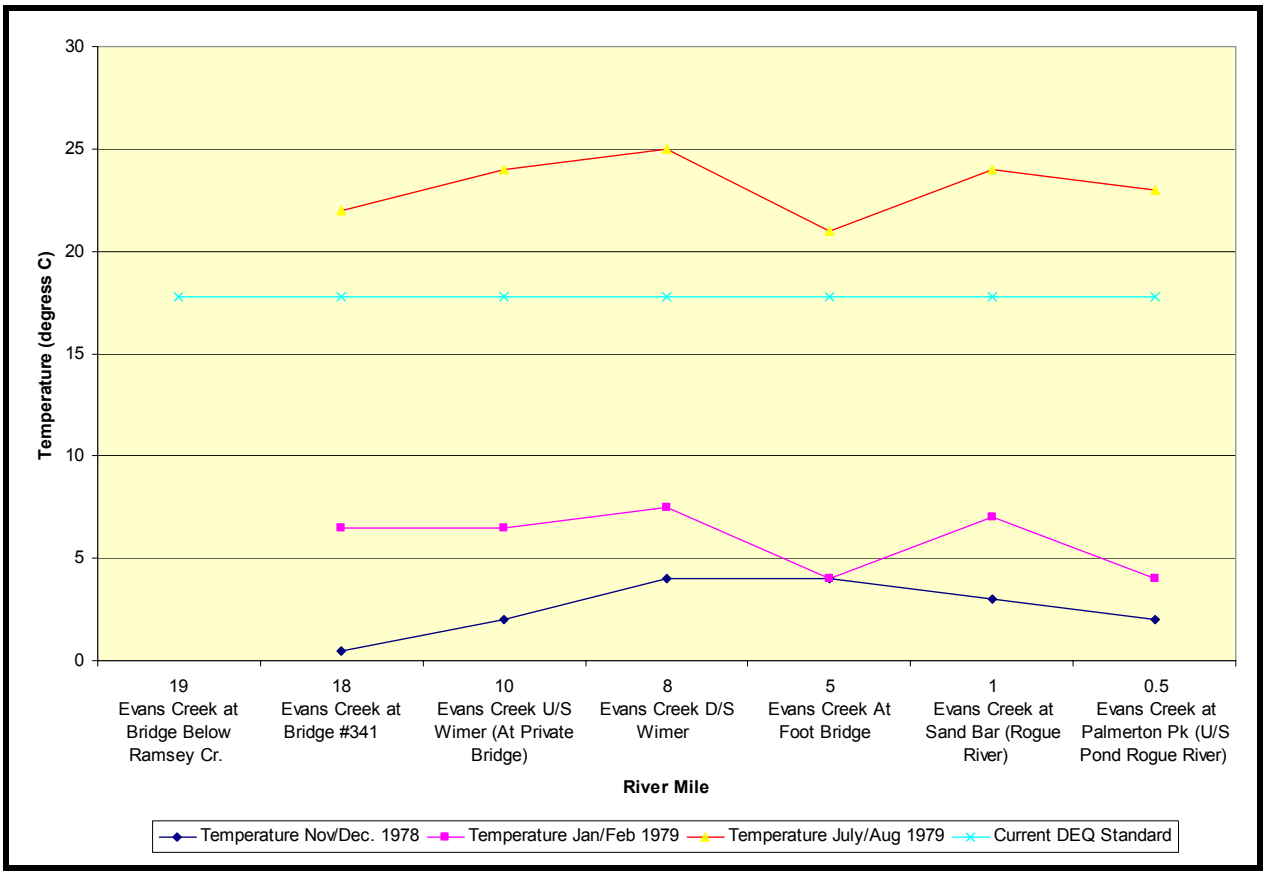


Figure 9-7

Temperature Profile Along Evans Creek Based DEQ Data Collected in 1978 and 1979

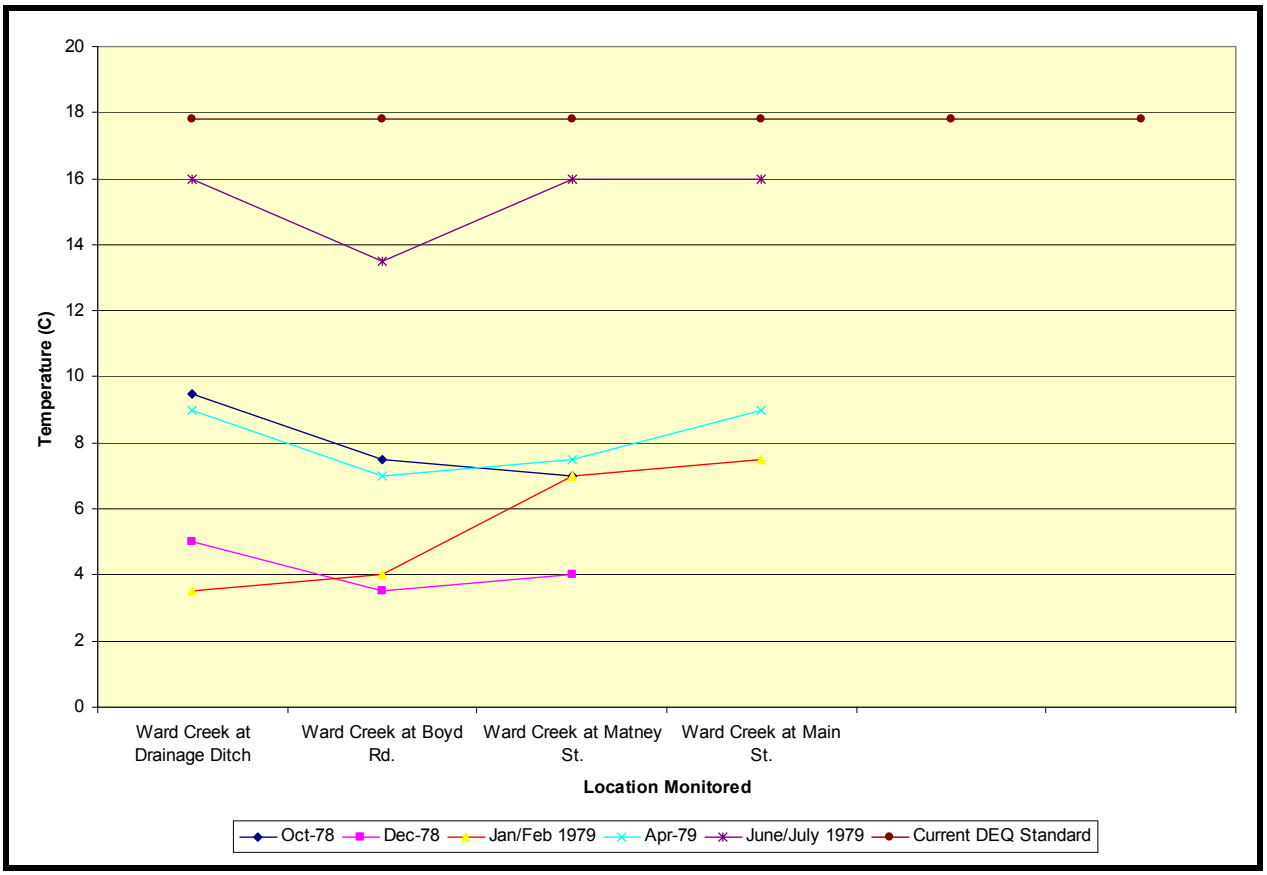


Figure 9-8
Temperature Profile Along Ward Creek Based on DEQ Data Collected in 1978 and 1979

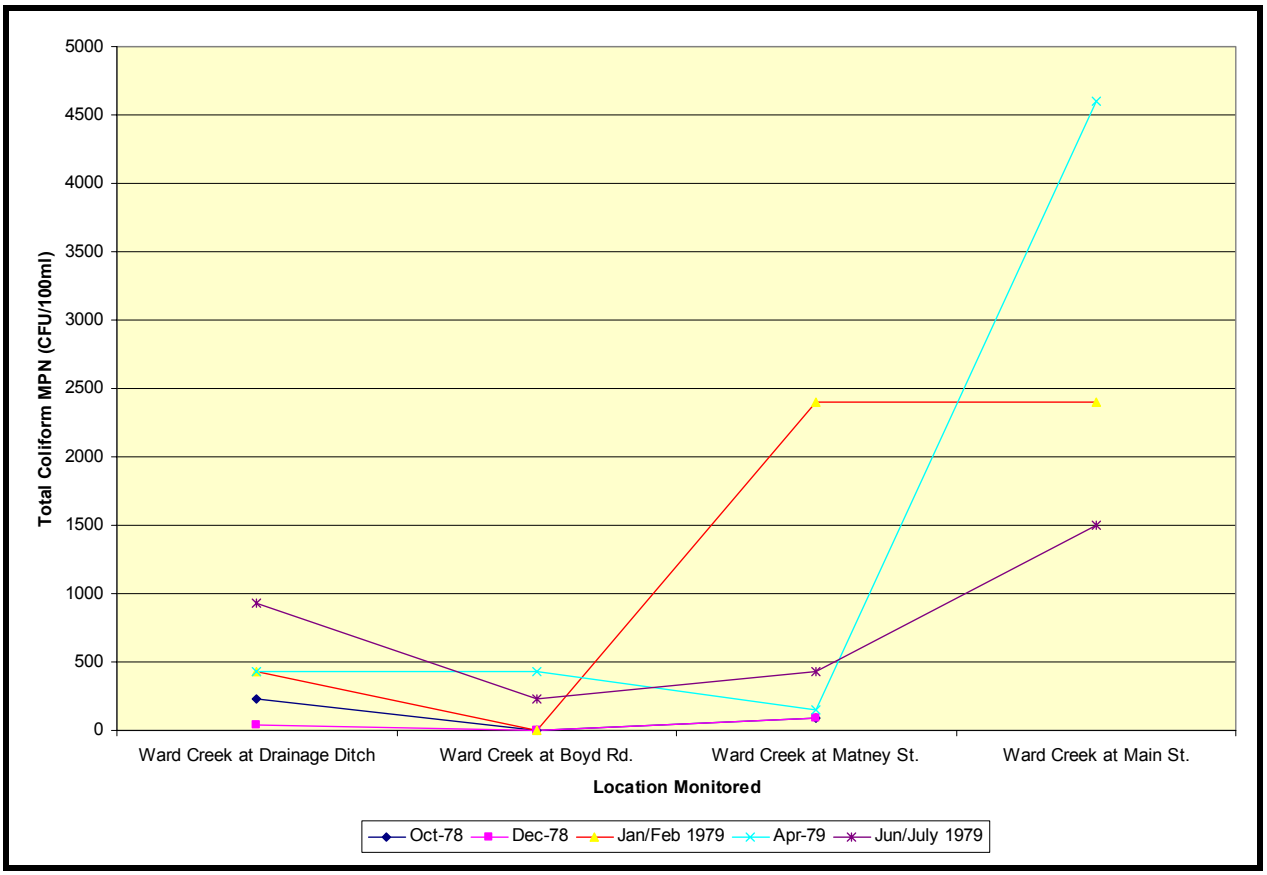


Figure 9-9
Profile of Total Coliform Along Ward Creek Based on DEQ Data Collected in 1978 and 1979

Temperature decreased from the Drainage Ditch station to Boyd Road during all months with the exception of January/February 1979. Water temperature increased or stayed approximately the same between the Boyd Road and Matney Street sampling locations for all periods sampled. Water temperatures were approximately 14°C higher in the summer than winter. Water temperatures during the period of record did not exceed the DEQ standard of 17.8°C (64°F).

Levels of total coliform MPN showed considerable variation both with space and time. Significant increases were observed between the Boyd Road and Main Street sampling stations. Temporal differences were also observed with the

largest increase occurring in April 1979. The increases are most likely due to input from septic tanks from homes located along Ward Creek. The density of housing increases from the Boyd Road sampling station to the Main Street sampling station. The highest coliform values were observed during April 1979, and most likely reflect increases of runoff and rising of the shallow water table in the general vicinity of Ward Creek in response to spring runoff and rainfall. Increased surface runoff would also be expected to increase overland transport of coliform resulting from pasture land adjacent to the creek.

The DEQ data set provides an historical perspective of water quality in Evans Creek and Ward Creek. This type of information produced during this type of monitoring is useful in assessing the impacts of point and non-point sources of inputs to the streams due to various land uses and activities that occur along specific stretches of a stream. This type of monitoring provides an understanding of how water quality changes both temporally and spatially as water travels from the uplands to the Rogue River. By comparing one river mile to another through water quality monitoring, a quantitative evaluation of the stream's condition can begin to be formulated. However, the most recent DEQ data available for this assessment was collected in 1978 and 1979. Since 1979, no data have been generated; creating a data gap. These data can be used in a comparative nature to assess how water quality has changed since the time it was collected. However, no definitive statements can be made regarding water quality conditions between 1979 and present.

BLM Water Quality Data

BLM collected water quality data on Kane Creek, Galls Creek, Right Fork Foots Creek, and Birdseye Creek between 1994 and 2001. These data were part of a multi-year baseline data collection program related to summer stream temperatures on BLM land. Some streams have been monitored continuously while only seasonal data were collected from other streams. At various

monitoring locations, a grab sample was collected and tested in the field for pH during the initial placement or retrieval of the temperature recorders. Temperature and pH data are the only water quality parameters available for this portion of the watershed. The location of the monitoring stations is illustrated on Figure 9-6.

The 7-Day Average Max Temperature is a small data set that depicts Birdseye Creek and Galls Creek as streams that have relatively constant temperature from year to year (Figure 9-10). Kane Creek and Right Fork Foots Creek do not have enough data points to determine if they have a similar trend.

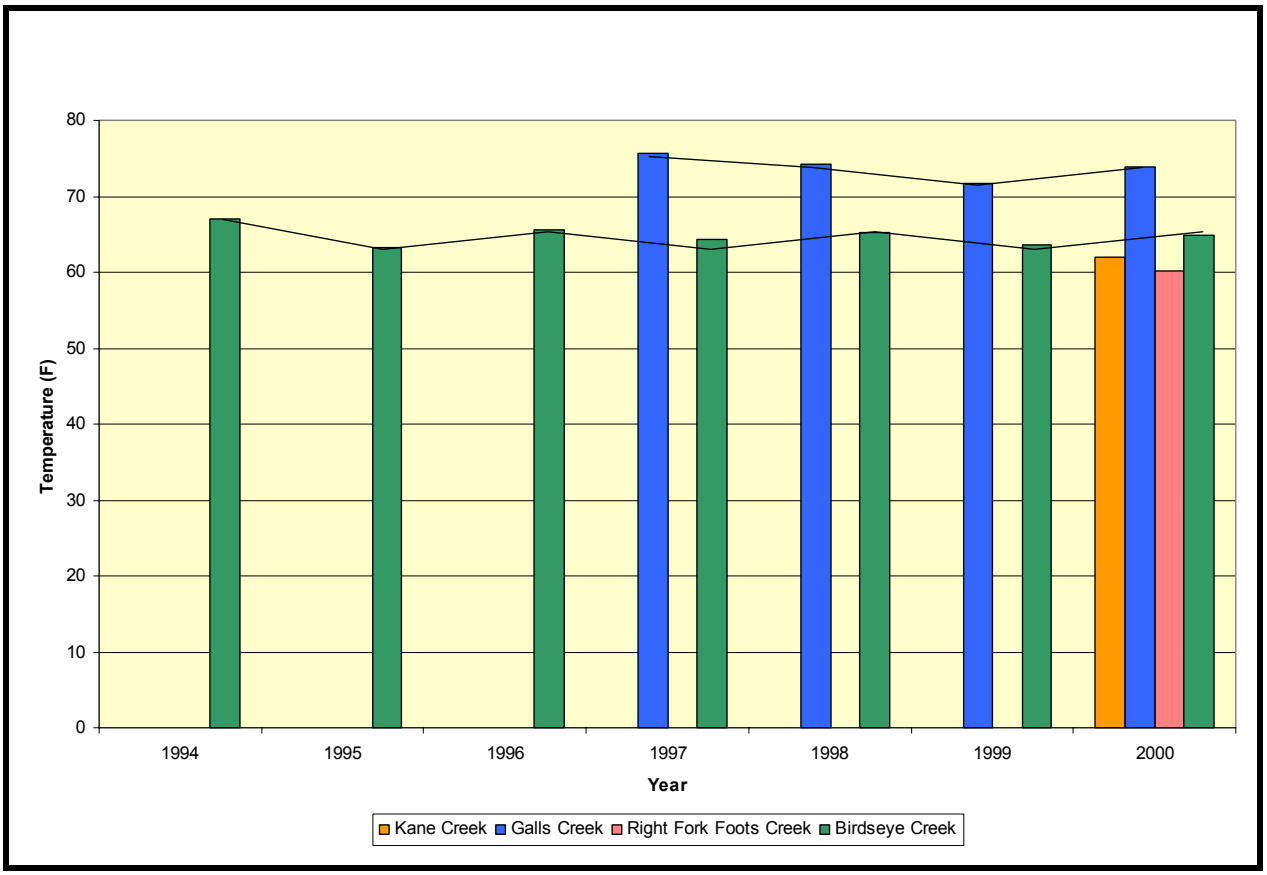


Figure 9-10
7-Day Average Maximum Temperature Values for Selected Streams

Figure 9-11 illustrates the number of times that Birdseye Creek and Galls Creek exceeded the DEQ temperature standard of 17.8°C. Based on the BLM data, Galls Creek exceeds the standard nearly 22% of the year. Such exceedances are why both steams have been placed on the DEQ 303(d) stream list for temperature.

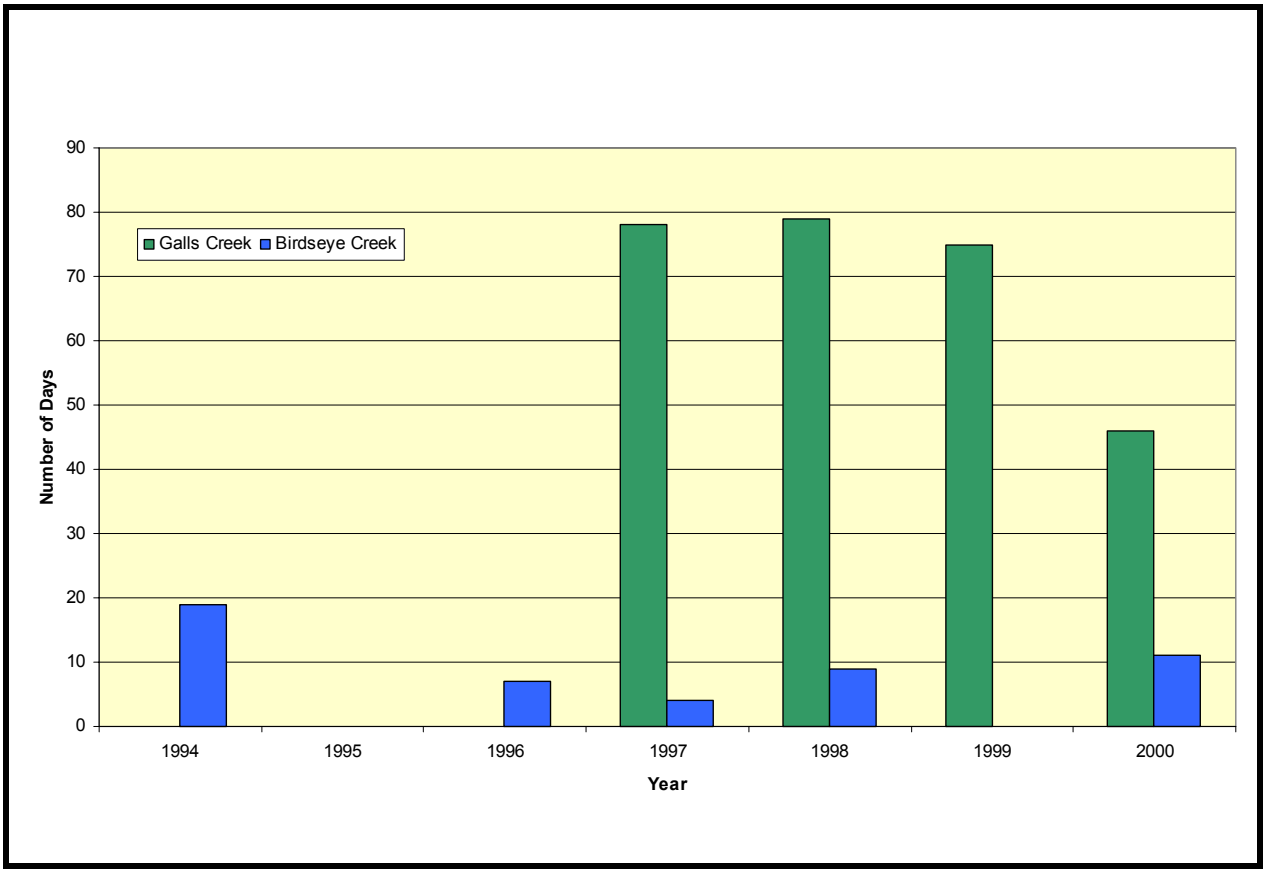


Figure 9-11
Number of Times the 7-Day Average Maximum Temperature Exceeded the DEQ Temperature Standard for Selected Streams

Despite the recentness of the temperature and pH data collected by BLM, it is discontinuous and has only been collected for seven years. Continued monitoring of these streams would be beneficial and allow a better understanding of the temporal and spatial relationships that occur within these subwatersheds.

USGS Water Quality Data

USGS water quality data was collected at five stations along Evans Creek and West Fork Evans Creek. This study was part of the Five Basin study funded by DEQ as part of the 208 (non-point source) planning process that was going on state wide during 1977 and 1978. Basins were selected around Oregon, including Evans Creek in southern Oregon, to represent various climate and land use differences. All the sampled sites were along streams where there were no known influences from municipal or industrial discharges, reservoir releases, or water diversions. The intent was to select sites that were influenced by non-point sources only. Further, the state was interested in low-flow or critical conditions, not storm water conditions as storm water runoff was considered at the time too difficult to address under 208 planning. The specific criteria for why each basin was selected were not available in project archives. The primary criteria appeared to be land use characteristics for the watersheds upstream from each sampled site.

Physical, chemical, and biological measurements were collected to characterize the watersheds selected in consultation with the state of Oregon (Oregon DEQ, 2003 [a] and USGS, 2003). The locations of the sampling stations are shown on Figure 9-6. Parameters monitored included temperature, pH, and DO. As part of the monitoring program, algae (periphyton) samples were collected. The purpose of the monitoring was to ascertain if algae populations in the streams were influencing DO and pH over a 24-hour cycle. The time of year for the sampling (July through September) was selected to be at times of low flow, and followed 10 to 14 days of no measurable precipitation. The specific dates were determined on the logistics for field work. Sampling in 1977 was during a drought year and the follow-up sampling at these sites in 1978 was during a more normal precipitation year, providing a contrast to the drought of 1977.

Figure 9-12 illustrates the diurnal fluctuations of temperature that occur throughout a 24-hour period. These data also illustrate the inverse relationship between temperature and DO that occurs throughout a day. Temperature changes are due energy input from the sun and DO varies throughout a 24-hour period due to process of photosynthesis. As discussed previously, the solubility of DO is also affected by temperature. This is illustrated in Figure 9-13 where as temperature increases, DO decreases.

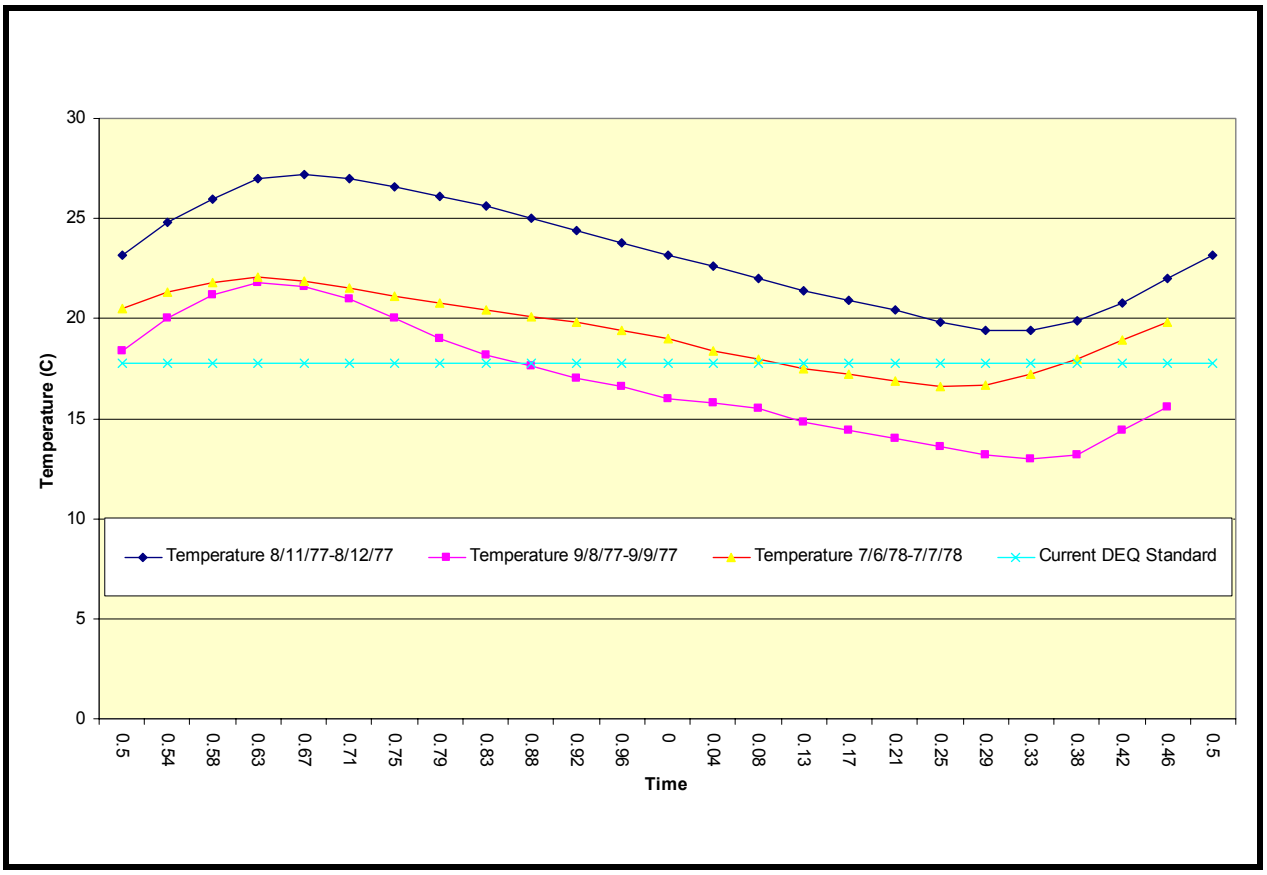


Figure 9-12
Diurnal Fluctuation of Temperature over a 24-Hour Measurement Period on West Fork of Evans Creek

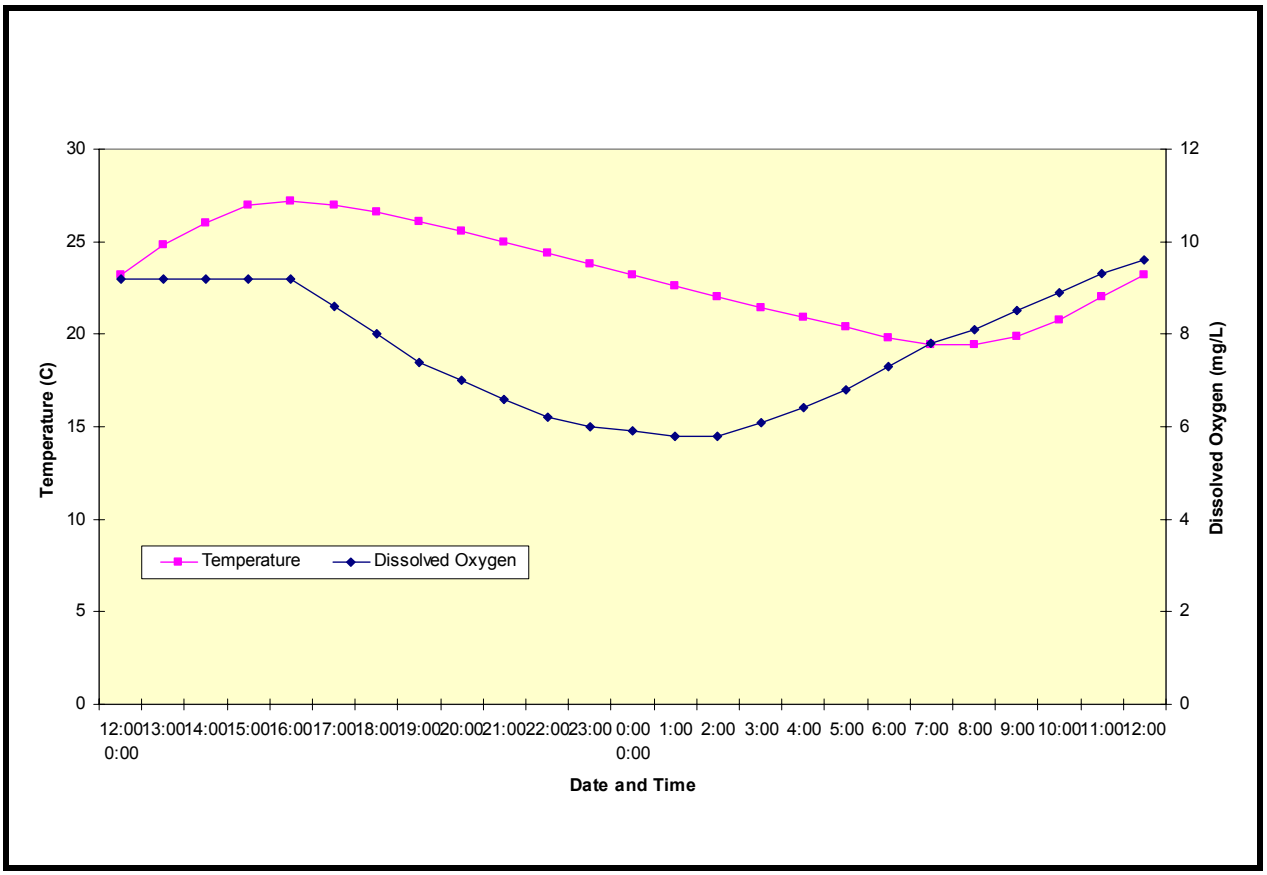


Figure 9-13
Inverse Relationship of Temperature and DO over a 24-Hour Measurement Period on West Fork of Evans Creek

During daylight hours, the process of photosynthesis utilizes CO_2 and produces O_2. As a result, pH is increased due to the shift in carbonate equilibrium of the system. The opposite occurs during the night time hours when respiration is occurring. Thus, due to the phenomena of photosynthesis, streams are naturally the most basic in the mid afternoon and most acidic just before sunrise. Figure 9-14 illustrates the relationship between pH and DO as a result of photosynthesis.

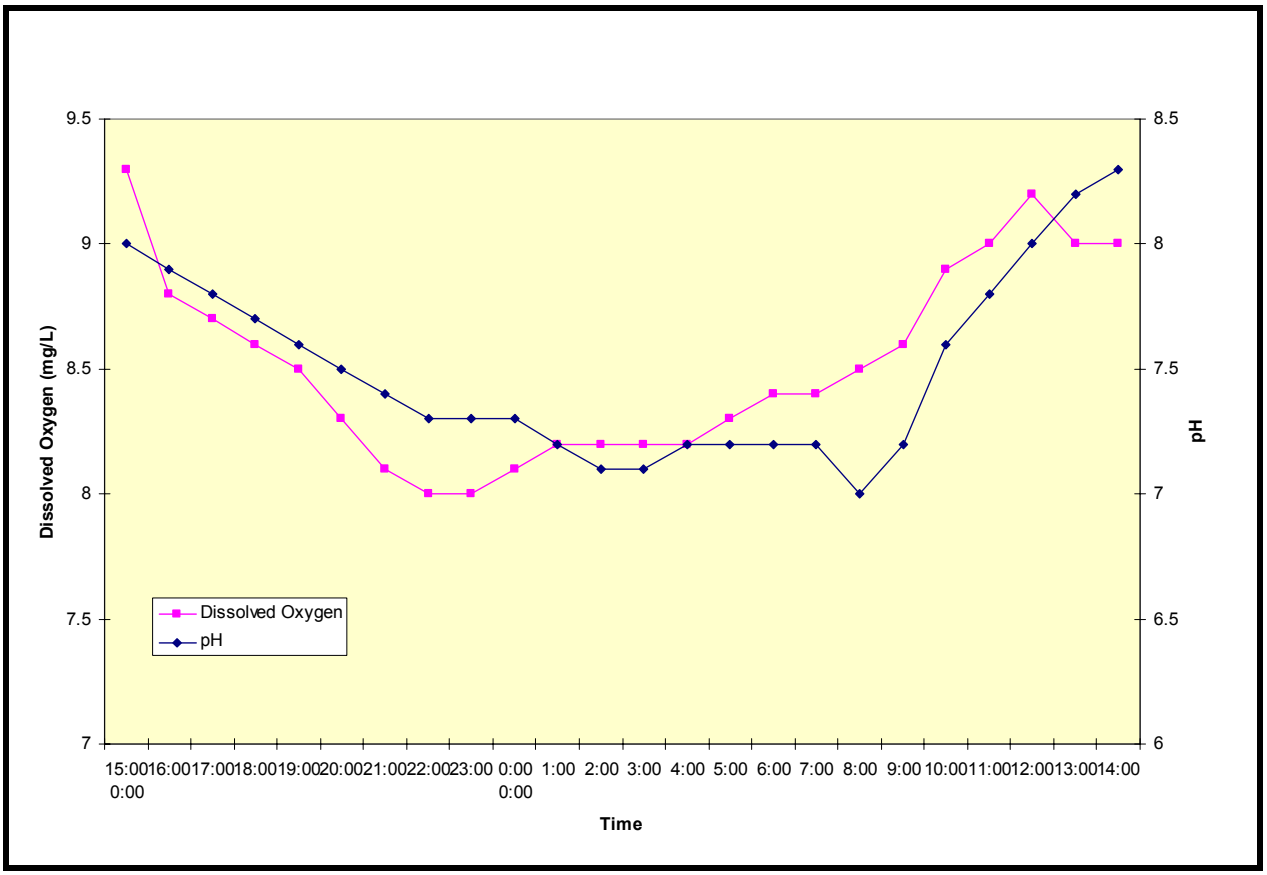


Figure 9-14
Relationship of pH and DO over a 24-Hour Measurement Period in West Fork of Evans Creek

The USGS water quality monitoring program was terminated in 1978 and there was no funding available to analyze the data set and/or produce a report. This data set, like that collected by DEQ, provides a "snap shot" of historical water quality conditions in Evans Creek and West Fork Evans Creek. Unfortunately, these data are 25 years old and most likely do not reflect current conditions in the streams. Land use activity and population density have all changed significantly along these streams since the late 1970s, both of which have a profound impact on water quality.

CONCLUSIONS

Water quality monitoring provides a means for quantitative analysis of chemical and physical properties within a stream ecosystem. By monitoring various parameters, the health of a stream and its inhabitants can be ascertained. Understanding the water quality of a stream ecosystem allows informed land use management decision to be made.

Water quality data within the entire SBW is outdated and incomplete. Available data provides a "snapshot" of water quality conditions in portions of the watershed decades ago.

Since the 1970s, the watershed has changed dramatically. Land use practices are different, urbanization has intensified, environmental awareness has increased, and agency regulation has evolved. All of these factors impact current water quality trends and the reaction of various agencies to those trends.

DATA GAPS

- Water quality data are completely lacking for Rogue-Table Rock subwatershed, Evans-May/Sykes subwatershed, and Evans-Rock/Salt subwatershed.
- Limited and/or historical water quality data are available for Evans Creek-Upper subwatershed, Evans Creek- Lower subwatershed, West Fork Evans subwatershed, Pleasant Creek subwatershed, Rogue-Kane/Galls subwatershed, Rogue-Sardine subwatershed, Rogue-Birdseye/Ward subwatershed, and Foots Creek sub watershed.

- Available data sets are random and discontinuous both spatially and temporally.
- Existing data does not represent current water quality conditions in the SBW.

POTENTIAL ACTION PLAN RECOMMENDATIONS IDEAS

- Seven Basins Watershed Council and community volunteers should be involved in water quality sampling and monitoring within the SBW.
- Develop a comprehensive strategy to address specific water quality monitoring needs to include other watershed assessment components such as sediments, fire, toxics, urbanization and development, riparian areas, wetlands, fisheries, and fish habitat.
- Devise a sampling and analysis plan which takes into account collection, analysis, location, protocol, and frequency. This plan should include a Quality Assurance/Quality Control program to ensure high quality data is collected.
- Seven Basins Watershed Council should coordinate water quality sampling, monitoring, and analysis efforts with state and federal agencies to maximize efficiency and promote broad dissemination of water quality results.
- Develop an interactive environmental data base coupled with GIS to document inventory information and map spatial data.
- Provide community education related to the importance of water quality issues. This program should include ways that stakeholders can get involved in the sampling, monitoring, and analysis.

REFERENCES CITED

Arbuckle, Brownell, Case, Halbleib, Jensen, Landfair, Lee, Miller, Nardi, Olney, Sarvadi, Spensley, Steinway, Sullivan, *Environmental Law Handbook; Twelfth Edition*, 1993.

Bureau of Land Management (BLM), *South Rogue-Gold Hill Watershed Analysis*, August 2001.

Coordinated Science 2, University High School, <www.iusd.k12.ca.us/uhs/ cs2/carbon_cycle.htm>.

Federal Interagency Stream Restoration Working Group (FISRWG), *Stream Corridor Restoration: Principles, Processes, and Practices*, 1998.

Kadlec, R.H.; Knight, R.L.; *Treatment Wetlands*, 1996.

Lake Access and Empact Metro Project, "The Lawn Fertilizer Experiment," <www.lakeaccess.org/lakedata/lawn fertilizer/ p-diagram.htm> (Accessed November 12, 2003).

Manahan, Stanley E., *Environmental Chemistry*, 2nd Ed., Willard Grant Press, Boston, Mass, 1975.

McShaffrey, Dave, "Environmental Biology," January 8, 2004 <http//mcnet.marietta.edu./~mcshaffd/>.

Ophardt, C., E., "Lecture Outline for Chemistry 110, Chemistry and Issues in the Environment, the Nitrogen Cycle," <http://www.elmhurst.edu/~chm/onlcourse/chm110/outlines/nitrogencycle.html>, (Accessed August 7, 2003).

Oregon Department of Environmental Quality (DEQ), "The 2002 303(d) List of Impaired Waters in Oregon," Updated February 7, 2003 (d), <http://www.deq.state.or.us/wq/wqfact/Final2002_303(d)list.pdf>.

Oregon Department of Environmental Quality (DEQ), "Beneficial Uses of State's Waters," <http://www.deq.state.or.us/wq/standards/WQStdsBeneficialUses.htm> (Accessed August 8, 2003 [c]).

Oregon Department of Environmental Quality (DEQ), "Laboratory Analytical Storage and Retrieval Database Data Summary Information," <http://www.deq.state.or.us/wq.lasar/StationDataSumListTxt> (Accessed May 28, 2003 [f]).

Oregon Department of Environmental Quality (DEQ), "Laboratory Analytical Storage and Retrieval Database List of Monitoring Stations for USGS Watershed 1710030803," <http://www.deq.state.or.us/wq/lasar/StationList2.asp?WatershedName=1710030803> (Accessed May 28, 2003 [g]).

Oregon Department of Environmental Quality (DEQ), "Oregon's Existing Water Quality Criteria for Stream Temperature," June 4, 2003 (b), <http://www.deq.state.or.us/wq/standards/TempCriteriaGuide.pdf>.

Oregon Department of Environmental Quality (DEQ), *Oregon's 2000 Water Quality Status Assessment Report, Section 305(b) Report*, 2000.

Oregon Department of Environmental Quality (DEQ), "Subbasin Target Dates for Completion of TMDLs for Waters Listed on the 303(d) List," <http://www.deq.state.or.us/wq/303dlist/TMDLTargetsMap.htm> (Accessed May 19, 2003 [e]).

Oregon Department of Environmental Quality (DEQ), "Water Quality, Nonpoint Source Pollution," <http://www.deq.state.or.us/wq/nonpoint/nonpoint.htm> (Accessed June 4, 2003 [a]).

Oregon Plan for Salmon and Watersheds, "Water Quality Monitoring Guidebook," <http://www.oweb.state.or.us> (Accessed 2003).

United States Environmental Protection Agency (USEPA), *Ambient Water Quality Criteria for Dissolved Oxygen*, EPA 440/5-86/003, MRC. Report Series, USEPA, Washington D.C., 1986.

United States Environmental Protection Agency (USEPA), "Clean Water Act 303(d) List", (Accessed May 19, 2003 [a]).

United States Environmental Protection Agency (USEPA), "EPA Region 10 Guidance for Pacific Northwest State and Tribal Temperature Water Quality Standards," April 2003 (b), <http://www.yosemite.epa.gov/R10/water.nsf>.

United States Environmental Protection Agency (USEPA), "Overview of the TMDL Process," <http://yosemite.epa.gov/R10/WATER.NSF/> (Accessed May 19, 2003 [c]).

United States Environmental Protection Agency (USEPA), "Overview of Current Total Maximum Daily Load- TMDL- Program and Regulations," <http://yosemite.epa.gov/R10/WATER.NSF/> (Accessed May 19, 2003 [d]).

United States Environmental Protection Agency (USEPA), *The Quality of Our Nations Water:1994*, EPA 841-R-95-006, Washington D.C., 1997 (a).

United States Environmental Protection Agency (USEPA), *Volunteer Stream Monitoring: A methods Manual*, U.S. EPA Office of Water 4503F, 841-B-97-003, Washington D.C., 1997 (b).

United States Geological Survey (USGS), "Water Quality Samples for Oregon," <http://waterdata.usgs.gov/or/nwis/inventory?station_> (Accessed June 4, 2003).

CHAPTER 10
FISH ASSESSMENT

Prepared By:
Katie M. Mosser, EMS
Dave Graham, EMS
Reviewed By:
Monty Bruner, PhD, EMS

INTRODUCTION

Oregon places exceptional value in the use of natural resources and their protection. Residents of Oregon have recognized the importance of fish as one of these natural resources and as a result have taken steps to ensure their protection, preservation, and success. In addition to federal efforts to maintain natural resources, various state agencies have adopted multiple policies aimed at the preservation of species throughout Oregon. Two of these policies include the Oregon Endangered Species Act and the Oregon Plan for Salmon and Watersheds.

The Oregon Endangered Species Act (ESA), enacted in 1987 and amended in 1995 (ODFW, 1997, b) compliments the Federal Endangered Species Act and calls for the listing and protection of species considered to be threatened or endangered of becoming extinct in Oregon. ODFW is the state agency responsible for preserving the status of fish and wildlife in Oregon under the Oregon ESA. If the majority of the populations of a species are losing their range or habitat; or the species is being excessively used for commercial, recreational, scientific, or educational purposes; or state and/or federal programs are insufficient in protecting a species or its habitat, then through ODFW, the Oregon Fish and Wildlife Commission can choose to list the species (ODFW, 1997, b). Once a species has been placed on the threatened or

endangered list, the "take" of that species is prohibited by Oregon law. Those species listed under the Oregon ESA are also listed under the Federal ESA. Most enforcement and listing of threatened or endangered species is done on the federal level, rather than by the state.

In addition to the Oregon ESA, the state of Oregon has developed the Oregon Plan for Salmon and Watersheds. The Oregon Plan was spawned out of Governor Kitzhaber's efforts to restore coastal coho salmon after its listing as threatened under the Oregon ESA in July 1995. By March 1997, the Oregon State Legislature had adopted the Oregon Plan for Salmon and Watersheds. Following its adoption, the Southern Oregon-Northern California Coastal Coho was also listed as threatened under the Oregon ESA in May 1997, prompting full scale implementation of the Oregon Plan in the summer of 1997.

This comprehensive document calls for an adjustment of state and local agency operations to ensure their practices do not harm the health and/or protection of salmon in Oregon. The Oregon Plan legislation draws from existing state and federal laws which include Fill and Removal Law, Water Law, Fishing Regulations, Forest Practices Rules, state and federal Endangered Species laws, and the CWA (State of Oregon, 2001). Agencies which have incorporated the Oregon Plan include, but are not limited to, ODFW, DOA, Land Conservation and Development, Department of Forestry, DEQ, and Oregon State Police (State of Oregon, 2001).

In response to the Oregon Plan, independent state agencies were created to help facilitate the goals of the plan. OWEB, formerly the GWEB, was established in 1999. This agency promotes and funds volunteer efforts which are aimed at protecting and/or restoring watersheds within Oregon. Examples of these voluntary efforts are watershed councils. With funding from OWEB, watershed councils are able to generate watershed assessments, monitor watershed health, and educate residents about pertinent ecological issues within the watershed (State of Oregon, 2001).

The purpose of a watershed assessment is to evaluate conditions within the watershed as they pertain to the ESA and the Oregon Plan. Salmonids are sensitive to prolonged human disturbance and their population sizes can be indicators of adverse land use practices. By monitoring salmonid populations and their habitat conditions, watershed councils will begin to understand the status of salmonid populations and the effect of local land use practices. Through this understanding, watershed councils are able to educate the general public of the watershed about the effects of land use practices on streams and salmonid populations.

SALMONID LIFE HISTORIES

The SBW contains populations of both anadromous and resident salmonids. Anadromous salmonids have complex life histories which vary dependent on the species and run. However, the general characteristics are the same. The cycle begins as an egg in the redd (nest) in clean gravel within freshwater. Once hatched, the offspring become alevins with a yolk sac still attached to provide nutrients. These alevins stay within the gravel bed until the yolk sac has been completely absorbed. At this time, they emerge into the stream as juvenile salmonids. They mature into fingerlings and parr. As this maturation occurs, the salmonid is slowly moving downstream towards the ocean. The timing of migration to salt water varies, dependent on the species. Many salmonids begin smoltification as they approach brackish water, others smolt in their natal streams. This process enables their bodies to adjust to the salt water conditions of the ocean. During this time, they are known as smolts. Once smoltification is complete, the fish make their way to the ocean. Anadromous salmonids remain in the ocean for the majority of their adult life, during which, they grow and sexually mature (NMFS, 2003, a). Once they are able to reproduce, they migrate back to their natal streams and spawn. Re-entry into freshwater is dependent upon species.

Anadromous species present in the SBW include fall chinook salmon (*Oncorhynchus tshawytscha*), coho salmon (*Oncorhynchus kisutch*), and winter and summer steelhead (*Oncorhynchus mykiss*). Resident species present include rainbow trout (*Oncorhynchus mykiss*) and cutthroat trout (*Oncorhynchus clarki*).

Salmonids provide revenue to the state economy as a large fisheries resource. Research has been funded for salmonid conservation and restoration throughout the Pacific Northwest. These fish also retain a cultural significance endemic to the Pacific Northwest, making them natural objects of interest and research. In addition, salmonids are paid close attention due to many of their listings as threatened or endangered species. Various other anadromous and resident fish species are also present within the SBW. These species are not considered threatened or endangered as are salmonids. These species will be briefly discussed.

Chinook Salmon (Oncorhynchus tshawytscha)

Anadromous chinook salmon have two runs that occur within the Rogue Basin: spring and fall chinook. Spring chinook are present within the Rogue Basin, but do not occur in the tributary streams of the SBW. Fall chinook are present within the SBW.

Spring Chinook

Spring chinook begin their entrance into the Rogue River in early spring and peak migration occurs in June. Spring chinook do not spawn in the SBW. The majority of the Rogue River run of spring chinook are hatchery fish migrating to Cole M. Rivers Hatchery at Lost Creek Dam. Spring run chinook spawn September through mid-November. Spawning usually peaks in early October

(ODFW, 1991). Spring chinook juveniles generally emerge from redds between December and March.

Fall Chinook

Fall chinook generally emerge January through April. Juvenile chinook generally spend the first three to six months following emergence in freshwater streams while migrating towards the mouth of the Rogue River (Futish et al., 1993). This is followed by a period of one week to five months in estuarine rearing habitat (ODFW, 1995). Fall chinook smolts migrate to the ocean from April to August and most enter the Pacific Ocean mid-August through mid-September. This lifecycle can be seen in Figure 10-1.

When Oregon chinook salmon enter the Pacific Ocean between the Columbia Basin and Cape Blanco, they tend to remain in the area ranging from along the northern Oregon coast up to the southeastern Alaskan coast (ODFW, 1995). Chinook that enter south of Cape Blanco tend to inhabit the southern Oregon and California coasts (ODFW, 1995). Generally, Chinook populations locate themselves in specific rearing areas within these ranges (ODFW, 1995).

Chinook populations most commonly contain adults that are three to six years old. Fish in this species are rarely older than seven. Chinook that return to Oregon freshwater can range from 2 to 70 pounds, but are usually between 10 and 40 pounds (ODFW, 1995).

Chinook generally rear for three to four years in the Pacific Ocean. Some fall chinook return to spawn after only 1.5 years in the ocean. These are commonly referred to a “jacks.” Fall Chinook return to the freshwater streams of the Rogue River beginning in mid-July. In the Rogue Basin, the highest spawning densities of Chinook salmon occur in the middle section of the Rogue River, which includes portions of the SBW (Futish et al., 1993). Spawning occurs mid-September through late December. The peak of fall chinook

spawning occurs in late-October through mid-November (Little Butte Creek Watershed Council [LBCWC], 2003). Chinook are only able to spawn once, after which, they die.

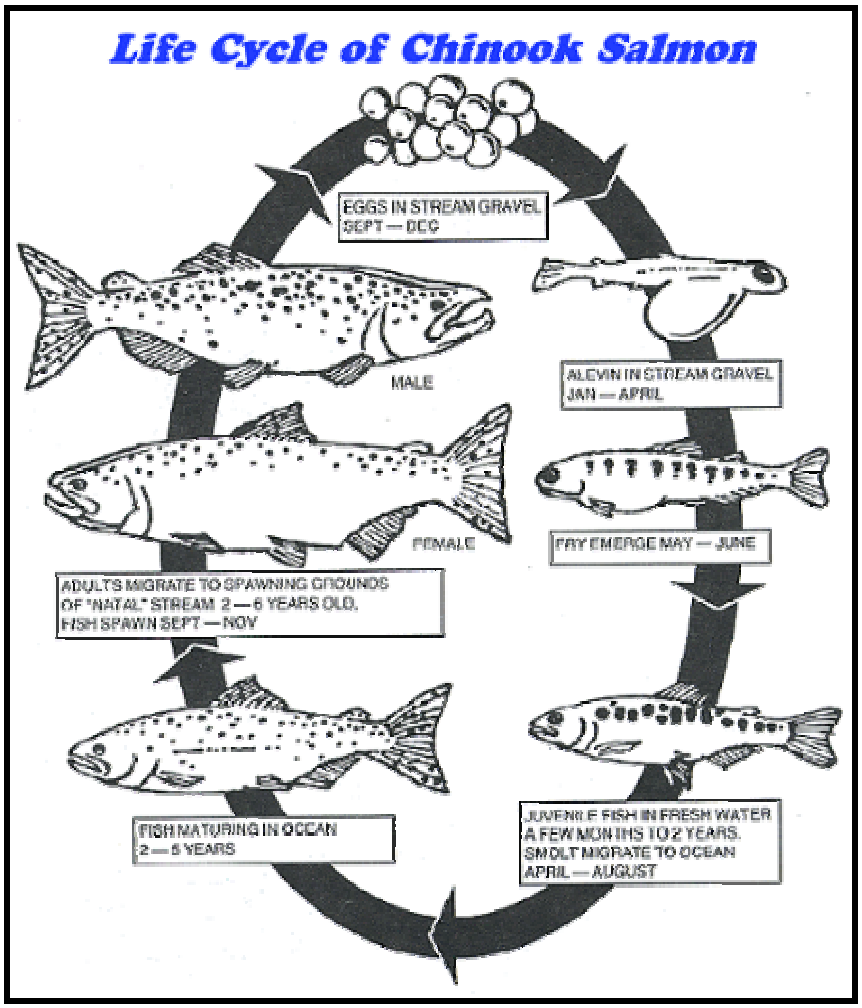


Figure 10-1
Life Cycle of Chinook Salmon
(Source: <http://www.bpa.gov/power/pl/columbia/stories/Salm-4.gif>)

Coho Salmon (Oncohynchus kisutch)

Coho salmon are anadromous and range from Monterey Bay, California to Point Hope, Alaska. Coho migrate as adults back to freshwater in the fall after

spending 16-20 months in the ocean. In the Rogue River, adult coho usually begin their migration in September (Futish et al., 1993). These adult coho are approximately three years old. Some coho, however, reach sexual maturity after only one summer at sea and return the following fall as two year old "jacks."

Coho are usually more than two feet long when they return to freshwater and weigh an average of eight pounds (ODFW, 1996). Several weeks to several months may be spent in freshwater before spawning. This delay is dependent on the distance the coho travels to reach their natal stream and spawning ground. This delay also creates variability within the population, enabling more resistance to possible environmental stressors. Spawning takes place November through January. All adult coho die soon after spawning.

Emergence of coho offspring occurs March through May. After hatching, coho spend an average of 15 months in their natal stream (LBCWC, 2003). Juvenile coho prefer pools, slow water, and off-channel habitats during the summer months and tend to be territorial (Futish et al., 1993).

Juvenile coho salmon usually spend one summer and one winter in freshwater. Emigration to the ocean begins in the spring of their second year (ODFW, 1996), usually beginning in February and lasting through June. The peak of this emigration is in late April to late May. In the coldest rivers, some coho stay an extra one or two years in freshwater. A general coho life cycle can be seen in Figure 10-2.

Rainbow Trout/Steelhead Trout (Oncorhynchus mykiss)

Rainbow trout and steelhead trout are the same species. However, they exhibit different life histories. Resident rainbow trout remain in freshwater and steelhead trout are anadromous. It is most common for anadromous steelhead

to reproduce with each other. This is also true for resident rainbow. However, reproduction can occur between anadromous steelhead and resident rainbow. The distinction between the migratory and resident form is not apparent in the juvenile phase. After spending at least two years in freshwater, steelhead begin a physiological process called smoltification. This change prepares the steelhead for life in saltwater. Resident fish do not undergo smoltification.

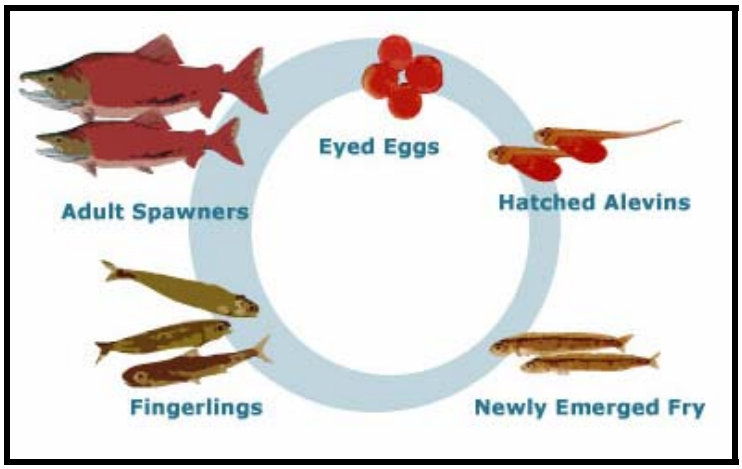


Figure 10-2
Coho Life Cycle
(Source: <http://www.canfisco.com/wildsalmon/life_cycle.asp>)

Resident rainbow trout live out their entire life history within freshwater streams. Spawning is variable and occurs between three to five years of age. Resident rainbow trout are able to spawn more than once throughout their life. Populations of rainbow trout reside above natural and artificial barriers within the SBW.

Winter Steelhead

Steelhead migrating between November and April are referred to as "winter-run" fish. Winter-run steelhead are more sexually mature when they re-enter freshwater and spend less time in freshwater before spawning (ODFW, 1996).

Spawning occurs in tributaries of main stem rivers when flows are appropriate. Spawning occurs March to June, usually peaking in April or May. Following emergence, fingerlings move to pools to avoid low summer flows in the tributaries. Migration to the ocean begins after two years in freshwater. The peak out-migration of winter steelhead occurs in mid-April to late May (Vogt, 2001).

Summer Steelhead

Steelhead which migrate back to freshwater between May and December are referred to as "summer-run" fish. The summer-run steelhead spend several months in freshwater before spawning. Spawning occurs late December through March. Fry emerge and emigrate to the Rogue River March through July, dependent on the stream temperature. It is typical in the SBW for steelhead trout to abandon their natal streams for larger streams almost immediately after emergence due to low stream flows in their first summer (Futish et al., 1993). Steelhead trout mature in freshwater for one to four years before migrating to the ocean for the first time. Once they have reached the ocean, steelhead mature in the saltwater for one to three years.

Rogue populations have an unusual life history trait, however. Some steelhead re-enter freshwater after only three or four months. They mature for up to eight months in the freshwater and then return to saltwater for the duration of their development. These immature steelhead are called "half pounders." The half-pounder life history is more prevalent in summer steelhead, but occurs in winter steelhead as well.

Upon reaching sexual maturity, steelhead will migrate back to freshwater to spawn. Steelhead prefer to spawn in tributaries. They will use main stream channels only when access to smaller tributaries are blocked or there is low stream flow (Futish et al., 1993). As long as there is available habitat, the steelhead can move back and forth between the ocean and their natal streams

to spawn year round. However, spawning usually occurs in the winter and spring. The general steelhead trout life cycle can be seen in Figure 10-3.

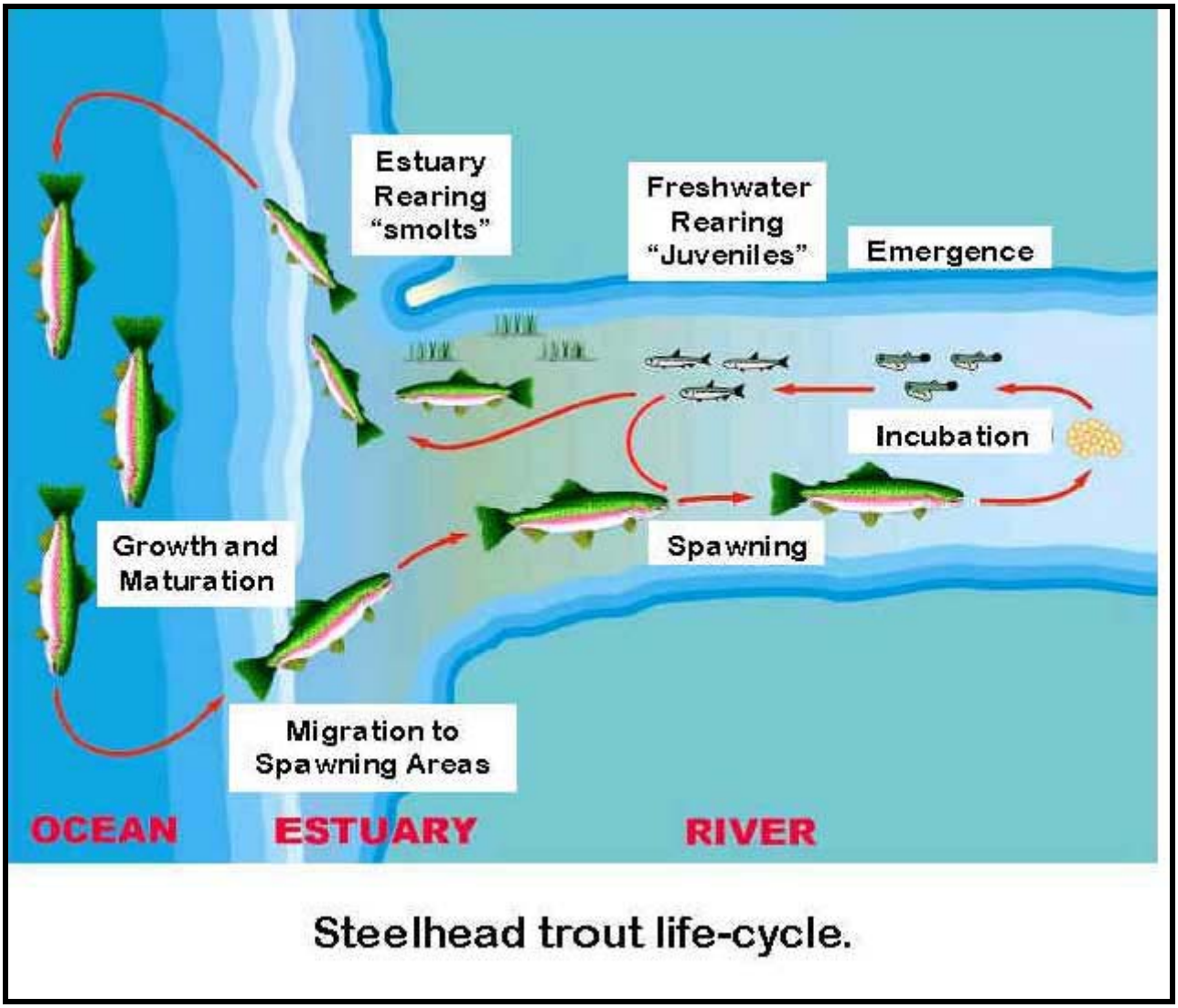


Figure 10-3
Steelhead Trout Life Cycle
(Source:http://www.ci.san-luis-obispo.ca.us/naturalresources/images/steelhead-lifecycle-for web.jpg)

Cutthroat Trout (Oncorhynchus clarki)

Coastal cutthroat trout are present in resident populations within the SBW. They tend to prefer small headwater streams. Resident fish tend to be smaller in size, achieve sexual maturity at a younger age, and have shorter life spans than populations of anadromous cutthroat trout. Resident salmonids hatch in their natal fresh water streams and remain in freshwater streams for the duration of their life. These resident populations consistently contain multiple age classes (ODFW, 1997, a). Resident cutthroat generally spawn in tributary streams from February into the spring.

Miscellaneous Species

Many species of fish are present within the SBW that are not salmonids. Common species include Carp (*Cyprinus carpio*), Redside Shiner (*Richardsonius balteatus*), Klamath Small-Scale Sucker (*Catostomus rimiculus*), Pacific Lamprey (*Lampreta tridentata*), Mosquitofish (*Gambusia affinis*), Speckled Dace (*Rhinichthys osculus*), and Reticulate Sculpin (*Cottus perplexus*) (Futish et al., 1993). Carp are mostly found in private ponds. However, if they manage to make their way into the Middle Rogue or its tributaries, they reside in slow, warm waters. Carp are not native to the SBW. Mosquitofish are also non-native. These fish are live bearers, which means they do not lay eggs, but give birth to live offspring. County Vector control agencies originally distributed this species to private land owners with ponds in an attempt to control mosquitoes throughout the area. They have subsequently colonized some streams of the SBW.

Redside Shiners are present in the Middle Rogue and its tributaries. They are native to some basins in Oregon, but it is not certain if they are native to the Rogue Basin. These fish are found in warm waters, are very prolific, and can out compete salmonids in warm waters. Klamath small-scale suckers and

lamprey are both native to the Rogue and are likely present in the SBW. Pacific lamprey are anadromous and parasitic in their ocean phase. Very little research has been done on the lamprey population in the Rogue Basin; however, much interest is being generated about this species (Doino, 2003). The Speckled Dace and Reticulate Sculpin are both native to the Rogue Basin and present in the SBW (Futish et al., 1993).

These miscellaneous species do not have the economic and charismatic value as salmonids. Conservation legislation protects salmonids, driving funding and research towards understanding their life histories. Due to the fact that these miscellaneous species have not been recognized to be of similar value to that of salmonids, there is considerably less research and knowledge regarding these species.

NATIVE SPECIES AND ESA LISTINGS

Chinook salmon, coho salmon, summer and winter steelhead trout, and cutthroat trout are all native to the SBW. Winter and summer steelhead, coho, and spring chinook are also stocked directly into the Rogue River, at the Cole Rivers Hatchery at Lost Creek Dam, upstream of the SBW. Straying of hatchery fish into tributaries of the Rogue may occur, but is minimal (Doino, 2003).

Southern Oregon-Northern California Coho Salmon were listed as threatened under the Oregon ESA in May 1997. In August 1998, all Oregon Coastal Salmon were listed as threatened under the Oregon ESA as well. These species occur in the SBW. Lamprey are currently petitioned for listing under the Federal ESA. Under the Federal ESA, coho are listed as an endangered species.

HABITAT REQUIREMENTS

Salmonids require a specific set of habitat criteria in order to maintain viable populations. These criteria have been discussed in previous chapters of this assessment, they include:

- Stream Temperature (Chapter 9);
- Water Quality (Chapter 9);
- Stream Complexity (Chapter 5); and
- Sediment Composition (Chapter 7).

Tables 10-1 through 10-3 describe the individual habitat requirements for chinook, coho, and steelhead. Each species has specific habitat needs; however, all salmonids generally require cold water, clean spawning gravel, and minimal turbidity to ensure continued generations of salmonids. Table 10-4 lists the ODFW habitat benchmarks for salmonids. These benchmarks are used by ODFW to describe stream health and determine the parameters for habitat improvement.

Table 10-1
Chinook Salmon Freshwater Habitat Requirements
(Source: U.S. Army Corps of Engineers http://www.nww.usace.army.mil/salmonriver/chinook.htm)

Life History Stage	Substrate Size	Water Depth	Stream Feature	Velocity	Water Temperature
Spawning	Most prevalent is 2-in to 3-in; Gradation ranges from 1-in to 4-in; Substrate must be stable to avoid shifting and damage to eggs	Generally less than 36-in and more than 20-in	Tail of pool and occasionally within long runs	More than 3-ft/sec	Optimum range is 42ºF to 51ºF, upper limit is 60.8ºF
Rearing Fry/Parr	NA	Variable, but generally less than 4-ft	During spring and summer: concentrated in backwaters, side channels, and edges where velocities are lower; During winter: fish are in deeper water and interstitial spaces in substrate	Slow, but flowing (edge of main channel)	Optimum range is 53ºF to 60ºF, upper limit is 77ºF for short time periods
Smolts	NA	Variable	Main channel free of obstructions	Variable	Same as fry
Adults	NA	More than 5-ft or in areas with at least 3-ft that have cover	Hold in main channel, logjams, and deep holes in the area of where they spawn	Variable	Same as fry

Table 10-2
Coho Salmon Freshwater Habitat Requirements
(Source: Coho Habitat Requirements http://users.snowcrest.net/sikfarm/coholife.html)

Life History Stage	Substrate Size	Water Depth	Stream Feature	Velocity	Water Temperature
Spawning	1.3 cm to 10.2 cm in diameter; <5% fines up to 10%fines	10cm-54cm	Low gradient riffles that run over small gravel	30cm/s to 91 cm/s	Optimum range is 43ºF-50ºF
Rearing Fry/Parr	NA	Variable	Prefer deep pools <3-ft with plenty of overhead cover	Variable	Optimum range is 50ºF-59ºF
Smolts	NA	Variable	Pools and slack water during summer months, associated with large woody debris (LWD), undercut banks, overhanging vegetation	Variable	Same as fry
Adults	NA	Variable	Deep pools containing root wads, boulders, and heavily shaded sections of stream	Variable	Same as fry

Table 10-3
Steelhead Trout Freshwater Habitat Requirements
(Source: U.S. Army Corps of Engineers http://www.nww.usace.army.mil/salmonriver/steelhead.htm)

Life History Stage	Substrate Size	Water Depth	Stream Feature	Velocity	Water Temperature
Spawning	1-in to 3-in, must be stable to avoid shifting and damage to eggs	1-ft to 2-ft	Not much spawning in main channel, primarily in small tributaries and side channels; Occurs in tail of pool, long runs, and in areas of thermal refugia	Variable	Optimum range is 50ºF to 60ºF
Rearing Fry/Parr	NA	Variable	During 1 to 3 yrs., juveniles seek cover in pocket water of swift flowing tributaries;	Reside in edges and pocket water of main channel flow, behind large boulders	Optimum range is 53.6ºF to 64.4ºF; upper limit is 77ºF for short time periods
Smolts	NA	Variable	Main channel free of obstructions	Variable	Same as fry
Adults	NA	2-ft to 6-ft	Hold in pool-like runs; less than 4-ft deep, but generally more than 2-ft	Same as fry	Same as fry

Table 10-4
ODFW Habitat Benchmarks

Habitat Condition	Undesirable	Desirable
Pools		
Pool Area	<10%	>35%
Pool Frequency	>20%	5 to 8%
Residual Pool Depth	<0.2%	>0.5%
Complex Pools	<1%	>2.5%
Riffles		
Width/Depth Ratio	>30%	<15%
Gravel	<15%	>35%
Silt-Sand-Organics	>20%	<10%
Shade		
Shade	<60%	>70%
Large Woody Debris		
Pieces/100m Stream Length	<10	>20
Volume/100m Stream Length	<20	>30
"Key" Pieces (>60cm and 100m long)/100m	<1	>3
Riparian Conifers		
Number >20in DBH/1000ft Stream Length	<150	>300
Number >35in DBH/1000ft Stream Length	<75	>200

ANALYSIS OF AVAILABLE DATA

Data were gathered from various public agencies, including ODFW, BLM, National Oceanic and Atmospheric Administration (NOAA), and RBFAT. Private stakeholders within the watershed also provided data independently gathered for personal use as well as historical anecdotal information about the fisheries within the SBW.

Sub Watershed Data

Fish presence/distribution data were acquired from ODFW's Rogue Basin Fish Database. Fish barrier data were acquired from a Rogue Basin Barrier Database compiled by the RBFAT in conjunction with other agencies.

RBFAT is a group associated with the Rogue Basin Coordinating Council (RBCC). Both groups consist of members from various state and federal agencies and watershed councils. RBCC works to encourage communication and collaboration between organizations that consider increased fish passage within the Rogue Basin a primary goal. RBFAT was developed solely to carry out the first priority of RBCC, which is to improve fish passage throughout the Rogue Basin.

The Rogue Basin Barrier Database was developed by RBFAT in conjunction with the Southwest Oregon Salmon Restoration Initiative, Southwest Oregon Province Resource Information GIS data CD set, American Fisheries Society, and the Rogue Watershed Office of ODFW (Restore the Rogue, 2003, [a]). This database prioritizes over 800 fish passage barriers throughout the Rogue Basin. To prioritize each barrier, a scoring system was developed, with points given based on criteria which included: the location of the barrier within the watershed; the percentage of available habitat found above the barrier; the presence of coho, summer and winter steelhead, spring and fall chinook, resident rainbow trout, and cutthroat trout; and the severity of the barrier. Points for each barrier were tallied and listed from highest to lowest. The higher the ranking, the greater the need is for modification with respect to fish passage (ODFW, 2003 [a]).

Fisheries data specific to the SBW were obtained from the Rogue Basin Fish Database and the Rogue Basin Fish Barriers Database. Using the data specific to the SBW, a SBW Presence/Distribution Database and a SBW Fish Barriers Database were developed. These fisheries data were organized into sub

watersheds. Due to the large area of the SBW, fish presence/distribution and fish barriers will focus on the larger streams within each sub watershed. Information from these databases for the main stream within each sub watershed is provided in the Table 10-5. Full data sets for both fish presence/distribution and fish barriers can be found with additional agency comments in Appendices I and J. Figure 10-4 shows the presence/distribution of salmonids as well as the location of barriers in the SBW.

Presence/Distribution Data

Information presented in Table 10-5, indicates the furthest river mile that each species has been observed above the confluence of the specified stream with a higher order stream.

Populations of fall chinook, coho, summer steelhead, winter steelhead, and trout are all present throughout the SBW. Their distributions vary among individual streams as well as among sub watersheds. Trout and summer steelhead occur in all main streams listed in Table 10-5. Winter steelhead are present in East Fork Evans Creek, Evans-Rock Creek, West Fork Evans Creek, and Pleasant Creek. Coho occur in more than half of all the main streams listed in Table 10-5. Fall chinook occur only in East Fork Evans Creek and Pleasant Creek. East Fork Evans Creek and Pleasant Creek are the only main streams that contain all of the previously mentioned species. However, East Fork Evans Creek only has 0.1 stream miles of fall chinook distribution. Though all species are present within both of these streams, their actual stream mile distribution may be affected by degraded stream conditions. For a complete data set of fish presence and distribution refer to Appendix J.

INSERT FIGURE 10-4 (11x17)

Seven Basins Watershed

Table 10-5
Species Presence/Distribution and Barrier Information for Seven Basins Sub Watersheds

Sub Watershed	Species Present to River Mile				
	fall chinook	coho	summer steelhead	winter steelhead	trout
Upper Evans Sub Watershed					
East Evans Creek	0.1	12.5	12.5	12.5	18
Evans Creek: Rock/Salt Subwatershed					
Rock Creek	NP	2.9	4.2	4.2	7.1
Salt Creek	NP	0.25	0.25	NP	5
West Fork Evans Creek Sub Watershed					
West Fork Evans Creek	NP	16.1	16.2	16.2	18.6
Evans Creek: May/Sykes Sub Watershed					
May Creek	NP	NP	1.8	NP	4.25
Sykes Creek	NP	NP	4.3	NP	5.5
Pleasant Creek Sub Watershed					
Pleasant Creek	2.6	7.3	12.5	12.5	12.5
Lower Evans Creek Sub Watershed					
Fielder Creek	NP	NP	1.3	NP	1.3
Rogue: Birdseye/Ward Sub Watershed					
Birdseye Creek	NP	0.25	3.25	NP	4.4
Ward Creek	NP	NP	4	NP	6
Rogue: Sardine Sub Watershed					
Sardine Creek	NP	3.4	3.4	NP	3.4
Foots Creek Sub Watershed					
Main Foots Creek	NP	3.3	3.4	NP	3.4
Rogue: Galls/Kane Sub Watershed					
Galls Creek	NP	NP	5.1	NP	5.1
Kane Creek	NP	NP	4.5	NP	5.7
Rogue: Table Rock Sub Watershed					
Sams Creek	NP	5.5	6	NP	6.5
Snider Creek	NP	NP	8.8	NP	8.8
Rock Creek	NP	NP	5.2	NP	5.2

NP = Not Present

Barrier Data

Approximately 150 fish passage barriers are present within the SBW, based on the RBFAT Barriers Database. These consist of concrete dams, metal culverts, box culverts, and corrugated metal pipe. The highest ranked barriers within the SBW are found on the Rogue River. This ranking is due to the type of barriers, the presence of threatened or endangered species, and the position of the barrier within the watershed.

Top 20 Barriers for Removal

Table 10-6 represents the 20 most critical barriers to be removed throughout the entire SBW. The Rogue River contains the greatest number of barriers listed in the top 20 for removal. This is followed by the Right Fork Foots Creek. Many of these dams were originally used for irrigation throughout the SBW. Today, these dams are considered by RBFAT and ODFW to be a hindrance to fish passage in the SBW.

Specific Fisheries Data

Specific ODFW data has been gathered which does not encompass the entire SBW. Therefore, these data have been separated from the Sub Watershed Data in an attempt to clarify the extent of fisheries data for the SBW. Specific fisheries data includes random coho spawning surveys, coho and steelhead smolt trapping surveys, summer steelhead redd counts, and carcass placement monitoring.

Table 10-6
Top 20 Barriers to be Modified or Removed from Seven Basins Watershed as Prioritized by RBFAT/ODFW

Stream	Subbasin	Location	Name	Final Score
Rogue River	Middle Rogue	RM 120.5	Ideal Cement Co.	1080
Rogue River	Middle Rogue	RM 122.5	GHID	1074
Rogue River	Middle Rogue	125.7	Gold Ray Dam	1050
Rogue River	Middle Rogue	RM 134	Table Rock Diversion Dam	900
Evans Creek	Evans	RM 3.0	Fielder Dam Fwy.	570
Evans Creek	Evans	RM 9.0	Wimer Dam	498
Evans Creek	Evans	RM 12.2	Moore Dam	468
Evans Creek	Evans	Appx. RM 14	Neathammer Dam	214.5
Evans Creek	Evans	RM 18	Evansizer Dam	199.5
Sams Creek	Middle Rogue	RM 2	NA	60
Sardine Creek	Middle Rogue	RM 3.0	Lower Kellog	60
East Fork Evans Creek	Evans	RM 1	Lower Alphonso Dam	55.5
Right Fork Foots Creek	Middle Rogue	RM 1.8	Rd 903	29.2
West Fork Evans Creek	Evans	RM 16	West Fork Evans Creek Road	27
Pleasant Creek	Evans	RM 6.0	Wakeman	24
Queens Branch Creek	Evans	RM 1.5	Unnamed Dam	22.5
Right Fork Foots Creek	Middle Rogue	RM 2.4	915	20.8
Ditch Creek	Evans	RM 0.9	Balt Dam	15
Constance Creek	Middle Rogue	RM 2.9	Hwy 234	14.8
Sykes Creek	Evans	RM 0.2	East Evans Creek Road	12.6

Random Coho Spawning Surveys

Random coho spawning surveys were conducted by ODFW in December of 2001 and November and December of 2002. Estimated run size and peak counts for coho were monitored in both years. The stream segments and reaches monitored varied between years (Figures 10-5 through 10-8). In 2001, peak counts of adults/mile were greatest in Sand Creek and Sams Creek. Sardine Creek had the lowest peak count of zero adults/mile. Sand Creek also had the greatest peak count in 2001 of jacks/mile. The estimated run size was greatest in Sand Creek for both adults/mile and jacks/mile. Evans Creek and Sardine Creek both had zero adults/mile (Figures 10-5 and 10-6).

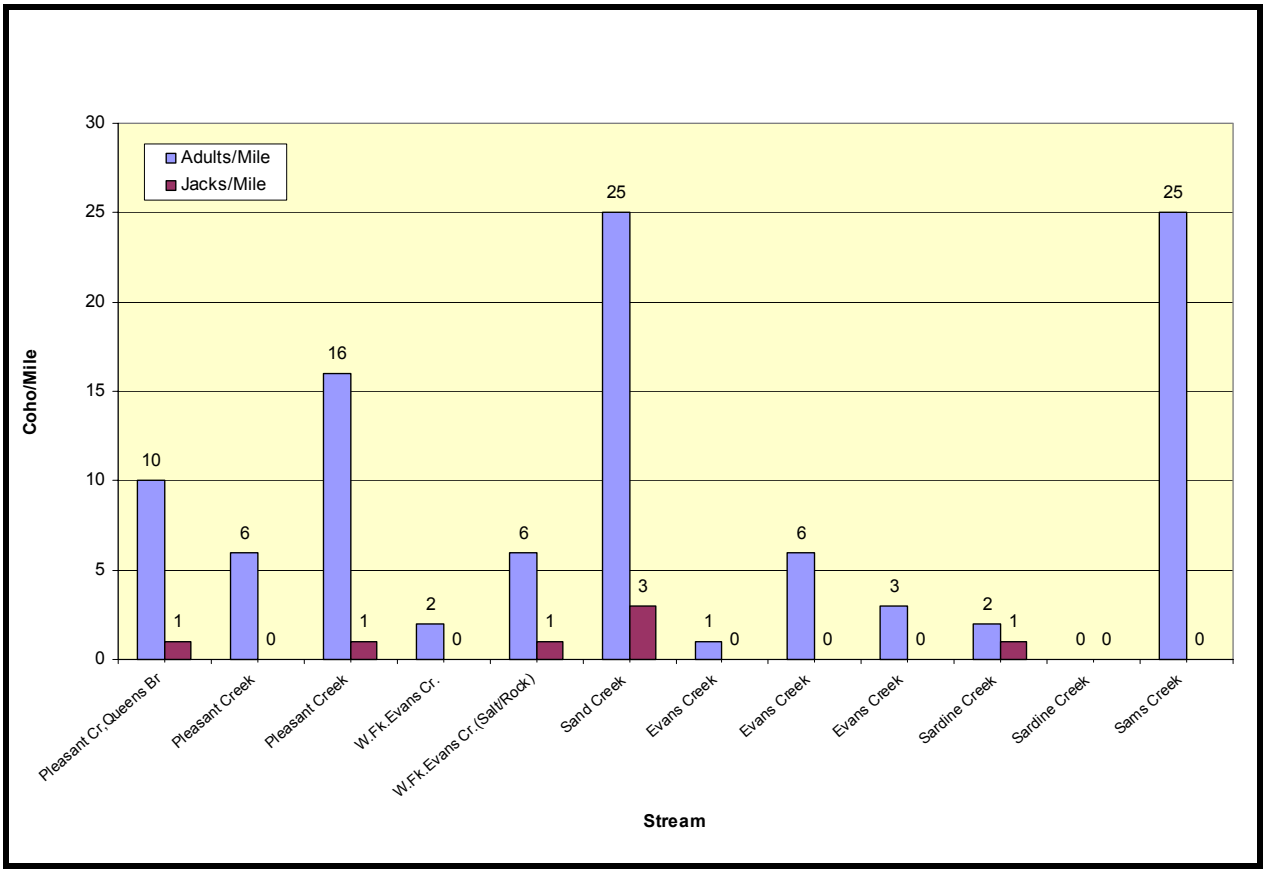


Figure 10-5
Peak Counts of Coho/Mile in 2001 ODFW Random Spawning Survey

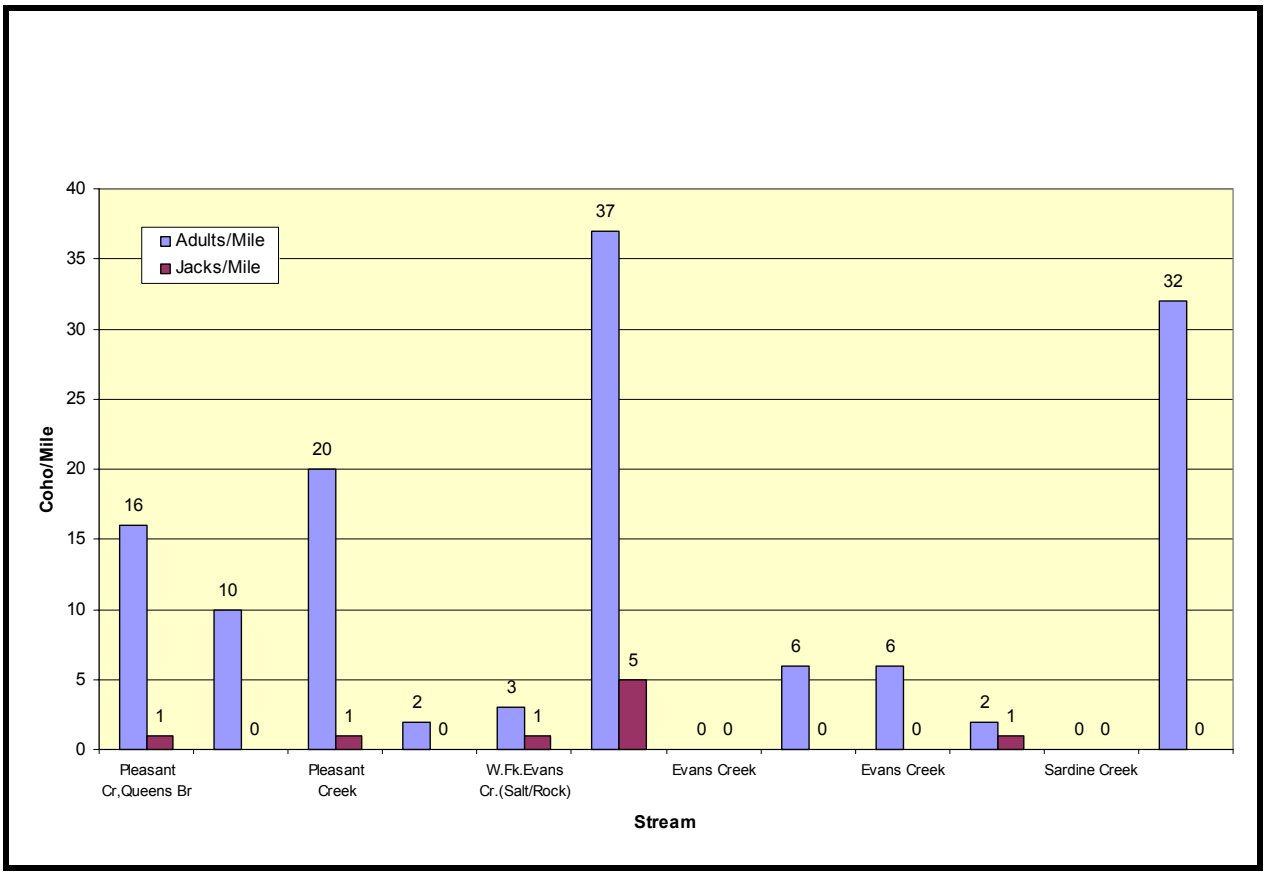


Figure 10-6
Estimated Size Run for Coho in 2001 ODFW Random Spawning Survey

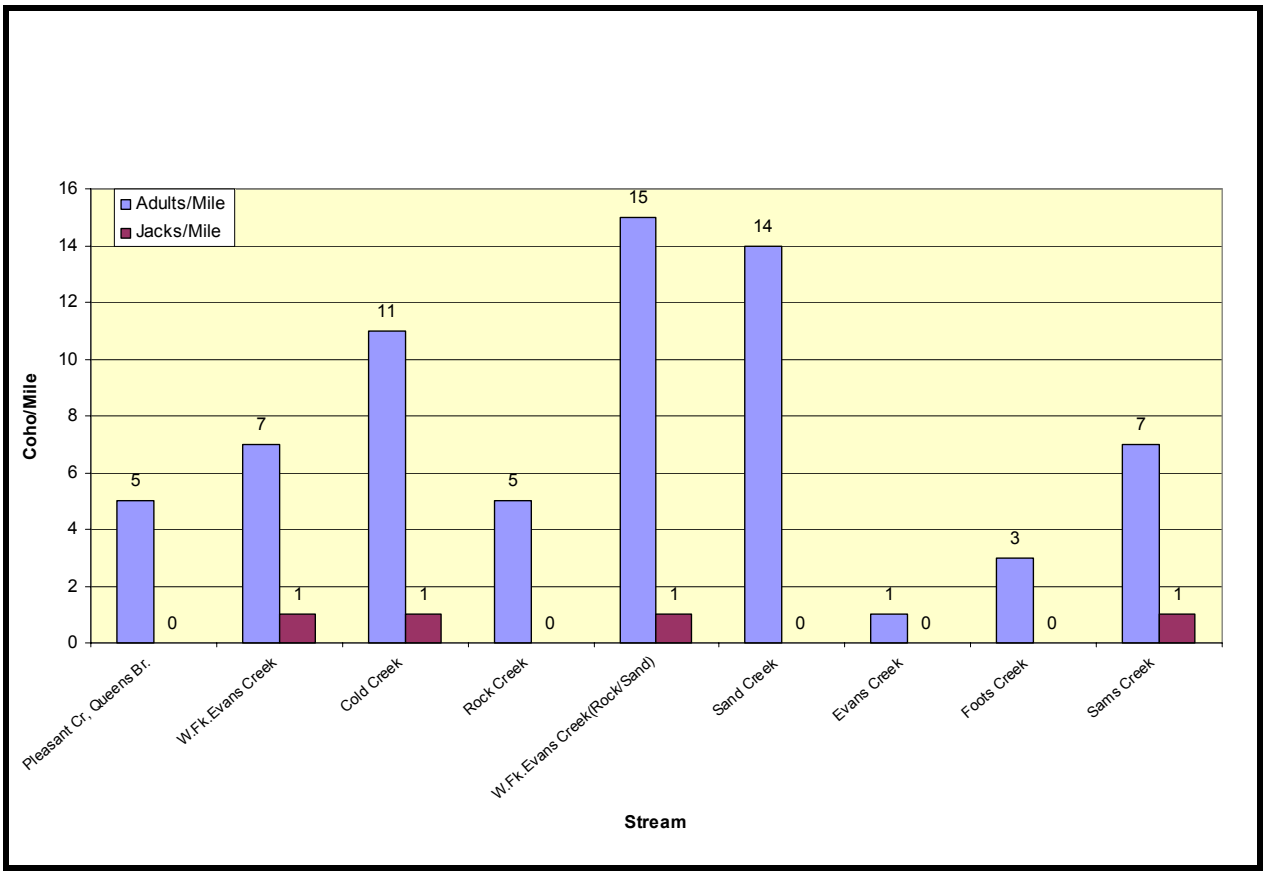


Figure 10-7
Peak Counts of Coho/Mile in 2002 ODFW Random Spawning Survey

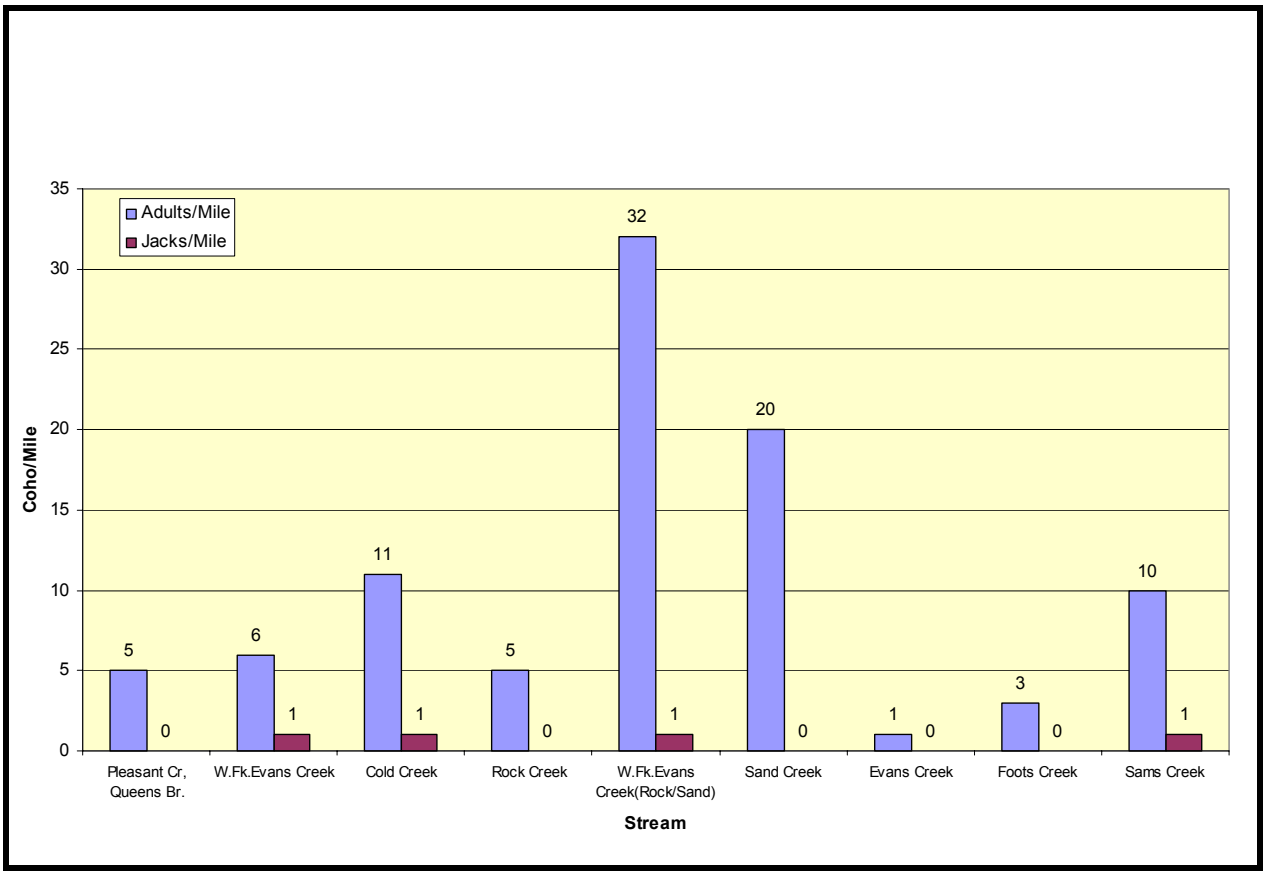


Figure 10-8
Estimated Run Size of Coho in 2002 ODFW Random Spawning Survey

In 2002, the highest peak count for adults/mile was in the West Fork of Evans Creek (Rock/Sand). Evans Creek had the lowest peak count of adults/mile. The West Fork of Evans Creek, Cold Creek, West Fork Evans Creek (Rock/Sand), and Sams Creek all had the greatest peak count of one jack/mile in 2002. The estimated run size for adults/mile was greatest in the West Fork Evans Creek (Sand/Rock) and lowest in Evans Creek. Estimated run size for jacks/mile was greatest in the West Fork Evans Creek, Cold Creek, West Fork Evans Creek (Rock/Sand), and Sams Creek (Figures 10-7 and 10-8).

These data provide a snapshot of the run size coho population throughout the watershed during two years. To truly understand the status of fish populations within a given stream or watershed, careful monitoring over long

periods of time are necessary due to the natural fluctuation of fish populations over time. Therefore, overall population trends from large data sets provide a greater understanding of fishery health within a watershed. Random coho spawning monitoring should continue for many more years to accumulate a data set which adequately depicts the spawning coho population within the SBW.

Coho and Steelhead Smolt Trapping

Coho and steelhead smolt trapping is conducted in the SBW by ODFW for multiple purposes. This trapping helps to obtain smolt production estimates for the creeks within the watershed. The timing of out-migration of coho and steelhead can be determined though these efforts. In addition, smolt size is also determined from coho and steelhead smolt trapping (Doino, 2003).

Coho and steelhead smolt trapping was conducted on the West Fork of Evans Creek March 8-June 2, 1999, March 1-June 7, 2000, March 1-May 3, 2001, and March 1-May 15, 2002. In 2002, the greatest amount of coho smolts were captured and recaptured. However, the greatest estimated population of coho smolts was in 2000. Capture and recapture of steelhead smolts was greatest in 1999. The year 2001 yielded no capture, recapture, or population estimate of coho or steelhead smolts. This is most likely due to the efficiency of the trap in 2001. Due to low stream flows, the traps die not work properly during this year. No distinct trends can be derived from these data, due to the short time frame of collection. The results of these surveys may be directly related to the methods used for trapping and the trap efficiency each year (Figures 10-9 and 10-10). Ninety-five percent confidence intervals have been placed in Figures 10-9 and 10-10 to depict the confidence in the population estimates. If the confidence interval is wide, as seen in the year 2000 for both coho and steelhead, then the confidence in the population estimate is low, as compared

to narrower confidence intervals seen in 1999 and 2002 for coho (Figure 10-9). Confidence in population estimates is due to the difference in number of coho and steelhead captured and recaptured.

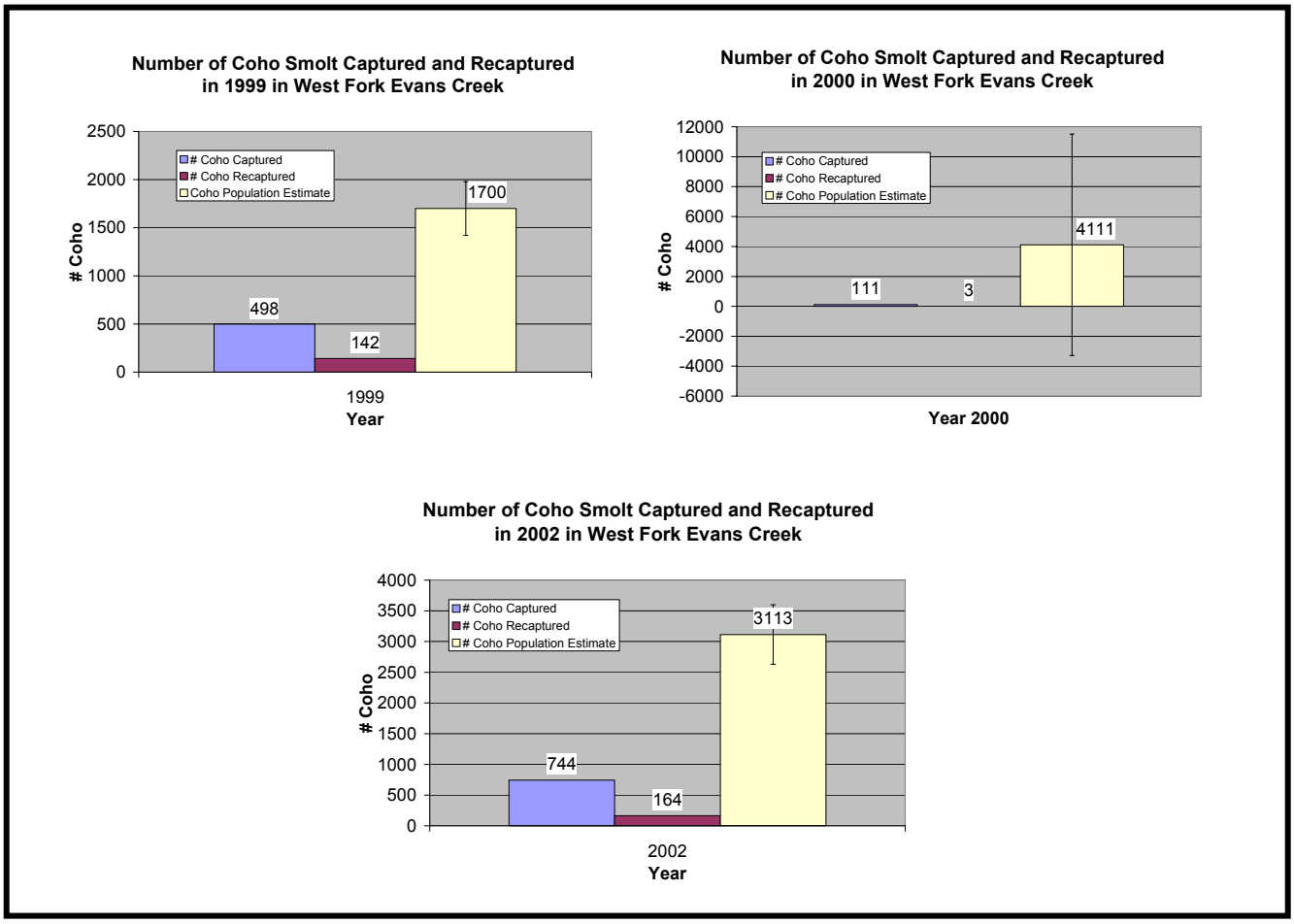


Figure 10-9
Number of Coho Smolt Captured and Recaptured 1999-2002 in West Fork Evans Creek

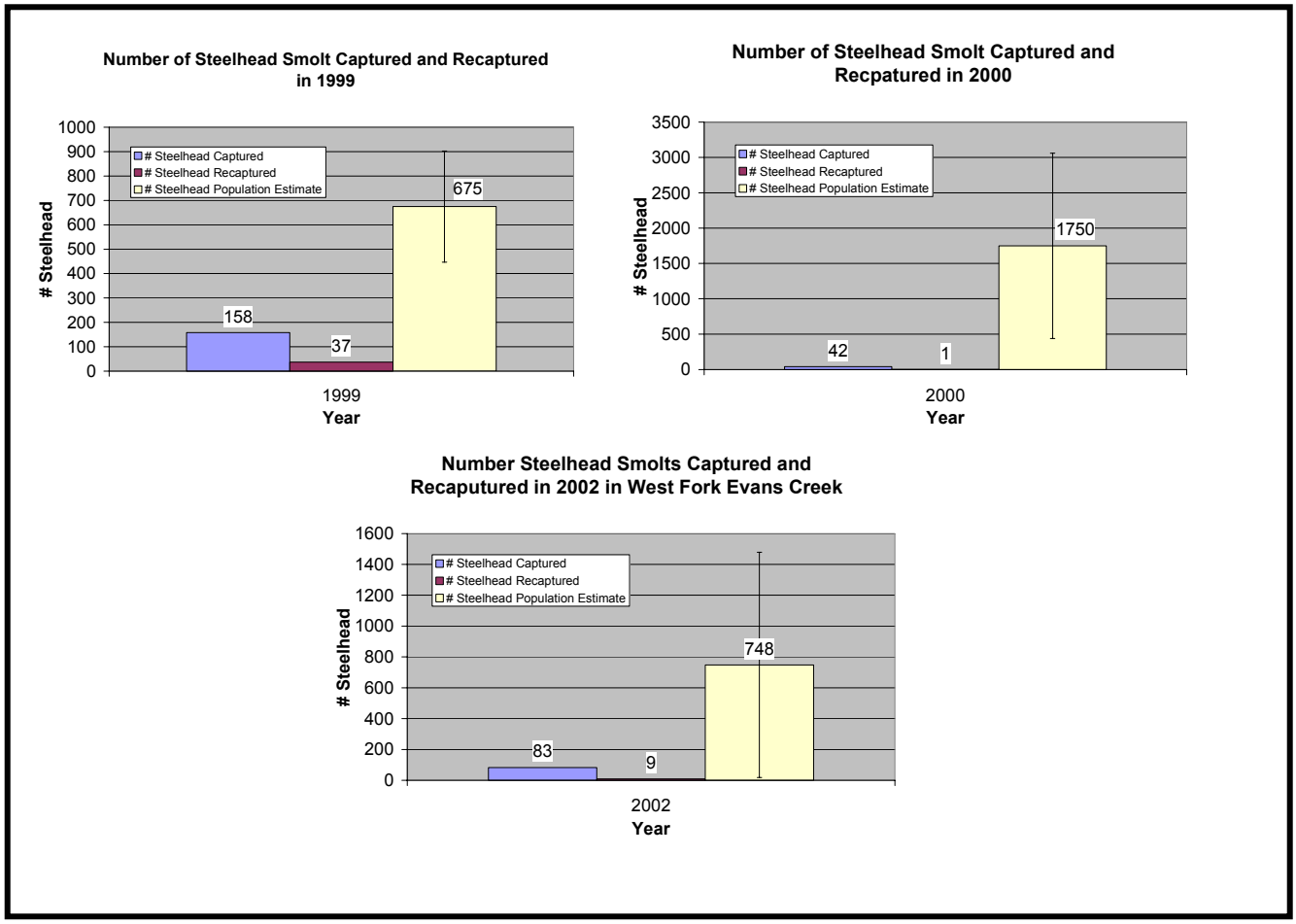


Figure 10-10
Number of Steelhead Smolt Captured and Recaptured in 1999-2002 in West Fork Evans Creek

Summer Steelhead Redds/Mile

Summer steelhead redds/mile were surveyed by ODFW on various streams within the SBW. These surveys are conducted to be used as an index to measure short and long term trends in spawner densities within selected reaches of streams known to be used by steelhead (Doino, 2003). Surveys took place on various streams between 1976 and 2003, but not all streams were surveyed in all years. The streams in these surveys include: Ditch Creek, Foots Creek, Galls Creek, Harris Creek, Kane Creek, Salt Creek, Sam's Creek,

Sardine Creek, and Sykes Creek. Kane Creek and Foots Creek are the only two streams which have been surveyed annually from 1976-2003. All other streams have smaller, less complete data sets for summer steelhead redds/mile. Due to these incomplete data sets, all stream data was graphed from 1990-1994. This was a common time frame held for all streams in the surveys, yielding a data set that could be more readily analyzed.

From 1990-1994 all streams, except Foots Creek, yielded less than 40 redds/mile for all four years. Foots Creek yielded close to 120 redds/mile in 1990, then less than 40 redds/mile for the remaining three years (Figures 10-11 and 10-12). In 1990, Foots Creek had the greatest number of redds/mile and Kane Creek had the lowest, near zero. In 1991, Foots Creek also had the greatest number of redds/mile and Ditch Creek and Sam's Creek both produced zero redds/mile. Ditch Creek yielded the greatest redds/mile in 1992, while Kane Creek and Galls Creek both had zero redds/mile. In 1993, Foots Creek had the greatest redds/mile, and Ditch Creek yielded the least at zero. In 1994, Sardine Creek yielded the greatest redds/mile and Kane Creek, Sykes Creek, and Galls Creek all produced zero redds/mile (Figure 10-11). This four year time span only allows for general analysis of year to year trends in redds/mile. Additionally, due to the limited duration of collection, graphing provides a skewed representation of the data.

The only two streams surveyed annually over the 27 year period were Kane Creek and Foots Creek. The historical counts of redds/mile were much greater than those currently observed. A distinct drop in redds/mile can be seen during specific spans of time in both streams. Redds/mile have generally been in decline since 1976 in both Kane Creek and Foots Creek. Kane Creek and Foots Creek both show recent increases in redds/mile since 2001 (Figure 10-12). This trend may be attributed to good ocean conditions (Doino, 2003).

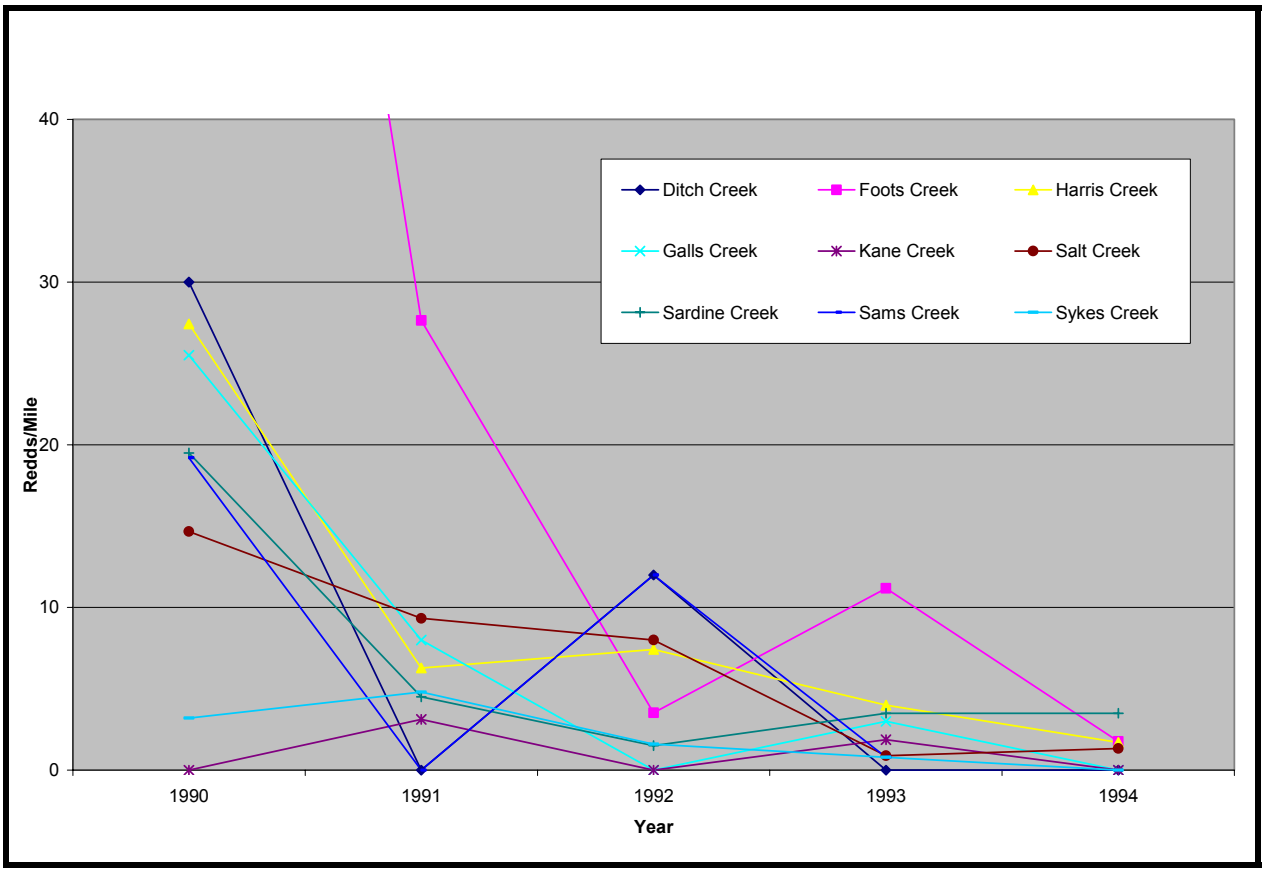


Figure 10-11
Summer Steelhead Redds/Mile in Seven Basins Watershed from 1990-1994

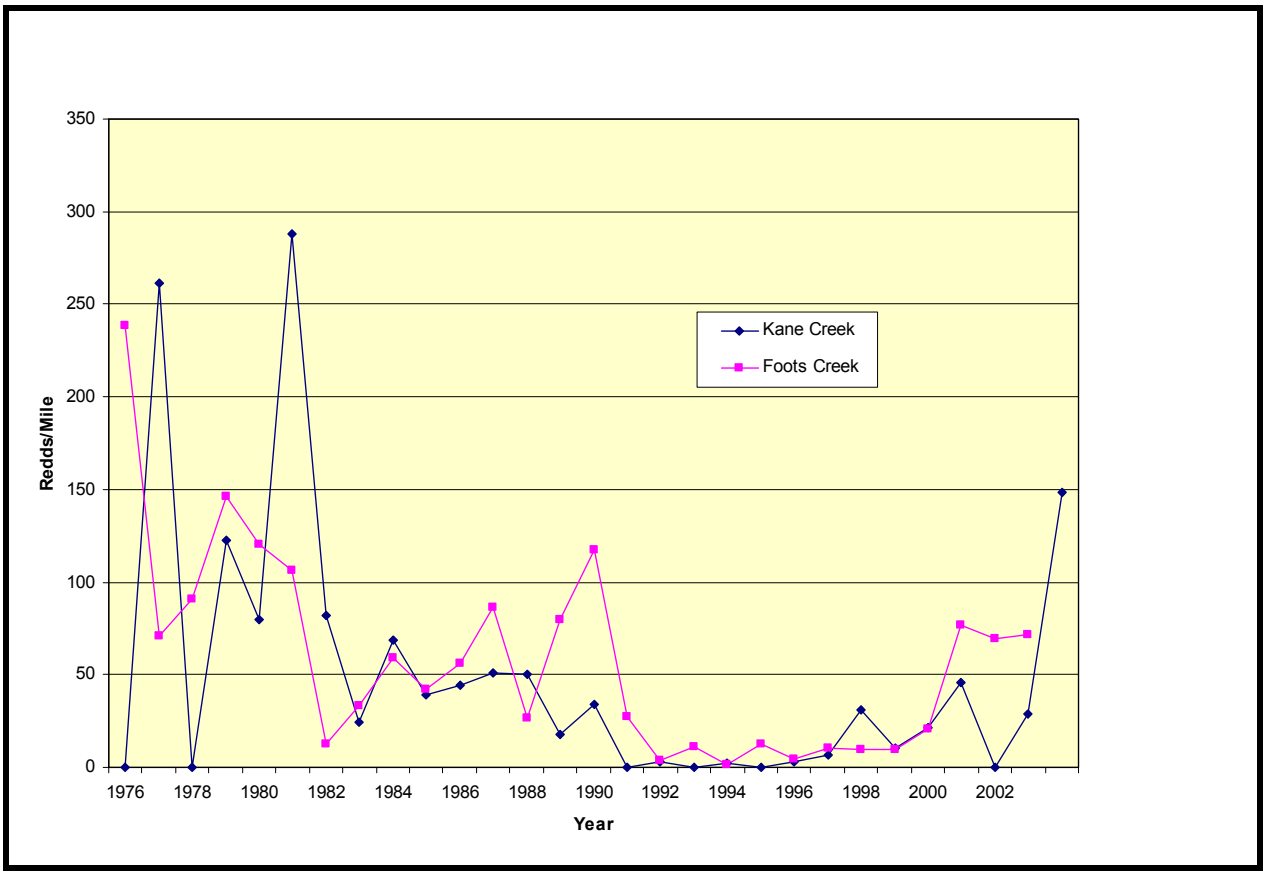


Figure 10-12
Steelhead Redds/Mile in Kane Creek and Foots Creek

This data set provides a 27-year baseline for redds/mile in two streams within the SBW. Natural variation in redds/mile is easily seen from year to year when graphing this data set. Long term trends are also depicted, showing the change in redds/mile over nearly three decades of record. This data set provides strong baseline data for analysis of current trends in part of what is considered "the center of wild steelhead production within the Rogue Basin" (Oregon State Game Commission, 1973). Following years of monitoring can easily be compared to historical data and trends observed in these streams. Data of this longevity is needed for not only fisheries, but for the other components of this watershed assessment as well.

CONCLUSIONS

Fisheries data within the SBW is relatively broad, but discontinuous. ODFW and RBFAT are the only agencies known to be collecting fisheries data in this watershed. ODFW has extensive presence/absence data which has been converted into maps. RBFAT has inventoried and prioritized fish barriers within the Rogue Basin, which includes the SBW. These combined data sets are highly useful resources.

DATA GAPS

Due to the fact that only two major agencies are currently tackling fisheries surveying and monitoring, much of the watershed has been neglected due to its sheer size and the limits these agencies face with regard to staffing and funding. As a result, data gaps exist within the fisheries assessment of the SBW. A list of these data gaps includes the following:

- Random coho spawning surveys have been conducted over the past seven years within the watershed. This is currently an incomplete data set in that insufficient data are available spatially and temporally to allow trends to be observed.
- Coho and steelhead smolt trapping surveys have only been conducted from 1999-2003, along West Fork Evans Creek. This is not a complete representation of the entire watershed.
- Summer steelhead redds/mile surveys do not encompass enough sample years or streams surveyed to adequately understand the trends in these data.
- Non-native species inventories are lacking for the entire watershed.

ACTION PLAN RECOMMENDATIONS

To put this assessment to use, an action plan will need to be written to prioritize monitoring projects for the Seven Basins Watershed Council. The following is a list of recommendations to be incorporated in the action plan with regard to fisheries.

- Watershed council members and volunteers should work closely with ODFW staff and RBFAT to combine the fish database and barrier database into one useful and accessible database. This should be maintained and updated quarterly. A GIS component should be used with this database to make it fully functional.
- Barrier priorities should be addressed with the cooperation of watershed council volunteers, RBFAT, and ODFW.
- Flow issues in relation to salmonid life cycles needs immediate attention. Monitoring flow throughout this watershed should be a top priority.
- ODFW fish surveys should continue and expand throughout the entire watershed. Use of trained watershed council volunteers will aid in expansion of resources and labor.
- Watershed council and agencies should be instrumental in local education regarding fisheries life cycles, effects of barriers, flow issues, and land use effects on fisheries.

REFERENCES

Busby, P.J.; Wainwright, T.C.; Bryant, G.J.; Lierheimer, L.J.; Waples, R.S.; Waknitz, F.W.; Lagomarsino, I.V., *Status Review of West Coast Steelhead from Washington, Idaho, Oregon, and California*, National Marine Fisheries Service, August 1996.

Doino, Jay, ODFW, 2003, Personal Communication.

Environmental Protection Agency (EPA), "EPA Region 10 Guidance for Pacific Northwest State and Tribal Temperature Water Quality Standards," April 2003, <http://www.yosemite.epa.gov/R10/water.nsf>

Futish, C.A.; Satterthwaite, T.P.; MacLeod, J.R.; Unterwegner, T.; Haight, D.R.; Nemeth, D.; Mullen, B.; *Draft of Rogue Basin Fish Management Plan* Oregon Department of Fish and Wildlife, April 1993.

Little Butte Creek Watershed Council (LBCWC), Little Butte Creek Watershed Assessment, 2003.

National Marine Fisheries Service (NMFS), National Oceanic and Atmospheric Administration (NOAA) Fisheries, "Anadromous Fish," <http://www.nmfs.noaa.gov/habitat/habitatprotection/anadromousfish.htm> (Accessed July 30 2003 [a]).

National Marine Fisheries Service (NMFS), National Oceanic and Atmospheric Administration, (NOAA), "Coho Salmon (*Oncorhynchus kisutch*) Threatened and Candidate Species," <http://www.nmfs.noaa.gov/prot_res/species/fish/coho_salmon.html> (Accessed July 22, 2003 [b]).

National Marine Fisheries Service (NMFS), National Oceanic and Atmospheric Administration (NOAA), "Major Threats and Impacts to Pacific Salmonids," <http://www.nmfs.noaa.gov/prot_res/PR3/Fish/salmon_impacts.html> (Accessed July 22 2003 [c]).

National Marine Fisheries Service (NMFS), Northwest Region, National Oceanic and Atmospheric Administration (NOAA) Fisheries, *Formal Section 7 Consultation on Wimer Dam, Maple Gulch Dam, Farmer's Ditch Dam, Beaver Creek Dam, and Buck and Jones Dam Removal Projects in the Rogue Basin, Jackson County, Oregon*, July 12, 2001.

National Marine Fisheries Service (NMFS), National Oceanic and Atmospheric Administration (NOAA), "Southern Oregon/Northern California Coasts ESU Listed Threatened," May 1997 <http://www.nwr.noaa.gov/1salmon/salmesa/cohosoc.htm>

Oregon Department of Fish and Wildlife (ODFW). <http://oregonstate.edu/dept/nrimp/information/fishcounts.htm> (Accessed April 15, 2003 (a).

Oregon Department of Fish and Wildlife (ODFW), "Fish Passage Report; Rogue Basin Fish Access Operating Plan Overview," <http://www.dfw.state.or.us/ODFWhtml/Research&Reports/> (Accessed 2003 [c]).

Oregon Department of Fish and Wildlife (ODFW) and Rogue Basin Fish Access Team (RBFAT), "Rogue Basin Fish Barrier Data Base," <http://www.restoretherogue.org> (Accessed 2003 [b]).

Oregon Department of Fish and Wildlife (ODFW), *Summer Steelhead Redd Counts, Rogue District Index Stream,* Provided in 2003 (d).

Oregon Department of Fish and Wildlife (ODFW), Coastal Salmonid Inventory Project Data Summaries, "Summary of Random Coho Spawner Surveys, 2002 Spawning Season," 2002, <http://oregonstate.edu/Dept/ODFW/spawn/data.htm>

Oregon Department of Fish and Wildlife (ODFW), Coastal Salmonid Inventory Project Data Summaries, "Summary of Random Coho Spawner Surveys, 2001 Spawning Season," 2001, <http://oregonstate.edu/Dept/ODFW/spawn/data.htm>

Oregon Department of Fish and Wildlife (ODFW), "Backgrounder: Oregon's Coastal Cutthroat Trout," Revised February 5, 1997 (a), <http://www.dwf.state.or.us>.

Oregon Department of Fish and Wildlife (ODFW), "Backgrounder: Questions and Answers About the Oregon Threatened and Endangered Species Act," Revised January 30 1997 (b), <http://www.dwf.state.or.us>.

Oregon Department of Fish and Wildlife (ODFW), "Backgrounder: Coho Salmon," Revised February 7, 1996, <http://www.dwf.state.or.us>.

Oregon Department of Fish and Wildlife (ODFW), "1995 Biennial Report on the Status of Wild Fish in Oregon," 1995, <http://www.dwf.state.or.us/ODFWhtml/Research&Reports/WildFish>.

Oregon Department of Fish and Wildlife (ODFW), "Rogue Basin Fisheries Evaluation, Effects of Lost Creek Dam on Winter Steelhead in the Rogue River, Phase II Completion Report," Rogue Basin Fisheries Evaluation Report, ODFW, U.S. Army Corps of Engineers Contract DACW57-77-C-0033, 1991.

Oregon Department of Fish and Wildlife (ODFW), "Rogue Basin Fisheries Evaluation, Effects of Lost Creek Dam on Winter Steelhead in the Rogue River, Phase II Completion Report," Rogue Basin Fisheries Evaluation Report, ODFW. U.S. Army Corps of Engineers Contract DACW57-77-C-0033, 1990.

Oregon State Game Commission, Research Division, *Ecology and Management of Summer Steelhead in the Rogue River*, 1973.

Restore the Rogue, The Rogue Basin Fish Access Team, "The Strategic Plan," <http://restoretherogue.org/rbfat/index.html> (Accessed July 25 2003 [a]).

Restore the Rogue, The Rogue Basin Fish Access Team, <http://restoretherogue.org/rbfat/index.html> (Accessed July 25 2003 [b]).

State of Oregon, "The Oregon Plan for Salmon and Watersheds," 2001, <http://www.oregon-plan.org/>.

Tuscon Myers & Associates, Bill Haight, *Sams Creek Anadromous Fish Enhancement Concepts*, February 1995.

Weitkamp, L.A.; Wainwright, T.C.; Bryant, G.J.; Milner, G.B.; Teel, D.J.; Kope, R.G.; Waples, R.S., *Status Review of Coho Salmon from Washington, Oregon, and California*, National Marine Fisheries Service, September 1995.

West Coast Chinook Salmon Biological Review Team; National Marine Fisheries Service, *Review of the Status of Chinook Salmon (Oncorhynchus tshawytscha) from Washington, Oregon, California, and Idaho under the U.S. Endangered Species Act*, December 1997.

Vogt, J., "Upper Rogue Smolt Trapping Project, 2002 Oregon Department of Fish and Wildlife Rogue Fish District Report," 2002, <http://oregonstate.edu/dept/nrimp/information/smoltreports.htm>

Vogt, J., "Upper Rogue Smolt Trapping Project, 2001 Oregon Department of Fish and Wildlife Rogue Fish District Report," 2001, <http://oregonstate.edu/dept/nrimp/information/smoltreports.htm>

Vogt, J., "Upper Rogue Smolt Trapping Project, 2000 Oregon Department of Fish and Wildlife Rogue Fish District Report," 2000, <http://oregonstate.edu/dept/nrimp/information/smoltreports.htm>

Vogt, J., "Upper Rogue Smolt Trapping Project, 1999 Oregon Department of Fish and Wildlife Rogue Fish District Report," 1999, <http://oregonstate.edu/dept/nrimp/information/smoltreports.htm>

CHAPTER 11
SUMMARY OF WATERSHED CONDITIONS

Prepared By:
Katie M. Mosser, EMS
David L. Graham, EMS

SUMMARY

Many of the critical watershed components within the SBW are currently unknown. Historical conditions have documented a watershed heavily mined, quickly populated, supporting agriculture, timber harvesting, and fisheries. The ramifications of these land use practices are still present, but have largely not been quantitatively evaluated within the SBW.

Limited data are available for the SBW related to water quality, water quantity, sedimentation sources and loading, riparian conditions, fish habitat and distribution, and the impact of past and present land uses on the various components of the watershed. Available information is highly variable both in time and space and has been collected by numerous groups for a wide range of applications. A significant effort is needed to field verify most of the information complied for this assessment.

A list of data gaps and suggested recommendations for action plan development were provided at the end of each chapter. For the purposes of Action Plan development the data gaps and recommendations are reiterated below for reference. It is critical that a well focused Action Plan be developed if the condition of the watershed is to be further understood. It is even more critical that a well designed and **implementable** program be developed if conditions within the watershed are to be improved. As the term Action Plan

implies, actions must be taken to further expand our understanding of the many facets of the watershed. This can only be accomplished by strong leadership from the Board of Directors, an enthusiastic volunteer program, development of good working relationships with state and federal agencies, and a vigorous education and community outreach program.

DATA GAPS

Chapter 3: Channel Habitat Type Classification

- Channel confinement designations have not been determined.
- Field verification has not been conducted for any CHT classifications.
- Stream size was not incorporated into this analysis due to the unavailability of ODF Stream Classification maps for the SBW.

Chapter 4: Hydrology and Water Uses

- Stream gage information is not available for all streams in the SBW. Historical data exists only for Evans Creek.
- There are no accurate records of the actual number of wells located in the SBW. A detailed well inventory documenting locations is not available.
- No information is available regarding the amount of water used as a result of exempt uses in the watershed. A survey should be conducted to quantify this gap.

Chapter 5: Riparian

- Riparian Conditions Assessment has not been completed for the entire SBW.
- Riparian Conditions Assessment must be mapped.
- Riparian Conditions Assessment must be ground truthed.
- Habitat surveys have only been located for six years (1994-2000). Recent riparian conditions need to be evaluated.
- All streams throughout the watershed need evaluation as conducted by DEQ in the Riparian Condition Assessment of 303(d) listed streams.
- 303(d) streams have not been mapped in relation to riparian condition.
- Riparian condition of 303(d) streams has not been ground truthed.
- Broad community education of importance of riparian areas and effects of land use practices on riparian areas is needed.

Chapter 5 (cont.): Wetlands Assessment

- National Wetlands Inventory Map is not complete.
- Baseline wetland water quality data is not available.

Chapter 6: Impact of Wildfire

- Fuels research.
- Comparison of efficiency of fuels reductions methods within the watershed.
- Community education of the benefits of fuels reductions.
- Affects of fire on soils, erosion potential, and slope stability.

- Inventory of current water chance locations within the SBW.
- Impacts of fire on water quality.
- Understanding of cumulative effect of fire on salmonid habitat.

Chapter 7: Sediment Sources

- No comprehensive field inventory or mapping of recent and historical landslides and severely eroded terrain is available.
- Quantification of landslide and erosion rates for both anthropogenic and natural areas has not been conducted.
- Inventory of roads by type, road density, and distance from riparian areas has not been completed.
- Mapping and evaluation of mine properties located upstream from major barrier structures is insufficient to evaluate impacts on stream sediments and aquatic habitat.
- Geochemical characterization of sediments behind dams that may be impacted by mine tailings has not been conducted.
- Inventory and mapping of streambank erosion has not been completed.

Chapter 8: Channel Modification Assessment

- The exact type and significance of each of the 645 modifications detected from the topographic map inspection is unknown.
- Topographical map inspections for channel modifications are lacking for a portion of the watershed.
- Information concerning channel modifications other than stream crossings and barriers to fish passage is lacking.

- Analysis of aerial photographs and field verification of identified channel modifications has not been conducted.

Chapter 9: Water Quality

- Water quality data are completely lacking for Rogue-Table Rock subwatershed, Evans-May/Sykes subwatershed, and Evans-Rock/Salt subwatershed.
- Limited and/or historical water quality data are available for Evans Creek-Upper subwatershed, Evans Creek-Lower subwatershed, West Fork Evans subwatershed, Pleasant Creek subwatershed, Rogue-Kane/Galls subwatershed, Rogue-Sardine subwatershed, Rogue-Birdseye/Ward subwatershed, and Foots Creek sub watershed.
- Available data sets are random and discontinuous both spatially and temporally.
- Existing data does not represent current water quality conditions in the SBW.

Chapter 10: Fish Assessment

- Random coho spawning surveys have only been conducted for the last two years. This is currently an incomplete data set in that insufficient data are available spatially and temporally to allow trends to be observed.
- Coho and steelhead smolt trapping surveys have only been conducted from 1999-2002, along West Fork Evans Creek. This is not a complete representation of the entire watershed.

- Summer steelhead redds/mile surveys do not encompass enough sample years or streams surveyed to adequately understand the trends in these data.
- Non-native species inventories are lacking for the entire watershed.

ACTION PLAN RECOMMENDATIONS

The Action Plan Recommendations are based on the data gaps present within the SBW. No attempt has been made during this assessment to prioritize the recommendations. Prioritization will be done by the Action Plan Committee of the Seven Basins Watershed Council. It is intended that the following recommendations be used to guide the generation of the companion document to this assessment: ***The Seven Basins Watershed Action Plan.***

Chapter 3: Channel Habitat Type Classification

- Channel confinement designations should be determined.
- Field verification should be conducted for the channel confinement designations once completed.
- Stream size should be incorporated into this analysis as ODF Stream Classification maps become available for the SBW.
- Highly sensitive and moderately sensitive CHTs should be prioritized for monitoring efforts with regards to LWD, fine sediments, coarse sediments, and peak flows.
- Field verification should be conducted for all CHT classifications.
- A database should be assembled to efficiently manage future data. A GIS component should be used with this database in order to make it fully functional, accessible, and current.

Chapter 4: Hydrology and Water Uses

- Use prediction equations developed by OWRD to estimate peak flows for primary streams in each subwatershed. Develop a data base of subwatershed characteristics needed for calculations.
- Design a stream gauging program and establish gauging stations in each subwatershed. Data can be used to evaluate the peak flow estimates based on prediction equations.
- Develop a plan to establish several weather stations within the SBW. Stations should be located various locations throughout the watershed that have different weather conditions (i.e., upland areas, Sams Valley, etc.) Data could be collected and by volunteers.
- Work with OWRD to develop a data base of wells with emphasis given to location and flow.
- Develop and interactive environmental data base coupled with GIS to document information collected and map spatial data.
- Provide educational information regarding surface water and ground water resources in the SBW.

Chapter 5: Riparian

- Riparian Conditions Assessment should be completed for the entire SBW.
- Riparian Conditions Assessment should be mapped for the entire SBW. By mapping this data in GIS, this component will become fully accessible, functional, and easily updated.
- Riparian Conditions Assessment should be ground truthed. Seven Basins Watershed Council members and community volunteers should

conduct ground truthing to increase understanding of riparian processes and effects of land use practices.

- Current riparian conditions need to be evaluated through continued ODFW habitat surveys. The contribution of SBW volunteers will aid in the continuation, regular occurrence, and community understanding of these surveys.
- All streams throughout watershed need evaluation as conducted by DEQ in the Riparian Condition Assessment of 303(d) listed streams. 303(d) streams should be mapped in relation to riparian condition. The use of GIS will make this data fully functional and accessible.
- Riparian condition of 303(d) streams should be ground truthed. SBW volunteers will provide DEQ with extra labor, and provide the Council with an enhanced understanding of agency processes and assessment goals.
- Baseline riparian data should be generated regarding plant and animal species within the SBW that are dependent on riparian areas during specific life cycle stages. SBW volunteers should produce a database and GIS component to make this data functional, accessible, and easy to update.
- Broad community education of the importance of riparian areas and the effects of land use practices on riparian areas is needed. The Seven Basins Watershed Council should provide community education and outreach with regard to basic riparian processes, effects of land use practices, and proactive land use practices which should be used by landowners.

Chapter 5 (cont.): Wetlands Assessment

- Seven Basins Watershed Council volunteers should work with agencies to create a database for baseline wetland water quality. This should be coupled with a GIS mapping component to make this database easy to update and readily accessible.
- Field verification of wetland locations should be conducted by Seven Basins Watershed Council volunteers to enhance understanding of location of wetlands, characteristics of wetlands, and effects of local land use practices.
- Community education regarding wetland functions, processes, characteristics, and effects of land use practices should be provided by the Seven Basins Watershed Council.

Chapter 6: Impact of Wildfire

- Investigate the relation between rainfall intensity and peak water discharge from burned watersheds, a relation that depends on the size of the rainstorm, the size of the burned area and burn severity, and the changes in infiltration capacity of the soil.
- Investigate hillslope and channel erosion and deposition processes after wildfire.
- Evaluate water quality impacts of wildfire and develop post-fire water-quality sampling protocols.
- Development of additional water chance sites.
- Develop an interactive environmental data base of fire information coupled with GIS to allow mapping and tracking of changes in the watershed as a result of fire activity.

Chapter 7: Sediment Sources

- Work with federal and state agencies to develop a program for characterization of sediments behind dams that have a high potential for contamination based on historic mining activity.
- Develop a program to map areas that have a high potential for slope instability. This should include field checking of areas mapped by ODF as having high to moderate potential for debris flows.
- Devise a strategy for mapping roads throughout the watershed and continue to map sediment sources associated with roads. This should include mapping distances from streams and determining widths of buffer zones along stream reaches.
- Develop an approach for quantifying the amount of sediment transport potential and impact to steams from both natural and anthropogenic sources. This should be coupled with sediment evaluations related to wildfire.
- Develop an interactive environmental data base coupled with GIS to document inventory information and map spatial data. All information collected as part of Action Items listed above.
- Provide community education related to the importance of sediment issues. This program should include ways that stakeholders can get involved in the characterization effort.

Chapter 8: Channel Modification Assessment

- The types and significance of the 645 modifications detected from the topographic map inspection should be studied and identified using aerial photographic analysis and field verification.

- Additional topographical map inspection should be completed for the entire watershed. This should be conducted in conjunction with aerial photographic analysis and field verification.
- Information concerning channel modifications other than stream crossings and barriers to fish passage should be obtained using analysis of aerial photographs and field verification.
- Research should be conducted to determine priorities with respect to channel modification mitigation. These issues should be addressed with the cooperation of watershed council volunteers, RBFAT and ODFW.
- All information thus obtained should be assembled into one useful and accessible database. A GIS component should be used with this database to make it fully functional.

Chapter 9: Water Quality

- Seven Basins Watershed Council and community volunteers should be involved in water quality sampling and monitoring within the SBW.
- Develop a comprehensive strategy to address specific water quality monitoring needs to include other watershed assessment components such as sediments, fire, toxics, urbanization and development, riparian areas, wetlands, fisheries, and fish habitat.
- Devise a sampling and analysis plan which takes into account collection, analysis, location, protocol, and frequency. This plan should include a Quality Assurance/Quality Control program to ensure high quality data is collected.
- Seven Basins Watershed Council should coordinate water quality sampling, monitoring, and analysis efforts with state and federal

agencies to maximize efficiency and promote broad dissemination of water quality results.

- Develop an interactive environmental data base coupled with GIS to document inventory information and map spatial data.
- Provide community education related to the importance of water quality issues. This program should include ways that stakeholders can get involved in the sampling, monitoring, and analysis.

Chapter 10: Fish Assessment

- Watershed council members and volunteers should work closely with ODFW staff and RBFAT to combine the fish database and barrier database into one useful and accessible database. This should be maintained and updated quarterly. A GIS component should be used with this database to make it fully functional.
- Barrier priorities should be addressed with the cooperation of watershed council volunteers, RBFAT, and ODFW.
- Flow issues in relation to salmonid life cycles needs immediate attention. Monitoring flow throughout this watershed should be a top priority.
- ODFW fish surveys should continue and expand throughout the entire watershed. Use of trained watershed council volunteers will aid in expansion of resources and labor.
- Watershed council and agencies should be instrumental in local education regarding fisheries life cycles, effects of barriers, flow issues, and land use effects on fisheries.

APPENDIX A
HISTORY OF SBW

Prepared by:

Linda Davis
Seven Basins Watershed Council

CHAPTER 1
PHYSIOGRAPHY OF THE SBW

The Rogue River is located in southwestern Oregon and flows through the SBW on its 215 mile course to the Pacific Ocean. The Rogue River headwaters begin at the foot of Mt. Thielsen and near Crater Lake. The congressionally designated "National Wild and Scenic" portion of the Rogue is 84 miles long. It begins 7 miles west of Grants Pass and ends 11 miles east of Gold Beach. The Rogue was one of the original eight rivers included in the Wild and Scenic Rivers Act of 1968.

As the Rogue River emerges from the Cascade Range, it cuts into Sams Valley, a broad alluvial valley in the Umpqua Formation (Baldwin, 1964). It then cuts through the Eastern Klamath Mountains that house the gold bearing area of the SBW. The Mountains are broken up into valleys, mountain and hill ranges, densely wooded in the 1850s and 1860s. The majority of hill slopes have been disturbed by a century of human use (settlement patterns, forest harvest practices, road systems, mining, and agriculture). Tributary streams of varying size generally follow the northeast to southwest orientation of mountain valley drainages. Within the SBW are a number of direct tributaries to the Rogue River: Snider, Sams, Curry Gulch, Kane, Blackwell and Faults, Galls, Sardine, Colvig Gulch, Miller Gulch, Foots, Birdseye, Schieffelin Gulch, Wards, Evans, and Savage Creeks.

WATERSHED ECOSYSTEM

Natural elements such as wind, water, geologic disturbances, insects, disease, drought and lightning caused fires, are all part of the ecological system that typically shapes a forest and ultimately the watershed. The ecology of many ecosystems is dependent on some of these elements; such as fire to maintain diversity. A number of species are dependent on fire to reproduce.

As forest ecosystems have evolved; the composition, structure, and ecological process of the forest have essentially produced an ongoing physical environment. Nature has not been the only hand in disturbing and shaping

the historical ecosystem. The indigenous people had long interacted with the ecosystem where they lived; changing the landscape to promote the resources important to them.

Later the Euro-Americans, and to some extent the Chinese, would help to shape the SBW by developing the economic resources that were significant to them. The fur trade, game, fish, minerals, water, trees, and the land were all resources that have been derived from this watershed. The method in which these resources were reaped and the affect of natural elements served to create a watershed is a reflection of its historical conditions.

SBW CLIMATE AND WEATHER

The SBW is located in the region of southern Oregon that has been described by many locals as the "Banana Belt." The region lays in what has been explained as, a transitional area between four very different climate zones: Pacific Maritime to the west, Oregon High Desert to the east, California Mediterranean to the south, and Northern Temperate to the north.

Southern Oregon's generally mild climate is one of its most attractive features. The regions experience all four distinct seasons. Winters are mild; average temperature can range into the 50s in the daytime. The coldest month is traditionally January; the minimum average around 33 degrees and the maximum temperatures averaging 47 degrees Fahrenheit. Annual snowfall is minimal on the valley floor, but does snow enough at times to close school for a day (Rogue River Chamber of Commerce, 2002).

Precipitation levels averaging between 19 inches on valley floor and up to 47 inches at the higher elevation, of the more mountainous areas, but is generally less than 30 inches annually. The rain station at Modoc Orchard has 21.847 inches for, an average rainfall year for the complete years between 1915 and 1966 (NCDC).

Summers are characteristically dry with warm temperatures and low humidity. July temperatures range from 53 degree lows to 90 degree highs. A maximum temperature has been 115 degrees Fahrenheit in Medford. A welcome aspect of southern Oregon's dry, hot summer days is the cooling winds that generally begin in the late afternoon. Summer rainfall is less than 2 inches in the valleys (Rogue River Chamber of Commerce, 2002).

HISTORIC FLOODING

The watershed has experienced both periodic flooding, with resulting landscape and channel changes as well as drought. Less than one inch falls during the summer months. Snow accounts for very little of the available moisture in the lower elevations. Major floods occurred in 1853, 1858, 1861, 1866/67, 1880, 1890, 1927, 1945, 1948, 1953, 1955, 1962, 1964, 1974, and 1997.

DROUGHT CYCLES

Recurrent drought cycles have been shown to be influenced by repeated *El nino* and *La nina* cycles. According to Taylor and Southards (1997) "There is increasing evidence that salmon populations in the northeast Pacific are significantly influenced by long-term climate changes. Recently, scientists have found that salmon returns in the Northwest show long-term behavior which closely follows the climate cycles. In the Northwest, temperature and precipitation data go back about 100 years. During that time there have been four relatively distinct climatic periods (Taylor and Southards (1997):

- 1896-1914 – Generally wet (and cool)
- 1915-1946 – Generally dry (and warm)
- 1947-1975 – Generally wet (and cool)
- 1976-1994 – Generally dry (and warm)

They note that "in any given period, not all the years are dry or wet, but that a high percentage follows that pattern." For example, in 1915-1946, there were 22 dry years and only 10 wet ones. Consecutive dry years were common (indicating drought periods). The wet period immediately following had 21 wet years versus 7 dry ones, and consecutive dry years never occurred. Droughts were nonexistent during the latter period, although there were several major floods. The most severe drought years recorded were the years of 1929–1931. The entire Pacific Northwest experienced an extended drought from 1976 to 1995. 2001 was the driest year since recording began (Taylor and Southards, 1997).

SBW COMMUNITY

The SBW community encompasses the cities of Gold Hill, Rogue River, and historic unincorporated hamlets. During their day, Asbestos, Beagle/Antioch, Dardanelles/Kane Creek, Evans Valley/Wimer, Foots Creek/Draper, Fort

Birdseye, Fort Lane, Rock Point, Sams Valley, Spikenard/The Meadows, Table Rock, and Tolo/Willow Springs/Fort Lane, were distinct autonomous rural communities.

The 1886 list of 19 Voting Districts for Jackson County list six registers and clerks, (in the watershed), that were appointed by the County Commissioners court, in conformity with the registry law passed by the last legislature, who would also act as judges and clerks of elections: District No. 10: Table Rock, District No. 11: Willow Springs, District No. 12: Rock Point, District No. 13: Woodville, District No. 14: Pleasant Creek, and District No. 15: Foots Creek (Ashland Tidings, 1880).

Prior to World War II, the economy of the watershed communities was based on what the land would yield; whether it be mineral, tree, water power, or harvest from the soil. Post World War II saw a shift to a more timber based industry. The heaviest timber extraction taking place in the watershed occurred between the years 1950-1980. Today, mining, agriculture and forest products have seen a decline, influenced to some extent by less available raw product, federal trade agreements and imports, as well as politics and other outside influences. The trend in recent years in the Rogue Valley has been a move from these historic industries to service industries, increased government services, tourism, manufacturing, and processing.

Today's residents living within the watershed are a real smorgasbord of lifestyles, interests, and employment. A typical rural neighborhood may be comprised of someone who is the third or fourth generation living on the same land, a retired California transplant, a medial professional, retail clerk, cattleman, or owner of commercial business. People vary in their knowledge of county ways and live in harmony with their surroundings.

Being on the I-5 corridor is advantageous to the people living up the gulches and creeks as well as in the cities of Gold Hill and Rogue River. A hundred years ago, a trip to Medford by team and wagon took six hours. Today the same trip takes only 20-30 minutes. They can live in a rural or small town setting and have a quick commute to work in the nearby cities and have all the conveniences of modern life.

Urban sprawl has encroached upon some of the best farmlands as housing demands have increased. Jackson County has grown at two percent a year for the past fifteen years. Greater demand is being placed on the land and available water resources. Paved roads convenient for quick travel also absorb the solar rays and radiate the stored heat. One wonders to what effect the blacktop has on the water temperature of the nearby waterways.

CHAPTER 2
INDIGENOUS PEOPLE/NATIVE POPULATIONS

It is estimated that humans have been present in southwest Oregon for at least 10,000-12,000 years, and possibly earlier (LaLande, 1982). Beckham estimated the total of Native population living in southwestern Oregon at the time of Euro-American contact at about 10,000 people (Beckham, 1971).

Though, there is little definite information as to where they came from, archaeological research seems to indicate that the natives of the Rogue, may have migrated into the area from the Plateau. Radiocarbon dating of archaeological sites including Cascadia Cave in the western Cascades, the Marial Site in the Rogue River Valley, and several localities along the Long Tom River west of Eugene is between 6,000-10,000 years old. A long-standing way of life focused on hunting and root crops is indicated by the stone tools and charred plant remains at the sites (Buan and Lewis, 1991).

The "Rogue Rivers," according to various authorities, called themselves Lo-to-ten, Tutatamy, Totutime, Tootouni, Tootooton, Tutoten, Tototin, Tututna, and Too-too-na; all of which may be regarded as the same word, uttered variously by individuals of different tribes, and reproduced in writing in varying was as well. Tribes of restricted numbers frequently called themselves by the name of the chief (Wailing, 1884). They lived in small, independent villages in semi-subterranean plank houses.

Much has been lost of the primitive history, culture and arts of the native people of the Rogue. There are a few official government reports dealing with their language and a limited account of their life and customs to tell us of this now vanished people. It is a limited history that has been maintained, for the most part by incidental segments of the accounts of their extended and bitter struggles with the Euro-American's. In the early 1900s linguistics and ethnographers began interviewing the last of the Takelma. From these interviews comes much of our information on the life and customs of this vanished people.

It is believed that they were a relatively friendly and peaceful people; until their home was threatened and their land and women taken from them by Euro-Americans, by whom they were considered fierce and war-like (Jackson County

Extension Office, 1980). According to Morehouse-Genaw, the Indians that lived around the valley could be very aggressive. If a neighboring tribe blocked a stream and prevented salmon from reaching another tribe, it could be a cause for war (Morehouse-Genaw). There also is indication of occasional warring with the Shastas.

The land use of the hunters and gatherers was closely related to their subsistence economy. They followed the food sources and the settlements moved with the seasons, except where staple resources were available most of the year. Meadows and wetlands that provided abundant wildlife were preferred to steeply inclined canyons. Winter settlement was mainly along the river. Summer encampments tended to be in the upper elevations for hunting and gathering seasonal crops.

Villages were usually dispersed to maximize the food sources. The native groups had similar economies, though their environment provided food specialties. Presence of grinding tools indicates subsistence partially based on wild roots, seeds, and vegetables (Follansbee and Pollock, 1978).

Animal husbandry was not part of native agricultural practices, although dogs were apparently used some in hunting. In Ogden's 1827 journal, he reported of his men to have seen a domesticated cat in a rather wild state. Ogden presumed it must have come from the Coast as there were almost a dozen in every village along there (LaLande, 1991).

Before Euro-American contact, horses were evidently unknown to the people west of the Cascade Range of Southern Oregon. From Ogden's 1827 trek along the Rogue River, he deduced that from their awe-struck reaction to his brigade's mounts, that the natives had never before seen such animals. The native people were quick to see their usefulness and soon took advantage of the increased mobility offered by the beast. The native people of southwestern Oregon soon acquired a reputation among Euro-American trappers as accomplished horse thieves. In 1841, a sighting of "three mounted Indians" was recorded, as being seen in the open plains of the Rogue River Valley, during a venture of a U.S. Exploring Expedition through the region (LaLande, 1991).

THE LINGUISTS, ETHNOGRAPHERS, AND ANTROPOLOGISTS

The Takelma, whose name (Da-agelma-an) means "those living alongside the river," lacked a written language which curtails any record of their history. Much of the information we have today is the result of linguists,

ethnographers, and anthropologists. Sapir, Harrington, and Drucker were the primary Ethnographers whom undertook to research the Takelma language (Jackson County Extension Office, 1980).

Edward Sapir's research took place around 1906. His interviews with Mrs. Frances Johnson took place during that time. She was one of his primary sources of information. By that time the Takelma language was spoken by only three or four older women. Frances was one of the last surviving Takelma Indians living on the Siletz Reservation. The results of his study appeared in various journals of the early 1900s (Gray, 1987).

John Peabody Harrington interviewed Mrs. Frances Johnson about twenty-five years after Sapir. She was his primary source of information for the Lowland Takelma. Molly Orton or Orcutt who spoke the Upland or "Table Rock" dialect was his primary informant of that group (Gray, 1987)

Philip Drucker's informant was also Molly Orton for the areas around Table Rock and eastward in the Bear Creek Valley. According to Drucker, Molly was the last member of her people to have any recollection of the old culture (Gray, 1987).

THE TRIBES AND THEIR TERITORY

Upland Takelma or Lat-ga-wa

In describing the territory of the Upland Takelma, Edward Sapir in his 1907 article on the Takelma noted: "they dwelt further to the east of the Lowland Takelma, occupying the poorer land of the Upper Rogue, east say of Table Rock towards the Cascades and also in the neighborhood of the present town of Jacksonville" (Gray, 1987).

Little Butte Creek drainage formed the approximate northeast boundary at its junction with the Rogue River. The entire Table Rock region extending to Gold Hill was Upland Takelma land, and according to Molly Orton, "…a line goes from Gold Hill to Jacksonville separating the Ashland -Jacksonville-Table Rock language from Frances [i.e., Lowland Takelma] language" (Gray, 1987).

The hunting and gathering of the Upland Takelma relied less on fish than the Lowland Takelma. They would fish for salmon when the water was low near Table Rock. The women split, dried, or pulverized the fish to be put up for later use. Vegetable foods in their diet were acorns, pine nuts, grass seeds, and camas. Deer, rabbits, and other game were hunted or snared. Protein

supplementation in the diet could include caterpillars, yellow jacket larvae, grasshoppers, and snails (Follansbee and Pollock, 1978).

Lowland Takelma

The Lowland Tekelma's nuclear territory extended westward from the Gold Hill-Jacksonville line along the northern bank of the Rogue River to Galice Creek (Gray, 1987). Their diet consisted of fish, meat, berries, acorns, and roots. The men often used snares for elk, deer, and antelope. Important foods derived from the water were salmon and trout species, crawfish, and freshwater mussels. They built fish weirs and dams of interwoven *Ceanothus* or "buckbrush" that helped them trap and harvest the river's abundant salmon and steelhead and to contain the fish for easy spearing. They also speared the salmon by torchlight. Trout were caught by using branches and beating the water driving them into pools where they were scooped out. Clubbing was also a method often used to kill animals or fish, after driving them into a fenced or netted area. The club was also the main weapon used on an enemy (Follansbee and Pollock, 1978).

Carbohydrate for the diet was supplied by acorns, bulbs, and roots while seeds and nuts provided fat. Fruit such as berries was a sweet and condiment to improve palatability. In the Rogue Valley, the acorn of the California Black Oak (*Quercus kelloggii*) was much preferred to that of Oregon white oak (*Quercus garryana*). A staple of the Takelma vegetable diet, the camas bulb, was dug with a sharpened and fire hardened stick of Mountain Mahogany or deer antlers. Manzanita berries were pounded into flour and mixed with pine nuts. The harvesting of tarweed seed required burning of the plants first. Perhaps this was done to prevent skin irritation. Some people find dermal contact with the fresh plant to cause a reaction much like that of poison oak. The women would collect the seed by walking through them, and hitting the seeds off the plant into a basket.

Fire was the main tool of choice in the Takelma groups agricultural practices; it kept meadows clear, and fostered seed and root growth. Journals of early travelers through the Rogue Valley report, a valley often filled with smoke (LaLande, 1987). Controlled burns were usually conducted by women who apparently specialized in this activity.

Twice a year, south facing slopes were burned to maintain grassy areas, and replenish meadows for wildlife and hunting, to clear trails and maintain open areas under the forest canopy, and add fertilize to new growth in plants and shrubs. The fires were of low intensity and rarely burned more than a few acres, a few hundred acres at the most. The fire reduced overall fuel load of the forests, by removing the combustible underbrush (Agee, 1990). The only

plant cultivated by both of the Takelma groups was tobacco and it was grown on land cleared by burning.

The Lowland Takelma had five basic shelter types: a semi-subterranean winter dwelling, the bark structures of the poor people, the man's sweathouse, the women's sweathouse, and the summer brush shelter. The rectangular winter dwelling was excavated to about one and a half to two feet and had a smooth stamped floor. There were four corner posts with connecting crossbeams. The walls were split sugar pine boards placed vertically between the crossbeams on the floor. Above the cross beams was a ridge post supported by two forked posts. The rectangular door, made of several pieces of lumber, was above the surface of the ground and had a dirt ramp for access. Inside a ladder stretched from the door to the center of the lodge, where the fire was located (Follansbee and Pollock, 1978). Brush fences were planted and used as windbreaks around villages.

Tobacco and bear grass are examples of items used in trade conducted among the tribes. Bear grass was used for basket making and rope making for animal snares.

The Rogue Bands

According to the best evidence, about 600 native people lived along the Rogue River between Table Rock and Evans Creek in the early 1850s. They were broke up into tribal communities of greater or less importance and all owed a quasi allegiance to Joe and Sam, (brothers) co-chiefs of the Table Rock band, the main division of the tribe (Wailing, 1884). They were the most dominant, largest and wealthiest of the seven bands of Rogues living around the Rogue Valley. Sam's winter residence was about where the town of Gold Hill now stands (Morehouse-Genaw).

Walling described the setting of the Table Rock bands being "in the mist of a pleasant country fruitful in game, roots, seeds, and acorns, while in the river, at the proper season, salmon swarmed by the thousand. They derived an easy and abundant living from the advantageous surroundings and were the dominate band of the tribe. Their number probably reached at one time 500 souls, but in addition quite a number of Indians of other tribes were settled within the valley and through some consideration of Indian polity, gave their adhesion to the Table Rock chiefs and were in effect a part of their people. This band was ever regarded with jealousy by the whites until their removal to a distant reservation in 1856, but with little cause (Wailing, 1884).

"The ethno-historic sources for southwest Oregon date from a time period when epidemic diseases may have already substantially altered the traditional lifeway

of the Indiana groups. Therefore we cannot project the 'Ethnohistorical present' very far back into the prehistoric past" (LaLande, 1991). By 1884, it was reported that there were no more that twenty-seven Takelma's.

The Contact Period

"Southwestern Oregon's Contact Period," during the time which the Ethnohistorical observations were made, lasted from the mid-1770s to the mid-1850s" (LaLande, 1991). The most direct Euro-American contact in Oregon began in this period. European contact on America's shores is considered to have begun with Columbus and should be marked as the beginning of the influx of European settlement. Balboa sailed around Cape Horn in 1513 and reached the Pacific Ocean. Other Spanish sea faring explorations were made up until 1603. Then 150 years elapsed before Spain sent out another exploration of the Pacific.

In 1787 American Captain's Robert Gray and John Kendrick of Boston arrived on the Oregon coast with a cargo of buttons, beads, and blue cloth, of which they bargained with the natives for the pelts of sea otters and other items. They in turn sailed to the Orient, where they sold pelts and bought tea and possibly silk and spices. To complete the voyage, they sailed west to Boston, making Gray the first American merchant sailor to circumnavigate the globe.

On Gray's second voyage to the Oregon coast in 1792, he noted a flow of muddy water fanning from the shore. He decided to explore his belief that it was the "Great River of the West." Gray crossed the treacherous sand bar and named the river after his ship, the "Columbia Rediviva." After a week or so of trading with the natives, Gray left without investigating where the river led. He then, once again circumnavigated the globe on a trading voyage.

About 1580, Francis Drake stopped about 30 miles north of San Francisco to repair his ship. Some suggest he perhaps went as far north as the southern Oregon coast. It wasn't until 1792-1794 that British sea voyages by Vancouver and Broughton and the overland expedition by MacKenzie for the Hudson's Bay Company gave Britain a strong foothold in the area. By 1824 they had established Fort Vancouver.

The 33 members of the Lewis and Clark Expedition reached the mouth of the Columbia River in the fall of 1805. They encountered the Clatsop Indians who shared their salmon, berries, and hunting lore. Five years after the Lewis and Clark expedition ended, parties were arriving by land and by sea to the new settlement of Astoria.

A British and American presence was soon entrenched in the Oregon Territory, and it was encouraged by the high demand for fur in Europe. A fierce competition pursued for dominance and ownership of the region. Trappers and explorers chronicled their observations of the land and people.

In 1828, Jedediah S. Smith journeyed through Northern California and Southern Oregon to the Hudson's Bay Company's settlements at Vancouver. Evidence shows that Smith followed the coast line in his trip northward to cape Arago (Wailing, 1884).

Hudson Bay Company employee, Peter Skene Ogden led a trapping expedition into the Rogue Valley and southern Oregon in 1827. In February of that year, his party camped along the Rogue River and he recorded some of his observations of the native people. Ogden's journal reports that over 1,500 pelts were taken from the Applegate area. As trapping continued over the next decades, the decline of beaver began to alter the stream side and aquatic environment. The result yielded more stream channelization, less channel complexity, and reduced the quality of habitat for fish (LaLande, 1987).

Through the 1830s and 1840s, there was not much Euro-American activity in the Rogue Valley. A reported lack of beaver and hostility of the native people apparently kept many of the trappers out of the area. In 1835 hostilities of the natives were confirmed when a party of eight white trappers (the Turner party), while camped on the south side of the Rogue, down river from Rock Point, were suddenly attacked and several died. In September 1837, the Ewing Young cattle drive from northern California to the Willamette Valley was attacked near this same location (Morehouse-Genaw).

With the opening of the Emigrant Road through the Southern Oregon region in 1846 and the California gold rush of 1849, the Rogue River Valley became a thoroughfare of ever increasing travel. Many of the travelers going south rushing to the gold fields of California, didn't want to waste time by stopping to deal with any difficulty with the natives. The result of inaction was that the native people came to feel that to escape immediate punishment was tantamount to escape from all punishment, and constantly grew bolder in their attacks upon the passing groups.

Robison points out that "One factor often overlooked in explaining the Indians' adjustment to white neighbors is that though they had seen white people pass through their region for twenty years, occupation of the region occurred, figuratively speaking, overnight" (Robison, 1943). There was little time for the native people to make any gradual adjustment to the new basis for relationship with the whites with which they were then faced for the first time.

CIRCA 1830-1856 EXPLORATION, GOLD RUSH AND INDIAN WARS

The Land Act of 1850

A land giveaway of 2,500,000 acres, that brought thousands of settlers to Oregon and the Rogue Valley. old was discovered in 1850 on Josephine Creek (a tributary of the Illinois) and in 1851 on Rich Gulch near Jacksonville. By March word had leaked out of the large strike and miners flocked in from every direction increasing the population by mid-summer to around a thousand persons. And lastly the completion of a wagon road connecting the county with California to the south and Douglas County to the north (the Yreka to Umpqua Road) led to an influx of settlers. The flood of outsiders coming to the region, was to lead to the beginning of prolonged period of "Indian troubles," that would continue through 1851-1856.

Jackson County government began with the appointment of the first county officials in March, 1853. These officers included three county commissioners, a county clerk, a sheriff, a prosecuting attorney, and a treasurer. An assessor and surveyor were added later.

The miners or settlers who flocked to southern Oregon gave little consideration to securing title to the land from the native people. As the farmers cultivated the land, it caused destruction to native people's sources of plant foods. The miners with operations along every stream of the region, and it began to affect the supply of fish. After the treaty of 1853, the discontent of the Indians was found to be largely among those hill tribes. This discontent was mainly toward the miner in the mountains who regarded his time there as being of a temporary nature, as compared to the farmer in the valleys expected to make a permanent home in the area. This may have been one of the major reasons why, after the treaty of 1853, the discontent of the Indians was found to be largely among those hill tribes, whose associations were usually with the mining population (Robison, 1943).

Euro-American Foray

The hostilities of 1853 lead to the signing of a Treaty near the "Table Rocks" in September of that year. The event was described "As the Indian and volunteer forces moved down into the valley, each keeping strict watch on the other. The ground chosen for the council was on the south side of Rogue River, the Indians making their encampment on an elevation directly opposite the cliffs of

Table Rock, and Lane in the valley one mile distant, on the spot where Fort Lane was soon afterwards established. The camp was selected by Lane and was near the location of present day Bybee Bridge, at the time called Hailey's Ferry.

Treaty With The Rogue River, 1853

"Article 2. It is agreed on the part of the United States that the aforesaid tribe shall be allowed to occupy temporarily that portion of the above described tract of territory bounded as follows, to wit: Commencing on the north side of Rogue River, at the mouth of Evan's Creek; thence up said creek to the upper end of a small prairie bearing in a northwesterly direction from Table Mountain, or Upper Table Rock, thence through the gap to the south side of the cliff of the said mountain, thence in a line to Rogue River, striking the southern base of Lower Table Rock, thence down said river to the place of beginning. It being understood that this described tract of land shall be deemed and considered an Indian reserve, until a suitable selection shall be made by the direction of the President of the United States for their permanent residence and buildings erected thereon, and provision made for their removal" (Treaty, 1953).

The majority of the area in which the SBW encompasses was the area that would be a temporary reservation. A Fort was built across the river from the reservation. It was named for General Joseph Lane.

Fort Lane was built and used by the U.S. military from 1853-1856. The fort served mainly as a protection for the native people from the Euro-American settlers. Chief Sam's tribe sought protection there several times (Wailing, 1884). Its location was in the southern part of the north eastern quadrant of Section 19, Township 36 South, Range 2 West, across the river from Lower Table Rock.

In Walling's opinion, "the Table Rock band, was ever regarded with jealousy by the whites until their removal to a distant reservation in 1856; but with little cause." The discovery of gold and the Land Act of 1850 brought on an influx of non-native settlers to the Rogue Valley. The flood of outsiders coming to the region, led to the beginning of a prolonged period of "Indian troubles" that would continue through 1851- 1856. There would be a series of treaties (1851, 1853, and 1854) and conflicts until what is know as the Rogue Indian Wars 1855-1856 ended with the removal of the remaining tribal bands to their permanent reservation at Siletz.

CHAPTER 3
AGGREGATE & MINING PRACTICES IN SBW

THE GEOLOGICAL RESOURCES

In the stories of their travels early explorers hinted that experienced miners might find precious metals in the "northwest country." The writings of Bonneville, Father De Smet, Fremont, and Lewis and Clark describe geological formations favorable to the discovery of precious metals. Reverend Samuel Parker devoted an entire chapter of his journal to describing the geological formations of Oregon country, including a list of minerals already discovered and he expressed his belief that gold and silver would probably be discovered at a future date (Spreen, 1939).

The mineral resources of central Jackson County are grouped by Oregon Department of Geology and Mineral Industries into four major headings: Aggregate, Metallic Minerals, Groundwater, and Energy Sources. The materials that can be removed profitably under current technological conditions are considered to be resources. Most of these resources are non-renewable.

Aggregate

Large active quarry operations are generally near major lines of transportation. Construction materials such as sand and gravel, quarry stone, and clay have occurred and been mined within the watershed. Like other minerals these materials can be mined only where they occur naturally. Limitations on production include hauling distance, weathering, thickness of overburden, and necessary specifications of the intended use. Other conflicts and constraints include noise, dust, increased turbidity, and preservation of fish spawning areas (Mason, 1977). Most of the current aggregate mining in the SBW is near the railroad and the river and not far off Interstate 5. Aggregate activities are in operation at sites near the river, off Table Rock Road, Modoc Road, at Tolo, on Kirkland Road, and west of Gold Hill past Rock Point on North River Road.

Minerals: Metallic and Nonmetallic

The history of most of the metallic and nonmetallic minerals shows a piece-meal production under a variety of economic and technological conditions. The experience of miners has shown that the gold veins of Jackson County are "spotted." Gold and silver have had a history of ongoing mining and there are probably quantities and grades still present and able to be mined. Coal, oil, and uranium are considered by the Oregon Department of Geology and Minerals to have a possibly high potential for future development in Jackson County. Though commercial quantities of uranium have not been discovered, "the bedrock geology, ground water conditions, and sediment source areas, of the Eocene bedrock units in the northern Bear Creek Valley and Sams Valley are consistent, however, with the development of economic uranium deposits in other areas of the United States." "Minerals with moderate potential of future development based on past production include clay, chromite, copper, lead, zinc, and tungsten. Generally, however known deposits are not large enough to compete with outside sources" (Mason, 1977). The Oregon Department of Geology and Mineral Industries, included mercury with molybdenum, nickel, platinum, manganese, and cobalt as having low probability of future development; due to outside completion and poor record of discovery (Mason, 1977). However, mercury has a history of being mined in the SBW on Evans Creek, at Spikenard, on Cinnabar Mountain and Ramsey Canyon.

Prominent resource developer, Dr. C. R. Ray held over 7,000 assorted acres of land, much within the SBW. "Getting old and wishing to retire" he wrote an ad to sell these properties. Along with his quartz and placer mines, he made claim of "Copper, Quicksilver, Iron, Coal, and some lands with good oil indications, there being two oil rigs operating nearby with good oil and gas showing. A granite quarry (similar to Barre Vermont Granite) marble, lime, and sandstone quarries adjoining the railroad were also present (Parks, 1916).

Groundwater

When we talk about ground water we are basically referring to wells and natural springs. Ground water begins as precipitation and soaks into the ground where it is found at various depths at any location on the Earth's surface. It is the water that fills the natural open spaces (e.g., fractures or pore spaces between grains) in soil and rocks beneath the land surface. It is comparable to the way water fills a sponge. Ground water is accumulated in underground geological water systems called aquifers. An aquifer is geologic material that is filled with water and will yield that water to the well. Ground water has the capability of moving sideways as well as up or down in response to gravity, differences in elevation, and differences in pressure. The movement

is usually quite slow, frequently as little as a few feet per year, although it can move as much as several feet per day in more permeable zones. Ground water does not occur as underground lakes or streams.

Two factors that affect water quality in Jackson County are pollution and natural mineral content. When rainwater comes in contact with any source of contamination at the surface or in the soil, it dissolves some of that contaminant and carries it to the aquifer. Ground water moves from areas where the water table is high to where the water table is low. Consequently, a contaminant may enter the aquifer some distance up gradient of a public or private drinking water and move towards the well.

Approximately 95 percent of Oregonians in rural areas are dependent on ground water. In many areas, ground water is the only source of household water. The majority of the households in the SBW are dependent on a well with the exception of the two cities of Rogue River and Gold Hill, and several private associations that have their own water systems and take their household water from the Rogue River.

"Because of local and regional variations in geological conditions, groundwater quality and availability vary considerably." The sedimentary rocks of the Sams Valley area are generally high in sodium carbonate. Many wells in southeast Sams Valley and Beagle have a high boron content" (Mason, 1977). Landfills, gas stations, industry, or agriculture, are more highly visible potential contaminates, but common everyday activities have the potential to contaminate and are widespread. These include septic systems, lawn and garden chemicals, pesticides applied to highway right-of-ways, storm water runoff, auto repair shops, beauty shops, dry cleaners, medical institutions, photo processing labs, etc. One of the properties of water is that it is an excellent solvent. It can contain lots of dissolved chemicals and, it takes only a very small amount of some chemicals in drinking water to raise health concerns.

The native populations found areas of natural springs a favorite place to camp or for settlement. Traditional Sam's Valley history is that Chief Sam's tribe had a camp or settlement at the springs along Sams Creek off Holcomb Springs Road. This site was referred to at an earlier date as the Eddington place and for the past fifty years as the Hilkey place. The property has recently changed ownership. In the early days of Euro-American settlement, springs were often developed into shallow wells.

Two resorts based on their mineral water springs were developed within the SBW. Bybee Springs Resort was constructed in 1892 (Liles and Boulter, 1992). Holcomb Mineral Springs Resort was operating in the 1930s (Outdoors Guide, 1930). Neither was near easy access to major transportation and tourist routes nor received the acclaim of the mineral springs of Ashland. Little

to nothing has been written of their use and history, but there are still a few locals who remember their parents using the waters to "cure" an ailment. The Holcomb Mineral Springs gave the water analysis of "grains per gallon;" Magnesia 28 grs., Lithia 6 grs., Sod. Chloride 6 grs., Sod. Bicarbonate 4 grs., Silica 4 grs., and about .06 of 1% Mercury. Although Holcomb Mineral Springs advertised hot mineral baths they must have heated the water as neighboring resident report there is no hot spring (Fitzgerald Collection, Circa 1930s).

Energy Resources

Jackson County has owned the now defunct power plant at the Gold Ray Dam since about 1971. Astute developers, the Ray brothers, harnessed the Rogue to produce electrical power at Gold Ray. There is no evidence of geothermic activity within the watershed. Solar and wind power are not being generated at a commercial level.

THE GEOGRAPHY OF THE GOLD PRODUCING AREAS

The region of western Oregon of which we are concerned are the Klamath Mountains. They are broken up into valleys, mountain and hill ranges, densely wooded in the 1850s and 1860s, with numerous streams of varying sizes, all or most all of which flow into the Rogue River. The river begins in the Cascade Range, and flows in a westerly and northwesterly direction to the sea and its mouth at Gold Beach. The Gold Hill mining district is located in the Klamath mountains between latitude 42˚23' north and 42˚43' north and longitude 122˚47' west and 123˚15' west, in northwestern Jackson County. Placers were worked in the district as early as 1853, but the big strike occurred in 1859 when lode gold was discovered. The state of Oregon Department of Geology and Mineral Industries officially recorded the amount taken from the Gold Hill pocket as $700,000 of which $400,000 was taken out in the first year. At 1990 prices that same amount of gold would be worth $15,312,500.00 (DOGAMI, 1943).

Christian August Spreen described how the gold was carried and deposited in the streams. "The streams having the Rogue River as the parent stream, with their generally rapid current were responsible for the presence of gold at the spots where the prospectors and packers found it. The currents, with their eroding action, wore away the parent rock, broke it up and carried the fragments down their courses until compelled by a change to a less steep gradient to drop this material. In the passage of years it was often covered by sedimentary deposits brought down by floods, perhaps to be uncovered again

by a later flood. The gold deposits in southwestern Oregon were the results of ages of weathering of rock, floods, and sedimentary deposit which often reached a considerable thickness" (Spreen, 1939).

THE HISTORY OF GOLD MINING IN SBW

Apparently for the native people, gold was of no value. Stories have been recorded of their attacking miners, taking the gold, and pouring it into the stream. The Takelma and others tribes used strung shells called Dentalia as their currency.

During the fall of 1852, gold was discovered on Foot's creek, fifteen miles west of Jacksonville, at Willow Springs, five miles north of Jacksonville, and at Pleasant creek in the northern part of the county. Hostilities with the native people caused some curtailment of mining activities in these areas until after 1856.

The miners or settlers who flocked to southern Oregon gave little consideration to securing title to the land from the native people. The miners with operations along nearly every stream of the region began to affect the supply of fish. After the treaty of 1853, the discontent of the Indians was found to be largely among those hill tribes, where the attitude of the miner in the mountains regarded his time there as being of a temporary nature (Robison, 1943).

Josephine County is placed as the first in the Northwest to furnish a mining code. These laws help to understand what constituted a mining claim.

"Know all men by these present, that the miners in council assembled on this the 1st day of April AD, 1852 do ordain and adopt the following rules and regulations to govern this camp. Resolved, first that 50 yards shall constitute a claim in the bed of the creek extending to hip high water on each side. Resolved, second that 40 feet shall constitute a bank or bar claim on the face extending back to the hill or mountain. Resolved, third, that all claims to be worked when workable, after five days be forfeited or jumpable. Resolved, fourth, that all disputes arising from mining claims shall be settled by arbitration and the decision shall be final. E. J. Northcutt, chairman. attest: Philip Althouse, clerk" (Spreen, 1939).

The first gold was found in streams where the early miners of southern Oregon operated small placer mines using the simpler mining devices. One person operating with a pick, shovel, and pan could pay well in a rich area. This type of small operation would leave less of an impact on water quality than what was to follow. When rockers and long-toms were used, the streams were often diverted for a short distance. The rocker or cradle took two people to operate.

It was a box like device mounted on rockers with one open end. It handled from three to five cubic yards of earth in ten hours. A lot of fine gold was lost with this method. This accounts for the Chinese miners being able to profit from reworking the abandoned claims (Wailing, 1884).

A placer is an alluvial deposit of sand and gravel containing gold in particles large enough to be obtained through washing. Placer mining requires the use of water to extract the gold from the gravel. This method is based on the fact that gold is heavier than the accompanying rock debris and will work downward with agitation. Running water is needed to wash away the debris, thus a prime factor in the method and length of an operation. The early water rights laws were closely connected with water for mining.

Between 8 Oct 1856 to 30 June 1880, 5,438 mining locations were made in Jackson county. Of these 16 were copper, one tin, 124 cinnabar, and the rest gold and silver. There were 1,221 conveyances of mining claims and 133 transfers of water ditches and rights during the same time. Claims in the SBW were as follows: Willow Springs, 785; Gold Hill, 361; Gall's Creek, 95; Foot's Creek, 288; Evans Creek, 115; and Sardine Creek, 132 (Wailing, 1884).

By the 1860s, hydraulic mining had been introduced in southern Oregon. This form of mining greatly increased the amount of gravel that could be worked at any given time. Up to 1,500 cubic yards of tailings were dumped into the watercourse daily. This type of mining also required a great deal of water, capital, skill and much labor. Long flumes to span deep gulches had to be built; many miles of ditches had to be constructed, reservoirs were erected, thousands of feet of piping lain, and giants and other machinery set.

Companies were organized about 1870 that hired groups of Chinese labors to build the long ditches and flumes necessary to operate the large hydraulic placers mines. This method allowed larger volumes of lower valued gravels to be worked at a profit. Pressurized water from a pipe or hose was used to expose gold deposits by scouring away hundreds of cubic yards of earth per day. The water washed the sediments into sluice boxes where the gold amalgamates were collected with the use of Quicksilver (mercury). The miners were able to remove the soil and uncover the gold faster with these methods; yet they had a more drastic effect on the land, waterways, and water quality than the small placer mines of the earlier decade (McKinley and Frank, 1996).

Water, so important to the placer miner could at times be an adversary. Some of the winter floods carried away their flumes and washed away reservoirs. These floods did offer some compensation to the miners in that the accumulated deposits of tailings were also swept away, and it cleaned out some old channels to bedrock.

By 1865, all the placer deposits known today had been discovered. The cost of freight and supplies determined whither a placer was worked. At least one half ounce of gold per day needed to be recovered from a placer to cover expenses. So only the coarse gold was removed leaving the finely powered gold (Mayo, 1994). During the early years in our history, placer mining in southwestern Oregon produced millions of dollars, this gold helped to bolster the nation's economy, which was mightily needed (Potter, 1977).

As the richer placers were being exhausted, some miners began to search for the sources of the gold placer deposits. Many rich deposits of gold ore were discovered. Prospecting for the lode began as early as 1859 on the Gold Hill. Five quartz claims were filed at 3 p.m. on 13 January 1860, called the "Emigrant Lead" situated on the North side of the divide running towards Big Bar on Rogue River southwest quarter of the northeast quarter of section 14, Township 36 south, Range 3 west. It was situated at the 2,000 foot elevation. "The outcropping rock was so full of gold that it could scarcely be broken by sledging" (Libbey, 1976). People began to file clams until 10 p.m. that night. Soon there were about 150 claims taking up the whole side of the mountain (Morehouse-Genaw, 1988).

The process to recover gold from its ore depends primarily on the mineralogical character of the ore. Initially the ore needs to be crushed and finely ground. Water or horse/mule powered arrastras were built in the early days to grind the ores. From the initial step to free gold and gold-bearing sulfide minerals may be removed from the finely ground ore by: amalgamation, flotation, cyanidation, jigging, table concentration, or a combination of these processes. Free gold recovered by amalgamation or cyanidation is sold as bullion. Sulfide concentrates are usually shipped to a smelter (Brooks and Ramp, 1968).

The Rogue River and its tributaries have produced a large amount of placer gold from a short distance up stream from Gold Hill to its mouth, but after a time the gold mining industry in southwest Oregon saw a decrease in production. Until the early 1900s when bucket line dredges were developed and came into use, placer mining had been mainly done with hand-operated equipment.

These dredges worked the deeper stream gravels. The machines were able to open large areas of very rich ground as well as make a profit working the lower grade deep stream placers. Foots Creek was dredged in 1903 and Kane Creek was dredged in 1908. Dredges also operated on parts of Sardine, Sykes, and Pleasant Creeks. Dredging operations continued to some extent in southern Oregon until the 1940s (Mayo, 1994).

Oregon's gold mining and production declined sharply under the general prosperity that the 1920s economic climate provided (Mayo, 1994). Southwest

Oregon saw a steady decline in gold production between the years 1906 to 1934 except for a small increase after World War I.

The Great Depression brought renewed interest in mining activity to southern Oregon. Labor and material costs were back in line with gold prices (Mayo, 1994). Job opportunities in the 1930s were few and far between and many took to the streams in search of gold. The small scale mining became a means of economic survival for many. Federal money was used by the Jackson County court to provide a three-day class in "gold mining techniques" for indigent families, in hopes of easing the pressure on the county relief funds (LaLande, 1980).

More efficient dredges and improved methods in quartz mining plus and increase in the price of gold from $29 per fine ounce to $35 in 1934 were factors that lead to a steady increase in the regions gold production, and by 1940, gold yield in dollars was $1,053,395 for a single year. It was during this era that the Oregon Department of Geology required miners to construct settling ponds, which greatly reduced downstream sedimentation (Rivers, 1963).

Placer and lode mining have both seen rise and fall patterns. As mining and milling methods improved the production of lode gold increased until 1942. With World War II, the U. S. government put a stop to all gold mining as non-essential to the war effort. Some mining equipment was even shipped to the Soviet Union (Mayo, 1994). The cost of running a mine had increased after the war. Material and labor cost prohibited many mines from reopening. Because of the span of time that the mines were left abandoned and neglected, many operating plants deteriorated. Mining in Oregon continued to decrease from 1942 to practically nothing by 1965, except for a peak in 1947, which was comparable to 1907-08 production (Brooks and Ramp, 1968).

During the period of lean years, a few miners eked out a living working both lode and placer mines. An interest in gold mining was revived as mining laws changed. Private ownership of gold bullion was allowed and the price of gold was allowed to follow market demands as it rose and fell.

Technology opened up a new form of gold mining. Skin and scuba diving was combined with a suction type gold dredge. Like a vacuum cleaner, sand, gravel, and gold were suctioned up from the steam bottom. Some of these dredges have a suction hose up to twenty-four inches in diameter and are capable of working many feet under the water surface. A floating sluice box is used to process the sand and gravel (Mayo, 1994).

The first gold boom in Oregon expired about 1870, but it had been strong enough to attract people with diversified talents so that other industries such as farming and raising cattle cushioned the shock. In addition, the gold rush

was responsible for the early entry of railroads into the state, and this hastened the growth of cities and provided a more stable economy.

The impact of mining can be found across the SBW. Placer mining, dredging, and hard rock mining took place along nearly all the creeks, surrounding hillsides from Sams Creek west. Mine shafts, tailings, residence sites, and water ditches remain from mining activity.

Cinnabar was found in the "Meadows" area of the Gold Hill district in 1878. Local production was made with retorts and was sold locally to the placer-gold miners in the vicinity. No record of the amount produced was kept. However, a record of quicksilver production for Oregon for certain years was kept, they are: 1887-65 flasks, 1888-32 flasks, 1889-20 flasks (Schuete, 1981).

Then there seems to have been a long interval of time in which no quicksilver whatever was produced here. The fact that the ground was cinnabar bearing was well known however, and transfers of parcels of land around 1900 describe the land as "valuable cinnabar mines." This area now comprises the War Eagle, Chisholm, and Dave Force mines (Schuete, 1981).

The Depression era also saw resurgence in mercury production. Redevelopment of the region's quicksilver industry was apparently stimulated by the high prices which followed the formation of the Spanish-Italian Mercury Cartel in 1927. In that year, the State of Oregon produced over 2,000 flasks of quicksilver, an amount nearly equal to the state's total previous production. A flask is 76 pounds of mercury, which is shipped in a special iron container or flask (LaLande, 1980).

Other minerals that were mined were copper at the Cartinell Mine. It was discovered in 1902 in Section 9, Township 34 South, Range 4 West. Chrome was mined on a tributary of Pleasant Creek, Boulder Creek, Section 3, Township 34 South, Range 3 West. Manganese was found in Section 6, Township 35 South, Range 3 West (DOGAMI, 1943). Foster and Grunnells Mining Map shows several coal deposits northwest of Asbestos, in Township 33 South, Range 2 West (Foster and Grunnells, 1904). "The dams on Evans Creek by and large were built in the 1930s or before, the sediment behind these dams was building at the same time the mining operations were going on full speed. This caused the filling in behind the dams in the thirties and forties bringing with the sediment and aggregates, gold, mercury and other materials stirred up, dumped or lost by the early miners.

"Mercury as a liquid metal, with a heavy specific gravity comparable to gold, moves through gravel and sand downward with very slight disturbance or vibration. Sampling for this metal and having an accurate test made is very difficult and expensive. Mercury on bed rock and in the cracks of bedrock can be very hard to sample although high volume and velocity water may move this

material quickly downstream when high water exposes bed rock. Exposure to low water flows and summer time water temperatures could cause added problems to the environment and community from materials from past mining activities being introduced to the stream waters in summer and pumped onto fields where animals may ingest them" (Howell, 2003).

CHAPTER 4
AGRICULTURE

The native people of the watershed used agricultural methods that are not as apparent when looked through the eyes of the Euro-American of the same period. Fire played a big part; it was used to keep meadows clear, and fostered seed and root growth. It was also used in the harvest process of tarweed seed. After the area where the plant grew was burned, it was harvested by walking through and hitting the seed heads, with a stick, into a basket. Tobacco was the only plant grown by the native people of the area. A piece of land was also burned before cultivation and planting of tobacco (Follansbee and Pollock, 1978).

Alonzo A. Skinner, government Indian agent, was among the first to select a donation land claim in the Rogue Valley. His was southeast of Table Rock, where he constructed a log home. James Kennedy and Nathaniel Dean settled at Willow Springs. Enoch Pelton and James Bruce selected donation land claims along Snider Creek and began cultivating grain and raising hogs. Others selected the fertile land close to the river near Table Rock to farm (Government Land Office). Further west on the south bank of the Rogue, the Birdseye and Savage families began farming on the fertile river bottom soil. The basic food supply was provided by dairy cattle, and newly planted potatoes, corn, cabbage, and other vegetables grown in the gardens. Wheat, oats, and barley were planted as soon as possible and would feed people as well as livestock.

The winter of 1852-53 brought harsh weather and the summer was a dry one, bringing only a small yield of the planted crops. That winter, many were struggling to survive, living mainly on game. The snow had blocked the passes into the valley, preventing the pack trains from getting through with supplies. Grain was crudely ground in coffee grinders and used to make pancakes. By 1855, flour mills were operating in Ashland along Bear Creek, and Phoenix and the valley became less dependent on outside sources for flour.

With the population of the Rogue River Valley swelling with prospectors and opportunist, the need to feed that population became important. Raising stock animals was important to the local economy. Hogs were raised in large numbers. They were fed on the abundance of fish that the Rogue River offered

for protein, and acorns from the many oaks, fattened them and helped to remove any fishy taste. Pork was a prime source of meat and it was made into sausage, hams, and bacon. The smoked meats were more desirable as they were less perishable. Hog drives to Happy Camp began in the 1850s, with William Bybee being one of the leading organizers (Leavitt).

The family farm was usually diverse and fairly self sufficient. They raised their own chickens which supplied them with eggs and meat and a family cow furnished their milk and butter. Corn, wheat, rye, oats, barley, potatoes, and hay were probably their best income crops. Nearly everyone raised a garden. Family orchards were planted and made up of many varieties of apples, pears, peaches, plums, cherries, grapes, and berries. The Alta California commented on the fruit trees and lands of the Rogue Valley in April 1860: "The climate is remarkably mild, fruit trees being in full bloom. The lands are well fenced, many with fine broad fences, such as we see in the East, and the houses are invariably fine large two story dwellings and all painted white" (Alta California, 1860).

Enoch Pelton bought 162 acres closer to the Rogue River, where he also operated a ferry, near the present day Bybee Bridge. During the flood of 1861, Enoch Pelton suffered severe losses. His ferry boat was lost and all his buildings with their contents were destroyed. His grain, hay, and a few hogs and some other stock were all swept away, plus all but about 500 fence rails around his farm. Other farmers along the waterways suffered similar losses (Morehouse-Genaw, 1998).

Water posed a problem to the farmer, not only if there was too much but, also if there was too little. The July 3, 1869 Democrat News reported on the dry weather: "Dry weather-This summer has proven a little the driest of the many dry summers we have ever witnessed in Southern Oregon. Streams that were never know to dry up before have quite failed this season, and as a consequence, farms and gardeners complain of a deficiency of water for irrigation. All kinds of vegetation are burning up for want of water, and even the fruit crop is destined to suffer greatly from the same cause. We understand that the plum crop is 'gone up' in some parts of the valley" (Democrat News, 1869).

Willow Springs, the Sams Valley area, including Beagle and Table Rock become noted farming communities. The farmers were becoming fairly prosperous, commanding a good price for their grain. Most communities were close knit and many were often related at least by marriage. Farming was often a cooperative effort among neighbors. Harvest often became a community project. What one farmer didn't raise another did. Barter and trade of a skill or product was often exchanged in lieu of cash.

A farmer would own a horse drawn binder and cut the grain for him and the neighbors. This could often be quite an experience as the grain had to be cut just at the right time and everyone's grain seemed to ripen at once. When the binder broke down it necessitated a fast trip to town with a horse and wagon to get some new part, or to the blacksmith to make the part. It was important to return as quickly as possible so the harvest could be resumed. Nearly all farmers owned their own mowing machine, drawn by two horses, and hay rakes drawn by one horse. The threshing was usually hired out to someone with a thresher (Leavitt).

By the 1860s there were eight large flour mills in the Rogue Valley and the processed grain was even transported out by pack animals and wagons (Follansbee and Pollock, 1978). In northwest Jackson County there was the Daily's mill in Eagle Point (Butte Creek Mill), the Houck mill at Gold Hill, or the Welch Mill in Central Point where farmers took grain to have it ground into flour. The farmer usually ran the grain through a fanning mill to remove the chaff before taking it to the flour mill.

Many early farmers raised sheep, mostly for the wool which they sheared from the sheep in the spring. Ashland had woolen mills that ran successfully until the price of wool dropped in the 1930s (Follansbee and Pollock, 1978). Coyotes were a serious menace to the sheep and they reacquired being penned at night. The coyotes were known to kill sheep in the fields even during the day. The Table Rocks harbored many coyote dens. In the early 1920s, a Coyote Club was formed by the people of Sams Valley and Table Rock, and they were quite successful in chasing the coyotes out of their dens with dogs and guns. Later there were government trackers that helped keep the coyote population under control. Lack of range and pasture land was not favorable for raising many sheep (Leavitt).

The early agricultural effort of the Rogue Valley farmers was very important. Thousands of miners depended on the wheat raised locally. Local farming was very lucrative during this period. Transportation of produce and commodities into the area was costly, being brought in via packers and freight wagons. This gave the local growers an edge over wheat imported from other areas. Wheat was grown as a favorite crop along with barley, rye, and oats. In the 1880s, two factors effecting local agriculture would be the coming of the rail and the decrease in mining. Many prospectors moved on to the gold strikes in Alaska and other areas.

Those who stayed continued to mine the south bank tributaries of the Rogue, Sardine Creek, and Evans and Pleasant Valleys where they often combined mining and farming. The same ditches that were used in the winter for placer mining were sometimes used in the summer for irrigation.

In 1887 the railroad was completed. Within the SBW area there were depots at Tolo, Gold Hill, Ray Gold, and Woodville, to handle passage and freight, going both north and south. The first fruit and nut trees in the Rogue Valley were grown from a few seeds of Black Walnut and pears brought to Ashland by the Billings family. The seeds were planted in 1854 in the Valley View area of Ashland (Cordy, 1977). Fruit orchards that had been planted in the 1850s were producing and local newspapers would make reference to Rogue River Valleys "fine fruit crop" (The Oregon Sentinel, 1863). Up until this time the producing orchards had provided fruit for the owners and small transactions within the area.

With the railroad came the opportunity to export agricultural products, yet on the reverse, competition came from the outside as crops were shipped in at a lower price. Most early farmers had planted a small orchard, but some were quite large. They found the hard fruits such as apples and pears were well suited to the hills and mountainsides. Grapes and berries were found to grow well in the lowland valleys (Follansbee and Pollock, 1978).

In Jackson County a period of economic expansion had begun by 1910. The development of the pear orchard industry in the Bear Creek Valley had much to do with the boom. "Donation Land Claims were subdivided into tracts of newly planted orchards and many new homes were built. This posed a need for additional water for both domestic and agricultural purposes" (LaLande, 1991).

The new orchards were being planted, some with irrigation, others without. Fruit such as; pears, apples, cherries, and peaches were planted at Rogue River, Rock Point, Table Rock, Sams Valley and of course other areas of the Rogue River Valley. Mrs. Amelia Frierson left a diary that made mention of an irrigation ditch, indicating that they probably had water at Table Rock, as early as 1896. The project that brought irrigation water from the Rogue River is credited Mr. R. E. Drum for having promoted it (Leavitt).

The new orchard industry was heavily promoted by the Medford Commercial Club and many easterners were induced to invest in the growing industry. One such venture was the ill fated promotion of the Western Orchard Company. It was organized in Chicago by a John A. Westerlund, who had taken options on about 2,000 acres on Roxy Ann Butte. Many lost everything when the speculation failed. Even the Ray brothers organized the Orchard Home Company that planted, subdivided, and sold inexpensive land to moderate income people from the east (Atwood, 1980).

The Bear Creek Valley began receiving water from the Cascade lakes as early as 1902. Orchard owners and farmers without irrigation found it challenging to compete. Enlargement of the irrigation system took place over a thirty year span and others water systems were developed. But it wasn't until 1923 that

the Rogue Valley saw widespread orchard irrigation. With irrigation came the need for drainage of the relatively shallow soils underlain with layers imperious to water. Government assistance was sought and drainage districts were organized. The depression and low pear prices made it cost prohibitive to many to install the drain tiles (Cordy, 1977).

As producing orchards increased so did the need for packing houses, these were mainly built at the larger orchards. Transportation from the orchard to market was the limiting factor. Horse drawn wagons had to transport the fruit over rough, dirt roads. The shift to larger centralized packing houses with cold storage facilities along the railroad came when the roads improved and trucks became more widespread. A better quality product that could command a premium price in the market was the result. A professionally packed product was needed, and in 1909 the first packing school was conducted. A standardized grading system for the fruit soon followed (Cordy, 1977).

The fruit crops presented their own set of problems, though there weren't as many in the early days. For the most part it took experimenting and learning what worked and what didn't. For many it meant working with the extension agents from Oregon State College, who worked with plant diseases and insect problems.

In 1905, local orchards were attacked by Blight, a bacteria that spreads when the tree is cut and also by insects (mainly bees). It feeds on the plant through the sap and eventually kills the tree. Disinfecting the tools after each cut with either cyanide of mercury or bichloride of mercury, helped to prevent the spread of the Bight. The Blight also is worse in the hotter pear districts. This can be a bit of a "double edge sword," as the hotter districts also produced the best quality of the fruit (Atwood, 1980).

Hard hit by the Blight were the apple orchards, which also suffered from poor soils and low prices. It is estimated that 10,000 acres of apples had been planted at its peak in 1910. Within a few years pear trees had replaced most of the apple orchard as they grew better on the same soil and commanded a higher price on the market (O'Harra, 1993).

Pear psylla, certain aphids, spider mites, and coddling moths were some of the pest that plagued the industry. Pear scab is a fungus disease that affects the fruit. Various chemical sprays have been used in the orchard industry over the years. Lime and sulfur dormant sprays were used, then Bordeaux. Arsenate of lead was used for coddling moths for years, then guthion was used, but it tended to kill off the predators for pear psylla and spider mites. Tobacco was tried on aphids. In 1958 they were using DDT extensively on the pear orchards with good control (Atwood, 1980).

Spring frost, the frozen dew, has been the bane of the Rogue Valley orchards because of the measures necessary to save developing fruit crops. Temperatures vary widely within the valley, but frost damage is usually confined to the lowest elevations, hillside orchards often escape the lowest temperatures. The valley's climate has apparently changed during the past four decades, however, and some locations at one time not endangered now experience frost. In the decade from 1930-39, for example, the average number of officially cold spring nights each year was 18; during the 1960-69 decade, this number jumped to 27 a 50% increase. "From 1926-1971 the average number of cold nights (32 degrees or lower) was: March-5.1, April-12.4, May-4.6. For the same period the average number of nights actually requiring firing was March-2.8, April-9.9, May-2.8" (Harry and David, 1972).

When the orchards started loosing crops to frost, they attempted to control the frost. In the early day of learning and experimentation it was commonly believed that a heavy smudge would prevent the loss of heat, thereby preventing frost damage. It was also thought that smoke would help to prevent the morning sun from thawing the frozen fruit too rapidly, as the rapid thawing was thought to cause more frost damage. Wet straw, manure and leaves were kindled to produce smoke, thus the terminology "smudging" became popularized. The growers figured out the need to add heat to keep the fruit warm and the term "heating" was used (Cordy, 1977).

The three most commonly used methods of frost prevention are heating (the most widely used throughout the world), overhead sprinkling and wind machines. Almost all current methods utilize heat, either natural or artificially generated (Harry and David, 1972).

Wood burning heaters were used originally, until oil became readily available (Cordy, 1977). The original oil heaters, effective but smoky, were simply lard buckets filled with oil. These evolved into so-called "side lids" or "bread boxes" – metal containers that resembled square cake pans with lids that slid back and forth, permitting the regulation of heat intensity by adjusting the opening. Because of poor air circulation and incomplete combustion, side lids spewed large quantities of smoke (Harry and David, 1972). By 1972 three types of heaters were being used that conformed most to "clean air" regulations. The Return Stack and the Lazy Flame were the most widely used along with the Jumbo Cone (Harry and David, 1972).

For many of the Rogue Valley's young men, "smudging" (as lighting the smoky oil heaters referred to), was a first job. Smudging continued into the 1970s. Some orchards have converted over to sprinklers or wind machines, but there are still a few scattered spots where you can see the smudge pots sitting among the trees.

About 1917 the orchard boom and local economy began to crumble due to lost harvest from frost, drought, disease, pest, and a poor market as World War I prevented the export of fruit to many countries. Many were forced to sell everything. Others got through the tough times by creating organizations to pool resources and were able to revive the industry after World War I.

The sugar beet industry lasted only a brief two seasons in the Rogue Valley during the years 1916 and 1917. Sorghum has been grown and manufacture locally several times. Post World War II, there was a shift from the farm to the timber industry. The 1960s and 1970s experienced the back to the land movement. More roads were improved because of the logging industry. With more dependable transportation, more people found the valleys and gulches to their liking. These people were not farmers to make their living from the land. They worked off the land, some raising their own meat and fruit and garden, others were hobbyists, enjoying the county life style.

Traditionally, timber production and grazing were the primary natural resource industries within the upper reaches of the watershed. The valleys having deeper soils and were able to support a wider diversity of agriculture. Orchards in the valley are close to irrigation and to transportation routes. Livestock production is currently the predominant form of agriculture. Commercial crops include wheat, barley, hay, oats, and corn. During the last decade, however, vineyards have been established while specialty crops such as cut-flowers, herbs, and organic fruits and vegetables are also being produced. Growers markets in Medford and Grants Pass have a showing from several producers within the watershed. For several years, Wimer has had a weekly growers market during the growing season.

CHAPTER 5
THE ROGUE WATER WAY

The source of the Rogue River is near Crater Lake and Mt. Thielsen. The river drops 6,000 feet as it runs a 215 mile course to the mouth at Gold Beach on the Pacific Ocean. The river runs through three counties, each with its own needs and thoughts on the river's use. The waterways are not as they were two hundred years ago. Change to the channels, politics, removal of riparian coverage, roads built near the streams, introduction of non-native fish species and other aquatics, as well as fish hatcheries all have played a role in shaping the Rogue River and tributaries that we have today.

Two early descriptions of the Rogue paint two different pictures of the river, one by an engineer and the other by a historian. During an 1872 visit to the Rogue, writer/historian Frances Fuller Victor extolled its summer flow, "The waters are as blue as a clear sky, and banks overhung in some places with wild trees, shaggy cliffs, and in others by thickets of grapevines and blossoming shrubbery" (Victor, 1993).

In December 1878, Philip Eastwick of the U.S. Army Corps of Engineers was dispatched to scrutinize the Rogue River for navigability between what is now Gold Hill and the ocean. He wrote of the river; "During the presence of these freshets, all the rapids and falls of the river are lost sight of and the river assumes the character of a boiling, surging mountain torrent filled with strong eddies and whirlpools, and carry down with it immense quantities of driftwood to the ocean." In 1910 the magazine published by the Medford Commercial Club, reported the warmth of the Rogue's waters as "bath water qualities" (Victor, 1993).

NATIVE PEOPLE FISHING PRACTICES AND RITUALS

We have no written record of what the salmon runs were like on the Rogue River two hundred years ago. We do know that the river provided the native people with salmon and trout species, crawfish, and freshwater mussels. Clubbing was the method often used to kill the fish after driving them into a netted area (Follansbee and Pollock, 1978).

Most of the native people who obtained fish from the waterways had some type of ceremony to help insure a bountiful salmon run. The ritual was usually based on the arrival of the first salmon and may have served a conservational or management purpose. In allowing the salmon to run free during the initial period of ritual restriction, they would have maintained a productive inventory of spawning salmon each spring, thus ensure successful reproduction and return of the salmon runs in following years (Winthrop, 1993).

MINING CHANGES WATERWAYS

Euro-Americans and Chinese were lured to the Rogue Valley to mine the gold rich placer streams. The small placers operations of the 1850-60s, probably had minimal impact upon stream water quality, because of the small size and limited operation. According to LaLande, "early miners sometimes found more salmon in their sluice boxes than gold, often harvesting the fish for sale to finance continued mining" (LaLande, 1995).

The 1860s brought changes to the waterways as long flumes to span deep gulches were built. Many miles of ditch constructed, reservoirs erected, thousands of feet of piping laid, and giants and other machinery set. Water was the key to a hydraulic placer operation. Pressurized water from a pipe or hose was used to expose gold deposits by scouring away hundreds of cubic yards of earth per day. Thus riparian areas were removed and the course of waterways changed. Ditches were built throughout the gold bearing areas of the watershed. Many of these ditches would serve another purpose, by bringing irrigation water to the farmer.

POLITICAL INFLUENCES

The native peoples along the Rogue had their own politics and ways in dealing with fishing the river and streams. Their fishing rituals provided for taking only small portions of the fish run for any particular day, so that upstream tribes would also have fish to harvest. According to Genaw, the native people could be very aggressive. If a neighboring tribe blocked a stream and prevented salmon from reaching another tribe, it could be a cause for war (LaLande, 1995).

Ballot initiatives have allowed citizen majorities to initiate and implement governmental policy. Natural resource issues appearing on Oregon voter ballots, allowing citizen majorities to initiate and implement governmental policy, occurred as early as 1908 and 1910 (Beard and Schultz, 1912).

The Rogue runs through the three counties of Jackson, Josephine, and Curry. Each county has had its own needs and interests. As early as 1876, the Hume Company in Curry County controlled the fisheries on the Rogue. Robert Hume owned both sides the river at the mouth for twelve miles up stream. His fleet would stretch their nets across the river at the mouth, and haul in Chinooks and silvers. Up river fishermen claimed they also hauled in the big steelhead as well (Arman and Wooldridge, 1982).

Hume was also responsible for hatchery projects. The Rogue Elk Hatchery, on the upper Rogue, was controlled by Hume. Fry were released from Rogue Elk in the upper Rogue. Surplus eggs were shipped and released at the mouth of the Rogue, and even taken to the Clackamas hatchery and fry released into the Columbia (Arman and Wooldridge,1982).

In Josephine County, the gillnetters organized in 1906 as the Rogue River Fishermen's Union. The purpose in organizing was to promote building a fish hatchery for the middle section of the Rogue. They were also concerned over the diminishing migration of big steelhead. They offered to discontinue commercial fishing during the steelhead season, but defended their own industry, which was said to bring in $20,000 annually to the Grants Pass merchants (Arman and Wooldridge, 1982).

In Jackson County, it wasn't the working man trying to make a living from the land and river, but a totally new sector, the sports fisherman, who flexed a political arm. The turn of the century had brought to Jackson County, a period of economic expansion, and people with money to invest. The railroad offered ease of travel to the area. Tourism and recreation were just starting to gain a hold. Lodges were starting to be built along the river and wealthy sportsmen came from afar to angle for the Rogue's steelhead and trout.

The sportsman group organized in 1910, as the Rogue River Fish Protection Association. Their purpose was to propose a legislation to close the Rogue River to all fishing but hook and line. They circulated an initiative petition and got eleven thousand signatures. The measure was put on the ballot in the 1910 general election (Arman and Wooldridge, 1982).

In Josephine County there arose a complaint that over half the signatures were from Portland, and shouldn't have a say in local matters. The sportsman group had the money to spend on the promotion of their cause. The ballot passed, closing all fishing but hook and line to the Rogue (Arman and Wooldridge, 1982).

For at least a twenty year period these groups lobbied their cause in the state initiatives system, making treaties and alliances that changed over the years. The river reopened to gillnetting in 1913. According to Glen Wooldridge, "The gillnetters fished at night unless the water was muddy; as you couldn't catch a

salmon if it was clear enough to see the net. The hydraulic giants didn't muddy the water enough, but once in a while a storm would muddy it enough for daylight fishing" (Arman and Wooldridge, 1982).

Over the past twenty years, there has been an increase in ballot initiative outcomes for wildlife management policy. Often paid circulators work from lists of voters, known to support or oppose certain issues (Cronin, 1989). Voters may not fully understand the issues when they sign a petition. Voters are not necessarily well informed on the issues or lack the education to understand the technical issues. Strong, financially backed lobbies have money to influence voters via media campaigns and influence initiative outcome (Eule, 1990).

Besides setting policy for natural resources, funding initiatives have created special taxes or bonds, increased taxes for specific purposes or reserved tax revenues for specific purposes. Prohibitory initiatives have generally banned certain practices (Beard and Schultz, 1912).

CREATION OF A U.S. COMMISSIONER OF FISH AND FISHERIES

Spencer Fullerton Baird, Assistant Secretary of the Smithsonian Institution, wrote to Congress in January 1871 calling attention to the problem of depletion of food fishes of the seacoasts and lakes of the United States and offering suggestions for remediation (Guinan and Curtis, 1971).

As a result of Baird's efforts, the National Fish Hatchery System was established in 1871 by Congress through the creation of a U.S. Commissioner of Fish and Fisheries. According to the National Fish Hatchery System, "The original purpose of National Fish Hatchery System was to provide additional domestic food fish to replace declining native fish populations. Cultured fish were used to replace fish that were lost from natural (drought, flood, habitat destruction) or human (over-harvest, pollution, habitat loss due to development and dam construction) influences, to establish fish populations to meet specific management needs, and to provide for the creation of new and expanded recreational fisheries opportunities" (National Fish Hatchery System, 2003).

Fish Hatcheries

The new Commissioner's primary interest was in biological research. However, his policies did reflect other areas of interest and reportedly his vision was broad for the period. In 1872, with support from the American Fish Culturists Association, he established a marine hatchery at Woods Hole for artificial propagation of fish. In 1879, Baird's staff worked with the Census Office on the first comprehensive statistical survey of the U.S. fishing industry. For many years, fish culture was foremost in the federal fishery program (Guinan and Curtis, 1971).

Cannery owner R. D. Hume had hatcheries at the mouth of the Rogue and in the upper Rogue near Trail. In 1878 he built his first hatchery at "Hatchery Gulch," located about a quarter mile south of Indian Creek. He had a second hatchery next to Mill Rock. A fire burned the Gold Beach hatcheries and in 1909, another was built at Indian Creek. This hatchery was run by the state of Oregon from 1926 until the mid 1930s, when the state closed the hatchery (Rogue River Salmon, 2003).

In 1958, beginning with a group called Salmon Unlimited; volunteer groups have worked in cooperation with the Oregon Game Department to improve salmon production in the lower Rogue system. Small hatcheries and "hatch boxes" along the tributaries, have been maintained by volunteers (Rogue River Salmon, 2003).

In 1890, Hume built a hatchery at Trail on the upper reaches of the Rogue. Fry were released from Rogue Elk in the Upper Rogue. Surplus eggs were shipped and released at the mouth of the Rogue, and even taken to the Clackamas hatchery and fry released into the Columbia. In 1897, an area near Gold Hill was considered for a hatchery but was built instead at the mouth of Elk Creek. The gillnetters at Grants Pass were never happy about not having a hatchery in the middle Rogue (Arman and Wooldridge, 1982).

In 1897, fish hatcheries were built on several of Oregon's waterways, the Salmon River, Little White Salmon River, Rogue River, and Siuslaw River. The Rogue River's hatchery was built at the mouth of Elk Creek. A rack was built across the river to capture the fish and furnish eyed eggs to the Commission. There was a hatching house built on the banks of the river, equipped with 8 hatching troughs, 35 feet long, 12 inches wide, and 10 inches deep, and a filtering-tank 12 feet long, 4 feet wide, and 3 feet deep. "The water supply was taken from Elk Creek, its temperature being considerably warmer than that of Rogue River." A dam, 10 feet high and 100 feet long, was built about 1,800 feet from the hatchery, the water being conveyed in a 2-foot flume. The dam was needed in order to raise the water in the creek to a sufficient height (Smith, 1898).

The presence of many salmon below the rack afforded a fair prospect for good collections. During October and November, 2,027,000 eyed eggs were delivered. "The results were not satisfactory, as it is believed that there was a sufficient number of salmon in the river to have yielded at least 5,000,000 more if the fishing had been properly managed" (Smith, 1898).

During the incubation, heavy losses occurred and apparently the shells were so tough that the fry could not burst through the egg. When the Rogue River eggs were compared with ones collected from the tributaries of the Clackamas, it was observed the Rogue River salmon eggs were much larger (Smith, 1898).

The November rains raised the water in Elk Creek and carried away about 30 feet off the top of the dam. As the winter progressed it became colder, with ice and slush forming in the flume to such an extent that it was decided to liberate all of the fry rather than risk loosing them. Almost two million small fry were deposited on the spawning-grounds in Rogue River near Trail (Smith, 1898).

The genetic composition of Rogue salmonids is thought to have been altered through propagation of salmonids beginning about 1875. Cole Rivers collected anecdotal information and records, indicating that in 1880, cannery managers released up to 250,000 chinook fry into coastal streams. The eggs did not necessarily come from the streams into which the fry were released, but may have come from various streams in Oregon as well as California and Washington (Rivers, 1963). This practice continued until 1931 when state legislation was enacted to protect native fish.

It is now thought that the early artificial propagation programs were unsuccessful and that prior to 1960, few of the salmon fry actually survived when released from the hatcheries. There was no monitoring or evaluation to verify the survival of the fry (Lichatowich, et al., 1996).

Hume fed his hatchery fry blood, horse meat, herring, salmon, and beef. Industry research began in the 1930s, and in 1960 a program of nutritious diets, disease treatments, and improved hatchery practices had been achieved. Since then there have been advances in hatchery technology and science, combined with improving ocean conditions. The survival of salmon to the adult stage dramatically increased. By the mid-1970s, coho salmon harvests were approaching and even exceeding historical harvest levels with most of the fish being of hatchery origin (Lichatowich, et al., 1996).

In today's hatchery, technologic advances bring increased nutritional value of feed, development and treatment of disease, and improved tagging technology has allowed more effective monitoring of survival. Control of the hatchery environment, such as water temperature and pathogens has improved, and geneticists have improved animal husbandry practices. Many of the problems

that once plagued early hatchery operations have now been either resolved or controlled (Lichatowich, et al., 1996).

Hatchery management is a different matter, it involves: brood stock selection, mixed stock fisheries, and inter-basin transfers. These practices have been found to be detrimental to wild stocks of salmon and have failed to conserve salmon biodiversity (Lichatowich, et al., 1996).

Hatchery management is partly responsible for the decline of wild salmon stocks. Recommendations were made to the Oregon Plan in 1998 by the Independent Multidisciplinary Science Team, Forrest Sciences Laboratory, and Oregon State University for fundamental changes in the hatchery programs. "Those changes are to reflect a stronger emphasis on ecosystem management. For example, hatchery operations using local stocks need to take into consideration the life history responses of the native stock to the environmental conditions in the watershed. This will influence rearing practices and the timing of or manner of release of juveniles. Other ecological considerations include differential predation and competition between hatchery and wild fish" (Lichatowich, et al., 1996).

There are 11 hatcheries operated by the state of Oregon are located in coastal watersheds. In 1995, 11.7 million salmon and steelhead were released (Lichatowich, et al., 1996).

Fish Farming

Salmon farming began throughout the world in the 1970s and has since grown rapidly. It may have seemed to be an answer to demands on declining wild salmon. "Before the 1980s, almost 100% of the world's supply of salmon came from wild stocks. By 1999, the majority of the world's salmon supply came from salmon farms" (Gross, 1998). The fish are selected and bred for performance traits that will do well in farm pen conditions, much like the "poultry factories" where the fowl are bred for such traits as large breasts.

Much like poultry, the fish production objective is to maximize the conversion of feed into growth while minimizing loss of fish due to disease, parasitism, and escapes. Traits such as high food conversion rate, rapid growth, delayed age of maturity, and resistance to diseases and parasites are looked for when selecting breeding stock. The genetic selection and the rearing they experience alter the behavior, physiology, and morphology of the farmed fish from those of wild fish (Gross, 1998).

The potential impact of escaped farm and hatchery-raised fish upon wild salmon is already being seen through out the world in the genetic effects, ecological effects, and effects of diseases and parasites.

Farmed fish interbreeding with wild fish, could disrupt wild population's genetic adaptability, by replacing naturally occurring genetic adaptations and/or reducing wild genetic variability, thus their future evolutionary capacity.

Ecologically, the escaped farm fish, compete for food and space and alter habitat and predation. These concerns are particularly strong in the freshwater environment (Gross, 1998). Food harvested to feed farm fish removes food sources from the ocean feeding fish.

Two diseases are of special concern. A highly contagious and lethal viral disease, ISA, is spread by horizontal transmission (adult to adult) in both freshwater and seawater. Up until 1984, the disease was unknown. It first appeared in Norway as an epidemic in the Norwegian salmon farming industry (Gross, 1998).

A parasitic sea louse, *Lepeophtheirus salmonis*, is a problem in the Atlantic waters. The lice have been contracted by wild smolts migrating to the ocean and passing through farming areas. The infestations have had stronger immediate impacts than the ecological and genetic concerns mentioned above, as they have rapidly exterminated some wild stocks (Gross, 1998).

CHANNEL MODIFICATION, FLOODING

Although high water events wreak havoc with man's work, flooding is a natural phenomenon that cycles water, nutrients, and sediment through river systems. Flood waters will scour away organic materials that accumulate on river bottoms and deposit sediment onto stream banks, encouraging growth of riparian vegetation. Flooding is also beneficial to streams because it serves in both local and regional environmental balance, affecting water quality and aquatic life. Many species of fish and macroinvertebrates require high water events to complete there life cycle. Large amounts of water are suspended and river sediment is distributed over vast areas. In many areas, this sediment helps replenish valuable topsoil. Water tables are raised and ground water is recharged from high water events.

When combined with increased human activity, a high water event can possibly spread pollutants and invasive organisms by disrupting normal drainage systems in cities and overwhelming sewer systems.

Floods have been recorded since Euro-American settlement. Records show fifteen high water events in the past one hundred fifty years: 1853, 1858, 1861, 1866/67, 1880, 1890, 1927, 1945, 1948, 1953, 1955, 1962, 1964, 1974, and 1997 (Fattig, 1993).

The flood of 1861 has been called the "mother of all floods." According to the U.S. Army Corps Engineers' records, the Rogue River rose to 43 feet at Grants Pass. The flood levels at Grants Pass for 1890-36 feet, 1964-35.15 feet, 1955-36.2 feet, 1927-32 feet, with the normal stage at 24.45 feet (Fattig, 1993).

Truly major floods are caused by a combination of a heavy snow pack in the mountains and warm torrential rain melting the snow (Victor, 1993). Over the years, flooding has taken out homes, bridges, and ferries as trees and logs with the power the water behind them, ram the man made structures until they give. The rushing waters have changed the course of the rivers and streams. The 1890 flood changed the course of the Rogue River at Shady Cove (Fattig, 1993).

The waterways have always attracted man, with water and other resources readily available. When a high water event occurs, much damage can be caused to man's projects and habitation. A sever flood in 1927 led the Bureau of Reclamation to propose a flood-control dam on the Rogue, called 'Plan A." It included a major dam near Trail as well as several on the river's principle tributaries (Fattig, 1993).

It was the flood of 1955 that led to the organizing of Rogue Basin Flood Control and Water Resources Association. The organization was dedicated to taming the Rogue and its tributaries. The flood waters had carried away homes, furniture, and appliances. More people were living in the flood plain, so the high water events were wiping out neighborhoods and threatening lives. The 1955 flood caused $8.8 million in damages to Jackson and Josephine Counties, and the 1964 flood caused $16 million in damage in Jackson County alone. Rogue Basin Flood Control and Water Resources Association agreed that a dam should have other purposes such as irrigation, electrical generation, and recreation. Fishery enhancement was added later. The association lobbied Washington D. C., and in the fall of 1962 Congress authorized the Rogue Basin Project, including Lost Creek, Applegate, and Elk Creek dams (Fattig, 1993).

CHANNEL MODIFICATION, DAMS

Dams were first built on the Rogue River of logs and lumber. Diversion dams and small dams on creeks and feeder streams were built for mining purposes. Around 1889, just below Fifth Street, a small water power dam was built in

Grants Pass. Made of cribbed fir poles and filled with rocks, the dam furnished electricity and water to the town. The dam had two fish ways so it didn't prevent the fish from getting up river to spawn. The little lake offered the town recreation opportunities in swimming and boating (Arman and Wooldridge, 1982).

It was early in 1900 that commercial salmon fishing started below the dam. The gillnetters would take their turn on the river at night. First, one boat, then another would row up toward the dam, cast their nets, drift back and pull up their nets. Commercial fishing took place in the Middle Rogue for only about thirty years. When commercial fishing was reopened, they could fish 400 feet down river from Ament Dam to Jump off Joe Creek, from the first week in June until the end of July. Commercial fishing ended in 1935 (Arman and Wooldridge, 1982).

In 1902 The Golden Drift Mining Company bought eight acres of land with river frontage, three miles up stream from Grants Pass. There was apparently enough timber on site for construction and a mill ran two extra shifts to cut the wood. Two and half million board feet of lumber was milled for the dam. M. C. Ament built a large steam shovel that he designed to dig to the bedrock. Boulders were blasted out. The structure was called Ament Dam, after the builder. Some of the buildings were washed out during a flood not long after construction, but the dam held (Arman and Wooldridge, 1982).

Below Ament Dam, fish would pool up, not wanting to go through the fish way's dark tunnel. Around 1919 the fish warden dynamited a wing dam on the Ament structure. About this same time, a fire burned the dam down to the water line (Arman and Wooldridge, 1982).

Construction began on Savage Rapids Dam in 1920, six miles up stream from Grants Pass, located at Township 36 South, Range 4 West, Section 19. It was completed in 1933. Dam length was 400 feet, dam height was 34 feet, maximum discharge in cubic feet per second (CFS) was 8,000, normal storage in acre per feet (ac/ft) was 1,500, surface area (acres) was 150, and drainage area (square miles) was 2,459. The dam was built by Shattuck Company and E. J. Carillo did the engineering (Arman and Wooldridge, 1982).

Savage Rapids Dam was built for irrigation. When they started to use the water, one of the problems to arise were small fish being pumped into the farmland. Screens were added but there was a problem with algae and moss clogging them. Screens were designed to be revolving to prevent and remove the growth. A ten foot wide fish way was built on the north side and was rebuilt several times. A fish way was built on the south side at a latter date (Arman and Wooldridge, 1982).

A diversion dam was built up river from Gold Hill, near river mile 121 in NW ¼, NE ¼, Section 15, Township 26 South, Range 3 West, of the Willamette Meridian. There is a grated concrete head works structure on the right abutment of the dam that regulates diversions into the 2,000-foot-long diversion canal (OWEB, 2003).

Gold Ray Dam is located a mile north of Tolo and construction took place in 1903-1904. Even at that date there was some controversy over the building of the dam, as some believed it would obstruct fish passage. The Rogue was diverted around the dam site to expose the basalt river bed. Logs came from Prospect and were floated down the river, to be bolted into the riverbed, and strengthened by cement to provided extra strength. Utility contracts were signed with many local municipalities as well as mines and orchards of the area. In 1941 the original dam was replaced with a concrete dam that includes a concrete chamber to house a fish counter at the fish ladders (Thorne, 1968).

Lost Creek Dam on the Upper Rogue was built primarily for flood control. It was finished in 1977. Applegate Dam was finished in 1980. However, in 1987, construction on the dam at Elk creek was stopped by a federal court injunction, citing the potential for fishery damage (Fattig, 1993).

CHANNEL MODIFICATION, BLASTING

In 1878, the U.S. Army Corps of Engineers dispatched Philip Eastwick to scrutinize the Rogue River for navigability between what is now Gold Hill and the ocean. In 1892, Captain Thomas W. Symons of the Corps investigated the possibility of making the river navigable for commercial ships from the mouth to the Rogue Valley. It would have required 52 locks and dams with an average lift of 15 feet (Fattig, 1993).

The Rogue was historically much wilder than today. During the 1930s and 1940s, the early river runners, such as Glen Wooldridge, blasted boulders in the river. They cleared a channel from Dunn Riffle to Agnes, using dynamite and blasting powder that was often furnished by the Forest Service. The rapids on this section on the Rogue are now big and glassy, dropping into haystacks and standing waves (Tice, 1995).

CHAPTER 6
EVANS VALLEY/WIMER

THE WATERSHED

Situated in the north western corner of Jackson County is the Evans Valley. The narrow southern entrance to the valley begins at the outskirts of the city of Rogue River and widens out to a valley surface varying from one to three miles in width. The valley is encircled by mountains, some named, others remain unnamed except by local lore. Near the Josephine County border; Fielder Mountain (3,747 foot elevation), Old Baldy (3,999 foot elevation), and Elk Mountain (4,434 foot elevation) rise from the west at a steeper and higher elevation than the eastern slopes; Starvation Heights, Wilcox Peak, and Hillis Peak. V-shaped valleys and sharp ridges mark the topographical makeup of the surrounding area. The highest elevation is Round Top Mountain, with the height summit at 4,555 feet. A dirt road to the top, leads to an ODF fire lookout and helipad. Winding through the valley is Evans Creek, it makes an exit at the town of Rogue River, where it empties into the Rogue River (Jackson County, 2003).

Leaving the city of Rogue River and traveling north, the Evans Valley is entered by two perpendicular roads, named for the creek, West Evans Creek Road and East Evans Creek Road. West Evans Creek Road ends were it connects to Pleasant Creek Road, that leads into the mountains. Pleasant Creek Road meets East Evans Creek Road at Wimer, where East Evans Creek Road makes a sharp right angle and heads east following Evans Creek. Following the creeks with the same name; Sykes Creek Road, Mays Creek Road, and West Fork Evans Creek Road each connect with East Evans Creek Road and the mouth of the creeks empty into Evans Creek. These roads all lead north into the mountain canyons often following the creeks (Jackson County, 2003).

In the lower Evans Valley Fielder Creek, Trimble Creek and Bear Branch are tributary streams to Evans Creek (Jackson County, 2003).

Evans Creek itself begins as two forks: the East Fork and the West Fork, both originate near the Douglas County line. The East Fork travels for about 14 miles and the West Fork for about 12 miles before the two converge. After the

confluence, Evans Creek travels another 14 miles before discharging into the Rogue River. West Fork Evans Creek headwaters begins near Goolaway Gap. East Evans Creek headwaters near Richter mountain and Cleveland Ridge (Jackson County, 2003).

Migratory fish found in Evans Creek include native steelhead trout and coho and chinook salmon. The coho salmon is a federally-threatened species, and the steelhead trout is being considered for listing as threatened. Resident fish found in the creek include cutthroat trout and sculpin (Jackson County, 2003).

Native People

The native people were apparently peaceful unless their access to the salmon was blocked (Morehouse-Genaw). But there is evidence of the people along the Rogue showing some hostility near Rock Point and Foots Creek in the early days of late 1830s and 1840s. Conflict did not arise with the Euro Americans, in the Evans Valley until 1853 when a war broke out and General Lane's volunteers pursed the warring tribes into the area. The resulting treaty included Evans Valley, as part of the Table Rock Reservation.

It was from this "war" that several features in this locale of the watershed received their names. Pleasant Creek was named for Pleasant Armstrong, who was killed near there, in the battle of August 1853 (Tucker, 1951). Battle Mountain and Little Battle Mountain, also received their name for where this battle took place. The War of 1853 ended with the signing of a treaty at Table Rock and the temporary reservation setting aside the north side of the Rogue river.

Before the conflict, sometime in the mid 1840s, there was a Euro-American, named William Peck Hillis, living peacefully with and among the Takelma near Evans and Sykes creeks. He apparently came in search of gold and he lived quietly with the natives, without promoting the area to others. Eventually he found gold and built himself a cabin on a "grassy flat" near the native encampment. He continued living among the natives, planting a few crops and looking for gold (Liles and Boulter, 1992). Other know native camps were near Neathamer Gulch and adjacent to both Mays and Evans Creeks. The Wakemans found, what early settlers called "wigwam pole holes" on Pleasant Creek (Liles and Boulter, 1992).

Wailing (1884) commented that "Evans Creek was prospected for gold before the Indian war of 1853, it was then abandoned by whites from fear of the Indians, and on the final settlement of these difficulties in 1856, the Chinese, then coming in large numbers, took possession of the ground, and mined successfully. They were driven out by whites when their good fortune became

known, and the latter took the claims and made good wages. Various other mineral substances of value are found upon this stream."

Hostilities flared again in 1855-56 and ultimately the surviving native people were taken on foot to the Grande Ronde and Siletz . Mr. Hillis obtained a Donation Land Claim that encompassed an area from what is now called Wimer to Mays Creek and included both sides of Evans Creek (RVCOG, 1997). About 1856, Mr. Hillis struck a deal with some Chinese laborers to work for a percentage on his mining operations at Sykes Creek. There was a bunk house for them on the opposite side of Evans Creek from Hillis cabin. Remains of large underground dugouts, and caved in tunnels along with various artifacts remain in the area (Liles and Boulter, 1992).

Gold Seekers and Early Settlement

With the removal of the native people, the miners were free to enter the north side of the river and between 8 Oct 1856 to 30 Jun 1880. Evans Creek had 115 mining claim locations (Wailing, 1884). Mines were claimed for both gold and quicksilver. Soon there were rich strikes on McConnel and Murphy Gulches, and Mays, Pleasant, and Sykes Creeks. Mr. M. H. Chapin found a 10¾ ounce nugget on his Pleasant Creek claim in 1868 (Oregon Sentinel, 1868). Dixie Gulch, Sypfer's Gulch, Bear Branch, and Ditch Creek were also prospected.

Davis Evan's ferry, on the mouth of Evans Creek, was the beginning of "civilization" for the area. There Evans had a cabin on each side the river. The Ferry was the starting point for pack trains of mules to bring supplies to the gold miners on Evans creek. A freighter named John Breeding used both mules and two wheeled charts. The trail followed along Evans Creek and cut across to Ditch Creek to supply the settlers and miners near Jump-Off Joe Creek (Liles and Boulter, 1992).

Davis Evans built a water-powered saw mill located about four miles up West Evans Creek and south of Fielder Creek. He later sold it to Martin A. Steckel. It was known as the Steckel Sawmill. It was of the old circular-saw type and it would cut a maximum of four thousand board feet of lumber a day. The mill was operated by Mr. Seckel and his eldest daughter (Nesheim, 1977). Steckel's Mill was powered by a water wheel. Steckel milled the lumber for the first homes to be built from cut lumber, such as the John Woods home. A settlement grew up around the Wood's home known as Woodville, later the city of Rogue River (Liles and Boulter, 1992).

By the 1860s, the simpler mining techniques gave way to hydraulic mining and all that goes with it. This type of mining required a great deal of water, capital,

skill, and labor. Long flumes to span deep gulches had to be built; ditches had to be constructed, reservoirs erected, thousands of feet of piping laid, and giants and other machinery set. Pressurized water from a pipe or hose was used to expose gold deposits by scouring away hundreds of cubic yards of earth per day. The water washed the sediments into sluice boxes where the gold amalgamates were collected with the use of Quicksilver (mercury). A high water event would wash away their flumes and reservoirs.

The hydraulic "giants" rapidly altered the landscape. Stream riparian areas disappeared. Trees were cleared, ditches and channels changed, and stream beds widened. Large expanses of rock tailings were left as gravel and rock were processed on Pleasant and Sykes Creeks. Later the ditches were used to carry irrigation water.

Miners had been in and out of the Evans Valley for twenty some years, but nothing of a community had been established. Most miners were of a temporary nature, setting up a quick tent, shack, or small cabin. They used the resources at hand; developing the water and building ditches to run their placers. Wood was cut for shelter, and fuel for warmth and to cook their food. The miner could be gone overnight if they hear rich strike elsewhere.

As mining began to wane, some began to look at the Evans Valley from another perspective. They saw the potential of the rich farm land and a new sector began to enter the Evans Valley. The homestead act of 1862 encouraged settlement and improvement of agricultural properties.

WIMER

Permanent Settlement

In the 1870s, Evans Valley began it's growth into a small thriving community as people began to settle on the rich farm land. Family groups came, got married, and settled in the area. Soon homesteads with families were established. What would come to be called; Wimer, and Neathamer Gulch were seeing settlement. A cemetery was established at Mays Creek. Murphy Gulch had Chinese miners living there.

By this time, Mr. Hillis had married and had children in need of an education. In he 1870, agreed to room, board, and give a little pay to a teacher. This first school was held in an old log cabin. In 1879 the Jacksonville Democratic Times reported thirty-seven voters and fifty-six school age children in Evans Valley. In 1889 a school was opened at Wimer (#68). It was located a couple of miles up Pleasant Creek Road from Wimer. Other schools soon followed; Pine

Grove school was half way up Pine Grove Road, Mays Creek (#79) was believed to be built in 1896, Bybee Springs (#101) was open from 1913-1918, and Upper Pleasant Creek school was near Fry's Gulch. They were all consolidated in 1923 (Nesheim, 1977; Liles and Boulter, 1992).

In 1923, the one room schools consolidated to become Evans Valley Union School District # 62. Privately owned buses transported the children to school. At that time the roads were poor, even wagons had a hard time traversing them. Sometimes the older boys would have to push the bus through the muddy ruts, and when fording a stream. In 1923 work was begun on a new school building. It had four classrooms, an auditorium with stage, modern pluming, a well with adequate water, and electricity from a 110 volt power plant with batteries. When electrical power was brought to the Evans Valley around 1929, the school converted over from the 110 volt system. A wood burning furnace supplied heat to the building. In the 1950s, a gymnasium was built, followed by more class rooms a few years later. They have been a part of the Rogue River School system since 1965 (Nesheim, 1977; Sheffield and Miller).

It wasn't until 1886 and 1887 that the community began to be called by the name Wimer. William Wimer, editor of the Grants Pass Courier, was influential in having a post office established at this place. He also had a relative in the Evans's Creek neighborhood, for which the post office was named (Tucker, 1951). Wimer had a postmaster appointment from 1887-1908 (Kidd, 1998).

The Wimer Market was built in the early 1900s. The covered bridge was originally built in 1892 and rebuilt in 1927. There have been repeated attempts to remove the bridge, but valley residents have consistently protected it (RVCOG, 1997). On July 6, 2003, the bridge collapsed with three pedestrians standing near its center. The bridge was scheduled for a $660,000 restoration through the National Historic Covered Bridge Preservation Program.

The bridge was the Evans Valley and Wimer's most famous historical site and has been closely tied to the community's identity. It was featured in books, websites, and tourist literature. It drew tourist off of Interstate 5 to view, take pictures, enjoy the scenery, and perhaps spend money in the community. Over 130 people turn out in support of rebuilding a covered bridge as a replacement.

Cindy Blankenship, of the Rogue River Press, interviewed, Don Worthington Sr., who owned and ran the Wimer Market at the bridge for several years. Worthington recalled he would have his morning coffee every day on the bridge. Worthington said, "I'd look up and down the stream and monitor the creek. I could look through a drainage crack in the deck and watch the steelhead and salmon spawning or coming upstream. I remember one time when the creek froze over watching the mink scooting around on the ice. They'd try to play

with each other and lose control, slipping and sliding on the ice and trying to understand what was happening."

In a Mail Tribune interview, County Engineer Dale Petrasek, said, "The Wimer Bridge was the only covered bridge in Jackson County that still allowed vehicle traffic. He said the most likely cause of failure was a weakened truss that had been identified in an earlier inspection."

The citizens of Wimer and the Evans Valley want the replacement bridge to be covered as well. The Citizens for Rebuilding the Wimer Covered Bridge Committee has been organized.

The Enterprise Grange #489 was formed in 1912 and has continued to this day. This is believed to be the oldest grange organization in Jackson County (RVCOG, 1997). The Grange is the meeting hall for the Wimer community.

In the early 1930s, a Civilian Conservation Corps (C.C.C.) camp was attached to the Oregon state forestry Department; Camp Wimer was located near the Pleasant Creek Guard Station. The young men of the C.C.C. built 44 miles of mountain roads. The roads for Savage Creek, Battle Creek, King Mountain, Daisy Mine, Jack Creek and Evans Creek were constructed and over 60 miles of telephone poles set and line strung. They built the state forestry headquarters in Grants Pass, the McCloud guard station, and worked on the Medford Forestry Headquarters. The C.C.C.s also cleared hundreds of acres of brush and snags and fought forest fires. The C.C.C. end when the U.S. entered World War II and young men required for military service. Nothing remains of Camp Wimer (Liles and Boulter, 1992).

Homesteaders prior to 1900 spent decades removing trees and brush to clear land for cultivation of crops and range for livestock. They also claimed water, dug ditches, and built dams for irrigation. Wheat, hay, rye, barley, and oats were raised for family use as well as supplement for grazing livestock. The Gold Hill News reported the Wimer vicinities agricultural production for the year 1900 as: "wheat, 78,000 bushels; corn, 18,000 bushels; beans 62,000 bushels; onions, 56,000 pounds."

Several businesses once resided at Wimer, a saw mill, dairy, restaurants, and even a mercantile (that burned in the late 1930s). Although the business section is smaller, the area in general has more people living there. In recent years many of the large farms have been cut into smaller 5 and 10 acre plots to satisfy the need for housing in a fast growing community. The small dairies and many of the hay fields have disappeared as well as commercial crops of beans, onions, and cabbage (Liles and Boulter, 1992).

Today, the main agriculture activity is the raising of livestock or feed for livestock. In the non-timbered areas, if the ground is flat enough to till, dry land alfalfa is grown; where there is irrigation, the land is in pasture. Some

produce is grown for local growers markets. Beef cattle, pigs, sheep, goats and llamas, and fowl are raised for the family larder, as pets, as 4-H projects, or to sale. Horses of various calibers from the children's pet, to a valued show or work horse can be seen on ranches ranging from many acres to small operations covering only a few acres.

Though the post office, the store and restaurant have since gone, there has been resurgence in the population of the valley in the recent decade. Most of the household supplies and services are purchased in the cities of Rogue River, Grants Pass, or Medford. Wimer itself has an active Grange, Fire Station, market, hair salon, real estate office, elementary school, and a few other businesses. The local residents have indicated through community meetings that there is a need to provide for the future population and local employment needs with the addition of other service areas (RVCOG, 1997).

EVANS CREEK FARMING AND MINING

As farming and agricultural interest increased in the area so did the need for a source of dependable water for crops. Most of the early water rights were filed and joined to mining interest. Some water rights were filed to co-mingle farming/mining use. William Peck Hillis owned one of the oldest water rights in the Evans Valley. He started a small ditch system on the south side of Evans Creek in the late 1800s. This water was most likely used in his mining operation to blast the placer gravels with a "giant." Hillis had water rights on both Evans Creek and on Sykes creek. He had a priority date of 1875; 0.15 seconds foot; for irrigation of 6 acres, and Domestic use at Sykes Creek, from Hull ditch; SW ¼ SE ¼; Sec 1, T. 35S., R. 4 W.

Mining partners John C. Williams and Jospeh Whalen purchased right of way for a mining ditch in February 1896. They enlarged and improved the existing Thoss and Smith ditch T. 35 S R. 4 W, Sec. 11, 12. In 1896, John Hillis and eight others claimed water rights for the "Williams–Whalen Ditch," and diversion branches. Mr. C. Vroman was contracted on September 8, 1902 to build an irrigation ditch seven feet wide and two feet deep within two years. After securing and filing all the necessary legal work, Vroman started the project. The water was to be taken out of Evans Creek, about one mile above Wimer.

The ditch was mainly dug by hand with pick and shovel, although horse teams were used for some of the work. The ditch was completed and the project was recorded in Jackson County on May 23, 1903. In 1904 a log dam was erected and the original water rights were issued by the state (Liles and Boulter, 1992).

The next part of the project was to erect a log trestle and wooden flumes to span the creek about one hundred feet or more up the creek from the Wimer Covered Bridge. The farmers had the same problem as the miners; a high water event could take out the piers and flumes. At the end of each growing season, the piers and flume boxes were taken down and stacked on higher ground. Each spring the structures were erected for summer irrigation. If an unexpected high water event occurred in the spring; there was always the chance that the structures would be washed away, causing a sever drain on the farmers operating funds and could put him out of business (Liles and Boulter, 1992).

The wooden flumes were replaced with half rounds of three foot galvanized pipe in 1912. The galvanized flumes were found to only last about three years. They also had to be taken down and stacked on higher ground and each spring the structures erected. It is interesting to note that during this time cinnabar was being mined on the West Fork of Evans Creek. It is believed that the minerals washing down the creek caused corrosion to galvanized pipe. Further examination found these minerals also cause the lily bulbs that were raised in the valley to disintegrate after harvest. The farmers went back to using the wood flumes, but they would wash out three times. A high water event in 1955 washed out 15 feet of bank. In 1963 the trestle and flume system was replaced by laying steel pipe under the creek bed (Liles and Boulter, 1992).

Around 1923, the farmers organized an irrigation district under Oregon corporation laws as “The Pleasant Valley District Improvement Company” (Liles and Boulter, 1992).

In 1999-2000 the Oregon Water Trust, with cooperation from the now defunct Evans Creek Watershed Council, was a major participant in the closure of the Williams-Whalen Ditch. The conservation project involved conversion of gravity flood irrigation to sprinklers with individual pumps located downstream of the old ditch diversion. An allocation of conserved water was approved for the project to establish an instream water right in Evans Creek with an 1896 priority date (OPSW, 2000).

In early 1996, two landowners on the Williams-Whalen Ditch converted from flood to sprinkler irrigation. They became the first water right holders in Oregon to create an in-stream water right by using an innovative law passed in 1987, The Conserved Water Statute. According to Oregon Water Trust, all the remaining landowners on the Williams-Whalen ditch approached OWT and the Evans Creek Watershed Council to develop a conservation project that would allow each landowner to switch from flood to sprinkler irrigation. The landowners now divert water directly from Evans Creek, thereby eliminating the need for the ditch system (Fish Flow News, 1997).

Quoted in the Fish Flow News Fall/Winter 1997 "We will have a more efficient and reliable irrigation system and will no longer have to spend all that time trying to maintain the ditch," said Irene Loper, who owns land at the end of the ditch. "Since we'll use less water than our original right, we'll be able to return some water to the creek" (Fish Flow News, 1997).

Looking back at about five years from the closing down of the Williams-Whalen ditch; community observation finds large dead trees, dried up wetlands where wildlife frequented and warmer water in the creek. The water from the "leaky ditch" had helped to cool the creek as the wetlands it created leaked back into the creek, cooling itself through the gravels as the water retuned to the creek (Howell, 2003). Another problem for the water users is people pumping water from the creek without a water right. This is found especially among the more recent property purchases.

The original log dam was replaced with another log structure in 1916. A ten foot high concrete dam with a corkscrew-style fish ladder, under regulations of the State Game Commission, was built to replace the log structure in the 1930s.

The Wimer Dam was featured in the August 31, 2003 issue of the Mail Tribune. The article reported, Special Agent Jim Houseman of NOAA-Fisheries, declared "the dam as an impediment to fish swimming upstream to spawn, including coho salmon, listed as threatened under the federal Endangered Species Act." He said, "It's in the best interest of the salmon, nobody is maintaining the dam, nobody has water rights off the dam and it is delaying or injuring fish."

Apparently, a near by property owner purchased all the assets of the Evans Valley Irrigation District, and that apparently includes the dam. This potential ownership of the dam has been brought to the attention of Larry Menteer, Jackson County Watermaster. When recently interviewed by Sanne Specht, of the Mail Tribune, Menteer said "this person was not listed in a recent title search on the dam or the properties, and the dam's ownership is currently unresolved."

Current owners of the properties that abut the dam, say they have been "pressured" by NOAA Fisheries and the Bureau of Land Management to remove the dam for over a year. "BLM mentioned horrendous fines of (up to) $10,000 per fish for harming or harassing the fish.". The abutting landowners say they don't own the dam. The BLM, who would be the agency involved in removal of the dam, was apparently seeking to gain ingress and egress for the removal project by using the land abutting the dam. The owners of the properties were asked to sign a document, which it is not believed to protect them from some potential liabilities (Mail Tribune, 2003; Kewish, 2003).

A concern for many nearby residents is mercury. Mercury, besides being used in the process of extracting gold, was also mined in the form of cinnabar in the Evans Creek watershed. Mercury, heavy like gold, will sink to the bottom, where it will stay if left undisturbed. Extracting core samples from sediment to test for mercury requires a special augur with a suction to keep the mercury held is place in the sample (Howell, 2003).

Wimer resident, Paul Howell, lives down stream from the dam. He reports that he has found mercury in sediment behind the dam. Howell said he dredged small test holes with a five-inch suction dredge behind the sediment-filled, 10-foot dam. "Most all the fine or coarse gold we found had mercury on it."

Mercury waste is found at mines and various industries including; municipal sewage plants, cement plants, auto wreckers and repair shops, and the printing industry, even the dentist office. When mercury is released into the environment, it can recycle through the air indefinitely or can bind with bacteria in water to create such compounds as methylmercury. It works it way through the food chain when the fish eats the organisms with these bacterial methylmercury, and on to the humans who eat the fish (Washington State Department of Ecology).

The Wimer Dam and other dams on Evans Creek, by and large were built prior to or in the 1930s. The sediment behind these dams was building, at the same time the mining operations were going on full speed. This caused the filling in behind the dams in the thirties and forties, bringing with the sediment and aggregates, gold, mercury, and other materials stirred up, dumped, or lost by the early miners (Howell, 2003).

Mercury is a liquid metal, with a heavy specific gravity comparable to gold, moves through gravel and sand downward with very slight disturbance or vibration. Sampling for this metal and having an accurate test made is very difficult and expensive. Mercury on bed rock and in the cracks of bedrock can be very hard to sample (Howell, 2003).

High water volume and velocity may move this material quickly downstream when high water exposes bed rock. Exposure to low water flows and summer time water temperatures could cause added problems to the environment and community from materials from past mining activities being introduced to the stream waters in summer and pumped onto fields where animals may ingest them (Howell, 2003).

According to USGS (2000), bacteria that process sulfate (SO_4^{-2}) in the environment take up mercury in its inorganic form and convert it to methylmercury through metabolic processes. The conversion of inorganic mercury to methylmercury is important because its toxicity is greater and because organisms require considerably longer to eliminate methylmercury.

These methylmercury-containing bacteria may be consumed by the next higher level in the food chain, or the bacteria may excrete the methylmercury to the water where it can quickly adsorb to plankton, which are also consumed by the next level in the food chain.

Because animals accumulate methylmercury faster than they eliminate it, animals consume higher concentrations of mercury at each successive level of the food chain. Small environmental concentrations of methyl-mercury can thus readily accumulate to potentially harmful concentrations in fish, fish-eating wildlife, and people. Even at very low atmospheric deposition rates in locations remote from point sources, mercury biomagnification can result in toxic effects in consumers at the top of these aquatic food chains (USGS, 2000).

Special Agent Houseman admitted to Mail Tribune, reporter, Sanne Specht, that there is heavy metal contamination along Evans Creek; "There are mercury and other heavy metals above and below Wimer Dam." Houseman said there would be federal funds to help defray costs of hazard removal or containment if the dam were removed. "We always approach these issues as one of collaboration first," he said. "NOAA-Fisheries, recognize the landowners inherited this issue." However, while determining ownership of the dam proves to be challenging for them; the dam remains on the block for removal.

PLEASANT CREEK

Pleasant Creek an affluent of Evans Creek was named for Pleasant Armstrong, who was killed near there in hostilities of 1853 (Tucker, 1951). Some of its tributaries are Ditch Creek, Queens Branch, Fry Gulch, and Jamison Gulch. In the fall of 1852, gold was discovered at Pleasant Creek. Pleasant Creek afforded pay-dirt to quite a number of miners about the year 1860 (Wailing, 1884).

The Pleasant Creek School was far up Pleasant Creek near Fry's Gulch. Major roads, are Pleasant Creek Road, West Evans Creek Road, and Ditch Creek Road. The higher reaches of the Pleasant Creek drainage were mainly trails; professional road construction into these areas didn't take place until after World War II.

Places of historic interest include the Pleasant Creek Guard Station, the site of C.C.C. Camp Wimer, dredge mine tailings on Pleasant Creek, and Wakeman Mine at the head of Pleasant Creek.

Miles S. Wakeman appropriated water for mining and irrigation in 1865 for both irrigation and mining via Lower Wakeman ditch, (34S. 4W. sec.34) near Pleasant Creek (Jackson County Planning, 1992). In 1877 Charles Williams in

partnership with Robert Montgomery, filed for water rights on Pleasant Creek for mining. (Williams Ditch, 34S 4W Sec. 29, 30). On Pleasant Creek there were the Upper Wakeman ditch, Collins ditch, Highline ditch, and Leason ditch and on the right fork was the Moore ditch (Jackson County Circuit Court, 1919).

On tributaries of Pleasant Creek; Brown Gulch had the Manning ditch, Queens Branch had the Calvin ditch, Neathammer ditch, and Ingladue ditch, Ditch Creek had Owens ditch, Dixie Gulch and Brush Gulch had Smith ditch, Collins Gulch had the Smith and Collins ditches. A. K. Gulch had Leason ditch, and Frys Gulch had Oden ditch. Most rights were filed for mining but some for irrigation (Jackson County Circuit Court, 1919).

In the early 1900s, the most important hydraulic mine operating in the Evans Creek area was the Lone Star Mining Company. Mr. C. E. Wicksrom was the principal stockholder, having acquired it from Calvert Brothers, Lister and Company. It was located on Pleasant Creek, about six miles from the confluence with Evans Creek. The holdings were of 305 acres, 200 of which were deeded land (SOHS, 1978).

Below the Lone Star Mine on Pleasant Creek was the Cameron Mine, it was a hydraulic; operated by its owner Mr. D. Cameron. A lack of pressure and dumping facilities considerably handicapped operations. Several parallel channels ran through the ground, from twelve to sixteen feet deep. Three short ditches furnished good pressure, but was over ground that been pretty much worked over (SOHS, 1978).

Pleasant Creek and its tributaries were heavily mined prior to 1914. Diller wrote at that time “For over three miles the bed of Pleasant Creek was almost completely mined out years ago” (Diller, 1914). The hydraulic “giants” rapidly altered the landscape. Stream riparian areas disappeared. Trees were cleared, ditches and channels changed, and stream beds widened. Large expanses of rock tailings were left; as gravel and rock were processed.

Pleasant Creek has been worked by a bucket line, numerous hard rock operations, and many types of placer mining from sluicing to hydraulic mining. From 1939 to 1942 the Pleasant Creek Mining Corp. operated a dredge, in sections 22 and 27, T. S., R. 4 W. It was a steel-hulled, three cubic-foot connected bucket-line, diesel-powered, flume type. Values tested at about 17 cents per yard. This dredge was shut down in 1942 as were all gold mining operations (Brooks and Ramp, 1968).

In 1981, Wimer bid farewell to an old familiar landmark, the “Wimer dredge.” It was the dredge that Joe Most, owner of the Pleasant Creek Mining Corp., operated until the diesel engine was confiscated for the World War II effort. The 300-ton, 45-foot high dredge floated on pontoons and used a chain of

metal buckets to eat into the earth, moving itself forward and filling in the pond behind it with tailings. The buckets dumped the earth into a series of sieves sluice boxes to separate the gold. The dredge was purchased by Henning Mining and Milling Corp. from Greg Adams and moved to the Caribou Mining District of central British Columbia. The Henning Mining and Milling Corp. planned to restore the site before leaving (Stanley, 1981).

SYKES CREEK

It was near the mouth of Sykes Creek and Mays Creek that native people had a camp. Mr. Hillis was the first Euro-American settler in this vicinity. He farmed and mined and had a ditch to provide water for these activities. There was also a dwelling of "Gilbert" at the confluence mouth of Sykes Creek in Section 12, T. 35 S., R. 4 W. (Atwood and Lang, 1995). Elizabeth A. Simmerville received water for irrigation from Hull ditch and Sykes Creek (Jackson County Circuit Court, 1919).

There was a stamp mill and cyanide processing facility within three quarter of a mile from the confluence with Evans Creek on Sykes Creek. There are also signs of placer and hard rock activities on Homestead Gulch, Greens Gulch, Steins Gulch, and Magerle Gulch. Most of these Gulches are above the Wimer Dam and below Murphy Gulch with the exception of Greens Gulch which is just above Wimer (Howell, 2003).

MAYS CREEK

Mays Creek is with in four miles from Wimer, while traveling East on the East Evans Creek Road. A one-room school was built about 1896, after the school districts combine in 1923 it became a personal residence of one of its former students, Mrs. Carrie Weide. The grounds border the stream that gave the school its name (Nesheim, 1977).

MURPHY GULCH

About a mile above Sykes Creek is the mouth of Murphy Gulch; a tributary of East Evans Creek on the south. Murphy Gulch was mined by Chinese in the 1800s. The creek furnished some of the richest of early-day diggings. Carter,

Siver, and Ammons operated a small plant on a back channel in the early 1900s. Several quartz ledges up the gulch received some attention also.

Situated at the mouth of Murphy Gulch, was a 207 acre property, under the ownership of W. A. Van Goethen in 1904. It was known as the old Albright place and had been under several different owners. It had previously been owned by John B. Hillis, and also E. D. Thompson, the merchant at Wimer, who sold the place to Van Goethen (SOHS, 1978) who stated that most of the acreage comprises the old channel wash. "Much of the gravel is covered by slide, this very slide matter, however, carrying a heavy trace of eroded quartz gold." The covered channel has about the same elevation as the present bed of Evans Creek and is known to carry good values."

During the depression years, resurgence in mining took place through out the Evans Creek drainage. In the early 1930s, the Oden's were mining on Murphy Gulch. Jim Oden was directly involved with three mine tunnels, as half owner. Jim and his wife lived in a cabin at the number one mine near the bottom of Murphy Gulch while the mines were worked.

There was a stamp mill and cyanide processing facility at the location of their cabin. For security reasons, their presence was required at the mine and processing site. The mines were worked up until World War II. At which time, they were shut down; as with many other mines in the area. The mines Jim Oden operated were called the Blue Ledge Mines at that time, but may have been renamed as time and owners changed.

The top two mines produced ore which was hauled down near the lower tunnel to the stamp mill for processing. By road, the distance from the lower mine to the upper mines is 5.2 miles, going straight up the canyon is only 911 feet or about three football fields in length. The problem is the elevation changes by 326 feet in the 911 feet. On foot you would go from 2,252 feet to 2,578 feet in elevation. This is very steep terrain to say the least. Mules and horses were used to pack this ore down from the upper mines.

From the upper mine tunnel ore was packed approx. 900 feet down the hill to the lower mine site and stamp mile to be processed. By BLM road the distance to the lower mine is 5.2 miles. The largest mine is over the bank. The mine under this road is the largest of the three with a portal of at least ten by ten feet.

Water was used from Murphy Gulch at the lower mine simply because of the need for a constant water supply for milling operations and amalgamation processes. The stamp mill reduced ore to a powder and freed gold from the ore. The ore was then run across a concentrating table which picked up the free gold. This table had riffles with mercury poured in them, on it and a copper plate with mercury adhering to it. The mercury supposedly picked up the gold

that was traveling across it. The ore that went across this table was then subjected to a cyanide solution in a large tank that stood nearby. This tank had zinc plates in it similar to paddles that turned and agitated the ore and the cyanide. This caused the remaining gold in the ore to be dissolved into a cyanide solution and then electrolysis caused the gold in solution to be electroplated on the zinc plate. When the plates were coated with gold new plates were installed and the old plates sent to a smelter to reclaim the gold (Brooks and Ramp, 1968).

The liquid cyanide was usually dumped at this point and new cyanide added. By dumping, I mean into Murphy Gulch, and the water took it on down. While cyanide supposedly has no long term effect on creeks, it does have short term effects. Also when cyanide reacts with sulfides in ore it may cause the extraction of arsenic compounds that may be very harmful to the environment. Arsenic may be detrimental for a much longer period of time.

The mercury was used on the copper plates on the concentrating table and in the riffles. Miners used mercury, a lot of mercury, and it got away from them ending up in Murphy Gulch and other streams throughout the area. Many people at the time were aware of this but; at the time the harmful effects of mercury were not as well known as they are today.

Murphy Gulch has mercury in it the full length of the creek; from both tunnel operations and the many small placer operations that took place on the Gulch. This has contributed to mercury being in Evans Creek. Some may be naturally occurring. It was thought at the time that there wasn't much gold upstream from Murphy Gulch and I have found this to be more or less true. There are very few signs above Murphy Gulch. Murphy Gulch is upstream less than two miles from the Wimer Dam and one half mile downstream from Sykes Creek which is another stream with extensive past mining operations both placer and hard rock (Howell, 2003).

Murphy Gulch Blue Ledge Mine, Jim Oden's cabin site, and site of stamp mill, cyanide tanks and other cabins are no longer visible. A small pile of decomposing lumber is all that is left of the cabin built in early 1930s. Approximately 30 yards from this site is a tunnel. It slopes straight out in front of the tunnel that dumps directly into the creek. The mine tunnel extends approximately two hundred feet back into the mountain in soft bedrock. This tunnel had no track or ore cars in it. A big tunnel beneath the BLM road is up near the top of the mountain. These two tunnels are approximately six feet high and three and a half to four feet in width. Both have water on the floors at the entrances (Howell, 2003).

BYBEE SPRINGS

There was a time during the later part of 19th century, when Mr. William Bybee was the largest land owner in Jackson County. The Bybee's had a home at the Meadows; 18435 East Evans Creek Road. Mr. Bybee built a resort at the mineral springs in 1882; it was called Bybee Springs Resort. Bybee Springs is located at T34 R3W section 34 western part of the north east quadrant. He also built a school in 1913. Bybee Springs School is located at 17019 East Evan Creek Road, near Maple Gulch and Sypher Gulch. Bybee Springs School is still intact on East Evans Creek Road (Liles and Boulter, 1992).

MAPLE GULCH DAM

Some time in the early 1900s a dam was built on Maple Gulch for water storage. It was eleven feet in height and was approximately 0.3 miles upstream of the confluence of Maple Gulch and Evans Creek. It is thought by some to have been built for the Bybee Springs School. It hardly seems likely that much expense and effort would be put forth to furnish water for the "tiny nearly playhouse size school house." Most of the one room county schools of the era had a water barrel or a hand pumped well at best. It seems more likely to have been built for irrigation purpose or for the resort (BLM, 2003 [a]).

Over the years the dam was pretty much ignored, it was not kept up or the water used. In the late 1970s some young men discovered the dam, but were dismayed to find the part of the dam had washed away. Thinking it would make an excellent swimming hole, they patched up the blowout with some plywood. Sediment gradually covered the plywood and dam again held water. However, the water was found to cold for swimming.

Over twenty years later the dam, located on BLM lands, had continued to fill with sediment and no longer served a purpose. However the dam served as a barrier to fish passage.

Maple Gulch dam was mechanically removed, during the summer of 2002, by BLM leaving behind approximately 750 cubic meters of sediment. A knickpoint formed in the reservoir sediments and quickly eroded a channel during the winter of 2002/2003 (BLM, 2003 [b]).

However, this is not the end of the story for Maple Gulch Dam. As part of his Ph.D. research at OSU, Greg Stewart is investigating the geomorphic consequences of two small dam removals; at Maple Gulch and Dinner Creek in southern Oregon. Greg Stewart has been using repeat surveys to estimate the volume and timing of sediment export from behind the dam. This data along

with process information is expected to result in a conceptual model for erosion following dam removal. This information provides guidance to future dam removal efforts (BLM, 2003 [b]).

ALPHONSO DAM

There appears to be no known historical records available, as to when the "Alphonso Dam's" were first built. The earliest water rights were filed in 1892. The water was use in the 1890s by farmers and ranchers to irrigate their fields. Mr. Billie Griffith grew up along this stretch of Evans Creek. He remembers, "the original dams were of logs" and "watching the fish jump over them" (Griffith, 2003).

About 1933, Mr. Griffith's grandfather, Dave Swihart bought a small, operating lumber mill from relations; Earl and Noble Zimmerman. It was located in the flat area near the confluence of West Fork Evans Creek and East Evans Creek. The saw mill was run by a steam engine and operated until it burned about 1938 or 1939. They cut and sold, mainly pine, not much fir. The lumber, cut, air dried, and delivered to Grants Pass; brought in $11.00/1,000 feet (Griffith, 2003).

In the early 1940s, Ben Alphonso came to the area. He lived on and owned much of the land along Evans Creek; from a little east of the confluence Ramsey Creek, to past the confluence of the West Fork Evans Creek and East Evans Creek. This included the Mission Bell Ranch where he originally lived (Griffith, 2003).

Ben was an interesting character. He seemed to think he owned the creek and the road; as much of his lands were on both sides. He tended to run his fences real close to the narrow road and was known to even stop a car a night; he even tried to intimidate people from using the road. Ben had a big bulldozer and went wherever he wished on it. He ran some cattle and logged timber off his land. He took out a lot of trees from around the creek and tried to run off any fishermen; he saw (Griffith, 2003).

Ben Alphonso was the one who built the concrete dam structures. The Upper Alphonso Diversion Dam, as it seems to be called, was 10 feet high, 56 feet long, and 3 feet wide and was made of aggregate material and concrete. It was in a V-shaped bedrock-constrained canyon two miles upstream from the confluence of West Fork Evans Creek and East Evans Creek. The impounded water behind the dam extended for a distance of approximately 550 feet, with an average width of 41 feet (BLM, 2003 [a]). Mr. Griffith remembers attending some meetings with Fish and Game in Grants Pass with Ben Alphonso back in the 1970s regarding the dam; it was during the period that the Rogue

Flyfishers Club, installed a fish ladder at the dam. There was also a Lower Alphonso Diversion Dam (Griffith, 2003).

When Ben Alphonso got older he sold the Mission Bell Ranch and moved down the road to some land near Spignet Creek. The new owners broke up the ranch and sold it off in smaller lots. The water rights and the irrigation may have become lost in the transactions. Water was no longer being used from the dam for irrigation. Over time the pool behind the dam filled with gravel and cobbles and no longer held much water (BLM, 2003 [a]).

The Upper Alphonso Diversion Dam was reported to impose the largest barrier of the seven irrigation diversion dams on East Evans Creek. Depending on the flow, the structure delayed or completely blocked upstream fish passage (BLM, 2003 [a]). On July 19, 1999, work began on the removal of the Upper Alphonso Diversion Dam Removal allowing fish to easily migrate upstream to an additional 12 miles of spawning and rearing habitat (BLM, 2003 [a]).

WEST FORK EVANS CREEK

West Fork Evans Creek is one of the few creeks that had a limited amount of gold mining activity. One water right was filed on a tributary, Wells Creek. The right had priority date of 1875 for the irrigation of 15 acres and stock watering. The water was diverted via the Montgomery ditch location at: S. E. ¼ N. W. ¼, Sec 33, TP. 34 S., R., 3 W (Jackson County Circuit Court, 1919).

Often over looked but very important to the whole southern Oregon region for the first twenty to thirty years, was the salt mined in the mountains above Evans Valley. The salt came from Salt Creek, a tributary of the West Fork Evans Creek. Located near Little Battle Mountain, the salt was of immense value as a preservative and condiment. Its value to the settlers was almost like gold. A rugged, winding, and steep road that could be quite treacherous in bad weather was used to bring out the salt. When the railroad came to Grants Pass in 1883, the commercial mining of salt was discontinued at Salt Creek (Liles and Boulter, 1992).

West Evans Creek Road was an early road because of the salt mine. Fuller and Company erected apparatus, in 1864, to evaporate the water and purify the contained salt (Wailing, 1884). Salt Creek Picnic Area is in Section 3, TP. 34 S., R., 3 W. and is near where the salt was mined. Battle Creek, Raspberry Creek, Rock Creek, Lick Creek, Cedar Creek, Elderberry Creek, Swamp Creek, Sand Creek, Steinmetz Creek, Sam Creek, and Slick Rock Creek are other tributaries of West Fork Evans Creek.

Elderberry Flat Campground is located on the banks of the West Fork Evans Creek at TP 33S, R 3W, Sec. 31; about nine miles up West Fork Evans Creek Road (BLM Road #34-3-24). For years it has been a popular spot for locals. Some large salmon have been taken at the creek over the years. It continues to be a popular with young people for parties. Swimming holes are located along the creek in the campground. Nine campsites are available with picnic tables, fire pits, garbage cans, and pit toilets provided (four campsites are located next to the creek) (BLM, 2003).

The campground is a popular fall hunting camp and may fill up at this time. ATV/motorcycle trails originate from this area and are allowed on trails and roads only; not in the creek and only on paved roads in the campground. A concern is the off road vehicles riding up the banks and road of the gravel soils in this area and adding increased sediment to the water (BLM, 2003).

Over the past summer, BLM built a new bridge on West Fork to replace a box culvert. There are more roads in the area than shown on topographical maps.

Glen Woolridge told about Harry Stokes who was the government hunter for many years. Harry had told him, “he had killed thirteen timber wolves in the Evans Creek area” (Arman and Wooldridge, 1982). Glen himself saw one up West Fork. Woolridge remembered hunting up West Fork in his model T, there were hardly any roads in there at the time, no bridges, you just forded the streams.

CHAPTER 7
GOLD HILL

Within a three mile stretch along Interstate 5 and the Rogue River are three communities nestled between the hills. During their hay day, Dardanells, Gold Hill, and Rock Point, played an important role in history of the Rogue Valley. The name Dardanells has been retained in the name of the local BP station and Mobile/RV Park. Gold Hill, an incorporated city, is void of its former prominence. Traffic whizzes past Rock Point, its former importance to weary travelers unacknowledged. It was along this stretch of the river, that a number of early attacks by the native inhabitants on travelers, took place. One can't help but wonder if it was to keep the visitors moving quickly through the area or to prevent the discovery of the gold in the waterways.

DARDANELLS

Only a concrete marker, standing to the right of the Gold Hill overpass and on-ramp to the south bound lane of Interstate Five, stands to acknowledge the historic community of Dardanells, where the first post office in Jackson County was established on 19 October 1852 with William G. T'Vault as postmaster. Other postal firsts are distinct to Dardanelles. It was the first to be discontinued (2 August 1853), and the first to be reestablished (29 October, 1855), until it was finally closed in 2 December 1878. It had been established and discontinued four times (Throne, 1968; Kidd, 1998).

Dardanells was situated in the neighborhood of Gold Hill, the mountain, and it was among Jackson Counties first precincts, established in 1853, at the home of William Lawless (Wailing, 1884). Some people referred to the Dardanells as the, "T'Vault place." The Colonel, as William G. T'Vault was called, took up a donation land claim near a creek that soon took his bore, T'Vault. The creek is now known as Kane Creek, named in honor of Dr. Kane, an immigrant who settled there in 1853 (Tucker, 1951).

The T'Vault home was located near where present day Foley Lane and Old Stage Road intersect. Its design was an important consideration for protection during native hostilities. Made of rough logs, the cabin had holes cut through

the walls for rifles. It was one of the homes where people "forted" up during the Rogue River Indian Wars of 1855-56. Nearby was Doctor G.H. Ambrose's, donation claim, sold to Davis Evans in 1857 (Throne, 1968).

Dardanells was located along the Umpqua to Yreka Road and the Old Stage Road to Jacksonville. It is in this vicinity of the river, where the position of Gold Hill, the mountain, forms a bend in the river. Here, there is a little valley with Gold Hill and Blackwell Hill to the north east. Kane, Vaults, and Blackwell Creeks flow through this little valley which is now divided by interstate 5. There was a ferry, and later a toll bridge spanning the river (Throne, 1968).

Thomas Chavner came into Jacksonville looking for gold about 1856. Being unsuccessful in prospecting, he came to Dardanells and purchased a farm. He bought the James Hawkins donation land claim of 159.05 acres for $750 in 1857. Chavner proceeded to lease this farm to Isaac Miller in July 1858. He left the area for a short time to prospect at Fraser River. He returned to Dardanells being unsuccessful in his venture (Morehouse-Genaw, 1988).

The lease agreement, between Chavner and Miller, gives an idea of agricultural activity that was taking place in this area: seven head of cows, seven calves, two yoke of oxen, one wagon, and six or eight hogs were included. Chavner agreed to furnish wheat and oats in good farming-like manner and he would do half the labor in securing the crop of grain that was on the farm by hauling, thrashing, and cleaning the same at the end of the lease. A garden was mentioned and Miller was to dig a good well near the house, plus some fencing. Chavner agreed to furnish enough timber to the saw mill on little Butte Creek to fence the house and yard. Miller agreed to haul the sawed lumber and build the fences. The lease also mentions the clover and timothy to be cut and stacked (Morehouse-Genaw, 1988).

On a small, unnamed butte near Fort Lane, now known as Gold Hill, was the sight of one of the largest pockets of gold found in Oregon. There are many varying stories on how the lead was found, and how much was actually produced, but there were five men filed on the claim: Bill Hays, George Ish, Jack Long, O. J. Graham, and Thomas Chavner. They filed five quartz claims at 3 p.m. on 13 January 1860, called the "Emigrant Lead." People began to file clams until 10:00 p.m. that night. Soon there were about 150 claims taking up the whole side of the mountain (Morehouse-Genaw, 1988).

A letter sent to the Daily Alta California and printed February 26, 1860, mailed from Jacksonville, was signed "On the Wing," and gave this description: "But the most simultaneous get up-and-bundle-out-to-diggin's we ever saw was the rush to Gold Hill the other day. At midnight every stable in town was empty, everything that had wheels had a full freight. Saturday morning, January 14, Gold Hill looked like an overgrown camp meeting. Horses were hitched to trees

all around the glittering garden of gold. Like turkeys picking up corn did they pick up rocks loaded with gold. The next day, Sunday, the census of the county could have been taken without much trouble, as everybody was at Gold Hill" (Dufur, 1975)

The pocket was not immediately found. Hays sold out for $5,000 to Henry Kippel, John McLoughlin, and Charley Williams. O. J. Graham sold out for $5,000 to Henry Kippel and John E. Ross. At first, an arrastas driven by two mules was used to crush and finely grind the ore, but some gold was lost due to the inefficiency of the process. A steam quartz mill to reduce the rock was obtained in San Francisco. Walling described the mill: "It was a twelve stamp mill, of the ordinary type of free gold mill, amalgamating in battery, and crushing wet. Its first performance was the reduction of one hundred tons of refuse quartz, thrown aside as being too poor for the arastra process, which yielded one hundred dollars per ton, but other runs were only three dollars per ton. The stamp mill was set up and operated at Dardanells" (Wailing, 1884).

The Dardanells precinct sprang into new life and activity. Down near the river, a hotel called the Adams House was built. In 1860, 25 people were living at Adams House. A general store, two blacksmiths, and a restaurant were soon operating businesses (Morehouse-Genaw, 1988). Dardanelles formed School District #17 in 1865. The school was in operation 56 years before joining with Gold Hill and eventually becoming a part of Central Point #6 (Nesheim, 1977).

Closer to the mine at the foot of Gold Hill, was erected a boarding house, trading post, and an eatery. During this period, mining companies were involved in trying to turn the course of the river. They hired 25 men to dig canals at Long Bar and Big Bar, with the intention of building dams across the river about one mile apart. The work that had been accomplished was destroyed by the big flood of the winter of 1861-62 (Morehouse-Genaw, 1988). However, the "boom" ceased, the mine was exhausted, and the Dardanelles decline into anonymity.

One of the main people to prosper was Thomas Chavner. Having gained financially from the Immigrant Mine, he had capital to invest. When a farmer needed money they often went to Chavner. If they were unable to meet the mortgage, Chavner would usually end up with the land. He soon became owner of a large amount of land and a toll bridge.

All the bridges and ferries had washed out in the flood of 1860-61, but reconstruction began right away. The August 9, 1862, Oregon Sentinel, called him "the irrepressible Thomas Chavner" when it announced the opening of his new bridge, across the Rogue River. Apparently, there was some dispute over the rights to bridges that were rebuilt after the 1860-61 flood, and kept the Chavner bridge out of operation for a time. In July 1867, the Oregon Sentinel reported a bridge fell during a heavy storm, owing to some of the braces being

broken. The bridge was built in 1862, but was out of repair for several years. "It was offered as a gift to the County last year by the owner, on condition that the Commissioners repaired and throw it open to the public. It has gone down to make way for the railroad bridge that will eventually span the river at that point." Chavner built another bridge which was completed in 1876 and called the Centennial Bridge. Chavner deeded the bridge to the county before his death in 1888. The bridge served the area until 1911.

About 1892, Chavner's offspring ordered a house from a catalog and had it assembled by William Stuart. The home and out buildings are still standing at 12162 Blackwell Road. The home, being a private residence, has in recent years had some restoration/maintenance work done. The Chavners had a large orchard of pears, apples, and cherries in addition to their grain crops and livestock.

Today, a KOA Campground, a District #3 Volunteer Fire station, and a RV Park are on the north side I-5 before entering Gold Hill. Lampman State Wayside, further west on Lampman Road, is showing neglect. On the south side of the interstate is a BP station, Mobile/RV Park, Laurel Hills Golf Course and a restaurant.

KANE CREEK

Five miles south of Gold Hill, on Kane Creek, was the Revenue pocket. It was mined out by the Rhoten brothers. The Ore Bin reported the amount taken from the pocket at $100,000. It was in Section 11, Township 37 South, Range 3 West, at about the 2,570 foot elevation (Brooks and Ramp, 1968). The Roaring Gimlet Pocket was described by Diller, as a rich deposit discovered in 1893. It was found at the mouth of China Gulch, about 2.5 miles south of Gold Hill pocket. The combined yield was said to be about $40,000 (Brooks and Ramp, 1968).

Centennial Gulch was the richest gulch of Upper Kane Creek in the vicinity of Paddy Hill. A circular eminence, Paddy Hill, was noted for its numerous pockets. Mining operations were handicapped by lack of right of way. Some surplus water from the McDougal ditch allowed for some sluicing.

Kane Creek was dredged in 1908 by the Electric Gold Dredging Co. They worked a tributary in SW ¼, Section 36, Township 36 South, Range 3 West. This operation made use of an electric power shovel which fed a washing plant at the rate of 500 cubic yards in 10 hours (Brooks and Ramp, 1968). The two forks and their tributaries were very rich wherever they were worked. They were worked until the flat basins of the valley made further work impractical. Paddy Hill and Centennial Gulch were on the west side and Harris Gulch on

the east. The Kane Creek basin is about a thousand feet wide here. A number of shafts were drilled in this area and showed good values. The old Miner and McDougal ranches were near where the right and left forks joined with the creek, cutting through them. One and a quarter miles of Kane Creek ran through the 350 acres of the Miner holdings (SOHS, 1978).

A present concern of the Kane Creek community, as well as others on the south bank, is heavy vegetation and brush on the hillsides and the fire hazards they present. Another concern is that of a proposed BLM Medford District Resource Management Plan (RMP) designating 16,250 acres in Timber Mountain/John's Peak for Off-Highway Vehicle (OHV) use. There are areas of granitic soils in the headwaters of Kane, Galls, Foots, Willow, and Jackson Creeks. These areas are very susceptible to surface erosion when the surface has been disturbed. This could cause increase sediment in the streams.

GALL'S CREEK

Galls Creek is named for Jacob Gall, who settled on a 317 acre donation land claim in that vicinity on September 7, 1852 (Tucker, 1951). The claim bordered the Rogue River and Galls Creek. Jacob Gall was killed by Indians on the road near Fort Dardanelles on 7 August 1856. The farm sold at sheriff's auction a few years latter. His decedents settled in and were influential in the north end of the county.

The Galls Creek community had a close connection to that of Rock Point. Galls Creek was one of the few communities that never had a Post Office of its own. Mail for the people living on Galls Creek went through the Post Office at Rock Point, which was the main trade center for the Galls Creek area. In the days before Gold Hill was founded, Rock Point was the largest town for many miles (Morehouse-Genaw, 1988).

Galls Creek was one of the most famous as well as among the most productive mining areas in the Gold Hill vicinity (Brooks and Ramp, 1968). It was referred to as the Bohemia mining district (Morehouse-Genaw, 1988). Between 8 October 1856 and 30 June 1880, Gall's Creek had 95 mining claims (Wailing, 1884).

Galls Creek drew in both placers and quartz miners. In the 1890s, nearly every man living on Galls Creek was a miner, or a day laborer for a mining company. There were very few farmers in the narrow Galls Creek basin at that time. Some of the famous mines on Galls Creek were: Tin Pan, Lucky Dee, Red Oak, and Big Foot (Morehouse-Genaw, 1988).

Much of the early community was made up of miners. But by the late 1870s, miners were settling with families. There was at least one family living on Galls Creek in 1878, as the Ashland Tidings report suggests: "A violent wind-storm visited Galls Creek the other day, unroofing the house of Mr. Shoemaker, while the family was at dinner, moving large timbers which took several men to replace. A little girl received a slight wound on the head from some particle of the falling roof, but otherwise no serious damage was done" (Ashland Tidings, 1878).

Other miners with families came to the Galls Creek area. Thomas Dungey, a carpenter with seven children, settled on 40 acres on Galls Creek. He was a placer miner. The James and Luann Horn family, with six offspring, also settled in the area. One son Dee (Dillard) mined, farmed, and raised a family on his father's homestead. He apparently had an uncanny ability to find gold. He had several mines "The Home," "The Old Gold," and "Braden" (Morehouse-Genaw, 1988). The Braden mine was located two miles south of Gold Hill at SE ¼, Section 27, SE ¼, Section 28, Township 36 South, Range 3 West, at 1,550 feet. It had six adits and an inclined shaft with several drifts total about 25,000 feet. The mine was discovered about 1885 and the first ore ground by arrastra. Total production was not reported, but production for the year 1907, using a 10 stamped mill, was $30,000. In 1916, the mill was sold to the owners of the Ashland Mine (Brooks and Ramp, 1968).

Even after the turn of the century there were several large mining companies working Galls Creek area. They often had mining camps set up at their claims and offered food and lodging to the men who worked in the mines.

Diller reported in 1914 that until a few years prior, the Blockert mine on Galls Creek was the most important placer mine in the Gold Hill district (Brooks and Ramp, 1968). The mine's owners were William and Sarah Blackert, who had four offspring. Other spellings were Blackert, Blacket, Blackard, and Blacket (Morehouse-Genaw, 1988).

Galls Creek was one of the later districts to establish a school. It was most likely because of its predominance in mining and as very few farmers who lived on Galls Creek in the early days. The school was established 3 March 1889, as District #61. The Galls Creek School continued until consolidation with Gold Hill in 1923 (Morehouse-Genaw, 1988).

ODFW surveys (2001) confirmed steelhead, rainbow trout and cutthroat trout in Galls Creek, up to river mile 5.5. Galls Creek is a 303(d) listed stream for summer temperature (BLM, 2000).

ROCK POINT

Rock Point stands upon the north bank of the river, in Township 35 South, Range 3 West. The area that became known as Rock Point has some of the earliest recorded history in Jackson County. It was near here that Ewing Young's party was attacked by the native people during his cattle drive from California to the Willamette Valley in 1836. And earlier the Turner party had been attacked in the same vicinity.

In 1854, Frederick and Christina Rosenstock took up a donation land claim of 320 acres that encompassed both sides of the river. There was a ferry landing up river between the Miller and Rosenstock farms. A man named Brown operated the ferry in 1857. It was also know as Null and King ferry. Rosenstock sold part of the land claim in 1859 to J. B. White (Morehouse-Genaw, 1988).

John B. White is considered the founder of Rock Point. He became the original town proprietor and postmaster with the establishment of a post-office in 1859. This Post Office also served the Dardanelles off and on between 1864-1878 (Kidd, 1988). White was appointed a judge in the Dardanelles precinct of which Rock Point was a part, in 1857 (Morehouse-Genaw, 1988).

A toll bridge was built before 1859, but the flood of 1861-1862 destroyed the bridge. Lytle J. White immediately began work on a new bridge. It was a wood-covered bridge and was operated by the Rock Point Bridge Co. Most of the early bridges across the Rogue River were toll. It was later purchased by Jackson County in 1890 and operated as a free bridge until replaced by the Pacific Highway Bridge. The bridge marker is reached by taking the Rocky Point exit up to the bridge that crosses over the north side of the river. At the end of the bridge on the south side of the river the marker will be noted about 100 feet out onto the rocks.

In 1862, Abram Schulz put up a blacksmith shop. The Rock Point School appeared in 1863. Lytle J. White started construction in 1864 on the Rock Point Hotel. On February 8, 1865, the hotel opened to the public with a grand ball. White simultaneously established one of the first telegraph stations in the area when the hotel opened. Ben Haymond and John B. White dealt in merchandise, beginning in 1868 (Wailing, 1884).

John White hired J. S. Howard, to survey a town site and one block was platted for a town of Rock Point in 1871. Three years latter, he included another six blocks to the town Platte. The railroad ran out of money when it reached Roseburg and didn't resume construction, until 1883. John White donated the land for the Rock Point Cemetery in 1874 (Morehouse-Genaw, 1988).

White sold his part of the interest in the store to the Magruder brothers who also had a general store at the crossroads of the stage route and the wagon road to Jacksonville from Sams Valley and the Upper Rogue River area, later known as Central Point. Haymond eventually bought out the Magruders and continued to run the store until his death in 1906.

Rock Point was an important travel station and tavern for the stage on the Oregon and California Stage road (Tucker, 1951). A young girl named Ella Beal kept a diary in 1872 and she recorded her family's journey by wagon from Oregon to California. "Monday Evening September 2nd: Left Camp Birdseye this morning sun about an hour high traveled two miles came to a small town called Rockpoint. There we crossed the Rogue River on a toll bridge. (toll one dollar) (Beals, 1937).

Walling's said of Rock Point: "It is characterized by an excellent location, being upon the railroad, of which it is an important station, and in the geographical center of the two counties of Jackson and Josephine. Rock Point now contains a store, hotel, liver stable, blacksmith shop, saloon, post-office, school house and telegraph office. Above the town a short distance is the railroad bridge across Rogue river, a very considerable structure over 1,000 feet long, substantial and durable, one of the succession of extensive engineering works by which the iron causeway attains the valley" (Wailing, 1884).

Railroad construction resumed in 1884 when the railroad prepared a right away through the property owned by L.J. White. He was not pleased by this course of events. He and other land owners had differences of opinion on location and other rights-of-way. The railway accepted Chavner's offer to the Railroad Company for rights-of-way and town lots at low prices. With the coming of the railroad and the depot at the new and growing town of Gold Hill, the town of Rock Point began to wane.

Rock Point had only three Postmasters: John B. White, Ben Haymond, and Rose Haymond since its first appointment until it closed in 1912 (Kidd, 1988). In 1918, Rock Point School District #25 joined with the Gold Hill and eventually, Central Point School Districts (Nesheim, 1977).

Lytle White died in 1878 and his son Henry White eventually bought out other family members and continued to run the hotel. By the turn of the century Henry closed the hotel and turned to farming. The buildings of the town that once numbered 200 people gradually disappeared.

1907, marked a new period for the area when F.K. Duel and others purchased the hotel and surrounding land. The property grew from a one-acre family orchard to an eight hundred acre orchard yielding leading varieties of pears, apples, cherries, peaches, apricots, walnuts, and filberts. The orchards became known as Del Rio Orchards. The cold storage and packing facilities are

still standing along the railroad tracks. Up until 1997 locals were still able to by apples, peaches, and pears right at the farm. The Duel family sold to Lee and Margaret Traynham of California in 1997.

Over several years the Traynhams transformed the orchard into Southern Oregon's largest wine grape vineyard. One hundred eighty acres are planted with over 200,000 vines, twelve varietals, and 17 clones. Large windmills have been installed for frost protection. Del Rio supplies premium wine grapes to over 20 vintners in Oregon and California. The Rock Point Hotel is now opened to the public for wine tasting featuring Oregon wines produced with Del Rio Vineyard's grapes.

There are several restaurants across the river, as well as homes all along the south side of the Rogue River. Further down on the north side the river is farmland and aggregate facilities near the railroad tracks.

SARDINE CREEK

Sardine Creek enters the Rogue River on the north bank, just up river from Rock Point. It is best described as a narrow steep canyon, with a long ridge on each side. At about three miles, the creek forks around a ridge, splitting, the creek and the road. The Left Fork Sardine Creek has as its headwaters, a draw between Hillis Peak and Wilcox Peak. Right Fork Sardine Creek continues for about a mile before splitting again into Middle Fork Sardine Creek and Right Fork Sardine Creek. Their headwaters are in the vicinity of Sardine Mountain and McConville Peak. The early land survey records the area with high rugged hills, second rate soils, timber, fir, pine, and oak. At the time, the area was part of the 1853 Reservation Lands (Ives and Hyde, 1854-55).

Sardine Creek also has a long history as a mining region. According to Wailing, “Its mines were discovered in 1853 by a prospector living with A.J. Kane, near the Dardanelles. Mr. Kane reported that its name is derived from the fact that sardines formed a part of the provisions of the first arrivals. The story of its riches went forth and within a few days, a large number of miners were on the ground. The banks of the stream were worked extensively afterward by whites and Chinese, between whom the usual one-sided antagonism existed. Between 8 Oct 1856 and 30 Jun 1880, Sardine Creek had 132 mining claim locations (Wailing, 1884). Many along the creek were both farmers and miners. Placer mining was practiced along the creek, and later quartz mining dominated the area.

In 1890, Bartholomew Signorritti found gold west of the left fork of Sardine Creek (Morehouse-Genaw, 1988), on the northwest corner of Section 29, Township 35 South, Range 3 West. These workings are known as the Lucky

Bart mine are between 2,080 and 2,900 feet elevation. There are 11 claims and at least one in NE ¼ Section 29 is patented. Practically all the ores from the group were treated at a five stamp mill on Sardine Creek and the sulfides were shipped to the smelters. Production was possibly $200,000. It has only been worked intermittently since 1913 (Brooks and Ramp, 1968). The Lucky Bart produced longer than many of the mines nearby, it was realizing about $800 per ton in 1906 (Morehouse-Genaw, 1988).

The Lone Eagle (Gray Eagle) mine was also in the Sardine Creek area; located at SE ¼ Section 29, Township 35 South, Range 3 West, 1850 feet in elevation. Its development was prior to 1911, followed by inactivity until small operation just prior to 1942. It was equipped with an aerial tram that moved the ore to a 10-stamp mill on lower Sardine Creek (Brooks and Ramp, 1968).

Hammersly had a placer mine above Lucky Bard. Hinkle, Sperry, and White all had mines on Sardine Creek (Morehouse-Genaw, 1988). Sardine Creek has been an important producer of placer gold. A Dragline dredge was worked over one mile of the stream (Mayo, 1994).

The Sardine Creek area farmers, like others who were settled on rich gold producing creeks, also mined in the off season. The Neathammer family homestead was at the lower end of Sardine Creek, their farm holdings eventually were up to nearly 400 acres of farm land where they were occupied in general farming (Morehouse-Genaw, 1988).

Smith Dusenberry had a dairy a little further up the creek (Morehouse-Genaw, 1988). S.A. Dusenbery received irrigation water from West ditch and East ditch, plus from November 1st to May 1st he used water from East ditch for placer mining, with water returned to the stream after use. The placer mine was located at SE ¼, NE ¼, Section 8, Township 36 South, Range 3 West. The irrigated lands were in sections 8, 10, and 17. Other ditches were the Gold Hill ditch, Smith ditches, and Ring ditch. Sardine Creek Tributaries: from Spring Gulch, the Newton ditch usage was to irrigate two acres for watering stock and domestic use. On the Right Fork was the Young ditch and on the Left Fork were the Beeman at a quartz mill, and Hardman ditches in section 29 (Jackson County Circuit Court, 1919).

Joseph Dusenberry ran a saw mill on Sardine Creek and Samuel Elroy Dusenberry had a saw mill that he could transport and operate as he moved from place to place (Morehouse-Genaw, 1988).

Sardine Creek School District #88 operated from 1905-1922, when it joined the Gold Hill District. The first building and desk were crude but a modern building was built in 1915. The school was called Alderbrook School and there were eighteen students in 1924 (Nesheim, 1977).

The most unique and famous attribute, of Sardine Creek is the House of Mystery, or the Oregon Vortex. It is located at 4303 Sardine Creek Road. The oldest building at the site is one that leans precariously. It was built around 1890 by a mining company. A slide shortly after the turn of the 20th century caused it to lean at an angle. It is reported that a person will look taller or shorter than they really are, depending on where they're standing within the house. There are also reports that a compass will go haywire at the vortex (Fattig, 2003).

A physicist, Dr. H. John Lister, was intrigued by the site and purchased the property in 1918. He performed more than 14,000 experiments and explained the strange phenomena found there as a whirlpool of invisible energy. He felt the site contained unique properties, possibly distorting light. A pamphlet for the site describes the three-quarter-acre vortex as a "spherical field of force, half above the ground and half below," and by reason of this, the effected area is a circle (Fattig, 2003).

We are told the "vortex actually expands and contracts as much as 19 inches several times daily." And that "Albert Einstein thought a person's molecular structure also expands and contracts as they walk through the area." Apparently, the House of Mystery was a fore runner of similar "vortex" areas that would spring up. Such places are much the same with a house or cabin that has "slid" to its location and discovered. According to one critic: "The anti-gravity house is actually built at an angle of 25° off the true horizontal. This will explain every effect seen. Once in the area of an anti-gravity house you are always comparing the effects to what you are used to: normal, level floors and walls that are perpendicular to the ground." Whatever the explanation, the tour and mystery has been enjoyed by many.

Local school children have enjoyed field trips to the site for over fifty years. Over the years the site has attracted tourist from around the world and has been featured on television's "Unsolved Mysteries," the Discovery Channel and an "X-Files" episode (Fattig, 2003).

The Sardine Creek community has seen its share of fires. The largest and most threatening were the September 1981 Tin Pan Fire and August 1992 East Evans Creek Fire (Stockard and Stockard, 2003).

In more recent Sardine Creek history, a conflict with BLM ended in the court system. A local property owner protested the building of a proposed "logging road" adjoining his property. The proposed road was connected to a BLM timber sale. A preliminary report showed slide potential in this zone but his protest and concern was rebuffed by the agency. Building of the road proceeded over his protest. When the rains came his fears were realize, when a large mud slide covered a portion of his land. BLM was duly sued for the clean up and restoration of the injured land (Weiss, 2003).

GOLD HILL

The city of Gold Hill sits along the north side of the Rogue River. The I-5 Freeway runs south of the river and the city. The railroad runs through the town and was a major influence in the city's genesis and growth. State Highway 234 goes through the town and on toward Sams Valley. Nugget Butte sits to the north. The portion of town, north of the railroad tracks is on a hillside. According to the Gold Hill Historical Society, the amount of land area in Gold Hill is 1.567 square kilometers or 2.51 square miles. Its altitude is slightly over 1,000 feet. Annual rain precipitation is about 22 inches. The current population of Gold Hill is approximately 964. The approximate number of families is 378. The amount of surface water is 0 square kilometers. Gold Hill is positioned 42.43 degrees north of the equator and 123.05 degrees west of the prime meridian.

The city of Gold Hill is the new comer of the watershed communities. Its development was stimulated by the coming of the railroad. According to A.G. Wailing, between 8 October 1856 and 30 June 1880, the Gold Hill area had 361 mining claim locations (Wailing, 1884). The miners were not particularly interested in settling the area but there is a house that dates back to the 1870s. The house owned in 1968 by Mr. and Mrs. Lee H. Marsden, on 7th Street.

A toll bridge was constructed in 1858 on land owned by Thomas Chavner. It was destroyed by the 1862 flood but was rebuilt. The bridge was operated by Chavener's Rogue River Bridge Company from 1876-1888 when it was sold to Jackson County. The site, is located off the Gold Hill freeway north exit. Just before the bridge into Gold Hill, a turn right made on the Upper River Road, then a drive under the Southern Pacific Railroad bridge, you park just beyond it, and there is a marker. It has been placed about 200 feet out toward the river among the remains of old bridge abutments.

Gold Hill, the mountain, is just a little east of the town and on the south side of the Rogue. Gold was discovered there in 1859 and 1860. The Gold Hill Lode was originally owned by a partnership, with Thomas Chavner being one of the biggest stockholders. The others were James Hayes, O.J. Graham, George Ish, and A.J. Long. The state of Oregon Department to Geology and Mineral Industries officially recorded the amount taken from this mine as $700,000. At 1990 prices, that same amount of gold would be worth $15,312,500.00. With his share of profits, Chavner acquired nearly 2,000 acres of prime land along the Rogue River over the next twenty years (Morehouse-Genaw, 1988).

There was already the settlement at Dardanells when Thomas Chavner came to Jacksonville in 1856. He bought land and would continue to do so, and by

1877 he would pay taxes on 1,570 acres of farmland (Morehouse-Genaw, 1988).

In June of 1883, Chavner sold a right of way through his land to the O and C railroad. By November 1883, the bridge was built and tracks lane. A station was built where 4th Street is now. By the end of December the same year, noted surveyor James S. Howard had completed surveying and laying out a town site. The plat for the town of Gold Hill was filed with the Jackson County Commissioners by the Chavners and the streets and alleys deeded to the Public on 7 January 1884. Seven acres had been sold to the railroad and 80 acres surveyed for the town site. The town was named Gold Hill but it wasn't until 1895 that the city became incorporated. With incorporation, a town council was elected. In 1893 William S. Fitzgerald became the first postmaster (Kidd, 1988).

The railroad was completed in 1886 and a depot was established. Growth soon followed with several stores, saloons, a hotel, livery stable, newspaper (the Gold Hill News), bank, movie theater, bowling alley, and an opera house. A telegraph office and rail road linked the area to the rest of the country (Fitch, 1970). A flour mill was located just out of town on the road to Sams Valley. The Trumbles sold it to Oscar Gainard and he put A. Lamb in charge of the milling (Morehouse-Genaw, 1988).

Dr. Arad C. Stanley, a twenty year resident of Sams Valley, sold his Tolo and Sams Valley drug stores and moved his home and business to the growing town of Gold Hill. He soon became active in the city council and served as president. Sams Valley's tinsmith, W. H. Runnells, was also lured to Gold Hill where he opened another smithy (Morehouse-Genaw, 1988).

The Democratic Times for 31 October 1889 mentions over two thousand boxes of apples had been shipped out from the Gold Hill Station. A good mining season was being anticipated but depended on plenty of water. They received more water than they could wish for that winter. In February 1890 came a devastating flood, it was compared to the flood of 1861-62. The Rogue's high water took part of the town of Gold Hill. Several blocks were cut away and washed down stream. Tailings accumulated from the old mines caused some streams to change course, while some tailings were washed out and deposited onto farmlands. Mining dams, ditches, and reservoirs were also washed out. The railroad had to be closed to repair the damage it sustained (Democratic Times, 1889). However, it was not all bad news the flood waters had uncovered new seams and pockets of gold bearing material. Gold Hill area was enlivened with renewed mining activity (O'Harra, 1993).

News of quartz discoveries soon had the town full of activity. Miners came to the area to stake their claims while investors came looking for opportunity. Gold Hill was fast becoming a major shipping and trade site. Grain, hay,

cattle, hogs, and produce were shipped out by the Sams Valley farmers. J.W. Hays shipped fruit to the Willamette Valley from his orchard near Rock Point (Morehouse-Genaw, 1988).

Builders Griffis and Walder milled their own lumber with a portable sawmill which they would set up at different locations (Morehouse-Genaw, 1988). Trees were cut and milled locally for the buildings of the town.

In 1895, Utility Companies began to operate in Gold Hill. Rogue River Telephone Company installed poles and wire. Gold Hill saw the need for a fire department and in 1898 organized a hook and ladder: Co. No 1. In 1899 the Council approved the issuance of bonds to construct and operate a water works. In 1902 an Electric Light and Power Plant was granted an ordinance to operate (Fitch, 1970). Jesse Houck's Rogue River Milling Company supplied the town with electrical power and a pumping station for the water plant. In 1897 the town's newspaper was established, it would move from Gold Hill to Rogue River.

An interesting piece of Gold Hill history was that of the Gold Hill High Line Ditch Company. In June 1899, a Gold Hill High Line Ditch Company proposed, the building of a canal. It would begin near Prospect, and bring water from the Rogue River to the city of Gold Hill. The project had an estimated cost of $1,000,000. A fifteen foot wide and ninety three mile long ditch at a depth between six and nine feet was envisioned (Fitch, 1970).

The water would be used for irrigation, mining, and floating timber to the railroad at Gold Hill. By 1900, the Gold Hill High Line Ditch Company (GHHLDC) had purchased much of the right of ways for the project. Surveyor J.S. Howard with his crew did a preliminary survey marking the route the canal would follow. The GHHLDC continued to promote their project and a part of the ditch was begun above the town and is still visible near the city water reservoir. By 1906 the GHHLDC was having difficulty purchasing the additional right-of-ways and was lacking capital to continue. It was sold to the Gold Hill Canal Company. The ditch never materialized (Morehouse-Genaw, 1988).

By 1911 Gold Hill had a large businesses district containing several large general stores, drug, furniture, jewelry, and confectionery stores. There was also an undertaker, a bank, a brick factory, and flour mill. Churches were being built, and a school, an opera house, and skating rink and hospital were in operation.

Over a hundred years ago hydro power began to be produced on the Rogue River for the needs the citizens of Gold Hill. In 1886 the Trumble's flour mill, located off Hwy. 234, a mile north of Gold Hill, changed ownership when it was purchased by Sams Valley farmer, Oscar Gainard. A. Lamb was hired to

operate the mill. When this mill first began operating and how it operated, is unknown (Morehouse-Genaw, 1988).

In 1899 the City Council approved the issuance of bonds to construct and operate a water works. In 1902, Jesse Houck's Electric Light and Power Plant was granted an ordinance to operate. His Rogue River Milling Company supplied the town with electrical power and a pumping station for the water plant (Fitch, 1970).

Beaver-Portland Cement Company built a plant at Gold Hill in 1914 and produced up to 1,000 barrels a day. It was the main employer of the people of Gold Hill from 1914 until it closed in the mid-1960s (Fitch, 1970). Other sources refer to it as the Ideal Cement Company. On the south side the river near the dam is a large irrigation ditch that carries water west past Galls Creek. There is also a small slough on the south bank, down river from the dam (Metskers, 2003).

The Electric Light and Power Plant was the first to supply electrical power to the community. Someone built a dam in the river and a canal or raceway, where for about one hundred years, the city of Gold Hill has obtained its municipal water supply. The dam was built for power generation, not flood control. The cement company generated power to operate its plant.

A diversion dam is near river mile 121 in the NW ¼, NE ¼, Section 115, Township 26 South, Range 3 West. There is a grated concrete headworks structure on the right abutment of the dam that regulates diversions into the 2,000 foot long diversion canal. The City's water treatment plant currently pumps water from the diversion canal at a point just upstream from the abandoned power plant (OWEB, 2003). The powerhouse has three generators and it would generate close to three kilowatts. The dam would be shut down for a couple of months of the year because of the low flow of the river.

Apparently, the canal was rebuilt in 1944, along with a fish weir, that was built to pipe salmon and steelhead out of the canal. Additional diversion facilities were built by the cement company, such as a fish ladder. The canal provides a natural way to keep logs and debris from damaging fish screens on the intake pumps. "The city's two pumps in the canal carry 450 gallons a minute to the nearby treatment plant, where the water is purified and distributed to nearly 500 homes and businesses in town" (Martin, 1999).

According to a Mail Tribune interview with ODFW fish and wildlife technician Brad Fuss, "On one end, the water velocity at the head gate creates more pressure than a fish can overcome to get out. On the other end is the channel's return to the river by narrowing through a culvert and dropping turbulently six to eight feet onto bedrock, bouncing through a 40-foot tunnel and emptying out into the Rogue River. That's not a good situation for a fish,

to get dropped six feet onto rough bedrock and bounced through a rock tunnel" (Martin, 1999).

In 1968 the Ideal Cement Company abandoned the power plant facilities and transferred title to the City of Gold Hill. The city unsuccessfully attempted to keep the power plant on line, but the power plant fell into disuse (OWEB, 2003).

The City of Gold Hill lost its hydroelectric water right because they stopped using it and stopped paying the re-licensing fees. It hasn't produced power since the late 1970s. As they couldn't sell the electricity, they lost the water rights because they lacked capital to pay for them. The water rights were canceled in 1991. PP and L did a preliminary study of the power plant in the mid 1970s and found it to be an uneconomical venture.

However, the city has water rights for diverting water for municipal uses and for diverting water for hydroelectric power generation. It was the permit for hydroelectric generation that was canceled. They continue to divert water for municipal uses.

There is a non-operational, impassable fish ladder. ODFW had the fish passage closed because it takes the fish so long to get through that they are too easy to catch. They also closed Rainey Falls to fishing for the same reason. According to Water Watch, "there is no significant fish passage problem there now; there is a poaching problem though where the fish school up. The passage problems are more severe in the rapids upstream."

The City of Gold Hill inherited problems that they have been trying to resolve for the past twenty to thirty years. Previous solutions have been hampered by lack of funds and opposition by government agencies and environmental groups. Gold Hill's Public Works Department has worked with RVCOG and obtained grant funding for three projects: removal of the Gold Hill Dam by the Corps of Engineers, moving the city's water supply intake, and wetland and riparian restoration in the adjacent diversion channel and the adjacent wetland and riparian areas.

Last January, The Oregonian reported on the removal and of decommissioning plans for the Gold Hill diversion dam. It will apparently "become a military training exercise for operating heavy equipment. If the Department of Defense agrees to help the city, reservists may use bulldozers and other equipment to remove the diversion dam. We try to find real-world training opportunities on American soil that can help us prepare for the global experience," said Captain Sheldon White of Robins Air Force Base in Warner Robins, Georgia (The Oregonian, 2003).

Drinking water for the City of Gold Hill is supplied by an intake on the Rogue River. This public water system serves approximately 1,000 citizens. Gold

Hill's portion of the drinking water protection area is located in the Bear Creek and Rogue River/Snider Creek Watersheds in the Middle Rogue Sub-Basin of the Southern Oregon Coastal Basin.

Included in this area are a number of tributaries to the Rogue River including Water Gulch, Rock Creek, Sams Creek, Snider Creek, Bear Creek (and its numerous tributaries), and Whetstone Creek. A total of 50 potential contaminant sources were identified in City of Gold Hill's drinking water protection area.

A new water system was recently installed to improve the city's capacity to deliver water. It has been an issue in the summer season, when demand for water is high. Residents would often experience low pressure. The old and undersized 4-inch water mains on Sixth Avenue, First Street and Fourth Avenue, were replaced with new 6-inch pipes which are looped. Water will remain fresh and not stay in some of these dead-end lines where it used to collect and become discolored because of the iron in the old pipes. Funding of a $695,137 grant came from the Oregon Economic and Community Development Department (Mail Tribune, 2000).

On July 31, 1955 the last passenger train came to the Gold Hill the depot, and it closed. Although many businesses have closed in Gold Hill over the years, the population has remained fairly constant, averaging about 600. The highest population being 700 in 1909, and the lowest was 502 in 1950. Gold Hill and surrounding communities have grown and many living up the creeks and gulches are only a few minutes away from Interstate 5, and less than 20 30 minutes from their place of employment. The current population is over 1,000 (Fitch, 1970).

CHAPTER 8

ROGUE RIVER AND SURROUNDING COMMUNITIES

ROGUE RIVER/TAILHOLT/WOODINVILLE

The city of Rogue River, the largest of the two incorporated cities within the watershed, is located at the western border both of Jackson County and the SBW. Its proximity is close to the city of Grants Pass, situated about seven miles to the west. Medford is located approximately 26 miles south east. The population of Rogue River is just under 2,000. The amount of land area in Rogue River is 2.508 square kilometers.

The city is ensconced in a valley with the Rogue River running through it from an east to west direction. The town straddles the Rogue River, from which it took its name in 1912, as well as Interstate 5 and the railroad. A saw mill is still in operation near its eastern city limits. Evans Creek flows down through the Evans Valley to the north. From the west, Fielder Creek intersects with Evans Creek. Fielder Mountain to the west is 3,747 feet in elevation. Ward Creek, a tributary of the Rogue River, runs through the town from the north east.

The town of Rogue River has had a series of names. It is one of the earlier settlements in the Rogue River Valley. It was first know as Evans Ferry, later Tailholt, and Woodville (1876-1912). Woodville was the first legal name given to the town. The settlement of Woodville became a stage station and a blacksmith establishment for shoeing horses. From the ferry, pack trains went to the gold mines in Evans Valley, carrying supplies to the miners (Tucker, 1951).

Evans Creek was prospected for gold before the Indian war of 1853. It was abandoned by whites from fear of the Indians, until the final settlement of these difficulties in 1856. Possibly before this date, the Chinese came in large numbers, took possession of the ground, and mined successfully. They were driven out by whites when their good fortune became known, and the latter took the claims and made good wages. Various other mineral substances of value were found on this stream (Wailing, 1884).

A river-crossing known as Tailholt was used by the early miners and prospectors that came in 1848 looking for gold. The original settlers swam across the sometimes treacherous Rogue River by grabbing hold of their horse's tail. Davis "Coyote" Evans saw a chance to cash in on the growing need for dependable transportation across the river. In the year 1850 or 1851, he built a ferry and two cabins at the mouth of Evans Creek (Sheffield). He also planted two acres in potatoes, cabbage, onions, corn, and beans (Waldron, 1992).

This first ferry established by Davis Evans, was know as Jewett Ferry. On October 12, 1854, a receipt was filed in the county courthouse in Jacksonville for a ferry license on Rogue River. The receipt states that D. Evans paid one hundred dollars for a ferry license (Nesheim, 1977). The ferry boat was approximately eleven feet by forty feet and maneuvered by a rope of two inch rawhide that spanned the river (Waldron, 1992).

In 1854 the state legislature (for advertising purposes) changed the name of the Rogue River to Gold River. Since the new name did not prove popular, the original name was restored to the river by the legislature in 1855. In the early 1850's, the settlement near the north of Evans' Ferry was served by the post office at "Gold River", which was located at Evans Ferry about three miles below the present town. It opened, 18 April 1855 with Davis Evans as postmaster. The following spring John Sears became postmaster until it was discontinued in 1859 (Nesheim, 1977).

Davis Evans' ferry at the mouth of Evans Creek was in operation only about a year when the station was burned by hostile natives in August 1852, and the ferry boat suffered damage. Evans sold the site and moved downstream about two miles to supply miners and packers from a new location.

In 1868, a covered bridge was built beside the Rogue River ferry so the stage could cross Evans Creek. The Evans Creek covered bridge was moved seven miles up Evans Creek in 1914 and replaced with a concrete bridge. In 1872, John Wood built a cabin on the east side of the creek. His was an improvement over some of the more rustic dwellings since his was of sawed lumber. The settlement that grew up around him honored him with naming itself for him. The name Woodville continued until the change in 1912 to Rogue River (Nesheim, 1977).

By the early 1870s, Tailholt had been renamed Woodville, a center for small scale lumber and agricultural activities. The 1862 flood destroyed the ferry, but it was replaced. First a rope bridge, then in the late 19th century, a wooden bridge spanned the river. With the arrival of the railroad to the region in 1884, the railroad tracks were laid parallel to the river and a station was built just north of the present bridge, at the head of the aptly named "Depot Street." In 1909, the first steel bridge was built across the Rogue River. A new bridge was started in 1949 and by September 30th, 1950, the bridge was

complete. Construction of a new bridge started in April 2003 and is slated for completion in the fall of 2005 (RVCOG).

When you get off the freeway and cross the bridge there is a little park at the right of the bridge, there is a marker for the ferry site at the park. Coyote Evans and Fleming Wayside Parks, located on the Rogue River, are accessed off I-5 and Rogue River Highway, each on one side or the other of Depot Street. The Jet Boat Excursion landing is located in Fleming Wayside Park. Parking and a dock for private boats and rafts can be found at Coyote Evans Park (RVCOG).

Originally, in the general area of the Rogue River District, there appeared in the 1860s, the Schleifflin School. It was a log building and it was given #35. The building was subsequently replaced numerous times each being an improvement over the former, but in 1882, while William M. Colvig was Superintendent, there was a change. By 1883, the first schoolhouse was built in Woodville, with the creation of the Woodville School which took #35, Schleifflin was issued #48. No explanation of the number switch has surfaced (Nesheim, 1977).

In 1906 the Woodville High School had one teacher. In 1909, a modern six-room, brick building costing $25,000 was constructed. The bricks were made locally. In 1912, the city and school names were changed to "Rogue River" (Nesheim, 1977).

In 1874 quicksilver was found and mined on Evans Creek. An assay office was established in Woodville (Wailing, 1884). The stage route passed through Woodville. Later a bridge was built for the train and it passed through Woodville. The rural shipping point soon drew a new village around it, suddenly becoming a familiar center of activity. In 1912, by a vote of the people, Woodville was renamed City of Rogue River and incorporated.

Prune and apple orchards were established in Rogue River, but were cut down after 1913. Pears and strawberries were grown, where many of today's business and homes now sit (O'Harra, 1993).

The new city grew slowly. In 1915 Rogue River had a population estimated at 500, but by 1920 the census reported just 211 residents, growing to just 286 by 1930. There were just less than 600 residents in 1950 (RVCOG). Rogue River has experienced steady growth over the past fifty years. The current population is around 2,000. The area is also known for its growing senior population. The lure of a small, rural community, natural beauty, availability of comfortable, affordable housing, and level of personal safety, has drawn many retired residents to the area. A residential living home has been built in recent years to accommodate the senior citizens. The Rogue River Community Center and the Multi-Service Center are located at 132 Broadway Street. The

Community Center serves lunch to seniors every weekday for a nominal fee. The center serves residents inside and outside the city.

The five-acre Palmerton Arboretum located on West Evans Creek Road was originally a nursery during the 1920s and 1930s. It contains plant specimens from all over the world, including pines from Japan, cedars from the Mediterranean, and several large coastal redwoods. The city is a 15-year member of the Tree City U.S.A. program, joining with cities across America to celebrate Arbor Day and works to promote trees and tree-planting (Rogue River Chamber of Commerce, 2001).

A large modern district fire station is located in Rogue River and serves not only the city of Rogue River, but the surrounding rural community. Other public buildings include city hall, a new library, and post office.

There is a small shopping center as well as business and shops on both sides the river. Most of the housing is concentrated on the north side of the river.

"Drinking water for the City of Rogue River is supplied by an intake on the Rogue River. This public water system serves approximately 2,000 citizens. The intake is located in the Rogue River/Savage Creek/Evans Creek Watershed. In addition, Rogue River uses groundwater wells for drinking water supply. A total of 30 potential contamination sources were identified within the Rogue River portion of the drinking water protection area" (City of Rogue River).

FIELDER CREEK

Thomas Fielder was a pioneer settler for whom the creek and mountain were named (Tucker, 1951). Fielder purchased land from Samuel Smith in Section 9, Township 35, Range 4 West. Lumber for the town of Woodville had been furnished by the Steckel Sawmill since the 1870s. It was located about four miles up West Evans Creek and south of Fielder Creek. It was of the old circular-saw type and it would cut a maximum of four thousand board feet of lumber a day. The mill was operated by Mr. Steckel and his eldest daughter (Nesheim, 1977).

Fielder Dam is located on Evans Creek a few miles out of Rogue River. Apparently it is privately owned and was built about 70 years ago to divert water for irrigation. Fielder Dam is about 18 feet high and has an existing ladder that is reported in 1979 to be deteriorated to the point of being dysfunctional (Bureau of Reclamation, 1979).

WARDS CREEK

Wards Creek, a tributary of the Rogue River, runs through the town from the north east. The creek was named for Oliver P. Ward (Tucker, 1951). Metsker's Map of Jackson County shows the headwaters for Wards Creek near Wilcox Peak and in the vicinity of the mines at the head of Left Fork Sardine Creek, the creek has produced placer gold. There is Magerle Reservoir in Section 25, Township 35 South, Range 4 West. Boyd Creek appears to be the only tributary of Ward Creek.

Mining Wealth in 1904 reported "Wards Creek as the scene of an interesting new enterprise, that of combining mining with fruit, hay, and stock ranching. The gist of the plan is to store the water by means of great retaining dams. The winter season will furnish water in abundance for mining the dams will store water for irrigation of the summer. This corporation is the Bagley Improvement Company. It dates from 1900, the year in which John H. Bagley visited Rogue River and latter with a partner bought some land and mining claims on Wards Creek" (SOHS, 1978). The Bagley ditch named after John Bagley was used for placer mining and irrigation (Jackson County Circuit Court, 1919).

Meadowbrook Orchard had 27 acres irrigated from Wards Creek ditch in Section 14, Township 36 South, Range 4 West. Lizzie Hale had 6.5 acres irrigated from Trimble ditch in Section 14, Township 36 South, Range 4 West (Jackson County Circuit Court, 1919).

CHAPTER 9
FORT LANE/WILLOW SPRINGS/TOLO/GOLD RAY

FORT LANE

Fort Lane was built and used by the U. S. military in 1853-1856. The fort served mainly as a protection for the native people from the Euro-American settlers (Morehouse-Genaw, 1998). The location of the fort was in the southern part of the north eastern quadrant of Section 19, Township 36, Range 2 West. The reserves boundaries extended to the river, into sections 17, 18, and 20. It was situated across the river from the western appendage of Lower Table Rock. Most roads connected to or led to Fort Lane. The hills west, south, and southwest of the military reserve are described as Oak & Y (young?) Pine, openings, rounded hills, soil second rate. To the east in the Bear Creek Basin were the Rich Prairie Bottom lands.

The fort was considered to be commodiously and even handsomely built. A stockade enclosed quite a spacious area in which a parade ground, together with barracks for private soldiers, houses for officers, and an armory, a hospital and other necessary buildings, were all built of log (Wailing, 1884). There was abundant grazing for the horses and hay and wood available for cutting on the 640 acre reservation. In 1854 there was a good garden attached to the post, but they had a problem with grasshoppers devouring it. The river was used for bathing (Grants Pass Daily Courier, 1960).

Lieutenant Henry Larcom Abbot of the corps of topographical engineers, while on exploration and survey of California and Oregon, (railroad survey) made notations in his diary: "Nov 2: Camped at Harris's house where woman fought where we found forage. Bad divide to Jump-Off Joe Creek could be avoided by following Creek down. Then level country with slight hills and open timber of sugar maple oak and a little pine and hemlock. Nov. 3: Good road to Fort Lane. Trees mostly thin and of oak, pine, etc. Salt spring. Nov. 4: Lay by at Fort Lane & observed and turned over property." The party continued south the next day. Sawyer noted there was a salt lick at Fort Lane (Sawyer, 1932).

A quarter of a century after its last days for the military, Wailing remarked that the old fort had fallen into ruins, and was scarcely a vestige of what was once

(Wailing, 1884). In 1929, the Daughters of the American Revolution, Crater Lake Chapter, placed a marker at the ruins site south of Gold Ray Road. The stones for this marker were gathered from the site of the former fort.

WILLOW SPRINGS

One of the early farms in the Rogue Valley was the Dean farm, taken up in 1851. It was located on "Old Stage Road," of the Willows Springs district, about five miles north of Jacksonville. It included the spring of Willow Springs. The old farm home was characteristic of many of the farm home yards of the day, as it was surrounded by shade trees and a lawn. John Kennedy also built at Willow Springs and for a number of years, both he and Sears kept wayside lodging for miners (Daley).

Daniel Fisher had a claim nearby in the gulch where gold was discovered in 1852. Lane Gulch was also reported as being very "rich" (Daley). The 1855 GLO survey map shows about 20 Donation Land Claims of 160-300 plus acres. Portions of the lands were under cultivation. The Bowdin mining claim, less than a mile east of the fort, was probably a hard rock mine. There was a saw mill, with a mill race, branching off Stewart Creek (Bear Creek), flowing to the northwest. The race was in sections 20 and 21 and a little over ½ mile long. This map shows all the land along the river to have been surveyed, they were numbered and the lot sizes varied (GLO, 1855). From 8 October 1856 to 30 June 1880, Willow Springs had 785 mining claim locations (Wailing, 1884).

In 1862 Willow Springs had three boarding houses, three saloons, a store, a blacksmith shop, and other buildings (Oregon Sentinel, 1862). The community opened a Post Office in 1864 at the home of the first Postmaster, rancher Samuel Dean. There would be seven Postmasters from 1864-1886 (Kidd, 1998). The people who settled there were of mixed vocations including fishing, brick making, lumbering, and mining but mostly the Willow Springs area was noted as a farming community.

The Willow Springs mines were worked over several times with considerable profit and later abandoned as exhausted. Reports in The Democratic Times, April 1880, show that gold mining activity was still alive in 1880:

- Ralls & Co. in the Willow Springs district are cleaning up and making several dollars a day to the hand.
- Kabler, McDonnough & Co. of the Fort Lane diggings, made another clean-up last week, which resulted favorably. They will do quite well this season.

- Egan & Co. will resume work on their quartz ledge near Willow Springs at once.
- Montgomery & Dodge have struck a rich pocket of quartz in the Blackwell diggings (The Democratic Times, 1880).

TOLO

In 1886 the name of Willow Springs was changed to Tolo. With the coming of the railroad, the farmers saw an opportunity for a shipping point and decided to take advantage of it. A town site was platted and surveyed by Payne Page Prim and filed 6 December 1888. It was located in part of Section 19 and 20, Township 36, Range 2 West. It was an ambitious plan for a large town, with 16 more blocks than the neighboring railroad town of Gold Hill (Morehouse-Genaw, 1998). Tolo had postmaster appointment from 1886-1918. However, Tolo didn't develop as the promoters planned (Kidd, 1998).

The Tolo Townsite and Milling Company promoted the Townsite and offered building materials at low prices. A Democratic Times ad on January 24, 1889, claimed "A mill site, mill race, and side track that would be furnished by the Tolo Townsite and Milling Company for a nominal sum to any responsible party who will put up a flour mill at Tolo" (The Democratic Times, 1889).

Dr. Charles Ray came to the Rogue Valley in 1898, to look after his brother Colonel Frank Ray's mining interest. Beside their mining interest, they also had vast timber holdings in the reaches of the Upper Rogue. The Rays were men who saw potential in the many natural resources of southern Oregon and they had the capital and financial backing to make their ventures work.

Their timber operation used the Rogue River to get their logs to a saw mill at Tolo. Men in boats accompanied the logs, as they floated down the river. At the Tolo mill, the logs were cut into lumber, and used locally or shipped out. The mill being near the railroad was advantageous for transportation of the finished product. The Ray brothers accumulated and developed land surrounding Tolo. They opened up a rock quarry on Blackwell Hill, but their most noted achievement would be at the Rogue River itself (Morehouse-Genaw, 1998).

The Tolo community was producing a lot of building materials from its large brick factory, saw mill, and a rock quarry, thus it received its nickname of "Construction City." Other businesses were established including a hotel, boarding house, and several stores. In 1910 a lovely school house of brick was built. It burned in 1950. Even with all its assets, the town of Tolo never really

took off. By 1918 the stores had closed as well as the railroad depot (Morehouse-Genaw, 1998).

The old wood framed Willow Springs School still stands on the hillside with views of the Bear Creek Valley to the east. Apparently, the land is owned by Jackson County and the building by School District 6. Interstate 5 separates the community that is mainly farm and rural residential to the south. North of the Interstate is located more of the industry as well as residential and farmland. The industries are much of the same venue as in times past: aggregate, wood, and agricultural products.

GOLD RAY

When the Ray brothers Dr. C. R. Ray and Colonel Frank Ray, bought a mine owned by Dan Condor, they also acquired a site to harness the power of the Rogue River. The Ray's raised some capital from the American Tobacco Company, of which Frank Ray was a vice-president. Additional capital was raised on the New York Market in the sale of bonds for a dam and power plant. The dam site was located a mile north of Tolo and construction took place in 1903-04. Even at that date there was some controversy over the building of the dam, as some believed it would obstruct fish passage. The site was placed under 24-hour armed guard after it had been discovered that someone had went so far as to sabotage it with dynamite. The dynamite was found and no damage was done to the project or a person from it. However, in May 1903 over 50 pounds of dynamite was set off by those working on the dam. As Teddy Roosevelt's, presidential train went past the construction site, on his historic trip through the valley, the workers saluted him by blasting the dynamite as well as shooting off their guns (Morehouse-Genaw, 1998).

In early 1900, there was very little in the way of a requirement if a person decided to dam the river. If you owned the land adjacent to the river, and posted your intent to build a dam and got the fish ways approved by the fish warden, you could build a dam (Arman and Wooldridge, 1982). Dr. C. R. Ray declared his intent of using it for mining, irrigation, and power.

The project started with the diversion of the Rogue around the dam site to expose the basalt river bed. Logs came from Prospect and were floated down the river, to be bolted into the riverbed, and strengthened by cement to provided extra strength. The laborers worked a twelve hour day for $2.00.

When the Rays began filling their reservoir, it affected the city of Grants Pass and the river below. Instead of closing the gates gradually and letting the water fill the reservoir accordingly, Ray just shut the gates down tight. The result was the river dropping to a brook-sized trickle. Grants Pass spent the night in

darkness until the river rose again because the stream was dropped too low to operate the power plant's wheel at the Grants Pass Dam. Below the Grants Pass dam, 20-25 pound salmon flopped around in the mud (Arman and Wooldridge, 1982).

The dam was equipped with two vertical 56-inch turbines to drive the generating unit. It generated power from 7 December 1904 until 1971. The generating unit was replaced by two 750 KW generators in 1905 (Morehouse-Genaw, 1998). The dam was named as the Gold Ray Dam and the power plant as the Condor Water and Power. In 1907 it became Rogue River Electric. California-Oregon Power Company acquired the plant in 1913. It became Pacific Power and Light Company's original holdings. Shortly after the power plant closed in 1971, negotiations started with Jackson County to gain ownership of the dam and surrounding property. In 1941 the original dam was replaced with a concrete dam that included a concrete chamber to house a fish counter at the fish ladders (Thorne, 1968).

Utility contracts were signed with many local municipalities as well as mines and orchards of the area. It furnished electrical power to Medford, Jacksonville, Central Point, Grants Pass, Gold Hill, and Ashland. With this relatively inexpensive source of electrical power, many of the large mining companies took advantage of it to run their mining equipment and giant dredges.

Gold Ray Bridge once spanned the river below the dam, but it was washed out during a high water event. Across the river was the Ray's lodge. A little up river on the south bank was a small railroad depot. In order to avoid confusion with Gold Ray, the railroad company named its station "Ray Gold" (Tucker, 1951). It was convenient for the Rays to be able to board the train there. Today there is an upscale residential community on the north bank know as Gold Ray Estates. The community is entered via John Day Drive from Highway 234.

Jackson County owns 85.28 acres that are maintained as a natural area. Gold Ray Dam is located on Tax Lot 300, in Section 16, Township 36 South, Range 2 West, and is also county-owned. The county owned properties are zoned Open Space Reserve. Kelly Slough behind Gold Ray Dam provides unique habitat for many aquatic birds and has been identified as a potential Bird Conservation Area.

FLOOD DAMAGE

The largest flood in recorded history in the Rogue Basin was in December of 1861 when an estimated 1,260,000 acre-feet was discharged on the Rogue

River near Tolo. The second largest flood occurred in 1890, releasing 132,000 acre-feet near Tolo (OWRD, 1985).

The Bybee Bridge, built in 1913, suffered its heaviest damage from the big flood of 1927. The approach was washed out and the bridge was closed to traffic for a considerable length of time. During the 1955 flood, Camp White Military Bridge was washed out (Leavitt).

During the 1964 flood at Table Rock, "Fences were washed out and many trees were uprooted, but worst of all was the damage it did to the farmer's fields. It carried the good soil away and left great depressions deep enough and wide enough to set a house in. Great deposits of sand were left where the river loam had been" (Leavitt). The 1964 flood, a 100-year flood event, released 131,000 acre feet at Gold Ray Dam, caused over $25 million in damage, and instigated a myriad of flood control measures (OWRD, 1985).

The New Year's high water event of 1997 turned the river away from Table Rock and sent it crashing through a series of old aggregate pits on the south bank, before spilling back into its original channel between Touvelle State Park and Gold Ray Dam. Opinion is that if left to its own devices, the river's winter flows would continue washing through more old pits, eventually drying up about a mile of prime riverbed that has channeled the Rogue since before the 1930s (Freeman, 2002).

The flood water washed through a 250-foot earthen berm and into a state-owned, reclaimed gravel pond. This breach threatened adjacent mine ponds and nearby Harry and David pear orchards. With emergency authorization, a downstream cut through the pond bank diverted the river flow back to the original channel downstream of Salmon Rock. This action greatly minimized the flood damage to surrounding properties. The river has since cut a larger opening in the berm and the washed out materials have created a midstream island that have caused all flows toward Salmon Rock to be cut off.

The dried-out stretch includes prime fall chinook spawning gravel as well as key "side-channels" used by juvenile wild steelhead and wild coho salmon. David Haight, a fisheries biologist with the Oregon Department of Fish and Wildlife, quoted in the Medford Mail Tribune said, "It's a fairly complex habitat for the Rogue River. You'd lose a lot of developed side-channels if the river got captured in those (gravel) pits" (Freeman, 2002).

A 2000 state assessment reported that the re-channeled river dumps an estimated 100 tons of sediment annually into this stretch of the Rogue. A concern is that future high water events will continue to blast through more berms and farmland all the way to Kirkland Road (Freeman, 2002). Near here down stream from the mouth of Bear Creek, is a gray area where the

boundaries lines of the northwest Bear Creek Watershed and of the southeast boundaries of the SBW meet.

Salmon Rock has been a favorite, chinook-fishing hole for fishermen. Its deep, cool hole was the first primary resting place for salmon once they crossed the passage at Gold Ray Dam more than two miles downstream. Apparently, a jet boat was the only access to the hole, as walk-in access was closed and driftboat access was limited because there are no public ramps downstream of it (Freeman, 2002).

Mark Freeman, reporter for the Mail Tribune described Salmon Rock as "The actual rock is a house-sized piece of basalt that juts into the river from an underground rock formation that is most likely the base of Lower Table Rock. Decades, perhaps centuries, of flowing water carved a deep hole around the rock big enough to hide three truck-and-trailer rigs under water" (Freeman, 2002).

A project costing over $1 million, with more than half of that coming from state funds has begun. The Oregon Watershed Enhancement Board gave $283,000 toward the project, and the Oregon Department of Transportation contributed over $220,000. Rogue Aggregates donated materials, equipment, and personnel to this project, providing $200,000 in in-kind support. The engineering and hydrologic study necessary for this project was completed and paid for by Rogue Aggregates before the OWEB funding was approved. This amounted to close to $50,000.00. Rogue River Guides and Rogue Flyfishers Association also have put money or sweat into the project (Freeman, 2003).

Frank Schnitzer, a reclamation specialist with the Oregon Department of Geology and Mineral Industries, helped devise a plan to reroute the river by installing huge piles of large rocks. Excavators were used to place the jetty-like rock bars in the stream. These "barbs," are to slow down water flows and fortify the berm. Earth movers thickened the berm, and its slopes were either planted with willows or lined with the willow branch piles. A path was scraped through the old river channel in hopes to eventually to realign the river into its pre-flood path past Salmon Rock via further high water events (Freeman, 2003).

CONSIDERATION OF A PARK AND BOAT LAUNCH

In April and May of 2002, Jackson County Parks and Recreation Committee considered the question of the land and the wetland created by the Gold Ray Dam. One issue was, "Most of that is private property and the owners were having a hard time selling because it is designated wetland. It was suggested that the State could possibly take that over. ODOT is trying to sell a piece of

property just above Kelly Slough. It's the property where the river took it over. Land that is turned over to State Parks will be good for our economy. It will do nothing but help our economy. It would create more recreational opportunities, without the County incurring the costs of operation and maintenance of the acquired land." The Committee wanted to look into it further.

At the second meeting of the Committee, an aerial photo was viewed to show where the property is located. "It's mostly water and is located where the river in the '97 flood changed it's course and took out some renovated bottle pits, used as fishing ponds. A boat launch is needed at the backwaters of Gold Ray Dam." It was stated that, we do have a place there just above the powerhouse, that would make a good launch ramp. The jet boat community is against any access there because they want to keep it private and not heavily used. It was added that the reason that idea hasn't moved forward is because the County has liability problems with the Dam. There is also a parking problem on the North side of the river. There is a site plan that has been developed for the area around the powerhouse, including a boat ramp and creating a parking lot.

Paul Korbulic has been "working with CH2MHILL," a region-wide engineering firm, to come up with a project for them to seek out grant money to do a feasibility study for Gold Ray Dam. They have agreed to donate a certain value of their services. "If we can match that, they will do all the research, make all the contacts, and find out if there is money out there for a feasibility study" (Freeman, 2003).

The 53 acres of aggregate land along the Rogue, across Lower Table Rock, that was until recently for sale by Oregon Department of Transportation, was bought by The Oregon State Parks Department at the cost of $1. This is the land that is part of a project to repair damage caused by the 1997 flood (Freeman, 2003).

Parks officials may be looking at the site soon to see whether recreational use could one day fit in there. Andre Briggs, the state park's assistant area manager in Rogue River, was quoted in the Mail Tribune as saying "I think the priority and focus is completing the project. We have to go slow and work with the stakeholders. There's no master plan, no site-development plan, anything from a few picnic tables to a boat ramp could one day fit in there" (Freeman, 2003).

There is currently no public boat ramp downstream and no walk-in access, the only access to these waters are primarily by jet boat and by a few driftboaters who rent keys at $60 a year to a private ramp just upstream of Gold Ray Dam. It has been suggested that the State Parks not put in a public boat ramp, but create a low-intensity recreation area for people to beach their boats, have lunch, and perhaps read some interpretive signs highlighting the re-channeling

project. This would make the waters pretty private to a few, and some see it as suggestive of elitism. On the other side, is a potential safety problem, caused by an increase of rafts and boats commingled among the jet boats. Another concern is that the area will be trashed like other areas along the Rogue. There has been a push for a ramp near Gold Ray Dam also, but opinion has been split among members of various groups that use the waterway (Freeman, 2002).

Near Gold Ray Dam, Gold Ray Road becomes a rough, narrow, one way road. The river is on the north side and train tracks on south side of the road. It is also along this stretch of the river that vehicles are parked to fish below the Dam. At times vehicle passage is difficult to maneuver though this stretch. Rafters put in lower down, at a wider stretch, on government land. Kayaking events have been held along this stretch of the river.

REFERENCES CITED

Agee, James K., *The Historical Role of Fire in Pacific Northwest Forests*, in: John D. Walstad, Steven R. Radosevich, and David Sandberg (Ed). Natural and Prescribed Fire in Pacific Northwest Forests, Corvallis: Oregon State University Press, 1990.

Alta California, April 1860.

Arman, Florence and Wooldridge, Glen, *The Rogue, A River to Run*, Wildwood Press, Grants Pass, Oregon, 1982.

Ashland Tidings, March 12, 1878.

Ashland Tidings, Friday, April 16, 1880.

Atwood, Katherine C. and Lang, Frank A., *As Long as the World Goes On: Environmental History of the Evans Creek Watershed*, Prepared for the BLM, Medford District, Medford, Oregon, Butte Falls Resource Area, February 1995.

Atwood, Kay, *Blossoms & Branches, a Gathering of Rogue Valley Orchard Memories*, Ashland, Oregon, 1980.

Baldwin, Ewart M., *Geology of Oregon*, Edwards Brothers Inc., Ann Arbor Michigan, 1964.

Beals, Ella, *Oregon to California by Wagon, 1872*, Oregon Historical Society Quarterly, Vol. XXXVIII, No.1., March 1937.

Beard, C. A. and Schultz, B. E., "Documents on the State-wide Initiative," Referendum and Recall. In: MacMillan Scot J. Williamson, Origins, History, and Current Use of Ballot Initiatives in Wildlife Management Northeast Field Representative, Wildlife Management Institute, North Stratford, NH, 1912, <http://www.responsiblewildlifemanagement.org/origins_&_history.htm>

Beckham, Stephen Dow, *Requiem For A People: The Rogue Indians and the Frontiersmen*, Norman, Oklahoma: University of Oklahoma Press, 1971.

Blankenship, Cindy, Rogue River Press, July 30, 2003.

BLM, American Rivers, BLM Websites, 2003(a), <http://www.geocities.com/scott_cotter/fishprojects7.htm>.

BLM, Website, Greg Stewart Website, 2003(b), <http://www.geocities.com/scott_cotter/fishprojects7.htm>.

BLM, *Environmental Assessment For Motorcycle Riders Association 2000-2005 Events*, Medford District, Ashland Resource Area, EA No. OR-110-00-28.

Brooks, Howard and Ramp, Len, *Gold and Silver in Oregon*, Bulletin 61, State of Oregon, DOGAMI, 1968.

Buan, Carolyn M. and Lewis, Richard (Ed), *The First Oregonians*, Oregon Council for Humanities, Portland, Oregon 1991.

Bureau of Reclamation, *Formulation Working Document*, Grants Pass Diversion, Rogue River Basin Project Oregon, Pacific Northwest Region, October 1979.

City Of Rogue River, *Source Water Assessment Summary Brochure*, PWS # 4100712.

Cordy, Clifford B., *History of the Rogue Valley Fruit Industry*, Medford, Oregon, 1977.

Cronin, T. E., "Direct Democracy, The Politics of Initiative, Referendum and Recall," Cambridge, MA: Harvard University Press, 1989, <http://www.responsiblewildlifemanagement.org/origins_&_history.htm>

Daily Alta California, February 26, 1860.

Daley, Venita, *Rogue Valley History*.

Democrat News, July 1869.

The Democratic Times, October 31, 1889.

The Democratic Times, ad of January 24, 1889.

The Democratic Times, April 1880.

Diller, J. S., *Mineral Resources of Southwestern Oregon*, U.S. Geological Survey, Bulletin 546, Washington DC, pg. 106, 1914.

DOGAMI, *Oregon Metal Mines Handbook*, Bulletin No.14-C, State of Oregon, Vol. II, Section 2, Jackson County, 1943.

Dufur, Lee, *A Mix of Shrewdness and Nerve*, True West, July-August 1975.

Eule, J. N., "Judicial Review of Direct Democracy," The Yale Law Journal, Vol. 99 (7) pp.1508-1590, 1990, <http://www.responsiblewildlifemanagement.org/origins_&_history.htm>

Fattig, Paul, Mail Tribune, July 9, 2003.

Fattig, Paul, Special Report, Mail Tribune, May , 9 1993.

Fish Flow News, Fall/Winter, 1997.

Fitch, Ronald R., *History of Gold Hill*, Prepared for the Southern Oregon College History Department, 1970.

Fitzgerald Collection, *Holcomb Springs Add Card*, Circa 1930s.

Follansbee, Julia and Pollock, Nancy L., *Prehistory and History of the Jackson-Klamath Planning Unit: A Cultural Resources Overview*, 1978.

Foster and Grunnells, *Mining Map*, SOHS, 1904.

Freeman, Mark, Mail Tribune, September 19, 2002.

Freeman, Mark, Mail Tribune, August 21, 2003.

Genaw, Linda Morehouse, *Gold Hill and Its Neighbors Along the River*, pg. 24, April 1988.

Gold Hill News, 1899-1910.

Government Land Office (GLO), Survey Map of Sams Valley.

Government Land Office (GLO), The 1855 Survey Map.

Gray, Dennis J., *The Takelma and Their Athapascan Neighbors. A New Ethnographic Syntheses for the Upper Rogue River Area of Southern Oregon*, University of Oregon Anthropological Papers, No. 37, 1987.

Grants Pass Daily Courier, Indian and Mining Section Records, from 1854 Report Covering Findings of Military Department Officials at Fort Lane, April 2, 1960.

Griffith, Billie, Personal Communication, October 2003.

Gross, Mart R., *Net Risk: Assessing Potential Impacts of Fish Farming on BC's Wild Salmon*, Chapter 5 (Fleming, et al., 1994; Gross, 1998)

Guinan, John A. and Curtis, Ralph E., "A Century of Conservation", NMFS April 1971, <http://www.nefsc.noaa.gov/history/stories/century.html>

Hamilton, Eva, Medford Mail Tribune, July 21, 1963.

Harry and David, *Frost and Orchard Heating in the Rogue River Valley*, Bear Creek Orchards, Medford, Oregon, pg. 3, April 1972.

Howell, Paul, Personal Communication, 2003.

Ives and Hyde, GLO Map Survey, 1854-55.

Jackson County, *Pathfinder Maps, Highway and Street Guide for Jackson County, Oregon*, Jackson County Roads, Parks and Planning, Jackson County, Oregon, 2003.

Jackson County Circuit Court, Rogue River Decree, April 20, 1919.

Jackson County Extension Office, *Indians of the Rogue Valley*, Oregon State University, Medford, Oregon, 1980.

Jackson County Planning, Jackson County Cultural and Historical Resource Survey, 1992.

Jacksonville Democratic Times, February 28, 1879.

Kewish, Dan, Personal Communication, 2003.

Kidd, Julie, Postmaster Appointments for the State and Territory of Oregon 1847-1971, abstracted from National Archives Microfilm Publication of Record Group 28, Oregon Territorial Press, 1998.

LaLande, Jeff, *An Environmental History of the Little Applegate River Watershed*, USDA Forest Service, Rogue River National Forest, Medford, Oregon, 1995.

LaLande, Jeff, *The Indians of Southwestern Oregon: An Ethnohistorical Review*, Anthropology Northwest Number 6, Department of Anthropology, Oregon State University, Corvallis, Oregon, 1991.

LaLande, J., *First Over the Siskiyous: Peter Skene Ogden's 1826-1827 Journey Through the Oregon-California Borderlands*, Oregon Historical Society, Portland, Oregon, 1987.

LaLande, Jeff, *Rogue River Time-Line: A Chronology of the Rogue River National Forest and the Surrounding Area*, Rogue River National Forest, Medford, Oregon, 1982.

LaLande, Jeffrey M., *Prehistory and History of the Rogue River National Forest: A Cultural Resource Overview*, Rogue River National Forest, Medford, Oregon, June 1980.

Leavitt, Katherine Nealon, *History of Table Rock*, Grants Pass Daily Courier, Indian and Mining Section, pg. 15.

Libbey, F. W., *Least We Forget*, The Oregon Bin, XXXVIII, No. 12, Oregon Department of Geology, 1976.

Lichatowich, J. A., Mobrand, L. E., Costello, R. J., and Vogel, T. S., "A History of Frameworks Used in the Management of Columbia River Chinook Salmon," 1996, A report prepared for Bonneville Power Administration included in Report DOE/BP 33243-1, Portland, Oregon, Review Of The Hatchery Measures In The Oregon Plan For Salmon And Watersheds Part I: Consistency of the Oregon Plan with Recommendations from Recent Scientific Review Panels Report, 1998, <www.fsl.orst.edu/imst/reports/1998->

Liles, Connie Weide and Boulter, Gladys, *The Salt of the Earth Pioneers of Evans Valley*, 1992.

The Mail Tribune, August 31, 2003.

The Mail Tribune, July 7, 2003.

The Mail Tribune, January 20, 2000.

Martin, Melissa, The Mail Tribune, November 7, 1999.

Mason, Ralph S., *Bulletin 94: Land Use Geology O Central Jackson County*, State of Oregon Department of Geology and Mineral Industries, 1977.

Mayo, Roy F., *Gold Mines of Southern Oregon*, Nugget Enterprises, Enumclaw, Washington, 1994.

McKinley, G. and Frank, D., *Stories on the Land: An Environmental History of the Applegate and Upper Illinois Valleys*, Medford, Oregon, 1996.

Metskers, *Map of Jackson County*, Oregon Pathfinder Maps, Highway and Street Guide for Jackson County, Oregon, Jackson County Roads, Parks and Planning, Jackson County, Oregon, 2003.

Morehouse-Genaw, Linda, *Gleanings from the Gold Hill Echo*.

Morehouse-Genaw, Linda, *Gold Hill and its Neighbors Along the River*, April 1988.

National Fish Hatchery System, 2003, <http://fisheries.fws.gov/FWSFH/NFHSintro.htm>.

NCDC Cooperative Stations, MODOC ORCHARD, JACKSON COUNTY data derived from 47 complete years between 1915 and 1966, <http://www.worldclimate.com/cgbin/data.pl?ref=N42W122+2200+355656C>

Nesheim, Margaret, *One Hundred Twenty-three Year Search For Community*, Gandee Printing, 1977.

O'Harra, Marjorie, *Land in Common: An Illustrated History of Jackson County. Oregon*, Southern Oregon Historical Society, 1993.

OPSW Progress Report, October 1, 2000-December 31, 2000, <http://www.wrd.state.or.us/publicaton/notices/oregon-plan/81.htm>.

The Oregonian, January 19, 2003.

The Oregon Sentinel, May 30, 1868.

The Oregon Sentinel, July 13, 1867.

The Oregon Sentinel, September 2, 1863.

The Oregon Sentinel, August 9, 1862.

The Oregon Sentinel, December 22, 1862.

Outdoors Guide, 1930.

OWEB, *Gold Hill Dam Removal and Restoration*, Watershed Restoration Grant Application, May 2003.

OWRD, Rogue River Basin Study, Grants Pass, Oregon, 1985.

Parks, H.M., *Mining Progress Is Unhampered by Tendency Towards Stagnation in Other Industries*, Director of Oregon Bureau of Mines and Geology, The Morning Oregonian, <http://gesswhoto.com/or-article2.html,>, Jan. 01, 1916.

Potter, Miles F., *Oregon's Golden Years: Bonanza of the West*, Caxton Printers, LTD., Caldwell, Idaho, 1977.

Rivers, Cole, *History and Development of the Rogue River Basin as Related to Its Fishery Prior to 1941, Rogue River Fisheries, Vol.1*, Salem, Oregon State Game Commission, 1963.

Robison, Huston T., *The Rogue River Indians and Their Relations with the Whites*, A Thesis presented to the Department of History and the Graduate Division of the University of Oregon in partial fulfillment of the requirements for the degree of Master of Science, Chapter VIII: Conclusion, June 1943.

Rogue River Chamber of Commerce, *Our Town Community Profile*, 2001-2002.

Rogue River Chamber of Commerce, *Our Town Welcome To The City of Rogue River*, Community Profile Rogue River Area, 2001-2002.

Rogue River Salmon, 2003 <www.rogueriversalmon.org/history.html>.

RVCOG, <http://www.deainc.com/depot_street/history.htm>

RVCOG, 1997.

Sawyer, Robert W, *Abbot Railroad Surveys, 1855*, The Oregon Historical Quarterly, Vol. XXXIII, Number 1, March 1932.

Schuete, C. N., *Quicksilver in Oregon*, DOGAMI, State of Oregon, Bulletin No. 4., Portland, Oregon, 1981.

Sheffield, Elizabeth and Miller, R. A., *The Evans Valley History*, A twelve page paper, no date.

Sheffield, Elizabeth, *Rogue River, Oregon and Vicinity*.

Smith, R. Gess, "Report of Commissioner of Fish and Fisheries," 1898, <http://gesswhoto.com/fisheries-1.html>

SOHS, *Mining Activity in Southern Oregon Part 24-Mining Wealth-1904*, Reprinted in Jacksonville Nugget, Vertical File, Mining, 1978.

Southern Oregon Historical Society, Mail Tribune, Special Report, pg. 5, May, 9 1993.

Spreen, Christian August, *A History of Placer Gold Mining in Oregon 1850-1870; A Thesis*, University of Oregon, Dept of History, 1939.

Stanley, Denise, Mail Tribune, January 18, 1981.

Stockard and Stockard, *Living With Wildfire*, Seven Basis Fire Planning Project, 2003.

Taylor, George H. and Southards, Chad, *Long-term Climate Trends and Salmon Population*, April 1997.

Thorne, Dorothy Joanne, *A Brief History of The Gold Hill Area*, for Southern Oregon College, History Department, 1968.

Tice, Kevin Keith, *The Rogue River Guide*, Mountain N'Air Books, 1995.

Treaty, 1953

Tucker, William Pierce, *The History of Jackson County*, A thesis submitted for the degree of Master of Arts, University of Washington, 1951.

USGS, "Mercury in the Environment: Fact Sheet 146-00," October 2000, <http://www.usgs.gov/themes/factsheet/146-00/>.

Victor, Frances Fuller, *All Over Oregon and Washington*, Mail Tribune, Special Report, May 9, 1993.

Wailing, A.G., *History of Southern Oregon*, 1884.

Waldron, Sue, *County Byways*, Table Rock Sentinel, Vol. 12 No. 1, Jan-Feb, 1992.

Washington State Department of Ecology, *Mercury in the Environment*, Don't Mess with Mercury Campaign, Olympia, Washington.

Weiss, Eric, Personal Communication, 2003.

Winthrop, Kathryn R., *Prehistoric Settlement Patterns in Southwest Oregon*, Unpublished Ph.D. dissertation, University of Oregon, 1993.

ACKNOWLEDGEMENTS

The Seven Basins Watershed Council would like to thank the many people involved in contributing to and preparing Appendix A: History of the SBW. Our special thanks to:

Southern Oregon Historical Society:

Ed Jorgenson, Board of Directors

Carol Harbinson Samuelson, Library Manager/Photo Archivist

Bill Miller, Historian

Rogue Valley Genealogical Society:

Emillee Hill Brazill, Library Manager

Charleen Ferguson Brown, President

Chuck Sears

Woodville Museum:

Dale Hatch, Curator

Jackson County Libraries:

Ashland Library

Central Point Library

Eagle Point Library

Gold Hill Library

Medford Library

Rogue River Library

Jackson County Water Master

Private Historical Collections:

Davis Collection

Fitzgerald Collection

Gaar Collection

Sanderson Collection

Walker Collection

Fredenburg Collection

Those interviewed by Doris Walker and/or Linda Tourville Davis:
Al Allen, Cleo Bissoff Browner, Ray Case, George Fredenburg, Billie and Wanda Griffith, Ina Pearl Hilkey, Beverly Maplesten, Mrs. Mose, Orville Mose, "Bud" Dan Morton, Sylvia Case Nelson, Edgar Pleasant, Charlotte Sweet, Lois Glass West, Virginia Fredenburg Younger, Mae Edler Hull, Marcellus C. Morton, and Elizabeth Hall Morton.

Those who provided information through conversations with Linda Tourville Davis:
Ken Bigham, Althea Buresson, Marty Buresson, Mike Davis, Newt Elder, Walt Fitzgerald, Morris Frink, Barbara Fry, Charley Hilkey, Paul Howell, John Hunt, and Robert and Nellie Sanderson.

A special thanks as well to watershed council researchers Max Bennett, Dan Kewish, and Claire Martin. A special dept of gratitude is also extended to Linda Davis who gave many hours of her time in preparing this history of the SBW and to Max Bennett for preparation of the historical vegetation discussion.

APPENDIX B
VEGETATION OF THE SBW

APPENDIX B:
VEGETATION OF THE SEVEN BASINS WATERSHED: A BRIEF ENVIRONMENTAL HISTORY

Prepared by:
Max Bennett, OSU Experiment Station

INTRODUCTION

This section of the Historical Conditions Assessment reviews the major natural and human influences on vegetation in the SBW over time. The focus is on the "historic period," i.e., the time since Euro-American settlement, but earlier influences including climate change and Indian use of fire are briefly addressed.

This section draws heavily on *As Long As the World Goes On: Environmental History of the Evans Creek Watershed* by Katherine Atwood and Frank Lang. Their extensive study was prepared for the Butte Fall Resource Area, Medford District, Bureau of Land Management, in February 1995. In many places we quote directly from this study (page numbers cited) or closely paraphrase its findings. Readers interested in more details of the environmental history of the SBW should review this highly readable report. The discussions of climate change and Indian use of fire are drawn from Rogue River National Forest historian Jeff LaLande's excellent study, *An Environmental History of the Little Applegate Watershed*. Other sources are cited in the text.

Vegetation Overview

According to the *Atlas of Oregon* (University of Oregon, 2001), the SBW is largely occupied by the Siskiyou Mixed Conifer (SMC) Forest. Douglas-fir, ponderosa pine, sugar pine, incense cedar, and white fir are abundant in this type. Madrone, bigleaf maple, and western white pine are common. Portions of the watershed close to the Rogue River are part of the Siskiyou Mixed Evergreen (SME) formation, which is similar to the SMC but has a higher proportion of broadleaf trees, especially madrone. Much of the Evans Valley

and part of Sams Valley belong to the Oregon white oak type, which is dominated by this species will small amounts of Douglas-fir, ponderosa pine, and incense cedar. The watershed also has small areas of agricultural land and cleared grasslands.

Climate Change

Climate change has been in the news lately, but it is nothing new to southwestern Oregon. Since the end of the last ice age, about 10,000 years ago, there have been several dramatic climactic shifts that have resulted in changes in local vegetation. As the ice age glaciers receded from Mt Ashland and other high peaks of the Siskiyous around 9-10,000 years before present (BP), the climate was still cooler and wetter than it is today. Then, starting around 7,500 years BP, things warmed up and dried out. During this "xerothermic" period, there were shorter-term fluctuations in temperature and rainfall, but the overall climate was somewhat drier and warmer than at present. The mixed conifer forest migrated upslope, and oak woodland and other dry forest types increased in area. There is speculation that some of the grassy "balds" and higher elevation opening in southwest Oregon are relicts from this period.

Approximately 4,500 years ago, the climate shifted again to a regime of cooler temperatures and higher precipitation. For a period, glacier ice may even have returned to Mt Ashland and other high Siskiyou summits. The mixed conifer forest probably moved downslope at the expense of oak woodlands.

Within this general cooling cycle leading up to the present, there have been a number of significant short-term fluctuations. For example, there is strong evidence of major droughts from 900-1100 AD and 1200-1350 AD. Evidence from elsewhere in the Pacific Northwest indicates that major stand-replacing forest fires occurred during this period, initiating some of the magnificent old growth Douglas-fir forests we see today. From AD 1400 to 1900, the world experienced the "Little Ice Age" with cooler temperatures and glaciers advancing to lower elevations. Since 1900, we have experienced intense drought in the 1930s, a relatively rainy, cool period from 1945-1970, and many droughty years since then.

Given these climatic "cycles within cycles," the idea of the "average" climate seems less meaningful. It is normal to experience long periods of drought interspersed with cool moist periods, all within longer-term cycles of cooling and warming trends. We can expect vegetation to respond accordingly. Droughty periods will favor drought resistant trees such as pines and oaks. More moisture dependent species will migrate upslope and be increasingly confined to cooler northern slopes. The reverse will occur during cooling

trends. However, if climate shifts are too rapid, vegetation may not be able to respond in time, resulting in increased levels of insect and disease problems and a higher incidence of catastrophic fire.

The Prehistoric Period - Indian Influences

Humans have been present in and influencing the environment of southwest Oregon since the end of the last ice age. Probably the most significant of these influences was the use of fire. The Indian use of fire to manage the landscape is well documented. Fire was used to improve the yield of important food crops, such as berries and tarweed; to clear areas of dense forest and brush to facilitate passage; to increase the amount of grass forage for horses, deer, and elk; to reduce the danger of stand-replacing crown fires; and for many other purposes. Indian fires occurred mainly in low elevation savannas, oak woodlands, and transitional pine forests. Mixed conifer forests and higher elevation forests were probably much less affected, though localized areas at high elevations were burned off to promote berry patches, beargrass, and other favored plants. The frequency of Indian burning varied but some areas were probably burned annually to every few years, typically in the fall or spring when fires were easier to control. These frequent fires played a major role in maintaining certain vegetation types across the landscape. For example, prairies tended to remain covered with grass and other herbaceous vegetation rather than succeeding to brush and trees. Likewise, oak woodlands retained on open, savanna like character under a frequent fire regime rather than growing denser and being invaded by conifers. Transitional pine forests tended to stay open and park-like rather than being invaded by Douglas-fir and growing denser.

Southwest Oregon Indian groups had a subsistence lifestyle based on largely on hunting, fishing, and gathering food plants. Agriculture played a minor role and occurred only on a limited scale, primarily in association with tobacco production. Some localized harvest of sugar pine and ponderosa pine also took place. These activities had some influence on local vegetation but the major influence was probably fire.

Vegetation at the Time of Early Settlement – Evidence from GLO Surveys

The General Land Office (GLO) surveyed the SBW in the 1850s, just when the watershed was first being settled by European-Americans. The primary objective of the surveys was to divide up the land in an orderly fashion in order to prepare for settlement and development. Figure B-1 and B-2 are examples of maps generated as part of the GLO surveys. Nevertheless, the surveyors did

make some cursory observations about vegetation, mostly with regard to the suitability of agricultural land and the types of trees present. One hundred fifty years later, these early observations, as sketchy as they are, provide some of the best evidence of the vegetation present before large-scale development.

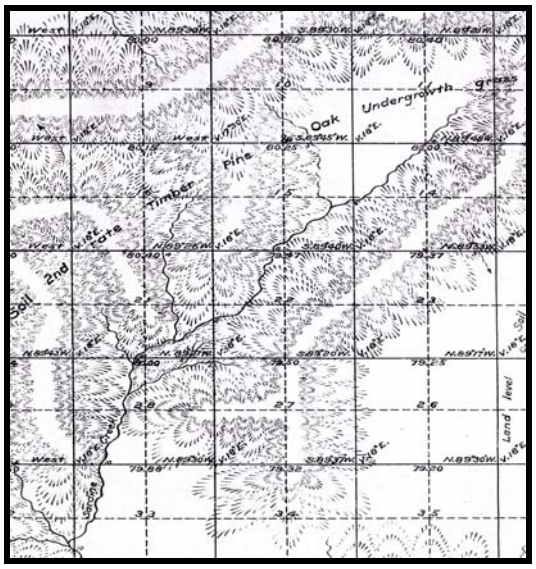


Figure B-1
GLO survey map (1854), portion of T35S, R3W
(Sardine Creek north of Gold Hill)

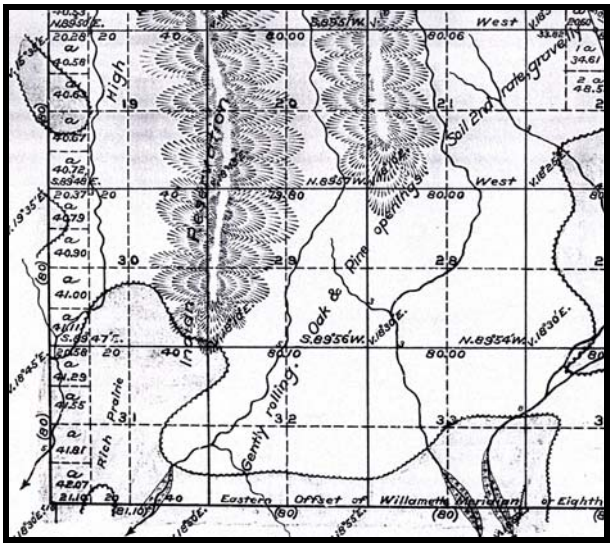


Figure B-2
GLO survey map (1854), portion of T35S, R2W
(Sams Valley north of lower Table Rock)

The following descriptions are taken from the GLO survey notes or associated maps generated from the notes.

Township 34S, Range 4w (Pleasant Creek)

"Land mountainous. Soil 2nd & 3rd rate. Timber pine, fir, oak, cedar, laurel, etc." A road is in place along Pleasant Creek.

Township 35S, Range 4w (Mid-Evans, near Wimer)

Middle of Evans Valley: "Soil 2nd rate. Timber pine and oak. Good grazing."

Western edge of township: "Soil 3rd rate. Timber pine, oak, and laurel with undergrowth."

On an eastward course between sections 17 and 20 (near the present day Bear Brach Road), the surveyors noted "Open timber, pine, fir, oak etc., soil a clay and gravel, 3rd rate."

On a north course between sec. 20 and 21, the surveyors found the "...surface rolling. Open pine and oak timber. Second rate soil, gravelly."

East on line between sec. 16 and 21, their description was of "...rocky mountains. Third rate soil. Timber, fir pine, cedar, and laurel with thick undergrowth of manzanita, fir, live oak, and laurel."

Township 37S, Range 4w (Foots Creek)

"Mountainous and hilly. Soil 2nd and 3rd rate. Timber pine, oak, fir, laurel, etc. Undergrowth laurel and manzanita, etc."

Township 35S, Range 3w (W. Fork Evans Creek)

"The land in this township is mountainous except along Evans Creeks where there are some level bottom and bench lands. The township is generally covered with dense forests of Yellow Pine, fir and sugar pine and oak, with undergrowth of Matherone and Oak, etc."

Township 34S, Range 3w (Sardine Creek above Forks)

"Land hilly. Soil 2nd rate. Timber pine and oak. Undergrowth grass."

Township 345, Range 3w (Gold Hill)

Hills just north of Gold Hill: "Indian Reservation. High rugged hills. Soil 2nd rate. Timber fir, pine, oak, etc."

Kane Creek and nearby hills: "High broken hills. Timber oak, pine and laurel."

Township 35S, Range 2w (Sam's Valley)

Just north of Lower Table Rock: "Gently rolling. Oak and pine opening. Soil 2nd rate, gravelly clay loam. Good grazing land." Further to the NW, the description is of "High broken hills. Timber, pine, oak, fir, and laurel. Some good grazing." The east side of Sam's Valley is mapped as gently rolling prairie. "Soil good second rate."

Taken together, these descriptions paint a picture of prairies and open pine and oak forests on the valley bottoms, with denser forests clothing the mountainsides. Many of the low elevation valley bottom and foothill forests were quite open, with grassy understories. Lower forests probably had a much higher proportion of pine than at present, and less Douglas-fir. These conditions were no doubt maintained in part by frequent, but low intensity surface fires, many set by Indians, and well as ignited by lightning.

Early Settlement – Farming, Logging, and Mining

Attracted by free land, the first settlers arrived in the Evans Valley around 1850. A post office was established in Wimer in 1852. The Bear Creek Valley - including Sam's Valley - was settled around the same time. These homesteaders were mostly farmers, and they set about clearing land for crops. The best bottomlands were cleared first.

Early settlers needed wood for houses, barns, fences, and fuel. Most of the timber cutting activity was confined to the valley bottoms and lower hillslopes where timber was most accessible. Merchantable trees growing along streamsides were often felled into the creek, to be carried short distances to local sawmills during high water.

Small sawmills sprang up to meet the growing demand for lumber. Much of this was for local farm use. In addition, local mining activity generated a demand for mine timbers, lumber for miner's houses and outbuildings, and firewood. The arrival of the railroad created additional demand for lumber for railroad ties and trestles. Small mills were operated by water power and so were located next to creeks. Atwood and Lang cite early mill locations at the mouth of Evans Creek (1852), Fielder Creek (1871), Evans Valley (1875), and Meadows vicinity (1867). Mills were also located near Wimer, on Bear Branch, and Pleasant Creek. Logging tools included axes and crosscut saws, and logs were yarded with horses.

Regarding the early clearing for homesteads, Atwood and Lang cite one Evans Valley resident:

> "A lot of it was big trees. They cut the timber down and sold it or used it themselves and burned the stumps. I remember Dad saying at Starvation Heights…he had seen some of the finest sugar pine that was in this country on that flat there… Day said that they took the sugar pine from Starvation Heights to a mill at Wimer. After they got rid of that sugar pine he'd seen oats and vetch up past the stirrups on a horse."

At the turn of the century, much of Sams Valley, Evans Valley, and other lowland areas were settled with farms. Lowland forests had been cleared for agricultural, many streamside conifers had been removed, and low-lying foothills had been logged. Logging was probably selective, with the largest and best quality trees first cut. Sugar pine was the most highly prized species, but ponderosa pine and Douglas-fir were also utilized. While logging was active near the valley floors, most of the upper mountain slopes and higher reaches of the watershed remained largely untouched.

A general picture of Jackson County forests around 1900 comes from Forester Henry Gannet (quoted in Atwood and Lang p.86): The "valley of the Rogue River contained much open land, in which are scattered bodies of timber." The Siskiyous are described as "timbered, but not heavily, with a mix of yellow and sugar pines, red fir (i.e., Douglas-fir), and other species."

The USGS classified and mapped the forests of Oregon in 1900. The SBW is shown as largely timberless or covered in "woodland" (Figure B-3). The methods used to produce this map and the level of detail in ground-truthing are unknown. One interpretation of the map is that the "woodland" category includes areas with relatively open, even sparse forest, at least compared to the denser forests of the Oregon coast range and Cascades.

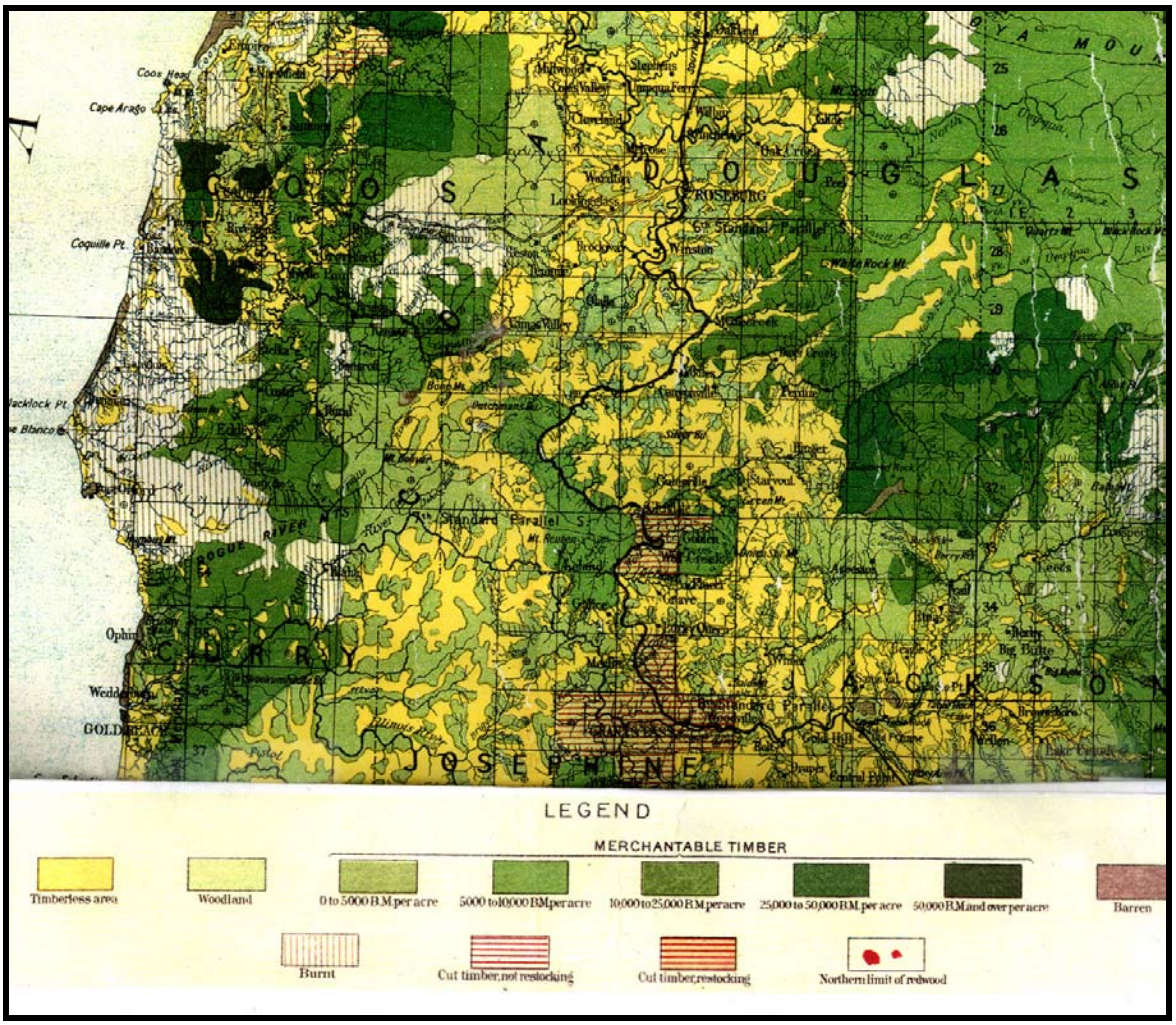


Figure B-3
USGS Forest Type Map of Oregon Showing SW Oregon, 1900

In 1914, Oregon's first state forester, F. A. Elliot, commissioned a map of Oregon vegetation showing areas of merchantable timber, burned areas, cutover areas, brush, and non-timber areas (Figure B-4). Much of Sams Valley, lower Sardine Creek, lower and mid-Evans Creek, Pleasant Creek, and upper Evans Creek in the vicinity of "the Meadows" are shown as non-timber. Non-timber areas in Sams Valley are largely surrounded by brush, which borders on timbered areas to the north and west. Cutover areas are shown on the west and east sides of Evans Valley and on Pleasant Creek. Much of the rest of the watershed is shown as merchantable timber. Interestingly, the watershed is shown as having relatively little burned area. (It should be noted that burned areas on the map are those where most or all of the trees were consumed. Forests that underburned would not be included in this category.)

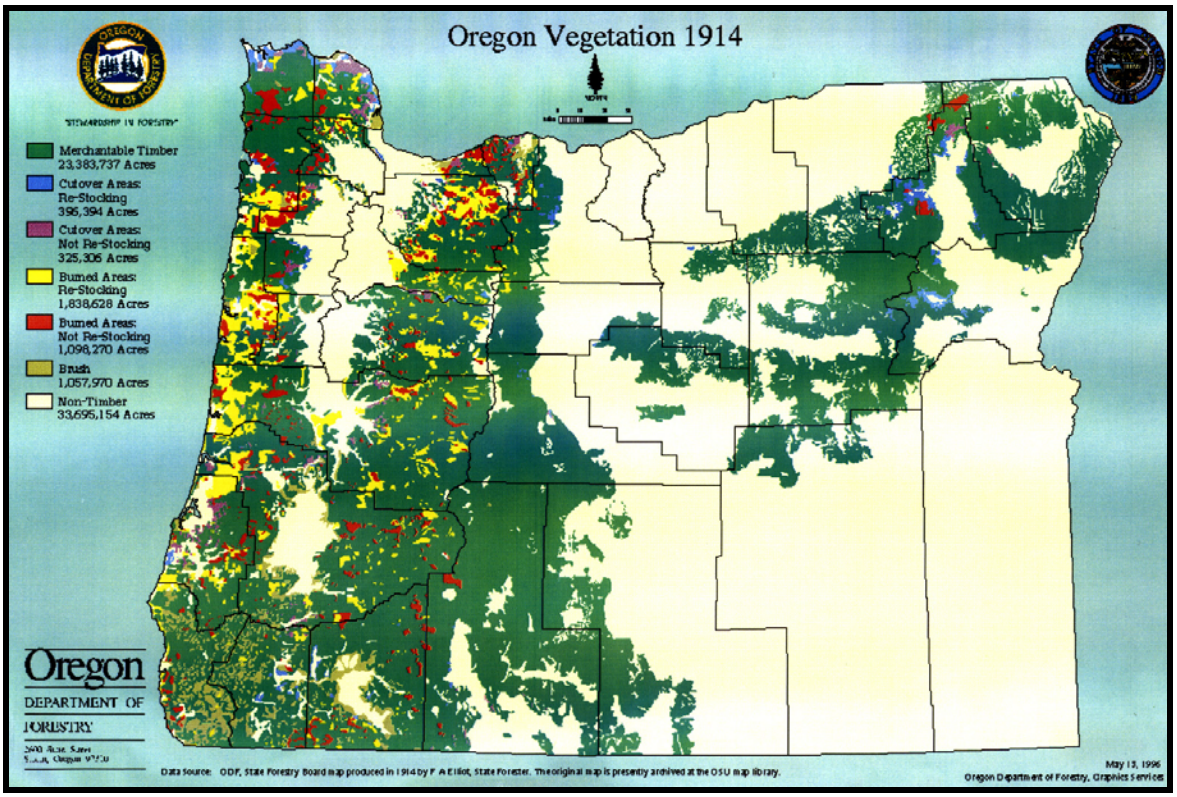


Figure B-4
Oregon Vegetation, 1914

1900-1945 – Logging and Milling

Improvements in lumber markets, logging technology, and the road network accelerated the pace of timber harvesting after the turn of the century. As eastern and mid-western forests were tapped out, lumber manufacturers moved west to take advantage of the region's vast and seemingly inexhaustible timber resources. A few private companies acquired land in the watershed, and local loggers sold to Timber Products Co. in Medford and other firms. In addition, much forest land reverted to the US Government through the O & C Act of 1916, and through subsequent forfeitures of tax delinquent private land. These resulted in a distinctive land ownership pattern in the watershed. Most lowland areas were privately owned as small farms or woodlots. Higher slopes and upstream reaches in the watershed had a checkerboard pattern, with alternate sections privately held and owned by BLM. Ultimately, BLM came to control over 40% of the land in the watershed.

Technological developments in the logging industry included the steam donkey in the early 1900s, the crawler tractor in the 1930s, and the chainsaw around

World War II. All these facilitated more efficient harvest of the timber resource. In addition, the road network continued to expand, giving access to previously distant areas of the watershed.

Small sawmills sprang up throughout the watershed, in fact, "...up every little creek there was a sawmill. They were little mills. There would always be a big pile of sawdust where they would mill their lumber right there and then haul it out." (Dale Hatch quoted in Atwood and Lang, p. 89). Despite this increased level of activity, much of the watershed was too remote and remained untouched by logging activity until after World War II.

Fire

As noted above, much of the watershed was subject to natural and human-set fire for millennia. Writing about the Cascade and Siskiyou Forest Reserves in the late 1800s, forest surveyor John Lieberg noted: "Fire have widely ravaged the region examined. There is not a single forested township either on the west side or on the east side of the range in which the timber is not more or less fire marked. Without much doubt the present agricultural areas, once grass covered and carrying extensive scattered stands of oak, were burned over quite as extensively as the timbered tracts..." (quoted in Atwood and Lang, p. 89).

Historical evidence suggests that if anything, the frequency and perhaps severity of fires increased with early settlement. Fires were used to clear woods for farming, by miners, and by stockraisers seeking to improve grass forage. Newspaper accounts from the 1860s on, provide a flavor of the smoke-filled summers that plagued local residents:

> "Never since white men trod the soil of Southern Oregon, has there been so much fire in the mountains as during the past few weeks. From north of the Canyon to the Siskiyous, the fire has been raging with creased fury. Much of the sickness among us at present, is attributed to the heated state of the atmosphere, and the immense volume of smoke ever created by these vast fires." (Jacksonville paper, August 1864, as quoted in Atwood and Lang, p. 57).
>
> "It seem as though no year shall pass but what the woods are afire and the country deluged with smoke,...the sun can hardly be seen for smoke." (Jacksonville paper, 1872, as quoted in Atwood and Lang, p. 58).

An observation by forester Lieberg provides evidence of the frustration with which many in authority viewed fire: "Fires are not infrequently set to burn away windfalls...This is done to avoid the severe labor of fifteen minutes work with the ax...A case of this kind came under my observation...In an attempt to

remove a windfall across a little-used road the fire in the log had spread into the adjoining forest, and at the time when I saw it, had burned over about 3,000 acres." (Quoted in Atwood and Lang. p. 58). To a conservationist of the progressive era, this was pointless waste, and a good reason for initiating fire suppression programs. The fires of 1910 in northern Idaho and Montana, in which millions of acres of valuable forest were consumed in a few days and where dozens died and towns burned to the ground, galvanized public concern about wildfire. Ultimately a national policy of wildfire suppression developed, where the goal was to suppress any and all fires by 10 am the next day. As will be discussed later, this well-intentioned policy has had severe unintended consequences for fire hazard and forest health.

While the official policy after 1910 was fire suppression, there were advocates of a different approach to fire hazard reduction: "Burn the underbrush. Every summer much valuable timber is burned, and although the government has established a system whereby a force of rangers is kept in the forests to prevent fire and extinguish the flames after they have started, it is the same old story to more or less degree…One of the greatest pieces of folly is preventing fires to be set in the hills and government reservations until the brush and undergrowth become so high and thick that when the inevitable fire comes the whole forest is destroyed. Old settlers and Indians know that they only safe method is to annually burn off the undergrowth, when it is so thin that it would not endanger the big trees. Then the grass can grow and you have a beautiful forest instead of a fire trap." (Jacksonville Democratic Times, 1903, quoted in Atwood and Lang, p. 102). This sentiment was common among ranchers and some other rural residents, as well as a few maverick foresters (LaLande 1995).

While there was much fire in southwest Oregon during the second half of the 19th century, it is interesting to note that relatively little of the SBW was denuded by stand-replacing fires. The 1914 state foresters map shows two small burned areas in the northern part of the watershed.

Despite the official policy of fire suppression, actual suppression capabilities took time to develop. The acreage burned in southwestern Oregon remained high throughout the first three decades of the 20th century. Evans Valley residents (Atwood and Lang. p. 104) recall early fires: "In 1938 we had a big fire on Round Top. It started over on the Salt Creek side over on the West Fork of Evans Creek and burned about 8,000 acres up through there. It left a big snag patch under Round Top." (Doyle Stockton quote). "They used to burn through here all the time…Old timers set fire to get rid of brush. They set fires and they ran stock up here--they'd see a pile of brush and throw a match on it." (Dick Skevington quote). "I can remember 1929 when the whole Fielder Mountain was on fire. In the 30s there was a lot of fires--a lot were deliberately set because it was depression days and there was no work." (Dale Hatch quote).

Jackson County timber harvests increased greatly after World War II to accommodate the growing demand for lumber (Figure B-5). In 1946, there were 76 sawmills in operating in Jackson County, including larger facilities operating two shifts a day (Atwood and Lang p. 114). Total harvest levels exceeded 800 million board feet annually through most of the 1950s and 1960s. There was a dramatic drop during the recession of the early 1980s, and again after about 1990 after harvest levels on federal lands declined sharply due to legal challenges and policy changes.

In the SBW, while lowland areas had largely been harvested, upper slopes and higher reaches of the watershed still had extensive stands of valuable mature timber. Following the war, these areas were roaded and then logged. Clearcutting was the main harvest method, though some partial and shelterwood cutting was used, the latter on BLM land. Figures B-6a-d and B-7a-b, show areas near the West Fork of Evans Creek that were harvested and roaded during this period. Ultimately, all or nearly all of the private timber holdings in the watershed were harvested, and much of the BLM lands as well.

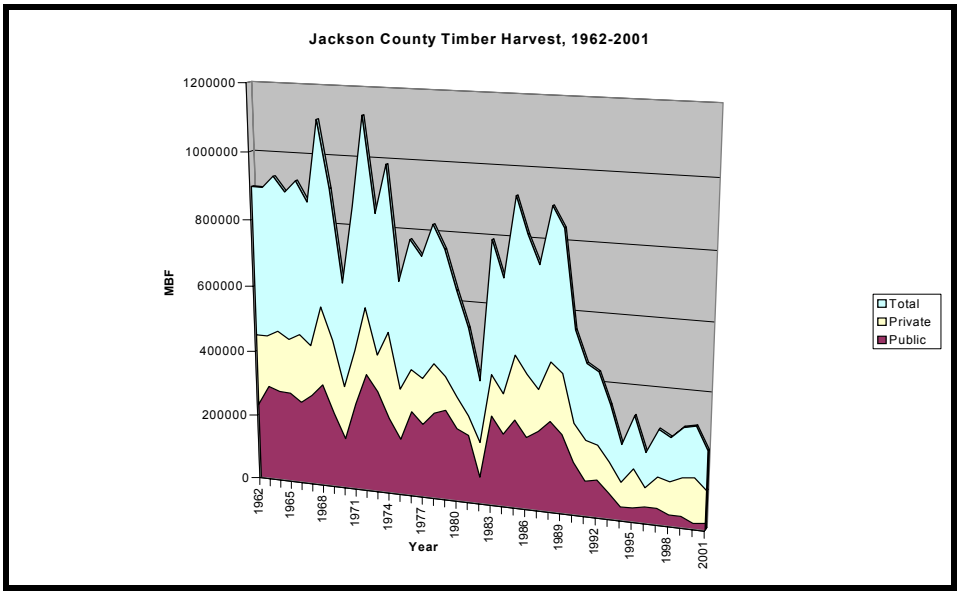


Figure B-5
1945-Present – The Timber Boom
Jackson County Harvest History, 1962-2001
(Source Data: Oregon Department of Forestry Timber Harvest Reports)

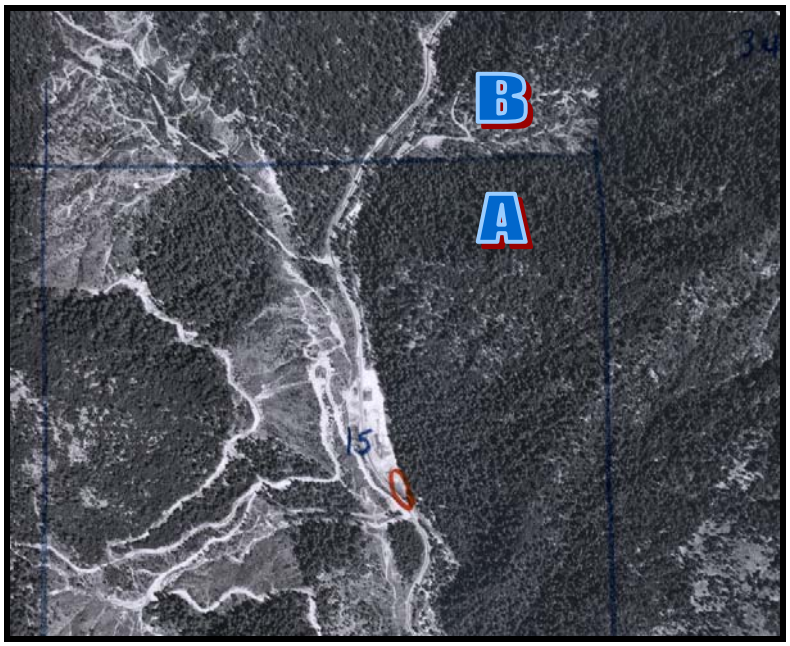


Figure B-6a
Logging and Road Building, West Fork Evans Creek
West Fork Evans Creek (34-3-15), 1965.
"A" is uncut forest on BLM, "B" is logging on private. (BLM photo)

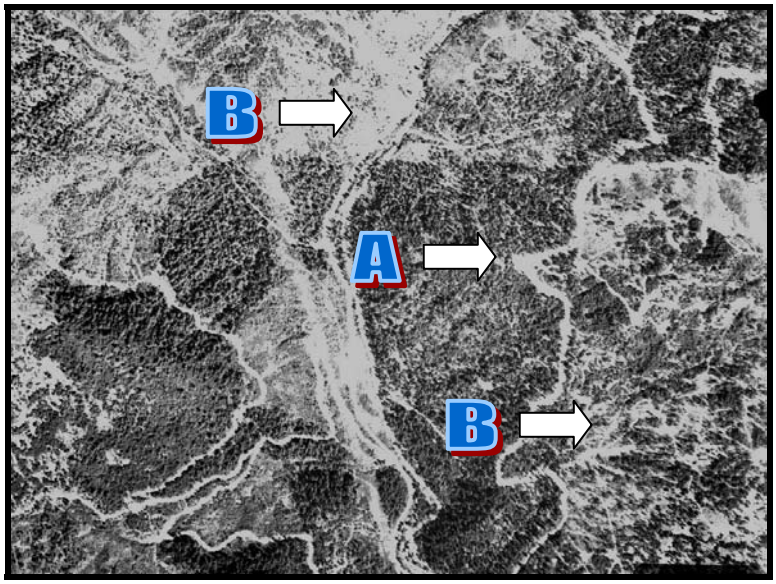


Figure B-6b
Same location, 1975.
Note new road (A), new logging (B). (BLM photo)

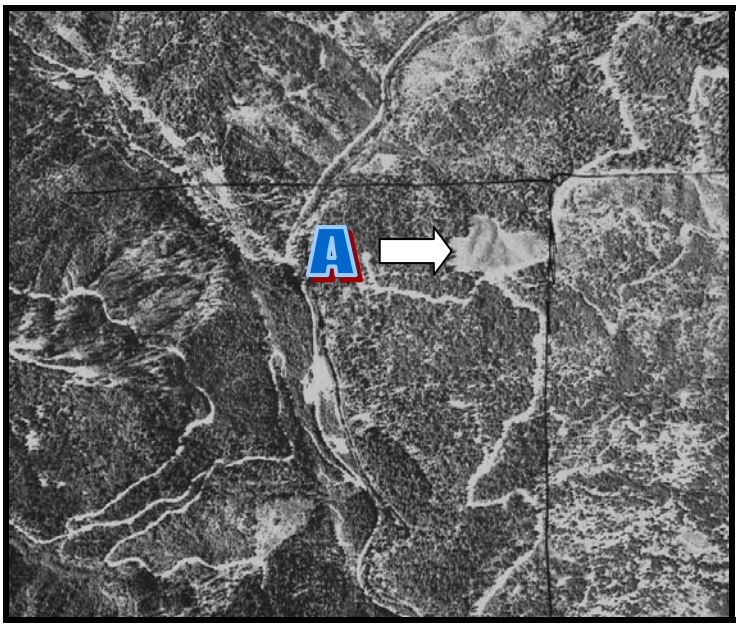


Figure B-6c
Same location, 1985.
Note new clearcut (A). (BLM photo)

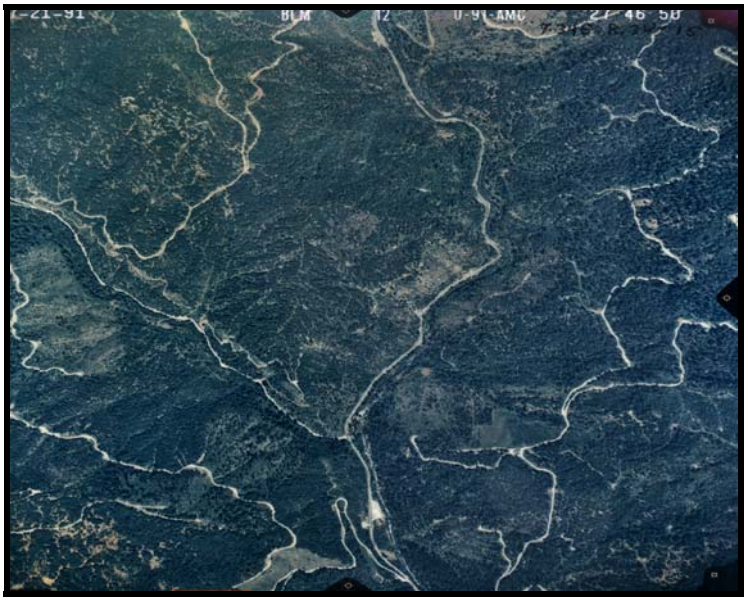


Figure B-6d
Same location, 1991. New Harvesting on BLM, Regrowth Evident on BLM Clearcuts and Logged Areas on Private Land. (BLM photo)

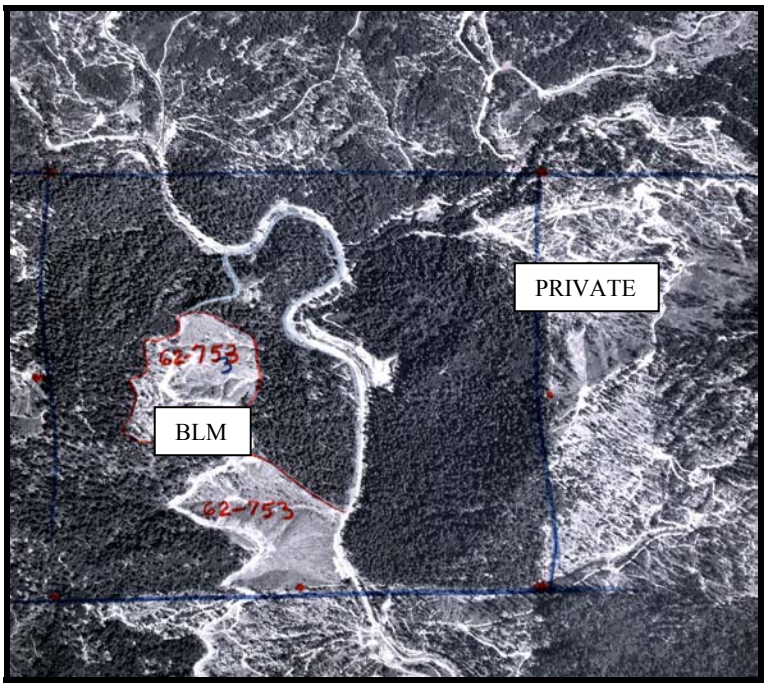


Figure 7a
Logging and Road Building, West Fork Evans Creek
In Vicinity of 34S, 3W, Sections 3 and 4
1966. Note alternate section of BLM and private land. (BLM photo)

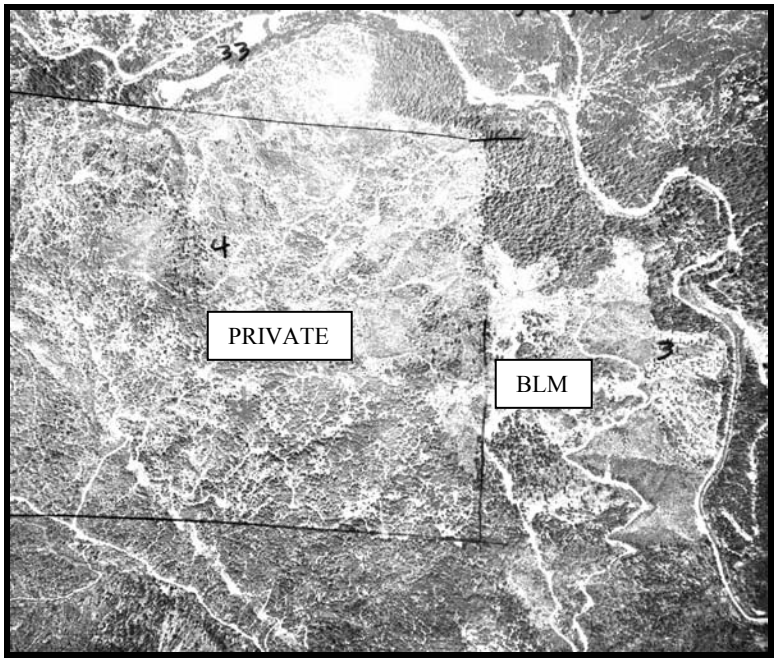


Figure 7b
1985 Photo Offset Further West. (BLM photo)

Wilber Milton, a logger, recalled this era:

> "We just went further out in the Evans Creek area....I started my own outfit in 1953. We logged on Pleasant Creek. Worked up there for years. Logged everything -- Red fir, cedar, and pine. We cut on both private and public land. Timber companies bought up all the private timber they could." (Atwood and Lang, p. 120).

Another logger, Dale Hatch, talked about logging for Timber Products on many BLM sales:

> "I logged in there in the 60s when they first started putting the BLM roads up in there. There really hadn't been that much logging going on. It was kind of a new area. They've hit it pretty hard since the big roads went in. It was real big timber -- Doug fir...Up on the ridges you'd hit sugar pine and yellow pine, most was heavy in Douglas fir. Railroad Gap, Round Top, still big timber up in that area, but not much. You started getting into heavy timber in Angel Camp area. Red Mountain. That was the big timber area. I logged about every other section up in the West Evans Creek area and over into East Evans creek...logged a lot of cut-over area later on because I could re-log some of the areas that had been selectively cut." (Atwood and Lang, p. 121).

Milton (quoted in Atwood and Lang, p. 130) made the following observation about the logging:

> "When I first started working for Timber Products, they told you to take the timber down to eighteen inches breast high. In certain area there was a lot of good stands of reproduction. You kept out of that. You didn't put a cat in that. They stayed with that until the old company sold. When the next guy bought it...he more got set in here with his upper foreman, than he had us go back and take what we had already. When we got through it was a clearcut. Nothing left. That ruined the whole thing. You cannot have water without trees. Trees hold your water and give shade."

Another logger, Dick Skevington, had this to say:

> "Years and years ago, everything was forested. We got nobody to blame but ourselves. Years ago they cut only the best timber and left the scrubby stuff and so your grade of timber run down. They were doing pretty fair up until after World War II. Then they got big motorized equipment and went in and did all the clear cutting...Well, we went for forty years and nobody planted anything..." (Atwood and Lang, p. 131.)

Yet another logger made this comment::

> "The Evans Creek area has very little old growth left up there…there are some little pockets where they've left some old growth, but not much. It's been logged pretty heavy most anywhere you go. You drive up there and see some big timber and remember when it all used to be like that. It is kind of sad. They way we logged it there was no restrictions. You had to fall snags. You don't get into our streams anymore like we used to. Used to be we'd cat log it and come down into the bottom of the stream and go right down the middle of creek. It pushed mud in the creeks.
>
> "It looks different because we've got more brush now and more young trees than we used to have. Used to be big timber and young trees wasn't under a canopy. Now that they've cut everything off or it's been burnt off the brush is coming back heavy. Years ago when you went hunting it was all bug timber and things smelled so woodsy. You don't have that kind of smell now." (Dale Hatch, quoted in Atwood and Lang, p. 129).

It is important to note that while extensive areas have been logged, most of these areas are forested today. A combination of natural regeneration and planting has ensured the return of tree cover to most harvested areas, whether on private or public land (Figure B-8, a-d). The major changes in forest vegetation have been a shift from predominantly larger, older timber, with more open understories, to younger, smaller timber (Figure B-9). The species composition has probably shifted to a lower proportion of pine (both ponderosa and sugar) and a higher proportion of Douglas-fir and hardwoods.

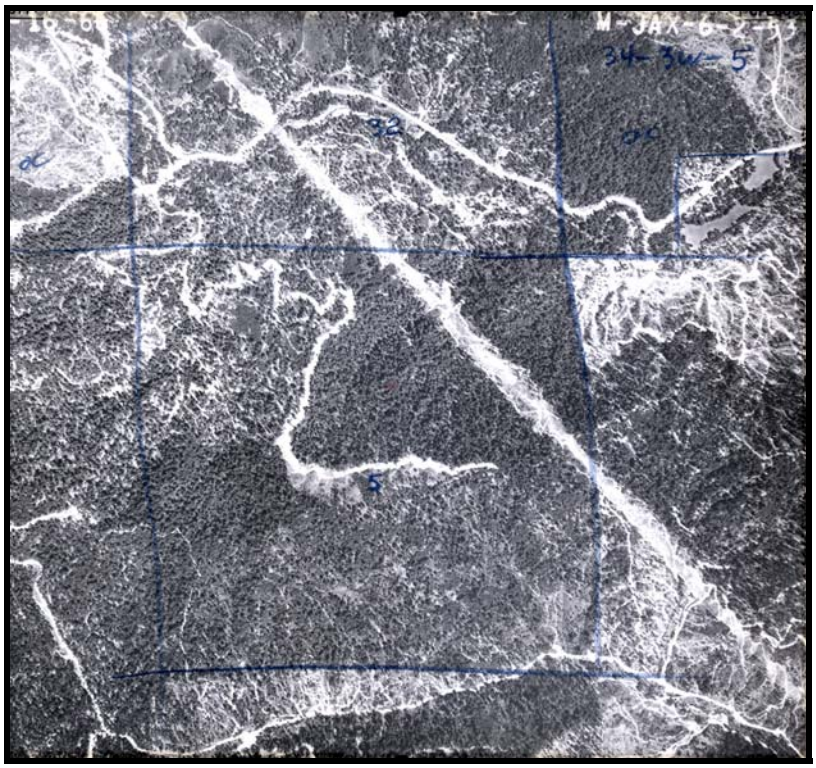


Figure B-8a
Regrowth after Logging on West Fork Evans Creek,
34S, 3W, Section 5
1965. Section 5 in photo center is BLM land. Diagonal swath in powerline right of way. Creek is just below road that goes from left to right, top of photo. (BLM photo)

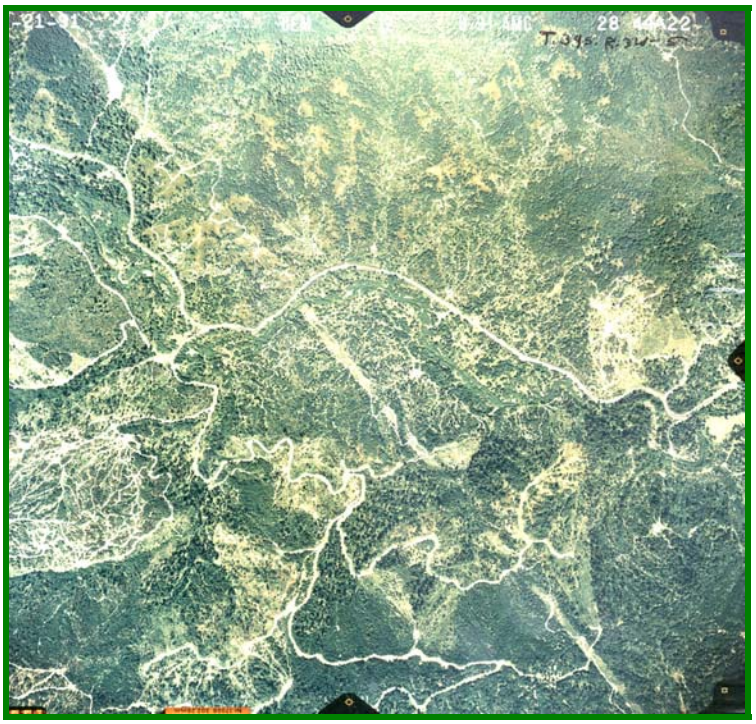


Figure B-8b
1991. New roads and harvesting are evident. Regrowth evident in logged areas. (BLM photo)

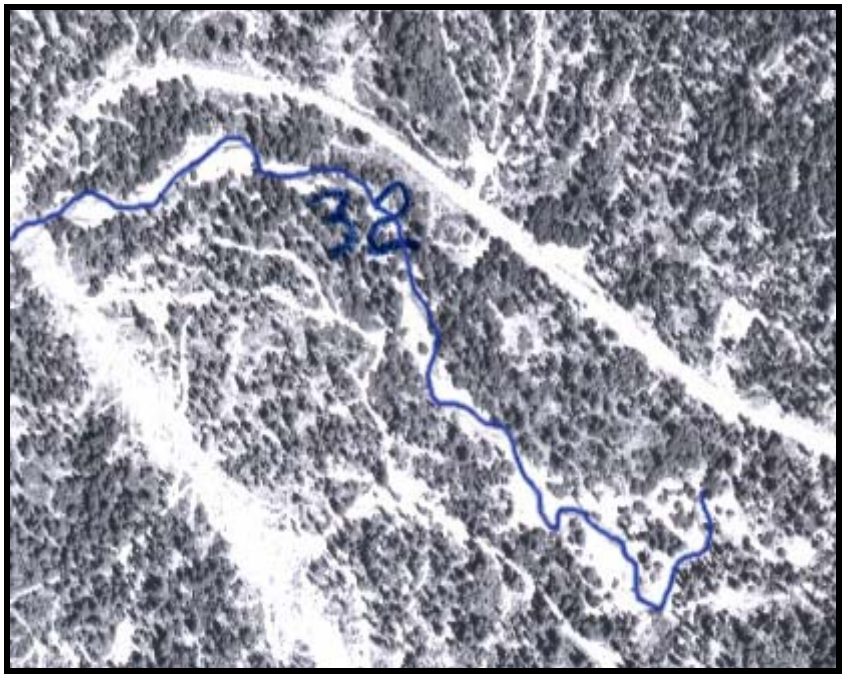


Figure B-8c
1965. Blue line denotes approximate location of West Fork. Note lack of riparian cover in many areas. (BLM photo)

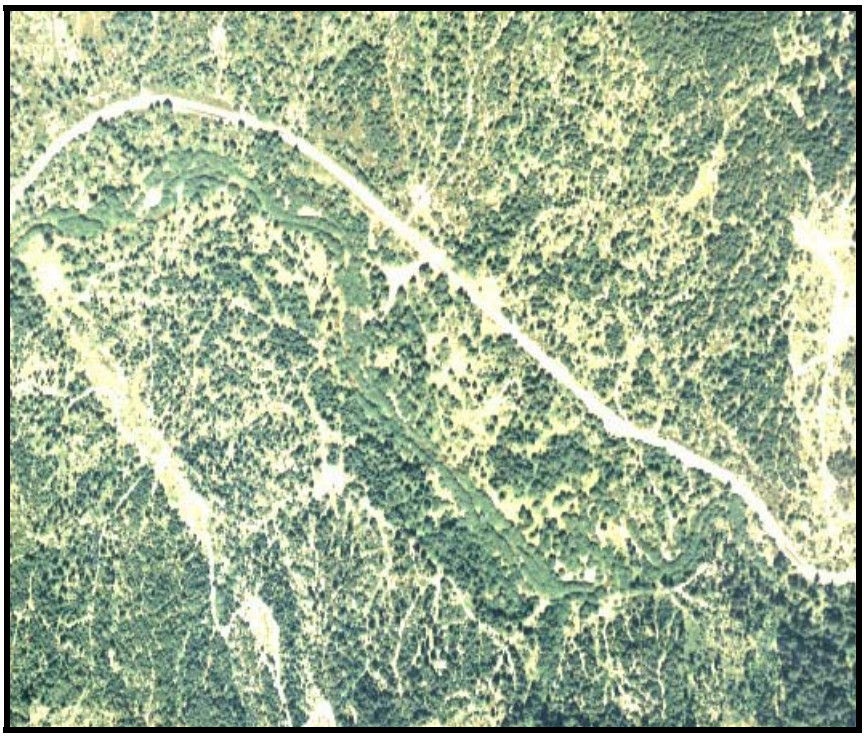


Figure B-8d
1991. Note swath of light green vegetation along stream course. This cover (mostly alder and other deciduous vegetation) has grown up since 1965. (BLM photo)

Figure B-9
Representative forest vegetation, pre-fire suppression and post suppression. These photos depict forests in Jackson County, but not in the Seven Basins Watershed. Not all forests fit this pattern but it is generally representative of changes that have occurred over the past 50-100 years in many of the county's forests. (BLM Photo)
(Photo on left depicts pine stand in Prospect area, 1930s [USFS archival photo]. Photo on right depicts dense Douglas-fir stand, BLM lands)

Changes in Riparian Vegetation

There is little direct evidence of historical conditions in riparian areas. As noted above, many lowland streams were cleared of large conifers shortly after settlement. Trees typically were logged to the water's edge in upland streams as logging moved higher up in the watershed. Many of the logged streamside areas were quickly colonized by hardwoods such as alder, but conifers have been slower to return (Figure B-8, a-d).

Adoption of a state forest practices act in 1972 and numerous revisions to the act since then have increased the level of protection to riparian zones on private forest land. Riparian zones also receive much greater protection on federal land today than a few decades ago.

Historically, floods shift channels and removed areas of streamside vegetation. Most such areas are quickly revegetated (Figure B-10, a-b). It is important to note that many riparian species such as cottonwood, willow, and alder require disturbance such as flooding for renewal. Floods scour streambanks and expose bare mineral soil or sand and gravel that provides an ideal environment for germination and growth of seedlings of these species. Without disturbance, riparian areas may be overtaken by invasive weeds such as Himalayan blackberry, which choke out younger native trees and shrubs.

Figure B-10a
Evans Creek Channel Shifts, Changes in Riparian Vegetation
Evans Creek just downstream from Minthorne bridge,
1965, one year after historic 1964 flood. (BLM Photo)
(Note extensive gravel bars and absence of streamside vegetation in some areas.)

Figure B-10b
Same location, 1991.
Many gravel bars now partially revegetated, presumably with willow.
Channel has shifted to right (east) bank in lower part of photo.
(BLM photo)

1965-Present: Development

From the 1960s on, Evans Valley's largely rural character changed as many land parcels near the valley bottom were subdivided. New homes sprang up, and the population increased significantly. Figure B-11, a-b, shows an example of development in the mid-Evans Valley. Similar trends occurred in Sams Valley and other areas of the watershed.

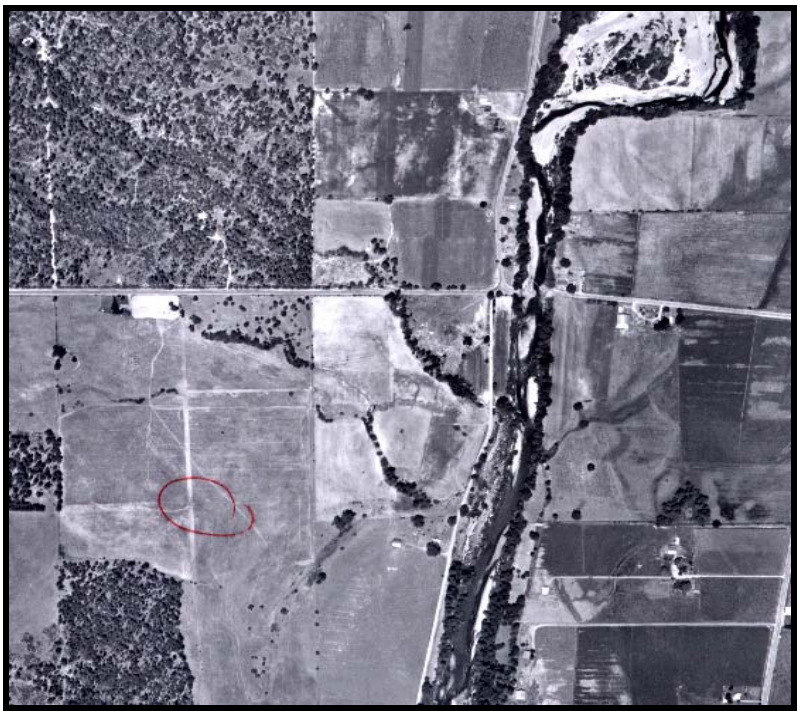


Figure 11a
Development
Evans Creek in the vicinity of Minthorne Road, 1965.
Bridge not yet in, appears to be under construction. (BLM photo)

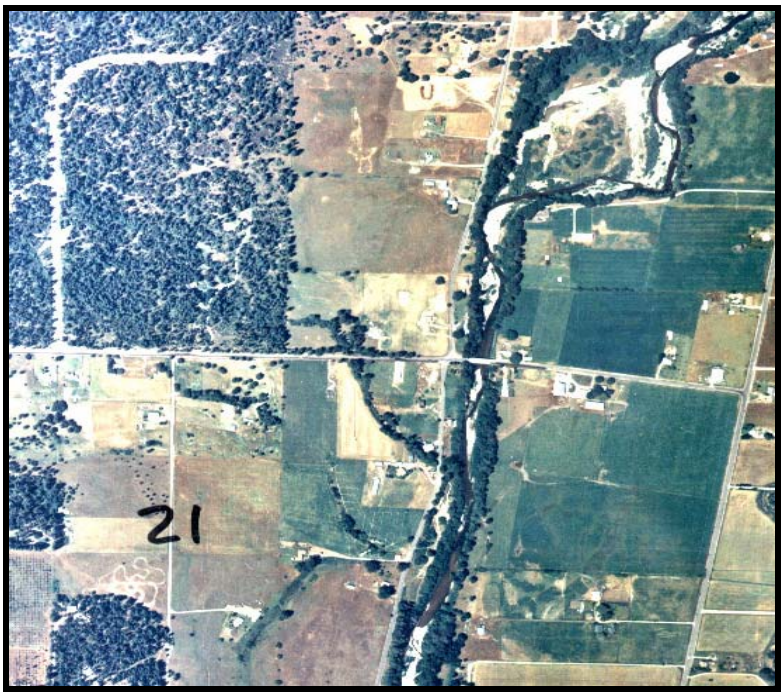


Figure 11b
Same location, 1985. Note new road (Redthorne), several new dwellings and structures. (BLM photo)

Upper right township is lower West Fork Evans Creek; lower left township is middle Evans, with Wimer located approximately in middle of upper third of township. Purple denotes agricultural land; red areas are deforested burns; light green areas are younger to middle aged Douglas-fir and pine stands; and dark green denotes old growth Douglas-fir or pine stands. A small percentage of the old growth stands were partially cut. Note that lower elevation stands are largely second growth; stands further up mountain slopes and in higher reaches of watershed are mostly older forest.

Quantifying Vegetation Change from 1950-2000

In 1948, The USDA Forest Service, Pacific Northwest Research Station, published a forest type map of Jackson County. This map is much more detailed than the 1900 or 1914 maps described above, and provides an accurate macro-scale picture of forests just prior to the post-war timber boom that resulted in extensive logging in upper reaches of the watershed (Figure B-12). These maps can be compared to more recent maps to help quantify the type and amount of vegetation change in the watershed over the last half century.

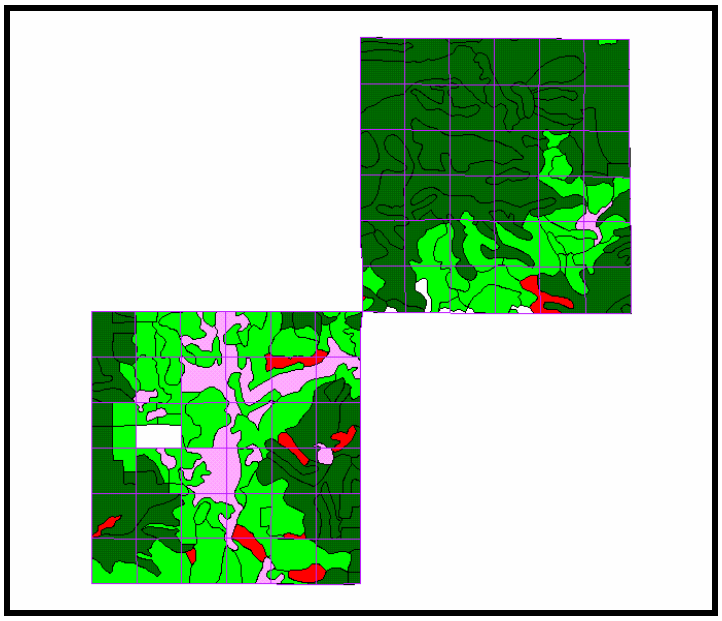


Figure B-12
1947 Vegetation, T34S, 3W and T35S, 4W

Taking a Closer Look – Township 34S, 3W

This township comprises the area of the main stem of Evans Creek near and below the junction with the West Fork, and the lower part of the West Fork. The 1947 map indicates that the bulk of the township is covered by unlogged old growth Douglas-fir forest (52.8%) and unlogged old growth pine (23.7 %). Just under three percent of the township had been selectively or partially cut, and less than one percent was clearcut. About one percent was deforested burn.

Forest type	Percent of acreage
Agricultural lands	0.7
Noncommercial woodlands (pine & oak)	1.4
Partial cut old growth D-fir	2.4
Old growth fir Douglas-fir	46.6
D-fir second growth (6"-20")	2.7
Old growth sugar pine	0.2
Old growth ponderosa pine	18.7
Old growth mixed pine	7.1
Partial cut of mixed pine	0.5
Second growth ponderosa pine	9.7
Large second growth pine	4.4
Restocked pine clearcut	1.0
Deforested burn	1.0

A comparison of these data with 2003 BLM data (covering only BLM lands in the township) reveals the following:

- In 1947, 72.4% of the township was in mature or old growth forest (dominant trees >22" diameter at breast height); in 2003, 34% of BLM land in the township was mature/old growth (>21" diameter). The current percentage of mature/old growth forest in the township as a whole is unknown but likely much less, since there is little of this forest type today on private lands.
- In 1947, 41.6% of the township was in pine dominated stands (pines at least 50% of stand); today 8% of the BLM acreage in the township consists of pine stands.
- In 1947, less than 1% of the township acreage was hardwood-dominated; currently about 10% of the BLM acreage in the township is hardwood-dominated.
- 39% of the BLM acreage in the township has been harvested since 1950.

Interpretation

The character of the in T34S, R3W has changed dramatically in 50 years. Much of the old growth and mature forest in the township has been harvested. Some pockets of older forest remain on BLM land. A much higher proportion of the acreage was in pine-dominated stands in 1947 than currently, and the area of hardwoods has increased tenfold. These developments are due to a combination of fire suppression and timber harvesting.

Fire Suppression

Fire suppression was initiated early in the 1900s and became much more effective after World War II. The acreage burned annually in southwestern Oregon dropped significantly after the war and remained low by historical standards until recently. There were many fire ignitions, but most remained small (Figure B-12, SBW fire history map). In dry years, some fires got away and reached thousands of acres in size. Recent examples include the 10,000 acre Sykes Creek fire in 1987, the Pleasant Creek fire (1988), caused by lightning, and the 1994 arson-caused Hull Mountain fire. These tended to be stand-replacing crown fires regarded by most as destructive, as opposed to light underburns. In the last two decades, many observers believe the acreage burned and intensity of fire has increased.

Fires have been excluded for decades from many stands in the SBW that experienced frequent burns historically. In effect, these stands have missed one or more fire cycles. As a result, overall stand densities are much higher across the landscape, a condition that poses a serious threat to the health of area forests:

1) Higher stand densities have increased fuel loading and the continuity of fuels from ground to crown (i.e., ladder fuels) and crown to crown.
2) Many areas of the watershed are dominated by moderate to high fire hazards.
3) Fire regimes have shifted from relatively frequent, low to moderate intensity burns to a much higher proportion of moderate to high intensity burns, including stand-replacing crown fires.
4) The amount and quality of understory vegetation has declined.
5) Large trees on low productivity sites are subject to greatly increased risk of insect attack due to competition from understory trees and shrubs.

6) There has been a decrease in the proportion of early seral vegetation, e.g., pines, and in increase in hardwoods, which sprout back after fires.
7) Some past timber harvesting practices have contributed to the problem by removing the largest, most fire-resistant trees in stands and by failing to adequately treat logging slash, thus increasing fuel loads.

It is important to note that these problems are most severe in stands with low to moderate severity natural fire regimes – primarily the low elevation ponderosa pine and mid-elevation dry Douglas-fir types.

As noted above, early accounts of SBW vegetation suggest that most lowland forests were open in character, with grassy understories. Upland forests were denser and had more brush and small trees, but were likely still much more open with a higher proportion of pine than today.

Though these changes were not necessarily attributed to fire suppression, they have been noticed by long time watershed residents:

> "The biggest change is that hardwood and brush has grown in where the large trees were. Laurel was bad because it loses leaves all year round. It'll close the ground off to new seed – natural reseeding. Oak leaves are bad but they only drop once a year. You used to be able to look out through the forest and see all through there. Now you look out through the forests and you can't see twenty feet. Buck brush, wild lilac…manzanita on the sunny slopes…"(Logger Dick Skevington, quoted in Atwood and Lang, p 131.)

Summary and Conclusion

The vegetation of the SBW has been significantly altered over the past 150 years. The first settlers encountered prairies and open pine and oak forests on the valley bottoms, with denser forests clothing the mountainsides. Indian-set and lightning caused fires helped maintain the relatively open conditions of these forests. From roughly 1850-1950, logging was concentrated largely along stream courses and in lower reaches of the watershed. Forests were transformed to agricultural or settled areas, or were returned to earlier stages of development. Riparian areas were largely denuded of conifers, but hardwoods probably returned rapidly to provide some streamside cover.

Most of the upper reaches of the watershed were still dominated by old growth forests at the end of World War II. However, the pace of logging accelerated dramatically after the war.

Both partial cuts, usually of the larger trees in the stand, and clearcutting were used. Nearly all of the private land in the watershed has been logged at one time or another, and much of the BLM land has been harvested. There are still tracts of older forest on BLM land, many of them small patches surrounded by younger forests.

Fire suppression has had a dramatic effect on forest density and composition. The relatively open forests that greeted the first settlers have largely been replaced by younger, much denser forests. There are fewer pine stands, which require open conditions for growth, and a higher proportion of Douglas-fir, which can regenerate and grow in partial shade, as well as sprouting hardwoods. The risk of fire and insect attack has increased dramatically. Despite these changes, it is important to note that most of the watershed is still forested, as it was 150 years ago.

REFERENCES CITED

Atwood, Katherine C. and Lang, Frank A., Lang, *As Long As The World Goes On: Environmental History of the Evans Creek Watershed*, Report prepared for the Bureau of Land Management, Medford District, Butte Falls Resource Area, Medford, Oregon, February 1995

Bureau of Land Management, Medford District, Aerial photos and current vegetation data on file, Medford, Oregon.

Bureau of Land Management, Medford District, General Land Office Survey Notes and Maps, on file (microfiche), Medford, Oregon.

LaLande, Jeff, *An Environmental History of the Little Applegate River Watershed, Jackson County, Oregon,* USDA Forest Service, Rogue River National Forest, Medford, Oregon. September 1995.

Rogue River/Siskiyou National Forest Headquarters, Forest Survey, Douglas-fir Region, *Forest Type Map, North Part, Jackson County, Oregon,* Prepared by, R.W. Cowlin, in Charge, on file in Medford, Oregon, July 1, 1947.

University of Oregon, *Atlas of Oregon*, University of Oregon Press, William G. Loy, editor, Eugene, Oregon, 2001.

APPENDIX C
CHANNEL HABITAT TYPE

Appendix C
Channel Habitat Type Stream Miles in Sub Watersheds of Seven Basins Watershed

Sub Watershed	Stream Name	FP1, FP2, FP3	LC	LM	MM	MV, MH, MC	SV	VH	Not Classified	Total Stream Miles	Total Stream Miles in Sub Watershed
Upper West Fork Evans Creek	Cedar Creek					1.25	0.77	0.49		2.51	
	Elderberry Creek								1.33	1.33	
	Lick Creek								1.38	1.38	
	Sam Creek								1.61	1.61	
	Sand Bar Gulch						1.28	0.25		1.53	
	Sand Creek		0.42	0.59		1.56	0.85	0.36		3.78	
	Slick Rock Creek					0.56	1.04	0.44		2.04	
	Steinmetz Creek								0.52	0.52	
	Swamp Creek					2.08	0.31			2.39	
	West Fork Evans Creek	3.10	0.67	4.13		2.27	1.07	0.66		11.90	28.99
Upper Evans Creek	Canon Creek					0.62	1.90	0.08		2.60	
	Chapman Creek		0.39			1.55	0.24	0.31	1.25	3.74	
	Coal Creek					1.44	0.42	0.27		2.13	
	Evans Creek		2.06	7.46		7.41	0.84			17.77	
	Mill Hollow								1.46	1.46	
	Morrison Creek				0.74	5.06				5.80	
	Musty Creek								0.54	0.54	
	Mystery Creek								2.85	2.85	
	Railroad Gap Creek								0.85	0.85	
	Sprignet Creek								3.37	3.37	
	Wolf Creek					1.00	0.78	0.23		2.01	43.12
Rogue River/Ward Creek	Bear Gulch								0.86	0.86	
	Birdseye Creek		0.31			1.09				1.40	
	Boyd Creek					1.57	0.30			1.87	
	Left Fork Birdseye Creek					2.50	0.43	0.64		3.57	
	Oak Gulch (South)								1.05	1.05	

Appendix C
(Continued)

Sub Watershed	Stream Name	FP1, FP2, FP3	LC	LM	MM	MV, MH, MC	SV	VH	Not Classified	Total Stream Miles	Total Stream Miles in Sub Watershed
Rogue River/Ward Creek (cont.)	Resevior Gulch								1.04	1.04	
	Rogue River										
	Right Fork Birdseye Creek					0.68	1.54	0.73		2.95	
	Schlefflin Gulch								2.07	2.07	
	Ward Creek	0.65		1.91		6.21	0.91			9.68	24.49
Rogue River/Snider Creek	Curry Gulch								1.03	1.03	
	Molby Creek			1.52	0.22	2.63		0.34		4.71	
	Rogue River										
	Snider Creek	8.51	0.89	1.83		1.06	0.35	0.13		12.77	18.51
Rogue River/ Sams Creek	Cardwell Creek								3.65	3.65	
	Cliff Creek								3.30	3.30	
	Hence Creek								1.75	1.75	
	Mineral Creek								1.09	1.09	
	Peffley Creek								1.92	1.92	
	Rock Creek	2.34		1.56	0.69	3.13	0.36			8.08	
	Rogue River										
	Sams Creek	2.30	0.33	1.08	0.55	1.48	1.64	0.25		7.63	
	Water Gulch								2.81	2.81	
	Zana Creek								4.04	4.04	34.27
Rogue River/ Sardine Creek	Colvig Gulch								1.43	1.43	
	Jordan Creek								1.56	1.56	
	Left Fork Sardine Creek					2.63	1.09			3.72	
	Middle Fork Sardine Creek			0.25		1.67	0.32			2.24	
	Millers Gulch								1.99	1.99	
	Right Fork Sardine Creek			0.52		6.69	0.15			7.36	
	Rogue River										
	Sardine Creek			3.28						3.28	21.58

Appendix C
(Continued)

Sub Watershed	Stream Name	FP1, FP2, FP3	LC	LM	MM	MV, MH, MC	SV	VH	Not Classified	Total Stream Miles	Total Stream Miles in Sub Watershed
Rogue River/ Galls Creek	Alder Gulch								1.56	1.56	
	Blackwell Creek		0.69	1.94	0.24	0.28				3.15	
	East Branch Galls Creek					0.69	0.35	1.87		2.91	
	Faults Creek								2.19	2.19	
	Galls Creek		1.64			2.84				4.48	
	Harris Gulch								1.35	1.35	
	Kane Creek			2.45	0.92	1.58	0.60	0.58		6.13	
	Rogue River										
	West Branch Galls Creek					1.52	0.81	0.93		3.26	25.03
Pleasant Creek	Boulder Creek						0.90	1.09		1.99	
	Brown Gulch								3.09	3.09	
	Brushy Gulch					0.72	0.63	0.54		1.89	
	Collins Gulch								1.72	1.72	
	Ditch Creek			0.87		3.96	1.04	0.14		6.01	
	Dixie Gulch				0.63	0.64	0.46	0.42		2.15	
	Fry Gulch								2.20	2.20	
	Harris Gulch						0.71	0.58		1.29	
	Jamison Gulch					0.41	0.67	0.60		1.68	
	North Fork Queens Branch					0.51	1.12	0.88		2.51	
	Pleasant Creek	0.83		6.15		4.42	0.89			12.29	
	Queens Branch			1.15	0.52	1.13	0.89	0.71		4.40	
	Right Fork Queens Branch					1.75	0.71	0.37		2.83	44.05
Lower West Fork Evans Creek	Battle Creek		0.42			2.90	0.54	0.14		4.00	
	Cold Creek					2.52	1.27	0.32		4.11	
	Raspberry Creek								2.67	2.67	
	Right Fork Salt Creek					0.94	1.00	0.17		2.11	
	Rock Creek (Evans)				1.47	4.79	0.46			6.72	
	Salt Creek				0.52	5.93	0.08			6.53	

Appendix C
(Continued)

Sub Watershed	Stream Name	FP1, FP2, FP3	LC	LM	MM	MV, MH, MC	SV	VH	Not Classified	Total Stream Miles	Total Stream Miles in Sub Watershed
Lower West Fork Evans Creek (cont.)	Wells Creek								1.35	1.35	
	West Fork Evans Creek		3.62	1.51		1.15				6.28	33.77
Lower Evans Creek	Bear Branch				1.38	1.12	1.08	0.58		4.16	
	Evans Creek		2.03	8.57						10.60	
	Fielder Creek					1.25				1.25	
	Greens Gulch								2.18	2.18	
	Left Fork Fielder Creek					1.31	0.25			1.56	
	Maple Creek			0.95	0.78	0.50	0.20	0.35		2.78	
	Right Fork Fielder Creek					0.32	0.94	0.52		1.78	
	Sugar Pine Gulch								1.55	1.55	
	Trimble Creek				0.95	1.02	0.51	0.45		2.93	28.79
Foots Creek	Bailey Gulch								0.71	0.71	
	Brushy Gulch								0.87	0.87	
	Eads Gulch								1.22	1.22	
	Foots Creek			1.71		1.91				3.62	
	Gold Gulch								1.27	1.27	
	Horn Gulch								2.25	2.25	
	Iron Gulch					0.48	0.70	0.47		1.65	
	Left Fork Foots Creek					2.98	0.69			3.67	
	Lonesome Gulch								1.45	1.45	
	Long Gulch						1.49	0.18		1.67	
	Lyons Creek								1.85	1.85	
	Max Gulch								1.41	1.41	
	Middle Fork Foots Creek					1.41	2.15	0.41		3.97	
	Moore Gulch								0.94	0.94	
	Right Fork Foots Creek					2.88	1.93	1.21		6.02	
	Schoolhouse Gulch								1.25	1.25	
	Womens Gulch								0.90	0.90	34.72

Appendix C
(Continued)

Sub Watershed	Stream Name	FP1, FP2, FP3	LC	LM	MM	MV, MH, MC	SV	VH	Not Classified	Total Stream Miles	Total Stream Miles in Sub Watershed
Evans Creek/ Sykes Creek	Bear Trap Gulch								1.25	1.25	
	Braton Hollow								0.38	0.38	
	Carter Gulch					0.88		0.58		1.46	
	Davies Gulch								0.74	0.74	
	Evans Creek			8.92						8.92	
	Fawn Creek								1.38	1.38	
	Homestead Gulch								1.71	1.71	
	Lover Gulch								0.71	0.71	
	Magerly Gulch								1.04	1.04	
	Maple Gulch						1.02	0.76		1.78	
	May Creek		0.61			2.98	1.28			4.87	
	McConville Gulch				0.48	0.56	0.43	0.35		1.82	
	Miller Gulch								0.58	0.58	
	Murphy Gulch								1.98	1.98	
	Neathammer Gulch						1.86	0.81		2.67	
	Oak Gulch (North)								0.80	0.80	
	Ramsey Canyon				0.30	2.88				3.18	
	Stein Gulch					0.89	0.25	0.97		2.11	
	Sykes Creek				3.42	2.99		1.00		7.41	
	Sypher Gulch								2.23	2.23	
	Taylor Gulch					0.37	0.88	0.15		1.40	48.42

APPENDIX D
WATER RIGHTS-TOTAL CERTIFICATES

Appendix D
Seven Basins Watershed
Water Rights
Total Certificates and Uses

Sub Basins	Total Certificates	CERTIFICATE USES																										
		IR	IS	DO	CS	MI	IC	ID	DI	IM	FP	RC	FM	RW	I*	IL	LV	WI	DS	LW	TC	FI	MU	ST	PW	CM	DN	SC
West Fork Evans Creek																												
W. Fork Evans Cr.>Evans Cr.	**3**	2		1						1	1			1				1										
Wells Cr.>W. Fork Evans Cr.	**0**																											
Total Uses	**3**																											
Upper Evans Creek																												
Evans Gulch>Pleasant Creek	**1**	1																										
Morrison Creek>Evans Creek	**4**	3	1																									
Chapman Creek>Evans Creek	**5**	4							1																			
E. Fork Chapman Creek>Chapman Creek	**4**	3									2			1				1										
Total Uses	**14**																											
Lower Evans Creek																												
Evans Creek>Rogue	**207**	155	3	10			2	2	2		1			1	27	12	10	1	2				1					
Bear Branch>Evans Creek	**4**	2		1		1																			1			
Trimble Creek>Evans Creek	**4**	3	1																									
Fielder Creel>Evans Creek	**2**	2																										
R. Fork Fielder Cr.>Fielder Cr.	**2**	2																										
Sugar Pine Gulch>Evans Creek	**3**	2		1																								
Red Ditch>Evans Creek	**6**	3		1		2			1								1		1									
Maple Creek>Evans Creek	**9**	6	3					1																				
Maple Gulch>Fielder Creek	**1**							1																				
Total Uses	**238**																											
Evans-May/Sykes																												
May Creek>Evans Creek	**14**	11	4	1							1			1			1		1	1				1				
Sykes Creek>Evans Creek	**10**	9		3				1	1		1	1																
Davies Gulch>May Creek	**0**																											
Stein Gulch>Sykes Creek	**0**																											
Maple Gulch>Evans Creek	**1**	1																										
Carter Gulch>Evans Creek	**2**	2																										
Neathammer Creek>Evans Cr.	**4**	3															1											
Murphy Gulch> Evans Creek	**4**	2		1					1																			
W. Fork Murphy G.>Murphy G.	**1**			1		1																						
Homestead Gulch>Evans Creek	**3**	3	1																									

Appendix D
(Continued)

Sub Basins	Total Certificates	CERTIFICATE USES																										
		IR	IS	DO	CS	MI	IC	ID	DI	IM	FP	RC	FM	RW	I*	IL	LV	WI	DS	LW	TC	FI	MU	ST	PW	CM	DN	SC
Greens Gulch>Evans Creek	**2**	2		1				1								1	1											
Maple Gulch>Evans Creek	**1**	1																										
Total Uses	**42**																											
Evans-Salt/Rock																												
R. Fork Salt Creek>Salt Creek	**1**										1									1								
Salt Creek>W. Fork Evans Cr.	**0**																											
Rock Creek> W. Fork Evans Cr.	**0**																											
Cold Creek>Rock Creek	**1**										1			1						1								
Total Uses	**2**																											
Pleasant Creek																												
Pleasant Creek>Evans Creek	**41**	34	2	3		3			1		1			1		1	2	1	1									
R. Fork Pleasant Creek>Pleasant Creek	**2**			1		2																						
Harris Gulch>Pleasant Creek	**3**	2		1		1		1																		1		
Queens Branch>Pleasant Creek	**16**	13	1	3		1		2									1		1									
N. Fork Queens Br.>Queens Br.	**2**	2																										
S. Fork Queens Br.>Queens Br.	**4**	3				1																						
Brown Gulch>Queens Branch	**8**	5	1			1					1						1											
Ditch Creek>Pleasant Creek	**13**	8	2	1		4																						
Dixie Gulch>Ditch Creek	**2**	2		2											2		2											
Brushy Gulch>Pleasant Creek	**3**	2				1		1																				
Collins Gulch>Pleasant Creek	**7**	5	1			2		1																				
Fry Gulch>Pleasant Creek	**7**	5		1					1							1												
Jamison Gulch>Pleasant Creek	**7**	2	4			1																						
Boulder Creek>Pleasant Creek	**1**					1																						
Total Uses	**116**																											
Foots Creek																												
Foots Creek>Rogue	**13**	4			1	4			1		2	2																
L. Foots Creek>Foots Creek	**6**	2				1		1			2		2	2														
Mid.Foots Creek>Foots Creek	**11**	9		1		2					1																	
R. Foots Creek>Foots Creek	**11**	7		1		6									1													
Gold Gulch>Foots Creek	**2**	1		1																								
Millers Gulch>Rogue	**5**	1						1	1						1		1				1							
Lonesome Gulch>Foots Creek	**3**	2		2		2		1																				
Moore Gulch>M. Fork Foots Cr.	**4**	4		1																								
Lyons Gulch>Lonesome Creek	**5**	2		1		4		1	1																			

Appendix D
(Continued)

Sub Basins	Total Certificates	CERTIFICATE USES																										
		IR	IS	DO	CS	MI	IC	ID	DI	IM	FP	RC	FM	RW	I*	IL	LV	WI	DS	LW	TC	FI	MU	ST	PW	CM	DN	SC
Brushy Gulch>Foots Creek	**3**	1		1		2		1																				
Horn Gulch>Foots Creek	**2**					2																						
Max Gulch>L. Fork Foots Creek	**0**																											
Long Gulch>R. Fork Foots Cr.	**2**	1		1		2																						
Iron Gulch>R. Fork Foots Creek	**2**	1				1																						
Total Uses	**69**																											
Rogue-Galls/Kane																												
E. Branch Galls Cr.>Galls Cr.	**1**									1																		
Galls Creek>Rogue	**16**	12	1			3		1	2																			
W. Branch Galls Cr.>Galls Cr.	**3**			1		2																						
E. Fork Kane Creek>Kane Cr.	**8**	7							1								2											
Kane Creek>Rogue	**17**	9	1	2		1			3								1		1									
Harris Gulch>E. Fork Kane Cr.	**2**	2																										
Alder Gulch>Galls Creek	**2**	1	1			2																						
Faults Creek>Blackwell Creek	**3**	3														1	1		1									
Blackwell Creek>Rogue	**5**	3		1					1	1							1											
Total Uses	**57**																											
Rogue-Sardine Creek																												
L. Fork Sardine Cr.>Sardine Cr.	**5**	3		1		2			2																1			
Mid. Fork Sardine Cr.>R. Fork Sardine Creek	**1**										1		1	1														
R. Fork Sardine Cr.>Sardine Cr.	**7**	6	1	2	1																							
Sardine Creek>Rogue	**21**	15	2	1		2		3	2	1																		
Total Uses	**34**																											
Rogue-Table Rock																												
Sams Creek>Rogue	**19**	12	5	1		1															3							
Rock Creek>Sams Creek	**21**	18	1									2					1	1				2						
Snider Creek>Rogue	**26**	22	3									1																
Water Gulch>Rogue	**1**	1																										
Curry Gulch>Rogue	**1**																										1	
Constance Creek>Rogue	**14**	11	1														2											
Dry Creek>Rogue	**2**									2																		
Cardwell Creek>Sams Creek	**10**	6	2	1					2		1					1	2											
Hence Creek>Sams Creek	**2**	1		1		1																						
Mineral Creek>Sams Creek	**2**		2																									
Zana Creek>Rock Creek	**9**	5	3									2																

Appendix D
(Continued)

Sub Basins	Total Certificates	CERTIFICATE USES																										
		IR	IS	DO	CS	MI	IC	ID	DI	IM	FP	RC	FM	RW	I*	IL	LV	WI	DS	LW	TC	FI	MU	ST	PW	CM	DN	SC
Cliff Creek>Zana Creek	**3**	2															1											
Molby Creek>Snider Creek	**10**	6	2														1							2				2
Total Uses	**120**																											
Rogue-Birdseye Ward																												
Ward Creek>Rogue	**14**	12				3																						
Birdseye Creek>Rogue	**11**	5	1			1					1			1			1	1										
L. Fork Birdseye Creek>Birdseye Creek	**0**																											
R. Fork Birdseye Creek>Birdseye Creek	**2**			1		2																						
Oak Gulch>R. Fork Birdseye Cr.	**3**	3		2																								
Total Uses	**30**	505	50	56	2	68	2	20	24	6	18	8	3	10	31	17	34	6	8	3	4	2	1	3	2	1	1	2
		IR	IS	DO	CS	MI	IC	ID	DI	IM	FP	RC	FM	RW	I*	IL	LV	WI	DS	LW	TC	FI	MU	ST	PW	CM	DN	SC

Use	IR	IS	DO	CS	MI	IC	ID	DI	IM	FP	RC	FM	RW	I*	IL	LV	WI	DS	LW	TC	FI	MU	ST	PW	CM	DN	SC
Percent Use	56.93%	5.63%	6.31%	0.22%	7.66%	0.22%	2.25%	2.70%	0.67%	2.00%	0.90%	0.33%	1.12%	3.49%	1.91%	3.83%	0.67%	0.90%	0.33%	0.45%	0.22%	0.11%	0.33%	0.22%	0.11%	0.11%	0.22%

APPENDIX E
WATER RIGHTS-TOTAL PERMITS

Appendix E
Water Rights in the Seven Basins Watershed
Total Permits and Uses

Sub Basins	Total Permits	Permit Uses				
		R	S	G	P	E
West Fork Evans Creek						
W. Fork Evans Creek>Evans Creek	**3**		3			
Wells Creek>W. Fork Evans Creek	**0**					
Total Uses	**3**					
Upper Evans Creek						
Evans Gulch>Pleasant Creek	**1**		1			
Morrison Creek>Evans Creek	**3**		3			
Chapman Creek>Evans Creek	**5**		5			
E. Fork Chapman Creek> Chapman Creek	**1**		1			
Total Uses	**10**					
Lower Evans Creek						
Evans Creek>Rogue	**137**	4	118	14		1
Bear Branch>Evans Creek	**4**		4			
Trimble Creek>Evans Creek	**2**		1	1		
Fielder Creek>Evans Creek	**3**	1	2			
R. Fork Fielder Creek>Fielder Creek	**3**		3			
Sugar Pine Gulch>Evans Creek	**2**		2			
Red Ditch>Evans Creek	**7**	1	5	1		
Maple Creek>Evans Creek	**10**	2	6	2		
Maple Gulch>Fielder Creek	**1**		1			
Total Uses	**169**					
Evans-May/Sykes						
May Creek>Evans Creek	**9**	1	7	1		
Sykes Creek>Evans Creek	**10**		10			
Davies Gulch>May Creek	**0**					
Stein Gulch>Sykes Creek	**0**					
Maple Gulch>Evans Creek	**1**			1		
Carter Gulch>Evans Creek	**2**		2			
Neathammer Creek>Evans Creek	**3**	1	2			
Murphy Gulch>Evans Creek	**4**				4	
W. Fork Murphy Gulch>Murphy Gulch	**1**					

Appendix E
(Continued)

Sub Basins	Total Permits	Permit Uses				
		R	S	G	P	E
Homestead Gulch>Evans Creek	**3**	1	1			
Greens Gulch>Evans Creek	**2**		2			
Maple Gulch>Evans Creek	**1**			1		
Total Uses	**36**					
Evans-Salt/Rock						
R. Fork Salt Creek>Salt Creek	**0**					
Salt Creek>W. Fork Evans Creek	**0**					
Rock Creek>W. Fork Evans Creek	**0**					
Cold Creek>Rock Creek	**0**					
Total Uses	**0**					
Pleasant Creek						
Pleasant Creek>Evans Creek	**29**	1	24	4		
Rt. Fork Pleasant Creek> Pleasant Creek	**1**		1			
Harris Gulch>Pleasant Creek	**3**		2	1		
Queens Branch>Pleasant Creek	**13**		12	1		
N. Fork Queens Branch> Queens Branch	**2**		2			
S. Fork Queens Branch> Queens Branch	**3**		2	1		
Brown Gulch>Queens Branch	**8**	1	7			
Ditch Creek>Pleasant Creek	**14**	2	11	1		
Dixie Gulch>Ditch Creek	**3**	1	2			
Brushy Gulch>Pleasant Creek	**3**		3			
Collins Gulch>Pleasant Creek	**5**	1	4			
Fry Gulch>Pleasant Creek	**6**		6			
Jamison Gulch>Pleasant Creek	**7**		7			
Boulder Creek>Pleasant Creek	**0**					
Total Uses	**97**					
Foots Creek						
Foots Creek>Rogue	**11**	2	8	1		
Left Foots Creek>Foots Creek	**3**		3			
Mid. Foots Creek>Foots Creek	**8**	1	7			
Rt. Foots Creek>Foots Creek	**5**	1	4			
Gold Gulch>Foots Creek	**2**		2			
Millers Gulch>Rogue River	**5**		5			
Lonesome Gulch>Foots Creek	**3**		3			

Appendix E
(Continued)

Sub Basins	Total Permits	Permit Uses				
		R	S	G	P	E
Moore Gulch>Mid. Fork Foots Creek	**4**	1	3			
Lyons Gulch>Lonesome Creek	**5**		5			
Brushy Gulch>Foots Creek	**2**		2			
Horn Gulch>Foots Creek	**1**		1			
Max Gulch>Lt. Fork Foots Creek	**0**					
Long Gulch>Rt. Fork Foots Creek	**1**		1			
Iron Gulch>Rt. Fork Foots Creek	**2**		2			
Total Uses	**52**					
Rogue-Galls/Kane						
E. Branch Galls Creek>Galls Creek	**1**		1			
Galls Creek>Rogue	**8**		8			
W. Branch Galls Creek>Galls Creek	**3**		3			
East Fork Kane Creek>Kane Creek	**10**	3	4	3		
Kane Creek>Rogue	**17**		13	4		
Harris Gulch>E. Fork Kane Creek	**2**	1	1			
Alder Gulch>Galls Creek	**0**					
Faults Creek>Blackwell Creek	**3**		2	1		
Blackwell Creek>Rogue	**5**		5			
Total Uses	**49**					
Rogue-Sardine Creek						
Left Fork Sardine>Sardine	**3**		3			
Mid. Fork Sardine>Rt. Fork Sardine	**0**					
Rt. Fork Sardine>Sardine	**7**		7			
Sardine>Rogue	**16**	1	15			
Total Uses	**26**					
Rogue-Table Rock						
Sams Creek>Rogue	**18**	2	15	1		
Rock Creek>Sams Creek	**22**	5	14	3		
Snider Creek >Rogue	**34**	4	16	14		
Water Gulch>Rogue	**1**		1			
Curry Gulch>Rogue	**1**		1			
Constance Creek>Rogue	**22**	3	4	15		
Dry Creek>Rogue	**4**	1	3			
Cardwell Creek>Sams Creek	**10**	1	9			

Appendix E
(Continued)

Sub Basins	Total Permits	Permit Uses				
		R	S	G	P	E
Hence Creek>Sams Creek	**2**	1		1		
Mineral Creek>Sams Creek	**2**	1	1			
Zana Creek>Rock Creek	**13**	3	8	2		
Cliff Creek>Zana Creek	**4**	2	2			
Molby Creek>Snider Creek	**10**	3	4	3		
Total Uses	**143**					
Rogue-Birdseye Ward						
Ward Creek>Rogue	**12**	1	8	3		
Birdseye Creek>Rogue	**9**	1	8			
Left Fork Birdseye Creek> Birdseye Creek	**0**					
Rt. Fork Birdseye Creek> Birdseye Creek	**1**		1			
Oak Gulch>Rt. Fork Birdseye Creek	**3**		3			
Total Uses	**25**	55	468	80	4	1
		R	**S**	**G**	**P**	**E**

Use	R	S	G	P	E
Percent Use	9.01%	76.72%	13.11%	0.65%	0.16%

Oregon Water Resources Department Codes for Permit Use

IS- Irrigation/Supplemental
IR- Irrigation
DO- Domestic
CS- Campground
MI- Mining
ID- Irrigation and Domestic
DI- Domestic/Inc lawn and garden
IM- Industrial/Manufacturing
FP- Fire Protection
RC- Recreation
FM- Forest Management
RW- Road Construction
IC- Irrigation/Primary and Supplemental
PW- Power
E-Enlargement
DN-/Inc noncommercial

I*- Irrigation/Domestic and Stock
S- Surface
G- Groundwater
R- Reservoir
P-Primary
IL- Irrigation and Stock
LV- Livestock
WI- Wildlife
DS- Domestic/Stock
LW- Livestock/Wildlife
TC- Temperature Control
FI- Fish
MU- Municipal
ST- Storage
MF-Converted Minimum Flow
CM-Commercial
SC-School

APPENDIX F
WATER RIGHTS-APPLICATIONS

Appendix F
Water Rights in the Seven Basins Watershed
Applications and Uses

Sub Basins	Total Applications	Application Uses						
		R	S	G	P	IS	MF	E
West Fork Evans Creek								
W. Fork Evans Creek>Evans Cr.	**2**	1	1					
Wells Creek>W. Fork Evans Cr.	**1**				1			
Total Uses	**3**							
Upper Evans Creek								
Evans Gulch>Pleasant Creek	**3**		1		2			
Morrison Creek>Evans Creek	**4**		4					
Chapman Creek>Evans Creek	**4**		4					
E. Fork Chapman Creek>Chapman Creel	**3**	2	1					
Total Uses	**14**							
Lower Evans Creek								
Evans Creek>Rogue	**125**	8	95	15	7			
Bear Branch>Evans Creek	**6**		4		2			
Trimble Creek>Evans Creek	**2**		1		1			
Fielder Creek>Evans Creek	**5**	1	2		2			
R. Fork Fielder Creek>Fielder Cr.	**2**		2					
Sugar Pine Gulch>Evans Creek	**3**		2		1			
Red Ditch>Evans Creek	**9**	1	5	1	2			
Maple Creek>Evans Creek	**17**	2	6	2	7			
Maple Gulch>Fielder Creek	**1**		1					
Total Uses	**170**							
Evans-May/Sykes								
May Creek>Evans Creek	**8**	2	5	1				
Sykes Creek>Evans Creek	**11**		10		1			
Davies Gulch>May Creek	**1**				1			
Stein Gulch>Sykes Creek	**1**				1			
Maple Gulch>Evans Creek	**1**			1				
Carter Gulch>Evans Creek	**3**		2		1			
Neathammer Creek>Evans Creek	**3**	1	2					
Murphy Gulch> Evans Creek	**4**		4					
W. Fork Murphy Gulch>Murphy Gulch	**1**		1					
Homestead Gulch>Evans Creek	**3**	1	1					

Appendix F
(Continued)

Sub Basins	Total Applications	Application Uses						
		R	S	G	P	IS	MF	E
Greens Gulch>Evans Creek	**5**		2		3			
Maple Gulch>Evans Creek	**1**			1				
Total Uses	**42**							
Evans-Salt/Rock								
R Fork Salt Creek>Salt Creek	**2**	1			1			
Salt Creek>W. Fork Evans Creek	**0**							
Rock Creek> W. Fork Evans Cr.	**0**							
Cold Creek>Rock Creek	**1**	1						
Total Uses	**3**							
Pleasant Creek								
Pleasant Creek>Evans Creek	**36**	2	2	4	7	2		
Rt. Fork Pleasant Cr.>Pleasant Cr.	**1**		1					
Harris Gulch>Pleasant Creek	**3**		2	1				
Queens Branch>Pleasant Creek	**18**		12	1	5			
N. Fork Queens Br.>Queens Br.	**2**		2					
S. Fork Queens Br.>Queens Br.	**3**		2	1				
Brown Gulch>Queens Branch	**8**	1	7					
Ditch Creek>Pleasant Creek	**14**	3	10	1				
Dixie Gulch>Ditch Creek	**5**		2		2			1
Brushy Gulch>Pleasant Creek	**5**		3		2			
Collins Gulch>Pleasant Creek	**5**	1	4					
Fry Gulch>Pleasant Creek	**7**		6		1			
Jamison Gulch>Pleasant Creek	**7**		7					
Boulder Creek>Pleasant Creek	**0**							
Total Uses	**114**							
Foots Creek								
Foots Creek>Rogue	**15**	2	8	1	3	1		
Left Foots Creek>Foots Creek	**5**	3	2					
Mid. Foots Creek>Foots Creek	**8**	1	6		1			
Right Foots Creek>Foots Creek	**5**	1	4					
Gold Gulch>Foots Creek	**3**		2	1				
Millers Gulch>Rogue	**4**		4					
Lonesome Gulch>Foots Creek	**3**		3					
Moore Gulch>Mid. Fork Foots Cr.	**4**	1	3					
Lyons Gulch>Lonesome Creek	**5**		5					
Brushy Gulch>Foots Creek	**2**		2					

Appendix F
(Continued)

Sub Basins	Total Applications	Application Uses						
		R	S	G	P	IS	MF	E
Horn Gulch>Foots Creek	**1**		1					
Max Gulch>Left Fork Foots Creek	**1**				1			
Long Gulch>Rt. Fork Foots Creek	**3**		1		2			
Iron Gulch>Rt. Fork Foots Creek	**2**	2						
Total Uses	**61**							
Rogue-Galls/Kane								
E. Branch Galls Creek>Galls Cr.	**2**		1		1			
Galls Creek>Rogue	**8**		8					
W. Brach Galls Creek>Galls Cr.	**3**		3					
E. Fork Kane Creek>Kane Creek	**13**	3	4	3	3			
Kane Creek>Rogue	**17**		13	4				
Harris Gulch>E Fork Kane Creek	**2**	1	1					
Alder Gulch>Galls Creek	**0**							
Faults Creek>Blackwell Creek	**4**		3	1				
Blackwell Creek>Rogue	**5**		5					
Total Uses	**54**							
Rogue-Sardine Creek								
Lft. Fork Sardine>Sardine	**3**		3					
Mid. Fork Sardine>Rt. Fork Sardine	**1**				1			
Rt. Fork Sardine>Sardine	**7**		7					
Sardine>Rogue	**18**	1	15	1			1	
Total Uses	**29**							
Rogue-Table Rock								
Sams Creek>Rogue	**19**	2	14	1	2			
Rock Creek>Sams Creek	**30**	7	14	3	6			
Snider Creek>Rogue	**47**	5	14	14	14			
Water Gulch>Rogue	**1**		1					
Curry Gulch>Rogue	**1**		1					
Constance Creek>Rogue	**34**	3	4	17	10			
Dry Creek>Rogue	**4**	1	3					
Cardwell Creek>Sams Creek	**8**	1	7					
Hence Creek>Sams Creek	**2**		1	1				
Mineral Creek>Sams Creek	**2**	1	1					
Zana Creek>Rock Creek	**12**	3	7	2				
Cliff Creek>Zana Creek	**4**	2	2					

Appendix F
(Continued)

Sub Basins	Total Applications	Application Uses						
		R	S	G	P	IS	MF	E
Molby Creek>Snider Creek	**12**	3	4	3	2			
Total Uses	**176**							
Rogue-Birdseye Ward								
Ward Creek>Rogue	**12**	1	8	3				
Birdseye Creek>Rogue	**11**	2	8		1			
Lft. Fork Birdseye Creek> Birdseye Creek	**1**				1			
Rt. Fork Birdseye Cr.>Birdseye Cr.	**1**		1					
Oak Gulch>R. Fork Birdseye Cr.	**3**		3					
Total Uses	**28**	75	458	87	99	3	1	1
		R	**S**	**G**	**P**	**IS**	**MF**	**E**

Use	R	S	G	P	IS	MF	E
Percent Use	10.80%	65.99%	12.53%	14.26%	0.43%	0.14%	0.14%

Oregon Water Resources Department Codes for Application Use

IS- Irrigation/Supplemental
IR- Irrigation
DO- Domestic
CS- Campground
MI- Mining
ID- Irrigation and Domestic
DI- Domestic/Inc lawn and garden
IM- Industrial/Manufacturing
FP- Fire Protection
RC- Recreation
FM- Forest Management
RW- Road Construction
IC- Irrigation/Primary and Supplemental
PW- Power
E-Enlargement
DN-/Inc noncommercial

I*- Irrigation/Domestic and Stock
S- Surface
G- Groundwater
R- Reservoir
P-Primary
IL- Irrigation and Stock
LV- Livestock
WI- Wildlife
DS- Domestic/Stock
LW- Livestock/Wildlife
TC- Temperature Control
FI- Fish
MU- Municipal
ST- Storage
MF-Converted Minimum Flow
CM-Commercial
SC-School

APPENDIX G
WELLS IN THE SBW

Appendix G
Wells in Seven Basins Watershed

Sub Watershed	Total Wells in Sub Watershed	Number of Wells in Sections	Township	Range	Section	Percent Domestic	Percent Irrigation	Percent Community	Percent Livestock	Percent Industrial	Percent Not Specified
Rogue-Birdseye/Ward	515	6	35S	3W	30, 31	100	0	0	0	0	0
		8	35S	4W	24, 25, 36	100	0	0	0	0	0
		53	37S	4W	3, 4, 8, 9, 10, 17	98	0	0	0	0	2
		116	36S	4W	27, 33, 34, 35	93	0	0	0	0	7
		332	36S	4W	1, 12, 13, 14, 15, 22	83	0.5	5	0	0.5	11
Foots Creek	298	75	36S	4W	35	91	0	0	0	0	9
		223	37S	4W	1, 2, 10, 11, 14, 15, 21, 22, 23, 26, 27, 28, 34, 35	96	0	0	0	0	4
Rogue-Galls/Kane	553	14	37S	3W	4, 9, 10, 15, 16, 20, 22	93	0	0	0	0	7
		30	37S	3W	2, 11, 14	97	0	0	0	0	3
		186	36S	3W	20, 21, 28, 33	97	1	0	0	0	2
		323	36S	3W	22, 26, 27, 35, 36	91	4	1	0	0	4
Rogue-Sardine	239	115	35S	3W	10, 11, 12, 14, 15, 16	99	0	0	0	0	1
					19, 20, 21, 22, 27, 28, 29, 32, 33						
		124	36S	3W	4, 5, 8, 9, 16, 17	97	0	0	0	0	3
Rogue-Table Rock	982	14	36S	2W	5, 6, 7	100	0	0	0	0	0
		18	36S	3W	1	95	5	0	0	0	0
		30	35S	2W	31	84	3	0	3	0	10
		57	36S	2W	4, 9, 16	96	0	0	0	0	4
		70	34S	2W	32, 33	99	0	0	0	0	1
		78	35S	3W	1, 12, 13, 24, 25, 36	100	0	0	0	0	0
		283	35S	2W	7, 8, 17, 20, 29, 32	97.5	0.3	0	0.3	0	2
		432	35S	2W	3, 4, 10, 15, 22, 23, 26, 27, 33, 34	97	0.7	0	0.3	0	2

Appendix G
(Continued)

Sub Watershed	Total Wells in Sub Watershed	Number of Wells in Sections	Township	Range	Section	Percent Domestic	Percent Irrigation	Percent Community	Percent Livestock	Percent Industrial	Percent Not Specified
Evans Creek-Lower	659	328	36S	4W	4, 9, 10, 15, 16	89	0	3	0	0	8
		331	35S	4W	15, 16, 21, 28, 33	96	1	0	0	0	3
Pleasant Creek	508	196	34S	4W	2, 3, 10, 15, 22, 27, 28, 33, 34	96	3	0	0.5	0	0.5
		312	35S	4W	4, 9, 10, 15	95	1	0	0	0.3	3
Evans-May/Sykes	498	26	34S	3W	7, 17, 20, 29, 32	92	8	0	0	0	0
		27	35S	4W	1	100	0	0	0	0	0
		36	35S	3W	5	92	5	0	0	0	3
		56	34S	4W	12, 13, 23, 24, 25, 26, 35, 36	96	0	0	0	0	4
		72	34S	4W	25, 26, 34, 35	96	0	0	0	0	4
		72	35S	3W	3, 4, 5, 6, 7	96	1	0	0	0	3
		209	35S	4W	10, 11, 12	94	0.4	0	0.4	0.4	5
Evans West Fork-Lower	2	2	34S	3W	3, 7, 8, 9, 10, 15, 22, 23	100	0	0	0	0	0
Evans West Fork-Upper	4	4	33S	3W	5, 6, 7, 8, 17, 18, 19, 20, 29, 31, 32, 33	100	0	0	0	0	0
Evans-Rock/Salt	0	0	NA	NA	NA	0	0	0	0	0	0
Evans Creek-Upper	254	15	34S	3W	24	100	0	0	0	0	0
		17	33S	2W	4, 5, 8, 17, 20, 29, 33	100	0	0	0	0	0
		222	34S	2W	3, 4, 9, 10, 15, 16, 18,19, 20, 21, 22, 28, 29, 32, 33	84	0	0	0	0	16

APPENDIX H
RIPARIAN CONDITION UNITS

Appendix H
Riparian Condition Unit

Created By Southern Oregon University Capstone Students:
Laura Michelon and Amanda Pelletier

Stream Segment	Width				Continuity			Density	
RCU	Absent	Narrow to Absent	Narrow	Wide	Discontinuous	Some Discontinuity	Mostly Continuous	Sparse	Dense
1-10 Left Side	22.50%	20%	2.50%	55%	87.50	10%	2.50%	60%	40%
1-10 Right Side	10%	40%	12.50%	37.50%	100%			65%	35%
11-20 Left Side	22.50%	27.50%	5%	45%	70%	30%		67.50%	32.50%
11-20 Right Side	15%	7.50%	27.50%	50%	70%	20%	10%	52.50%	47.50%
21-30 Left Side	37.50%	10%	10%	42.50%	100%			77.50%	22.50%
21-30 Right Side	17.50%	20%	7.50%	55%	70%	10%	20%	57.50%	42.50%
31-40 Left Side	2.50%	12.50%	30%	55%	70%	10%	20%	35%	65%
31-40 Right Side	12.50%	25%	35%	27.50%	80%	10%	10%	55%	45%
41-45 Left Side		10%	20%	70%	60%	20%	20%	45%	55%
41-45 Right Side	10%	5%	20%	65%	80%	20%		50%	50%

APPENDIX I
FISH BARRIERS

Appendix I
Seven Basins Watershed Fish Barriers
Extracted From: Rogue Basin Fish Barrier Database
Created by: ODFW and RBFAT

Stream	Subbasin	Location	Name	Final Score
Rogue River	Middle Rogue	125.7	Gold Ray Dam	1050
Rogue River	Middle Rogue	RM 134	Table Rock Diversion Dam	900
Evans Creek	Evans	RM 3.0	Fielder Dam Fwy.	570
Evans Creek	Evans	RM 9.0	Wimer Dam	498
Evans Creek	Evans	RM 12.2	Moore Dam	468
Evans Creek	Evans	Approx. RM 14	Neathammer Dam	214.5
Evans Creek	Evans	RM 18	Evansizer Dam	199.5
Sams Creek	Middle Rogue	RM 2	NA	60
Sardine Creek	Middle Rogue	RM 3.0	Lower Kellog	60
East Fork Evans Creek	Evans	RM 1	Lower Alphonso Dam	55.5
Right Fork Foots Creek	Middle Rogue	RM 1.8	Rd 903	29.2
West Fork Evans Creek	Evans	RM 16	West Fork Evans Creek Road	27
Pleasant Creek	Evans	RM 6.0	Wakeman	24
Queens Branch Creek.	Evans	RM 1.5	Unnamed Dam	22.5
Right Fork Foots Creek	Middle Rogue	RM 2.4	915	20.8
Ditch Creek	Evans	RM 0.9	Balt Dam	15
Sykes Creek	Evans	RM 0.2	East Evans Creek Road	12.6
Ramsey Canyon Creek	Evans	RM 0.2	Evans Creek Road	12
Left Fork Sardine Creek	Middle Rogue	RM 0.7	Unnamed Dam	12
Kane Creek	Middle Rogue	RM 0.4	Stage Road	10
Kane Creek	Middle Rogue	RM 0.2	I-5	10
Right Fork Pleasant Creek	Evans	RM 0.6	BLM Road 34-4-11.1	9.6
Right Fork Foots Creek	Middle Rogue	RM 3.9	Right Fork Foots Creek Road	9.6
Right Fork Foots Creek	Middle Rogue	RM 3.8	Rd 915	9.2
Galls Creek	Middle Rogue	RM 0.2	I-5	9
Sugarpine Gulch	Evans	mouth	West Evans Creek Road	9
Elderberry Creek	Evans	RM 0.1	Rd. 34-3-24	9
Brown Gulch	Evans	RM 1.1	Rd 875	9
May Creek	Evans	RM 0.25	Unnamed Dam	8.5
May Creek	Evans	RM 0.3	803	8.4
Trimble Creek	Evans	RM 0.3	803	8

Appendix I
(Continued)

Stream	Subbasin	Location	Name	Final Score
McConnville Gulch	Evans	RM 0.1		8
Left Fork Sardine Creek	Middle Rogue	near mouth	811	8
Raspberry Creek	Evans	mouth	Rd 34-3-24	7.8
Rock Creek	Middle Rogue	RM 3.7	Private road	7.2
Greens Gulch	Evans Creek	RM 0.1	Private driveway	6.6
Ramsey Canyon Creek	Evans	near mouth	Private driveway	6.2
Rock Creek	Middle Rogue	RM 4.2		6.2
Sand Creek	Middle Rogue	RM 0.25	Leonard Rd	6
Bear Gulch (east of I-5)	Middle Rogue	RM 0.1	I-5, Speaker Road	6
Fawn Creek	Evans	at mouth	May Creek Road	6
Molby Creek	Middle Rogue	RM 0.7	Hwy 234	5.6
Snider Creek	Middle Rogue	RM 8.4	518	5.6
Blackwell Creek	Middle Rogue	RM 0.2	Hwy 99	5.6
Rock Creek	Middle Rogue	RM 4.6		5.4
Trimble Creek	Evans Creek	near mouth	Private	5.1
Blackwell Creek	Middle Rogue	RM 0.5	KOA Drive	5
Left Fork Sardine Creek	Middle Rogue	RM 0.6	811	4.8
Wolf Creek	Evans	RM 0.5	BLM Road	4.5
East Fork Evans Creek	Evans	RM 16.75	East Evans Creek Road	4.5
Trimble Creek	Evans Creek	RM 0.3	East Evans Creek Road	4.2
Rock Creek	Middle Rogue	RM 5.2	BLM Rd 35-2-20	4.2
Lick Creek	Evans	RM 0.1	Rd. 34-3-24	4
East Fork Evans Creek	Evans	RM 16.25	East Evans Creek Road	4
Steinmetz Creek	Evans	near mouth	Rd. 34-3-24	4
Bear Gulch (west of I-5)	Middle Rogue	RM 0.3	Rd. 33-6-36	4
Molby Creek	Middle Rogue	RM 1.7	Perry Road	3.6
Right Fork Fielder Creek	Evans	near mouth	Fielder Creek Road	3.8
Trib E	Evans	RM 0.05	BLM Road 34-4-28	3.3
Right Fork Sardine Creek	Middle Rogue	RM 2.7	Right Fork Sardine Creek Road	3.3
Right Fork Foots Creek	Middle Rogue	RM 4.3	Right Fork Foots Creek Road	3
Trib W (trib of W. Fork Evans)	Evans	Near mouth	Rd. 33-3-32.1	3
West Fork Evans Creek	Evans Creek	RM 17.6	West Fork Evans Creek Road	3
Trib A (trib of Sykes Creek)	Evans	at mouth	BLM Road 35-4-1	3
Trib A (trib of Slick Rock Creek)	Evans	RM 0.4	Rd. 33-3-7.2	3

Appendix I
(Continued)

Stream	Subbasin	Location	Name	Final Score
Trib H, trib of Sykes Creek	Evans	RM 0.1	Sykes Creek Road	3
Sprignett Creek	Evans	near mouth	803	3
Trib E (Trib of Battle Creek)	Evans	RM 0.1	Rd. 34-3-15	3
Trib J (trib of East Fork Evans Creek)	Evans	near mouth	BLM Road	3
Trib B (trib of Chapman Creek)	Evans	RM 0.4	Spur off of Chapman Creek Rd.	3
Fielder Creek	Evans	RM 0.1	West Evans Creek Road	2.8
Neathammer Creek	Evans	mouth	803	2.8
Oak Gulch	Middle Rogue	RM 0.05	Birdseye Creek Road	2.7
Brushy Gulch	Evans Creek	RM 0.5	Private road	2.4
Jamison Gulch	Evans	RM 0.9	BLM Road 34-4-9	2.4
Brushy Gulch	Evans	RM 0.2	875	2.4
Dixie Gulch	Evans Creek	RM 0.75		2.4
Bear Gulch	Middle Rogue	near mouth	Birdseye Creek Road	2.4
Mill Hollow	Evans	mouth	819	2.2
Fry Gulch	Evans	RM 0.2	875	2.2
Birdseye Creek	Middle Rogue	RM 3.6	Rd 37-4-4.3	2.1
Maple Creek	Evans	RM 1.0	803	1.8
Railroad Gap Creek	Evans	near mouth	East Evans Creek Road	1.8
Trib 7	Middle Rogue	near mouth	Middle Fork Foots Creek Road	1.6
Right Fork Sardine Creek	Middle Rogue	RM 4.5	Right Fork Sardine Creek Road	1.5
Trib II (trib of West Fork Evans Creek)	Evans	RM 0.1	Rd. 33-3-18.6	1.5
Trib D (trib of trib 9, trib of Rock Creek)	Evans	near mouth	Rd. 33-3-10	1.5
Pleasant Creek	Evans	RM 12.5	Rd. 34-4-15	1.4
Un Cr (T34S, R2W, Sec. 29)	Evans	RM 0.3	693	1.2
Trib M-1 (trib of Miller Gulch)	Middle Rogue	near mouth	Miller Gulch Road	1.2
Middle Fork Sardine Creek	Middle Rogue	RM 1.8	BLM Road 35-3-28	1.2
Right Fork Sardine Creek	Middle Rogue	RM 5.4	BLM Road	1.2
Left Fork Foots Creek	Middle Rogue	RM 2.8	Left Fork Foots Creek Road	1
Reservoir Gulch	Middle Rogue	near mouth	Birdseye Creek Road	1
Trib 9 (trib of Rock Creek)	Evans	RM 0.5	Rd. 33-3-2	1
Lucky Hollow	Evans	RM 0.1	803	1
Birdseye Creek	Middle Rogue	RM 4.0	Rd. 37-4-5.4	0.9

Appendix I
(Continued)

Stream	Subbasin	Location	Name	Final Score
Trib AAA (trib of West Fork Evans Creek)	Evans	RM 1.0	Rd. 33-4-25.1	0.75
Trib 4	Evans	RM 0.3	BLM Rd. 34-4-28	0.6
Kane Creek	Middle Rogue	RM 5.1	Rd. 835	0.4
Harris Gulch	Evans Creek	near mouth	Private road	0.4
Harris Gulch	Evans Creek	RM 0.07	Private road	0.33
Kane Creek	Middle Rogue	RM 5.0	Kane Creek Road	0.3
Kane Creek	Middle Rogue	RM 5.0	Kane Creek Road.	0.3
Brushy Gulch	Evans Creek	RM 0.2		0.3
Trib 10	Evans	RM 0.07	Private road	0.23
A K Gulch	Evans Creek	RM 0.08	Private road	0.22
Maple Gulch	Evans	RM 0.1	819	0.2
Trib 10	Evans	RM 0.2	Private road	0.2
Trib 10	Evans	RM 0.3	Private road	0.1
Trib FFF	Evans	RM 0.2	West Fork Evans Creek Road	0
East Fork Evans Creek	Evans	RM 2.5	Alphonso Dam (Upper)	0
Trib A6	Evans Creek	RM 0.06	Rd 34-4-2.3	0
Right Fork Fielder Creek	Evans	RM 0.2	Private	0
Ditch Creek	Evans		Upper Ditch Creek Diversion	0
Mystery Creek	Evans	RM 1.7	689	0
Evans Creek	Evans	RM 11.3	Reese Dam	0
Trib EEE	Evans	RM 0.1	West Fork Evans Creek Road	0
Trib RR	Evans	RM 0.5	Pleasant Creek Rd	0
Trib QQ	Evans	RM 0.1	East Evans Creek Road	0
Maple Gulch	Evans	RM 0.2	Unnamed Dam	0
Trib XX	Evans	RM 1.9	Antioch Road	0
Trib AA	Evans	RM 0.4	Antioch Road	0
Maple Gulch	Evans	mouth	Fielder Creek Road	0
Redwood Springs	Evans	RM 1.2	689	0
Trib DD (trib of West Fork Evans Creek)	Evans	At mouth	Rd. 34-3-24	0
Trib VV	Evans	RM 0.4	West Fork Evans Creek Road	0
Water Gulch	Middle Rogue	RM 0.1	Hwy 234	0
Ward Creek	Middle Rogue	at mouth	I-5	0
Rocky Creek	Middle Rogue	mouth	Sardine Creek Road	0

Appendix I
(Continued)

Stream	Subbasin	Location	Name	Final Score
Faults Creek	Middle Rogue	RM 0.8	804	0
Faults Creek	Middle Rogue	RM 0.06	KOA Campground Road	0
Blackwell Creek	Middle Rogue	RM 2.1	Foley Road	0
Trib H	Middle Rogue	RM 0.1	Sardine Creek Road	0
Snider Creek	Middle Rogue	RM 9.1	803	0
Trib 2	Middle Rogue	RM 0.08	Foots Creek Road	0
Trib 1	Middle Rogue	RM 0.1	Foots Creek Road	0
Trib 2	Middle Rogue	RM 0.06	Sardine Creek Road	0
Trib 1	Middle Rogue	RM 0.08	Sardine Creek Road	0
Zana Creek	Middle Rogue	RM 1.2	Old Sams Valley Road	0
Zana Creek	Middle Rogue	RM 2.7		0
Trib D	Middle Rogue	mouth	Sardine Creek Road	0
Zana Creek	Middle Rogue	RM 2.85		0
Foots Creek	Middle Rogue	RM 0.5	Hill Dam	0
Trib 1	Middle Rogue	near mouth	Left Fork Foots Creek Road	0
Trib G	Middle Rogue	RM 0.05	Ward Creek Road	0
Trib F	Middle Rogue	RM 0.1	Ward Creek Road	0
Trib E	Middle Rogue	RM 0.1	Ward Creek Road	0
Gold Gulch	Middle Rogue	RM 0.1	Foots Creek Road	0
Trib F	Middle Rogue	at mouth	Right Fork Sardine Creek Road	0
Trib F	Middle Rogue	RM 0.09	Sardine Creek Road	0
Trib M	Middle Rogue	RM 0.1	Galls Creek Road	0
Trib K	Middle Rogue	RM 0.1	Galls Creek Road	0
Trib C (T35S, R3W, Sec 29)	Middle Rogue	at mouth	Left Fork Sardine Creek Road	0
Max Gulch	Middle Rogue	RM 0.2	Left Fork Foots Creek Road	0
Trib 3	Middle Rogue	RM 0.04	Left Fork Foots Creek Road	0
Trib J	Middle Rogue	RM 0.25	Galls Creek Road	0
Lyons Gulch	Middle Rogue	near mouth	Foots Creek Road	0
Schoolhouse Gulch	Middle Rogue	near mouth	Private road	0
Edds Gulch	Middle Rogue	near mouth	Right Fork Foots Creek Rd	0
Iron Gulch	Middle Rogue	near mouth	Right Fork Foots Creek Road	0
Long Gulch	Middle Rogue	RM 1.0	Long Gulch Road	0
Trib 1	Middle Rogue	RM 0.04	Right Fork Foots Creek Road	0
Trib B	Middle Rogue	RM 0.1	Galls Creek Road	0

Appendix I
(Continued)

Stream	Subbasin	Location	Name	Final Score
Middle Fork Foots Creek	Middle Rogue	RM 2.8	Foots Creek Trail	0
Middle Fork Foots Creek	Middle Rogue	RM 2.9	Foots Creek Trail	0
Harris Gulch	Middle Rogue	RM 0.5	Old Stage Road	0
Trib 2	Middle Rogue	RM 0.05	Left Fork Foots Creek Road	0
Cardwell Creek	Middle Rogue	RM 2.0	Holcomb Springs Road	0
Sand Creek	Middle Rogue	RM 0.5	GPID Dam #2	0
Left Fork Sardine Creek	Middle Rogue	RM 2.2	Rd 811	0
Zana Cr	Middle Rogue	RM 0.2	Hwy 234	0
Rock Creek	Middle Rogue	RM 2.2	Hwy 234	0
Rock Creek	Middle Rogue	at mouth	Hwy 234	0
Sams Creek	Middle Rogue	RM 0.2	Hwy 234	0
Blackwell Creek	Middle Rogue	RM 1.0	I-5	0
Cardwell Creek	Middle Rogue	RM 1.5	Holcomb Springs Road	0
Schlieffelin Gulch	Middle Rogue	mouth	Hwy 99	0
Trib 4	Middle Rogue	RM 0.1	Hwy 234	0
Trib 1	Middle Rogue	RM 0.03	Hwy 234	0
Trib 2	Middle Rogue	RM 0.04	Hwy 234	0
Un Creek	Middle Rogue	RM 1.5	Antioch Road	0
Un Creek	Middle Rogue	mouth	Jones Road	0
Un Creek	Middle Rogue	RM 0.1	Hwy 234	0
Un Creek	Middle Rogue	RM 0.5	Hwy 234	0

APPENDIX J
FISH DISTRIBUTION

Appendix J
Seven Basins Watershed Fish Distribution

ID	Stream	Trib To	Sub Basin	ChF Miles	ChF Uses
Fall Chinook					
114	E. Fork Evans Creek	Evans Creek	Evans Creek	0.1	s, m, r
112	Evans Creek	Rogue River	Evans Creek	19	s, m
261	Pleasant Creek	Pleasant Creek	Evans Creek	2.6	s, m
Coho Salmon					
14	Battle Creek	W. Fork Evans Creek	Evans Creek	0.9	s, m, r
16	Bear Branch	Evans Creek	Evans Creek	0.5	s, m, r
38	Birdseye Creek	Rogue River	Middle Rogue	0.25	s, m, r
1117	Blackwell Creek	Rogue River	Middle Rogue	0.01	m, r
607	Cedar Creek	W. Fork Evans Creek	Evans Creek	1	s, m, r
507	Cold Creek	Rock Creek	Evans Creek	0.7	s, m, r
93	Ditch Creek	Pleasant Creek	Evans Creek	2	s, m, r
114	E. Fork Evans Creek	Evans Creek	Evans Creek	12.5	s, m, r
495	Elderberry Creek	W. Fork Evans Creek	Evans Creek	0.1	s, m, r
112	Evans Creek	Rogue River	Evans Creek	19	s, m, r
122	Foots Creek	Rogue River	Middle Rogue	3.3	s, m, r
135	Gilbert Creek	Rogue River	Middle Rogue	0.3	s, m, r
261	Pleasant Creek	Pleasant Creek	Evans Creek	7.3	s, m, r
268	Queens Branch	Pleasant Creek	Evans Creek	1.3	s, m, r
282	Rock Creek	W. Fork Evans Creek	Evans Creek	2.9	s, m, r
302	Salt Creek	W. Fork Evans Creek	Evans Creek	0.25	s, m, r
304	Sams Creek	Rogue River	Middle Rogue	5.5	s, m, r
512	Sand Creek	W. Fork Evans Creek	Evans Creek	1.2	s, m, r
307	Sardine Creek	Rogue River	Middle Rogue	3.4	s, m, r
606	Swamp Creek	W. Fork Evans Creek	Evans Creek	0.25	s, m, r
113	W. Fork Evans Creek	Evans Creek	Evans Creek	16.1	s, m, r
Winter Steelhead					
25	Big Boulder Creek	Grave Creek	Lower Rogue	0.25	s, m, r
1140	Canon Creek	E. Fork Evans Creek	Evans Creek	1.9	s, m, r
507	Cold Creek	Rock Creek	Evans Creek	1	s, m, r
114	E. Fork Evans Creek	Evans Creek	Evans Creek	12.5	s, m, r
112	Evans Creek	Rogue River	Evans Creek	19	s, m, r

Appendix J
(Continued)

ID	Stream	Trib To	Sub Basin	ChF Miles	ChF Uses
261	Pleasant Creek	Pleasant Creek	Evans Creek	12.5	s, m, r
268	Queens Branch	Pleasant Creek	Evans Creek	1.3	s, m, r
282	Rock Creek	W. Fork Evans Creek	Evans Creek	4.2	s, m, r
113	W. Fork Evans Creek	Evans Creek	Evans Creek	16.2	s, m, r
Summer Steelhead					
14	Battle Creek	W. Fork Evans Creek	Evans Creek	2	s, m, r
16	Bear Branch	Evans Creek	Evans Creek	0.75	s, m, r
25	Big Boulder Creek	Grave Creek	Lower Rogue	0.25	s, m, r
38	Birdseye Creek	Rogue River	Middle Rogue	3.25	s, m, r
1117	Blackwell Creek	Rogue River	Middle Rogue	0.4	s, m, r
44	Boulder Creek	Grave Creek	Lower Rogue	1	s, m, r
49	Brown Gulch	Queens Branch Creek	Evans Creek	1	s, m, r
1140	Canon Creek	E. Fork Evans Creek	Evans Creek	1.9	s, m, r
1066	Constance Creek	Rogue River	Middle Rogue	4.8	s, m, r
507	Cold Creek	Rock Creek	Evans Creek	1	s, m, r
93	Ditch Creek	Pleasant Creek	Evans Creek	2	s, m, r
95	Dixie Gulch	Ditch Creek	Evans Creek	0.3	s, m, r
114	E. Fork Evans Creek	Evans Creek	Evans Creek	12.5	s, m, r
495	Elderberry Creek	W. Fork Evans Creek	Evans Creek	0.1	s, m, r
112	Evans Creek	Rogue River	Evans Creek	19	m, r
117	Fielder Creek	Evans Creek	Evans Creek	1.3	s, m, r
122	Foots Creek	Rogue River	Middle Rogue	4.1	s, m, r
134	Galls Creek	Rogue River	Middle Rogue	5.1	s, m, r
135	Gilbert Creek	Rogue River	Middle Rogue	2.2	s, m, r
180	Kane Creek	Rogue River	Middle Rogue	4.5	s, m, r
39	Lft. Fork Birdseye Cr	Birdseye Creek	Middle Rogue	0.5	s, m, r
120	Lft. Fork Foots Creek	Foots Creek	Middle Rogue	2.1	s, m, r
308	Lft. Fork Sardine Cr.	Sardine Creek	Middle Rogue	0.3	s, m, r
496	Lick Creek	W. Fork Evans Creek	Evans Creek	0.1	s, m, r
215	Maple Creek	Evans Creek	Evans Creek	1.3	s, m, r
620	Maple Gulch	Evans Creek	Evans Creek	0.2	s, m, r
612	May Creek	Evans Creek	Evans Creek	1.8	s, m, r
680	McConnville Gulch	Evans Creek	Evans Creek	0.4	s, m, r
481	Mid Fork Foots Creek	Foots Creek	Middle Rogue	2.6	s, m, r

Appendix J
(Continued)

ID	Stream	Trib To	Sub Basin	ChF Miles	ChF Uses
694	Mill Hollow	East Fork Evans Cr.	Evans Creek	0.04	s, m, r
1197	Molby Creek	Snider Creek	Middle Rogue	1.8	s, m, r
485	Morrison Creek	E. Fork Evans Creek	Evans Creek	0.5	s, m, r
261	Pleasant Creek	Pleasant Creek	Evans Creek	12.5	s, m, r
268	Queens Branch	Pleasant Creek	Evans Creek	1.3	s, m, r
621	Ramsey Canyon Cr.	Evans Creek	Evans Creek	0.2	s, m, r
276	Red Ditch Creek	Evans Creek	Evans Creek	0.2	s, m, r
121	Rt. Fork Foots Creek	Foots Creek	Middle Rogue	4.3	s, m, r
447	Rt. Fork Pleasant Cr.	Pleasant Creek	Evans Creek	0.6	s, m, r
309	Rt. Fork Sardine Cr.	Sardine Creek	Middle Rogue	0.3	s, m, r
281	Rock Creek	Sams Creek	Middle Rogue	5.2	s, m, r
282	Rock Creek	West Fork. Evans	Evans Creek	4.2	s, m, r
302	Salt Creek	West Fork. Evans	Evans Creek	0.25	s, m, r
304	Sam's Creek	Rogue River	Middle Rogue	6	s, m, r
512	Sand Creek	West Fork Evans	Evans Creek	1.2	s, m, r
307	Sardine Creek	Rogue River	Middle Rogue	3.4	s, m, r
616	Slick Rock Creek	West Fork Evans	Evans Creek	0.5	s, m, r
328	Snider Creek	Rogue River	Middle Rogue	8.8	s, m, r
610	Steinmetz Creek	West Fork Evans	Evans Creek	0.05	s, m, r
347	Sykes Creek	Evans Creek	Evans Creek	4.3	s, m, r
681	Taylor Gulch	McConnville Gulch	Evans Creek	0.7	s, m, r
1070	Trib 1	Snider Creek	Middle Rogue	0.7	s, m, r
1073	Trib 4	Snider Creek	Middle Rogue	0.4	s, m, r
604	Trib AAA	W. Fork Evans Creek	Evans Creek	0.4	s, m, r
514	Trib WEV 3	W. Fork Evans Creek	Evans Creek	0.2	s, m, r
690	Trib XX	E. Fork Evans Creek	Evans Creek	0.6	s, m, r
362	Trimble Creek	Evans Creek	Evans Creek	2.5	s, m, r
375	Ward Creek	Rogue River	Middle Rogue	4	s, m, r
1137	W. Branch Galls Creek	Galls Creek	Middle Rogue	0.4	s, m,
113	W. Fork Evans Creek	Evans Creek	Evans Creek	16.2	s, m, r
616	Slick Rock Creek	W. Fork Evans Creek	Evans Creek	0.5	s, m, r
Trout					
1115	A K Gulch	Pleasant Creek	Evans Creek	0.3	s, m, r
14	Battle Creek	W. Fork Evans Creek	Evans Creek	3.5	s, m, r

Appendix J
(Continued)

ID	Stream	Trib To	Sub Basin	ChF Miles	ChF Uses
16	Bear Branch	Evans Creek	Evans Creek	3.2	s, m, r
25	Big Boulder Creek	Grave Creek	Lower Rogue	1	s, m, r
38	Birdseye Creek	Rogue River	Middle Rogue	4.4	s, m, r
1117	Blackwell Creek	Rogue River	Middle Rogue	0.4	s, m, r
484	Boulder Creek	Pleasant Creek	Evans Creek	0.7	s, m, r
44	Boulder Creek	Grave Creek	Lower Rogue	3	s, m, r
49	Brown Gulch	Queens Branch Creek	Evans Creek	1.6	s, m, r
1116	Brushy Gulch	Pleasant Creek	Evans Creek	0.5	s, m, r
1140	Canon Creek	E. Fork Evans Creek	Evans Creek	1.9	s, m, r
678	Carter Gulch	Evans Creek	Evans Creek	0.1	s, m, r
607	Cedar Creek	W. Fork Evans Creek	Evans Creek	1.9	s, m, r
668	Chapman Creek	E. Fork Evans Creek	Evans Creek	1.4	s, m, r
667	Coal Creek	E. Fork Evans Creek	Evans Creek	1	s, m, r
507	Cold Creek	Rock Creek	Evans Creek	2.8	s, m, r
1065	Collins Gulch	Pleasant Creek	Evans Creek	0.4	s, m, r
93	Ditch Creek	Pleasant Creek	Evans Creek	5.1	s, m, r
95	Dixie Gulch	Ditch Creek	Evans Creek	0.3	s, m, r
114	E. Fork Evans Creek	Evans Creek	Evans Creek	18	s, m, r
495	Elderberry Creek	W. Fork Evans Creek	Evans Creek	0.5	s, m, r
112	Evans Creek	Rogue River	Evans Creek	19	s, m, r
117	Fielder Creek	Evans Creek	Evans Creek	1.3	s, m, r
122	Foots Creek	Rogue River	Middle Rogue	4.1	s, m, r
1120	Fry Gulch	Pleasant Creek	Evans Creek	0.8	s, m, r
134	Galls Creek	Rogue River	Middle Rogue	5.1	s, m, r
135	Gilbert Creek	Rogue River	Middle Rogue	1	s, m, r
1117	Harris Gulch	Pleasant Creek	Evans Creek	0.4	s, m, r
1118	Horn Gulch	Mid Fork Foots Creek	Middle Rogue	0.4	s, m, r
448	Jamison Gulch	Pleasant Creek	Evans Creek	0.8	s, m, r
180	Kane Creek	Rogue River	Middle Rogue	5.7	s, m, r
39	Lft. Fork Birdseye Cr.	Birdseye Creek	Middle Rogue	1	s, m, r
453	Lft. Fork Fielder Creek	Fielder Creek	Evans Creek	1.2	s, m, r
120	Lft. Fork Foots Creek	Foots Creek	Middle Rogue	3.3	s, m, r
308	Lft. Fork Sardine Cr.	Sardine Creek	Middle Rogue	0.7	s, m, r
695	Lucky Hollow	E. Fork Evans Creek	Evans Creek	0.2	s, m, r

Appendix J
(Continued)

ID	Stream	Trib To	Sub Basin	ChF Miles	ChF Uses
687	Magerly Gulch	Sykes Creek	Evans Creek	0.4	s, m, r
620	Maple Gulch	Evans Creek	Evans Creek	0.2	s, m, r
612	May Creek	Evans Creek	Evans Creek	4.25	s, m, r
1172	Mid. Fork Sardine Cr.	Rt. Fork Sardine Cr.	Middle Rogue	1.8	s, m, r
485	Morrison Creek	East Fork Evans Cr.	Evans Creek	4.8	s, m, r
698	Musty Creek	Morrison Creek	Evans Creek	0.2	s, m, r
692	Mystery Creek	E. Fork Evans Creek	Evans Creek	0.6	s, m, r
244	Neathammer Creek	Evans Creek	Evans Creek	0.5	s, m, r
1068	N. Fork Queens Br.	Queens Branch Creek	Evans Creek	1.6	s, m, r
261	Pleasant Creek	Pleasant Creek	Evans Creek	12.5	s, m, r
268	Queens Branch	Pleasant Creek	Evans Creek	2.7	s, m, r
670	Railroad Gap Creek	E. Fork Evans Creek	Evans Creek	0.1	s, m, r
621	Ramsey Canyon Cr.	Evans Creek	Evans Creek	1.5	s, m, r
276	Red Ditch Creek	Evans Creek	Evans Creek	0.2	s, m, r
121	Rt. Fork Foots Creek	Foots Creek	Middle Rogue	4.3	s, m, r
447	Rt. Fork Pleasant Cr.	Pleasant Creek	Evans Creek	0.6	s, m, r
515	Rt. Fork Salt Creek	Salt Creek	Evans Creek	1.9	s, m, r
309	Rt. Fork Sardine Cr.	Sardine Creek	Middle Rogue	5.3	s, m, r
281	Rock Creek	Sams Creek	Middle Rogue	5.2	s, m, r
282	Rock Creek	W. Fork Evans Creek	Evans Creek	7.1	s, m, r
302	Salt Creek	W. Fork Evans Creek	Evans Creek	5	s, m, r
613	Sam Creek	W. Fork Evans Creek	Evans Creek	1.1	s, m, r
304	Sam's Creek	Rogue River	Middle Rogue	6.5	s, m, r
498	Sandbar Gulch	W. Fork Evans Creek	Evans Creek	0.2	s, m, r
512	Sand Creek	W. Fork Evans Creek	Evans Creek	2.9	s, m, r
307	Sardine Creek	Rogue River	Middle Rogue	3.4	s, m, r
616	Slick Rock Creek	W. Fork Evans Creek	Evans Creek	0.9	s, m, r
328	Snider Creek	Rogue River	Middle Rogue	8.8	s, m, r
702	Sprignett Creek	E. Fork Evans Creek	Evans Creek	1.6	s, m, r
686	Stein Gulch	Sykes Creek	Evans Creek	1	s, m, r
610	Steinmetz Creek	W. Fork Evans Creek	Evans Creek	0.05	s, m, r
606	Swamp Creek	W. Fork Evans Creek	Evans Creek	2.2	s, m, r
347	Sykes Creek	Evans Creek	Evans Creek	5.5	s, m, r
679	Sypher Gulch	Evans Creek	Evans Creek	0.9	s, m, r

Appendix J
(Continued)

ID	Stream	Trib To	Sub Basin	ChF Miles	ChF Uses
681	Taylor Gulch	McConnville Gulch	Evans Creek	0.7	s, m, r
1069	Trib 1	Ditch Creek	Evans Creek	0.4	s, m, r
672	Trib 1	Trib E (E. Fork Evans Cr.)	Evans Creek	0.1	s, m, r
614	Trib 1	Sam Creek	Evans Creek	0.1	s, m, r
617	Trib 1	Cedar Creek	Evans Creek	0.1	s, m, r
1119	Trib 10	Fry Gulch	Evans Creek	0.4	s, m, r
506	Trib 11	Rock Creek	Evans Creek	0.2	s, m, r
673	Trib 2	Trib E (E. Fork Evans Creek)	Evans Creek	0.05	s, m, r
608	Trib 2	Cedar Creek	Evans Creek	0.8	s, m, r
516	Trib 2	Rt. Fork Salt Creek	Evans Creek	0.5	s, m, r
1121	Trib 3	Ditch Creek	Evans Creek	0.4	s, m, r
1072	Trib 4	Ditch Creek	Evans Creek	0.3	s, m, r
1122	Trib 5	Lf. Fork Foots Creek	Middle Rogue	0.1	s, m, r
502	Trib 6	Rock Creek	Evans Creek	0.6	s, m, r
1074	Trib 6	Ditch Creek	Evans Creek	0.25	s, m, r
503	Trib 8	Rock Creek	Evans Creek	0.8	s, m, r
505	Trib 9	Rock Creek	Evans Creek	0.9	s, m, r
1075	Trib A	N. Fork Queens Br.	Evans Creek	0.04	s, m, r
696	Trib A	Morrison Creek	Evans Creek	0.01	s, m, r
618	Trib A	Slick Rock Creek	Evans Creek	0.5	s, m, r
445	Trib A	Cold Creek	Evans Creek	0.2	s, m, r
693	Trib AA	E. Fork Evans Creek	Evans Creek	0.02	s, m, r
604	Trib AAA	W. Fork Evans	Evans Creek	1.4	s, m, r
697	Trib B	Morrison Creek	Evans Creek	0.03	s, m, r
504	Trib B	Trib 9 (Rock Cr. Trib)	Evans Creek	0.05	s, m, r
669	Trib B	Chapman Creek	Evans Creek	0.2	s, m, r
619	Trib B	Slick Rock Creek	Evans Creek	1.2	s, m, r
1076	Trib B	Pleasant Creek	Evans Creek	0.09	s, m, r
517	Trib C	Salt Creek	Evans Creek	0.1	s, m, r
513	Trib C	Sand Creek	Evans Creek	0.1	s, m, r
1077	Trib C	Pleasant Creek	Evans Creek	0.5	s, m, r
492	Trib C	Battle Creek	Evans Creek	0.2	s, m, r
609	Trib CC	West Fork Evans	Evans Creek	0.3	s, m, r
493	Trib D	Battle Creek	Evans Creek	0.4	s, m, r

Appendix J
(Continued)

ID	Stream	Trib To	Sub Basin	ChF Miles	ChF Uses
699	Trib D	Morrison Creek	Evans Creek	0.3	s, m, r
605	Trib DDD	West Fork Evans	Evans Creek	1.4	s, m, r
700	Trib E	Morrison Creek	Evans Creek	0.1	s, m, r
1078	Trib E	Pleasant Creek	Evans Creek	0.05	s, m, r
510	Trib E	Sand Creek	Evans Creek	0.05	s, m, r
494	Trib E	Battle Creek	Evans Creek	0.1	s, m, r
683	Trib E	Sykes Creek	Evans Creek	0.04	s, m, r
671	Trib E	E. Fork Evans Creek	Evans Creek	0.9	s, m, r
508	Trib F	Sand Creek	Evans Creek	0.15	s, m, r
674	Trib F	E. Fork Evans Creek	Evans Creek	0.3	s, m, r
684	Trib G1	Sykes Creek	Evans Creek	0.1	s, m, r
675	Trib H	E. Fork Evans Creek	Evans Creek	0.1	s, m, r
685	Trib H	Sykes Creek	Evans Creek	0.1	s, m, r
701	Trib H	Morrison Creek	Evans Creek	0.05	s, m, r
611	Trib II	W. Fork Evans Creek	Evans Creek	0.06	s, m, r
677	Trib J	E. Fork Evans Creek	Evans Creek	0.01	s, m, r
615	Trib JJ	W. Fork Evans Creek	Evans Creek	0.5	s, m, r
688	Trib L	E. Fork Evans Creek	Evans Creek	0.05	s, m, r
703	Trib Spig 1	Sprignet Creek	Evans Creek	0.06	s, m, r
705	Trib Spig 2	Sprignet Creek	Evans Creek	0.03	s, m, r
497	Trib V	W. Fork Evans Creek	Evans Creek	0.1	s, m, r
706	Trib W	E. Fork Evans Creek	Evans Creek	0.7	s, m, r
499	Trib W	W. Fork Evans Creek	Evans Creek	0.04	s, m, r
514	Trib WEV 3	W. Fork Evans Creek	Evans Creek	0.2	s, m, r
500	Trib X	W. Fork Evans Creek	Evans Creek	0.04	s, m, r
690	Trib XX	E. Fork Evans Creek	Evans Creek	0.6	s, m, r
691	Trib XX1	Trib XX (E. Fork Evans Trib)	Evans Creek	0.04	s, m, r
501	Trib Z	W. Fork Evans Creek	Evans Creek	0.25	s, m, r
622	Trib ZZ	W. Fork Evans Creek	Evans Creek	0.06	s, m, r
362	Trimble Creek	Evans Creek	Evans Creek	2.3	s, m, r
375	Ward Creek	Rogue River	Middle Rogue	6	s, m, r
1137	W. Branch Galls Creek	Galls Creek	Middle Rogue	0.4	s, m, r
113	W. Fork Evans Creek	Evans Creek	Evans Creek	18.6	s, m, r
676	Wolf Creek	E. Fork Evans Creek	Evans Creek	0.6	s, m, r

WATERSHED ACRONYMS

ac/ft	acre feet
amsl	above mean sea level
ATV	all terrain vehicle
BLM	Bureau of Land Management
BP	Before Present
CFER	Cooperative Forest Ecosystem Research
cfs	cubic feet per second
CHT	channel habitat type
cm	centimeters
CWA	Clean Water Act
DEM	Digital Elevation Model
DEQ	Department of Environmental Quality
DO	dissolved oxygen
DOC	dissolved organic carbon
DOGAMI	Department of Geology and Mineral Industries
DSL	Division of State Lands

EESC	Extensions and Experiment Station Communications
EMS	Environmental Management Services
EPA	Environmental Protection Agency
EPT	Ephemeroptera, Plecoptera, Trichoptera
ESA	Endangered Species Act
FDA	Food and Drug Administration
FISRWG	Federal Interagency Stream Restoration Working Group
FLIR	Forward Looking Infra-red
ft/sec	feet per second
GIS	Geographic Information Systems
GLO	General Land Office
gpd	gallons of water per day
gpm	gallons per minute
GPPSC	Grants Pass Power Supply Company
GWEB	Governor's Watershed Enhancement Board
K-Ar	potassium-argon
LBCWC	Little Butte Creek Watershed Council
LWD	large woody debris
m	meters
Ma	million years ago

mg/L	milligrams per liter
MIC	Mobile Information Center
mm	millimeter
MPN	most probable number
NOAA	National Oceanic and Atmospheric Administration
NMFS	National Marine Fisheries Service
OAR	Oregon Administrative Rules
ODA	Oregon Department of Agriculture
ODF	Oregon Department of Forestry
ODFW	Oregon Department of Fish and Wildlife
ONHP	Oregon Natural Heritage Program
ORV	Off Road Vehicle
OSCS	Oregon State Climatological Service
OSU	Oregon State University
OWEB	Oregon Watershed Enhancement Board
OWRD	Oregon Water Resources Department
OWT	Oregon Water Trust
PCBs	polychlorinated biphenyls
PNI	Pacific Northwest Index
ppb	parts per billion

ppm	parts per million
RBCC	Rogue Basin Coordinating Council
RBFAT	Rogue Basin Fish Access Team
RCUs	Riparian Condition Units
SBNFPP	Seven Basins Neighborhood Fire Planning Project
SBW	Seven Basins Watershed
SBWC	Seven Basin Watershed Council
SMC	Siskiyou mixed conifer
SME	Siskiyou mixed evergreen
SOU	Southern Oregon University
STEP	Salmon and Trout Enhancement Program
TMDLs	Total Maximum Daily Loads
TUF	transitional upland fringe
µg/g	micrograms per gram
µgml	micrograms per milliliter
µmhos/cm	micromhos/centimeter
USEPA	United States Environmental Protection Agency
USFWS	United States Fish and Wildlife Service
USGS	United States Geological Survey
WAD	weak acid dissociable

WAU	Watershed Analysis Unit
WUI	Wildland Urban Interface

WATERSHED GLOSSARY

Acre Feet – the amount of water required to cover an acre of land with water to a depth of one foot (325,900 gallons)

Aerobic – Living, active, or occurring only in the presence of oxygen.

Anadromous Species – Ascending rivers from the sea for breeding.

Anaerobic – living, active, occurring, or existing in the absence of free oxygen.

Anthropogenic – Effects or processes that are derived from human activity.

Aquatic Beds – Generally permanently flooded areas that are vegetated by plants growing principally on or below the water surface.

Aquatic Buffer – An area of land and water which is important to the integrity and quality of a stream, river, lake, wetland, or other body of water. An aquatic corridor usually consists of the actual body of water ("corridor" usually connotes a river or stream), the adjacent buffer, and a fringe of adjacent upland areas.

Artificially Flooded – Duration and amount of flooding is controlled by pumps or siphons in combination with dikes or dams.

Base Flow – The sustained portion of stream discharge that is drawn from natural storage sources and not affected by human activity or regulation.

Baseline Monitoring – Data collection intended to define existing biological conditions and to set up a framework for long-term study.

Benthic – That portion of the aquatic environment inhabited by organisms which live permanently in or on the bottom.

Benthic Macroinvertebrate – An aquatic animal lacking a backbone and generally visible to the unaided eye.

Best Management Practice (BMP) – Structural or nonstructural practice that is designed to minimize the impacts of change in land use on surface and groundwater systems.

Bioaccumulation – Process in which uptake of contaminants into biomass results in higher contaminant concentrations in organisms than in water or other compartments of habitat.

Biodiversity – Used interchangeably with taxa richness, the total assemblage of taxa groups present at a given location and time (Jones, Palmer, Motkaluk, Walters, 2002).

Biomonitoring – The use of living organisms to assess environmental conditions.

Bioretention Basin – See Rain Gardens.

Buffer – An area adjacent to a lake or estuarine shoreline, wetland edge, or streambank, where a) critically important ecological processes and water pollution control functions take place, and b) development may be restricted or prohibited for these reasons.

Channelization – Strengthening, widening, deepening, clearing, or lining of existing stream channels.

Clean Water Act – A law enacted by the United States Congress in 1972 and enforced by the Environmental Protection Agency on the national level and by the fifty states. The Clean Water Act established three main

goals: "zero discharge" or the elimination of polluting discharges to the nation's waters by 1985; "fishable and swimmable waters" or the restoration and protection of water quality and wildlife habitat; and "no toxins in toxic amounts" or the prohibition of the discharge of toxic pollutants in amounts that are toxic to the environment or life.

Cluster or Open Space Development – the use of designs which incorporate open space into a development site; these areas can be used for either passive or active recreational activity or preserved as naturally vegetated land.

Coastal Plain – The physiographic province that lies along the Atlantic coast and extends inland to the Piedmont physiographic province. This area is generally characterized by low gradient, meandering streams with mobile sand/silt or gravel substrates.

Combined Sewer Overflow – Discharge of a mixture of storm water and domestic waste, occurring when the flow capacity of a sewer system is exceeded during rainstorms.

Confluence – A flowing together of two or more streams.

Conservation Easements – A practice used to apply and enforce restrictions to preserve natural resources. Typically, a landowner will grant very specific rights concerning a parcel of land to a qualified recipient (e.g. public agency or non profit land conservancy organization). The easement gives the recipient the right to enforce the restrictions. The recipient does not assume ownership but does assume long-term responsibility for enforcement and stewardship of the easement. For example, a wildlife management agency may obtain easements in forested floodplains from private landowners that help them manage wildlife and fish.

Cyanide – Various compounds having the chemical group CN; one single atom of carbon (C) and one single atom of nitrogen (N). Cyanide is a carbon-based organic compound and it reacts readily with other carbon-based matter including living organisms.

Debris Flow – Rapidly moving landslide.

Denudation – Removal of all vegetation.

Dissolved Oxygen (DO) – The amount of oxygen freely available in water and necessary for aquatic life and the oxidation of organic materials.

Diurnal – Of, relating to, or occurring in the daytime.

Doctrine of Prior Appropriation – In Oregon and other western states, water rights are determined under the appropriation doctrine. The Doctrine of Prior Appropriation is based on the concept of first in time, first in right.

Ecology – A branch of science concerned with the interrelationship of organisms and their environments.

Ecoregion – A physical area that is defined by ecological factors such as meteorology, elevation, plant and animal speciation, landscape aspect, and soils.

Ecosystem – All of the component organisms of a community and their environment that, together, form an interacting system.

El Niño - About every 3 to 7 years, the ocean off the South American coast suddenly warms up. At the same time, temperatures in the western Pacific usually decrease. This phenomenon is known as an El Niño, or "warm event."

Electrofishing – Fish sampling method using electrical currents to temporarily stun fish to facilitate capture.

Embeddedness – Refers to the extent to which stream substrate (gravel, cobble, boulders, and snags) is filled and/or covered with silt, sand, or mud.

Emergent – Rising out of or as if out of a fluid.

Endangered Species – Species threatened with extinction

Endangered Species Act (ESA) – Endangered Species Act (ESA) regulates a wide range of activities affecting plants and animals designated as endangered or threatened. The Act was passed in 1973 and reauthorized in 1988. An endangered species is an animal or plant listed by regulation as being in danger of extinction. A threatened species is any animal or plant that is likely to become endangered within the foreseeable future. A species must be listed in the Federal Register as endangered or threatened for the provisions of the act to apply (Federal Endangered Species Act, 2003).

Endemic – Restricted or peculiar to a locality or region.

Erosion – The wearing away of the earth's surface by any natural process. The chief agent of erosion is running water; minor agents are glaciers, the wind, and waves breaking against the coast.

Estuary – Water passage where the tide meets a river current; an arm of the sea at the lower end of a river.

Eutrophication – The process by which a body of water becomes enriched in dissolved nutrients (as phosphates) that stimulate the growth of aquatic plant life usually resulting in the depletion of dissolved oxygen.

Evaporation – The process that involves the changing the state of water from a liquid to a vapor and the net transport of the vapor into the atmosphere.

Evapotranspiration – The combination of the processes of evaporation and transpiration. The process can dominate the water balance and control soil moisture content, groundwater recharge, and streamflow.

Family Biotic Index (FBI) – The general tolerance/intolerance of an assemblage that considers the numbers of individuals in each tolerance class at the family level taxonomic resolution.

Fecal Coliform Bacteria – A group of organisms common to the intestinal tracts of humans and of animals. The presence of fecal coliform bacteria in water is an indicator of pollution and of potentially dangerous bacterial contamination.

Fish Barrier – An obstacle in a stream or river, such as a dam or elevated culvert, that prevents the up and downstream movement of fish and other aquatic species.

Flood Plain – For a given flood event, that area of land adjoining a continuous water course which has been covered temporarily by water.

Fluvial Processes – Those processes that are created by the action of running water.

Gabion – A wire basket or cage that is filled with gravel and generally used to stabilize stream banks and improve degraded aquatic habitat.

Gaining Stream – A stream or segment of a stream where groundwater contributes to stream flow.

Geographic Information System (GIS) – A method of overlaying spatial land and land use data of different kinds. The data are referenced to a set of geographical coordinates and encoded in a computer software system. GIS is used by many localities to map utilities and sewer lines and to delineate zoning areas.

Geomorphology – The study of landforms and the processes that are responsible for creating them.

Global Positional System (GPS) – Network of satellites that emit continuous location finding radio signals; GPS receivers use the signals from multiple satellites to determine their exact three-dimensional coordinates (latitude, longitude, and height).

Grab Sample – Simple water chemistry sampling procedure whereby practitioners manually fill sample containers for laboratory submission.

Groundwater – Water within the earth that supplies wells and springs.

Groundwater Discharge Area – An area where groundwater is flowing toward land surface. May result in the formation of springs, seeps, or baseflow.

Groundwater Flowpath – The movement of groundwater through geologic media along a preferred path.

Groundwater Recharge – Precipitation or surface water that enters the saturated zone.

Habitat – The environment in which an organism lives.

Half-Pounder – Steelhead trout that re-enter freshwater after only three or four months in saltwater. They mature for another eight months in the freshwater and then return to saltwater for the duration of their development. The immature steelhead are called "half pounders."

Headwaters – The area where a stream begins; usually a network of small tributaries at least slightly elevated in comparison to the middle and lower reaches of the stream.

Heterogeneous – Consisting of dissimilar or diverse ingredients or constituents.

Homogeneous – Of the same or a similar kind or nature; of uniform structure or composition throughout.

Hydraulic Head – The sum of the elevation head, the pressure head, and the velocity head at a given point in an aquifer.

Hydric – Soils that in their undrained condition are saturated, flooded, or ponded long enough during the growing season to develop anaerobic conditions that favor the growth and regeneration of hydrophytic vegetation.

Hydrogeology – The science that examines the interrelationships of geologic materials and processes with water. Primarily emphasis is given to groundwater.

Hydrologic Cycle – Describes the continuum of the transfer of water from precipitation to surface water, groundwater, to storage and runoff, and its eventual return to the atmosphere by evapotranspiration.

Hydroperiod – The duration standing water remains in a depression that constitutes a wetland.

Hydrophytic – A perennial vascular aquatic plant having its overwintering buds under water; a plant growing in water or in soil too waterlogged for most plants to survive.

Hyporheic Zone – That area directly beneath a streambed that is a mixture of surface water and groundwater and is underlain by unmodified groundwater with physical and chemical characteristics considerably different from stream water.

Illicit Connections – Illegal and/or improper waste discharges into storm drainage systems and receiving waters.

Impacted Stream or Subwatershed – A very general, watershed imperviousness-based classification category for a subwatershed with 11 to 25% impervious cover. Urbanization is generally expected to lead to some impacts on stream quality, but the type and magnitude of these effects can vary significantly among different watersheds at similar levels of imperviousness.

Impaired Stream – An aquatic system in which the water quality is degraded to an extent such that resident biological communities lack the diversity and/or abundance that would otherwise be present.

Impervious Cover – A surface composed of any material that significantly impedes or prevents natural infiltration of water into soil (i.e. sidewalks, houses, parking lots…).

Imperviousness – The percentage of impervious cover within a defined area.

Impoundment – A body of water contained by a barrier, such as a dam.

Index of Biotic Integrity (IBI) – A stream assessment tool that evaluates biological integrity based on characteristics of the fish and benthic assemblage at a site.

Indicator Species – An organism whose presence (or state of health) is used to identify a specific type of biotic community or changes occurring in the environment.

Infiltration – The portion of rainfall or surface runoff that moves downward into the subsurface rock and soil.

Infiltration Capacity – The maximum rate that water can infiltrate into a soil.

Infiltration Rate – The amount of water that soaks into soil over given period of time.

Instream Erosion – Erosion of stream banks caused by high flow rates.

Intermittently Flooded – The substrate is usually exposed and only flooded for variable periods without detectable seasonal periodicity (may be upland in some situations).

Intermittent Streams – Streams flowing temporarily or periodically rather than continuously throughout the year.

Intolerant Species – Populations of animals and/or plants that are adversely affected even at low levels of degradation.

"Jack" – Coho salmon that reach sexual maturity after only one summer at sea and return to freshwater the following fall, two years old.

La Niña – La Niña is the counterpart of El Niño and is referred to as "cold event". During La Niña conditions there is an increase in the east-west gradient, with western Pacific temperatures even warmer than average and eastern waters cooler. The result is an even stronger and more concentrated area of storms and clouds in the western Pacific.

Lacustrine – Wetland system associated with lakes.

Lentic – A non-flowing or standing body of fresh water, such as a lake or pond.

Limnetic – Deep water.

Losing Stream – A stream or segment of a stream where surface water recharges an underlying aquifer.

Macroinvertebrate – An animal without a backbone, large enough to be seen without magnification.

Mercury – Mercury is a highly toxic element that is found both naturally and as an anthropogenic contaminant. Elemental mercury [Hg(O)] can be converted to the more toxic form methymercury (CH_3Hg).

Metric – A characteristic of a habitat or biological community structure that changes in some predictable way with increased disturbance or divergence from normal, natural conditions.

Morphology – The form and structure of an organism or any of its parts.

Natal Streams – The stream a fish was born in.

National Pollutant Discharge Elimination System (NPDES) – Mandated by Congress under the Clean Water Act, a two-phased national program to address nonagricultural sources of stormwater discharge and prevent harmful pollutants from being washed into local water bodies by stormwater runoff.

Non-Point Source – Diffuse pollution sources that are not recognized to have a single point of origin.

Non-Point Source Pollution – Contaminants such as sediment, nitrogen and phosphorous, hydrocarbons, heavy metals, and toxins whose sources cannot be pinpointed but rather are washed from the land surface in a diffuse manner by stormwater runoff.

Nutrients – Chemicals that are needed by plants and animals for growth (e.g., nitrogen, phosphorus). In water resources, if other physical and chemical conditions are optimal, excessive amounts of nutrients can lead to degradation of water quality by promoting excessive growth, accumulation, and subsequent decay of plants, especially algae. Some nutrients can be toxic to animals at high concentrations.

Open Space – A portion of a site which is permanently set aside for public or private use and will not be developed. The space may be used for passive or active recreation, or may be reserved to protect or buffer natural areas.

Oregon Plan for Salmon and Watersheds – The purpose of the Oregon Plan for Salmon and Watersheds (the "Oregon Plan") as stated in the Plan and reaffirmed in this Executive Order is to restore Oregon's wild salmon and trout populations and fisheries to sustainable and productive levels that will provide substantial environmental, cultural, and economic benefits and to improve water quality. The Oregon Plan is a long-term, ongoing effort that began as a focused set of actions by state, local, tribal and private organizations and individuals in October of 1995 (EXECUTIVE ORDER NO. EO 99-01, 2003).

Outfall – Site of discrete water and/or effluent discharge.

Overland Flow – Precipitation that drains across the land surface and enters a stream or other surface water body.

Palustrine – Wetland system associated with nontidal, emergent vegetation.

Peak Discharge – Refers to a specific period of time when the discharge of a stream or river is at its highest point.

Perennial Streams – A body of water that normally flows year-round in a defined channel or bed, and is capable, in the absence of pollution or other manmade stream disturbances, of supporting bottom dwelling aquatic animals.

Permanently Flooded – Flooded throughout the year in all years.

Photosynthesis – Synthesis of chemical compounds with the aid of radiant energy and especially light; formation of carbohydrates from carbon

dioxide and a source of hydrogen (as water) in the chlorophyll-containing tissues of plants exposed to light.

Physiographic Provinces – A region whose pattern of relief features or landforms differs significantly from that of adjacent regions.

Piedmont Upland – This physiographic province bordered by the Atlantic Coastal Plain to the east and the Appalachian Mountains to the west and is generally characterized by rolling terrain with streams of moderate gradient and cobble/gravel substrates.

Point Source – Specific points of origin where pollutants are emitted.

Quality Assurance/Quality Control (QA/QC) – A system of procedures, checks, audits, and corrective actions to ensure that research design and performance, environmental monitoring and sampling, and other technical and reporting activities are of the highest achievable quality.

Rain Gardens – Water quality BMP engineered to filter the water quality volume through an engineered planting bed, consisting of a vegetated surface layer (vegetation, mulch, and ground cover), planting soil, and sand bed (optional), and into the in-situ material. Also called a Bioretention Basin.

Rapid Stream AssessmentTechnique (RSAT) – A stream monitoring protocol for visually assessing instream and localized watershed conditions.

Recurrence Interval – Expected or observed time intervals between hydrological events of a particular magnitude (i.e., 100-year flood event) described by stochastic or probabilistic models.

Redd – Steelhead trout nests, where eggs are deposited and develop.

Reference Conditions – Conditions (i.e. habitat, chemical, biological) that reflect least impaired or best attainable conditions in a given area.

Reference Streams – Streams which exhibit highest quality or least impaired habitat conditions that are used as a standard to which all other streams are compared.

Resident Species – Not migratory.

Resource Management Area (RMA) – That component of the Chesapeake Bay Preservation Area that is not classified as the Resource Protection Area. RMAs include land types that, if improperly used or developed, have the potential for causing significant water quality degradation or for diminishing the functional value of the Resource Protection Area.

Resource Protection Area (RPA) – That component of the Chesapeake Bay Preservation Area comprised of lands at or near the shoreline of water bodies that have an intrinsic value due to the ecological and biological processes they perform or are sensitive to impacts which may result in significant degradation to the quality of state waters. All other land outside RPAs within Fairfax County is considered RMAs.

Respiration – The chemical process in which cells convert sugars into energy.

Restoration – Improving conditions within a natural system so that its functional characteristics are comparable to its original, unaltered state.

Retrofit – The modification of stormwater management systems through the construction and/or enhancement of wet ponds, wetland plantings, or other BMPs designed to improve water quality.

Riffle – A reach of stream that is characterized by shallow, fast moving water broken by the presence of rocks and boulders.

Riparian Buffer – A transitional area around a stream, lake, or wetland left in a natural state to protect the waterbody from runoff pollution. Development is often restricted within such zones.

Riparian Zone – Relating to or living or located on the bank of a natural watercourse (as a river) or sometimes of a lake or a tidewater.

Run – Section of a stream with a relatively high velocity and with little or no turbulence on the surface of the water.

Salmonid – Any of a family (Salmonidae) of elongate bony fishes (as a salmon or trout) that have the last three vertebrae upturned.

Saturated – Surface water is seldom present, but the substrate is saturated to the surface for most of the growing season.

Saturated Zone – The zone in which the voids in the rock or soil are filled with water a pressure greater than atmospheric. The water table is the top of the saturated zone in an unconfined aquifer.

Seasonally Flooded – Flooded for extended periods in the growing season, but surface water is usually absent by the end of the growing season.

Sediment Transport – The movement of eroded mineral materials by flowing water.

Semipermanently Flooded – Flooded throughout the growing season in most years.

Seven-Day Moving Mean of Daily Maximum – The federal and Oregon state standard statistical measure of stream temperature.

Silt Fence – Temporary sediment barrier consisting of filter fabric, sometimes backed with wire mesh, attached to supporting posts and partially buried.

Spawning – To produce or deposit (eggs) -- used of an aquatic animal; to induce (fish) to spawn.

Species – A class of individuals having common attributes and designated by a common name; a logical division of a genus or more comprehensive class.

Stormwater "Hotspots" – Land uses or activities that generate highly contaminated runoff. Examples include fueling stations and airport de-icing facilities.

Stormwater Runoff – That portion of precipitation that is discharged across the land surface or through conveyances to one or more waterways.

Stream Hydrograph – A graph showing discharge, stage, or velocity or other properties of water flow with respect to time. A hydrograph can be regarded an integral expression of the physiographic and climatic characteristics that govern the relations between rainfall and runoff of a particular drainage basin.

Subwatershed – A defined land area within a watershed drained by a river, stream or drainage way, or system of connecting rivers, streams, or drainage ways such that all surface water within the area flows through a specific point.

Surface Water – Water flowing above the surface of the ground.

Temporarily Flooded – Flooded for only brief periods during the growing season, with the water table usually well below the soil surface for most of the season.

Threatened Species – Having an uncertain chance of continued survival; likely to become an endangered species.

303(d) Stream – Federal Clean Water Act (CWA) required list of water quality impaired or threatened waters found in each state.

Thelweg – The deepest part of a channel.

Tolerant Species – Animals and/or plants that can withstand high levels of degradation.

Total Maximum Daily Load (TMDL) – The maximum levels of a particular pollutant water body can receive in a given day without violating pre-established water quality standards. Total Maximum Daily Loads are the sum of point and non-point source loads.

Transferable Development Rights (TDRs) – a form of incentive for developers in which the developer purchases the rights to an undeveloped piece of property in exchange for the right to increase the number of dwelling units on another site. Often used to concentrate development density in certain land areas.

Transpiration – The diffusion of water vapor from plant leaves to the atmosphere. Transpiration originates from water taken in through the roots of plants.

Turbidity – A measure of the suspended solids in a liquid.

Unconfined Aquifer – An aquifer that is located close to land surface comprised of materials that have high permeability extending from land surface to the base of the aquifer. The top of an unconfined aquifer is commonly referred to as the water table. Also referred to as a water table aquifer.

Unconsolidated Bottom – Generally permanently flooded areas with bottom substrates consisting of at least 25% particles smaller than stones and less than 30% vegetative cover.

Unconsolidated Shore – Wetlands having unconsolidated substrates with less than 75% coverage by stones, boulders, and bedrock and less than 30% coverage by vegetation.

Unsaturated Zone – The zone between the land surface and the water table. It includes the root zone, intermediate zone, and capillary fringe. The pore spaces contain water as well as air and other gases.

Urban Runoff – Stormwater from city streets and adjacent domestic or commercial properties that carries non-point source pollutants of various kinds into the sewer systems and receiving waters.

Watershed – A discrete unit of land drained by a river, stream, drainage way, or system of connecting rivers, streams, or drainage ways such that all surface water within the area flows through a single outlet.

Watershed Restoration – Improving current conditions of watersheds to restore degraded fish habitat and provide long-term protection to aquatic and riparian resources.

Water Table – The surface of an unconfined aquifer at which the pore water pressure is atmospheric.

Wetland – Land that is saturated with water and which contains plants and animals that are adapted to living on, near, or in water. Wetlands have hydric soils and are usually located between a body of water and land.

Zoning – A set of local government regulations and requirements that govern the use, placement, spacing, and size of buildings and lots (as well as other types of land uses) within specific areas designated as zones primarily dedicated to certain land use types or patterns.